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MILITARY SPECIFICATION

ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS, SYSTEMS

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification outlines the overall requirements for systems electromagnetic compatibility, including control of the system electromagnetic environment, lightning protection, static electricity, bonding and grounding. It is applicable to complete systems, including all associated subsystems/equipments (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for kids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-C-5	Capacitors, Fixed, Mica-Dielectric, General Specification for
MIL-B-5087	Bonding, Electrical, and Lightning Protection for Aerospace Systems
MIL-C-11693	Capacitors, Feed Through, Radio Interference, Reduction, AC and DC (Hermetically Sealed in Metallic Cases), General Specification for
MIL-C-12889	Capacitors, By-Pass, Radio Interference, Reduction, Paper Dielectric, AC and DC (Hermetically Sealed in Metallic Case:: , General Specification for
MIL-C-15733	Filters, Radio Interference, General Specification for
MIL-P-24014	Preclusion of Hazards from Electromagnetic Radiation to Ordnance, General Requirements for

STANDARDS

Military

MIL-STD -454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Interference Characteristics,Requirement for
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of

MIL-STD-831	Test Reports, Preparation of
MS25384	Plug, Fuel Nozzle, Grounding
MS33645	Receptacle Installation, Fuel Nozzle Jumper, Aircraft to Servicing Hose
MS90298	Connector, Receptacle, Electrical Fuel, Nozzle Jumper Plug

MANUALS

Air Force

AFSM 80-7	Handbook of Instructions for Aerospace Vehicle Equipment Design
AFSCM 80-9, Vol. IV	Electromagnetic Compatibility

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

The American Society of Mechanical Engineers

USAS Cl 1965	National Electrical Code

(Application for copies should be addressed to The American Society of Mechanical Engineers, 345 East 47th Street, New York, New York 10017.)

3. REQUIREMENTS

3.1 System electromagnetic compatibility program. The prime or integration contractor designated in the contract shall establish an overall integrated electromagnetic compatibility program (EMCP) for the system. This overall program shall include the necessary approach, planning, technical criteria and management controls, and shall be based on the specifications and requirements in this specification, the statement of work, system specification, and other applicable contract documents. Each vendor, subcontractor, associate contractor, et cetera, involved shall establish a technical effort and necessary management and controls to accomplish their individual parts of the overall EMCP.

3.1.1 Electromagnetic compatibility board. An electromagnetic compatibility board shall be established to govern the system EMCP, provide means of expediting solution of problems, and establishing high level channels of coordination. The details of operation and proposed charter for the board shall be included in the system electromagnetic compatibility plan. Members of the board will typically be the integration contractor, other invited subcontractors, and the Government project offices that are

involved. The procuring activity may waive this requirement for systems that do not involve a sufficient number of participating organizations to justify such a board.

3.1.1.1 The board shall ensure that each participating associate, or subcontractor, and vendor establishes an individual effort in consonance with the overall program EMC objectives; that effective methods of monitoring EMC efforts and progress are established and followed; that periodic EMC program design reviews are scheduled; and that deficiencies noted are promptly corrected.

3.1.1.2 The procedures for appointing members to the board shall be carefully prepared to ensure that each representative has adequate authority to participate in, concur with, and implement board recommendations and agreements.

3.2 System requirements. The system and all associated subsystem/equipment, both airborne and ground, shall be designed to achieve system compatibility. Every effort shall be made to meet these requirements during initial design rather than on an after-the-fact basis. Since each system has its own unique requirements and characteristics, which general EMC design criteria documents may not satisfactorily cover, the system and subsystems/equipments control plans shall be used for supplementary requirements as necessary. As a minimum, the system design program shall cover the following areas:

a. Subsystem/equipment criticality categories

b. Degradation criteria

c. Interference and susceptibility control

d. Wiring and cable

e. Electrical power

f. Bonding and grounding

g. Lightning protection

h. Static electricity

i. Personnel hazards

j. EM hazards to explosives and ordnance

k. External environment

1. Suppression components.

3.2.1 Subsystem compatibility. Compatibility shall be demonstrated between all subsystems to a specific requirement during all modes of operation while the subsystems are individually or collectively operated. Examples of subsystem to subsystem compatibility are aircraft formation; air vehicle to AGE; aircraft to inboard missile; and launch facilities to air vehicles. Training devices and simulators shall also be designed for compatibility.

