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USACE / NAVFAC / AFCEC | **UFGS-13 49 33.70 (May 2026)**

Preparing Activity: NAVFAC | **Superseding UFGS-08 56 46.10 20**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2026

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SECTION TABLE OF CONTENTS

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 49 33.70

TEMPEST [DEMOUNTABLE] [TRANSPORTABLE] [MODULAR] RADIO FREQUENCY INTERFERENCE (RFI) SHIELDED ENCLOSURE

05/26

-- End of Section Table of Contents --

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SECTION 13 49 33.70

TEMPEST [DEMOUNTABLE] [TRANSPORTABLE] [MODULAR] RADIO FREQUENCY INTERFERENCE (RFI) SHIELDED ENCLOSURE
05/26

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This guide specification covers the requirements for electromagnetic shielded facilities.

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. This guide specification also covers RF shielded enclosures that are 'transportable' or 'modular,' as various services refer to these enclosures in similar terms. 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.

Refer to MIL-HDBK 419 for special grounding and bonding requirements for shielded enclosures.

Refer to MIL-HDBK-1195 for projects requiring RF and TEMPEST protection.

The designer should consult these documents and other appropriate sources before applying this guide specification to shielded enclosures or to TEMPEST projects.

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PART 1 GENERAL

This section includes standards and construction specifications for spaces using Electromagnetic Interference (EMI) Protection Subsystem.

1.1 REFERENCES

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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.

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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.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA L870	(2010) Voluntary Product Standard, PS 1-09, Structural Plywood

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel

ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	(2025a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B194	(2022) Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B633	(2023) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E84	(2026) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E90	(2023) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

COMPOSITE PANEL ASSOCIATION (CPA)

ANSI/CPA A135.4	(2012; R2020) Basic Hardboard

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2026; TIA 26-1; ERTA 26-1; TIA 26-2; TIA 26-3; TIA 26-4; TIA 26-5; TIA 26-6; TIA 26-7; ERTA 26-2; ERTA 26-3) National Electrical Code

NATIONAL SECURITY AGENCY (NSA)

NSA 94-106	(1964) Specification for Shielded Enclosures

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-HDBK-419	(1987; Rev A, Notice 1 2014) Grounding, Bonding, and Shielding for Electronic Equipments and Facilities Volumes 1 of 2 Basic Theory
MIL-HDBK-1195	(1988) Radio Frequency Shielded Enclosures
MIL-PRF-15733	(2020; Rev J) Filters and Capacitors, Radio Frequency Interference, General Specification for

MIL-STD-220	(2009; Rev C; Notice 2 2024) Method of Insertion Loss Measurement
MIL-STD-461	(2015; Rev G) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

UL SOLUTIONS (UL)

UL 486A-486B	(2025) UL Standard for Safety Wire Connectors
UL 1283	(2025) UL Standard for Safety Electromagnetic Interference Filters
UL 1449	(2021; Reprint Oct 2025) UL Standard for Safety Surge Protective Devices

1.2 DEFINITIONS

1.2.1 Demountable Definition

A demountable RF shielded enclosure is an RF shielded volume that may be assembled, disassembled, relocated, and reassembled at a new location. The shielded enclosure must maintain the overall shielding effectiveness (SE)requirement in this specification when the enclosure is fully assembled with all finishing materials. This definition includes "transportable" and "modular" RF shields.

1.2.2 Radio Frequency Shield Critical Item (RFSCI)

An RF Shield Critical Item is an item having performance requirements for the purpose of providing protection from radio frequency electromagnetic signals, such as the RF shield, surge arresters, RF shielded doors, RF filters, waveguides, and waveguides-below-cutoff. RF shield critical items are elements of the TEMPEST protection subsystem.

1.2.3 Radio Frequency Shield Critical Assembly (RFSCA)

A top-level assembly of RF shield critical items and other non-critical components such as mounting brackets and fasteners.

1.2.4 Radio Frequency Shield Critical Process (RFSCP)

A process, specification, or procedure which must be followed exactly to ensure that the associated RF shield critical item attains its required performance.

1.2.5 TEMPEST Protection Subsystem

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NOTE: TEMPEST Demountable systems will be bolted volumes usually consisting of modular steel laminated plywood panels bolted together with metal strips or channels. Thicker material may be used if it is more cost-effective or required for structural reasons. TEMPEST Demountable systems should be used when a shielded facility requires lower level, short service life protection of 50 dB attenuation.

Do not construct TEMPEST Demountable systems using RF foil. The fragility of RF foil does not make it suitable for demountable systems.

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The elements of a building or facility that provide Radio Frequency conducted and radiated emanation protection for classified or sensitive data processing.

1.3 SUBMITTALS

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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 and Air Force 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.

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. Submittals not having a "G" or "S" classification are 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-01 Preconstruction Submittals

Quality Control Plan; G, [_____]

SD-02 Shop Drawings

RF Shielded Enclosure Shop Drawings; G, [_____]

Fabrication Shop Drawings

Assembly Shop Drawings

Shield Shop Drawings

Ground System Shop Drawings

Shielded Door Shop Drawings

Waveguide-Below-Cutoff Penetrations Shop Drawings

Filter/ Electrical Surge Arrestor (ESA) Assembly Shop Drawings

HVAC WBC Array Assemblies Shop Drawings

SD-03 Product Data

Manufacturers Descriptive and Technical Literature

Quality Control Plan; G, [_____]

Catalog Cuts

Installation Instructions

Door Assemblies

Power Line Filters

Telephone and Signal Line Filters

HVAC WBC Arrays

Air Vents

Penetrations

SD-06 Test Reports

Daily QC Report Requirements

Acceptance Test Plan and Procedures

Acceptance Test Reports

Attenuation Testing

Welding Procedures; G, [_____]

HVAC WBC Array Assembly Factory Test Plan; G, [_____]

HVAC WBC Array Assembly Factory Test Report; G, [_____]

Sag Test

Static Load Test

Closure Test

SD-07 Certificates

Performance Test Plan

Qualifications of Installation Supervision Personnel

Manufacturers Certificates Of Compliance

Welders Certificates; G, [_____]

SD-08 Manufacturer's Instructions

Radio Frequency Shielded Enclosure

SD-10 Operation and Maintenance Data

Radio Frequency Shielded Enclosure, Data Package 2; G, [_____]

Shield Maintenance Procedures

1.4 CERTIFICATIONS

1.4.1 Manufacturers Certificates of Compliance

Certifications must certify that materials conform to the requirements of MIL-HDBK-1195. Certifications must be provided for shield materials, welding filler materials, RF shielded doors and access panels, waveguide-below-cutoff POE protective devices, electrical filters, and electrical surge arresters.

