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MILITARY HANDBOOK

ELECTRONIC EQUIPMENT, AIRBORNE GENERAL GUIDELINES FOR

THIS HANDBOOK IS FOR GUIDANCE ONLY. DO NOT CITE THIS DOCUMENT AS A REQUIREMENT.

AMSC N/A AREA GDRQ

FOREWORD

1. This military handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Systems Standardization, Code 4.1.4.2B120-3, Naval Air Warfare Center Aircraft Division, Highway 547, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. This handbook provides guidance for implementing and tailoring guidelines and documents contained in MIL-HDBK-454 Standard General Guidelines for Electronic Equipment, which have applicability in the design and production of electronic equipment for airborne applications. Included in this handbook are references to the applicable requirements, an index of applicable documents, and a guide for tailoring and application of those requirements and documents in conjunction with the various equipment design, development and production phases.

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1. SCOPE

1.1 Scope. This handbook contains general guidelines for electronic equipment for operation in piloted aircraft and helicopters, missiles, boosters and allied vehicles. Detail electrical and mechanical design, performance and test requirements should be as specified in the detail specification or contract. This handbook is for guidance only. This handbook cannot be cited as a requirement. If it is, the contractor does not have to comply.

1.1.1 Application. This handbook should not be invoked on a blanket basis; however, each guideline should be assessed in terms of need. This handbook is a compendium of general guidelines, the majority of which have been selected from MIL-HDBK-454, for specific applicability to airborne electronic equipment. Individual detail specifications or contract should invoke only those requirements which are applicable and necessary to that specific equipment.

1.1.2 Tailoring. A tailoring guide, Appendix B, is included to assist the acquisition activity and the contractor in applying MIL-HDBK-5400 guidelines to the various phases of equipment design, development and production.

1.2 Classification. Suggested classification for design and manufacture of electronic equipment is as follows (see 6.2).

Class 1 - Equipment designed for 15.20 km (50,000 feet) altitude and continuous sea level operation over the temperature range of -54° to +55°C (+71°C intermittent operation).

Class 1A- Equipment designed for 9.12 km (30,000 feet) altitude and continuous sea level operation over the temperature range of -54° to +55°C (+71°C intermittent operation).

Class 1B- Equipment designed for 4.56 km (15,000 feet) altitude and continuous sea level operation over the temperature range of -40° to +55°C (+71°C intermittent operation).

Class 2 - Equipment designed for 21.28 km (70,000 feet) altitude and continuous sea level operation over the temperature range of -54° to +71°C (+95°C intermittent operation).

Class 3 - Equipment designed for 30.40 km (100,000 feet) altitude and continuous sea level operation over the temperature range of -54° to +95°C (+125°C intermittent operation).

Class 4 - Equipment designed for 30.40 km (100,000 feet) altitude and continuous sea level operation over the temperature range of -54° to +125°C (+150°C intermittent operation).

Class 5 - Equipment designed for altitudes greater than 30.40 km (100,000 feet) for periods of time not exceeding 6 hours and continuous sea level operation over the temperature range of -54° to +95°C (+125°C intermittent operation).

1.2.1 External cooling. The addition of the letter "X" after the class number, e.g., (Class 2X), will identify the equipment as operating in the ambient environment of that class, but requiring cooling from a source external of the equipment.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in Appendix A are not necessarily all of the documents referenced in this handbook but are the ones that are needed to fully understand the information provided by this handbook.

2.2 Applicable issues. Unless otherwise specified, the applicable issues of documents listed in Appendix A are those listed in the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation. The applicable issue of nongovernment documents not listed in the DODISS should be the issue specified in the solicitation.

2.3 Copies. Copies of specifications, standards, handbooks, drawings and publications required by contractors in connection with specific acquisition functions should be obtained from the acquisition activity or as directed by the contracting officer.

3. DEFINITIONS

3.1 Accessory. An accessory is an assembly of a group of parts or a unit which is not always required for the operation of a set or unit as originally designed but serves to extend the functions or capabilities of the set, such as headphones for a radio set supplied with a loudspeaker, a vibratory power unit for use with a set having a built-in power supply, or a remote control unit for use with a set having integral controls.

3.2 Acquisition activity. The military or federal agency contracting for equipment.

3.3 Airborne. For purposes of this handbook, the term "airborne" combines applications of electronic equipment within aircraft, helicopters, missiles, boosters and allied vehicles as defined and limited by the classifications and guidelines contained herein.

3.4 Complete operating equipment. Complete operating equipment is defined as equipment, together with the necessary detail parts, accessories and components, or any combination thereof, required for the performance of a specified operational function. Certain equipments may be complete within

themselves and not require the addition of detail parts, accessories or components to perform a specified operational function.

3.5 Detail specification. For purposes of this handbook, the term "detail specification" is defined as the document which describes and controls the detail features of a specific equipment for acquisition by the Government. These details include, but are not limited to, such features as mechanical and electrical design parameters, quality and reliability requirements, performance and environmental requirements. The detail specification may be prepared by the Government, the equipment manufacturer for the Government, or the prime vehicle contractor. The preparing activity of the detail specification should utilize the applicable guidance contained in this handbook in the preparation of that specification.

3.6 Electronics. The term "electronics" is defined as a system or equipment, the primary purpose of which is the transmission or reception of intelligence. This includes or comprises communications or signal equipment, radio, radar, radiation, radio-controlling devices, meteorological, fire control, bombing, flight and navigational instruments, powerplant controls, synchronizers, photographic and test equipment, when such portions employ circuits which utilize a combination of electrical or electronic devices to generate, control, indicate or record any form of alternating or direct currents, or both.

3.7 Equipment. Equipment is a general term characterizing the broad category of electronic items (units, subsystems, systems, etc.).

3.8 Hermetic sealing. Hermetic sealing is the process by which an item is totally enclosed by a suitable metal structure or case by fusion of metallic or ceramic materials. This includes the fusion of metals by welding, brazing or soldering; the fusion of ceramic materials under heat or pressure; and the fusion of ceramic materials into a metallic support.

3.9 Installation (complete equipment). An installation (complete equipment) is defined as a combination of assemblies, accessories and detail parts required to make one complete operating equipment. An installation comprises a group of permanently installed parts and a group of removable assemblies.

3.10 Intermittent and short-time operation. Intermittent and short-time operations are the alternating periods of operation for the specified time after which the equipment should be required to remain operational following the high temperature transient.

3.11 Other component definitions. For definitions of part, subassembly, assembly, unit, set, system and models, MIL-STD-280 will apply.

3.12 Performance requirements of the equipment. Wherever referenced in this document, the "performance requirements of the equipment" is to be understood to mean the satisfactory performance of all electrical and mechanical characteristics performed under the "condition," "destructive," and "accelerated life" tests described in the detail specification for the purpose of simulating anticipated field service demands as closely as possible.

3.13 Permanently installed part. A permanently installed part is defined as a detail part or assembly which is permanently installed as a part of the vehicle. Examples: Rigid or whip antenna, bracket, cable assembly, fairlead, mounting and plug.

3.14 Removable assembly. A removable assembly is defined as an assembly which is easily removable from the vehicle. Examples: Dynamotor unit, indicator unit, radio receiver and radio transmitter.

3.15 Reordered production equipment. Reordered production equipment is equipment acquired on each contract after the original Category III contract for the equipment, regardless of the contractor, e.g., if contractor "X" is granted the original production, then the equipment acquired on a second or subsequent contract is considered reordered production equipment, whether it is acquired from contractor "X" or a new contractor.

4. GENERAL GUIDELINES

4.1 This section contains general guidelines for common application to all airborne electronic equipment design and construction. Also included in this section are requirements for the design selection and application of parts, materials and processes, selected primarily from MIL-HDBK-454 as applicable to airborne electronic equipment.

4.1.1 Tailoring of MIL-HDBK-454 guidelines. The guidelines of MIL-HDBK-454 have been tailored for inclusion in this handbook, and those documents applicable to airborne electronic equipment extracted and specified herein. Appendix A of this document lists those documents extracted from MIL-HDBK-454 determined to be suitable for airborne electronic equipment applications. The extent of applicability of any individual MIL-HDBK-454 guideline is limited to only those documents extracted and listed in Appendix A. Where reference is made to a complete MIL-HDBK-454 guideline, all documents listed in that guideline are considered applicable unless otherwise supplemented or restricted herein or in MIL-HDBK-454.

4.1.2 Standard hardware acquisition and reliability program (SHARP). This handbook is intended primarily for use in the design of militarized developmental electronic equipment for airborne applications. However, the use of militarized non-developmental items (NDI), standardized under SHARP for airborne electronics, should be utilized to the maximum extent possible.

SHARP developed hardware includes standard electronic modules (SEMs), standard enclosure systems (SES), standard power supply systems (SPS), and standard battery systems (SBS). SEMs should be implemented in accordance with MIL-STD-1378, SES in accordance with MIL-STD-2200, and SPS in accordance with MIL-STD-2038. Non-use of SHARP requires approval of the acquisition activity.

4.1.3 Requirements, tables and figures. Tables I through IV contain reference to subject matter cross-referenced to the applicable MIL-HDBK-454 guideline or MIL-HDBK-5400 paragraph number. Table V provides a cross-reference of temperature and altitude ranges to the applicable class of equipment for tests under operating and nonoperating conditions. Figures 1 through 4 provide operational (temperature vs altitude) requirements for the various classes of equipment.

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4.2 Design and construction.

4.2.1 Table I lists general subject areas for consideration in the design and construction of airborne electronic equipment.

4.2.2 Accessibility. Guidance for accessibility to parts, wiring and terminations within equipment is contained in MIL-HDBK-454, Guideline 36.

4.2.3 Anti-jamming. The electronic system or equipment should be designed to obtain the maximum inherent protection against possible interfering signals caused by enemy jamming. The contractor should solicit and obtain the approval of the acquisition activity for the basic anti-jamming concepts before proceeding with the design of the models.

Table I. General design and construction.

Subject	MIL-HDBK-5400 Paragraph	MIL-HDBK-454 Guideline
Accessibility	4.2.2	36
Anti-Jamming	4.2.3	--
Castings	4.2.4	21
Corona	4.2.5	45
Derating	4.2.6	18
Electrical overload protection	4.2.7	8
Electrical power	4.2.8	25
Electromagnetic interference control	4.2.9	61
Electrostatic discharge control	4.2.10	75
Enclosures	4.2.11	55
Fabrication	4.2.12	--
Grounding, bonding & shielding	4.2.13	74
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Maintainability	4.2.16	54
Marking	4.2.17	67
Microphonics	4.2.18	--
Moisture pockets	4.2.19	31
Multiplexing	4.2.20	--
Nomenclature	4.2.21	34
Orientation	4.2.22	--
Panels	4.2.23	--
Pressurization	4.2.24	--
Reliability	4.2.25	35
Repairability	4.2.26	--
Safety	4.2.27	1
Test provisions	4.2.28	32
Testability program	4.2.29	32
Thermal design	4.2.30	52
Tools	4.2.31	63
Standard power supplies	4.2.32	--
Workmanship	4.2.33	9

4.2.4 Castings, metal. Metal castings should be designed, classified, inspected and repaired in accordance with MIL-STD-2175. Porous nonferrous castings should be impregnated in accordance with MIL-STD-276. Refer to MIL-HDBK-454, Guideline 21 for guidance in the choice of casting process and repairs to castings.

4.2.5 Corona and electrical breakdown prevention. Equipment should be protected against corona and electrical breakdown. Guidance regarding corona and electrical breakdown is given in MIL-HDBK-454, Guideline 45.

4.2.6 Derating. Guidance for derating of electronic parts and materials should be in given in MIL-HDBK-454, Guideline 18. In addition, derating should be accomplished based upon cooling conditions (either ambient or forced air) applied to the equipment when installed in the vehicle.

4.2.7 Electrical overload protection. Current overload protection for the equipment should be provided by fuses or circuit breakers. Circuit breakers should not be used as switches unless such breakers have been specifically designed and tested for that type service. Protective devices employed in the equipment should be in a readily accessible, safe location.

4.2.7.1 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.

4.2.7.2 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 should be incorporated in the equipment and should be contained in the same compartment.

4.2.8 Electrical power. The equipment should be designed to operate from power sources in accordance with MIL-STD-704.

4.2.8.1 Warm-up time. Warm-up time should be such as to provide the specified performance within a period as specified by the detail specification. Unless otherwise specified, the warm-up time at temperatures down to -54°C should not exceed 2 minutes for equipment essential to flight safety, and should not exceed 5 minutes for equipment not essential to flight safety.

4.2.8.2 Electronic equipment which will require shipboard alternating current (ac) power to be supplied for purposes of test or aircraft servicing should have electrical interface characteristics compatible with the applicable power system classification of MIL-STD-1399, Section 300.

4.2.9 Electromagnetic interference control. Guidance regarding electromagnetic interference control requirements, tests and test methods is given in MIL-HDBK-454, Guideline 61.

4.2.10 Electrostatic discharge control. Requirements for the establishment and implementation of an electrostatic discharge control program, including its deliverable data requirements, should be tailored for applicability to equipment and specified directly in the contract or detail specification. MIL-HDBK-263 provides guidance for the implementation of an ESD control program. Also, refer to MIL-HDBK-454, Guideline 75, for additional guidance in this area.

4.2.11 Enclosures.

4.2.11.1 Standardized avionics enclosures. As an integral part of the SHARP program (see 4.1.2), the selection of standardized enclosure systems should be as specified in MIL-STD-2200. Enclosures conforming to MIL-E-85726 and racks conforming to MIL-R-85725 are examples of standardized hardware which are available for use as conforming to the requirements of MIL-STD-2200.

4.2.11.2 Other enclosures. Guidance for the design and construction of other equipment enclosures (e.g., consoles, cabinets, cases), is given in MIL-HDBK-454, Guideline 55, except that performance for mounting bases should be met at the same vibration test frequencies and energy density levels as required for the specific equipment. Mounts and vibration isolators, whether integral or not, should be subject to approval of the acquisition activity. Positive self-locking case mounting fasteners should be used on all mountings. The fasteners chosen should be of a size specified for the weight of the equipment unit.