3.2.2 Subsys tern/equipment criticality categories, All subsystems/equipments installed in or associated with the system shall be assigned to one of the EMC criticality categories. These assignments shall be based on the impact of an electromagnetic interference (EMI), or susceptibility malfunction, or degradation of performance on the assigned mission.

a. Category I - EMC problems that could result in loss of life, loss of vehicle, mission abort, costly delays in launches, or unacceptable reduction in systems effectiveness.

b. Category II - EMC problems that could result in injury, damage to vehicle, or reduction in system effectiveness that would endanger success of mission.

c. Category III - EMC problems that result only in annoyance, minor discomfort, or loss of performance that does not reduce desired system effectiveness.

3.2.3 Degradation criteria, Degradation criteria shall be established by the contractor for each subsystem/equipment after consultation with the procuring activity. These criteria shall be used to define and evaluate malfunctions, unacceptable and undesirable responses. When available, the results of subsystem/equipment laboratory interference tests shall be used in establishing or defining the criteria. When error budgets are established, the portion allocated to EMC shall be included as part of the degradation criteria.

3.2.3.1 Safety margins. Consideration shall be given to establishing a safety margin for subsystems/equipments assigned to criticality categories I and II. Safety margins shall be used only when approved by the procuring activity and only when catastrophic results of an EMC problem justify their use. System performance requirements, error budgets, tolerances, repeatability and instrumentation requirements shall be considered in establishing the safety margins. Existing test points shall be used, and use of special equipment manufacturers or circuit breakouts shall be minimized. Unless otherwise specified in the contract, range safety procedures, or system control plan, safety margins less than 6 dB (20 dB for explosives) shall not be used.

3.2.4 Interference and susceptibility control. Interference and susceptibility within the system shall be controlled by adequate design provisions to eliminate undesired responses and emissions from all electronic and electrical subsystems/equipments in or associated with the system regardless of whether the output is electrical, aural, video, or mechanical. This requirement applies to the entire frequency ranges (including generated harmonics, spurious emissions, and susceptibilities) utilized by

the installed subsystems, those for which installation provisions have been made, and associated ground support equipment. This requirement specifically includes operation of subsystems/equipments when operating with their installed antennas or sensing elements when performing their intended function in all modes of operation. When subjected to the tests required in section 4 in accordance with the approved system test plan, there shall be neither unacceptable response nor malfunction of any subsystem/equipment because of electromagnetic interference produced by any or all of the subsystems/equipments associated with the system.

3.2.4.1 Subsystems/equipments. Unless otherwise specified in the contract, subsystems/equipments shall be designed to meet the requirements of MIL-STD-461 and MIL-STD-462. Since some of the limits in these standards are very severe, the impact of these limits on system effectiveness, cost, and weight shall be considered. Proposed modifications to the limits shall be included in the EMC plans for the system and subsystems/equipments. In addition, for Air Force procurements, AFSC Manual 80-9 (volume IV), Electromagnetic Compatibility, shall be used for general design guidance and criteria.

3.2.5 Wiring and cabling. Wiring and cabling shall be designed to minimize coupling, and obtain optimum separation and use of available wiring space. Cable design shall include provisions for adequate termination of shielded wires. Unless otherwise specified, connectors used to carry shielded wires shall not use a nonconductive finish, and shall use a back shell that provides for peripheral bonding of shields. Procedures shall be established to categorize each wire or cable according to its interference and susceptibility characteristics. Wires and cables shall be marked in such a manner that personnel can visually identify the EMC category for each wire or cable.

