SECTION 10
TEMPEST DESIGN STANDARDS

10.1 GENERAL

10.1.1 Correlation and Coordination

A. This section provides standards for the design of all facilities or areas that require electromagnetic containment of RF signals originating in electronic processing equipment (referred to as Tempest). These design standards shall correlate with the current edition of Lockheed Martin Missiles & Space(LMMS) Facility Engineering Standards (FES), Construction Specifications, Volumes I through IV, and other relevant sections of this Facility Design Standards. Where applicable, the Engineering Construction Details delineated in the FES Construction Specifications shall be used for compatibility to LMMS existing facilities design.

B. LMMS Technical Security organization shall determine when these requirements apply. All standards should be followed as a system. Application of a limited subset of these standards shall not be undertaken without the specific approval by Technical Security group of LMMS Physical Security organization.

C. The Tempest design work shall be designated under the current Construction Specifications Institute (CSI) format.

D. The design shall be fully coordinated with other related architectural and engineering disciplines to eliminate conflicts and omissions, and to ensure that the total project requirements are met. Prudent judgment must be exercised in collaborating design solutions with LMMS organizations and personnel.

E. All design/construction drawings shall follow LMMS drawing procedures and standards, unless specifically described otherwise in specific Sections of this Facility Design Standards. Refer to Section 11, Drawing Procedures for all drawing requirements.

10.1.2 Design Philosophy

The design shall be done in a manner to assure that the maximum benefit is obtained for the costs expended. Safety and reliability shall not be compromised as a cost saving measure. The methods of analysis and design shall follow established principles of professional engineering practices. The effective containment of electromagnetic energy can only be achieved when the components of a shielded facility work as a system. Therefore all standards delineated herein should be followed as a system. Value Engineering is encouraged during the development of the design of all systems.

10.1.3 Codes and Standards

Design work shall comply with the current adopted edition of all applicable city, county, state and federal codes and standards. In addition, the current adopted edition of the following codes, standards and publications are considered as the governing references to this section. Applicable recommendations of related trade and professional associations not listed here shall also be considered.

NACSEM 5204, Shielded Enclosures
National Security Agency Specification 73-2A, Foil RF Shielded Enclosure
Military Standards MIL-HDK-419A, Grounding, Bonding, and Shielding for Electronic Equipment and Facilities
Military Standards MIL-STD-188,-124A, Grounding, Bonding and Shielding for Common Long Haul/Tactical Communications Systems including Ground Based Communications-Electronics Facilities and Equipments
Underwriters Laboratories (UL)-1283, Electromagnetic Inference Filters
American Society for Testing Materials (ASTM) E90, Recommended Practice for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E-84, Test for Surface Burning Characteristics of Building Materials
National Fire Protection Association (NFPA)
Federal Specifications SS-A-118B, Flame Resistance Test
Underwriters Laboratories (UL)
Uniform Building Code (UBC)
State and Local Codes

10.1.4 Definitions and Acronyms

Item	Description
NSA 65-6	National Security Agency specification for RF shielded enclosures, normally considered a 100 db enclosure. Contains attenuation, design criteria and measurement requirements. Included in NACSEM 5204.
NSA 73-2A	National Security Agency specification for Foil RF shielded enclosures, normally considered a 50 db enclosure. Contains attenuation, design criteria and measurement requirements. Included in NACSEM 5204.
RF	Radio Frequency, a part of the electromagnetic spectrum.
EMT Conduit	Electrical Metallic Tubing made of ferrous material used in routing and/or shielding wiring.
Red/Black	Red: Any electrical and electronic circuit, component, equipment, system, etc., which handles classified plain text in electrical signal form. Black: Any electrical and electronic circuit, component, equipment, system, etc., which handles encrypted or unclassified information in electrical signal form.

Item	Description
Shielding	The reduction of radio frequency energy passing through a wall, floor, or ceiling normally through the use of metallic material.
Ferrous	Metal with a high Iron content.
Zone Test	An RF test that determines the attenuation characteristics of a facility or an area within a facility.
Tempest	An unclassified term referring to the study and investigations of compromising emanations.

10.1.5 Purpose

A. This section is intended to define the guidelines for the design of RF shielding systems for use in LMMS facilities. This section covers both high performance RF shielded enclosures and limited performance shielding.

B. The function of RF construction is to permit an interference-free environment with a single point signal ground and/or to retain RF signals inside of the shielded environment.

10.2 HIGH PERFORMANCE WELDED STEEL RF ENCLOSURES

Welded steel RF enclosures shall be designed, completely independent of the building structure including lateral loads imposed by seismic Zone 4 loads unless otherwise stated in the project requirements documents.