4.2.12 Fabrication. Boxes, cases, shields and compartment walls should be made by casting, drawing or bending, and welding, brazing or adhesive bonding except when ease of servicing of the equipment requires that a removable panel construction be used. When the applied stresses dictate the use of a strong aluminum alloy which does not provide a good weld or braze, riveting or bolting may be used.

4.2.13 Grounding, bonding and shielding. Grounding, bonding and shielding interface and installation requirements should be in accordance with MIL-B-5087. MIL-HDBK-274 provides guidance information relative to grounding practices for aircraft. Refer to MIL-HDBK-454, Guideline 74, for guidance covering Air Force applications.

4.2.14 Human engineering. Requirements for human engineering should be provided and tailored for applicability to the equipment and specified directly in the contract or detail specification. MIL-STD-1472 provides design criteria which may be selectively applied. Refer to MIL-HDBK-454, Guideline 62, for guidance covering Air Force applications.

4.2.15 Interchangeability. Provisions should be taken to assure for the interchangeability of parts, subassemblies, and assemblies. Information regarding interchangeability is contained in MIL-HDBK-454, Guideline 7.

4.2.15.1 Interchangeability of reordered equipment. For reordered equipment, interchangeability should exist between units and all replaceable assemblies, subassemblies and parts of a designated model of any previously manufactured equipment supplied or designated by the acquisition activity.

4.2.16 Maintainability. Requirements for the establishment of a maintainability program (maintainability program tasks, quantitative requirements, and verification or demonstration requirements) tailored for applicability to the equipment and program phase, should be specified directly in the contract or detail equipment specification. Other maintainability requirements which may be invoked and cited directly as a basis for contract are contained in MIL-STD-471. MIL-HDBK-472 gives guidance regarding maintainability programs for electronic equipment.

4.2.17 Marking. Guidance for the marking of items is given in MIL-HDBK-454, Guideline 67. Marking should not adversely affect the leakage path between conductors or any other factor of equipment performance.

4.2.17.1 Labels. Labels showing wiring and schematic diagrams of parts, lubricating and operating instructions, safety notices, list of tools, list of contents and similar information should be provided where space permits. Labels should be designed to remain legible and affixed for the service life of the equipment on which they are mounted.

4.2.17.2 Wire coding for identification. Hookup wires in the equipment should be distinctly coded by color or numbers, insofar as practicable. Codes should be in accordance with MIL-STD-681, unless otherwise specified. Short hookup wire, 150mm or less in length between termination points, need not be marked if the path of the wire can be easily and visually traced. Numbers should not be used where they would be difficult to read or trace. Flat cable conductors may be identified to termination points. The outer conductor of a flat multiconductor cable should be coded continuously for identification and orientation. Hot or cold stamp should be allowed only on insulated wire which will not accept ink. Marking should not be used on wires where the dielectric capability of the wire is reduced by such marking. Wire used for external wiring between units should be coded in accordance with MIL-W-5088.

4.2.17.3 Operational program marking. Operationally programmed units should provide a means to identify the software part number and the revision of the software program. Guidance is provided by MIL-HDBK-454, Guideline 67.

4.2.18 Microphonics. Equipment should be designed so that microphonics are not detrimental to equipment performance.

4.2.19 Moisture pockets. Guidance for the treatment and drainage of moisture pockets is given in MIL-HDBK-454, Guideline 31.

4.2.20 Multiplexing. Unless otherwise specified, multiplexing should be used to transmit bilevel signals for logic functions for ON-OFF, interlocking and proportional control of utilization equipments and components. The multiplex data bus system should be in accordance with MIL-STD-1553. MIL-HDBK-1553 provides guidance information for implementation of MIL-STD-1553.

4.2.21 Nomenclature assignment. Nomenclature assignment should be in accordance with MIL-STD-196, along with MIL-N-18307 for the Navy, MIL-STD-1812 for the Air Force, and the contract for the Army.

4.2.22 Orientation. Normal installation position or range of positions should be as specified in the detail specification. The equipment should operate within specified limits in any position specified in the detail specification.

4.2.23 Panels.

4.2.23.1 Control panels. Console and rack mounted control panels should conform to MIL-C-6781 and MIL-C-81774. Control panels should be integrally illuminated and conform to the requirements of MIL-P-7788.

4.2.23.2 Electroluminescent panels. The use of electroluminescent panels requires approval of the acquisition activity.

4.2.23.3 Ranges of adjustable parts. The electronic circuitry should be designed to provide a reserve in the adjustment range from the normal adjustment setting of all variable parts that require adjustment during operation or maintenance. This adjustment range should be sufficient to compensate for composite variations which may develop in the associated circuitry because of normal changes in part values during the specified life cycle of the equipment. The adjustment range should also be capable of compensating for variations resulting from replacement with parts within the tolerances specified.

4.2.24 Pressurization. Whenever pressurization of the electronic equipment is required, or is utilized to meet specification requirements, the following provisions should be met:

a. The case should withstand a positive or negative 5 psi pressure difference over the applicable pressure range.

b. The case should be of a type that will permit ready opening and clearing for access to the equipment for repair and maintenance. If practicable, the equipment should be completely operable after removal from the case, and alignment should be unaffected by replacement in the case.

c. When possible and advantageous, external points should be provided for check without removal from the case.

d. A means should be provided for determining the effectiveness of the seal. This may consist of an automobile-tire-type valve stem fitting to permit the use of an air pump for increasing the pressure approximately 5 psi above sea level pressure. A Schrader type 3715 gage, or equivalent should be used to measure the pressure.

e. Sealing instructions should be placed on one side of the case, if practicable.

f. Those parts of an equipment, including transmission lines, that are pressurized should be capable of withstanding any pressures developed under the required external operation conditions, after having been pressurized initially on the ground to not more than 5 psi gage at -20°C to +50°C, to such an extent that no arcing or loss of power caused by corona occurs that would not occur at atmospheric pressure on the ground. Nor should leakage be such as to permit the entrance of moisture or air to an extent that permanent damage or impaired operation occurs under any of the required operating conditions. Vacuum relief valves should be provided.

g. Unless specified or permitted in the detail specification, pressure should be maintained without the use or need of a pressurization pump. When a pressurization pump is required, redundant barostatic switches, or similar automatic means, should be provided to assure equipment is pressurized during flight, even though it is not being operated. The switch or automatic means should be energized from a common point and should be energized from a common point and should be energized as part of the take-off procedure.

h. The equipment should maintain pressure to accommodate the maximum operating time; in addition, and where applicable for captive and nonoperating flight, the equipment should maintain operating pressure for periods up to 24 hours. Unless otherwise determined as satisfactory, the loss of pressure should not exceed 5 pounds in a 24-hour period at the altitude and temperature specified in the detail specification.

i. If required, a desiccant should be provided within the case.

j. Parts used in pressurized container should meet the guidelines of this handbook, except that the altitude conditions may differ.

4.2.25 Reliability. Requirements for the establishment of a reliability program (reliability engineering and accounting tasks, quantitative requirements, and verification or demonstration requirements) tailored for

applicability to the equipment and program phase should be specified directly in the contract or detail specification. Other reliability requirements which may be invoked and cited directly as a basis for contract requirements are contained in MIL-STD-1629. MIL-HDBK-217 gives additional guidance regarding reliability programs for electronic equipment.

4.2.26 Repairability. Repairability should be determined in terms of warranties, mean time to repair (MTTR), stocking spare replacement parts and identifying procedures and personnel for the repair of the specified equipment. The detail equipment specification should specify the MTTR for militarized equipment, not to exceed thirty (30) minutes. Level of repair guidance is provided in MIL-STD-1390, and should be evaluated when making repairability and training decisions.

4.2.27 Safety.

4.2.27.1 System safety. Requirements for the development and implementation of a system safety program should be tailored for applicability to the equipment and acquisition phase and specified directly in the contract or detail specification.

4.2.27.2 Personnel safety. Guidance provisions for safety of personnel during installation, operation, maintenance and repair is provided in MIL-HDBK-454, Guideline 1.

4.2.28 Test provisions. Test provisions to provide means for monitoring performance, calibration and fault isolation should be directly specified in the detail specification or contract. Refer to MIL-HDBK-454, Guideline 32 for guidance in this area.

4.2.28.1 Built-in test devices. Built-in devices should maintain their accuracy under all operating conditions required by the equipment under test. These devices should be provided with connections or access for their operational checkout or calibration.

4.2.28.2 External test points. Protection should be provided in the test point circuitry to prevent equipment damage caused by the external grounding of test points.

4.2.28.3 Failure effect. Unless otherwise specified, provisions for testing should be so designed that any failure of built-in test devices will not degrade equipment operation or cause equipment shutdown.

4.2.29 Testability program. Requirements for the development and implementation of a testability program (program planning, design, prediction, demonstration, data, and review) should be tailored for applicability to the equipment and program phase, and specified directly in the contract or detail specification.

4.2.30 Thermal design. Guidance for thermal design is contained in MIL-HDBK-454, Guideline 52, and MIL-STD-2218.

4.2.30.1 Cooling design data. Cooling design data should be developed as soon as possible after major circuit parameters have been established. Initially, this data should include calculations, drawings and other information related to the choice of a particular cooling system configuration. As part of this initial data, the first set of applicable thermal design evaluation data should be developed, based on preliminary calculations at the specified operating conditions. The approval of the cooling system will be based upon consideration of this information. Applicable part temperatures from these calculations should be utilized in the reliability prediction analyses. As equipment development proceeds, this data should become more final and should be based on more actual thermal test results. Upon completion of the engineering development or preproduction models, and when required by the contract, a thermal evaluation test program should be conducted. Refer to MIL-STD-2218 for additional guidance in this area.

4.2.31 Tools.

4.2.31.1 Setscrew wrenches. One wrench for each size and type setscrew head employed for operational adjustments should be securely mounted within the equipment in a readily accessible location. Each wrench should be processed to resist corrosion.

4.2.31.2 Special tools. Special tools include jigs, fixtures, stands, and templates not listed in the Federal Supply Catalog, require approval of the acquiring activity for use. The design of equipment should be such that the need for special tools for tuning, adjustment, maintenance, replacement, and installation is kept to a minimum. Only when the required function cannot be provided by an existing standard tool should special tools be considered. Necessary tools should be identified as early as possible.

4.2.31.3 Furnishing and stowing. Special tools needed for operation and organization level maintenance should be furnished by the contractor except that the contractor should not mount tools in the equipment or make space provisions therefore, unless required by the detail specification or contract.

4.2.32 Standardized power supplies. As an integral part of the SHARP program (see 4.1.2), the selection of standardized power supplies for airborne applications should be as specified in MIL-STD-2038. Power supplies conforming to MIL-P-29590 should be of primary consideration for airborne applications.

4.2.33 Workmanship. Guidance for workmanship of mechanical assembly should be applied as given in MIL-HDBK-454, Guideline 9.

4.3 Parts selection.

4.3.1 Government-furnished baseline (GFB). When specified by contract or system specification, the applicable GFB should be the primary selection source for standard parts (see 4.3.3). The applicable GFB parts should meet the special part selection standard requirements referenced herein (e.g., 4.3.24 for MIL-STD-199 resistors). Table II provides identification of parts which are included in the applicable GFB. GFB parts, when specified by contract requirement, hold prior approval status. All parts listed in the applicable GFB are considered standard parts and should be used whenever suitable.

4.3.1.1 Choice of parts. Whenever the applicable selection standard, GFB or specification provides multiple characters or tolerances on items, the equipment manufacturers should consider the use of the broadest characteristics and greatest allowable tolerances to fulfill the overall requirement. The manufacturer should also consider limiting the variety of part types and review the system Program Parts Selection List (PPSL) for candidates prior to reaching a part decision. All new equipment should be designed to accommodate the maximum envelope dimensions specified in the military part specification.

4.3.2 Nonstandard parts. When the applicable GFB fails to provide the required part or Appendix A does not provide an applicable part standard or specification, the contractor should select a part from other established specifications or standards specified in the contract or by the design activity. Nonstandard parts must be equivalent to or better than similar standard parts and must be compliant with applicable contract requirements. Each vendor source for nonstandard parts documented by a source control drawing requires approval of the acquisition activity.

4.3.3 Parts control program. Requirements for the implementation of a contractor parts control program, including parts approval by the acquisition activity, should be directly specified in the detail specification or contract. Refer to MIL-HDBK-454, Guideline 22 and MIL-HDBK-402 for guidance in this area. A Military Parts Control Advisory Group (MPCAG) review in accordance with the requirements if MIL-STD-965 should be considered.

NOTE: The Parts Control Program requires the approval and listing of all parts in a PPSL unless the requirements have been otherwise tailored.

TABLE II. Parts selection.

Subject	MIL-HDBK-5400 Paragraph	MIL-HDBK-454 Guideline
Batteries	4.3.6	27
Bearings	4.3.7	6
Capacitors	4.3.8	2
Circuit breakers	4.3.9	37
Connectors, electrical	4.3.10	10
Controls (knobs, handles, dials)	4.3.11	28
Crystal units (quartz)	4.3.12	38
Fastener hardware	4.3.13	12
Filters, electrical	4.3.14	70
Fuses & fuseholders	4.3.15	39
Gears	4.3.16	48
Hydraulics	4.3.17	49
Lights and associated items	4.3.18	50
Meters, electrical indicating	4.3.19	40 & 51
Microelectronic devices	4.3.20	64
Motors	4.3.21	46
Readouts and displays	4.3.22	68
Relays	4.3.23	57
Resistors	4.3.24	33
Semiconductor devices	4.3.25	30
Servodevices, rotary	4.3.26	56
Sockets, shields and mounting pads	4.3.27	60
Springs	4.3.28	41
Standard electronic modules (SEMs)	4.3.29	73
Switches	4.3.30	58
Terminations	4.3.31	19
Transformers, inductors and coils	4.3.32	14
Tubes, electron	4.3.33	29
Waveguides and related items	4.3.34	53
Wire and cable	4.3.35	--
Wire and cable, internal	4.3.35.1	20 & 66
Wiring practices, internal	4.3.35.2	69
Wire and cable external interconnection	4.3.35.3	71
Cable, coaxial (RF)	4.3.35.5	65
Printed wiring	4.3.35.6	17

4.3.4 Approval of parts. In considering the approval of parts, contracts for electronic equipment are divided into the following categories:

Category I: Contracts which are fundamentally for the purpose of investigation or study and not for the fabrication of equipment.

