CHAPTER 3

SPECIFICATIONS, STANDARDS, AND DOCUMENTS

3.1 EMISSIONS AND SUSCEPTIBILITY

Since the issuance of MIL-I-6181 in 1950 many EMC/EMI specifications have appeared, most of them outgrowths of MIL-I-6181 adapted or modified to fit a specific service requirement. Each of the military services has issued different standards and specifications covering emission and susceptibility characteristics, measurements, and requirements for systems and equipments. Because of the problems created by the numerous documents and their interpretation, the Department of Defense initiated a program for the consolidation of documentation in the EMC field. The outgrowth of this effort was the issuance of the DOD documents MIL-STD-461, 462, and 463 providing for the standardization and simplification of EMI requirements for equipments. This three-part document supersedes many of the older specifications in common use, e.g., MIL-I-6181, MIL-I-16910, MIL-STD-826 and others. Table 3-1 is a listing of latest issue military and commercial EMC/RADHAZ specifications, standards, and documents. Superseded documents have been listed because many of these "earlier" documents, while in the process of being phased out, are still encountered. So long as technology provides improved procedures, and as electronic systems and equipment grow in complexity and density, it is certain that continual revision of these specifications will be mandatory.

To have meaningful use, standards and specifications should be applied at the inception of a project. Selection and tailoring of the requirements in applicable specifications and standards for the project should occur at this phase.

3.2 DOCUMENT SYNOPSES

The more comprehensive of those listed documents in Table 3-1 are MIL-STD-449, 461, 462, 463, 469, 1310, and Military Specification MIL-E-6051; a brief description of each follows.

o MIL-E-6051, Electrical-Electronic System Compatibility and Interference Control Requirements for Aeronautical Weapon Systems, Associated Subsystems and Aircraft. Of all the listed documents, MIL-E-6051 is the only one to approach the EMC problem from a systems viewpoint, i.e., it requires total system compatibility, including test, checkout, and support equipment where such equipment is capable of contributing to the electromagnetic environment. No specific test procedures or equipment are outlined. Instead, MIL-E-6051 requires the preparation by the contractor of a detailed test plan wherein it is demonstrated that all elements of a system operate properly, both individually and collectively, and that there is at least a 6 dB margin between the susceptibility level of each equipment and the electromagnetic interference environment resulting from the operation of the total system.

o MIL-STD-449, Measurement of Radio Frequency Spectrum Characteristics, is a DOD document established to provide standard techniques for the measurement of radio-frequency spectrum characteristics of electronic equipment. The data obtained may be used to predict equipment and systems performance in an operational electromagnetic environment, predict the effect of a particular equipment or systems on the electromagnetic environment of other equipment or systems, to establish the characteristics required of new equipment for compatible operation in present and future environments. The document sets forth specific requirements such as accuracy of frequency measurements, number of points for antenna pattern data, dynamic range of measurements, standard test frequencies, and format for data. The emission and susceptibility characteristics of

transmitters and receivers obtained by use of MIL-STD-449 are maintained in a Spectrum Signatures Library by the DOD Electromagnetic Compatibility Analysis Center and are available for use by all naval activities involved in EMC problems, as discussed earlier in paragraph 1.5.

o MIL-STD-469, Radar Engineering Design Requirements, Electromagnetic Compatibility, represents an initial attempt by the military departments to control the spectral characteristics of new radar systems by establishing minimum engineering design criteria. The document specifies limits and tolerances for frequencies, emission and acceptance bandwidths, spurious radiation, stability and other parameters. It also specifies test procedures and instrumentation for obtaining these parameters.

o MIL-STD-1310, Shipboard Bonding and Grounding Methods for Electromagnetic Compatibility, outlines equipment installation requirements, and shipboard construction and bonding methods for the minimization of EMI aboard Naval Ships and Submarines. Particular emphasis is placed on bonding and grounding techniques to ensure, as nearly as possible, that the topside area be made a single RF conducting structure.

o MIL-STD-461, Electromagnetic Interference Characteristics Requirements for Equipments, MIL-STD-462, Electromagnetic Interference Characteristics, Measurement of, and MIL-STD-463, Definitions and Systems of Units, Electromagnetic Interference Technology. These three standards taken together form a coordinated document which establishes requirements, test limits and techniques for the measurement of the EMI characteristics of electronic, electrical, and electromechanical equipment. The requirements are set forth to ensure that interference control is considered and incorporated into the design of equipment, and that compatible operation of the equipment in a complex electromagnetic environment is achieved. A number of tests, covering both conducted and radiated, emission and susceptibility characteristics are outlined, making these documents the most comprehensive of the interference standards. The equipment class, use, and intended installation as defined in MIL-STD-461, determines which of the MIL-STD-462 tests are applicable.

