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USACE / NAVFAC / AFCEC / NASA **UFGS-08 56 46.10 20 (August 2011)**

Preparing Activity: NAVFAC **Superseding**
UFGS-08 56 46.10 20 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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SECTION 08 56 46.10 20

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08/11

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SECTION 08 56 46.10 20

RADIO FREQUENCY SHIELDED ENCLOSURES, DEMOUNTABLE TYPE
08/11

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NOTE: This guide specification covers the requirements for radio frequency shielded enclosures, demountable Type.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

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NOTE: This guide specification covers the requirements for radio frequency shielded enclosures, demountable Type, in sizes under 50 square meter 500 square feet. For larger enclosures and for High Altitude Electromagnetic Pulse (HEMP) protected enclosures, contact NAVFAC Engineering Innovation and Criteria Office (Code EICO) before beginning design. Do not design HEMP enclosures utilizing demountable shield construction. The electrical designer should refer to MIL-HDBK-419 Volumes I and II for special grounding and bonding requirements for EMI enclosures and to NACSIM 5203 for TEMPEST enclosures. All metallic electrical conduits which penetrate a TEMPEST shield must be isolated within 50 mm 2 inches of the exterior of the shield by a nonmetallic conduit section at least 150 mm 6 inches long to prevent conduction of information from the shielded enclosure. Although

not addressed in this specification, it is recognized that fiber optic cable has gained acceptance as an effective method of transmitting data across the boundary of shielded enclosures without filtering. If fiber optic cable is used, describe the penetration of the shield in detail. For a discussion of the advantages and disadvantages of fiber optic systems see NAVFAC DM-12.02. Designer should consult these documents and other appropriate sources before applying this guide specification to large scale EMI enclosures to HEMP and to TEMPEST Projects. The potential requirement for thermal expansion joints inherent to large scale enclosures is not addressed in this guide specification. The extent and location of the work to be accomplished and wiring, equipment, and accessories necessary for a complete installation should be indicated on the project drawings.

****

****

NOTE: The following information shall be shown on the project drawings:

1. Assembly details;

2. Penetration details;

3. Location and method of mounting shielded enclosure within building;

4. Location of mechanical and electrical equipment within shielded enclosure;

5. Interior wall finish;

6. Suspended ceiling; and

7. Raised computer floor.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.
****

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 210	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B194	(2008) Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM F1066	(2004; R 2014; E 2014) Standard Specification for Vinyl Composition Floor Tile

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 299	(2006; R 2012) Standard Method for Measuring the Effectiveness of Electromagnetic Shielding Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS51	(1971) Hardwood and Decorative Plywood
DOC/NIST PS58	(1973) Basic Hardboard (ANSI A135.4)

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-15733	(2010; Rev J, Supp 1 2010; Notice 1 2015; Notice 2 2020) Filters and Capacitors, Radio Frequency Interference, General Specification for
MIL-STD-220	(2009; Rev C; Notice 1 2014; Notice 2 2019) Method of Insertion Loss Measurement
MIL-STD-461	(2015; Rev G) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

1.2 GENERAL REQUIREMENTS

****
NOTE: Insert additional details describing the specific project for which this specification is being used. Projects involving military communications equipment must be designed to incorporate the applicable requirements of MIL-STD-188-124, "Grounding, Bonding and Shielding for Common Long Haul/Tactical Communication Systems." Be aware that standard manufactured shielded doors are not designed for exposure to weather.
****

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, applies to this section, with the additions and modifications specified herein. The enclosure[s] shall be capable of being erected, disassembled, and reerected entirely from its interior without special tools [, except where RF enclosure ceiling is specified as being supported by the structural ceiling above]. Provide enclosure[s] complete with [power line filters,] [telephone/signal line filters,] [RF air vents,] [penetrations for compressed air lines, water lines and [_____],] [coaxial cables,] [lighting fixtures,] [workbenches with convenience outlets,] and door assembly. Provide each item with fittings and hardware necessary for a complete and operable RF shielded enclosure. Where two or more units of the same type, class, and size of equipment are required, these units shall be products of a single manufacturer. Provide means of completely isolating the structure electrically from the building in which it is to be installed.