Category II: Contracts for one or more models of equipment designed to meet the performance requirements of a specification or to establish technical requirements for production equipment. This category includes contracts for models to be used for test under service conditions for the evaluation of their suitability and performance.

Category III: Contracts for production equipment. These contracts will usually include requirements for a prototype or first article model.

4.3.4.1 Contracts under Category I. Approval of parts should not be required under contracts or orders which fall under Category I. General parts information is available upon request to the Military Parts Control Advisory Groups (MPCAGs).

4.3.4.2 Contracts for equipment which fall under Categories II and III. For a single contract covering like equipments which fall in both Categories II and III, parts approval should be required only for those items used in Category II equipments, and any new item sources or new nonstandard items used in Category III equipment. As specified by contract, approval of all parts used in the equipment should be obtained by the contractor prior to delivery of any equipment required by the contract.

4.3.4.3 Reordered production equipment. A design review directed toward replacement of nonstandard parts with standard parts should be performed on contracts for reordered equipment, whether reordered from the original contractor or from a different contractor. Where applicable, the PPSL listing should be utilized for the review function by the MPCAGs. Changes must conform to interchangeability requirements. The original part procured from the same source, when required by interchangeability or lack of a standard replacement part, may be used without reapproval.

4.3.4.3.1 Continuation of production. In those cases wherein the reordered production equipment represents continuous production by the same contractor, a review directed toward nonstandard parts replacement with standard parts is not required.

4.3.4.4 Replacing of approved parts. Whenever permission is sought by the contractor to use an item that is not the part approved for use in the system/equipment, the procedure used should be a "Request for Deviation" in accordance with the applicable configuration management requirements of the contract. The standard/approved item should be listed in technical manuals, parts lists, etc.

4.3.4.5 Equipment performance. The guidelines in this handbook regarding the use of parts, either standard or approved nonstandard, should not relieve the contractor of the responsibility for complying with all equipment performance and other requirements set forth in the detail specification or contract. Approvals for nonstandard parts are contingent on subsequent satisfactory performance during required equipment tests.

4.3.5 Substitution of parts. Information regarding the selection and application of substitute parts is given in MIL-HDBK-454, Guideline 72.

4.3.6 Batteries. The use of batteries requires approval of the acquisition activity. Batteries should be selected and applied using guidance given in MIL-HDBK-454, Guideline 27.

4.3.7 Bearings. Bearings should be selected and applied using guidance given in MIL-HDBK-454, Guideline 6.

4.3.8 Capacitors. Capacitors should be selected and applied in accordance with MIL-STD-198.

4.3.8.1 Fixed, tantalum electrolytic. For Naval Air Systems Command, the use of wet slug tantalum capacitors (except tantalum-cased units in accordance with MIL-C-39006/22 and MIL-C-39006/25) requires the approval of the acquisition activity, and silver-cased tantalum capacitors should not be used.

4.3.8.2 Aluminum electrolytic. Aluminum electrolytic capacitors should not be used in airborne electronic equipment applications.

4.3.9 Circuit breakers. Circuit breakers should be selected and applied in accordance with MIL-STD-1498. Trip-free circuit breakers should be used. Nontrip-free circuit breakers should be used only when the application requires overriding of the tripping mechanism for emergency use.

4.3.9.1 Manual operation. Circuit breakers should be capable of being manually operated to the ON and OFF positions. Circuit breakers should not be used as ON-OFF switches unless such breakers have been specifically designed and tested for that type of service.

4.3.9.2 Position identification. Circuit breakers should have easily identified ON, OFF and TRIPPED positions except that the TRIPPED position may be the same as the OFF position with no differentiation between OFF and TRIPPED being required.

4.3.9.3 Orientation. Circuit breakers should operate when permanently inclined in any direction up to 30 degrees from the normal vertical or normal horizontal position. The trip point of an inclined unit should not vary more than ±5 percent of the current specified for normal position mounting. Circuit breakers used on flight equipment should operate within the limits of the detail specification when the equipment is in any position or rotation about its three principal axes.

4.3.10 Connectors, electrical. Electrical connectors should be selected and applied in accordance with MIL-STD-1353. Additional selection and application guidance is given in MIL-HDBK-454, Guideline 10.

4.3.10.1 Mounting of electrical receptacles. Where practical, when receptacles are mounted on a vertical surface the largest polarizing or prime key or keyway of the receptacle should be at the top center of the shell of the receptacle. Mounting connectors on a top horizontal surface should be avoided, in order to prevent pooling of moisture in the connector. However, when necessary, the master keyway should be forward if designated.

4.3.10.2 Adjacent locations. MIL-W-5088 gives requirements for the spacing of electrical connectors used in adjacent locations.

4.3.10.3 Jacks. Microphone jacks should be type M641/5-1 and headset jacks should be type M641/6-1 conforming to MIL-J-641. Use of these jacks for other than microphone and headset use is prohibited in areas accessible to flight personnel.

4.3.11 Controls (knobs, handles, dials). Control knobs should be selected and applied in accordance with MIL-K-25049. Handles should be selected and applied in accordance with MIL-H-8810. Multiturn counter control dials should be selected and applied in accordance with MIL-D-28728. Additional application information is specified in MIL-HDBK-454, Guideline 28.

4.3.12 Crystals (quartz and oscillator). Quartz crystal units should be selected and applied in accordance with MIL-STD-683. Crystal oscillator units should be in accordance with MIL-O-55310.

4.3.13 Fastener hardware. MIL-HDBK-454, Guideline 12 gives information regarding applicable fastener specifications, mounting methods and techniques.

4.3.14 Filters, electrical. Electrical filters should be selected and applied in accordance with MIL-STD-1395.

4.3.15 Fuses, fuseholders and associated hardware. Fuses, fuseholders and associated hardware should be selected and applied in accordance with MIL-STD-1360. Additional guidance information is provided in MIL-HDBK-454, Guideline 39.

4.3.16 Gears. Gears should be designated, dimensioned, toleranced and inspected in accordance with applicable specifications of the American Gear Manufacturers Association (AGMA). Gears not operating in a lubricant bath should be made of a corrosion resistant material. Gears operating in a lubricant bath containing a corrosive inhibiting additive may be made of non-corrosive resistant material. Planetary gearing is preferred to worm gearing. Non-metallic gears may be used when they meet the load, life and environmental requirements of the applicable specification.

4.3.17 Hydraulics. Hydraulic systems which function as an integral part of an electronic system should be as follows:

4.3.17.1 Aircraft. The design and installation of hydraulic systems for aircraft should be in accordance with the applicable type, class or system of MIL-H-5440.

4.3.17.2 Missiles. The design and installation of hydraulic systems for missiles should be as specified directly in the detail specification or contract.

4.3.17.3 Additional guidance information and document references are provided in MIL-HDBK-454, Guideline 49.

4.3.18 Lights and associated items.

4.3.18.1 Indicator lights. Indicator lights, light housings, lamp-holders and lenses should be selected and applied in accordance with MIL-L-3661.

4.3.18.2 Press to test indicator lights. Press to test indicator lights should be selected and applied in accordance with MIL-L-7961.

4.3.18.3 Instrument lights. Instrument lighting should be integral red in accordance with MIL-I-25467, or integral white in accordance with MIL-L-27160, as required. The use of non-integral lighting requires approval of the acquisition activity, and when approved should be in accordance with MIL-L-5057.

4.3.18.4 Lamps. Incandescent lamps should be selected and applied in accordance with MIL-L-6363. When used as indicator lights, light emitting diodes (LEDs) should be selected and applied in accordance with MIL-S-19500.

4.3.18.5 Visual display and legend lights. Visual display and legend lights should comply with the requirements in MIL-STD-1472.

4.3.18.6 Night vision compatibility. When compatibility of equipment is required for night vision imaging, the requirements of MIL-L-85762 should apply.

4.3.19 Meters. Panel type electrical indicating meters should be selected and applied in accordance with MIL-M-10304 (color schemes W, B, Y, F and P). Time totalizing meters should be selected and applied in accordance with MIL-M-7793. When required, external meter shunts should conform to MIL-S-61 or MIL-I-1361.

4.3.20 Microelectronic devices. Microelectronic devices, including hybrids, should be selected and applied using guidance given in MIL-HDBK-454, Guideline 64. Devices selected should be connected by means of soldering, welding, or the use of shape memory metal alloy connectors.

4.3.21 Motors.

4.3.21.1 Motors, alternating current. Alternating current motors (400 Hz, 115/200 volt) should be in accordance with MIL-M-7969, except that motors used with a miniature blower for cooling electronic equipment should be in accordance with MIL-B-23071.

4.3.21.2 Motors, direct current. Direct current motors (28 volt) should be in accordance with MIL-M-8609.

4.3.22 Readouts and displays.

4.3.22.1 Readouts. Readouts should be selected and applied in accordance with MIL-R-28803.

4.3.22.2 Displays. Light emitting diode (LED) displays should be selected and applied in accordance with MIL-D-87157, quality level A or B. Liquid crystal displays (LCDs) exhibit limited operation of temperature extremes, and require acquisition activity approval for use in airborne electronic equipment.

4.3.23 Relays. Relays should be selected and applied in accordance with MIL-STD-1346. Hermetically sealed types only should be used. Reed relays should be in accordance with MIL-R-83516, and require acquisition activity approval for use in airborne electronic equipment.

4.3.24 Resistors. Resistors should be selected and applied in accordance with MIL-STD-199. Thermistors should be in accordance with MIL-T-23648.

4.3.25 Semiconductor devices. Semiconductor devices should be selected and applied in accordance with MIL-STD-701. Information concerning the order of precedence and restrictions in the selection of semiconductor devices is given in MIL-HDBK-454, Guideline 30.

4.3.26 Servodevices, rotary. Guidance concerning the selection and application of rotary servodevices is given in MIL-HDBK-454, Guideline 56.

4.3.27 Sockets, shields and mounting pads.

4.3.27.1 Sockets. Sockets for plug-in electronic parts should be of the single unit type and should conform to MIL-S-12883, MIL-S-83502 or MIL-S-83734. The use of sockets for microcircuits requires approval of the acquisition activity.

4.3.27.2 Shields. Heat dissipating tube shields should conform to MIL-S-24251.

4.3.27.3 Mounting pads. Where mounting pads are required for use with small electrical or electronic devices, they should conform to A-A-55485.

4.3.28 Springs. Springs and spring material should be selected and applied in accordance with MIL-HDBK-454, Guideline 41.

4.3.29 Standard electronic modules (SEMs). As an integral part of the SHARP program (see 4.1.2), standard electronic modules (SEMs) conforming to MIL-M-28787 should be utilized to the maximum extent possible. SEMs should be designed in accordance with MIL-STD-1389. SEMs should be applied in accordance with MIL-STD-1378. Guidance information for the SEMs program is contained in MIL-HDBK-246.

4.3.30 Switches. Switches and associated hardware should be selected and applied in accordance with MIL-STD-1132.

4.3.30.1 Mounting.

4.3.30.1.1 Rotary switches. Rotary switches with thru-panel shafts should be mounted to the panel by means of a single threaded bushing concentric with the shaft. A positive mechanical means, in addition to lock washers, should be provided to prevent rotation of the switch body.

4.3.30.1.2 Toggle switches. The mounting of toggle switches should be such that the handle of the switch operates in a vertical direction. The "off" position should be in the center position on three-position switches and in the bottom position on two-position switches. When clarification of a control function or convenience of operation would result (for example, a "left-right" function control), toggle switches may be so mounted that the handle of the switch operates in a horizontal direction.

4.3.31 Terminations. The selection of stud terminals, lug terminals, feed-thru terminals, binding posts, terminal boards, terminal junction systems and splices should be in accordance with MIL-STD-1277.

4.3.31.1 Number of wires per terminal or lug. The number of wires terminated in an individual terminal or lug should not be greater than three. Multisection turret, bifurcated, or multi-hole lug terminals should have not more than three wires per section, tong, or hole. In no case should the total cross sectional area of the terminated wires exceed the cross sectional area capacity of the terminal or lug. If a greater number of wires is required than those specified herein, approval of the acquisition activity should be obtained.

4.3.31.2 Number of lugs per terminal. The maximum number of lugs to be connected to any one terminal on a terminal board should be two for screw-type terminal boards covered by MIL-T-55164 and as specified in the detail specification sheets for stud-type terminal boards. Not more than four lugs should be connected to any one terminal of a board covered by MS27212. Accessories such as stud connectors, straddle plates, jumpers and terminal board lugs should be counted as lugs for this purpose.

4.3.31.3 Number of wires in a connector contact. In order to facilitate contact insertion and removal and wire sealing, only one wire should be terminated in a crimp contact in an electrical connector.

4.3.32 Transformers, inductors and coils. The selection and application of transformers, inductors and coils should be in accordance with MIL-STD-1286. Variable transformers should conform to MIL-T-83721, and intermediate radio frequency and discriminator transformers should conform to MIL-T-55631, Grade 1, 2 or 4. Grade 3 transformers should be limited to hermetically sealed or encapsulated assemblies.

4.3.33 Tubes, electron. Electron tubes should be selected and applied in accordance with MIL-STD-200.

4.3.34 Waveguides and related items. Guidance concerning the selection and application of waveguides and related items is given in MIL-HDBK-454, Guideline 53.

4.3.35 Wire and cable. Wire and cable having polyvinyl chloride (PVC) or FEP/polyimide (Kapton) insulating material should not be used in airborne electronic equipment applications.

4.3.35.1 Wire and cable, internal. Internal hookup wires conforming to MIL-W-22759 and MIL-W-81044 are preferred for use within the equipment. Further information concerning restrictions of other wire types is given in MIL-HDBK-454, Guideline 20. Multiconductor cables conforming to MIL-C-7078

and MIL-C-27500 and utilizing the above specified wire types are preferred for use within the equipment. Other cable types are subject to the above restrictions and those of MIL-HDBK-454, Guideline 66.

4.3.35.2 Wiring practices, internal. Internal wiring practices and wiring devices should conform to MIL-HDBK-454, Guideline 69. Use of organizational architectures, i.e., OIM (Organized wire, Integration boards, Mass termination), is strongly encouraged.