1.4.2 Welders Certificates

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NOTE: It is likely that demountable RF panels will be procured already fabricated, and the connection between adjacent panels is not expected to be a welded connection, in order for the shield to be demountable. Welding qualifications may be required for the fabrication of other RF Shield critical assemblies.

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Qualification certificates, including Disqualification Notices, and Requalification Notices for all qualified welders must be provided to the Contracting Officer before the welder is permitted to work on the RF shield. Welder disqualification notices must be provided within 24 hours of disqualification.

1.4.3 Certification of Test Equipment

Certify that the test equipment for the attenuation testing has been calibrates.

1.5 MAINTENANCE MATERIAL SUBMITTALS

1.5.1 Spare Parts

The ability to restore a TEMPEST protection subsystem to a satisfactory condition after failure implies that replacement parts and repair materials and supplies must be readily accessible. Cleaning kits, supplies, and repair parts for at least 2 years of normal maintenance on shielded doors.

At least 200 percent spares for each type of RF gasket used in the TEMPEST protection subsystem. At least 10 percent spares for each type of filter and ESA installed at the site.

1.5.1.1 Instruction Handbook

Two copies of an instruction handbook must be supplied with the TEMPEST protection subsystem. The handbook must contain a complete set of assembly drawings, prescribed methods for welding RFSCI or RFSCA into panels, making electrical bonds and other attachments to the shield, installing protection devices for points of entry (POE) penetrating the shielding material without degrading the attenuation characteristics, and a schedule of recommended shield maintenance procedures, including preventive maintenance, inspections and corrective maintenance repairs and tests, to ensure continuous TEMPEST protection.

1.6 QUALITY CONTROL

The shielding contractor must be responsible for all quality control including component testing, in-progress testing, and acceptance testing for the TEMPEST protection subsystem. The contractor must establish a quality control program to ensure compliance with contractual requirement and must document the program in the quality control plan. The contractor must maintain quality control records for all construction operations required under this part. The contractor must provide the services of an independent testing laboratory or consultant, approved by the Contracting Officer, to perform the acceptance testing.

1.6.1 Shop Drawings General Requirements

Include penetration details. Shop drawings must identify shield construction technique, material properties, attenuation levels of shield system/materials, anodic index/corrosion problems, and filters. The shop drawings for the shielded enclosures must be prepared by a shielding manufacturer/fabricator experienced in the installation of bolted, foil, and metal welded EMI shielded enclosures and who has supervised the installation of[two] such enclosures which have operated satisfactorily. Prior to commencing work, and as a condition of continuing work, forward to the Contacting Officer[and Site Security Manager] information demonstrating such experience.[Drawings must be approved by and bear the seal of a registered, professional structural engineer.]

1.6.2 Quality Control Plan

Quality Control Plan must include a description of the contractors organizational structure, indicating the manner in which QC is integrated into job site management; names, positions, and qualifications of all QC personnel or organizations and their specific responsibilities; manner, methods, procedures, and techniques to be employed in the execution of the

daily inspections and tests; a sample of the format that the contractor proposes to use for the daily QC report; the location and description of all testing facilities and equipment to be used; and procedures for control, submittal, and checking subcontractor submittals as required. Submit drawings for Contracting Officer approval within 30 days of notice to proceed.

The contractor's Quality Control (QC) plan must be submitted for Contracting Officer approval within 30 days after notice to proceed.

1.6.3 Regulatory Requirements

1.6.3.1 Test Procedures and Results

All required quality assurance testing must be documented with test procedures and test reports, as required by paragraphs ACCEPTANCE TEST REPORTS and MANUFACTURERS CERTIFICATES OF COMPLIANCE. It is emphasized that tests must be performed on actual units that are delivered and installed, unless type testing is specified, and that actual test data must be supplied to the Contracting officer. Certifications of specification compliance, without the supporting data, will not satisfy these requirements.

1.6.3.2 Notification of Inspection and Tests

The contractor must notify the Contracting Officer at least 14 days before the performance of tests as specified in PART 3 of this specification, except that notification before tests outside the continental United States must be at least 30 days before the performance of tests.

1.6.3.3 Site Visits

Personnel from Government agencies and contractors will be making random, but announced, visits to observe shielding testing and quality assurance program execution and to monitor progress of construction of the TEMPEST protection subsystem. All visitors will be identified by the Contracting Officer or a designated representative.

1.6.3.4 Additional Government Testing

At its discretion, the Government may conduct additional testing to verify compliance with specification requirements. Such tests will be performed in a manner that does not interfere with contractor activities and will not subject components or assemblies to stresses that exceed specified limits. The Government will notify the contractor of the nature and planned time of conduct of these tests, and the contractor may witness them.

1.6.3.5 Detailed Test Plans

Detailed test plans are required for in-progress testing of welds, for the complete (empty) shield effectiveness survey, for factory and in-place testing of shielded doors, waveguides and waveguide panels, filters, surge arresters, RF enclosures, and conduits, and for final acceptance testing. Test plans must be submitted for Contracting officer approval at least 30 days before the scheduled start of testing.

1.6.3.6 Field Training

Provide a field training course for designated operating and maintenance staff members. Provide training for a total period of [8][_____] hours of normal working time and start after the system is functionally complete but prior to the final acceptance test. Cover all the items contained in the Operating and Maintenance Manuals.

