MILITARY STANDARD

STANDARD GENERAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT

TO ALL HOLDERS OF MIL-STD-454M:

1. THE FOLLOWING PAGES OF MIL-STD-454M HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED.

NEW PAGES	DATE	SUPERSEDED PAGES	DATE
v	30 May 91	v	15 Dec 89
vi	15 Dec 89	(REPRINTED WITHOUT CHANGE)	
3	30 Apr 91	3	15 Dec 89
1-1	3 May 91	1-1	30 Jun 89
1-2 thru 1-5	30 Jun 89	(REPRINTED WITHOUT CHANGE)	
1-6	30 May 91	1-6	30 Jun 89
1-7 thru 1-11	30 Jun 89	(REPRINTED WITHOUT CHANGES)	
8-1	30 Apr 91	8-1	12 Feb 88
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2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-454M will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or cancelled.

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Preparing activity:
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Review activities:
Army - AR, AV, CR, ME, MI
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Project GDRQ-0092

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the earth's atmosphere; "space" denotes application peculiar to spacecraft and systems designed for operation near or beyond the upper reaches of the earth's atmosphere; and "aerospace" includes both airborne and space applications.

3.2 Other terms are defined in the individual Requirements.

4. GENERAL REQUIREMENTS

4.1 Application. The Requirements contained herein are intended to provide uniform requirements applicable to electronic equipment, unless otherwise specified in the Requirement, and shall be incorporated by reference in general equipment specifications. Other documents may reference Requirements when applicable.

4.2 *Use of selection and application standards*. When a selection and application standard is invoked in a Requirement, the devices or parts selected shall conform to the applicable military specifications referenced in the standard.

5. DETAIL REQUIREMENTS

5.1 Individual Requirements for electronic equipment follow.

6. NOTES

6.1 The margins of this standard are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This is done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

6.2 *Subject term (key word) listing*.

Cable selection	Nomenclature
Corona protection	Parts selection
Encapsulation	Printed wiring
Fasteners	Safety
Flammability	Soldering
Fungus protection	Substitutability of parts
Interchangeability of parts	Thermal design Marking
Waveguides Materials selection	Wire selection
Microelectronics	Workmanship

Custodians:
Army - ER
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Review activities:
Army - AR, AV, CR, ME, MI, TE
Navy - EC, SH, OS
Air Force - 17, 19, 85

Other: DLA - ES
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Preparing activity:
Air Force - 10

Agent: DLA-ES

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REQUIREMENT 1

SAFETY DESIGN CRITERIA - PERSONNEL HAZARDS

1. Purpose. This requirement establishes safety design criteria and provides guidelines for personnel protection.

2. Documents applicable to Requirement 1:

MIL-B-5087	Bonding, Electrical, and Lightning Protection, for Aerospace Systems
MIL-STD-1310	Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety Shielding
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-HDBK-600	Guidelines for Identification, Markings, Labeling, Storage, and Transportation of Radioactive Commodities
ANSI C95.1-1982	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 KHz to 100 GHz
ANSI C95.2-1982	Radio Frequency Radiation Hazard Warning Symbol
ANSI N2.1-1969	Radiation Symbol
ANSI Z35.1-1972	Accident Prevention Signs, Specification for
ANSI Z35.2-1968	Accident Prevention Tags, Specification for
ANSI Z35.4-1973	Specification for Informational Signs Complementary to ANSI Z35.1, Accident Prevention Signs
ANSI Z53.1-1979	Marking Physical Hazards, Safety Color Code for
*NFPA 70-1990	National Electrical Code
10 CFR 20	Code of Federal Regulations, Title 10, Chapter I, Part 20
21 CFR 1000-1050	Code of Federal Regulations, Title 21, Chapter I, Parts 1000-1050
29 CFR 1910	Code of Federal Regulations, Title 29, Chapter XVII, Part 1910

3. Definitions

3.1 Chassis, electrical equipment. The chassis is a structural item fabricated in such manner as to facilitate assemblage and interconnection of electrical or electronic items for the specific purpose of providing a basis for electrical or electronic circuits. It normally has drilled or stamped holes to accommodate the items but may include only the items necessary for its own mounting and support.

3.2 Frame. The frame is any construction system fitted and united together, designed for mounting or supporting electrical or electronic parts or units.

3.3 Fail-safe. The design feature of a part, unit or equipment which allows the item to fail only into a non-hazardous mode.

3.4 Interlock. An interlock is an automatic switch which eliminates all power from the equipment when an access door, cover or plate is removed.

3.4.1 Bypassable interlock. A bypassable interlock is an automatic switch with a manually operated electrical bypass device to allow equipment maintenance operations on energized equipment.

3.5 Battleshort. A switch used to bypass normal interlocks in mission critical equipment (i.e., equipment which must not be shut down or the mission function will fail) during battle conditions.

4. Requirements

4.1 Fail-safe. The design and development of all military electronic equipment shall provide fail-safe features for safety of personnel during the installation, operation, maintenance, and repair or interchanging of a complete equipment assembly or component parts thereof.

4.2 Bonding in hazardous areas. Electronic equipment to be installed in areas where explosive or fire hazards exist shall be bonded in accordance with MIL-B-5087 for aerospace systems, MIL-STD-1310 for shipboard systems, and NFPA 70, Chapter 5, for ground systems, or as otherwise specified in the detail equipment specification.

4.3 Temperature. At an ambient temperature of 25°C, the operating temperature of control panels and operating controls shall not exceed 49°C. Other exposed parts subject to contact by operating personnel shall not exceed 60°C.

4.4 Electrical. The design shall incorporate methods to protect personnel from inadvertent contact with voltages capable of producing shock hazards.

4.4.1 Power. Means shall be provided so that power may be cut off while installing, replacing, or interchanging a complete equipment, assembly, or part thereof. Interface with electrical power sources shall be in accordance with the applicable regulations or requirements. If a main power switch is provided, it shall be clearly labeled as such and shall cut off all power to the complete equipment.

4.4.2 Ground. The design and construction of equipment, excluding self-powered equipment, shall insure that all external parts, surfaces, and shields, exclusive of antenna and transmission line terminals, are at ground potential at all times during normal operation. The design shall include consideration of ground currents and voltage limits (possible arcing) established on a basis of hazardous location. Antenna and transmission line terminals shall be at ground potential, except for radio frequency (rf) energy on their external surfaces.

4.4.2.1 Self-powered equipment. Self-powered equipment shall have all external surfaces at the same potential.

4.4.2.2 Grounding methods. Plugs for use with metal cased portable tools and equipment shall have provisions for automatically grounding the metal frame or case of tools and equipment when the plug is mated with receptacle, and the grounding pin shall make first, break last. Ground connections to shields, hinges, and other mechanical parts shall not be used to complete electrical circuits. Any external or interconnecting cable, where a ground is part of the circuit, shall carry a ground wire in the cable terminated at both ends in the same manner as the other conductors. In no case, except with coaxial cables, shall the shield be depended upon for a current-carrying ground connection. Static and safety grounds shall not be used to complete electrical circuits.