3.2.6 Electrical power. Subsystems/equipments for aircraft installation shall not malfunction nor have unacceptable responses when applied with electrical power conforming to MIL-STD-704. This specifically includes surges, ripples, voltages, and other electrical conditions that can cause interference or susceptibility.

3.2.7 Spikes. For aircraft systems, spikes (transients) less than 50 microseconds duration shall not exceed +50 percent nor -150percent of the nominal d-c line voltage, nor ±50 percent for a-c power lines. Spikes of duration longer than 50 microseconds shall comply with the overvoltage curve in the applicable power quality specification. Requirements for other types of systems shall be included in the systems specification or EMC plan.

3.2.8 Bonding and grounding. Bonding and grounding provisions for the system shall be in accordance with MIL-B-5087.

3.2.8.1 External grounds for aircraft. Grounding jacks shall be installed on the system in sufficient quantity to permit connection of grounding cables for fueling, weapons handling, and other servicing operations. MS90298 jacks shall be used or an

approved equivalent flush-mounted jack. As a minimum, the following grounding jacks are required:

a. Fuel nozzle ground. A ground jack is required at each fuel inlet and shall be installed to comply with MS33645.

b. Servicing grounds. Multiple ground jacks shall be installed at locations convenient for servicing and maintenance. A minimum of two grounding jacks are required for utility and helicopter aircraft, and four for other types of aircraft, in addition to those required for fueling or weapons.

c. Weapon grounds. Multiple grounding jacks shall be installed at locations convenient for use in handling of weapons or other explosive devices. Typically, a grounding jack is necessary near each plyon or other attachment or loading point, in addition to those required for fueling or servicing.

3.2.8.1.1 Grounding jack installation. The grounding jacks shall be attached to structure so that the resistance between the mating plug and structure shall not be greater than 2.5 milliohms. When possible, the jacks should be mounted so that the grounding cable can disconnect, if inadvertently not removed before flight.

See Amend 1

3.2.8.2 External grounds for servicing equipment. Each item of servicing equipment or aerospace ground equipment shall have a grounding wire suitable for connection to an earth ground rod. In addition, all servicing equipment that handles flammables, explosives, oxygen, or other potentially hazardous materials shall have a permanent bonding cable attached for connection to the aircraft. The bonding and grounding cables shall use plug MS25384 for the connection to the aircraft and an approved fitting for connection to the ground rod.

3.2.8.3 External grounds for missiles and spacecraft, External grounding points for missiles and spacecraft shall be specified in the system specification or EMC plan.

3.2.8.4 Grounding at bases and fixed sites. Grounding provisions at fixed sites such as air base ramps, fueling and defueling, weapons handling, and other hazardous servicing areas, missile sites, and ground based subsystems shall, as a minimum, meet the requirements of the National Electrical Code USAS Cl 1965 and MIL-B-5087.

3.2.9 Lightning protection. The system shall be designed to provide lightning protection in accordance with MIL-B-5087 and, in addition for Air Force procurements only, AFSC Manual 80-9, volume IV. All elements of the system such as aerospace vehicles, launch sites, ground communication electronic sites, or other ground facilities shall be provided adequate protection. Protection of personnel, fuel, weapons, and ordnance subsystems shall be given special emphasis and proven by test.

3.2.10 Static electricity The system shall be designed to prevent static electricity from degrading system effectiveness. For Air Force procurements use AFSC Manual

80-9, volume IV. All elements of the system such as aerospace vehicles, launch sites, ground sites, fueling and servicing area shall be protected.

3.2.10.1 Dischargers. Static dischargers shall be installed on aircraft. The dischargers installed shall be as specified by the procuring activity.

3.2.10.2 Conductive coatings. Conductive coatings shall be applied to all nonmetallic materials on the external surface of airborne vehicles that are exposed to airflow. After application, coating resistance shall measure not less than 10 megohms and not greater than 50 megohms per unit area at any given point.