1.6.4 Qualifications for QC

Submit the following information:

a. Identification and credentials of the shielding contractor establishing evidence of 5 years experience involving the design, construction, and testing of RF enclosures of a similar type must be submitted within 15 days after notice to proceed.

b. Identification and credentials of on-site supervisors and quality control specialists showing requisite experience in the construction of TEMPEST projects must be submitted within 15 days notice to proceed.

c. Identification and credentials of vendors, catalog cuts, and manufactures data for shielded doors, electrical filters, ESAs, and waveguide-below-cutoff penetration protection devices must be submitted within 60 days of notice to proceed.

d. Identification and credentials of the independent testing agency or consultant who will perform the acceptance testing must be submitted 90 days before the start of testing.

e. Qualification certificates for all qualified welders must be provided to the Contracting Officer before the welder is permitted to work on the shield. Welder disqualification notices must be provided within 24 hours of disqualification.

f. Qualifications of Installation Supervision Personnel

1.6.4.1 Shielding Specialist

The shielded enclosure must be provided by an experienced firm that is regularly and successfully engaged in the installation [and][or] manufacturing of equally complex TEMPEST protection subsystems. The Contracting Officer may reject any proposed shielding specialist who cannot show documented evidence of 5 years of experience in the design, construction, and testing of electromagnetic shielding of similar complexity. The shielding contractor is responsible for providing all required materials and for all RF shield assembly work required under this part.

1.6.4.1.1 Responsibilities of the Shielding Specialist

Provide materials, products, and services necessary for a complete, tested, and operational protection system. Supervise and inspect all work performed under this section prior to submitting to the Contracting Officer for approval. TEMPEST protection subsystem submittals must be date stamped and signed by the shielding specialist. Coordinate the TEMPEST protection subsystem work with the work of all other trades that will interface with or affect the performance of the RF shield and penetration protection devices.

Provide sufficient and qualified supervisory and quality control personnel on site to supervise the installation crew and to conduct in-progress quality assurance inspections and tests. Provide the services of a qualified and independent shield testing specialist to perform the acceptance testing.

1.6.4.2 Certified TEMPEST Technical Authority (CTTA)

It is important to consult with a CTTA before beginning design of the enclosure. Failure to consult with a CTTA could result in the installation of unnecessary [and][or] expensive countermeasures or the omission of needed countermeasures.

1.6.4.3 Welders

Welding must be performed by certified welders. Certification must be provided that each welder has passed qualification tests in the processes specified in AWS D1.1/D1.1M, section 5; MIL-STD-248; and as required by the Contracting Officer. The contractor must require a welder to retake the tests when, in the opinion of the Contracting Officer, the work of said welder creates a reasonable doubt as to that welder's proficiency.

The Contracting Officer may require test specimens to be cut from any location in any joint. All sections of welds found to be defective must be chipped, ground, or cut to the base metal and properly rewelded before proceeding with the work. Should any two test specimens cut from the work of any welder show strengths less than that of the base metal, it will be considered evidence of negligence or incompetence, and such welder must be permanently removed from the work.

1.6.4.4 Shielded Door Specialist

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NOTE: The shielded door specialist is not a contractor provided position, but these requirements must be met by the manufacturer of the shielded door assembly.

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All work on shielded doors must be performed by a shielded door specialist. A shielded door specialist must have successfully completed at least five similar shielded door projects of comparable size in the last 10 years. Door supplier qualifications must be submitted to the Contracting Officer for approval within 60 days after the notice to proceed. Adequate information must be provided to show that the supplier is regularly engaged in the manufacture of RF shielded doors and access panels, and that doors of the design offered provides shielding effectiveness equal to or greater than the design requirements outlined in this document.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Shield Enclosure Materials

Materials must be delivered to the job site in an undamaged condition. Materials must be stored to ensure proper alignment, ventilation, and drainage, and must be protected against dampness before and after delivery. Materials must be stored under cover in a well-ventilated

enclosure and must not be exposed to extreme changes in temperature and humidity that could cause damage. Materials must not be stored in the building until concrete and masonry are fully cured. Defective or damaged materials must be replaced by the contractor at no additional cost to the Government. Damaged or misaligned materials must be rejected. Contractors must phase the installation of the various components of the TEMPEST protection subsystem to prevent damage during construction. The contractor must be responsible for adequately protecting elements of the TEMPEST protection subsystem whether they are stored or installed.

1.7.2 Shielded Door and Access Panel Materials

Shielded doors and access panels must be appropriately packaged for shipment. Packing containers must provide physical and moisture protection, so that these items will be delivered to the job site in an undamaged condition. If special protection is required after installation, but before building completion, protection materials and protection instructions must be provided by the door manufacturer.

1.7.3 Waveguide-below-cutoff Protective Device Materials

WBC protective devices must be appropriately packaged for protection during shipment and storage. Packaging must provide physical and environmental protection to ensure that these items are delivered to the site in an undamaged condition. The packages must be stored at the site under cover and must be protected from extreme temperature changes and moisture that would cause damage. Defective units must be replaced by the contractor at no cost to the Government. The shielding contractor must be responsible for receiving and storing WBC protective devices at the job site.

1.7.4 Filter and ESA Materials

All filter/ESA assemblies must be completely protected from weather, dust, and incidental contact during shipment and storage. The TEMPEST protection subsystem contractor must be responsible for receiving and storing the filter/ESA assemblies at the job site.

1.8 WARRANTY

1.8.1 Shielded Enclosure

The TEMPEST protection subsystem must be warranted by the contractor to satisfy all performance requirements for at least 1 year, when maintained in accordance with procedures supplied by the contractor. The performance requirements apply to the finished structure with all electrical and mechanical penetrations installed and operating.

1.8.2 Shielded Doors and Access Panels

The RF shielded doors and access panels must be warranted to provide the required attenuation, when properly maintained, for a period of 15 years. The operating mechanisms, including interlocking components for the doors, must be guaranteed by the contractor for 1 year or 50,000 cycles of opening and closing following the date of first beneficial use. Any part of these mechanisms failing during the guarantee period must be replaced or repaired, including the required reinstallation and testing labor, by the contractor. Copies of the warranty must be provided with each unit delivered.