1.2.1 Mechanical Work

****
NOTE: Modify or delete these paragraphs as required for each project. Additional items such as raised computer floors may be specified in the same manner.
****

****
NOTE: Insert appropriate Section number and title in blank below using format per UFC 1-300-02, "Unified Facilities Guide Specifications (UFGS) Format Standard".
****

Provide complete shielded enclosure[s] including work specified in [_____] [and [_____]].

1.2.2 Electrical Work

****
NOTE: Modify or delete these paragraphs as required for each project. Additional items such as raised computer floors may be specified in the same manner.
****

****
NOTE: Insert appropriate Section number and title in blank below using format per UFC 1-300-02.
****

Conform to the requirements of the NFPA 70, National Electrical Code. Provide a complete shielded enclosure[s] including work specified in [_____] [and [_____]].

1.2.3 Acoustical Ceiling System

****
NOTE: Modify or delete these paragraphs as required for each project. Additional items such as raised computer floors may be specified in the same manner.
****

Provide as specified in Section 09 51 00 ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

****
NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required

as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Radio frequency shielded enclosure

Include penetration details.

SD-03 Product Data

Telephone and signal line filters

Shielded air vents

Lighting fixtures

Exhaust fan

Door assemblies

SD-06 Test Reports

****

NOTE: When specifying nonlatching doors, delete door static load and sag tests and cycle test for door latches. Retain cycle test for door hinges.

****

Door static load test

Door sag test

Swinging door closure test

EMI tests for line filters

Submit final report to Resident Officer in Charge of Construction within 30 days following completion.

Attenuation testing

Seam leak detection testing

The results of EMI testing shall be submitted to the Contracting

Officer on a daily basis and test results incorporated into a EMI Shielding Test Final Report. Submit final reports within 30 days following completion of tests. List location of the permanent SELDS test leads.

SD-07 Certificates

Performance test plan

Qualifications of installation supervision personnel

Qualifications of testing agency

Certification of test equipment

Components of shielded enclosure individually and as a system, meet specified attenuation requirements.

SD-10 Operation and Maintenance Data

Shielded enclosure, Data Package 3; G[, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 RELIABILITY

Reliability to maintain high shielding effectiveness for long term usage with minimum maintenance shall be stressed throughout the design, construction, and erection of the specified shielded enclosure. Particular attention shall be paid to the total project so that corrosion and the installation of electrical service, power line filters, ventilation, and connector panels do not derate the required shielding effectiveness. The enclosures will be subject to varying moveable live floor loads and continuous use of the ventilation system and ac power line filters.

1.5 DELIVERY AND STORAGE

Deliver materials to the job site in undamaged condition. Store material to ensure proper alignment, and protect material against dampness and accumulated moisture before and after delivery. Store materials under cover in a well-ventilated enclosure, and do not allow materials to be exposed to extreme changes in temperature and humidity. Do not store materials in the building until concrete and masonry are dry.

1.6 QUALITY ASSURANCE

1.6.1 Certificates

1.6.1.1 Performance Test Plan

Submit a performance test plan for SELDS and IEEE 299 testing of the facility. The test plan shall include tester qualifications, equipment listings (including calibration dates and antenna factors), and proposed test report format. The plan shall also address specific dates and durations that testing will be conducted during the overall construction period so that the expert Government witness may be scheduled to observe the testing and so that repairs may be made to the shield and retests

conducted before the building finish materials are installed. Finally, the test plan shall indicate the proposed dates and duration of the lowest and the highest frequency tests following installation of the building finish materials [so that an expert Government witness may be available for these final acceptance tests].

