

SECTION 134900 - RADIATION PROTECTION

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. Lead sheet, strip, and plate.
 - 2. Lead-lined gypsum board.
 - 3. Lead-lined hollow-metal frames.
 - 4. Lead-lined flush wood doors.
 - 5. Informational signs.

1.3 DEFINITIONS

- A. Lead Equivalence: The thickness of lead that provides the same attenuation (reduction of radiation passing through) as the material in question under the specified conditions.
 - 1. Lead equivalence specified for materials used in diagnostic x-ray rooms is as measured at 100 kV unless otherwise indicated.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to radiation protection, including, but not limited to, the following:
 - a. Sequence and schedule of radiation protection work in relation to other work.
 - b. Supplementary lead shielding at duct, pipe, and conduit penetrations of radiation protection.
 - c. Methods of attaching other construction and equipment to lead-lined finishes.
 - d. Notification procedures for work that requires modifying radiation protection.
 - e. Requirements for field quality control.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Doors and Frames: Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Show layout of radiation-protected areas, indicating lead thickness or lead equivalence of components. Show components and installation conditions not fully dimensioned or detailed in product data.
 - 1. Show ducts, pipes, conduit, and other objects that penetrate radiation protection; include details of penetrations.
 - 2. Show details of joints between radiation protection materials.
 - 3. Include door details, including elevations, frame dimensions and profile, glazed light, and clearances and undercuts.
- C. Samples: For units with factory-applied color finishes.
- D. Product Schedule: For doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For assemblies with radiation protection materials, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Items penetrating radiation protection materials, including the following:
 - a. Electrical services.
 - b. Air outlets and inlets.
 - c. Sprinklers.
 - d. Access panels.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Lead-Lined Gypsum Panels: Store inside under cover, and keep dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.
- B. Lead-Lined, Hollow-Metal Doors and Frames: Comply with requirements in Section 081113 "Hollow Metal Doors and Frames" for delivery, storage, and handling.
- C. Lead-Lined Wood Doors: Comply with requirements in Section 081416 "Flush Wood Doors" for delivery, storage, and handling.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install radiation protection until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 WARRANTY

- A. Warranty for Lead-Lined Wood Doors: Comply with requirements in Section 081416 "Flush Wood Doors."

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of radiation protection product from single source from single manufacturer unless otherwise indicated.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide materials and workmanship, including joints and fasteners, that maintain continuity of radiation protection at all points and in all directions equivalent to materials specified in thicknesses and locations indicated.
- B. Materials, thicknesses, and configurations of radiation protection products indicated are based on radiation protection design prepared by Owner's radiation health physicist. This design is available to Contractor upon request.

- C. Lead-Lined Assemblies: Unless otherwise indicated, provide lead thickness in lead-lined assemblies of not less than lead thickness indicated for assemblies in which they are installed.
- D. Lead Glazing: Unless otherwise indicated, provide lead equivalence of not less than that indicated for assembly in which glazing is installed.

2.3 LEAD SHEET, STRIP, AND PLATE

- A. ASTM B749, Alloy UNS No. L51121 (chemical-copper lead).
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A&L Shielding Inc.
 - b. El Dorado Metals, Inc.
 - c. Mayco Industries.
 - d. NELCO, Inc.
 - e. Pitts Little Corporation.
 - f. Radiation Protection Products, Inc.
 - g. Ray-Bar Engineering Corp.
 - h. Ultraray Radiation Protection.
 - i.

2.4 LEAD-LINED GYPSUM BOARD

- A. 5/8-inch- thick gypsum board complying with Section 092900 "Gypsum Board," of width and length required for support spacing and to prevent cracking during handling, and with a single sheet of lead laminated to the back of the board.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A&L Shielding Inc.
 - b. Accurate Radiation Shielding, Inc.
 - c. El Dorado Metals, Inc.
 - d. Global Partners in Shielding, Inc.
 - e. Mayco Industries.
 - f. NELCO, Inc.
 - g. Pitts Little Corporation.
 - h. Radiation Protection Products, Inc.
 - i. Ray-Bar Engineering Corp.
 - j. Ultraray Radiation Protection.