1.8.3 Waveguide-below-cutoff Protective Devices

WBC protective devices must be warranted by the manufacturer or contractor to provide the required shielding effectiveness for at least five years, when maintained in accordance with the supplied procedures.

1.8.4 Filters and ESAs

Filter elements must be warranted by the manufacturer for a period of 1 year from acceptance by the Contracting Officer, or 18 months after installation, whichever is least. ESAs must be warranted by the manufacturer for a period of 3 years after acceptance by the Contracting Officer, provided that surge life and other ratings are not exceeded.

Filter/ESA enclosures must be warranted to provide the shielding effectiveness required for a period of 3 years after acceptance by the Contracting Officer when maintained in accordance with the supplied procedures.

1.9 OPERATING AND MAINTENANCE MANUALS

Submit manufacturer's written instructions for operation and maintenance of[RF Shielding system][TEMPEST protection subsystem]. Address all components and aspects of the RF shielding and include, but not be limited to, the following:

a. A complete set of assembly drawings to include penetration locations and installation details.

b. The construction specification on RF shielding.

c. Shield penetration schedule.

d. Power/signal filter schedule.

e. Test plan.

f. The prepared preventive maintenance instructions for periodic inspection, testing and servicing, lubrication, alignment, calibration, and adjustment events normally encountered. Extract complex preventive maintenance events from or refer to detailed vendor or manufacturer data. Derive this information from an evaluation of engineering data considering local environmental conditions, manufacturer's recommendations, estimated operating life for the specific application and use of the equipment, and types of job skills available at the operating site.

g. Spare parts data approved and verified by the shielding specialist prior to submission. Include a complete list of recommended parts and supplies with current unit prices and source of supply.

h. Provide a list of RF shield critical items (RFSCI) requiring periodic inspection to maintain RF shield integrity. RF Shield critical items are those components [and][or] construction features which singularly and collectively provide specific levels of RF protection, such as the RF shield, surge arresters, RF shielded doors, shield welding, electrical filters, waveguides, and waveguides-below-cutoff.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

2.1.1 General

Provide shielded facility that meets or exceeds the minimum attenuation requirements specified. The Demountable system must include, but is not limited to, the following:

a. The RF shield

b. RF Shielded doors for access into the facility

c. Electrical penetrations and point-of-entry protective devices

d. Mechanical penetrations and point-of-entry protective devices

e. Architectural penetrations and point-of-entry protective devices

f. Structural penetrations and point-of-entry protective devices

g. Special protective measures for mission-essential equipment outside the shield

h. Sufficient supervisory [and][or] quality control personnel onsite to supervise the installation crew and to conduct in-progress quality assurance tests.

2.1.2 Required Documentation

Identify all RF shield critical items and processes on the shop drawings with RFSCI labeling and symbols, respectively, in accordance with ASME Y14.100. Welding and brazing terms and symbols must be in accordance with ANSI/AWS A2.4 and ANSI/AWS A3.0.

All shop drawings must be approved by a professional engineer and must bear their seal.

a. Shielded Enclosure Shop Drawings

(1) Include penetration details. Shop drawings must identify shield construction technique, material properties, attenuation levels of shield system/materials, anodic index/corrosion problems, and filters. The shop drawings for the shielded enclosures must be prepared by a shielding manufacturer/fabricator experienced in the installation of EMI shielded enclosures and who has supervised the installation of two such enclosures which have operated satisfactorily. Prior to commencing work, and as a condition of continuing work, forward to the Contacting Officer information demonstrating such experience.[Drawings must be approved by and bear the seal of a registered, professional structural engineer.]

b. Fabrication Shop Drawings

(1) Drawings must provide complete list of parts and materials, sized, arrangements, and methods of fabrication.

c. Assembly Shop Drawings

(1) Drawings must a complete list of components and materials, a shield penetration schedule, a RF shield critical item list, and equipment locations and layouts.

d. Shield Shop Drawings

(1) Shield details must be provided within 60 days after notice to proceed. Drawings must provide a complete list of shield materials and show all assembly and erection details and processes. All RFSCI and RFSCP must be marked in accordance with ASME Y14.100.

e. Ground System Shop Drawings

(1) Ground system connection details must be provided within 60 days after notice to proceed.

f. Shielded Door Shop Drawings

(1) Drawings must provide a complete list of materials, arrangements, thicknesses, size of parts, construction fastenings, clearances, door weight, part number, assembly and erection details, and necessary connections to work of other trades. Catalog data for all manufactured items must be included as well. RF shield critical items and RF Shield critical processes must be identified on the drawings with RFSCI and RFSCP symbols, Shielded door drawings must be submitted within 60 days after the notice to proceed.

g. Waveguide-below-cutoff Penetrations Shop Drawings

(1) Shop drawings for all WBCs and WBC arrays must be prepared by the Contractor and shielding specialist and submitted to the Contracting Officer for approval as part of the shop drawings for the facility shields (see paragraph SHIELDED ENCLOSURE SHOP DRAWINGS). The drawings must provide a complete list of materials and parts, sizes, arrangements, and methods and sequence of assembly. RF jointing methods and details must be provided. Methods of attachment to the RF shield, ducts, louvers, or other attachments must also be detailed. RF shield critical items and RF Shield critical processes must be identified on the drawings with RFSCI and RFSCP symbols, respectively. Drawings must be submitted within 60 days of notice to proceed.

h. Filter/ Electrical Surge Arrestor (ESA) Assembly Shop Drawings

(1) Drawings must include a complete list of equipment and materials, including the manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Drawings must also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout and any other details required to demonstrate that the assembly has been coordinated and will properly function as a unit. Installation details must show the location of each penetration and the method of penetration. RF shield critical items and RF Shield critical processes must be identified on the drawings with RFSCI and RFSCP symbols,

respectively Drawings must be submitted within 60 days of the notice to proceed.

i. Installation Instructions

(1) Drawings must indicate the sequence of construction, coordination with the work of other trades, and any other information to demonstrate that the TEMPEST protection subsystem will function as a complete system. Drawings must show components and materials, fastenings, clearances, and installation methods including welding procedures.