A point on the electrically conductive chassis or equipment frame shall serve as the common tie point for static and safety grounding. The path from the tie point to ground shall:

a. Be continuous and permanent,

b. Have ample carrying capacity to conduct safely any fault currents that may be imposed upon it,

c. Have impedance sufficiently low to limit the potential above ground and to facilitate the operation of the over current devices in the circuits, and

d. Have sufficient mechanical strength of the material to minimize possibility of ground disconnection.

4.4.2.3 Hinged or slide-mounted panels and doors. Hinges or slides shall not be used for grounding paths. Panels and doors containing meters, switches, test points, etc, shall be attached or hinged in such a manner as to insure that they are at the same ground potential as the equipment in which they are mounted, whether in a closed or open position. A ground shall be considered satisfactory if the electrical connection between the door or panel and the system tie point exhibits a resistance of 0.1 ohm or less and has sufficient ampacity to insure the reliable and immediate tripping of equipment over-current protection devices.

4.4.2.4 Shielding. Except where a conflict with single-point shield grounding requirements would be created, shielding on wire or cable shall be grounded to the chassis or frame. The shielding shall be secured to prevent it from contacting exposed current-carrying parts or grounding to the chassis or frame at any point other than the ground termination. The shielding shall end at a sufficient distance from exposed conductors to prevent shorting or arcing between the conductor and the shielding.

4.4.3 Accidental contact. The design shall incorporate methods to protect personnel from accidental contact with voltages in excess of 30 volts rms or dc during normal operation of a complete equipment.

4.4.3.1 Guards and barriers. All contacts, terminals and like devices having voltages between 70 and 500 volts rms or dc with respect to ground shall be guarded from accidental contact by personnel if such points are exposed to contact during direct support or operator maintenance. Guards or barriers may be provided with test probe holes where maintenance testing is required.

4.4.3.2 High voltage guarding. Assemblies operating at potentials in excess of 500 volts shall be completely enclosed from the remainder of the assembly and equipped with nonbypassable interlocks.

4.4.3.3 Voltage measurement. When the operation or maintenance of equipment employing potentials in excess of 300 volts peak could require that these voltages be measured, the equipment shall be provided with test points so that these voltages can be measured at a relatively low potential level. In no case shall the potential exceed 300 volts peak relative to ground. Test points with voltages above 30 volts shall have the conducting material recessed a distance no less than the diameter of the probe hole and a minimum of 1.5 mm. If a voltage divider is used, the voltage divider resistance between the test point and ground shall consist of at least two resistors of equal value in parallel.

4.4.3.4 Guarding of rf voltages. Transmitter output terminals, antennas and other devices that carry sufficient rf voltage to burn or injure personnel shall be protected from accidental contact in the same manner as for ac voltages in the 70 to 500 volt range.

4.4.3.5 Main power switch. The power input side of the main power switch and the incoming power line connections shall be given physical protection against accidental contact.

4.4.4 Protective devices

4.4.4.1 Interlocks. When a unit is provided with access doors, covers or plates, these access points shall be interlocked as follows:

a. No interlocks are required when all potentials in excess of 70 volts are completely protected with guards or barriers to prevent accidental contact under all conditions of operation or any level of maintenance.

b. Bypassable interlocks are required when voltages between 70 and 500 volts are exposed as the result of an access door, cover, or plate being opened. Note that these internal voltages are allowed to be unguarded only if they are not exposed during direct support or operator maintenance. The bypass device shall be of such design that closing the associated door, cover or plate will automatically open the bypass device and leave the interlock in position to function normally. Visual means shall be provided to indicate when the interlock is bypassed.

c. Nonbypassable interlocks are required when any voltage in excess of 500 volts is exposed as a result of an access door, cover or plate being opened.

4.4.4.2 Battle short indicator. When a battle short switch is required by the individual equipment specification, a readily visible indicator light shall be provided to indicate when the battle short switch is ON.

4.4.4.3 Safety switches. Safety switches which will deactivate associated mechanical drive units shall be provided for the purpose of disconnecting these units without disconnecting other parts of the equipment. Such remotely located units and assemblies shall have provision for nonoverrideable safety switches to allow independent disconnection in the associated equipment.

4.4.5 Discharging devices

4.4.5.1 Automatic discharge devices. High voltage circuits and capacitors shall be provided with discharging devices unless they discharge to 30 volts or less within two seconds after power removal. The particular discharging device that is chosen shall insure that the capacitor or high voltage circuit is discharged to 30 volts or less within two seconds. These protective devices shall be positive acting, highly reliable, and shall actuate automatically either by mechanical release or by electrical solenoid when the door or cover is opened. When resistive bleeder networks are used to discharge capacitors, the bleeder network shall consist of at least two equal valued resistors in parallel.

4.4.5.2 Shorting rods. Shorting rods shall be provided with all transmitting equipment where voltages are in excess of 70 volts rms or dc. Where size permits, shorting rods shall be stored within the transmitting equipment, permanently attached, and readily accessible to maintenance personnel. The permanently attached rod shall be connected through a flexible stranded copper wire (covered with a transparent sleeving) to the stud provided at the transmitter main frame. Where size does not permit internal storage of the shorting rod, a grounding stud shall be provided to permit attachment of a portable shorting rod. The connection to the stud shall be such that accidental loosening or high resistance to the ground is prevented.

4.4.6 Connectors. Connectors used in multiple electric circuits shall be selected to preclude mismating. Where design considerations require plug and receptacles of similar configuration in close proximity, the mating plugs and receptacles shall be suitably coded or marked to clearly indicate the mating connectors. Plugs and receptacles shall not be of similar configuration if the major unit contains explosive items. The design of the connector shall be such that the operator is not exposed to electrical shock or burns when normal disconnect methods are used. Exposed pin contacts shall not be energized (hot) after being disconnected from the socket contacts.

4.5 Radiation. The design of all equipment for which a federal standard exists under 21 CFR 1000 - 1050, on the Radiation Control for Health and Safety Act of 1968, shall conform to the appropriate federal standard.

4.5.1 Microwave and rf radiation. All electronic equipment or electrical devices capable of emitting microwave or rf radiation between 300 KHz and 100 GHz shall be so designed, fabricated, shielded and operated as to avoid overexposure of personnel. In areas where unintended radiation levels exist, equipment design and installation in any unrestricted area accessible to personnel shall meet the requirements of ANSI C95.1. Shields, covers, doors, etc, which when opened or removed will allow microwave and rf radiation to exceed the above, shall be provided with nonbypassable interlocks.