Table 3-1. EMC/RADHAZ Specifications, Standards, And Documents

SPECIFICATIONS	TITLE	DATE	AGENCY
AFSC DH 1-4	Electromagnetic Compatibility	Current issue	USAF
AFSCM 100-31	Frequency Management and Electromagnetic Compatibility	13 March 1970	USAF
ANSI STD C63.2	American Standard Specifications for Radio Noise and Field Strength Meters 0.015 to 30 MHz	28 March 1963	ANSI
ANSI STD C63.4	Methods of Measurement of Radio-Noise Voltage and Radio-Noise Field Strength, 0.015 to 25 MHz, Low Voltage Electric Equipment, and Nonelectric Equipment	1963	ANSI
BSD Exhibit 67-87	Electro-interference Control Requirements for Minuteman (WS-133B)	12 June 1962	USAF, BSD Note (5)
D65/9371	General Requirements for Electrical Equipment and Indicating Instruments for Aircraft; RFI		British Standards Institute
DO 138	Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equipment and Instruments		RTCA Note (6)
FCC Part 15	Rules and Regulations, Radio Frequency Devices	May 1966	FCC
FCC Part 18	Rules and Regulations, Industrial Scientific, and Medical Equipment	May 1966	FCC
JAN-I-225 Note (4)	Radio Interference Control and Test Requirements	14 June 1945	USAF
MIL-B-5087	Electrical Bonding and Lightning Protection for Aerospace Systems	16 Oct. 1964	USN, USAF
MIL-C-11693	General Specification for Radio Frequency Interference Reduction Capacitor, AC and DC, Hermetically Sealed in Metal Cases	8 Feb. 1962	USA, USN, USAF
MIL-E-4957 Note (4)	Electromagnetic Shielding Demountable Enclosure, Prefabricated for Electronic Test Purposes	17 Nov. 1954	USN, USAF
MIL-E-6051	Electrical-Electronic System Compatibility and Interference Control Requirements for Aeronautical Weapon Systems, Associated Subsystems and Aircraft	7 Sept. 1967	USA, USN, USAF
MIL-E-55301 (EL) Note (1)	Electromagnetic Compatibility	1 March 1966	USA

Table 3-1. EMC/RADHAZ Specifications, Standards, And Documents (Con't).

SPECIFICATIONS	TITLE	DATE	AGENCY
MIL-F-15733	Radio Interference Filters	15 Aug. 1966	USA, USN, USAF
MIL-F-18327	General Specification for Filters; High Pass, Low Pass, Band Pass, Band Suppression and Dual Functioning	25 May 1966	USA, USN, USAF
MIL-F-25880	Band Pass, Band Suppression Filter	29 Jan. 1960	USAF
MIL-I-6181 Note (1)	Aircraft Equipment Interference Control Requirements	1 June 1962	USA, USN, USAF
MIL-I-11683 Note (2)	Requirements for Engine Generators and Miscellaneous Engines Radio Interference Suppression	19 Jan. 1953	USA, USN, USAF
MIL-I-11748 Note (2)	Interference Reduction for Electrical and Electronic Equipment	4 Nov. 1958	USA
MIL-I-16165	Engine Electrical Systems Interference	12 Aug. 1961	USN
MIL-I-16910 Note (1)	Electromagnetic Interference Measurement, Methods and Limits	26 Oct. 1964	USN
MIL-I-17623 Note (1)	Electromagnetic Interference Measurement Methods and Limits, for Electric Office Machines, Printing and Lithographic Equipment	19 April 1965	USN
MIL-I-26600 Note (3)	Interference Control Requirements Aeronautical Equipment	9 May 1960	USAF
MIL-I-43121 Note (1)	Interference Reduction for Electric Hand Tools	30 Aug. 1965	USA, USN, USAF
MIL-P-24014	Preclusion of Hazards from Electromagnetic Radiation to Ordnance, General Requirements for	30 Jan. 1965	USN
MIL-R-9673	Radiation Limits, Microwave and X-Radiation Generated by Ground Electronic Equipment (As Related to Personnel Safety)	13 Feb. 1961	USAF
MIL-S-10379 Note (1)	General Requirements for Vehicles and Vehicular Subassembly Radio Interference Suppression	23 July 1952	USA, USN, USAF
MIL-S-12348 Note (1)	General Requirement, Radio Interference Suppression	6 Aug. 1958	USA, USN, USAF

