SECTION 13090 - RADIATION PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Lead sheet, strip, and plate.
2. Lead glass.
3. Lead-lined building materials and products including the following:

a. Gypsum board.
b. Steel door frames.
c. Wood doors.
d. Observation-window frames.

4. Informational signs.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete floor topping over lead shielding in concrete slabs.
2. Division 9 Section "Gypsum Board Assemblies" for metal framing and furring for lead-lined gypsum board and for finishing materials, accessories, and trim applied to lead-lined gypsum board.

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 SYSTEM 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.

1. Materials, thicknesses, and configurations are based on radiation protection design prepared by Owner's radiation health physicist. **The Contractor is to verify thicknesses with the Physicist Report. This design is available to the Contractor on request.**

B. Lead-Lined Assemblies: Unless otherwise indicated, provide lead thickness in doors, door frames, window frames, penetration shielding, joint strips, film transfer cabinets, and other items located in lead-lined assemblies not less than that indicated for assemblies in which they are installed.

C. Lead Glazing: Unless otherwise indicated, provide lead equivalence not less than that indicated for assembly in which glazing is installed.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show layout of radiation-protected areas. Indicate 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 together with details of penetrations.
2. Show details of neutron-shielding doors and frames, including anchorage to and coordination with other work. Show locations of electrical conduit and boxes for connecting door operators, door operator switches, and door interlock switches.

C. Samples for Initial Selection: For each type of prefinished item indicated.

D. Qualification Data: For Installer and manufacturer.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of radiation protection product through one source from a single manufacturer.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to radiation protection including, but not limited to, the following:

1. Sequence and schedule of radiation protection work in relation to other work.

2. Supplementary lead shielding at duct, pipe, and conduit penetrations of radiation protection.
3. Methods of attaching other construction and equipment to lead-lined finishes.
4. Notification procedures for work that requires modifying radiation protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. General: Deliver materials in original packages, containers, or bundles bearing the brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

C. Lead-Lined Gypsum Panels: Neatly stack panels flat to prevent deformation.

D. Lead-Lined Steel Doors and Frames: Comply with requirements in Division 8 Section "Steel Doors and Frames" for delivery, storage, and handling.

E. Lead-Lined Wood Doors: Comply with requirements in Division 8 Section "Flush Wood Doors" for delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MATERIALS

A. Lead Sheet, Strip, and Plate: ASTM B 749, alloy UNS No. L51121 (chemical-copper lead).

B. Lead Glass: Lead-barium, polished plate glass containing more than 60 percent heavy metal oxides, including 55 percent lead oxide by weight.

1. Available Manufacturers:

a. Amerope Enterprises, Inc.
b. McGrory Glass, Inc.
c. Schott Corporation; Technical Glass Div.; Subsidiary of Schott Glass; a company of the Carl-Zeiss-Stiftung.

C. Lead-Lined Gypsum Board: 5/8-inch thick gypsum board complying with Division 9 Section "Gypsum Board Assemblies," 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. Provide lead lining full width and length of board.
2. Provide 3-inch wide lead strips for wrapping metal stud flanges.
3. Provide 2-inch wide lead strips for backing joints.
4. Provide 5/8-inch lead disks for covering screw heads.
5. Provide lead-headed nails for fastening gypsum board, accessories, and trim to wood members.
6. Minimum thickness of lead to be as noted in the Owner's Physicist Report.

D. Accessories and Fasteners: Provide manufacturer's standard fasteners and accessories as required for installation, maintaining same lead equivalence as rest of system.

2.3 MANUFACTURED UNITS

A. Lead-Lined Steel Door Frames: Steel door frames complying with NAAMM HMMA 861, except 0.0667 inch thick**,** and lined with lead sheet of thickness not less than that required for doors and walls where frames are used.

1. Available Manufacturers:

a. American Steel Products Corp.
b. Deronde Products.
c. Karpen Steel Custom Doors & Frames.
d. Kewanee Corp.
e. Pioneer Industries.
f. Precision Metals, Inc.
g. Security Metal Products Corp.
h. A & L Shielding Inc.
i. El Dorado Metals, Inc.
j. Lead Shield, Inc./LSI Sales, Inc.
k. Mayfield Manufacturing Company.
l. NELCO, Inc.
m. Radiation Protection Products, Inc.
n. Ray-Bar Engineering Corp.

2. Provide additional reinforcements and internal supports to adequately carry the weight of lead-lined doors. Install reinforcements and supports before installing lead lining.
3. 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.

B. Lead-Lined Wood Doors: Flush wood doors with lead lining.

1. Available Manufacturers:

a. Algoma Hardwoods, Inc.
b. Ampco.
c. Eggers Industries.
d. General Veneer Manufacturing Co.
e. Haley Bros. Inc.
f. Ideal Architectural Doors and Plywood.
g. Lambton Doors.
h. Marshfield DoorSystems, Inc.
i. Oshkosh Architectural Door Company.
j. Vancouver Door Company.
k. VT Industries Inc.
l. A & L Shielding Inc.
m. Ameray Company.
n. Atomic International.
o. El Dorado Metals, Inc.
p. Lead Shield, Inc./LSI Sales, Inc.
q. Mayfield Manufacturing Company.
r. NELCO, Inc.
s. Radiation Protection Products, Inc.
t. Ray-Bar Engineering Corp.