3.2.11 Personnel hazards. The system design shall include provisions for protection of personnel from R-F hazards, electromagnetic, electrostatic and shock hazards in accordance with requirement 1, MIL-STD-454. Where possible, protection provisions shall be designed into associated subsystems/equipments. When protection by design is not technically feasible, adequate safety precautions shall be included in operating and maintenance manuals. The shock hazard, requirement 5, MIL-STD-454, shall apply for all suppression devices used.

3.2.12 Electromagnetic hazards to ordnance. The system design shall include provisions to protect ordnance subsystems from inadvertent ignition or dudding caused by any form of electromagnetic or electrostatic energy. All wiring, cabling, and hardware associated with the ordnance subsystems shall be carefully designed to prevent stray pickup and eliminate undesired energy. All modes of operation during the mission, including loading, unloading, checkout, prelaunch, et cetera shall be considered. For the purpose of this specification, the term ordnance will be interpreted to include weapons, rockets, explosives, electroexplosive devices, squibs, flares, igniters, explosive bolts, destruct devices, JATO bottles, et cetera. For Army procurements, the procuring activity will specify appropriate requirements. For Navy procurements, the requirements of MIL-P-24014 shall be met. For Air Force procurements, the requirements of AFSCM 80-7, part D, shall be applicable.

3.2.13 External environment. As specified in the contract, the system design shall include consideration of the electromagnetic environment from sources not part of, and external to the system. Consideration shall be given to the intended mission profiles, the available electromagnetic environment data, and the degree to which the external environment can reduce the desired systems effectiveness.

3.2.14 Suppression components. Suppression components shall be of the minimum practicable volume and weight. Capacitors should be used when filters are not required. If excessively larger, heavy components are found to be necessary the procuring activity shall be notified. Suppression components shall be in accordance with MIL-C-115733 for filters, and MIL-C-5, MIL-C-11693, or MIL-C-12889 for capacitors. The components may be qualified during subsystem/equipment qualification tests when installed in the initial design, and with permission of the procuring activity.

3.2.15 Contractually approved capacitors and filters (for Army procurement only). A component will be given contractual approval upon submission of data to the contracting officer showing that the component meets all of the environmental requirements of the applicable military component specification, or upon completion of all

the required end item environmental and life test without a failure of the interference reduction component. The use of contractually approved components shall have prior authorization from the contracting officer.

3.3 Control Plan. The details of the system electromagnetic compatibility program shall be included in the system electromagnetic compatibility control plan that is submitted for review and approval by the procuring activity. The control plan shall be prepared and submitted in accordance with the requirements of the contract, and compliance with it, after approval, is a contractual requirement. The control plan shall include, but not be limited to, the following elements of the overall program and shall be updated during the contract as necessary.

a Responsibility, and authority of the individual who will direct and implement the contractor's electromagnetic compatibility program.

b. Number and experience of full time and part time electromagnetic compatibility personnel available for the program.

c. Methods and requirements for ensuring that contractor developed subsystems/ equipments will not be adversely affected by interference from sources within the system nor be sources of interference that might adversely affect the operation of other subsystems. (Implementation of MIL-STD-461, and 462.)

d. Predicted problem areas and proposed methods of approach for solution for problems not resolved by compliance with MIL-STD-461 and 462.

e. Radiation characteristics from system antennas, including fundamental and spurious energy, and antenna-to-antenna coupling.

f. General approach to cable design including wire categorization criteria for identifying, labelling and installing interference generating or susceptible wires; shielding techniques; and wire routing.

g. Impact of corrosion control requirements on electromagnetic compatibility and recommendations for resolution of problem areas.

h. Design criteria and required tests for lightning protection and design impact on individual subsystems.

i. Design criteria and required tests for electrification, including precipitation static and propulsion subsystem charging.

j. Methods of implementation of design changes required for EMC.

k. Special requirements, test methods, and limits necessary for the system and associated subsystem/equipment.