1.6.1.2 Qualifications of Testing Agency

Submit the experience and qualifications of an independent testing agency for review and approval. The testing agency shall have recent experience in Shielded Enclosure Leak Detection System (SELDS) and IEEE 299 shielded enclosure testing and shall list where and when the experience was obtained. Submit with the performance test plan.

1.6.1.3 Certification of Test Equipment

Certify that test equipment for the attenuation testing has been calibrated within last 12 months.

1.7 MAINTENANCE

1.7.1 Contents

In addition, the manual shall contain the following information:

a. A complete set of assembly and disassembly drawings;

b. A schedule of recommended maintenance and adjustment procedures to ensure continuous shielding effectiveness;

c. Allowable loads on top of room and on shelves mounted on walls, including permissible weights of equipment that can be mounted on walls; and

d. Prescribed method of handling panels, cleaning of seams and contact fingers, bonding jumpers, installing metallic items penetrating the shielding material without decreasing the attenuation characteristics.

PART 2 PRODUCTS

2.1 SHIELDED ENCLOSURE CHARACTERISTICS

2.1.1 Radio Frequency Interference Attenuation

The attenuation and shielding effectiveness requirements apply to the finished shielded enclosure[s] and enclosure's components when all power line filters are installed and carrying current, ventilation systems are operating, [the coaxial connector panels capped,] and shielded door[s] are in normal operation position. The specified shielded effectiveness shall be achieved without using conductive tapes, gaskets, or cement materials. Provide enclosure[s] having the following minimum magnetic, electric, and plane wave attenuation:

Magnetic - [60] [_____] dB at 14kHz increasing linearly to [100] [_____] dB at 200 kHz

Electric - [100] [_____] dB from 1.0 kHz to 50 MHz

Plane Wave - [100] [_____] dB between 50 MHz and 10 GHz

2.1.2 Sound Transmission Class (STC)

****
NOTE: STC 30 provides only minimum sound transmission loss. For greater sound control, more detailed acoustical design requirements must be incorporated into the specification.
****

Provide enclosure[s] having an STC of [30] [_____] dB minimum when tested according to ASTM E90 [not including sound transmission loss of surrounding building construction].

2.2 PANELS CONSTRUCTION

Flat steel sheet laminated to each side of a 20 mm 3/4 inch structural core of either plywood or hardboard. [Panels shall have a flame spread rating of less than 25 when tested according to ASTM E84.]

2.2.1 Flat Steel Sheet

ASTM A653/A653M with Z180 G-60 coating, minimum 24 gage, phosphatized.

2.2.2 Plywood

DOC/NIST PS51 for exterior, sound grade hardwood, Type I.

2.2.3 Hardboard

DOC/NIST PS58 for standard type hardboard.

2.2.4 Adhesive for Laminating Steel Sheets to Structural Core

Waterproof type which maintains a permanent bond for the lifetime of the enclosure.

2.2.5 Floor Finish

****
NOTE: Indicate or specify whether other flooring is to be provided or higher floor loads are required. This is most critical when raised floors are required. Allowances must be made for elevated door thresholds. Vinyl composition 1 is asbestos-free and should be specified for all projects.
****

Vinyl-composition tile, ASTM F1066, Type IV, composition 1, 300 by 300 mm, 3 mm 12 by 12 inches, 1/8 inch, thick.

2.3 FRAMING-JOINING SYSTEM

The panels shall be joined and supported by specially designed members that clamp the edges of the panels and provide continuous, uniform, and constant pressure contact against the shielding elements of the panels. The walls shall be self-supporting from floor to ceiling with no bracing. Deflection of walls under a static load of 35 kg 75 pounds applied normal to the wall surface at any point along the framing members shall not

exceed 1/250 of the span between supports. [Ceilings shall be self-supporting from wall to wall.] [Ceilings shall be supported by adjustable, nonconducting, isolated hangers from the structural ceiling above.] Ceilings shall be designed to have a deflection under total weight, including ceiling finish, of not more than 1/270 of the span. At corner intersections of walls, floor, or ceiling, provide a one-piece factory prewelded corner section or trihedral corner framed with brass machined cast corner cap assemblies consisting of inner and outer parts. The modular enclosure shall be designed for ease of erection, disassembly, and re-assembly.