4.5.2 X radiation. All electronic or electrical devices capable of producing X radiation shall be so designed, fabricated, shielded and operated as to keep personnel exposure as low as reasonably achievable. For equipment and installation design, shielding requirements shall be maintained at all times which limit radiation levels to not greater than 2 milliroentgens (mr) in any one hour and 100 mr in any 7 consecutive days at the operator position or within 5cm from the equipment (whichever is closer) in any unrestricted area accessible to personnel. In addition, these levels shall be reduced whenever necessary to ensure that exposed personnel never receive an absorbed dose to the whole body or any critical organ in excess of 125 millirem per calendar quarter or 500 millirem per year. Other exposure shall be based on application criteria and limits as required by Nuclear Regulatory Commission Rules and Regulations, 10 CFR 20; OSHA Regulations, 29 CFR 1910.96; and FDA Regulation, 21 CFR, Chapter I, Subchapter J, Radiological Health. Equipment which, when shields, covers, doors, etc, are removed, will allow X radiation to exceed 2.0 mr per hour shall be provided with nonbypassable interlocks.

4.5.3 Laser radiation. Laser equipment and system design, installation, and operational and maintenance procedures shall conform to 21 CFR 1040. If Title 21 cannot be met because of operational requirements, an exemption shall be requested from the procuring activity and applicable military laser safety regulations shall be used as a design requirement.

4.6 Mechanical. The design of the equipment shall provide personnel maximum access and safety while installing, operating, and maintaining the equipment. Equipment design shall include provisions to prevent accidental pulling out of drawers or rack mounted equipment components. Suitable protection shall be provided to prevent contact with moving mechanical parts such as gears, fans, and belts when the equipment is complete and operating. Sharp projections on cabinets, doors, and similar parts shall be avoided. Doors or hinged covers shall be rounded at the corners and provided with stops to hold them open.

4.6.1 Mechanical interconnection. The design shall provide positive means to prevent the inadvertent reversing or mismating of fittings; couplings; fuel, oil, hydraulic, and pneumatic lines; and mechanical linkage. When prevention of mismating by design consideration is not feasible, coding or marking shall be employed when approved by the procuring activity. Coding and marking will not be approved as a substitute for proper design or items involving explosive, emergency, or safety critical systems.

4.6.2 Power switch location. Equipment power switches shall be so selected and located that accidental contact by personnel will not place equipment in operation.

4.6.3 Cathode ray tubes. Provision shall be incorporated to protect personnel from injury due to implosion of cathode ray tubes.

4.7 Equipment safety markings. Danger, caution, etc, signs, labels and markings shall be used to warn of specific hazards such as voltage, current, thermal, or physical. The signs, labels, and markings shall be as permanent as the normal life expectancy of the equipment on which they are affixed. Guards, barriers, and access doors, covers or plates shall be marked to indicate the hazard which may *be present upon removal of such devices. When possible, marking shall be located such that i Additionally, hazards internal to a unit shall be marked adjacent to hazards if they are significantly different from those of surrounding items. Such a case would be a high voltage terminal in a group of low voltage devices.

a. Physical hazards shall be marked with color codes in accordance with ANSI Z53.1 where applicable to electronic equipment.

b. For potentials between 70 and 500 volts, warning signs or labels shall be in accordance with ANSI Z35.1, Class II, and ANSI Z35.4, and shall read, as a minimum, "*Caution* - (Insert maximum voltage applicable) *Volts.*"

c. For potentials in excess of 500 volts, warning signs or labels shall be in accordance with ANSI Z35.1, Class I and ANSI Z35.4, and shall read, as a minimum, "*Danger - High Voltage* - (Insert maximum voltage applicable) *Volts.*"

d. Microwave or rf radiation warning signs shall be in accordance with ANSI Z35.1 and ANSI C95.2. Labels shall be provided on all radiation shields to warn personnel of the radiation hazards involved upon removal thereof. Any item which can emit radiation levels in excess of those specified in paragraph 4.5.1 shall be labeled. Minimum safe clearance distances shall be clearly marked. Warning signs shall be posted in all areas having electronic equipment designed to operate between 300 KHz and 100 GHz with intended electromagnetic radiation levels exceeding those in paragraph 4.5.1.

e. (1) Laser labels shall be in accordance with 21 CFR 1040.

(2) Military exempt laser labels: A permanent label shall be affixed on all military laser systems that have been certified exempt from 21 CFR 1040 (Performance Standards for Light-Emitting Products), which reads:

CAUTION

This electronic product has been exempted from FDA radiation safety performance standards, prescribed in the Code of Federal Regulations, Title 21, Chapter I, Subchapter J, pursuant to Exemption No. 76 EL-01 DOD issued on 26 July 1976. This product should not be used without adequate protective devices or procedures.

f. Shields which protect personnel from X radiation shall be labeled in accordance with 10 CFR 20.

g. Coding for accident prevention tags shall be in accordance with ANSI Z35.2.

h. The marking or labeling of commodities containing radioactive materials shall be in accordance with 10 CFR 20.

i. Ionizing radiation hazard symbols shall be in accordance with ANSI N2.1.

4.8 Hazardous and restricted materials

4.8.1 Gases or fumes. The materials, as installed in the equipment and under service conditions specified in the equipment specification, shall not liberate gases which combine with the atmosphere to form an acid or corrosive alkali, nor shall they liberate toxic or corrosive fumes which would be detrimental to the performance of the equipment or health of personnel. The materials also shall not liberate gases which will produce an explosive atmosphere.

4.8.2 Mercury. Materials and parts containing mercury shall not be used unless use of mercury is specifically required or approved by the procuring activity.

4.8.3 Radioactive materials. Use of radioactive materials shall conform to Nuclear Regulatory Commission regulations and shall require approval of the procuring activity. Radium shall not be used to achieve self-luminosity.

4.8.4 Glass fibers. Glass fiber materials shall not be used as the outer surface or covering on cables, wire or other items where they may cause skin irritation

to operating personnel. This does not preclude the use of military specification wire and cable. When maintenance procedures require access to glass fibers, such as insulation, a proper caution note shall be provided.

5. Information for guidance only

5.1 Human engineering. Human engineering factors affecting safety should be considered when establishing general or detailed design criteria. Rigorous detailed operational or maintenance procedures are not acceptable substitutes for an inherently safe design. Hazard and safety requirements of MIL-STD-1472 should be used as a guide.

5.2 Electrical. Proper instructions in accident prevention and first-aid procedures should be given to all persons engaged in electrical work to fully inform them of the hazards involved.