10.3 HIGH PERFORMANCE MODULAR RF ENCLOSURES

A. Modular RF enclosures shall be designed to be supported by a structural system independent of the building structure. It will support all vertical loads including all finishes, lights, diffusers, piping and ducting unless otherwise stated in the project requirements documents. Lateral loads imposed by seismic forces may be transferred to new or existing shear walls within the building or to the shield's supporting structure. Live loads shall be considered as directed by LMMS.

B. The walls, floor and ceiling shall be constructed of rigid structural laminated panels faced with heat treated annealed steel.

C. The panel interlocking system is to be constructed of corrosion resistant zinc coated steel sections formed to provide continuous metal to metal contact with the RF panels.

D. Walls are to be designed to be self-supporting with a maximum deflection of 1/250 of unsupported span under a static load of 75 lbs. applied normal to the wall surface.

E. The entire RF enclosure is to be dielectrically isolated from the building, supporting structure, and ground. The rod hangers to support the top of the RF enclosure are to be isolated through the use of dielectric, adjustable connectors. The bottom of the tank is to be isolated from the building slab by a 1/8 inch polypropylene welded dielectric membrane and 1/2 inch cement board, or LMMS approved equal method. All penetrations, metal conduits, metal piping, and metal ducts are to be isolated from the RF enclosure by the use of dielectric connections at the point of entry into the enclosure, and at wave-guides.

10.4 LIMITED PERFORMANCE RF SHIELDING

A. Limited performance shielding includes those areas of RF shielding not normally referred to as RF enclosures. This type of shielding includes partial and whole building RF shielding through the use of various foils or sheet metal systems designed to be integrated with the construction of the building.

B. Since the requirements for limited performance RF shielding are dependent on the specific job and will vary from job to job, the following are general requirements when called out by the Technical Security group of LMMS Physical Security organization.

C. The wall(s) of the area to be partially shielded will be covered with 24 to 28 gauge sheet metal from the floor to the underside of the floor/roof above. The metal panels will be installed with an overlap of a minimum of 3 inches and will be attached to the supporting wall/structure with screws every 6 inches. The actual height of the sheet metal will be called out by Technical Security, and may be less than true floor to true roof/ceiling.

D. When required, the sheet metal will be installed on the floor for a distance of 6 feet from the wall and attached to the wall sheet metal with a minimum of 3 inches of overlap. Metal screws will be used every 6 inches. The metal will be attached to the floor with a suitable adhesive.

E. When called out, the seams of the overlap will be sealed with a conductive tape or sealant. On occasion this tape may be soldered.

F. In some instances, the roof/ceiling of the facility will require installation of sheet metal. The metal will be attached to the supporting structure, and will be connected to the wall sheet metal with a minimum overlap of 3 inches. Metal screws will be used on all seams and installed every 6 inches.

G. If the roof/true ceiling of the facility includes a metal pan, the wall shielding will be overlapped and attached to the metal pan a minimum of 3 inches. The metal pan should be cleaned so that a good metal to metal connection is made. Metal screws will be used for attachment and will be installed at least every 6 inches.

H. All seams of overlapping metal will be sealed with an electrically conductive tape, fabric, or sealant. On occasion this may be soldered. Conductive sealing will be required for all penetrations of the shielded surface, including all conduits, pipes, ducts, etc. Sealing of seams in metal roof pans and around metal structural members may also be required. All sealing shall be done such that a low impedance electrically conductive bond is formed between all portions of the two surfaces being sealed. The intent is to provide an unbroken RF shield of the treated area. This may include 100% coverage of all area walls, true floor, and true ceiling. Special care shall be taken to ensure that materials being bonded are chemically compatible, to avoid corrosion as much as possible.

I. The following are typical applications of limited performance shielding:

1. Type A wall

   Application of metal to one or more walls from floor to true ceiling, underside of roof or underside of floor above. Number of walls to be shielded will be called out by the LMMS Technical Security group.

2. Type B wall

   Same as Type A wall with the added installation of metal to the floor and to the underside of roof, ceiling or underside of floor above, for a distance of 6 feet from the wall.

3. Type C wall

   Application of metal to all perimeter walls from floor to true ceiling, underside of roof or underside of the floor above, and installation of metal to the floor for a distance of 6 feet from the wall and installation of metal to completely cover the underside of the roof, ceiling or floor above.

4. Type D wall

   Application of metal to all perimeter walls from floor to true ceiling, underside of roof or underside of the floor above, and installation of metal to completely cover the floor and to completely cover the underside of the roof, ceiling or floor above.

10.5 RF DOORS

10.5.1 Doors in RF Enclosures

All doors into the RF enclosures are to be designed to maintain the required RF attenuation of the shield as well as the STC requirements of the enclosure. Unless otherwise stated in the project requirements documents, doors are to be 3 feet x 7 feet.