2.3.1 Channels

The framing-joining system members shall consist of 3 mm 1/8 inch zinc-plated steel channels having minimum 16 mm 5/8 inch overlap along each side of the contacting surface. Screw fasteners shall be spaced at 75 or 100 mm 3 or 4 inch intervals.

2.3.2 Screw Fasteners

Screw fasteners shall be either zinc-plated or cadmium-plated steel, minimum size 6 mm 1/4 inch - 20 with pan or flat Phillips heads. Fasteners shall be heat treated and hardened with minimum tensile strength of 930 MPa 135,000 psi.

2.4 DOOR ASSEMBLIES

****

NOTE: Do not accept doors that deviate from this specification without consulting NAVFAC 15C. Probable deviations include: magnetic and electromagnetic doors, other non-finger stock type doors, adhesive mounted finger stock, and requests to approve doors tested to less than 10,000 open close cycles, among others.

****

The enclosure door shall be nonsagging and nonwarping and shall afford shielded effectiveness equal to the rest of the enclosure when the door is closed. The shielded door shall be provided with [multiple rows] [at least one row] of RF finger stock around the door or its frame. The fingers that form a contact between the door and its frame shall be protected from damage due to physical contact and shall be concealed within the door and frame assemblies. The door shall have a clear opening of [900 mm] [36 inches] [_____] wide and [2100 mm] [84 inch] [_____] high. Door assembly shall be the same manufacture as the enclosure. Doors shall be reinforced steel or laminated type. Laminated type shall be the same construction as enclosure panels, except the steel faces shall be electrically and mechanically joined by channels or overlapping seams, both of which shall be continuously seam welded along all joined surfaces.

2.4.1 Finger Stock

Contacts for doors shall be copper beryllium conforming to ASTM B194, Condition HT. The finger stock shall be secured to the door or frame without using special tools or soldering or adhesives and shall have a minimum overlap of 50 mm 2 inches.

2.4.2 [Latching Type

****
NOTE: Select the applicable paragraph(s) from the following:
****

****
NOTE: Specially designed door for electrical or pneumatic operation may be specified; however, these special doors are not compatible with all demountable enclosures.
****

The door shall be lever controlled with roller cam action requiring not more than 90 N 20 pounds of operating force on the handle for both opening and closing. The door shall be equipped with a two or three-point latching mechanism that provides proper compressive force for the RF seal. The mechanism shall be operable from both sides of the door and shall have permanently-lubricated ball bearings at points of pivot and rotation. The door latches and hinges shall be rated for a minimum of 10,000 cycles without loss of attenuation and without adjustments.]

[Nonlatching Type

****
NOTE: Nonlatching doors may be used for enclosures having many daily open-close operations; however, they may not retain as high an attenuation over the long term compared with doors having three-point latching mechanisms.
****

The door shall be equipped with three heavy-duty ball bearing hinges and a door pull. Door shall open and close with a force not to exceed 20 N 5 pounds.]

2.5 LINE FILTERS

2.5.1 Power Line Filters

Shall have current and voltage ratings as [indicated] [specified].

2.5.2 Telephone and Signal Line Filters

MIL-PRF-15733. Filters shall have an insertion loss of 100 decibels in the frequency range of 14 kHz to 10 GHz measured according to MIL-STD-220, full load condition. Filters shall have a pass band of [_____] kHz to [_____] kHz with a characteristic impedance of [_____] ohms.