5.2.1 Shock hazards. Current rather than voltage is the most important variable in establishing the criterion for shock intensity. Three factors that determine the severity of electrical shock are: (1) quantity of current flowing through the body; (2) path of current through the body; and (3) duration of time that the current flows through the body. The voltage necessary to produce the fatal current is dependent upon the resistance of the body, contact conditions, and the path through the body. See table 1-I. Sufficient current passing through any part of the body will cause severe burns and hemorrhages. However, relatively small currents can be lethal if the path includes a vital part of the body, such as the heart or lungs. Electrical burns are usually of two types, those produced by heat of the arc which occurs when the body touches a high-voltage circuit, and those caused by passage of electrical current through the skin and tissue. While current is the primary factor which determines shock severity, protection requirements are based upon the voltage involved to simplify their application. In cases where the maximum current which can flow from a point is less than the values shown in table 1-I for reflex action, protection requirements may be relaxed.

TABLE 1-I. Probable effects of shock.

Current Values (Milliamperes)		Effects
AC 25 Hz to 400 Hz	DC	
0-1	0-4	Perception
1-4	4-15	Surprise
4-21	15-80	Reflex action
21-40	80-160	Muscular inhibition
40-100	160-300	Respiratory block
Over 100	Over 300	Usually fatal

5.2.2 Insulation of controls. All control shafts and bushings thereof should be grounded whenever practicable. Alternatively, the control knobs or levers and all attachment screws that can be contacted during use should be electrically insulated from the shaft.

5.2.3 Grounding to chassis. Ground connection to an electrically conductive chassis or frame should be mechanically secured by soldering to a spotwelded terminal lug or to a portion of the chassis or frame that has been formed into a soldering lug, or by use of a terminal on the ground wire and then securing the terminal by a screw, nut, and lockwasher. The screw should fit in a tapped hole in the chassis or frame or it should be held in a through-hole by a nut. When the chassis or frame is made of steel, the metal around the screw hole should be plated or tinned to provide a corrosion resistant connection. When aluminum alloys are used, the metal around the grounding screw or bolt hole may be covered with a corrosion resistant surface film only if the resistance through the film is not more than 0.002 ohm. Hardware used for mounting of meters, switches, test points, etc, should be grounded, whenever possible.

5.2.4 Accidental contact. Suitable protective measures are defined in table 1-II.

5.2.4.1 High current protection. Power sources capable of supplying high current can be hazardous regardless of the voltage at which they operate because of the arcing and heat generated if an accidental short circuit occurs. All power buses supplying 25 amperes or over should be protected against accidental short circuiting by tools, jewelry or removable conductive assemblies. This may be accomplished by one or more of the following:

a. Use of guards and barriers,

b. Sufficient space separation to prevent short circuits,

c. Caution - warning signs.

5.2.4.2 Interlocks. Various equipment designs require different approaches to the use of interlocks. Interlock use does not modify any other requirements of this standard and must be consistent with equipment or system specifications. Equipment sub-assemblies operating in excess of 500 volts should be considered guarded from accidental contact only if they are completely enclosed from the remainder of the equipment and are separately protected by nonbypassable interlocks. (An example of an equipment where such compartmentalization is desirable is a display unit which utilizes a high voltage power supply for a cathode ray tube.) Modularized or sealed high voltage assemblies which are opened only at depot level are exempt from interlocking requirements when approved by the procuring activity.

5.2.4.3 Permanent terminations. Terminations such as soldered connections to transformers, connectors, splices, etc, which are normally permanent and not used during routine maintenance testing, may be protected by permanent insulation such as shrink sleeving, tubing, insulating shields, etc, provided the material is rated for the potential exposed voltage.

5.3 Mechanical. Design of rack-mounted equipment should maintain the center of gravity as low as possible to minimize tipping over.

5.4 Marking. MIL-HDBK-600 references known electronic items which require marking and may be used as a guide.

5.5 Materials. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with 29 CFR 1910.

TABLE 1-II. Suitable protective measures. 1/

Voltage range	Type of protection 2/								
				Marking		Interlocks		Discharge devices	
	None 3/	Guards and barriers (4.4.3.1)	Enclosures (4.4.3.2 4.4.4.1)	Caution (4.7b)	Danger (4.7c)	Bypassable (4.4.4.1b)	Non- 4/ bypassable (4.4.4.1c)	Automatic (4.4.5.1)	Shorting Rods (4.4.5.2)
0 - 30 Volts	X								
> 30 - 70 Volts	X							X	
> 70 - 500 Volts		X		X		X		X	X
>500 Volts			X		X		X	X	X

1/ Table is for reference only. See applicable paragraph for requirements.

2/ Confine the application of headings to voltage ranges indicated. More than one option may be available on design requirements.

3/ Although no specific requirements exist for servicing 0-70 volts, designs should be reviewed for possible hazards in accordance with table 1-I.

4/ Designs may use nonbypassable interlock applications below 500 volts, but the intent here is to imply complete enclosure.

REQUIREMENT 8

ELECTRICAL OVERLOAD PROTECTION

1. Purpose. This requirement establishes the criteria and philosophy for electrical overload protection..

*2. Documents applicable to Requirement 8:

MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-1539	Electrical Power, Direct Current, Space Vehicle Design Requirements
NFPA 70-1990	National Electrical Code

3. Definitions

3.1 Class 1 equipment: Ground and shipboard, including test and checkout ground equipment

3.2 Class 2 equipment: Manned aerospace equipment

3.3 Class 3 equipment: Unmanned aerospace equipment

4. Requirements. The requirements specified herein shall apply only to equipment and systems as defined in MIL-STD-280 for class 1 and class 2 equipment and MIL-STD-1539 for class 3 equipment.

4.1 Protection for class 1 equipment

4.1.1 Current overload protection. Current overload protection shall be provided for primary circuits. Devices such as fuses, circuit breakers, time delays, cutouts, or solid-state current-interruption devices shall be used to open a circuit whenever an overload condition occurs. No overcurrent protective device shall be connected in series with any conductor which is grounded at the power source unless the device simultaneously opens all load conductors in the circuit and no pole operates independently, or as otherwise allowed by the National Electrical Code, NFPA 70. Protective devices for wired-in equipment shall be connected to the load side of the equipment power switch (main circuit power disconnect). For portable equipment a separable connector or the attachment plug and receptable shall serve as the main circuit power disconnect and the protective device may be on either the line side or the load side of the equipment on-off switch.

4.1.2 Fuses. Where fuses are used, at least one extra fuse of each type and
rating used shall be supplied and attached to the applicable units of the equipment. Panel-mounted fuse posts shall be such as to permit renewal of fuses without use of tools.