4.3.35.3 Wire and cable, external interconnection. Wires conforming to MIL-W-22759 and MIL-W-81044, as identified in MIL-W-5088, Appendix A, and cables conforming to MIL-C-27500 which utilize the above specified wire types are preferred per use for external interconnections between units. Other wire and cable types are subject to the above restrictions and those of MIL-HDBK-454, Guideline 71 and MIL-W-5088, as applicable.

4.3.35.4 External wiring practices. The use of organized wiring systems (OWS) architecture and wiring practices specified in MIL-W-5088 is strongly encouraged to facilitate reliability, maintainability, and reduction of weight.

4.3.35.5 Cable, coaxial (RF). Coaxial cables (RF) should selected using the requirements of MIL-C-17, MIL-L-3890, MIL-C-22931, or MIL-C-23806.

4.3.35.6 Printed wiring. Printed wiring boards, assemblies, cards and associated hardware should be in accordance with MIL-STD-1861. Printed wiring boards should be connected into the equipment by means of connectors. Printed wiring boards utilizing the conductor pattern as the direct contact with the mating connector should not be used.

4.4 Material selection.

4.4.1 Choice of materials. Table III provides a list of material applicable for use in the design and construction of airborne electronic equipment. Also included in the table is reference to corresponding MIL-HDBK-454 guidelines, where applicable, and paragraphs herein which supplement or restrict the specific requirement. Whenever an applicable material specification provides more than one characteristic or tolerance, the equipment manufacturer should use, in the equipment, material of broadest characteristics and of the greatest allowable tolerances that will fulfill the performance requirements of the equipment. When acceptable materials of higher than minimum quality are readily available, the utilization of which would not increase the initial or life cycle cost to the acquisition activity, they may be used.

TABLE III. Materials selection.

Subject	MIL-HDBK-5400 Requirement	MIL-HDBK-454 Guideline
Adhesives	4.4.5	23
Arc resistant materials	4.4.6	26
Conformal coating	4.4.7	--
Dissimilar metals	4.4.8	--
Encapsulation and embedment materials	4.4.9	--
Fibrous materials, organic	4.4.10	44
Flammability of materials	4.4.11	3
Fungus inert materials	4.4.12	4
Insulators, insulating and dielectric materials	4.4.13	11
Lubricants	4.4.14	43
Metals, corrosion resistant	4.4.15	--

4.4.2 Polyvinyl chloride (PVC) materials. Polyvinyl chloride (PVC) materials should not be used in airborne electronic equipment applications.

4.4.3 Standard materials. Materials covered by documents listed in Appendix A are considered standard and should be used whenever they are suitable for the purpose. Materials should be acquired from QPL or QML sources when qualification is a requirement of the material specification.

4.4.4 Nonstandard materials. When Appendix A fails to provide an applicable material specification or standard, the contractor should select a material from other established specifications or standards in accordance with the order of preference set forth in the contract. Nonstandard materials must be equivalent to or better than similar standard materials. Each vendor source for a nonstandard material covered by a source control document requires approval of the acquisition activity. The request for approval of nonstandard material should be made at the time that the material is selected for use in the equipment design. The Government retains the right to request changes to the material, if the performance, description, test data or inspection of the material indicates that the material will not perform its intended function.

4.4.4.1 Approval of nonstandard materials. Requirements for the acquisition activity approval of nonstandard materials should be specified in the detail specification or contract.

4.4.5 Adhesives. The guidelines contained in MIL-HDBK-454, Guideline 23 should be used when selecting and applying adhesives. The use of adhesives in electrical applications requires the approval of the acquisition activity.

4.4.6 Arc-resistant materials. Arc-resistant materials should be selected and applied using the guidance given in MIL-HDBK-454, Guideline 26.

4.4.7 Conformal coating. Conformal coating for use with rigid printed circuit assemblies should conform to MIL-I-46058.

4.4.8 Dissimilar metals. Selection and protection of dissimilar metal combinations should be in accordance with MIL-STD-889. The use of dissimilar metals should be limited to applications where similar metals cannot be used due to peculiar design requirements.

4.4.9 Encapsulation and embedment materials. Encapsulation and embedment materials should be of a nonreversion type and should be selected from the following specifications: MIL-S-8516, MIL-I-16923, MIL-S-23586, MIL-M-24041, and MIL-I-81550. The materials selected should be capable of filling all voids and air spaces in and around the items being encased. Refer to MIL-HDBK-454, Guideline 47 for additional guidance information.

4.4.10 Fibrous material, organic. Organic fibrous material should be selected and applied using guidance given in MIL-HDBK-454, Guideline 44.

4.4.11 Flammability of materials. Materials used in military equipment should, in the end item configuration, be noncombustible or fire retardant in the most hazardous conditions of atmosphere, pressure, and temperature to be expected in the application. Fire retardant additives may be used provided they do not adversely affect the specified performance requirements of the basic materials. Fire retardance should not be achieved by use of nonpermanent additives to the basic material. Refer to MIL-HDBK-454, Guideline 3 for additional information on the testing of material to determine its flammability characteristics.

4.4.12 Fungus-inert materials. The selection and application of fungus-inert and fungicide treated materials should be accomplished using the guidance provided in MIL-HDBK-454, Guideline 4.

4.4.13 Insulators, insulating and dielectric materials. The selection and application of insulators, insulating and dielectric materials should be made using the guidance provided in MIL-HDBK-454, Guideline 11.

4.4.14 Lubricants. The selection and application of lubricants for airborne electronic equipment should be in accordance with MIL-STD-838. Standard lubricants should be limited to those given in MIL-HDBK-454, Guideline 43. Refer to MIL-HDBK-275 for guidance relative to application and limitations of specific lubricants.

4.4.15 Metals, corrosion resistant. Metals should be corrosion resistant or should be coated or metallurgically processed to resist corrosion. Materials and processes for metallic parts should conform to

applicable requirements of MIL-STD-889 and MIL-STD-1516. Coatings should be selected from MIL-STD-1516.

4.5 Processes and finishes. Processes and finishes, except painting, should be in accordance with Table IV and, where applicable, using the guidance of the referenced MIL-HDBK-454 guideline or supplemental paragraph herein. Welding and brazing should be accomplished by certified operators in accordance with the requirements of MIL-STD-248 or MIL-STD-1595, as applicable.

4.5.1 Protective platings and coating. A protective plating or coating should be applied to all metals which are not corrosion-resistant, except as follows:

4.5.1.1 Materials. Gold, nickel, chromium, rhodium, tin, lead-tin alloys, or sufficiently thick platings of these metals, are satisfactory without additional protection or treatment other than buffing or cleaning.

4.5.1.2 Aluminum alloy.

4.5.1.2.1 Surface, general. Parts fabricated from aluminum 1100, alloys 3003, 5052, 6053, 6061, 6063 or 7072 should be cleaned with a deoxidizing solution, other than an uninhibited caustic dip, and may be used with or without other surface treatment. Other aluminum alloys should be anodized in accordance with MIL-A-8625 or be given a chemical treatment in accordance with MIL-C-5541.

4.5.1.2.2 Surfaces, bonded and grounded. Where bonding or grounding is necessary, aluminum 1100, alloys 3003, 5052, 6053, 6061, 6063, 7072, or equally corrosion-resistant alloys, should be used. They may be used without other surface treatment.

4.5.1.2.3 Surfaces, extreme wear resistant. Where bonding or grounding is not necessary, hard anodic finish conforming to number E514 of MIL-F-14072 may be applied to obtain extreme wear-resistant surfaces under MIL-F-14072, Type II exposure on desired areas of aluminum alloys not subject to repeated high tensile stresses.

4.5.2 Magnesium and magnesium alloys. Magnesium and magnesium alloys should not be used except when approved or specified by the acquisition activity. The request for use of magnesium and its alloys should include the total environment exposure, the weight reduction and other advantages achieved, the proposed surface treatment and the application details.

TABLE IV. Processes and finishes.

Subject	Applicable process document
Anodizing/chemical film	Anodize per MIL-A-8625 or chemical film per MIL-C-5541
Brazing	MIL-B-7883
Cadmium plating 1/	QQ-P-416
Chromium plating	QQ-C-320
Coatings and surface treatments	MIL-S-5002
Finishes	(See para. 4.5.4)
Gold plating	MIL-G-45204, Type II or III depending upon application
Nickel plating	Electrodeposited per QQ-N-290
Soldering, component mounting, etc. - electrical/electronic assembly	Refer to MIL-HDBK-2000 for guidance information
Soldering, fabricated assemblies, non-electrical	DOD-STD-1866
Tin plating	MIL-T-10727
Welds, electrical connections	MIL-W-8939 (Refer to MIL-HDBK-454, Requirement 24 for guidance information)
Welds, structural (arc and gas)	Aluminum alloys MIL-STD-2219 Magnesium alloys MIL-STD-2219 Steel alloys MIL-STD-2219
Welds, structural (resistance)	MIL-W-6858 (Refer to MIL-HDBK-454, Requirement 13 for guidance information)
Zinc coating	Electrodeposited per ASTM B633

1/ Except where equipment may be exposed to temperatures above 205°C (400°F) or where it may come in contact with petroleum-based products.

4.5.3 Zinc and zinc-plated parts. Zinc and zinc-plated parts should be given a dichromate treatment in accordance with ASTM B633.

4.5.4 Finishes. Unless contained in a hermetically-sealed unit, part finishes (including hardware items of equipment not covered by subsidiary specifications) should be resistant to corrosion. Finishes should be capable of withstanding a 48-hour Salt Spray (Fog) test in accordance with MIL-STD-810, Method 509, Procedure I, without showing signs of corrosion beyond those established for the particular part, material or finish specification. Where applicable, these parts should have finishes providing suitable rates of heat lubricated condition. Lusterless finishes should be used on all surfaces visible to operating personnel. Where cleaning operations on metal parts are not specified in detail, they should be in accordance with MIL-S-5002. It is not the intent that parts acquired to the specifications listed in Appendix A must be refinished.

4.5.4.1 Cases and front panels. Equipment installed in the cockpit area should be Lusterless Black, Color No. 37038, in accordance with FED-STD-595. Unless otherwise specified, finish of all other equipment should be Lusterless Gray, Color No. 36231, in accordance with FED-STD-595.

4.5.4.2 Fasteners and assembly screws. Exposed surfaces of external fasteners and assembly screws used in areas other than the cockpit which are manipulated, loosened, or removed in the normal processes of servicing and installing the equipment should be finished, preferably in a noncorrosive black or bright finish, so as to provide strong contrast with the color of the surface upon which they appear. Exposed surfaces of external fasteners and assembly screws used in the aircraft cockpit should be finished using the guidance provided in 4.5.4.1. Other external fasteners and assembly screws used for securing the internal parts to the chassis should be similar in color to the surface upon which they appear.

4.5.4.3 Other standard finishes. Type I finishes in accordance with MIL-F-14072 are approved as alternates to any differing requirements specified under the paragraphs on finishes, except that colors specified should be used.

4.6 Environmental service guidelines.

4.6.1 MIL-STD-810 environmental tests. The contractual use of MIL-STD-810 for environmental testing requires the development of environmental management and test plans and engineering tasks to adequately tailor the specific test procedures, test conditions, variations, and limits for the life cycle environmental conditions which the equipment will realistically encounter. MIL-STD-810 provides details of these data requirements and reports and identifies the Data Item Descriptions (DIDs) which must be specified in the contract. Each specific test method required must be assessed for its applicability to the equipment deployment. The test method

must be tailored for the selection of appropriate test procedure, test duration, variations, limits, tolerances, etc., and invoked directly in the detail specification or contract. The services of an environmental specialist may be required to effectively tailor and apply MIL-STD-810 into the detail specification or contract.

4.6.1.1 The following list of MIL-STD-810 tests and test method numbers is provided for reference only. Specific methods, test procedures and variations, and limits must be selected and stated directly in the detail specification or contract for the proper performance of these tests.

Test	Method No.
Low Temperature	502
High Temperature	501
Altitude (Low Pressure)	500
Temperature Shock	503
Shock	516
Vibration	514
Fungus	508
Salt Fog	509
Humidity	507
Bench Handling	516
Sand and Dust	510
Explosive Atmosphere	511

4.6.2 Equipment operational requirements. The equipment should be designed and constructed that no fixed part or assembly becomes loose, no moving or movable part or control be shifted in setting, position, or adjustment, and no degradation be caused in the performance beyond that specified in the detail specification during operation or after storage in ambient conditions, as follows:

4.6.2.1 Temperature. The equipment should be exposed to the temperature conditions for the applicable class shown in table V. The ambient temperature within the specified temperature ranges may remain constant for long periods and may vary at a rate as high as 1 degree per second.

4.6.2.1.1 Operating. The equipment should be capable of operating under the conditions for the applicable class and within the ranges listed in columns I, II, III and VII of table V.

4.6.2.1.2 Nonoperating. The equipment in a nonoperating condition should be capable of withstanding long periods of exposure to the temperature extremes and shock as listed in table V.

TABLE V. Enviromental conditions.