10.5.2 RF Doors in Limited Performance Shielding

A. Doors used in limited performance shielding designs are to generally conform to the RF attenuation and STC of the wall(s) that the door is within. All doors are to meet fire code regulations and Title 24 barrier free access regulations.

B. On some installations, the door frames and doors will be required to be fitted with conductive RF seals on all 4 frame sides and metal threshold.

C. The doors and frames must make electrical contact and be bonded to the wall of the metal shielding, with no degradation of the shielding effectiveness.

10.6 MECHANICAL PENETRATIONS

10.6.1 Mechanical Penetrations of RF Enclosures

A. All penetrations of the RF enclosure are to be designed to include wave-guides to maintain the required RF attenuation of the enclosure. All metallic penetrations must have dielectric isolators, installed as close as possible to the penetration point.

B. Ventilation

The wave-guides type air vent filters shall be of such design as to provide proper air passage for cooling and ventilation. Metal collars and non-conductive boots shall be supplied for connection to building duct work and dielectric connections.

C. Mechanical penetration

Provide wave-guides type pipe penetrations for all pipes penetrating the RF shield; preceded by pipe strainer and shutoff valves.

D. Wave-guides shall be designed to provide a minimum of 50 db of electric field attenuation at 10 GHZ. Pipes/conduits which would pass through the shielded area unbroken and unused within the area will normally not be allowed. They should be routed around or above the enclosure. If an exception is granted by the LMMS Technical Security group, the pipe/conduit must be sealed and electrically bonded to the shield surface at each penetration point. If the pipe/conduit is not an electrically conductive material, it must be completely covered with an electrically conductive fabric for the entire length of its run within the shielded area, or wave-guides must be installed at the penetration points.

10.6.2 Mechanical Penetrations of Limited Performance Shields

All mechanical penetrations of any portion of a shielded surface are to be designed to include wave-guides to maintain at the penetration point.

10.7 ELECTRICAL AND COMMUNICATIONS FILTERS

10.7.1 Electrical and Communications Filters in RF Enclosures

A. All incoming electrical, data, smoke/fire protection circuits, thermostat, mechanical systems controls, security wiring, telecommunications etc., shall be provided with RF filters. Filters must be provided for each electrical wire including neutrals that enter or leave the enclosure. All filtered conductors shall penetrate the shielded material through isolated penetrations which are an integral part of the filter. All filters whether power, data, or telecommunications, should be reviewed by Facility Engineering organization to assure that the unit specified will meet the user requirements. The method of installing the filter to the enclosure will vary greatly to the type of enclosure specified. On welded steel enclosures the conduit from the filter to the penetration point must be rigid conduit with all seams welded. On modular enclosures, flanged hubs with RFI gaskets are required. Any conduit fittings or threaded appurtenances between filter exit and enclosure entrance must also be welded. The filter case must be monolithic member with the enclosure, and as such must be dielectrically isolated from any other grounds.

B. If filters are installed to provide EMC, lightning or EMP protection, an earth electrode shall be installed for the filter ground. In all cases, filters shall be grounded to the shielding or equipotential pane, or an extension thereto, that services the equipment requiring protection. This installation shall ensure a low impedance bond per MIL-HDBK-419A Section 1.7. The shielded end of the filter mounting enclosure shall be placed towards the non-secure facility side. Filters may be placed on either side of a shielding boundary provided they are always within the overall secure area perimeter.

C. Power filters shall provide 100 db of attenuation from 14KHZ to 10KHZ when tested under full load current per MIL-STD-220A. Power filters shall be rated at 125% of the circuit full load current. The power filter installation shall contain a green wire safety ground, bonded to the filter enclosure. This safety ground shall connect the building service ground to the panel board ground bar. These conductors shall be installed per NEC, Section 250-23(b) and sized per NEC, Section 250-95. The neutral conductor, if provided, shall be filtered. Load imbalance on a 3 phase system may require the use of a 400Hz power filter for the filter shall be run in ferrous RMC, IMC or EMT conduit. EMT conduit shall use ferrous compression fittings. Dielectric breaks shall not be used to break the conduit run to any power filter.

D. Telephone filters shall provide 100 db attenuation between 14KHz and 10GHz. Data filters shall be of a pass band type specifically designed for the data rates employed.

10.7.2 Electrical and Communications Filters Limited Performance Shielding:

These requirements will be dictated by specific project, LMMS user and the LMMS Technical Security group.