2.6 WAVEGUIDE-TYPE AIR VENTS

Honeycomb-type air vents shall have cores fabricated of brass or steel, and each guide shall be electrically and mechanically bonded to all adjacent guides. Air vents shall be a permanent part of the shielded enclosure and shall have a shielding effectiveness equal to that of the total enclosure. Static pressure drop through the vents shall not exceed 5 Pa 0.02 inch water gage at an air velocity of 3 m/s 600 feet per minute.

2.7 GROUNDING STUD

Enclosure shall have a permanently installed, solid brass or bronze grounding stud complete with hardware and jamb nuts located in the entrance plate [unless otherwise specified or indicated]. The stud shall be 13 mm 1/2 inch diameter double-threaded bolt which allows a full 50 mm 2 inch running thread inside and outside of the shielded enclosure.

2.8 SERVICE ENTRANCE PLATES (SET-UP PANELS)

Shall be minimum 3 mm 1/8 inch thick steel, sized [300 by 300 mm] [12 by 12 inches] [_____] and shall have a 6 mm 1/4 inch extruded brass frame for mounting to shielded enclosure wall panel.

2.9 NAMEPLATES

Major components of equipment shall have manufacturer's name, address, catalog number, model, style, and type on a plate securely and conspicuously attached to each item of equipment. Nameplates for electrical apparatus shall conform to NEMA Standards.

2.10 LIGHTING

****

NOTE: In shielded enclosures where electronic equipment is very sensitive to EMI, specify a dual lighting system so that fluorescent lighting can be turned off and incandescent lighting left on during sensitive tests or operations.

****

Provide lighting fixtures as indicated [and as specified in Section 26 51 00 INTERIOR LIGHTING]. Fluorescent lighting fixtures shall meet the requirements of MIL-STD-461, Class C3, Group I for both conducted and radiated interference.

2.11 EXHAUST FAN

****

NOTE: This paragraph cites only minimum requirements. Design calculations are necessary to size HVAC to suit room size and equipment/personnel contained within. Exhaust fan motors located inside shielded enclosure must meet MIL-STD-461, Class C3, Group I.

****

Propeller fans shall be [direct drive] [belt drive] for [wall or window] [roof or ceiling] mounting, except that fans shall be centrifugal type with aluminum housing and wheel. Additionally exhaust fans shall be electromagnetically compatible. Motors shall be completely shielded from the air stream. Provide exhaust opening and gravity closing type automatic louvers. Provide exhaust which can supply 15 room air changes per hour. Capacity of fans shall be certified in accordance with AMCA 210, and shall be not greater than 110 percent of the indicated capacity at indicated pressure drop.

2.12 COAXIAL CABLE PENETRATIONS

For each coaxial cable entering the shielded enclosure, provide RF waveguide threaded insert with cap and chain on shielded room side of enclosure.

2.13 SOURCE QUALITY CONTROL

****

NOTE: When specifying nonlatching doors, delete door static load and sag tests and cycle test for door latches. Retain cycle test for door hinges.

****

2.13.1 Door Static Load Test

The door shall be mounted and latched to its frame, then set down in a horizontal position such that the door will open downward and only the frame is rigidly and continuously supported from the bottom. A load of 2kPa 40 psf shall be applied uniformly over the entire surface of the door for at least 10 minutes. The door will not be considered acceptable if this load causes breakage, failure, or permanent deformation which varies the clearance between door leaf and stops to vary more than 2 mm 1/16 inch from the original dimension.

2.13.2 Door Sag Test

The door and its frame shall be installed normally and opened 90 degrees. Two 23 kg 50 pound weights, one on each side of the door, shall be suspended from the door within 125 mm 5 inches of the outer edge for at least 10 minutes. The door will not be considered acceptable if this test causes breakage, failure, or permanent deformation which varies the clearance between the door leaf and floor frame more than 2 mm 1/16 inch from its original dimension.