j. Daily QC Report Requirements

(1) Report requirements must be submitted for approval at least 10 working days prior to the first time they are to be used.

k. Acceptance Test Plan and Procedures

(1) Submit a performance test plan for[Seam Leakage Detection System(SELDS)][or][NSA 94-106] testing of the facility. The test plan must include tester qualifications, equipment listings (including calibration dates and antenna factors), and proposed test report. The plan must 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 must indicate the proposed dates and duration of the lowest and the highest frequency tests following installation of the building finish materials[so that a CTTA or an expert Government witness may be available for these final acceptance tests].

l. Acceptance Test Reports

(1) Include the method of testing, equipment used, personnel, location of tests, and test results. Submit daily reports of results of each test performed on each portion of the shielding system to the Contracting Officer within 3 working days of the test. Clearly identify location of the area tested. Identify leaks detected during testing with sufficient accuracy to permit relocation for testing in accordance with test procedures. Submit reports of testing to the Contracting Officer with required certification by the testing agency representative or consultant. Submit three reports (in-progress test report, initial test report, and final acceptance test report).

(2) Reports must include a Cover page, Introduction, Deviations from The Test Plan, Data, Data Summary, and Pass/Fail Conclusions.

m. Radio Frequency Shielded Enclosure, Data Package 2

(1) Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Indicate allowable loads on top of room and on shelves mounted on walls, including permissible weights of equipment that can be mounted on walls. Include prescribed method of welding panels, cleaning of seams and contact fingers, bonding jumpers, installing metallic items penetrating the

shielding material without decreasing the attenuation characteristics.

2.1.3 Shielding Effectiveness

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NOTE: Designer must coordinate requirements with the CTTA and COR to ensure that the compilation of the project location and the effectiveness requirements do not elevate the classification level of this specification section.
****

The attenuation and shielding effectiveness requirements apply to the finished shielded enclosure complete with all RFSCI. Provide enclosure[s] having the following minimum magnetic, electric, and plane wave attenuation:

a. Use minimum magnetic field attenuation of 20 dB [_____] at 10 kHz increasing linearly to 50 dB [_____] at 10 MHz [_____].

b. Use minimum electric field and plane wave attenuation of 60 dB [_____] from 1 kHz to 18 GHz.

2.1.4 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. For TEMPEST applications, STC 45 or greater may be required.
****

Provide enclosure(s) having an STC rating of [30][45][50][_____] minimum when tested according to ASTM 90[not including sound transmission loss of surrounding building construction].

2.2 MATERIALS AND EQUIPMENT

2.2.1 New and Standard Products

All materials, components and equipment must be new and must be the standard products of a manufacturer regularly engaged in the manufacture of such products. All materials, components and equipment must be identical to items that have been in satisfactory use for at least 2 years prior to bid opening. Support for the equipment must be by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2.2 Factory Test Plans

Detailed test plans/test procedures must be prepared for all required factory tests by the Contractor and shielding specialist and must be submitted to the Contracting Officer for approval. The test plan contents must include an introduction that states the purpose of the testing, a list of tests to be conducted, and the testing location and schedule; a list of applicable references; a general description of each test method and the associated test equipment requirements; detailed procedures including test equipment calibration, test configurations, measurement

locations, data requirements, and pass/fail criteria; examples of all test data sheets, and the format and outline of the test report to be provided. With the approval of the Contracting Officer, previous documented tests of components that are identical to those to be provided will be allowed to substitute for in-factory type tests. For example, a variance to performing the factory for filters could be requested if the same filter type by the same manufacturer was tested and provided as part of previous projects. The request for variance must include results of the previous tests and a letter from the manufacturer indicating that the type previously tested is the same, with no modifications, as that being provided now.

2.2.3 Factory Test Reports

Factory test reports must be prepared for all required factory tests by the Contractor and shielding specialist and must be submitted to the Contracting Officer. The format must be in the format described in the approved factory test plan. The contents must include copies of measured and processed test data; identification and rationale for any deviations from the test plan, and pass/fail conclusions.

2.2.4 Standards Compliance

When material, components, and equipment are specified to conform to requirements of standards published by industrial organizations, such as ASTM or ANSI, proof of such conformance must be provided to the Contracting Officer. The label and listing of the specified organization will be acceptable evidence.

2.2.5 Corrosion Control

Materials, components, and equipment must be inherently corrosion resistant, or they must be protected against corrosion by metallurgical processing, use of coatings, or other means. Comply with requirements in ASTM B633.

2.2.6 Galvanizing

Galvanizing, when practical and not otherwise indicated, must be hot-dipped processed after fabrication. Galvanizing must be in accordance with ASTM A123/A123M or ASTM A653/A653M, as applicable. Exposed fastenings must be galvanically compatible material. Electrolytic couples and dissimilar metals that tend to seize or gall must be avoided.

2.3 DEMOUNTABLE PANELS CONSTRUCTION

****
NOTE: Demountable panels are usually constructed with standard 4ft wide panels. Pre-laminated panels are acceptable, but they must meet the requirements of this specification.
****

Laminate flat steel sheets to each side of a 19 mm 3/4 inch thick structural core of either plywood or hardboard. Use waterproof type adhesive for laminating steel sheets to structural core which maintains a permanent bond for the lifetime of the enclosure. Provide panels with a flame spread rating of less than 25 when tested according to ASTM E84.

2.3.1 Steel Sheet

Provide flat steel conforming to ASTM A36/A36M with G-60 coating, minimum 26 gauge thick, zinc-coated phosphatized.

2.3.2 Structural Core

****

NOTE: When specifying structural core material, delete the unused method.

For TEMPEST applications requiring greater sound attenuation, thicker structural core may be required.

****

[Use plywood conforming to APA L870 for exterior, sound grade hardwood, Type I][Provide hardboard conforming to ANSI/CPA A135.4, Class 4, SIS, for standard type hardboard][_____].