2. Lead Sheet Lining: Full width and length of board of board and length necessary to extend from floor to 84 inches above floor of board and height as indicated on Drawings. Extend lead sheet lining 1 inch beyond one vertical edge of board.
3. Furnish 2-inch- wide lead strips for backing joints.
4. Furnish finishing materials, accessories, and trim for lead-lined gypsum board complying with Section 092900 "Gypsum Board."

B.

2.5 LEAD-LINED HOLLOW-METAL FRAMES

- A. Hollow-Metal Frames: Steel frames complying with NAAMM-HMMA 861, except as indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A&L Shielding Inc.
 - b. ABM Lead Corporation.
 - c. Accurate Radiation Shielding, Inc.
 - d. DCI Hollow Metal.
 - e. Deronde Products.
 - f. El Dorado Metals, Inc.
 - g. Global Partners in Shielding, Inc.
 - h. Karpen Steel Custom Doors & Frames.
 - i. Mars Metal Company.
 - j. NELCO, Inc.
 - k. New Shield, Inc.
 - l. Pioneer Industries.
 - m. Pitts Little Corporation.
 - n. Radiation Protection Products, Inc.
 - o. Ray-Bar Engineering Corp.
 - p. Republic Doors and Frames.
 - q. Security Metal Products; a brand of ASSA ABLOY.
 - r. Ultraray Radiation Protection.
 - s. .
 2. Provide knocked down frames where indicated where installed in existing partitions.
 3. Provide borrowed lite observation window frames of split or telescoping design with welded corners, allowing frame to be installed after construction of partition.
 - a. Construct so lead lining overlaps glazing material perimeter by at least 3/8 inch, and furnish removable stops.

- b. Form sill with an opening for sound transmission. Offset sound passage to make opening lightproof and to maintain required lead equivalence at all points and in all directions.
4. Provide door observation window frames from steel sheet with minimum thickness of 0.0667 inch.
5. Furnish with additional reinforcements and internal supports to adequately carry the weight of lead-lined doors. Install reinforcements and supports before installing lead lining.
6. Line frame with lead sheet of thickness not less than that required for doors and walls where frames are used. Form lead sheet to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Fabricate lead lining wide enough to maintain an effective lap with lead of adjacent shielding.
7. Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating factory-applied paint.
 - a. Color and Gloss: As indicated by manufacturer's designations Match Architect's sample As selected by Architect from manufacturer's full range Insert color and gloss.

2.6 LEAD-LINED FLUSH WOOD DOORS

- A. Solid-core wood doors with lead sheet laminated to each side of core, with faces applied over lead lining.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A&L Shielding Inc.
 - b. Accurate Radiation Shielding, Inc.
 - c. General Veneer Manufacturing Co.
 - d. Haley Brothers, Inc.
 - e. Lambton Doors.
 - f. Masonite Architectural.
 - g. Oshkosh Door Company.
 - h. Poncraft Door Company.
 - i. Ray-Bar Engineering Corp.
 - j. Ultraray Radiation Protection.
 - k. Vancouver Door Company.
 - l. VT Industries Inc.
 2. Construction: Hot pressed, bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before applying lead lining and faces.
 3. Core: Particleboard.

4. Lead-lined wood doors are 1-3/4 inch (44.5 mm) thick, with lead thicknesses of up to 1/8 inch (3.18 mm). Door thickness increases when lead thickness is above 1/8 inch (3.18 mm) thick.
 5. Lead Lining: Continuous sheets of lead extending from top to bottom and edge to edge; with total lead thickness not less than that required for partition in which door is installed.
 6. Wood Veneer Faces: Wood veneer applied to crossbands over core.
 - a. Comply with Section 081416 "Flush Wood Doors" for veneer species, grade, and matching; finishing; and other requirements unless otherwise indicated.
 7. ANSI/WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- B. Shield cutouts for locksets with lead sheet of same thickness used in door. Lap lining of cutouts with door lining.
- C. Furnish lead-lined astragals for pairs of doors.
- D. Factory fit doors to suit frame openings indicated with 1/16-inch Insert dimension clearance at heads and jambs and minimum clearance at bottom. Factory machine doors for hardware not surface applied.