4.1.3 Circuit breakers. Circuit breakers shall give a visual indication when tripped. Holding the switching device closed on an overload shall not prevent tripping of the breaker. Multi-pole circuit breakers shall be used

for three-phase equipment and shall disconnect all phases if an overload occurs in any one phase. Circuit breakers shall not be used as switches unless such breakers have been specifically designed and tested for that type service.

4.2 Protection for class 2 equipment

4.2.1 Current overload protection. Current overload protection for the equipment shall be provided by fuses or circuit breakers. Circuit breakers shall not be used as switches unless such breakers have been specifically designed and tested for that type service.

4.2.2 Spare fuses. When fuses are used, a minimum of one spare fuse for each
size and rating but a quantity of not less than 10 percent of the total shall be incorporated in the equipment and shall be contained in the same compartment.

4.3 Protection for class 3 equipment. Electrical overload protection shall not be provided in individual boxes or systems receiving power.

5. Information for guidance only

5.1 Location. Overload protection for the equipment should be provided therein. For class 1 and class 2 equipment, all protective devices employed in the equipment should be in a readily accessible, safe location.

5.2 Resettable circuit protectors. Circuit breakers or other resettable devices should be used to protect critical circuits, or where predictable overloads or surges occur because of peculiar equipment functions or operator effects which are unavoidable.

REQUIREMENT 13

STRUCTURAL WELDING

1. Purpose. This requirement establishes criteria for structural welds. Welded electrical connections are excluded from this requirement.

*2. Documents applicable to Requirement 13:

MIL-W-6858	Welding, Resistance, Spot and Seam
MIL-W-46132	Welding, Fusion, Electron Beam, Process for
MIL-STD-22	Welded Joint Design
MIL-STD-248	Welding and Brazing Procedure and Performance Qualification
MIL-STD-1261	Arc Welding Procedures for Constructional Steels
MIL-STD-1595	Qualification of Aircraft, Missile, and Aerospace Fusion Welders
MIL-STD-2219	Fusion Welding for Aerospace Applications
MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structures
MIL-HDBK-730	Materials Joining
ANSI/AWS A2.4-86	Standard Symbols for Welding, Brazing and Nondestructive Examination
ANSI/AWS A3.0-85	Standard Welding Terms and Definitions, Including Terms for Brazing, Soldering, Thermal Spraying and Thermal Cutting

3. Definitions. Not applicable.

4. Requirements

*4.1 Arc and gas welding. Welding by arc and gas methods shall be performed by operators who have passed the applicable certification tests and have a certificate of proficiency in accordance with MIL-STD-248 or MIL-STD-1595. Welding of aluminum, magnesium, and steel alloys shall conform to MIL-STD-2219.

4.2 Resistance welding. Resistance welding of joints shall conform to MIL-W-6858.

5. Information for guidance only

*5.1 General. The joint areas of all parts to be welded should be cleaned of contaminants and materials which may be detrimental to obtaining satisfactory welds. Degradation of material properties in the heat affected zone caused by welding should be considered. Weldments should be stress relieved when induced stress resulting from welding, design configuration, or materials welded may be harmful. See ANSI/AWS 2.4 for welding symbols, ANSI/AWS A3.0 for welding terms and definitions, and MIL-STD-22 for welded joint designs. MIL-HDBK-730 provides guidance in this field of materials joining and its related processes.

5.2 Resistance welding. MIL-HDBK-5 may be used as a guide for spot-to-sheet edge distances and allowable strengths.

5.3 Noncritical applications. In ground equipment applications, welding procedures in accordance with MIL-STD-1261 may be used where, if the weld should fail, it will not compromise personnel or equipment safety or prevent completion of the mission.

5.4 Other methods. Other welding methods, such as the electron beam process of MIL-W-46132, may be used provided approval is obtained from the procuring activity.

REQUIREMENT 17

PRINTED WIRING

1. Purpose. This requirement established criteria for the design and treatment of printed wiring assemblies.

*2. Documents applicable to Requirement 17:

MIL-P-46843	Printed Wiring Assemblies
MIL-STD-1861	Electrical and Electronic Assemblies, Boards, Cards, and Associated Hardward, Selection and Use of
ANSI/IPC-D-322	Guidelines for Selecting Printed Wiring Board Sizes Using Standard Panel Sizes

3. Definitions. Not applicable.

4. Requirements

*4.1 Rigid printed wiring and printed wiring boards. Rigid printed wiring and printed wiring boards for single-sided, double-sided, and multilayer printed wiring shall conform to MIL-STD-1861. The materials used for single-sided, double-sided, and multilayer printed wiring boards shall conform to MIL-STD-1861.

*4.2 Rigid printed wiring assemblies. Rigid printed wiring assemblies consisting of rigid printed wiring boards on which separately manufactured parts have been added shall conform to MIL-STD-1861. For Army missile weapon systems, MIL-P-46843 shall apply only for replacement purposes.

*4.3 Conformal coating. When conformal coating is required, rigid printing wiring assemblies shall be conformally coated with a coating material which conforms to MIL-STD-1861.

*4.4 Flexible and rigidflex wiring. Flexible and rigid flex printed wiring shall conform to MIL-STD-1861 and shall be designed in accordance with MIL-STD-1861.

*4.5 Discrete wiring boards. Discrete wiring boards with plated-through holes shall be in accordance with MIL-STD-1861. Discrete wiring boards shall not be used for space applications.

*4.6 Backplane assemblies, printed wiring. Electrical backplane printed wiring assemblies shall conform to MIL-STD-1861 and shall be designed in accordance with MIL-STD-1861.

5. Information for guidance only.

*5.1 Printed wiring board size. Guidelines for the selection of printed wiring board sizes are delineated in ANSI/IPC-D-322.

REQUIREMENT 30

SEMICONDUCTOR DEVICES

1. Purpose. This requirement establishes criteria for the selection and application of semiconductor devices.

2. Documents Applicable to Requirement 30.

MIL-S-19500	Semiconductor Devices, General Specification for
MIL-STD-701	Lists of Standard Semiconductor Devices
MIL-STD-750	Test Methods for Semiconductor Devices
MIL-STD-1547	Parts, Materials, and Processes for Space and Launch Vehicles, Technical Requirements for

3. Definitions. Not applicable.

4. Requirements.

4.1 Selection and application. Semiconductor devices shall be selected and applied in accordance with MIL-STD-701 and, for Space Division, AFSC (SD), MIL-STD-1547.

4.1.1 Reliability. Discrete semiconductor devices in military systems during full scale development and production shall, as a minimum, conform to MIL-S-19500, product assurance JANTX level. JANS level shall be used for space applications.