2.4 FRAMING-JOINING SYSTEM

Join and support panels by specially designed framing members that clamp the edges of the panels and provide continuous, uniform, and constant pressure for contact to connect the shielding elements of the panels. Provide walls that are self-supporting from floor to ceiling with no bracing. Deflection of walls under a static load of 34 kg 75 pounds applied normally to the wall surface at any point along the framing members must not exceed 1/250 of the span between supports.[Ceilings must be self-supporting from wall to wall.][Support ceilings by adjustable, nonconducting, isolated hangers from the structural ceiling above.] Design ceilings to have a deflection under total weight, including ceiling finish, of no more than 1/270 of the span. Provide a one-piece factory pre-welded corner section or trihedral corner framed with a brass machine cast corner cap assembly consisting of inner and outer parts at all corner intersections of walls and floor or ceiling. Design the modular enclosure for ease of erection, disassembly, and reassembly.

2.4.1 Channels

The framing-joining system members must consist of 3 mm 1/8 inch thick zinc-plated steel channels having a minimum 16 mm 5/8 inch overlap along each side of the contacting surface. Space screw fasteners at 75 or 100 mm 3- or 4-inch intervals. Use screw fasteners that are either zinc or cadmium-plated steel, minimum size 6 mm 1/4 inch, with a pan or flat Phillips head. Heat-treat and harden fasteners with a minimum tensile strength of 6 mm 135,000 psi.

2.5 PENETRATION PLATE

Provide a minimum 3 mm 1/8 inch thick ASTM A36/A36M steel plate, sized [450][_____] by [450][_____] mm [18][_____] by [18][_____] inch with a 6 mm 1/4 inch thick extruded brass frame for mounting to the shielded enclosure wall panel. Extend penetration plates at least {_____} mm [_____] inches beyond all penetrations. Bolt the penetration plate to the RF shield with bolts 75 mm 3 inch on center.

2.6 RF SHIELDED DOORS

****
NOTE: Do not accept doors that deviate from this specification without consulting NAVFAC 15C. Probable deviations include electromagnetic doors, RF Gasket seals, and requests to approve doors tested to less than 50,000 open close cycles, among others.
****

Doors must be reinforced steel or laminated type. Laminated type must be the same construction as enclosure panels, except the steel faces must be electrically and mechanically joined by channels or overlapping seams, both of which must be continuously seam welded along all joined surfaces. Use thicker metal where indicated or required for its use and purpose. Provide metal thresholds of the type for proper shielding at the floor. Provide EM shielded doors by a single supplier who has been regularly engaged in the manufacture of these items for at least the previous 5 years. Supply assemblies complete with a rigid structural frame, hinges, latches, and parts necessary for operation. Duplicate assemblies that have been in satisfactory use for at least 2 years. Provide electromagnetic filters, electromagnetic waveguide penetrations for door systems, and miscellaneous material for a complete system.

The enclosure door must be nonsagging and nonwarping and must meet or exceed the shielded effectiveness of the rest of the enclosure when the door is closed. The shielded door must 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 must be protected from damage due to physical contact and must be concealed within the door and frame assemblies.

2.6.1 Finger Stock

****
NOTE: Shielded doors with RF gasket seals may also be used, but they are associated with a shorter service life in high-use applications.
****

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

2.7 LINE FILTERS

****
NOTE: Designer must coordinate requirements with the CTTA and COR to ensure that the compilation of the project location and the effectiveness requirements do not elevate the classification level of this specification section.
****

Consult MIL-PRF-15733 for general requirements on RFI filters.

2.7.1 Power Line Filters

Electrical Characteristics:

Current Rating: [_____][60][100] A
Voltage Rating[208Y/120V][480Y/270V] [_____]
Impedance: [50][_____] ohms

Dielectric Withstand Voltage: [_____][2250] VDC
Leakage Current: Less than 1mA.
Frequency: [50][60][_____] Hz

Power Line Filters must have current and voltage ratings as[indicated] [specified].

Temperature rise must not exceed 25 degrees C 77 degrees F when operating at full rated load in a free space environment equivalent to that specified in MIL-PRF-15733 with an ambient temperature of 65 degrees C 150 degrees F. When filters are mounted in an enclosure as specified herein, temp rise of hottest filter must not exceed 40 degrees C 104 degrees F at full load when operating in an ambient temp of 65 degrees C 150 degrees F. Materials and components of filter must not exceed maximum acceptable temps specified in UL 1283.

2.7.2 Telephone and Signal Line Filters

Provide filtered units for operation on electric power lines of [50][60] Hz rated[as indicated]. Design filters to reduce conducted RF energy in electric power lines according to MIL-PRF-15733 an UL 1283 for facility type power line filters. Insertion loss between load side of filter and power supply side must be not less than [100][_____] dB at [14][_____] kHz to [10][_____] GHz.

Filters must have an insertion loss of at least 60dB decibels in the frequency range of [14][_____] kHz to [10 GHz][_____] measured according to MIL-STD-220, full load condition. Filters must have a pass band of [_____] kHz to [_____] kHz with a characteristic impedance of [_____] ohms.

2.7.3 Filter Enclosures

****
NOTE: The intent of this paragraph is to preserve the integrity of the filter and to shield the input and output circuits from each other. Usually, this is accomplished by mounting the filters in an RF-modified NEMA Type 1 enclosure with separate compartments for the input and the output terminals. If a weatherproof or hazardous area type enclosure is needed, it must be specified.
****

Mount filter units in an RF modified NEMA Type [1][_____] enclosure in accordance with NEMA ICS 6 and meet the requirements of UL 1283. Make enclosures of corrosion resistant steel of 1.9837 mm 14 gauge minimum thickness with welded seams and galvanized bulkhead cover plates. Finish enclosure nonconductive surfaces with a corrosion-inhibiting primer and two coats of baked or finish enamel. The input compartment must house the individual line filters and the input terminals of the filters and mounting for the surge arrestor. Space live parts in accordance with

NFPA 70. Use copper filter leads. Test filter enclosures for shielding effectiveness in accordance with NSA 94-106.

2.7.4 Filter Unit Mounting

Mount each filter unit individually in an enclosure containing one filter for each penetrating conductor. Attach one end of the individual filter case to the rf barrier plate between the two compartments to provide a rf tight seal between the RF barrier plate and the filter case. The terminals of the filters must project through openings in the RF barrier plate into the inner terminal compartment. Attach the case of each filter to both the enclosure and to the barrier plate to prevent undue stress being applied to the RF seal between the filter case and the RF barrier plate. Individual filters must be removable from the enclosure. Like filters must be interchangeable.