Equipment operating								Equipment operating and nonoperating Altitude	Equipment nonoperating	
Temperature extremes for the chamber (without external cooling provisions)				Combined temperature-altitude			Temperature shock		Temperature Extremes	Temperature shock
Equipment class	Column I continuous	Column II intermittent	Column III short-time	Column IV	Column V	Column VI	Column VII	Column VIII	Column IX	Column X
Class 1	-54°C +55°C	30 min. +71°C	...	Defined by curve A, figure 1	Defined by curve B, figure 1	...	-54°C to +71°C	Sea level (30.0 in. Hg.) (3.4 in. Hg.) 50,000 ft.	-57°C to +85°C	-57°C to +85°C
Class 1A.	-54°C +55°C	30 min. +71°C	...	Defined by curve A, figure 1	Defined by curve B, figure 1	...	-54°C to +71°C	Sea level (30.0 in. Hg.) (8.89 in. Hg.) 30,000 ft.	-57°C to +85°C	-57°C to +85°C
Class 1B	-40°C +55°C	30 min. +71°C	...	Defined by curve A, figure 1	Defined by curve B, figure 1	...	-40°C to +71°C	Sea level (30.0 in. Hg.) (16.89 in. Hg.) 15,000 ft. 1/	-57°C to +85°C	-57°C to +85°C
Class 2	-54°C +71°C	30 min. +95°C	...	Defined by curve A, figure 2	Defined by curve B, figure 2	...	-54°C to +95°C	Sea level (30.0 in. Hg.) (1.32 in. Hg.) 70,000 ft.	-57°C to +95°C	-57°C to +95°C
Class 3	-54°C +95°C	30 min. +125°C	10 min. +150°C	Defined by curve A, figure 3	Defined by curve B, figure 3	Defined by curve C, figure 3	-54°C to +125°C	Sea level (30.0 in. Hg.) (0.32 in. Hg.) 100,000 ft.	-57°C to +125°C	-57°C to +125°C
Class 4	-54°C +125°C	30 min. +150°C	10 min. +260°C	Defined by curve A, figure 4	Defined by curve B, figure 4	Defined by curve C, figure 4	-54°C to +150°C	Sea level (30.0 in. Hg.) (0.32 in. Hg.) 100,000 ft.	-57°C to +150°C	-57°C to +150°C
Class 5	-54°C +95°C	30 min. +125°C	...	Same as Class 3 2/	...	...	-54°C to +125°C	Sea level (30.0 in. Hg.) (10.10 in. Hg.) 2,000,000 ft.	-57°C to +125°C	-57°C to +125°C

1/ Altitude range shown is for operation only.
Classes 1A and 1B equipment should withstand a nonoperating altitude of 40,000 feet (5.5 in. Hg.).

2/ For altitude above 100,000 ft., the equipment's surrounding environment should not exceed 71°C and means should be available for rejection of heat into the surroundings by conduction, radiation or some other means.

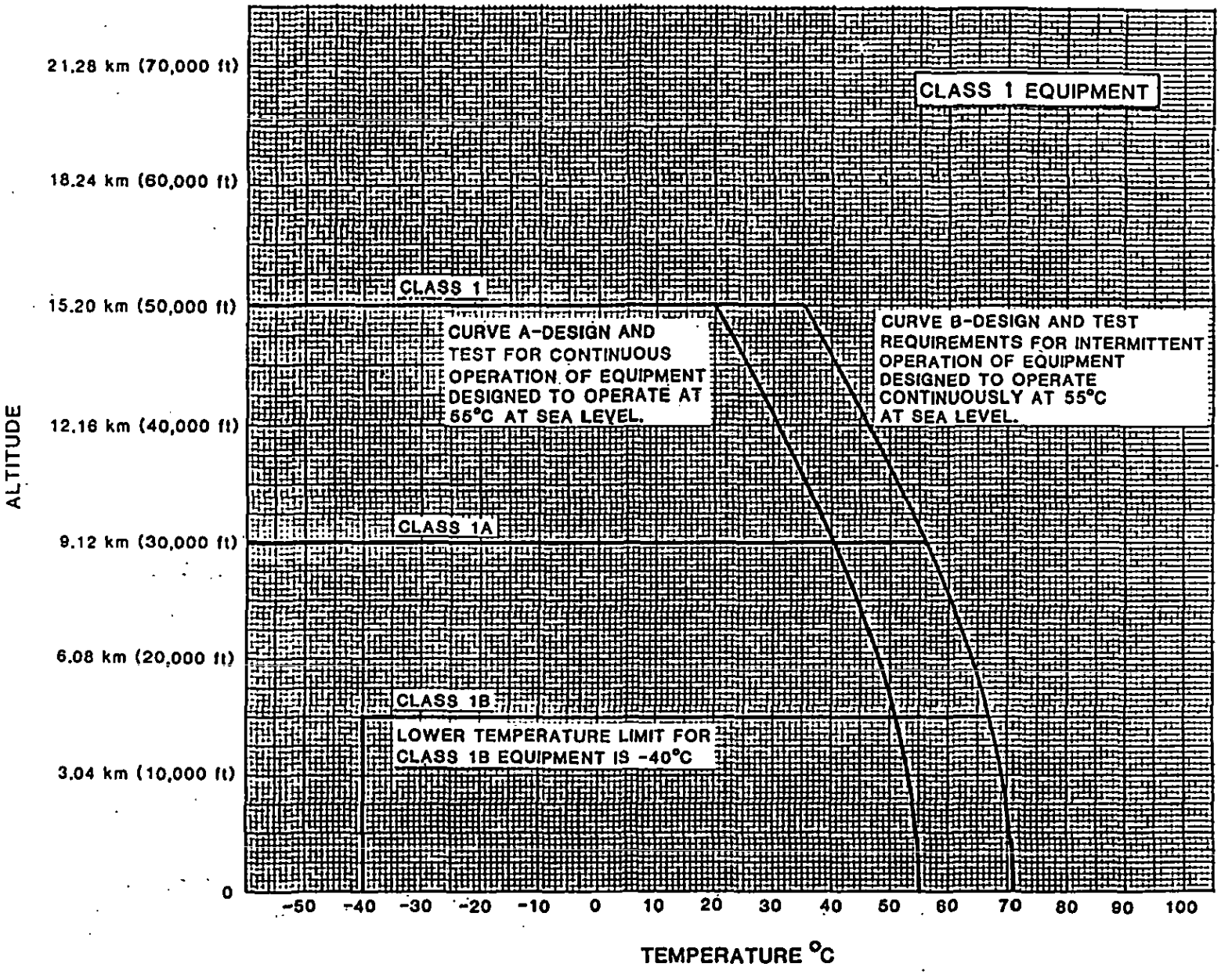

FIGURE 1. Operational guidelines for class 1 airborne electronic equipment (temperature vs altitude).

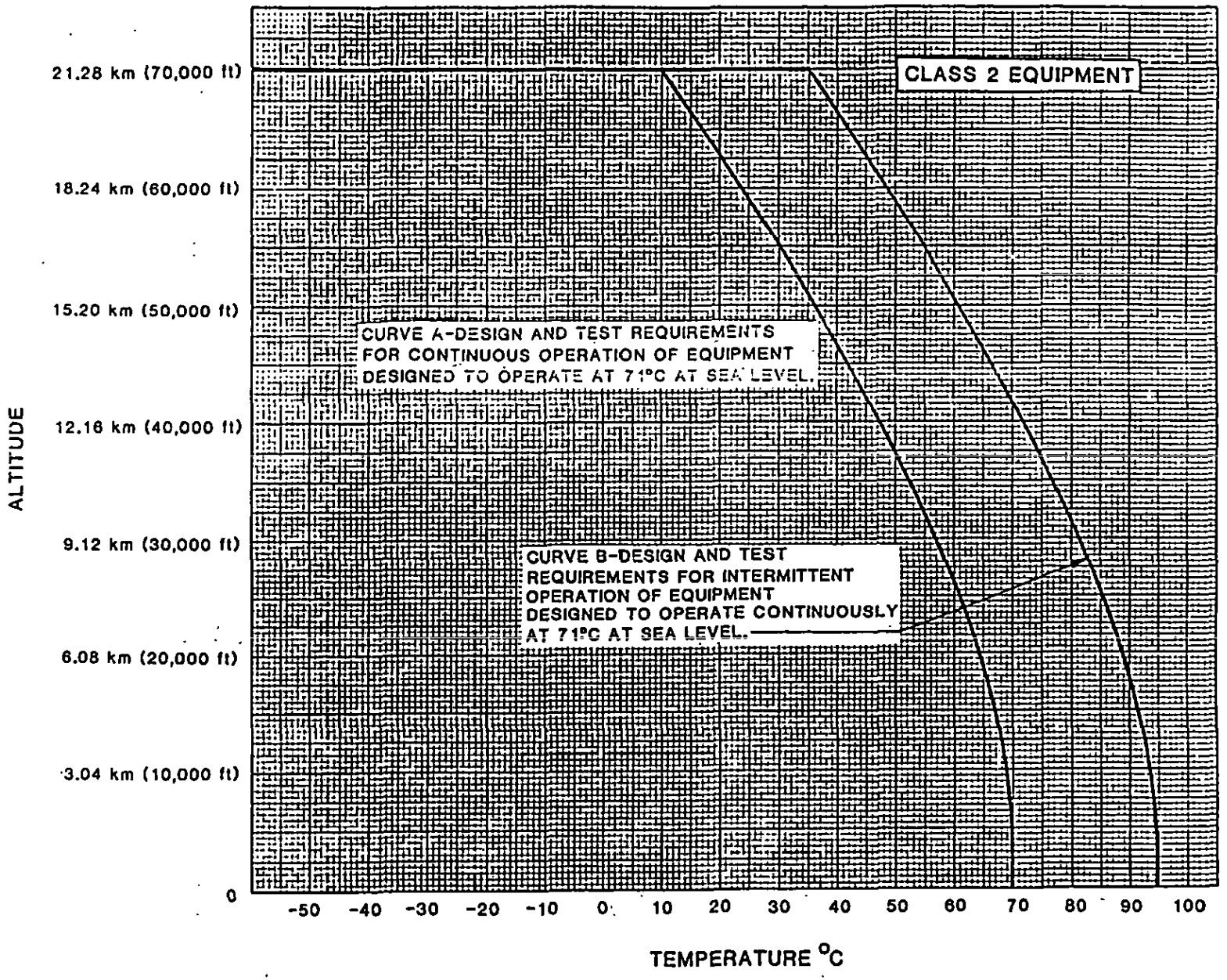

FIGURE 2. Operational guidelines for class 2 airborne electronic equipment (temperature vs altitude).

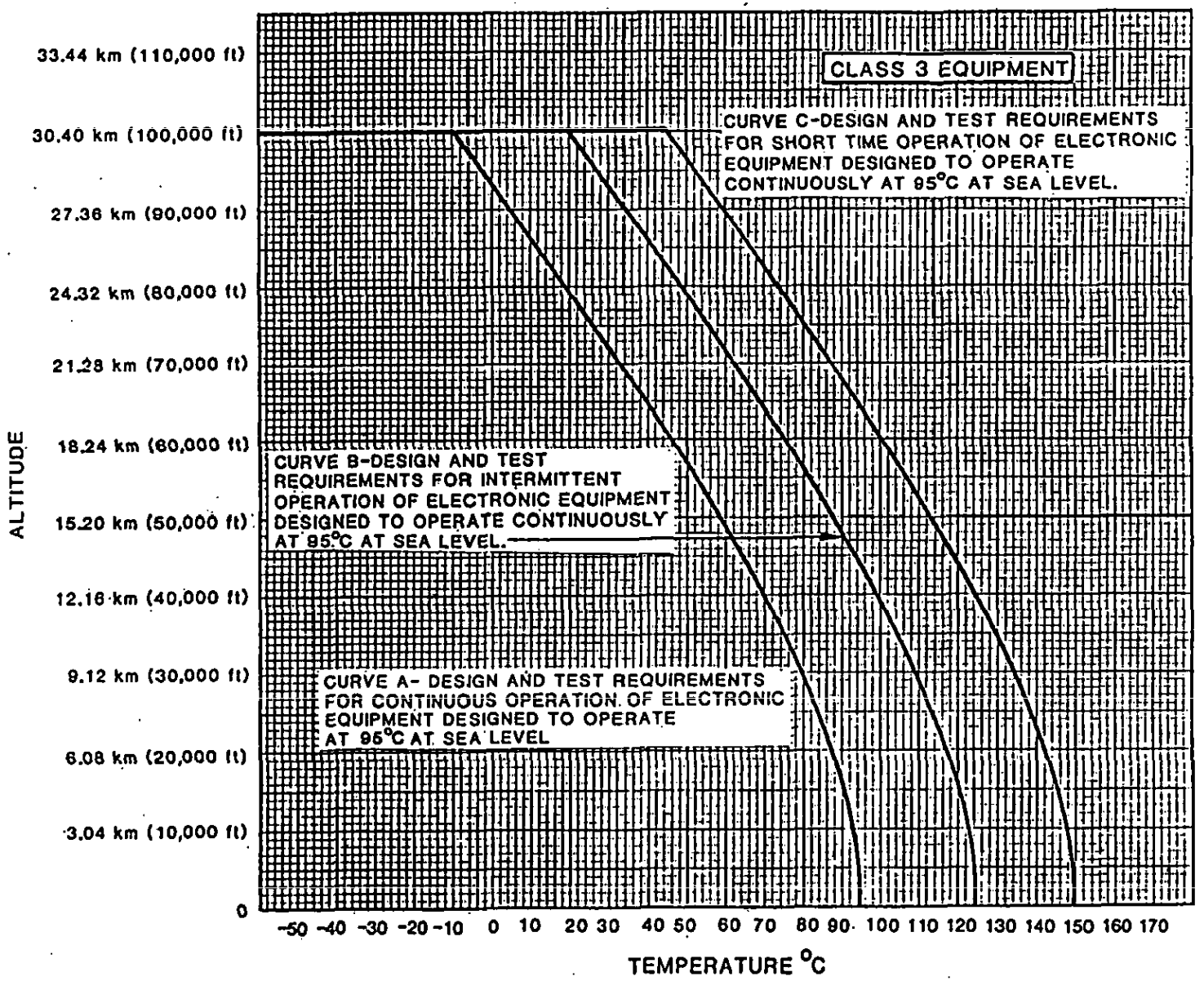

FIGURE 3. Operational guidelines for class 3 airborne electronic equipment (temperature vs altitude).