l. Facilities that will be required and made available for the EMCP.

m. Methods of accomplishing design review and coordination with subcontractors and vendors.

n. Spike protection requirements for sybsystems/equipments connected to the power bus.

o. Bonding criteria.

p. Grounding criteria.

q. EMC requirements for contractor furnished off-the-shelf equipment,

r. Application of interference control specifications and standards through the phases of definition, design, and production.

s. Proposed charter and details of operation of the electromagnetic compatibility board.

t. Criticality category and degradation criteria for each subsystem/equipment including safety margins, where necessary.

u. Spectrum utilization design provision measures including control of emitters and frequencies, harmonics thereof bandwidth control of oscillator frequencies, rise time, et cetera.

v. Scheduling and milestones.

3.3.1 Updating of control plan. The control plan shall be kept updated by use of supplements or revised pages as specified by the contracts. Information required by 3.3, but not available at the time of original submission of the EMC plan, shall be included in supplements.

3.4 Commercial subsystems/equipments. When commercial off-the-shelf subsystems/equipments, either airborne or ground, are considered for use in a system, the following rules shall be used in selecting and utilizing the equipment in the system:

a. The equipment may be considered adequate if the system requirements are not significantly more stringent than those to which the equipment was designed, and interference test reports are available to adequately demonstrate compliance; however, compliance with the requirements relating to subsystems/equipments shall not relieve the contractor of the responsibility of providing system compatibility.

b. Where compliance with interference requirements cannot be substantiated due to unavailability of test reports, the contractor may perform laboratory interference tests for qualification of the subsystem as negotiated with the procuring activity.

c. After evaluation of the data, if it is determined that more stringent requirements are necessary, it shall be the responsibility of the contractor to implement these requirements, or select another equipment with adequate characteristics.

3.5 Government furnished equipment. Government furnished equipment (GFE) that is required for use in the system shall be acceptable from an EMI viewpoint, provided the interference and susceptibility requirements as outlined below are met:

a. New subsystem/equipment designs must have met, as a minimum, the requirements of 3.2.4.1 and be supported by approved qualification test reports.

b. When compliance with applicable military specifications cannot be substantiated, the contractor may perform laboratory test for qualification of subsystem to the applicable requirements as negotiated with the procuring activity.

c. GFE, which cannot meet the requirements, and for which external suppression measures are ineffective, may be modified in accordance with the terms of the contract if approved by the procuring activity. If such procedures are not specified in the contract, the contractor shall advise the procuring activity, by letter, of subsystems/equipments that cannot meet the requirement and pertinent details concerning the modifications required.

3.6 Subsystem equipment installation. The contractor is responsible for the proper installation engineering of all subsystems/equipments to achieve a compatible installation. Where it is demonstrated that interference caused by Government furnished equipment cannot be eliminated either by proper installation, control of the system electromagnetic environment, or by reasonable modification to the subsystem/equipment, as permitted by the contract, the procuring activity may consider waiving the requirement applicable to the particular equipment upon request from the contractor in accordance with the terms of the contract.

3.7 Redesign of systems. When this document is applied to a system redesign (modification) program, the contractor's control plan shall propose requirements suitable for the system for review and approval by the procuring activity.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Electromagnetic compatibility test program (EMCTP). The electromagnetic compatibility test program (EMCTP) shall be developed and prepared by the contractor

in response to this specification, and submitted to the procuring activity for approval. The EMCTP shall be documented in a test plan which shall provide for a system EMC test, an EMC general acceptance test, missile and space systems tests, and shall include, but not be limited to, the following:

a. Methods to be used to select critical circuits to be monitored for compliance to the degradation criteria and safety margin.

b. Procedures used for developing failure criteria and limits.

c. Test conditions and procedures for all electronic and electrical equipment installed in or associated with the system and the sequence for operations during tests, including switching.

d. Implementation and application of test procedures which shall include- modes of operation and monitoring points for each subsystem and equipment.