2.8 WAVEGUIDE ASSEMBLIES

Waveguide-below-cutoff (WBC) protection must be provided for all HVAC, piping, plumbing and fiber optic cable penetrations of the facility shields as shown in the project drawings. No conductors (electrical wiring, louver operating rods, fiber optic cable metallic strength members or shields, pipes or hoses, etc.) will be permitted to pass through the WBCs. These WBC assemblies must provide at least the minimum shielding effectiveness required for the overall TEMPEST protection subsystem. The lengths of the WBCs must be at least five times the cross-sectional diameter for circular waveguides and at least five time the diagonal cross-sectional cell dimension for rectangular waveguides.

2.8.1 HVAC WBC Array Assemblies

Submit HVAC WBC Array Assemblies Shop Drawings to the Contracting Officer according to paragraph SHOP DRAWINGS GENERAL REQUIREMENTS.

2.8.1.1 Honeycomb-type Air Vents

Honeycomb-type air vents must have cores fabricated of aluminum, brass, or steel, tin-dipped, and each guide must be electrically and mechanically bonded to all adjacent guides. Air vents must have a shielding effectiveness exceeding that of the total enclosure. The size of the air vents must be chosen to provide an adequate air flow, static pressure drop, minimize the acoustical noise level, and air velocity. Static pressure drop through the vents must not exceed 5 Pa 0.02 inch water gage at an air velocity of 3 m/s 600 feet per minute. Welds for fabrication and installation of honeycomb waveguide panels are primary shield welds and inspect as indicated. Include acceptance testing of all honeycomb panels with the final acceptance test.

2.8.1.2 WBC Array Construction

All HVAC WBC arrays with the same size and functional requirements must be provided by the same manufacturer and must be of the same model number. The penetration plate frame must be welded or brazed to the WBC array by the WBC assembly manufacturer. The penetration plate frame must have a minimum thickness of [6.35][_____] mm [150][_____] degrees F and sufficient thickness to ensure that the WBC array is not damaged when the frame is welded or bolted to the shield. Welding of the penetration plate frame to the RF shield must be RF Shield critical and must conform to applicable welding guidelines in this specification. Pressure drop

through WBC arrays must not exceed 1.27 mm of water 0.05 inch water gage at an air flow below 457 Meter per minute 1500 feet per minute.

a. Materials: Waveguide to be constructed of[steel][brass][aluminum][stainless steel].[Provide[tin][tin lead][EN coating] on waveguide.]

b. Dimensions: Provide waveguide with [3.17][4.76][6.35] mm [1/8][3/16][1/4] inch cells and [12.7][19.0][25.4] mm [1/2][3/4][1] inch thickness.

c. Attenuation: [Insert attenuation range requirements]

2.8.1.3 Factory Testing

An HVAC WBC Array Assembly Factory Test Plan for the WBC assembly factory testing must be prepared by the Contractor and shielding specialist and must be submitted to the Contracting Officer for approval. The Contractor must notify the Contracting Officer at least 30 days before the scheduled performance of the factory tests, and the Government reserves the right to witness all required testing. Factory test results must be documented in an HVAC WBC Array Assembly Factory Test Report and submitted to the Contracting Officer. The test WBC assembly must be furnished on the project.

Each vendor must demonstrate satisfactory compliance with requirements of this specification. The shielding performance must be measured in accordance with the test procedures of NSA 94-106 at frequencies from [1][_____] GHz to [10][_____] GHz. The honeycomb WBC array assembly must not be acceptable if it fails to provide at least the minimum required shielding effectiveness in either of these measurement sequences.

2.8.2 Piping Waveguide Assemblies

Each system that passes through the facility RF shields must be provided with a metallic waveguide penetration protective device. For piping larger than 100 mm 4.0 inches I.D., a waveguide filter insert may be required and must have length greater than or equal to five diameters. The waveguide penetration protective device must be circumferentially welded to a penetration weld plate. The wall thickness of the device must be sufficient to ensure that the WBCs must not be damaged due to the heat of welding. Additionally, any piping system protected at its shield penetration with a waveguide penetration protective device must be constructed to be a closed metal piping system. Waveguide must be constructed of[copper][brass][steel].

To qualify as a closed metal piping system, the piping system must have the following RF Shield critical characteristics:

a. The pipe walls must be metallic.

b. If continuity must be maintained at all couplings in the piping system, using welded or threaded joints or RF-gasketed flanges.

c. Electromagnetic closure covers must be provided and installed when the oversized piping system is opened for maintenance.

2.8.3 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.

2.9 TEMPEST REQUIREMENTS FOR ELECTRICAL ISOLATION

TEMPEST shielding requires electrical isolations of all pipes, vents, drains and ducts within 51 mm 2 inches of the shield on the outside of the enclosure. The electrical isolation can be provided by inserting a section of nonconductive material with a minimum length of 152.4 mm 6 inches in each pipe, vent, drain or duct that enters or exits the enclosure. Minimize the number of penetrations to the RF shield. Penetrations must also be localized to one area, if possible.

2.9.1 TEMPEST Structural Penetrations

A major shielding penetration is the supporting column for ceiling or roof beams. For TEMPEST enclosures, the best electrical isolation between the shielding and the column is obtained by either isolating the column within the shielding, or, by totally enclosing the penetrating column in the shielding material with sufficient distance or nonconducting material provided to result in the necessary electrical isolation. A minimum of 25.4 mm 1-inch of air space is recommended between the column and the enclosing shield.

2.9.2 Single Point Ground Stud

The TEMPEST protection subsystem must have a single point grounding stud of solid brass or bronze permanently installed with hardware and jamb nuts located in the entrance plate[unless otherwise specified or indicated]. The stud must 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.

2.10 NAMEPLATES

Major components of equipment must 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 must conform to NEMA Standards.