4.1.2 Order of Precedence. Unless otherwise specified, the order of precedence shall be as follows:

4.1.2.1 For Packaged Devices:

a. MIL-S-19500 - Qualified semiconductors listed in MIL-STD-701.

b. Other MIL-S-19500 - Other qualified semiconductors subject to procuring activity approvals.

c. Active DESC drawings subject to procuring activity approval.

d. Other semiconductor documents (see 4.1.3) subject to procuring activity approval. All devices shall be screened and tested in accordance with 4.1.3.4.

4.1.2.2 For Dice:

a. MIL-S-19500 JAN C program (See paragraph 1.2.1.2, Appendix H, and detailed specifications).

b. Other semiconductor documents subject to procuring activity approval.

4.1.3 Qualified Devices. When the contract for a design specifies the use of TX equivalent quality level or higher or DESC drawings, and there is a JANTX, JANTXV, or JANS device available, the qualified JANTX, JANTXV, or JANS semiconductor shall be the only device authorized for use

4.1.3.1 JANS Level. JANS level devices shall be used in space flight, and critical applications for Space Division, AFSC (SD). When JANS level parts, in accordance with MIL-S-19500, are not available or cannot be qualified by the manufacturer, the requirements of MIL-STD-1547 shall apply in accordance with procuring activity direction.

4.1.3.2 JANTX, JANTXV, and JANS Levels. JANTX, JANTXV, or JANS level devices shall be used in Army Missile Command, Army Laboratory Command, Naval Air Systems Command and Air Force applications other than SD space, launch, and reentry equipment. When a qualified JANTX, JANTXV device does not exist and an active DESC drawing device of the required generic chip and package type or case outline does exist, the DESC drawing device shall be the preferred device authorized for that design.

4.1.3.3 JAN Level. JAN level is no longer authorized for new designs. When JAN level does not exist or is not available (for old design), the appropriate substitutions shall be JANTX, JANTXV, or JANS when available. When JANTX requirements of table II and be tested in accordance with requirements of table III (group A) and table IV (group B) of MIL-S-19500.

4.1.3.4 Other Semiconductors. When MIL-S-19500 qualified devices are not available, other semiconductors may be used subject to procuring activity approval. All devices shall be screened and tested as in 4.1.3.3 above.

4.2 Sealing. All semiconductor devices used in equipment shall be hermetically sealed in glass, metal, metal oxide, ceramic, or a combination of these. Use of plastic (organic or polymeric) encapsulated or sealed devices requires the approval of the procuring activity.

5. Information for guidance only. Semiconductor devices are susceptible to electrostatic discharge damage. Appropriate discharge procedures should be observed prior to handling these parts, and design selections of desired devices should include a consideration of the effectiveness of the input or other protective elements included in the device design.

REQUIREMENT 35

RELIABILITY

1. Purpose. This requirement offers guidance as to reliability requirements which must be considered when preparing contractual documents. IT DOES NOT ESTABLISH REQUIREMENTS, AND MUST NOT BE REFERENCED IN CONTRACTUAL DOCUMENTS. Reliability program tasks, quantitative requirements, and verification or demonstration requirements must be directly specified in the contract or the system/equipment specification, as appropriate.

2. Documents applicable to Requirement 35.

MIL-STD-721	Definitions of Terms for Reliability and Maintainability
MIL-STD-756	Reliability Modeling and Prediction
MIL-STD-781	Reliability Design Qualification and Product Acceptance Tests: Exponential Distribution
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-1629	Procedures for Performing a Failure Mode, Effects and Criticality Analysis
MIL-HDBK-217	Reliability Prediction of Electronic Equipment

3. Definitions. Not applicable.

4. Requirements. Not applicable.

5. Information for guidance only.

5.1 Reliability program. Reliability engineering and accounting tasks aimed at preventing, detecting, and correcting reliability design deficiencies, weak parts, and workmanship defects and providing reliability related information essential to acquisition, operation, and support management should be included in contract requirements with the objective of establishing and maintaining an efficient reliability program according to life cycle phase. MIL-STD-785 is the overall program document for the area. It is sectionalized into individual task statements and requires extensive tailoring when it is applied. Detailed application guidance as to the nature of the tasks and when they should be imposed is provided. Other reliability documents which may be invoked through MIL-STD-785 or which may be cited directly as a basis for contract requirements include MIL-STD-721, MIL-STD-756, MIL-STD-781, MIL-STD-1629, and MIL-HDBK-217.

5.2 Quantitative requirements. Quantitative reliability requirements and verification or demonstration requirements should be established appropriate to program phase.

REQUIREMENT 44

FIBROUS MATERIALS, ORGANIC

1. Purpose. This requirement establishes criteria for the selection and application of organic fibrous materials.

2. Documents applicable to Requirement 44:

V-T-276	Thread, Cotton
V-T-285	Thread, Polyester
V-T-291	Thread, Linen
V-T-295	Thread, Nylon
CCC-C-428	Cloth, Duck, Cotton; Fire, Water, Weather, and Mildew Resistant
MIL-W-530	Webbing, Textile, Cotton, General Purpose, Natural or in Colors
MIL-C-572	Cords, Yarns, and Monofilaments, Organic Synthetic Fiber
MIL-T-3530	Thread and Twine, Mildew Resistant or Water Repellant Treated
MIL-W-4088	Webbings, Textile, Woven Nylon
MIL-C-9074	Cloth, Laminated, Sateen, Rubberized
MIL-W-27265	Webbing, Textile, Woven Nylon, Impregnated
29 CFR 1910	Code of Federal Regulations, Title 29, Chapter XVII, Part 1910

3. Definitions. Not applicable.

4. Requirements

4.1 Webbing

*4.1.1 Cotton. Cotton webbing shall conform to MIL-W-530, class 4 or 7. Class 7 shall be used when webbing will come in contact with natural or synthetic rubber or class 4 when prolonged contact with the skin may occur.

4.1.2 Nylon. Nylon webbing shall conform to MIL-W-4088 or class R of MIL-W-27265.

4.2 Cotton duck. Cotton duck used for protective enclosures shall conform to type I or type II of CCC-C-428. Medium texture number 4 shall be used for heavy duty service and hard texture number 12 shall be used for services requiring light weight.

4.3 Thread. Thread shall conform to V-T-276, V-T-285, V-T-291, or V-T-295.

4.3.1 Treatment. Cotton and linen thread shall be treated in accordance with MIL-T-3530. Type I, class 2 mildew inhibiting agent shall be used when thread will come in contact with natural or synthetic rubber or type I, class 1 when prolong contact with the skin may occur.

4.4 Sateen. Laminated, two-ply rubberized cotton sateen shall conform to MIL-C-9074. This sateen shall not be used when prolonged contact with the skin
may occur.

4.5 Cords, yarn, and monofilaments. Cords, yarns, and monofilaments shall conform to MIL-C-572. Types PVCA, AR, VCR, and CTA shall not be used where they may be exposed to fungus attack.