e. Use of approved results from laboratory interference tests on subsystems and equipment.

f. Flight test program (manned systems only).

g. Methods and procedures for data readout and analysis.

h. Means of testing design adequacy of vehicle electrification (static electricity) and lightning protection.

i. Means of simulating and testing electroexplosive subsystems and devices.

j. Demonstration of the approval safety margin for electroexplosive devices, and for systems whose degradation affects safety-of-flight or mission success.

k. Electrical power voltage limits, and methods for monitoring a-c and d-c power buses to assure that voltages are within the proper limits,

1. Test locations and descriptions of arrangements for simulating operational performance in cases where actual operation is impractical.

m. Adjustments and settings of variable controls such as audio gain, video gain, sensitivity, squelch settings, et cetera.

n. Details concerning frequency ranges, channels, and combinations to be specifically tested such as image frequencies, intermediate frequencies, local oscillator, and transmitter fundamental and harmonically related frequencies. Subsystem susceptibility frequencies identified during laboratory testing shall be included.

o. Personnel required, Government, contractor, and vendor.

p. Calibration schedules and description of unique EMC instrumentation for measuring electrical, video, and mechanical outputs of equipments and subsystems to be monitored during the testing including applicable safety margins.

q. Means of simulating signal inputs such as doppler, radar altimeter, et cetera.

r. Evaluation and degradation criteria for each subsystem and equipment.

4.3 Tests

4.3.1 System compatibility test. The contractor shall perform a complete EM compatibility test on the system designated and approved by the procuring activity. The system tested shall be typical of the production configuration and shall preferably be the first article.

4.3.1.1 Any production changes or modifications required as a result of the compatibility test shall be incorporated into the system in accordance with the terms of the contract. The contractor shall then perform the mininum retesting deemed necessary to demonstrate that the production modifications enable the system to comply with this specification. The retest shall be performed on a system acceptable to the procuring activity.

4.3.2 General acceptance test. Each production system shall be given a limited test as outlined in the contractor's approved test plan to ensure production compliance with the EMC requirements. Each unmanned system shall be subjected to a simulated prelaunch countdown and mission with the minimum instrumentation necessary to ensure production compliance.

4.3.3 Additional tests for missile and space systems. The following tests shall be performed, when required, by an approved control plan.

a. Tests to demonstrate that ground support equipment is compatible.

b. Tests to demonstrate that each stage and its ground support equipment is compatible at the interface.

c. Tests to demonstrate that subsystems/equipments on each stage are compatible.

d. Tests to demonstrate compatibility at the interface of the facility and the system.

e. Tests to demonstrate compatibility at the interface between stages.

4.3.4 Lightning tests. Every effort shall be made to minimize lightning tests on actual sites or vehicles, although those tests required to demonstrate safety shall be run. Analyses and tests on scale models of the vehicle or sites will often be adequate. Safety of external stores, fuel tanks, radomes, canopies, navigation lights, fuel dump, wiring, explosives, weapons, gantries, and cable runs shall be demonstrated. The contractor shall investigate the availability of Government facilities for these tests.

4.3.5 Static electricity. Tests to verify adequacy of electrification design of the system shall be performed as specified in the contract or approved test plan.

4.4 Test conditions. All outstanding approved engineering orders, engineering change proposals, modifications, and configuration changes shall be incorporated and installed. All exceptions to these shall be approved, and all such requests shall identify that portion of the system that is not of flight or production configuration.

4.4.1 All subsystems/equipments shall have complied with MIL-STD-461 and MIL-STD-462, or have approved deviation requests.

4.4.2 The test plan and procedures for the system shall have been approved and all required changes incorporated. Tests shall not be permitted without an approved test plan.

4.4.3 External electrical power supplied to the system under test shall meet the power quality requirements of the applicable specification.

4.4.4 Test locations shall be approved by the procuring activity. Tests shall not be conducted in any area or at any time when the electromagnetic environment at the test site would affect the validity of the tests.