2.7 INFORMATIONAL SIGNS

- A. Panel Signs: Comply with Section 101423 "Panel Signage."
1. Color: As selected by Architect from manufacturer's full range of colors.
 2. Provide copy indicated or as directed.
 3. Indicate lead equivalence in millimeters and heights of radiation protection in inches.
- B. Rooms Where the Level of Protection Is Uniform Throughout: Provide one sign for each room indicating lead equivalence of partitions, ceilings, floors, doors, and other portions of radiation protection enclosure. Indicate height of radiation protection above floor, or indicate that partitions are radiation protected to full height.
- C. Rooms Where the Level of Protection Is Not Uniform Throughout: Provide one sign for each room with different lead equivalences in different locations. Indicate, in tabular form, lead equivalence of each wall, partition, ceiling, floor, door, and window. Indicate height of radiation protection above floor, or indicate that partitions are radiation protected to full height. Indicate where lead equivalence changes or is not continuous.
- D. Rooms Where Some Partitions Are without Radiation Protection: Provide one sign for each partition that contains radiation protection, and indicate its lead equivalence. Indicate height of radiation protection above floor, or indicate that partitions are radiation protected to full height.
- E. Rooms Where Only the Door Has Radiation Protection: Provide one sign for each door indicating its lead equivalence.

- F. Mounting: Provide manufacturer's standard two-faced tape adhesive.

2.8 DOOR AND DOOR FRAME FABRICATION

- A. Hardware Preparation: Factory prepare doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with door hardware schedule and templates furnished, as specified in Section 087100 "Door Hardware."

2.9 MISCELLANEOUS MATERIALS

- A. Glazing Compounds, Gaskets, and Accessories: Comply with requirements in Section 088000 "Glazing."
- B. Accessories and Fasteners: Manufacturer's standard fasteners and accessories as required for installation, maintaining same lead equivalence as rest of system.
- C. Asphalt Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Asphalt Felt: ASTM D226/D226M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates with Installer present for compliance with requirements, installation tolerances, and other conditions affecting performance of radiation protection.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LEAD SHEETS IN CONCRETE FLOOR SLABS

- A. Proceed with installation only after concrete surfaces are clean, dry, and free of depressions and sharp projections that could damage or penetrate lead sheet.
- B. Coat concrete surfaces with asphalt emulsion before installing lead sheet.
- C. Lead Sheet, 1/8 Inch Thick or Less: Install in a single layer with a 2-inch minimum lap at joints.

- D. Lead Sheet More Than 1/8 Inch Thick: Install in two or more layers with a 2-inch minimum lap at joints, or in a single layer with joints butted and covered with a 4-inch- wide lead strip of same thickness.
- E. Extend lead sheet at least 12 inches beyond radiation shielding in walls of treatment room.
- F. In floor slabs above shielded rooms, where lead sheet is indicated, extend lead sheet at least 12 inches beyond radiation shielding in walls of room below.
- G. At door openings, extend lead sheet at least 12 inches beyond radiation protection in walls and at least 12 inches beyond door opening on both sides, except where lead-lined thresholds are provided.
- H. After installation, apply one coat of asphalt emulsion on top surface of lead sheet and protect from damage until concrete topping is placed.
- I.