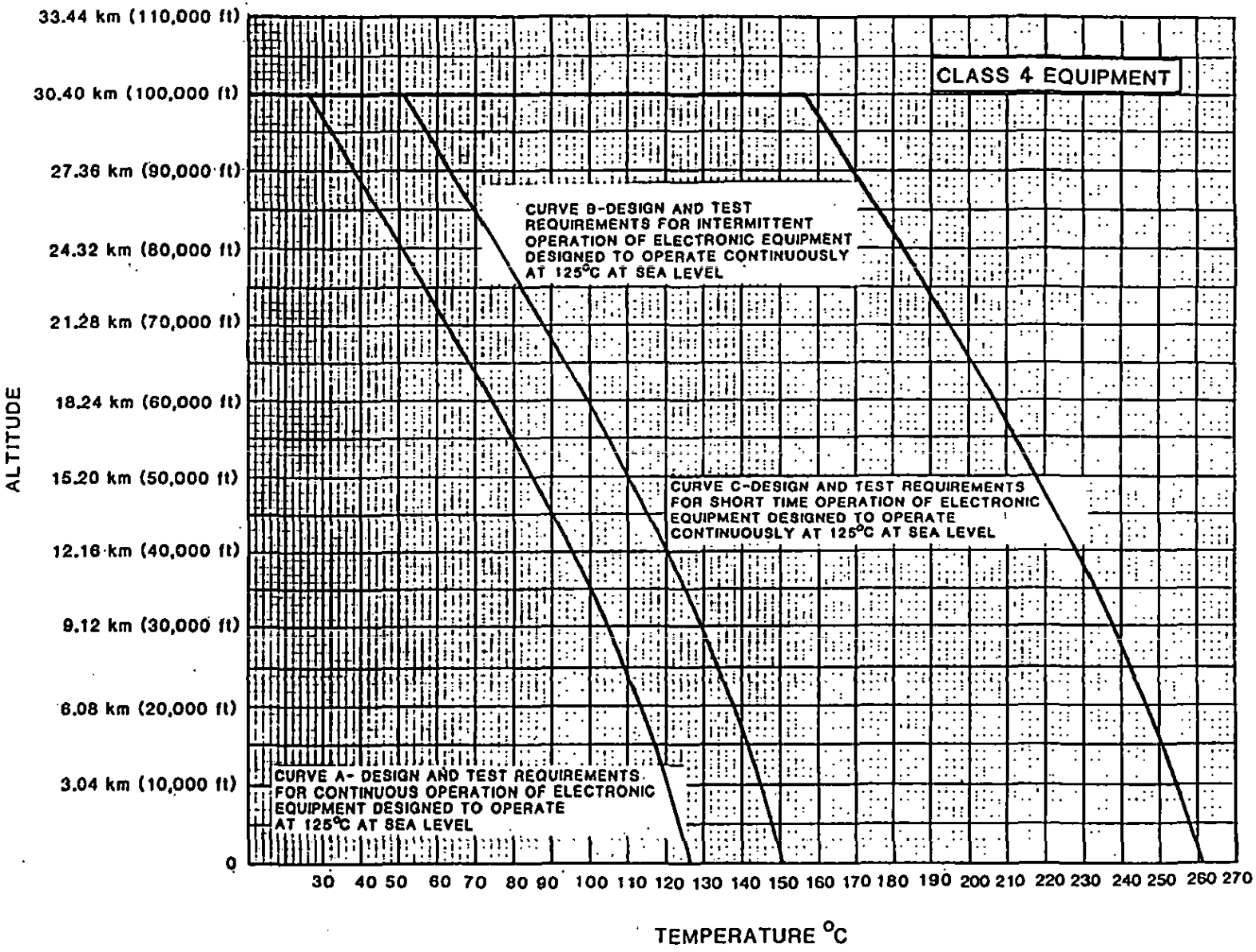

FIGURE 4. Operational guidelines for class 4 airborne electronic equipment (temperature vs altitude).

4.6.2.2 Altitude. The equipment should meet the altitude conditions, for the applicable class, listed in column VIII of table V, both for continuous operation and exposure in a nonoperating condition. The altitude may remain constant for long periods and vary at a rate as high as 0.5 inch of mercury per second.

4.6.2.3 Temperature-altitude combination. The equipment should be capable of operating under the applicable temperature-altitude combinations shown on figures 1 through 4, as applicable.

4.6.2.4 Humidity. The equipment should withstand the effects of humidities up to 100 percent, including conditions wherein condensation takes place in and on the equipment. The equipment should withstand the above conditions during operating and nonoperating conditions. Fogging on the inside of the cover glass of instruments should not occur.

4.6.2.5 Vibration.

4.6.2.5.1 Equipment normally mounted. When normally mounted (with vibration isolators in place, if any), the equipment should not suffer damage or fail to meet specified performance when subjected to the applicable vibration environment detailed herein or as specified in the detail specification or contract. Selection of the applicable vibration environment (type of excitation, frequency range and energy density level as a function of aircraft and application location) should be determined using the following criteria.

4.6.2.5.1.1 Equipment designed for installation in propeller aircraft. Equipment of this type should withstand random excitation over the frequency range of 15 to 500 Hz with energy density levels specified by the appropriate figure and table of MIL-STD-810, Method 514.

4.6.2.5.1.2 Equipment designed for installation in jet aircraft. Equipment of this type should withstand random excitation over the frequency range of 15 to 2000 Hz with energy density levels specified by the appropriate figure and table of MIL-STD-810, Method 514.

4.6.2.5.1.3 Equipment designed for installation in helicopters. Equipment of this type should withstand random excitation over the frequency range of 5 to 500 Hz with energy density levels specified by the appropriate figure and table of MIL-STD-810, Method 514. In addition, equipment of this type should withstand random excitation over the frequency range of 5 to 2000 Hz for the purposes of environmental stress screening (ESS).

4.6.2.5.1.4 Minimum integrity test. Equipment normally mounted on isolators, but with isolators removed, should be capable of meeting specified performance without suffering equipment damage, when subjected to a minimum integrity test within the vibration levels specified by the applicable figures and tables of MIL-STD-810, Method 514. The minimum integrity test should be applied as a basic test for items which are not designed for any of the other

vibration environments cited above. The vibration levels and durations are not based on application environments, but provide reasonable assurance that the equipment will withstand operations and handling during field installation, removal, and repair. The test exposures are based on "typical" electronic boxes and the maximum weight of the test item or subassembly should not exceed approximately 36 kilograms (80 pounds).

4.6.2.6 Shock.

4.6.2.6.1 Equipment. Equipment (with vibration isolators in place, if any) should not suffer damage or subsequently fail to provide the performance specified in the detail specification when subjected to 18 impact shocks of 20g, consisting of 3 shocks in opposite directions along each 3 mutually perpendicular axes, each shock impulse having a time duration of 6 to 9 milliseconds. The "g" value should be within ±10 percent when measured with a 0.2 to 250 Hz filter.

4.6.2.6.2 Mounting base (crash safety). With excursion stops or bumpers in place and with maximum rated load applied in a normal manner, the mounting base, individual isolators, or other attaching devices should withstand at least 12 impact shocks of 40g, consisting of 2 shocks in opposite directions along each of 3 mutually perpendicular axes. Each shock impulse should have time duration of 6 to 9 milliseconds. The "g" value should be within ±10 percent when measured with a 0.2 to 250 Hz filter. Bending and distortion should be permitted; however, there should be no failure to the attaching joints, and the equipment or dummy load should remain in place.

4.6.2.6.3 Bench handling. The equipment should withstand the shock environment encountered during servicing.

4.6.2.7 Sand and dust. The equipment should withstand, in both an operating and nonoperating condition, exposure to sand and dust particles as encountered in operational areas of the world.

4.6.2.8 Fungus. The equipment should withstand, in both an operating and nonoperating condition, exposure to fungus growth as encountered in tropical climates. In no case should overall spraying of the equipment be necessary to meet this requirement.

4.6.2.9 Salt atmosphere. The equipment should withstand, in both an operating and nonoperating condition, exposure to salt-sea atmosphere.

4.6.2.10 Explosive conditions. The equipment should not cause ignition of an ambient-explosive-gaseous mixture with air when operating in such an atmosphere.

5. DETAIL GUIDELINES

5.1 Detailed mechanical and electrical design. Specific requirements for individual equipment should be as specified in the detail specification or contract. The detailed mechanical and electrical design of specific equipment should be accomplished by the contractor, using the guidelines of this handbook and any detail specification to which it is subsidiary. This handbook is detailed only to the extent considered necessary to obtain the desired mechanical and electrical characteristics, performance and permanence of the same. The design layout and assembly of the units and their component parts should be such as to facilitate quantity production and to result in minimum size and weight.

5.2 Technical data. The requirements for the preparation and management of technical data during the various equipment design, development and production phases should be selected and tailored from MIL-T-31000 and specified in the contract. MIL-T-31000 defines the various types of drawings, associated lists and reports, along with the applicable Data Item Descriptions (DIDs) for listing in the Contract Data Requirements List (CDRL, DD Form 1423).

5.3 Quality assurance.

5.3.1 Responsibility for tests and inspections. The contractor is responsible for the performance of all tests and inspections as specified herein and in the detail specification or contract.

5.3.2 Government verification. All quality and safety assurance operations performed by the contractor will be subject to Government verification at any time. Verification consists of (a) surveillance of the operations to determine that practices, methods, and procedures of the quality and safety program requirements are being properly applied, (b) Government product inspection to measure quality and safety of product to be offered for acceptance, and (c) Government inspection of delivered items to assure compliance with the detail specification or contract.

5.3.3 Failure criteria. Unless otherwise specified in the detail specification or contract, the equipment, or portions thereof, should be considered to have failed the prescribed tests and inspections when any of the following conditions occur:

a. Equipment fails to meet the specified performance parameters, or fails within specified limits.

b. Structural failure or distortion.

c. Any condition that results in hazard to personnel or equipment safety.

d. Process control deficiencies.

e. Inspection and test procedure deficiencies.

f. Improper labeling, handling and packaging.

5.3.4 Problem/failure reporting and corrective action. Problem/failure reporting and corrective action of any failure occurring as a result of tests performed during incoming inspection should be specified in the contract or detail specification. In addition, a report depicting the yield or percentage of failures that occurred for each level of hardware should be specified in the contract or detail specification. For correction and consideration, a Government-Industry Data Exchange Program (GIDEP) should be established and specified in the contract or detail specification.

5.3.5 Design qualification tests. Design qualification testing should be performed prior to commitment to production. The requirements for design qualification of the equipment, to demonstrate that it conforms to specified performance and reliability requirements under specified combined environmental conditions, should be cited in the contract or detail specification. The requirements for environmental stress screening (ESS), to detect and correct latent manufacturing defects before the initiation of reliability accounting tests and applied in conjunction with the design qualification requirements, should be specified in the contract or detail specification. These tasks identify the details to be specified by the acquisition activity and the applicable Data Item Description (DIDs) for incorporation into the CDRL (DD Form 1423). Refer to MIL-STD-2218 for guidance on thermal design verification tests.

5.3.6 First article tests. The first article tests should be performed in conjunction with production contracts only. The requirement for the performance of first article tests should be specified in the detail specification or contract. First article tests are those tests to be performed on one (1) or more equipments (as required by the detail specification or contract) representative of production equipment to be supplied on contract or order.

5.3.6.1 Scope of tests. The requirement for first article tests should include all tests deemed necessary by the acquiring activity to determine that the equipment meets all of the requirements specified in the detail specification or contract. These tests should include environmental tests in accordance with the test methods and procedures of MIL-STD-810. Electromagnetic interference tests and test methods should be in accordance with MIL-STD-461.

5.3.7 Quality conformance tests. The requirement for the performance of quality conformance tests should be specified in the detail specification or contract. Quality conformance tests are those tests deemed necessary to determine that the equipments submitted for acceptance under the contract are

equivalent in performance and construction to the approved first article equipment. *Quality conformance tests should consist of the following:*

a. Individual tests to be performed on each equipment submitted for acceptance under the contract. These tests should include environmental stress screening (ESS) or burn-in.

b. Production reliability acceptance tests, to determine that production equipment continues to conform to performance and reliability requirements under specific environmental conditions, should be specified in the contract or detail specification. Production reliability acceptance tests identify those details to be specified by the acquisition activity, including test plan, sampling plan, environmental test conditions, performance requirements, and the applicable Data Item Descriptions (DIDs) for incorporation into the CDRL (DD Form 1423).

5.4 Preparation for delivery. Requirements for packaging, packing and marking for shipment of equipment should be specified in the detail specification or contract.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. This handbook is intended as a general design guide for use in the development and preparation of detail specifications and contracts for airborne electronic equipment to specify those requirements applicable to the specific equipment.

6.2 Details for inclusion in equipment specifications and contracts. Since this handbook only provides guidance, the detail specification (as prepared either by the Government, the equipment manufacturer for the Government, or the prime vehicle contractor) or contract must specify actual requirements from the multiple choices, tailoring, or exceptions available in the following paragraphs:

a. Classification requirements (see 1.2, 1.2.1).

b. Tailoring requirements (see 1.1.2 and Appendix B).

c. Warmup time (see 4.2.8.1).

d. Electromagnetic interference characteristics (see 4.2.9).

e. Electrostatic discharge control program (see 4.2.10).

f. Human engineering requirements (see 4.2.14).

g. Maintainability program requirements (see 4.2.16).

h. Equipment orientation (see 4.2.22).

i. Pressure and altitude requirements for specifying air leakage (see 4.2.24(g) and (h)).

j. Reliability program requirements (see 4.2.25).

k. Repairability requirements (see 4.2.26).

l. System safety program requirements (see 4.2.27.1).

m. Testability program requirements (see 4.2.29).

n. Thermal design requirements (see 4.2.30 and 4.2.30.1).

o. Special tools (see 4.2.31.2).

p. Parts control program requirements and GFB (see 4.3.1 thru 4.3.3).

q. Samples for nonstandard parts and material approval, if required.

r. Nonstandard material approval (see 4.4.4.1).

s. Environmental test methods, procedures, limits, etc. (see 4.6 thru 4.6.2.10).

t. Detail equipment design (see 5.1).

u. Technical data (see 5.2).

v. Equipment design qualification tests (see 5.3.5).

w. First article tests and sample (see 5.3.6, 5.3.6.1).

x. Accessory material and data to perform tests, if required.

y. Quality conformance requirements and tests (see 5.3.7).

z. Packaging requirements (see 5.4).

6.3 Use of helium. Helium should not be used as a pressurizing gas in sealed units containing electron tubes. When it is necessary to use helium for leak detection purposes, exposure should be limited to the time necessary for the test, followed by thorough purging.

6.4 Publications. In the design of electronic equipment, consideration should be given to the information contained in the following publication:

a. Handbook, Preferred Circuits Navy Aeronautical Electronic NAVAIR-16-1-519, Volume 2 Equipment.

6.5 Subject term (keyword) listing.

Classification
Design and construction
Environmental requirements
Material selection
Military standard
Parts selection
Processes and finishes
Tailoring requirements

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

Reviewer activities:
Army - MI, AR, AV
Navy - EC
Air Force - 15, 17, 99
DLA - ES

Preparing activity:
Navy - AS

(Project GDRQ-0164)

APPENDIX A

APPLICABLE DOCUMENTS

10. SCOPE

10.1 Scope. THIS APPENDIX IS NOT A MANDATORY PART OF THIS HANDBOOK. THE INFORMATION CONTAINED HEREIN IS INTENDED FOR GUIDANCE.