4.4.5 During tests, all electronic subsystems/equipments under control of crew personnel shall be adjusted, within the limits of the subsystem specification, for maximum indication of interference or susceptibility consistent with normal subsystem operation.

4.4.6 Tests shall be performed to indicate compatible operation, undesirable responses, unacceptable responses, or malfunctioning while all subsystems/equipments are operated. It shall be the responsibility of the contractor to determine conclusively and correctly the causes of all such indications of noncompatibility.

4.4.7 Each subsystem/equipment shall be monitored by appropriate means to adequately evaluate the effects of system operation and demonstrate applicable safety margins. Instrumentation to be used shall be specified in the test plan.

4.4.8 The overall system shall be operated in all normal modes of operation. Where necessary, programmed missions, flight, and launch sequences shall be used.

4.4.9 When subsystems/equipments require special inputs such as doppler, simulated stars, temperature, et cetera, the means of simulating these inputs shall be described in the test plan.

4.4.10 The EMC tests shall demonstrate the requiredcompatibility when subsystems/equipments, including AGE, trainers, and simulators, are individually or collectively operated in all modes of operation. Transmitters and receivers shall be operated at those critical frequencies identified during system analysis and subsystem/equipment

laboratory tests. Transmitter frequencies shall be chosen so that harmonics fall on receiver tuned frequencies, intermediate frequencies, et cetera. Multichannel transmitters and receivers shall be tested at a representative number of frequencies, usually not less than 20. If the systemuses special frequencies for command channels, distress messages, ***or*** other purposes, they shall be given special attention.

4.5 Acceptance criteria

4.5.1 Compliance with the specification shall have been achieved when compatible operation, including any approved safety margins, is demonstrated without unacceptable responses or malfunctions. If the procuring activity agrees that it is impractical, or not within the contractor's ability to make corrections, minor undesirable responses shall not prevent the system from complying.

4.5.2 At no time shall the spike (transient) voltage at the electrical power input terminals of category I or II subsystems/equipments exceed the levels specified in 3.2.4. Special equipments and spike detectors shall be used to monitor power input circuits .

4.6 Safety margins. When safety margins have been established and approved for subsystems/equipments the inputs, outputs or other test points shall be monitored on a continuous basis.

4.7 Instrumentation. Where possible, approved support equipment intended for use with the system shall be used to monitor subsystems/equipments and provide data records. If the procuring activity agrees, special instrumentation may be used. All records shall be provided with time or event correlation.

4.8 Test site ambient electromagnetic environment. The electromagnetic ambient environment at the test site shall be monitored, measured, analyzed, or controlled to the extent necessary to ensure that this ambient environment does not degrade test results or mask interference from the system. When possible, all support or site equipment that generates interference that is unacceptable shall be suppressed, removed, or not operated. The frequency range to be considered shall be from 10 kHz to 20 GHz. If the procuring activity agrees, measurements at the test site may be limited to the frequency ranges of receivers associated with the system. All ambient signals that may degrade test results shall be recorded on permanent records and identified.

4.9 Test report. A complete test report, describing the EMCTP, conforming to MIL-STD-831 shall be provided in accordance with the contract. The report shall contain complete information on all applicable tests and other information required by this document.

5. PREPARATION FOR DELIVERY

5.1 This section is not applicable to this specification.

6. NOTES

6.1 Intended use. This specification is intended for use by the Army for procurements of airborne systems and vehicles; by the Navy for associated subsystems and aircraft; and by the Air Force for both aerospace and ground systems.

6.2 Definitions

6.2.1 Electromagnetic compatibility. The capability of systems and all associated subsystems/equipments to perform with required effectiveness, and without degradation, in the total electromagnetic environment encountered during accomplishment of the assigned mission.

6.2.2 Electromagnetic environment. The composite of electromagnetic energy, including man made and natural sources, to which a system or subsystem/equipment will be exposed in performing its mission. When defined, the environment will be for a particular time and place.