5. Information for guidance only

5.1 Shrinkage. Fabric and thread should be preshrunk or allowance should be made for shrinkage in order to provide for satisfactory fit of finished items both before and after they are immersed in water and then dried.

5.2 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with 29 CFR 1910. Consideration of the toxicity of a substance should be given prior to material selection.

REQUIREMENT 46

MOTORS AND ROTARY POWER CONVERTERS

1. Purpose. This requirement establishes criteria for the selection and application of motors and rotary power converters.

*2. Documents applicable to Requirement 46:

MIL-D-24	Dynamotors, General Specification for
MIL-G-3111	Generator, Electric, Direct Current (Naval Shipboard Use)
MIL-G-3124	Generator, Alternating Current, 60 Cycle (Naval Shipboard use) MIL-M-4820 Motor-Generator, Skid Mounted, Type MD-4
MIL-M-7969	Motor, Alternating Current, 400 Cycle, 115/200-Volt System, Aircraft, General Specification for
MIL-M-8609	Motors, Direct Current, 28 Volt System, Aircraft, General Specification for
MIL-F-9397	Frequency Converter, Mobile, Type MC-1A
MIL-M-13786	Motors, Fractional Horsepower, Direct Current and Universal (for Communication and Other Electronic and Special Military Applications)
MIL-M-13787	Motors, Alternating Current, Fractional Horsepower, Squirrel Cage (for Communication and Other Electronic and Special Military Applications)
MIL-M-17059	Motor, 60 Cycle, Alternating Current, Fractional Horsepower (Shipboard Use)
MIL-M-17060	Motors, 60 Hertz, Alternating Current, Integral Horsepower (Shipboard Use)
MIL-M-17413	Motors, Direct Current, Integral Horsepower, Naval Shipboard
MIL-M-17556	Motor, Direct Current, Fractional Horsepower, (Shipboard Use)
MIL-M-19160	Motor-Generator, 60 Hertz AC to 400 Hertz AC, Shipboard Service
MIL-M-19167	Motor-Generator, AC to DC, Shipboard Service
MIL-M-19283	Motor-Generator, DC to DC, Shipboard Service
MIL-M-19633	Motor-Generator, 60 Cycle AC to 400 Cycle AC (Voltage and Frequency Regulated) Shipboard Service
MIL-B-23071	Blowers, Miniature, for Cooling Electronic Equipment, General Specification for

3. Definitions. Not applicable.

4. Requirements

4.1 Motors - alternating current. Alternating current motors shall conform to MIL-M-7969, MIL-M-13787, MIL-M-17059 or MIL-M-17060, except that any motor used with a miniature blower for cooling electronic equipment shall be in accordance with MIL-B-23071.

4.2 Motors - direct current. Direct current motors shall conform to MIL-M-8609, MIL-M-13786, MIL-M-17413 or MIL-M-17556.

*4.3 Motor-generators. Motor-generators shall conform to one of the following:

MIL-M-4820	MIL-M-19167
MIL-M-9397	MIL-M-19283
MIL-M-19160	MIL-M-19633

4.4 Generators - alternating current. Alternating current generators shall conform to MIL-G-3124.

4.5 Generators - direct current. Direct current generators shall conform to MIL-G-3111.

4.6 Dynamotors. Dynamotors shall conform to MIL-D-24.

5. Information for guidance only. Not applicable.

REQUIREMENT 50

INDICATOR LIGHTS

1. Purpose. This requirement establishes criteria for selection and application of indicator lights and associated items.

*2. Documents applicable to Requirement 50:

MIL-L-3661	Lampholders, Indicator Lights, Indicator-Light Housings, and Indicator-Light Lenses, General Specification for
MIL-L-6363	Lamps, Incandescent, Aircraft Service, General Requirements for
MIL-L-7806	Light, Panel, Plastic Plate Lighting
MIL-L-7961	Lights, Indicators, Press to Test
MIL-L-15098	Lamp, Glow, General Specification for
MIL-S-19500	Semiconductor Devices, General Specification for
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities

3. Definitions. Not applicable.

4. Requirements

4.1 Lights and accessories. Indicator lights, indicator light housings, lampholders, lenses, and lamps shall be selected in accordance with table 50-I.

4.2 Visual display and legend lights. Visual display and legend lights shall comply with the requirements in MIL-STD-1472.

4.3 Light emitting diodes (LED's). LED's when used as indicator lights shall conform to the applicable detail specifications of MIL-S-19500.

5. Information for guidance only. Not applicable.

TABLE 50-I. Indicator lights and associated items.

	MIL-L-3661	MIL-L-7806	MIL-L-7961	MIL-L-6363	MIL-L-15098	MIL-S-19500
Indicator lights	X		X			X
Indicator light housings	X					
Lamp holders	X	X				
Lenses	X					
Incandescent lamps, general purpose				X		
Incandescent lamps, severe environment				X		
Neon lamps					X	
Flourescent lamps						

REQUIREMENT 76

FIBER OPTICS

1. Purpose. This requirement establishes the criteria for the selection, application and testing of fiber optic material, devices and accessories.

2. Documents applicable to Requirement 76:

MIL-STD-188-111	Subsystem Design and Engineering Standards for Common Long Haul and Tactical Fiber Optics Communications
MIL-STD-790	Product Assurance Program Requirements for Electronic and Fiber Optic Parts Specifications
DOD-STD-1678	Fiber Optic Test Methods and Instrumentation
DOD-STD-1863	Interface Designs and Dimensions for Fiber Optic Interconnection Devices
DOD-STD-1864	Fiber Optic Symbols
MIL-STD-2163	Insert Arrangements for MIL-C-28876 (Navy) Environment Resisting Fiber Optic Connectors
MIL-C-22520/10	Crimping Tool, Terminal, Hand
DOD-D-24620	Detector, PIN, Fiber Optic (Metric)
MIL-C-24621	Coupler, Passive, Fiber Optic, General Specification for (Metric)
DOD-S-24622	Sourses, LED, Fiber Optic (Metric)
MIL-S-24623	Splice, Fiber Optic Cable, General Specification for (Metric)
MIL-H-24626	Harness Assemblies, Cable, Pressure Proof, Fiber Optic
MIL-P-24627	Penetrators, Bulkhead, Connectorized, Fiber Optic (for Inboard Use on Navy Ships and Submarines)
MIL-P-24628	Penetrators, Hull, Connectorized, Connectors, Pressure Proof, Fiber Optic, Submarine
MIL-S-24725	Switches, Fiber Optic, Shipboard, Electrical Nonlatching, Bypass, Multimode Cable, Standalone (Metric)
MIL-A-24726	Attenuators, Fiber Optic, Shipboard, General Specification for