2. Door Construction: Veneer face, five ply, bonded particleboard core.
3. Lead Lining: One or more continuous sheets of lead extending from top to bottom and edge to edge, constructed either in the core or between the core and faces, at manufacturer's option.
4. Comply with Division 8 Section "Flush Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements, unless otherwise indicated.
5. Quality Standard: "Architectural Woodwork Quality Standards Illustrated."
6. Grade Custom.
7. Face Veneer Species and Cut: Red oak, plain sliced.
8. Face Veneer Matching: Slip and balance match.
9. Faces: Any closed-grain hardwood of mill option, for opaque finish.
10. Factory finish with stain and transparent catalyzed lacquer or conversion varnish.
11. Factory fit doors to suit frame openings indicated with 1/16-inch clearance at heads and jambs and minimum clearance at bottom. Factory machine doors for hardware not surface applied.
12. Shield cutouts for locksets with lead sheet of same thickness used in door. Lap lining of cutouts with door lining.
13. Prepare doors to receive view windows and louvers as indicated. Provide removable wood stops for glazed openings.
14. Provide lead-lined astragals for pairs of doors.

C. Lead-Lined Observation-Window Frames: Fabricate from 0.0428-inch thick, formed-steel sheet or 0.064-inch thick aluminum extrusions with mitered corners, welded or bolted with concealed fasteners.

1. Line with lead sheet formed to match frame contour, continuous in each jamb and across head and sill, lapping the stops, and fabricated wide enough to maintain an effective lap with lead of adjoining assemblies.
2. Construct so lead lining overlaps glazing material perimeter by at least 3/8 inch and provide removable stops.
3. 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.

2.4 INFORMATIONAL SIGNS

A. Informational Signs, General: Fabricate signs by engraving lettering in high-pressure-laminate engraving stock with contrasting face and core. Machine engrave copy using high-speed cutters mechanically positioned by master templates for accurately formed letters, numbers, and symbols.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Provide copy indicated or as directed. Provide signs of sufficient size to contain required information.
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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive radiation protection, 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.

C. Concrete Surfaces: Proceed with installation only after surfaces are clean, dry, and free of depressions and sharp projections that could damage or penetrate lead sheet.

3.2 INSTALLATION OF LEAD SHEETS IN CONCRETE FLOOR SLABS

A. Apply a coat of asphalt mastic or paint to concrete surfaces before installing lead sheet.

B. Before installing floor linings, place lead strips not less than 7 inches wide under the base of vertical wall protection. Extend lead strips approximately 3 inches into the shielded room area.

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 2 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 the same thickness.

E. Extend lead sheet at least 12 inches beyond radiation protection in walls of room.

F. In floor slabs above shielded rooms where lead sheet is indicated, extend lead sheet at least 12 inches beyond radiation protection 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.

H. After installation, apply a coat of asphalt mastic or paint on top surface of lead sheet.

1. Cover lead sheet with reinforced-asphalt protection board.

3.3 INSTALLATION OF LEAD-LINED GYPSUM

A. Install with long edge parallel to supports and lead lining facing supports. Provide blocking at end joints. Install using construction adhesive and supplementary fasteners.

B. Fastening to Metal Supports: Use steel drill screws spaced as recommended in writing by gypsum-board manufacturer. Install lead strips covering face of framing and wrap around flange to cover points of screws.

1. Where possible, install lead-lined gypsum board before installing gypsum board on other side of partition, and do not fold lead strips back over inside of flange until after lead-lined gypsum board is applied.
2. Apply lead disks recessed flush with surface of board over heads of screws securing trim.

C. 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.

1. Locate fasteners above ceiling or behind wall base and cover fasteners with lead disks recessed flush with surface of board.

D. 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.

E. 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 DOORS AND FRAMES

A. Install lead-lined steel door frames according to Division 8 Section "Steel Doors and Frames," unless otherwise indicated.

1. Apply a coat of asphalt mastic or paint to lead lining in door frames where lead will come in contact with masonry or grout.

B. Install lead-lined wood doors according to Division 8 Section "Flush Wood Doors," unless otherwise indicated.

C. Frames: Comply with 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 will come 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. Lap lead lining of frames over lining in walls at least 1 inch.

E. Lead Lining of Frames: Line inside of frames with lead of thickness 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.

F. Install doors in frames level and plumb, aligned with frames and with uniform clearance at each edge.

G. Line astragals with lead sheet.

H. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. See Division 8 Section "Door Hardware" for other installation requirements.

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

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

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 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 10 inches from box.

E. Duct Openings: Unless otherwise indicated, line or wrap ducts with lead sheet for distance from partition/ceiling equal to three 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 10 inches from point of penetration.

3.6 FIELD QUALITY CONTROL

A. Field Inspection: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Correct deficiencies in or remove and replace radiation protection that inspection reports indicate does not comply with specified requirements.

C. Testing: After radiology equipment has been installed and placed in operating condition, Owner will engage a radiation health physicist to test radiation protection.

D. Correct deficiencies in or remove and replace radiation protection that testing indicates does not comply with specified requirements, including finishes and other work covering defective work.

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 13090