6.2.3 Electromagnetic interference. Any electrical or electronic disturbance, phenomenon, signal, or emission (man made or natural) which causes undesirable responses, unacceptable responses, malfunctions, degradation of performance, or premature and undesired location, detection or discovery by enemy forces, except deliberately generated interference.

6.2.4 Malfunction. A failure of a system or associated subsystem/equipment due to electromagnetic interference or susceptibility that results in a flight safety situation, a mission abort, or failure to accomplish mission.

6.2.5 Receiver area noise level. The receiver area electrical noise level at a particular frequency is that receiver output obtained with all controls at standard settings, all other subsystems/equipments turned off, and the receiver antenna connected.

6.2.6 Subsystem. A subsystem is a major functional element of a system, usually consisting of several equipments that are essential to the operational completeness of the subsystem/system. Examples are airframe, propulsion, guidance, navigation, and communication.

6.2.7 System. A composite of equipments, skills, and techniques capable of performing and supporting an operational role. A complete system includes related facilities, equipment, material, services, and personnel required for its operation to the degree that it can be considered a self-sufficient unit in its operational or support environment. A system may be aerospace, ground, or ship oriented.

6.2.8 Unaccepted response. An unacceptable response is an abnormality in the required operation or output of a subsystem/equipment due to electromagnetic interference which cannot be designated a malfunction but which is detrimental to system performance.

6.2.8.1 For equipment providing aural output, such as interphone (except communication receivers), an unacceptable response is an undesired output greater than 1.125 microwatts. Unacceptable response for communication receivers is an undesired output that exceeds the receiver area noise level with receiver unsquelched. With the receiver squelched to the point where the area noise level is just nondetectable, there shall be no signal generated by other subsystems/equipments that cause the receiver to break squelch.

6.2.9 Undesirable response. A recognizable interruption of normal output of a subsystem which cannot be designated as an unacceptable response or malfunction and which is considered tolerable by the procuring activity.

6.3 Changes from previous issues. Asterisks are not used in this revision to identify changes with respect to previous issues, due to the extensiveness of the changes.

Custodians :
Army - TM
Navy - AS
Air Force - 11

Preparing activity:
Air Force - 11

(Proj. MISC 0356)

Review activities :
Air Force - 17, 71

Federal Civilian Agency:
NASA (George Marshall Space Flight Center)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

OMB Approval
No. 22-R255

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MILITARY SPECIFICATION

INTERIM AMENDMENT

ELECTROMAGNETIC COMPATIBILITY REQUIREMENTS, SYSTEM

This Interim Amendment is issued for use by the Department of the Air Force with **MIL-E-6051D,** dated 7 September 1967.

Page 6, paragraph 3.2.8.2: Delete and substitute:

"**3. 2. 8. 2** External grounds for servicing equipment. Servicing and maintenance equipment that can cause electrical shock, or sparks in areas prone to explosion or fire hazards, shall be provided with a permanently attached grounding wire suitable for connection to an earth ground rod. Mobile electrical power carts are an exception and must not be grounded or provided with a grounding wire. In addition, all servicing equipment that handles or processes flamable fuels, fluids, or other hazardous materials shall be provided with permanently attached bonding wire for connection to the airvehicle. Bonding and grounding cables shall use plug MS25384 for connection to the aircraft, and an approved fitting for connection to the earth ground rods. Examples of requirements are refuelers, oil and hydraulic, servicing units require grounding wires; fuel and oxygen nozzles require bonding wires. Examples of AGE that do not require either grounding or bonding wires are lavatory servicing carts, jacks, towbars, lock pins, chocks, and similar items. In case of doubt, consult the cognizant engineering activity. "

Custodians:
Army - TM
Navy - AS
Air Force - 11

Review activities:
Air Force - 17, 71

Federal Civilian Agency:
NASA (George Marshall Space Flight Center)

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