10.2 This appendix lists specifications, standards, handbooks and other publications selected for their applicability in the design and construction of airborne electronic equipment. Those parts and materials covered by documents listed in this appendix will be considered standard items. When part selection standards are referenced, the documents listed in the selection standard have the same status as those listed directly in this appendix and the parts they cover are also considered standard (unless otherwise restricted or banned for airborne applications).

10.3 Selection of documents for nonstandard parts and materials. When Appendix A does not provide a document suitable for the design requirement, selection of specifications and standards for nonstandard parts and materials should be specified by the contracting or design activity, unless otherwise cited herein or in the referenced MIL-HDBK-454 guidelines.

20. APPLICABLE DOCUMENTS

20.1 The documents listed in this appendix are applicable to the extent specified directly herein or in the referenced MIL-HDBK-454 guidelines.

20.2 Applicable issues. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation. Later revisions, amendments and documents superseding those listed in Appendix A may be used when preferred by the contractor. When a later issue is used, all applicable requirements of the later revision should be used.

20.3 Copies. Unless otherwise indicated, copies of federal and military specifications, standards and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. Addresses for ordering copies of non-government documents are listed on the following page.

APPENDIX A

30. APPLICATION OF SELECTED DOCUMENTS

30.1 It is not the intent that all documents listed in this appendix apply to all contracts, or that those that do apply necessarily apply in full. Before proceeding with the application of any document, all contractual specifications and requirements should be reviewed by the contractor, and the extent of applicability to the specific equipment design be determined.

Industry Association Addresses. Addresses for obtaining copies of non-government industry association documents are as follows:

AGMA	American Gear Manufacturers' Association 1500 King Street, Suite 201 Alexandria, VA 22314
AMS	Society of Automotive Engineers, Inc. (SAE) 400 Commonwealth Drive Warrendale, PA 15096
ANSI	American National Standards Institute 11 West 42nd Street New York, NY 10036
ASM	American Society for Metals Metals Park, OH 44073
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
AWS	American Welding Society 550 NW LeJeune Road Miami, FL 33126
EIA	Electronic Industries Association 2500 Wilson Blvd Arlington, VA 22201
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane, P.O. Box 1331 Piscataway, NJ 08855-1331
IPC	Institute for Interconnecting and Packaging Electronic Circuits 7380 North Lincoln Avenue Lincolnwood, IL 60646-1776

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NAS	National Standards Association 1200 Quince Orchard Boulevard Gaithersburg, MD 20878
NFPA	National Fire Protection Association Battery March Park Quincy, MA 02269
UL	Underwriters Laboratories, Inc. 333 Pfingsten Road Northbrook, IL 60062-2096

FEDERAL SPECIFICATIONS

A-A-52401	Bearing, Sleeve (Steel-Backed)
A-A-52414	Bearing, Roller, Thrust
A-A-55485	Pads, Electrical-Electronic Component, General Requirements for
L-P-516	Plastic Sheet and Plastic Rod, Thermosetting, Cast
V-T-285	Thread, Polyester
V-T-295	Thread, Nylon
FF-B-171	Bearings, Ball, Annular (General Purpose)
FF-B-187	Bearing, Roller, Tapered
FF-B-575	Bolts, Hexagon and Square
FF-N-836	Nut, Square, Hexagon, Cap, Slotted, Castle Knurled, Welding and Single Ball Seat
FF-R-556	Rivet, Solid, Small; Rivet, Split, Small; Rivet Tubular, Small; Flat Washer (Burr); and Cap, Rivet, General Purpose
FF-S-85	Screw, Cap, Slotted and Hexagon-Head
FF-S-86	Screw, Cap, Socket-Head
FF-S-92	Screw, Machine; Slotted, Cross Recessed or Hexagon Head

FF-S-200	Setscrews; Hexagon Socket and Spline Socket, Headless
FF-S-210	Setscrews, Square Head (Inch) and Slotted Headless (Inch & Metric)
FF-W-84	Washers, Lock (Spring)
FF-W-92	Washer, Flat (Plain)
FF-W-100	Washer, Lock (Tooth)
QQ-C-320	Chromium Plating (Electrodeposited)
QQ-N-290	Nickel Plating (Electrodeposited)
QQ-P-416	Plating, Cadmium (Electrodeposited)
TT-S-1732	Sealing Compound, Pipe Joint and Thread, Lead Free, General Purpose
VV-L-800	Lubricating Oil, General Purpose, Preservative (Water-Displacing, Low-Temperature)
VV-P-236	Petrolatum, Technical
ZZ-R-765	Rubber, Silicone
CCC-C-428	Cloth, Duck, Cotton; Fire, Water, Weather and Mildew-Resistant
MMM-A-121	Adhesive, Bonding, Vulcanized Synthetic Rubber to Steel
MMM-A-130	Adhesive, Contact
MMM-A-132	Adhesive, Heat Resistant, Airframe Structural, Metal to Metal
MMM-A-134	Adhesive, Epoxy Resin, Metal to Metal Structural Bonding
MMM-A-138	Adhesive, Metal to Wood, Structural

MMM-A-181	Adhesive, Phenol, Resorcinol, or Melamine Base
MMM-A-189	Adhesive, Synthetic-Rubber, Thermoplastic, General Purpose
MMM-A-1617	Adhesive, Rubber Base, General Purpose
MMM-A-1931	Adhesive, Epoxy, Silver Filled, Conductive

MILITARY SPECIFICATIONS

MIL-I-10	Insulating Compound, Electrical, Ceramic, Class L
MIL-M-14	Molding Compounds, Thermosetting
MIL-C-17	Cable, Radio Frequency, Flexible and Semirigid, General Specification for
MIL-S-61	Shunts, Instrument, External, 50 Millivolt (Lightweight Type)
MIL-T-152	Treatment, Moisture and Fungus Resistant, of Communications, Electronic and Associated Electrical Equipment
MIL-C-172	Cases, Bases, Mounting and Mounts, Vibration (For Use With Electronic Equipment in Aircraft)
MIL-V-173	Varnish, Moisture and Fungus Resistant (For Treatment of Communications, Electronic and Associated Equipment)
MIL-W-530	Webbing, Textile, Cotton, General Purpose, Natural or in Colors
MIL-C-572	Cords, Yarns and Monofilaments, Organic Synthetic Fiber
MIL-I-631	Insulation, Electrical, Synthetic-Resin Composition, Nonrigid
MIL-J-641	Jack, Telephone, General Specification for
MIL-P-642	Plug, Telephone and Accessory Screws, General Specification for
MIL-T-713	Twine, Fibrous: Impregnated, Lacing and Tying

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MIL-S-1222	Studs, Bolts, Hex Cap Screws, Socket Head Cap Screws and Nuts
MIL-I-1361	Instrument Auxiliaries, Electrical Measuring: Shunts, Resistors and Transformers
MIL-L-2105	Lubricating Oil, Gear, Multi-Purpose (Metric)
MIL-L-3150	Lubricating Oil, Preservative, Medium
MIL-I-3158	Insulation Tape, Electrical Glass-Fiber (Resin Filled); and Cord, Fibrous-Glass
MIL-I-3190	Insulation Sleeving, Electrical, Flexible, Coated, General Specification for
MIL-T-3530	Thread and Twine, Mildew Resistant or Water Repellant Treated
MIL-L-3661	Lampholders, Indicator Lights, Indicator-Light Housings, and Indicator-Light Lenses, General Specification for
MIL-I-3825	Insulation Tape, Electrical, Self-Fusing: For Use in Electronics, Communications and Allied Equipment
MIL-L-3890	Lines, Radio Frequency Transmission (Coaxial, Air Dielectric)
MIL-L-3918	Lubricating Oil, Instrument, Jewel Bearing
MIL-A-3920	Adhesive, Optical, Thermosetting
MIL-B-3990	Bearings, Roller, Needle, Airframe, Anti- Friction, Inch
MIL-W-4088	Webbings, Textile, Woven Nylon
MIL-S-5002	Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems
MIL-L-5057	Lights, Instrument, Individual, General Specification for
MIL-B-5087	Bonding, Electrical and Lightning Protection, for Aerospace Systems
MIL-W-5088	Wiring, Aerospace Vehicle

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MIL-H-5440	Hydraulic Systems, Aircraft, Design and Installation Requirements for
MIL-A-5540	Adhesive, Polychloroprene
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-F-5591	Fasteners, Panel; Nonstructural
MIL-R-5674	Rivets, Structural, Aluminum Alloy, Titanium Columbium Alloy, General Specification for
MIL-B-5687	Bearings, Sleeve, Washers, Thrust, Sintered, Metal Powder Oil Impregnated, General Specification for
MIL-L-6085	Lubricating Oil, Instrument, Aircraft, Low Volatility
MIL-L-6086	Lubricating Oil, Gear, Petroleum Base
MIL-L-6363	Lamps, Incandescent, Aircraft Service, General Specification for
MIL-C-6781	Control Panel, Aircraft Equipment, Rack or Console Mounted
MIL-B-6812	Bolts, Aircraft
MIL-W-6858	Welding, Resistance, Spot and Seam
MIL-I-7444	Insulation Sleeving, Electrical, Flexible
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series; General Specification for
MIL-P-7788	Panels, Information, Integrally Illuminated
MIL-M-7793	Meter, Time Totalizing
MIL-B-7838	Bolt, Internal Wrenching, 160 KSI FTU

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MIL-B-7883	Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum and Aluminum Alloys
MIL-R-7885	Rivets; Blind, Structural, Mechanically Locked Spindle and Friction Locked Spindle, General Specification for
MIL-T-7928	Terminal, Lug Splices Conductor, Crimp Style, Copper, General Specification for
MIL-S-7947	Steel, Sheet and Strip (1095) Aircraft Quality
MIL-L-7961	Lights, Indicators, Press to Test
MIL-M-7969	Motor, Alternating Current, 400 Cycle, 115/200-Volt System, Aircraft, General Specification for
MIL-S-8516	Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured
MIL-A-8576	Adhesive, Acrylic Base, for Acrylic Plastic
MIL-M-8609	Motors, Direct Current, 28 Volt System, Aircraft, General Specification for
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-H-8810	Handles, Control, Aircraft
MIL-R-8814	Rivets, Blind, Nonstructural Type
MIL-B-8831	Bolt, 180 KSI FTU and 108 KSI FSU, 450°F, Protruding and Flush Head, General Specification for
MIL-S-8879	Screw Threads, Controlled Radius Root With Increased Minor Diameter, General Specification for
MIL-H-8891	Hydraulic Systems, Manned Flight Vehicles, Type III, Design, Installation, and Data Requirements for, General Specification for
MIL-W-8939	Welding, Resistance, Electronic Circuit Modules
MIL-B-8942	Bearings, Plain, TFE Lined, Self-Aligning
MIL-B-8943	Bearings, Journal Plain and Flanged, TFE Lined

MIL-B-8948	Bearing, Plain Rod End, TFE Lined, Self-Aligning
MIL-C-9074	Cloth, Laminated, Sateen, Rubberized
MIL-M-10304	Meters, Electrical Indicating, Panel Type, Ruggedized, General Specification for
MIL-C-10544	Connectors, Plug and Receptacle (Electrical, Audio, Waterproof, Ten Contact, Polarized)
MIL-T-10727	Tin Plating: Electrodeposited or Hot-Dipped, for Ferrous and Nonferrous Metals
MIL-C-12520	Connector, Plug and Receptacle (Electrical, Waterproof), and Accessories, General Specification for
MIL-S-12883	Socket and Accessories for Plug-In Electronic Components, General Specification for
MIL-T-13020	Tape, Rubber, Unvulcanized, Splicing and Molding (Tapes TL-317/U and TL-318/U)
MIL-M-13231	Marking of Electronic Items
MIL-S-13282	Silver and Silver Alloys
MIL-S-13572	Spring, Helical, Compression and Extension
MIL-F-14072	Finishes for Ground Based Electronic Equipment
MIL-P-15024	Plates, Tags and Bands for Identification of Equipment
DOD-B-15072	Batteries, Storage, Lead-Acid, Portable, General Specification for (Metric)
MIL-I-15126	Insulation Tape, Electrical, Pressure Sensitive Adhesive and Pressure Sensitive Thermosetting Adhesive
MIL-T-15659	Terminal, Lug, Solder, Copper and Phosphor Bronze
MIL-L-15719	Lubricating Grease (High-Temperature, Electric Motor, Ball and Roller Bearings)
MIL-F-16552	Filter, Air Environmental Control System, Cleanable, Impingement (High Velocity Type)

MIL-I-16923	Insulating Compound, Electrical, Embedding
MIL-I-17205	Insulation Cloth and Tape, Electrical, Glass Fiber, Varnished
MIL-H-17672	Hydraulic Fluid, Petroleum, Inhibited
MIL-F-18240	Fastener, Element, Self-Locking, Threaded Fastener, 250°F
MIL-N-18307	Nomenclature and Identification for Electronic, Aeronautical and Aeronautical Support Equipment, Including Ground Support Equipment
MIL-I-18746	Insulation Tape, Nonadhering, Glass Fabric, Polytetrafluoroethylene Coated
MIL-I-19166	Insulation Tape, Electrical, High-Temperature, Glass Fiber, Pressure Sensitive
MIL-C-19311	Copper-Chromium Alloy Forgings, Wrought Rod, Bar and Strip (Copper Alloy Numbers 182, 184 and 185)
MIL-S-19500	Semiconductor Devices, General Specification for
MIL-I-22076	Insulation Tubing, Electrical, Non-Rigid, Vinyl, Very Low Temperature Grade
MIL-I-22129	Insulation Tubing, Electrical, Polytetrafluoroethylene Resin, Nonrigid
MIL-T-22361	Thread Compound, Antiseize, Zinc Dust-Petrolatum
MIL-S-22432	Servomotors, General Specification
MIL-S-22473	Sealing, Locking and Retaining Compounds: (Single-Component)
MIL-W-22759	Wire, Electric, Fluoropolymer-Insulated, Copper or Copper Alloy
MIL-S-22820	Servomotor-Tachometer Generator, AC, General Specification for
MIL-T-22821	Tachometer Generator, AC, General Specification for