Table 3-1. EMC/RADHAZ Specifications, Standards, And Documents (Con't).

SPECIFICATIONS	TITLE	DATE	AGENCY
MIL-S-13237 Note (2)	Radio Interference Suppression Requirements for Watercraft		USA
MIL-S-13715	Transients on Vehicles		USA
MIL-STD-220	Method of Insertion-Loss Measurement	15 Dec. 1959	USA, USN, USAF
MIL-STD-285	Method of Attenuation Measurements for Electromagnetic Shielding Enclosures for Electronic Test Purposes	25 June 1956	USA, USN, USAF
MIL-STD-449	Measurement of Radio Frequency Spectrum Characteristics	1 March 1965	USA, USN, USAF
MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment	1 Aug. 1968	USA, USN, USAF
MIL-STD-462	Measurement of Electromagnetic Interference Characteristics	31 July 1967	USA, USN, USAF
MIL-STD-463	Definition and System of Units, Electromagnetic Interference Technology	9 June 1966	USA, USN, USAF
MIL-STD-469	Radar Engineering Design Requirements Electromagnetic Compatibility	1 Dec. 1966	USA, USN, USAF
MIL-STD-826 Note (1)	Electromagnetic Interference Test Requirements and Test Methods	30 June 1966	USAF
MIL-STD-833	Minimization of Hazards of Electromagnetic Radiation to Electroexplosive Devices	31 July 1963	USAF
MIL-STD-1310	Shipboard Bonding and Grounding Methods for EMC	27 Dec. 1967	USN
MOL 64-4	General EMC Specification for Systems	April 1965	USAF
MSC, Houston IESD-19-3	Interference Control Requirements for Spacecraft Equipment		NASA
MSC, Houston PACE-S/C, Project Office Spec. 53, Rev 1 to MIL-I-26600	Performance Specification for Equipment Grounding Requirements on Preflight Acceptance Checkout Equipment Spacecraft (PACE S/C) Program		NASA
MSFC-SPEC-279	Electromagnetic Compatibility	1 June 1964	NASA

Table 3-1. EMC/RADHAZ Specifications, Standards, And Documents (Con't).

SPECIFICATIONS	TITLE	DATE	AGENCY
NAVFAC 50-YA Note (1)	Overhead Power Lines Operating at Voltages from Zero to 1000 kV, 14 kHz to 1 GHz	April 1966	USN
NAVMAT P-5100	Safety Precautions for Shore Activities	March 1970	USN
NAVMED P-5052-35	Control of Hazards to Health From Laser Radiation	24 Feb. 1969	USN
NAVMED P-5055	Radiation Health Protection Manual	6 Nov. 1968	USN
NAVORD OP 3565/ NAVAIR 16-1-529	Technical Manual - Radio Frequency Hazards to Ordnance, Personnel, and Fuels		USN
NAVSHIPS 0900-005-8000	Technical Manual for Radio-Frequency Radiation Hazards	15 July 1966	USN
SAE-J551	Measurement of Vehicle Radio Interference (30-400 MHz)		SAE Note (7)
SAE ARP-936	10 Microfarad Capacitor for EMI Measurements		SAE
SAE ARP-958	Measurement of Antenna Factors		SAE
STANAG 3516	EMC Test Methods for Aerospace Electrical and Electronic Equipment		NATO
T.O. 31Z-10-4	Electromagnetic Radiation Hazards	10 May 1967	USAF

Notes:

(1) Superseded by MIL-STD-461/462, inactive for new designs
(2) Superseded by MIL-E-55301 (EL)
(3) Superseded by MIL-STD-826
(4) Cancelled
(5) USAF Ballistic Systems Division
(6) Radio Technical Committee for Aeronautics
(7) Society of Automotive Engineers