SECTION 13 49 00
RADIATION PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies lead radiation shielding.

B. Construction of products and assemblies used for radiation shielding complying with applicable requirements of NCRP Reports 147 and 102.

C. This section includes the following items:

1. Lead Lined Wood Doors
2. Lead Lined Shields
3. Lead Lined Frames
4. Lead Sheet
5. Lead Lined Gypsum Wallboard

1.2 RELATED WORK

A. Hardware for doors: See drawings.

1.3 MANUFACTURERS QUALIFICATIONS

A. Approval by Contracting Officer is required of product or service of proposed manufacturer and suppliers, and will be based upon submission by Contractor of certification that:

1. Manufacturer regularly and presently manufactures lead radiation shielding as specified as one of its principal products.
2. Manufacturer's product submitted has been in satisfactory and efficient operation or three installations similar and equivalent to this project for three years.
3. Manufacturer submits list of installations.

1.4 TESTS

A. At the Government’s option, lead radiation shielding will be tested at the expense of the Government after X-ray equipment is installed.

B. Any additional testing required due to correction and replacement of defective work will be done by the Government at Contractor's expense. **NOTE:** Lead lined gypsum wallboard and lead lined plywood will not be tested prior to installation.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings: Each lead radiation shielding item specified showing thickness of lead, details of construction and installation.

C. Samples:

1. Lead lined concrete masonry units, gypsum lath and gypsum wallboard.

2. Bottom corner section of lead lined door, 300 mm (12 inches) square showing bottom and side edge strips.

D. Manufacturers' Literature and Data: Each lead radiation shielding item specified.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):
QQ-L-201F(2).....Lead Sheet

C. American Society for Testing and Materials (ASTM):
A167-99(2009).....Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip
C1396/C1396M-04.....Gypsum Wallboard/Gypsum Lath
C90-11.....Load-Bearing Concrete Masonry Units
C1002-07.....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases
D1187-97(R2002).....Asphalt-Base Emulsions for Use as Protective Coatings for Metal

D. National Council on Radiation Protection and Measurements (NCRP):
Report 147.....Structural Shielding Design for Medical X-Ray Imaging Facilities (2004)
Report 102.....Medical X-Ray, Electron Beam and Gamma-Ray Protection for Energies up to 50 MeV (Equipment Design, Performance and Use), (1989)

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lead Sheet: Fed. Spec. QQ-L-201, Grade C, 1/16” thickness.

B. Lead Lined Gypsum Wallboard:
1. ASTM C1396, Type X, 16 mm (5/8 inch) thick.
2. Factory bond sheet lead to one side of wallboard.
3. Apply sheet lead in thicknesses shown, unpierced and in one piece.

C. Stainless Steel: ASTM A167.

D. Fasteners:
1. Cadmium or chromium plated steel screws for securing lead louvers.
2. Standard steel drill screws, ASTM C1002, with lead washers for application of lead lined sheet materials to metal studs and attach washers in accordance with shielding manufacturer's instructions.
3. Nails:
a. Use barbed lead head nails for application of lead lined materials to wood furring strips.

b. Long enough to penetrate furring strips not less than 25 mm (one inch).
c. Cast-lead head sufficiently thick to equal lead shielding of room provided.

E. Lead Discs: Same thickness as lead lining, diameter 25 mm (1 inch) larger than fastener.

2.2 FABRICATION

A. General: Lead lining of frames, doors and other items occurring in partitions shall provide an X-ray absorption equivalent to that of partitions in which they occur.

B. Hardware:
1. Hardware for doors is specified on the drawings.
2. Provide lead plugs or discs over recessed nut ends of such bolts, unless otherwise shown.
3. Nut ends of bolts for door closures and automatic door operators shall be countersunk and covered with lead lined 16 gage stainless steel pans.
4. Make total thickness of sheet lead used for lining hardware, equivalent to thickness of sheet lead core of door.

PART 3 - EXECUTION

3.1 FLOOR LEAD

A. Concrete floor slabs:
1. Thoroughly cleaned and smooth, and free of defects that might cause damage to lead.
2. Floor slab shall be cured a minimum of 90 days.
3. Before installation of lead, coat concrete surfaces with two coats of asphalt-base emulsion (ASTM D1187).
4. Lap sheets of floor lead not less than 38 mm (1-1/2 inches).

B. After installation of sheet lead, apply two coats of Asphalt base emulsion material over the lead and protect from damage until concrete fill and floor topping in installed.

C. For existing floors:
1. Lay lead sheets with butt joints.
2. Lay lead strip 38 mm (1-1/2 inches) wide and of same thickness as floor lead centered under full length of each butt joint.
3. Lay strips in concrete fill to same clearances provided in existing floor so that top of strip will be level with existing floor.

3.2 LEAD LINED GYPSUM WALLBOARD PANELS

A. Apply lead lined gypsum wallboard to metal studs.

B. Predrill or drill pilot holes for nails or screws as necessary to prevent deformation of the fastener and lead shielding and to prevent distortion of the wallboard.

C. Apply wallboard vertically with lead linings placed next to supports.

D. Install sheet lead strips behind joints not less than the thickness used for the wallboard.

1. The lead strips: 45 mm (1-3/4 inches) wide, except at corner joints, 45 mm by 45 mm (1-3/4 by 1-3/4 inch) lead angles shall be used.
2. Secure the lead strips to supports at outer edges of strips.

E. Wallboard:

1. Fastened to supports with screws and lead washers or discs at approximately 250 mm (ten inches) on centers.
2. Make provisions for connection with lead lined door frames and for cutouts for vision panels.

3.3 SUPPLEMENTAL LEAD SHIELDING

A. Line or cover penetrations of wall lead, pipe chases, columns fasteners and elsewhere where shown with sheet lead. Install sheet lead free of waves, lumps and wrinkles and with as few joints as possible. Joints in sheet lead shall provide X-ray absorption equivalent to adjacent sheet lead finished smooth and neat.

B. Where plaster finish is required over columns or other vertical surfaces covered with sheet lead, drive bolts or other fasteners securing the sheet lead to backing surface half way, and wrap an 18 gage stainless steel tie wire around fasteners. Both ends of each tie wire shall be of sufficient length so that when fastener is fully driven, fastening of metal lath may be accomplished. Locate fasteners not over 400 mm (16 inches) on centers both ways and cover heads with lead strips or discs if washers are not used.

C. Provide sufficient lead shielding for spaces around outlet boxes, junction boxes, film illuminators, and pipes, to obtain a net radiation protection at these spaces equaling net radiation protection specified for wall or partition in which they occur.

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