2.11 TESTS, INSPECTIONS, AND VERIFICATIONS

Specify tests, inspections, or verifications of products required at the source here, i.e., plant, mill, factory, or shop.

2.11.1 Door Static Load Test

The door must 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 2 kPa 40 psf must 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.

2.11.2 Door Sag Test

The door and its frame must be installed normally and opened 90 degrees. Two 23 kg 50 pound weights, one on each side of the door, must 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.

2.11.3 Swinging Door Closure

Test Door must 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.

2.11.4 Filter Performance

When filtering is required on power, signal, control and alarm conductors, the filters must be constructed and tested to the requirements of MIL-F-15733, Filter, Radio Interference, General Specification for, including the temperature rise, voltage drop, harmonic distortion, current loading, RF radiation, and UL 1283. The insertion loss must be tested in conformance with MIL-STD-220, Method of Insertion-Loss Measurement, modified to include extended buffer networks to 14 kHz, and to include filter current loads in excess of 100 amps. The limits of acceptable performance and type of testing must be clearly stated to avoid problems with rejection of products which do not meet the minimum performance requirements of this specification when tested. Filter must meet performance requirements in MIL-STD-461, Rev G.

2.11.5 Sound Transmission Class (STC)

Provide enclosure panels with an STC of [30][50][_____] dB minimum when tested according to ASTM E90.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

3.2.1 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-hour 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 filters, WBCs, RF doors, and access panels, furnish the services of the engineer or technician described herein to inspect the installation for compliance with the specifications. The inspection must be made before any finishing materials are installed.

3.2.2 Demountable 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.

3.2.3 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.

3.2.4 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.[If prefabricated shield is provided, confirm requirements for mounting with the CTTA or contracting officer on required method to provide inspection space below the shield.]

3.2.5 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). Provide blind nuts to prevent penetration of the shield.

3.2.6 Door Assemblies

Mount so that the clearance between the door edges and frame must not vary more than 2 mm 1/16 inch and the inner face 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.

3.2.7 Filters And Filter Enclosure

****

NOTE: Do not mount filter enclosures directly to the RF shield, this can cause excessive stress and damage the shield.

****

Install all filters and surge arrestors into a filter enclosure and mount on the outer surface of the RF shield. Floor standing mounts and mounting directly to the structural framework are both acceptable methods. Allow sufficient space for the filter units. Provide accessibility for maintenance and testing after construction. The enclosure is made of a minimum of 13-gauge steel with welded seams. The enclosure must then be galvanized and electroplated after fabrication and welding or finished with corrosion inhibiting primer and two coats of finish enamel. Ensure that there is a clean metal to metal surface margin between the filter cabinet and the filter cabinet covers. The 'clean' side of the filter cabinet must be fitted with an RF gasket material. No mounting hardware is allowed to penetrate the enclosure but screws for filter cabinet covers are permissible. However, screw spacing on the 'clean' side filter enclosure is critical and must not exceed about 10 percent of the wavelength of the highest frequency being protected against. The screws on the 'dirty" side cover can be 3 or 4 times the distance between screws as on the 'clean' side cover. All screws must be torqued to [25 in-lbs.] plus [3 in-lbs].

The filter enclosure must meet or exceed the required shielding effectiveness enclosure on at least the 'clean' side of the enclosure and must not degrade the main RF shield shielding effectiveness. Each filter enclosure will contain two separate conduits, one for the incoming conductors into the dirty side of the cabinet, and another of the outgoing conductors leaving the clean side of the cabinet and entering the RF shield. Fully welded rigid metal conduit is required on the 'clean side' of the filter enclosures.

3.2.8 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.]

All waveguide penetrations must penetrate the RF shield through a framing penetration plate. Continuously weld or braze the waveguide to the plate. Bolt the penetration plate to the RF shield.

3.2.9 Penetration Entry Area

The TEMPEST Demountable facility design must have a designated POE penetration entry area through which penetrations will enter and exit the facility and then be dispersed to their proper destinations. All penetrating conductors, fiber optic POEs, and piping POEs, except for exhausts and air intakes, must be concentrated in this area to allow for careful monitoring of the penetration area shield.

Use a 3 mm 1/8 inch thick steel plate for the penetration entry area. Thicker plate may be used for added mechanical strength.

3.2.10 Grounding Stud

Extend the grounding stud through and[bolt][weld] it to the electrical power panel as a single grounding point for the completely assembled shielded enclosure, both internally and externally. Grounding must be completed IAW MIL-HDBK-419.

3.2.11 Conductor Installation

Provide filtered conductors in conduit, except for coaxial cables, from filter to shielding and penetrate the enclosure through threaded rigid steel conduits. Filter and electrical work must be in compliance with NFPA 70, UL 486A-486B and UL 1283. ESAs must be provided in accordance with UL 1449.[Twist conductors leading from the filters and conductors inside the shielded enclosure approximately 10 turns per foot in the conduit.]

3.3 FIELD TESTING

3.3.1 Seam Leak Detection Testing

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.

3.3.2 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.

3.3.2.1 Test Methodology

Orient antennas for maximum signal pickup. Probe each test point for area of maximum leakage, such as around door frames, accessible joints, filters, pipes, and air ducts. Determine magnitude and location of maximum signal levels emanating from the enclosure for each accessible wall at a minimum of two locations on each wall, around doors, and at penetrations and seams of the enclosure. Accomplish measurement of attenuation in accordance with Table I.

3.3.2.2 Test Frequencies

****
NOTE: Test frequencies will be in accordance with NSA 94-106 [and][or] IEEE 299.
****

Testing frequencies for shielded enclosures are as follows:

NSA 94-106:

Magnetic field[1k Hz,][10 kHz,][100 kHz,][and][1 MHz]

Electric field[1 kHz,][10 kHz,][100 kHz,][1MHz,][and][10 MHz]

Plane wave[100 MHz,][400 MHz,][and][1 GHz][10 GHz]

[_____][GHz]

3.3.2.3 Additional Test Points

Measure additional test points beyond those specified in NSA 94-106. 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.

3.3.3 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 5 working days advance notice of the dates and times for checks and tests.

-- End of Section --