10.8 GROUNDING

10.8.1 Grounding in RF Enclosures

A. A single point ground system shall be provided for all RF enclosures. It shall be of the LMMS Trirod S-P type. The established configuration must be adhered to and cable lengths kept to an absolute minimum. The point of connection to the RF enclosure should be centrally located in relation to the filters point of entry. All ground rods used in the system must be 30 feet in length and 3/4 inch diameter. The accessible rod shall be located outside of the enclosure. All connections must be exothermically welded except the lead to the incoming ground plate which must be lug connected. The single point system shall be directly connected to the incoming power ground bus by a lug connection. The incoming ground plate will be clearly marked using 3/8 inch stamped, “caution - special single point ground”. Dielectric isolation of the enclosure must be maintained to a minimum of 10,000 OHMS.

B. Grounding shall be installed in accordance with the National Electric Code (NEC), MIL-HDBK-419A and MIL-STD-188-124A. Where conflicts exist, NEC shall take precedence. Amplifying guidance may be found in Federal Information Processing Standards (FIPS) Publication 94. The following assumes that building steel is connected to an earth electrode subsystem per MIL-HDBK-419A, Section 1.5.1.b and NEC 250-81(b). Refer to LMMS FES, Section 5, Electrical Design Standards.

10.8.2 Ground in Limited Performance Shielding

A. Ground Provision

A single point signal ground shall be provided on the shielded material by means of 1/2 inch brass stud located on the panel and as near as possible to the power line filters. A ground shall be located inside of the shielded facility. Connection to the shield shall be RF gasketed flanged hub type. See LMMS Construction Specifications, Section 13095, RF Shielding, for more specific information.

B. Limited performance shielding shall be bonded to building structure at every junction per MIL-HDBK-419A.

C. All facilities relying solely on computer decking as the equipotential plan shall utilize a transient suppression plate at the point of power entry. This plate shall consist of a 22-28 gauge galvanized steel sheet not smaller than 40 square feet. A bond per MIL-HDBK-419A, Section 1.7, to the computer decking shall be provided. Refer to applicable LMMS Facility Engineering Standards.

10.9 RED/BLACK ENGINEERING

Red/Black engineering requirements are necessary in all cases where Tempest security is a concern.

Red refers to any electrical conductor which carries unencrypted classified information.

Black refers to all other electrical conductors.

10.9.1 Red Couplings and Fittings

A. All red couplings, fittings, and conduit shall be ferrous metal and tested for magnetic attraction.

B. EMT with compression fittings can be used in controlled areas.

C. Rigid conduit with threaded fittings will be used in non-controlled areas. Further, these fittings shall be welded around 120 degrees + or - 5 degrees.

D. All red conduits and/or cables shall be distinctly marked with red tape or red paint at intervals of 1.5 meters.

10.9.2 Minimum Separations

A. All red conduits shall have a minimum separation of 6 inches from all black signal lines which are not in ferrous conduit.

B. All red conduits shall have a minimum separation of 2 inches from black signal lines in ferrous conduit.

C. There shall be a 6 foot separation between all non-Tempest approved red equipment, their associated wire lines/cables and any black non-filtered telephone or power lines, clocks, typewriters, personal computers, etc.

D. There shall be a 3 foot separation between all non-Tempest approved red equipment, their associated wire lines/cables and any filtered telephones or filtered power lines.

10.10 TESTING

10.10.1 Testing of Limited RF Shielding

Upon completion of construction and prior to occupancy, the facility will be subjected to a facility zone survey test. The test plan and procedure will be coordinated by the LMMS Technical Security group.

10.11 FIRE PROTECTION SYSTEMS IN RF ENCLOSURES

A complete smoke and fire detection system shall be provided as required by codes and the Fire Protection group of LMMS Facility Engineering organization. Refer to Section 8, Fire Protection Design Standards.

10.12 PHYSICAL SECURITY AND ALARMS

A. The physical security and alarms for RF enclosures will be as required in Section 6, Security Design Standards for the type of facility in which the enclosure is to be installed. ACAS installations inside the enclosure will require a filtered communications circuit to be installed inside the enclosure. Specific details on alarms and alarm filters will be provided by the ACAS group of LMMS Facility Engineering organization.

B. The physical security and alarms for a Limited Performance RF shielded facility will be as required in Section 6, Security Design Standards for the type of facility in which the shielding is to be installed. If filtering of the ACAS communications circuits is required, it will be called out by the LMMS Technical Security group.

10.13 AIR CONDITIONING SYSTEMS

10.13.1 General Air Conditioning Requirements in RF Enclosures

The design for air conditioning systems for use in RF enclosures should provide for minimal penetration of RF enclosure. In modular panel type enclosures the introduction of chilled water or make up water into the tank should be used only in cases where a ducted forced air system is not available. If a chilled water system is used, the A/C unit should be located outside the enclosure and the tempered air ducted in. Any control wires penetrating the enclosure are to be filtered.

END OF SECTION