2.13.3 Swinging Door Closure Test

Door shall be operated 5000 complete open-close cycles. The door will not be acceptable if the closure test causes any breakage, failure, or permanent deformation that causes the clearance between door and frame to vary more than 2 mm 1/16 inch from the original dimension.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Installation Supervision

Furnish the services of a qualified installation engineer or technician regularly employed by the shielding manufacturer/fabricator for a minimum of three 8 hours working days to instruct Contractor personnel in the installation of the RFI shield. A qualified installation technician is acceptable in lieu of a qualified installation engineer. After the shielded enclosure has been completely installed including RF filters, vents, and exhaust fans, furnish the services of the engineer or technician described herein to inspect the installation for compliance with the specifications. The inspection shall be made before any finishes or the concrete topping coat are installed.

3.1.2 Panel Installation

Lay panels in a straight line with true, level, and even surfaces and with the joints in alignment; install them in accordance with the shielding manufacturer's recommendations. Exercise care while handling and installing metal shielding panels to ensure that panels are not damaged. Clean exposed surfaces of all dirt, finger marks, and foreign matter resulting from manufacturing processes, handling, or installation. Inside the enclosure, mount items including boxes, conduits, fixtures, and switches directly to the RF panels with 16 mm 5/8 inch long, zinc-plated, self-tapping screws. Keep electrical conduits as close to RF shielding as possible. Do not use framing-joining system bolts to mount material and equipment. If material and equipment penetrate shielded enclosure, seam weld or solder materials and equipment to both shielding surfaces.

3.1.3 Surface Preparation

Clean and buff surfaces to ensure good electrical contact with shielding surface. Remove paint or other coverings on mating surfaces of special boxes such as for fire alarm systems, buzzers, and signal lights, including areas between box and cover, box and wall, and box and conduit. Remove insulating material to maintain a low-resistance ground system and to ensure firm mating of metal surfaces.

3.1.4 Floor Panel Setting

Place a polyethylene film of 6-mil thickness over the structural floor of the parent room before any other work is set thereon. Provide a 3 mm 1/8 inch thick layer of hardboard over this film with joints loosely butted. Over this layer provide an additional layer of similar filler material of equal thickness as the projection of the framing-joining member from the bottom surface of the floor panel leaving no more than 6 mm 1/4 inch space between the hardboard and the framing-joining member.

3.2 FRAMING-JOINING SYSTEM

Tighten screws with a calibrated adjustable torque wrench so that equal torque can be set on each screw. (Proper torque values will be approximately 9 Nm 80 inch pounds, but may vary somewhat depending on the manufacturer).

3.3 DOOR ASSEMBLIES

Mount so that the clearance between the door edges and frame shall not vary more than 2 mm 1/16 inch and the innerface of the door periphery does not vary more than 2 mm 1/16 inch from the plane of the face of the stop. Through-bolt hinges to the door and the frame.

3.4 LINE FILTERS

Provide filters for incoming electrical power lines [, including neutrals,] and for incoming telephone and signal lines. Support filters independently of the shielding.

3.5 WAVEGUIDE-TYPE AIR VENTS

[Provide each inlet and return air duct with the number and size of waveguide-type air vents at each location where the ducts enter the shielded enclosure.] [As a minimum, provide each enclosure with one 300

mm 12 inch square and one 300 mm 12 inch square return waveguide-type air vent.]

3.6 EXHAUST FAN

Mount on [wall] [or] [ceiling] over the exhaust vent on the exterior surface of shielded enclosure. Provide power from electrical source exterior to the shielded enclosure.

3.7 CONDUCTOR INSTALLATION

Provide filtered conductors in conduit, except for coaxial cables, from filter to shielding and penetrate the enclosure through threaded rigid steel conduits. [Twist conductors leading from the filters and conductors inside the shielded enclosure approximately 10 turns per foot in the conduit.]

3.8 GROUNDING

****

NOTE: If not specified in Division 16, "Electrical," the following sentence shall be added: "Wires inside the enclosure and for a distance of at least 15 meters 50 feet outside of the enclosure shall be enclosed in a grounded, threaded rigid steel conduit system."