3.3 INSTALLATION OF LEAD-LINED GYPSUM BOARD

- A. Install and finish lead-lined gypsum board in accordance with Section 092900 "Gypsum Board."
- B. Install lead-lined gypsum board panels with long edge parallel to supports and lead lining facing supports. Provide blocking at end joints. Install using construction adhesive and supplementary fasteners.
- C. Install lead-lined gypsum board panels in sequence, so lead lining that extends beyond edge of gypsum board is covered by next panel installed.
- D. At joints where lead lining does not extend beyond edge of gypsum board panels, install lead strips 2 inches wide and same thickness as lead lining to face of framing and blocking. Secure lead strips with construction adhesive.
- E. Provide shims at face of supports and blocking, where lead lining does not overlap, to provide a uniform plane across panel surfaces.
- F. Fasten lead-lined gypsum board to framing, with steel drill screws spaced as recommended in writing by lead-lined gypsum board manufacturer.
- G. Two-Layer System: Apply a facing sheet of gypsum board vertically over base sheet, using laminating adhesive recommended in writing by gypsum board manufacturer. Offset joints in finish layer from joints in base layer, and fasten at top and bottom of sheet to support finish panel until adhesive has set.

- H. Openings: Extend lead-lined gypsum board into frames of openings, lapping lead lining with lead frames or frame linings at least 1 inch. Arrange board around openings, so neither horizontal nor vertical joints occur at corners of openings.
- I. Install control and expansion joints where indicated, with appropriate trim accessories. Install lead strip on face of framing, extending across joint, and lap with lead lining of gypsum board.

3.4 INSTALLATION OF LEAD-LINED DOORS AND DOOR FRAMES

- A. Install lead-lined steel doors and door frames in accordance with Section 081113 "Hollow Metal Doors and Frames."
 - 1. Apply a coat of asphalt mastic or paint to lead lining in door frames where lead comes in contact with masonry or concrete.
- B. Install lead-lined wood doors in accordance with Section 081416 "Flush Wood Doors."
- C. Lead-Lined Hollow-Metal Door Frames: Comply with ANSI/NAAMM-HMMA 840 unless otherwise indicated. Except for frames located in existing walls or partitions, place frames before constructing walls. Set frames accurately in position, plumb, and brace securely until permanent anchors are set.
 - 1. Provide three anchors per jamb, located adjacent to hinge on hinge jamb and at corresponding heights on strike jamb.
 - 2. In masonry construction, use wire or T-strap anchors, and apply a coat of asphalt mastic or paint to lead lining where lead comes in contact with masonry or grout.
 - 3. In metal stud construction, use wall anchors attached to studs with screws.
 - 4. In wood stud construction, use strap anchors attached to studs with screws.
- D. Lead-Lined Split-Frame Observation Windows: Install lead-lined hollow-metal frames with split or telescoping design, with leaded side of frame on radiation side of wall.
- E. Lap lead lining of frames over lining in walls at least 1 inch.
- F. Lead Lining of Frames: Line inside of frames with lead of thickness of not less than that required in doors and walls where frames are used. Form lead to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Lap lining over lining in walls at least 1 inch.
- G. Install leaded side of frame on radiation side of wall. Lap lead lining of frames over lining in walls at least 1 inch.
- H. Lead Glazing: Comply with installation requirements in Section 088000 "Glazing" and with manufacturer's written instructions.

- I. Line astragals with lead sheet.
- J. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. See Section 087100 "Door Hardware" for other installation requirements.

3.5 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 of not less than that required in assembly being penetrated.
- C. Secure shields at penetrations using adhesive or wire ties but not penetrating fasteners unless indicated on Drawings.
- D. Outlet Boxes and Conduit: Cover or line with lead sheet lapped over adjacent lead lining at least 1 inch. Wrap conduit with lead sheet for a distance of not less than 10 inches from box.
- E. Duct Openings: Unless otherwise indicated, line or wrap ducts with lead sheet for distance from partition/ceiling equal to 3 times the largest opening dimension. Lap lead sheet with adjacent lead lining at least 1 inch.
- F. Piping: Unless otherwise indicated, wrap piping with lead sheet for a distance of not less than 10 inches from point of penetration.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections after radiology equipment has been installed and placed in operating condition.
- B. Correct deficiencies in or remove and replace radiation protection that inspection reports indicate does not comply with specified requirements.

3.7 PROTECTION

- A. Lock radiation-protected rooms once doors and locks are installed, and limit access to only those persons performing work in the rooms.

END OF SECTION