MIL-R-24727	Rotary Joints, Fiber Optic, Shipboard (Metric), General Specification for
MIL-I-24728	Interconnection Box, Fiber Optic, Metric, General Specification for
MIL-M-24731	Multiplexers, Demultiplexers, Multiplexers, Demultiplexers (Muldems), Frequency Division, Fiber Optic, Interfaceable, Shipboard (Metric), General Specification for
MIL-L-24732	Light Sources, Rigid and Flexible, Fiberscope, Fiber Optic (Metric), General Specification for
MIL-C-24733	Controllers, Interface Unit, Fiber Optic (Metric), General Specification for
MIL-F-24734	Fiberscope, Fiber Optic (Metric), General Specification for
MIL-T-24735	Transmitters, Light Signal, Analog, Fiber Optic (Metric), General Specification for
MIL-M-24736	Multiplexers, Demultiplexers, Multiplexers, Demultiplexers (Muldems), Time Division, Fiber Optic, Interfaceable, Shipboard (Metric), General Specification for
MIL-R-24737	Receivers, Light Signal, Analog, Fiber Optic, Shipboard (Metric), General Specification for
MIL-C-28876	Connectors, Fiber Optic, Environment Resisting (for Navy Shipboard Applications)
MIL-T-29504	Termini, Fiber Optic Connector, Removable
MIL-F-49291	Fiber, Optical, General Specification for
MIL-C-49292	Cable Assembly, Nonpressurized, General Specification for
MIL-I-81969	Installing and Removal Tools, Electrical Contact, General Specification for
MIL-C-83522	Connectors, Fiber Optic, Single Terminus, General Specification for
MIL-T-83523	Tools, Fiber Optic, General Specification for
MIL-M-83524	Microscope, Optical, for Field Inspection of Optical Fibers

MIL-K-83525	Kit, Portable Optical Microscope, Militarized, 200X Magnification for Field Inspection of Optical Fibers
MIL-C-83526	Connector, Fiber Optic, Circular, Environment Resisting, Hermaphroditic, General Specification for
MIL-C-83532	Connectors, Fiber Optic
MIL-M-83533	Maintenance Kit, Fiber Optic Components, General Specifiction for
DOD-C-85045	Cable, Fiber Optic, Environment Resisting (for Navy Shipboard Application), General Specification for
MIL-HDBK-277	Fiber Optic Checkout Procedure for Military Applications
MIL-HDBK-278	System Design Guide for Applying Fiber Optic Technology to Shipboard Systems
MIL-HDBK-282	Fiber Optic Cable Installation Procedures
MIL-HDBK-415	Design Handbook for Fiber Optic Communications Systems
IEC-693-80	Optical Fibers, Dimensions of
IEEE-STD-812-84	IEEE Standard Definitions of Terms Relating to Fiber Optics

3. Definitions.

3.1 Definitions of terminology used in fiber optics technology shall be as contained in IEEE-STD-812.

4. Requirements

4.1 Symbology. Graphic symbols for fiber optic parts for use on engineering drawings, specifications, etc, shall be as contained in DOD-STD-1864.

4.2 Dimensions. Dimensions for optical fibers shall be as specified in IEC-693-80 and MIL-F-49291.

4.3 Interface designs and dimensions. Standard interface designs, dimensions and termination types for use in fiber optic connectors and couplers shall be as specified in DOD-STD-1863.

4.4 System and subsystem design. Fiber optic system and subsystem designs shall be in accordance with the criteria specified in MIL-STD-188-111 (see 5.1 also).

4.5 Test procedures. Standardized test procedures for fiber optic components shall be as specified in DOD-STD-1678.

4.6 Light sources.

4.6.1 Light emitting diodes (LEDs). Fiber optic LED sources shall conform to the requirements of DOD-S-24622.

4.6.2 Fiberscope light sources. Fiber optic light sources for rigid and flexibie fiberscopes shall conform to the requirements of MIL-L-24732.

4.7 Splices. Fiber optic splices shall conform to the requirements of MIL-S-24623.

4.8 Cables. Fiber optic cables shall conform to the requirements of DOD-C-85045.

4.9 Cable assemblies. Cable assemblies shall conform to the requirements of MIL-C-49292.

4.10 Harness assemblies. Fiber optic harness assemblies shall conform to the requirements of MIL-H-24626.

4.11 Connectors. Fiber optic connectors shall conform to the requirements of MIL-C-28876, MIL-C-83522, MIL-C-83526 or MIL-C-83532. Insert arrangements for MIL-C-28876 connectors shall conform to MIL-STD-2163. Removable terminals for fiber optic connectors shall conform to MIL-T-29504.

4.12 Penetrators. Fiber optic penetrators (hull or bulkhead) shall conform to the requirements of MIL-P-24627 or MIL-P-24628.

4.13 Detectors. Fiber optic detectors shall conform to the requirements of DOD-D-24620.

4.14 Couplers. Fiber optic couplers shall conform to the requirements of MIL-C-24621.

4.15 Rotary joints. Fiber optic rotary joints shall conform to the requirements of MIL-R-24727.

4.16 Interconnection boxes. Fiber optic interconnection boxes shall conform to the requirements of MIL-I-24728.

4.17 Multiplexers and demultiplexers.

4.17.1 Frequency division. Fiber optic frequency division multiplexers and demultiplexers shall conform to the requirements of MIL-M-24731.

4.17.2 Time division. Fiber optic time division multiplexers and demultiplexers shall conform to the requirements of MIL-M-24736.

4.18 Controllers, interface unit. Fiber optic controllers shall conform to the requirements of MIL-C-24733.

4.19 Fiberscopes. Fiber optic fiberscopes shall conform to the requirements of MIL-F-24734.

4.20 Transmitters, analog. Fiber optic analog transmitters shall conform to the requirements of MIL-T-24735.

4.21 Receivers, analog. Fiber optic analog receivers shall conform to the requirements of MIL-R-24737.

4.22 Attenuators. Fiber optic attenuators shall conform to the requirements of MIL-A-24726.

4.23 Switches. Fiber optic switches shall conform to the requirements of MIL-S-24725.

4.24 Tools and inspection equipment. Fiber optic tools, inspection equipment, and related kits shall conform to the requirements of MIL-I-81969, MIL-T-83523, MIL-M-83524, MIL-K-83525, MIL-M-83533 and MIL-C-22520/10.

5. Information for guidance only.

5.1 Design guides. Fiber optic system design guide information is available in MIL-HDBK-415 and MIL-HDBK-278.

5.2 Installation and checkout procedures. Guidance for installation and checkout procedures is contained in MIL-HDBK-277 and MIL-HDBK-282.

5.3 Product assurance program. When a requirement exists for the implementation of a fiber optic product assurance program, refer to MIL-STD-790.

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