****

Extend the grounding stud through and [bolt] [weld] it to the electrical power panel with a minimum No. 4 AWG insulated stranded copper conductor to effectively serve as a single grounding point for the completely assembled shielded enclosure, both internally and externally.

3.9 SERVICE ENTRANCE PLATE

Install RF connectors for coaxial cable and other RF shielded cable on entrance plate. Soft solder connectors to the plate. If location of plate is not indicated, mount plate in wall panel adjacent to power line filters.

3.10 FIELD TESTS

3.10.1 Seam Leak Detection Testing

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NOTE: SELDS testing the seams in the floor shielding is usually very difficult because you cannot "sniff" on both sides (assuming the shield is on the ground level). To circumvent this problem SELDS loops may be positioned beneath the floor shield for SELDS testing.

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Continuously test seams during fabrication using the SELDS, commonly known as a "sniffer." Upon completion of the basic shielded enclosure, before applying any metal primer or installing any accessories, test the entire shielded enclosure with the SELDS. Install terminal points on the shielding exterior and permanently attach test leads on two sets of diagonally opposing corners during construction for use with the SELDS.

Continuously probe seams with the test receiver set to detect abrupt change of shielding level greater than 10 dB on the "shielding unit" scale. Clearly mark points having change greater than 10 dB and repair the seam to meet the specified requirement. Retest each repaired point until there are no points on seams which fail test.

3.10.2 Attenuation Testing

[Furnish the services of an independent testing laboratory, approved by the Contracting Officer, to test the shielded enclosure. Certify that laboratory is equipped and staffed to perform field tests of RF shielded enclosures and performs the tests as a normal service.] [Final acceptance testing will be by the Government.] Conduct the final shielding acceptance test after penetrations have been completed, specifically including electrical and other utility penetrations. In addition, the Contractor may schedule a complete or abbreviated test to verify that the shielding assembly is adequate prior to conducting final shielding acceptance test.

3.10.2.1 Test Method

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NOTE: Expert Government witness should be present for all final acceptance testing. Note that IEEE 299 requires one magnetic field test (150 kHz), three electric field tests (200 kHz, 1 MHz, 18 MHz), and one plane wave test (400 MHz). Also, note that IEEE 299 and NSA 65-6 differ on positioning of source and receiver. IEEE 299 requires source outside and receiver inside the shield, while NSA 65-6 requires source inside and receiver outside (to simulate TEMPEST conditions). For TEMPEST shielding effectiveness testing, continuous sweeping of seams at one or more plane wave frequencies should also be specified, in addition to testing around all door panels, filters, air duct penetrations and all other penetrations of the shielding at all test frequencies. If enclosure is designed specifically for attenuating microwave frequencies, specify additional test frequencies above 1 GHz. Such testing is expensive and should only be used when a firm requirement exists (e.g., NSA-65-6).

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The test procedure, frequencies, and equipment shall be as specified in IEEE 299 [plus the additional frequencies specified in the contract]. Perform the test as soon as possible after completion of the shielded enclosure, including installation of services, power/telephone/signal lines, RF filters, and waveguide vents. Conduct tests with doors closed and the filters under normal load conditions.

3.10.2.2 Additional Test Points

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NOTE: Use this paragraph if design includes strict tolerances, high attenuation requirements, and many penetrations.

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Measure additional test points beyond those specified in IEEE 299. Test points include the periphery of doors and covers, handles, latches, power filter penetrations, air vent filters, telephone and control line filter penetrations, and points of penetration by pipes, tubes, and bolts.

3.10.3 Final In Service Testing

Upon completion of acceptance checks, settings, and tests, show by demonstration in service that equipment and devices are in operating condition and performing the intended function. Give the Contracting Officer five working days advance notice of the dates and times for checks and tests.

-- End of Section --