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MIL-C-22931	Cable, Radio Frequency, Semirigid, Coaxial, Semi-Air Dielectric, General Specification for
MIL-F-22978	Fastener, Rotary, Quick-Operating, High Strength
MIL-I-23053	Insulation Sleeving, Electrical, Heat Shrinkable, General Specification for
MIL-B-23071	Blowers, Miniature, for Cooling Electronic Equipment, General Specification for
MIL-S-23190	Straps, Clamps, and Mounting Hardware, Plastic and Metal for Cable Harness Tying and Support
MIL-I-23264	Insulators, Ceramic, Electrical and Electronic, General Specification for
MIL-L-23398	Lubricant, Solid Film, Air Cured, Corrosion Inhibiting, NATO Code Number S-749
MIL-S-23586	Sealing Compound, Electrical, Silicone Rubber, Accelerator Required
MIL-I-23594	Insulation Tape, Electrical; High Temperature Polytetrafluoroethylene, Pressure-Sensitive
MIL-T-23648	Thermistor (Thermally Sensitive Resistor), Insulated, General Specification for
MIL-C-23806	Cable, Radio Frequency, Coaxial, Semirigid, Foam Dielectric, General Specification for
MIL-G-23827	Grease, Aircraft and Instrument, Gear and Actuator Screw
MIL-M-24041	Molding and Potting Compound, Chemically Cured, Polyurethane
MIL-I-24092	Insulating Varnishes and Solventless Resins for Application by the Dip Process
MIL-G-24139	Grease, Multi-Purpose, Water Resistant
MIL-A-24179	Adhesive, Flexible Unicellular-Plastic Thermal Insulation
MIL-I-24204	Insulation, Electrical, High Temperature, Bonded, Synthetic Fiber Paper

MIL-G-24211	Gaskets, Waveguide Flange, General Specification for
MIL-R-24243	Rivet, Blind, Nonstructural, Retained Mandrel, General Specification for
MIL-S-24251	Shields, Retainer (Bases), and Adapters, Electron Tube, Heat Dissipating, General Specification for
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive
DOD-G-24508	Grease, High Performance, Multi-Purpose (Metric)
MIL-I-24768/1	Insulation, Plastic, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin (GME)
MIL-I-24768/2	Insulation, Plastic, Laminated, Thermosetting, Glass-Cloth, Epoxy-Resin (GEE)
MIL-I-24768/3	Insulation, Plastic, Laminated, Thermosetting, Glass-Cloth, Epoxy-Resin (GEB)
MIL-I-24768/7	Insulation, Plastic, Laminated, Thermosetting, Glass-Cloth, Polytetrafluoroethylene-Resin (GTE)
MIL-I-24768/8	Insulation, Plastic, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin (GMG)
MIL-I-24768/9	Insulation, Plastic, Laminated, Thermosetting, Nylon-Fabric-Base, Phenolic-Resin (NPG)
MIL-I-24768/10	Insulation, Plastic, Laminated, Thermosetting, Paper-Base, Phenolic-Resin (PBE)
MIL-I-24768/11	Insulation, Plastic, Laminated, Thermosetting, Paper-Base, Phenolic-Resin (PBG)
MIL-I-24768/12	Insulation, Plastic, Laminated, Thermosetting, Paper-Base, Phenolic-Resin (PBM)
MIL-I-24768/13	Insulation, Plastic, Laminated, Thermosetting, Cotton-Fabric-Base, Phenolic-Resin (FBE)
MIL-I-24768/14	Insulation, Plastic, Laminated, Thermosetting, Cotton-Fabric-Base, Phenolic-Resin (FBG)
MIL-I-24768/16	Insulation, Plastic, Laminated, Thermosetting, Cotton-Fabric-Base, Phenolic-Resin (FBM)

MIL-I-24768/17	Insulation, Plastic, Laminated, Thermosetting, Glass-Cloth, Silicone-Resin (GSG)
MIL-N-25027	Nut, Self-Locking, 250°F, 450°F and 800°F
MIL-K-25049	Knobs, Control, Electronic Equipment, General Specification for
MIL-A-25463	Adhesive, Film Form, Metallic Structural Sandwich Construction
MIL-L-25467	Lighting, Integral, Aircraft Instrument, General Specification for
MIL-P-25518	Plastic Material, Silicone Resin, Glass Fiber Base, Low-Pressure Laminated
MIL-L-27160	Lighting, Instrument, Integral, White, General Specification for
MIL-W-27265	Webbing, Textile; Woven Nylon, Impregnated
MIL-R-27384	Rivet, Blind, Drive Type
MIL-C-27500	Cable, Power, Electrical and Cable Special Purpose, Shielded and Unshielded, Electrical, General Specification for
MIL-D-28728	Dial, Control, Multi-Turn Counters, General Specification for
MIL-M-28787	Modules, Standard Electronic, General Specification for
MIL-D-28803	Display Optoelectric, Readouts, Blacklighted Segmented, General Specification for
MIL-P-29590	Power Supplies, Airborne, Electronic, General Specification for
MIL-T-31000	Technical Data Packages, General Specification for
MIL-M-38510	Microcircuits, General Specification for (Inactive)

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MIL-PRF-38534	Hybrid Microcircuits, General Specification for
MIL-PRF-38535	Integrated Circuits (Microcircuits) Manufacturing, General Specification for
MIL-C-39006/22	Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte) Tantalum (Polarized, Sintered Slug), 85°C (Voltage Derated to 125°C), Established Reliability, Style CLR79
MIL-C-39006/25	Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte), Tantalum (Polarized, Sintered Slug) (Extended Range), 85°C (Voltage Derated to 125°C), Established Reliability, Style CLR81
MIL-T-43435	Tape, Lacing and Tying
MIL-G-45204	Gold Plating, Electrodeposited
MIL-L-46010	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
MIL-S-46049	Strip, Metal, Carbon Steel, Cold Rolled, Hardened and Tempered, Spring Quality
MIL-A-46050	Adhesive, Cyanoacrylate, Rapid Room-Temperature Curing, Solventless
MIL-I-46058	Insulating Compound, Electrical (for Coating Printed Circuit Assemblies)
MIL-P-46112	Plastic Sheet and Strip, Polyimide
MIL-A-46146	Adhesive-Sealants, Silicone, RTV, Non-Corrosive (For Use With Sensitive Metals and Equipment)
MIL-S-46163	Sealing, Lubricating and Wicking Compounds: Thread Locking, Anaerobic, Single Component
MIL-I-46852	Insulation Tape, Electrical, Self-Adhering, Unsupported Silicone Rubber
MIL-A-47315	Adhesive, Polyurethane

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MIL-A-47318	Adhesive, Copolymer Polyurethane
MIL-A-48611	Adhesive System, Epoxy-Elastomeric, for Glass-To-Metal
MIL-B-49030	Batteries, Dry (Alkaline)
MIL-B-49430	Batteries, Non-Rechargeable, Lithium Sulfur Dioxide
MIL-B-49436	Batteries, Rechargeable, Nickel-Cadmium, Sealed
MIL-I-49456	Insulation Sheet, Electrical, Silicone Rubber, Thermally Conductive, Fiberglass Reinforced
MIL-B-49458	Batteries, Non-Rechargeable, Lithium Manganese Dioxide
MIL-R-50781	Resolver, Electrical, Linear, General Specification for
MIL-A-52194	Adhesive, Epoxy (for Bonding Glass Reinforced Polyester)
MIL-S-55041	Switches, Waveguide, General Specification for
MIL-C-55116	Connectors, Miniature, Audio, Five-Pin and Six-Pin, General Specification for
MIL-B-55130	Batteries, Rechargeable, Nickel-Cadmium, Sealed
MIL-T-55156	Terminals, Lug, Splices, Conductor; Screw Type, General Specification for
MIL-T-55164	Terminal Boards, Molded, Barrier, Screw and Stud Types, and Associated Accessories, General Specification for
MIL-C-55181	Connectors, Plug and Receptacle, Intermediate Power (Electrical, Waterproof) Type MW, General Specification for
MIL-O-55310	Oscillator, Crystal Controlled, General Specification for
MIL-A-55339	Adapters, Connector, Coaxial, Radio Frequency (Between Series and Within Series), General Specification for
MIL-T-55631	Transformers, Intermediate Frequency, Radio Frequency and Discriminator, General Specification for
MIL-C-81021	Copper-Beryllium Alloy (Copper Alloy Numbers C17500 and C17510), Strip

MIL-W-81044	Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane-imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy
MIL-A-81236	Adhesive, Epoxy Resin With Polyamide Curing Agent
MIL-A-81253	Adhesive, Epoxy Resin With Polyamine Curing Agent
MIL-M-81288	Mounting Bases, Flexible Plastic Foam
MIL-G-81322	Grease, Aircraft, General Purpose, Wide Temperature Range
MIL-L-81329	Lubricant, Solid Film, Extreme Environment, NATO Code Number S-1737
MIL-E-81512	Encoder, Shaft Position to Digital, Contact Type, Altitude Reporting, General Specification for
MIL-I-81550	Insulating Compound, Electrical, Embedding, Reversion Resistant Silicone
MIL-B-81744	Barrier Coating Solution, Lubricant Migration Deterring
MIL-S-81746	Servtorqs, General Specification for
MIL-B-81757	Batteries and Cells, Storage, Nickel-Cadmium, Aircraft, General Specification for
MIL-I-81765	Insulating Components, Molded, Electrical, Heat Shrinkable, General Specification for
MIL-C-81774	Control Panel, Aircraft, General Requirements for
MIL-B-81793	Bearings, Ball, Annular, for Instruments and Precision Rotating Components
MIL-B-81934	Bearings, Sleeve, Plain and Flanged, Self-Lubricating, General Specification for
MIL-B-81936	Bearing, Plain, Self-Aligning (BeCu Ball, CRES Race), General Specification for
MIL-S-81963	Servo Components, Precision Instrument, Rotating, Common Requirements and Tests, General Specification for
MIL-A-83377	Adhesive Bonding (Structural) for Aerospace and Other Systems, Requirements for

MIL-S-83502	Sockets, Plug-In Electronic Components, Round Style, General Specification for
MIL-C-83503	Connectors, Electrical, Flat Cable, and/or Printed Wiring Board, Nonenvironmental, General Specification for
MIL-R-83516	Relays, Reed, Dry, General Specification for
MIL-T-83721	Transformers, Variable, Power, General Specification for
MIL-S-83731	Switch, Toggle, Unsealed and Sealed Toggle, General Specification for
MIL-S-83734	Sockets, Plug-In Electronic Components, Dual-in-Line Packages (DIPS) and Single-in-Line Packages (SIPs), General Specification for
MIL-B-83769	Batteries, Storage, Lead-Acid, General Specification for
MIL-I-85080	Insulation Sleeving, Electrical, Shrinkable Without Heat, General Specification for
MIL-E-85082	Encoders, Shaft Angle to Digital, General Specification for
MIL-R-85725	Rack, Integrated Avionics, Forced Air Cooled, General Specification for
MIL-E-85726	Enclosure, Standard Avionics, Forced Air Cooled, General Specification for
MIL-L-85762	Lighting, Aircraft, Interior, Night Vision Imaging System (NVIS) Compatible, General Specification for
MIL-A-87135	Adhesives, Non-Conductive, for Electronics Application
MIL-D-87157	Displays, Diode, Light Emitting, Solid State, General Specification for

FEDERAL STANDARDS

FED-STD-H28	Screw-Thread Standards for Federal Services
FED-STD-595	Colors Used in Government Procurement

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MILITARY STANDARDS

MIL-STD-12	Abbreviations for Use on Drawings, Specifications, Standards and in Technical Documents
MIL-STD-22	Welded Joint Design
MIL-STD-108	Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-195	Marking of Connections for Electrical Assemblies
MIL-STD-196	Joint Electronics Type Designation System
MIL-STD-198	Capacitors, Selection and Use of
MIL-STD-199	Resistors, Selection and Use of
MIL-STD-200	Electron Tubes, Selection of
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-248	Welding and Brazing Procedure and Performance Qualification
MIL-STD-276	Impregnation of Porous Metal Castings and Powdered Metal Components
MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-411	Aircrew Station Altering Systems
MIL-STD-470	Maintainability Program for Systems and Equipment
MIL-STD-471	Maintainability Verification/Demonstration/Evaluation
MIL-STD-681	Identification Coding and Application of Hook-Up and Lead Wire
MIL-STD-683	Crystal Units (Quartz) and Crystal Holders (Enclosures) and Oscillators, Selection of

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MIL-STD-701	Lists of Standard Semiconductor Devices
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-710	Synchros, 60 and 400 Hz, Selection and Application of
MIL-STD-783	Legends for Use in Aircrew Stations and on Airborne Equipment
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-838	Lubrication of Military Equipment
MIL-STD-883	Test Methods and Procedures for Microelectronics
MIL-STD-889	Dissimilar Metals
MIL-STD-965	Parts Control Program*
MIL-STD-983	Substitution List for Microcircuits
MIL-STD-1130	Connections, Electrical, Solderless, Wrapped
MIL-STD-1132	Switches and Associated Hardware, Selection and Use of
MIL-STD-1189	Standard Department of Defense Bar Code Symbology
MIL-STD-1277	Splices, Chips, Terminals, Terminal Boards, Binding Posts, Electrical
MIL-STD-1279	Meters, Electrical Indicating, Selection and Use of
MIL-STD-1285	Marking of Electrical and Electronic Parts
MIL-STD-1286	Transformers, Inductors, and Coils, Selection and Use of
MIL-STD-1327	Flanges, Coaxial and Waveguide; and Coupling Assemblies, Selection of
MIL-STD-1328	Couplers, Directional, Selection of
MIL-STD-1329	Switches, RF Coaxial, Selection of

* MIL-STD-965 is planned for retention and will be redefined as either a standard practice or an acquisition guideline. A final decision is due by January 1996.

MIL-STD-1334	Process for Barrier Coating of Anti-Friction Bearings
MIL-STD-1346	Relays, Selection and Application of
MIL-STD-1352	Attenuators, Fixed and Variable, Selection of
MIL-STD-1353	Electrical Connectors, Plug-In Sockets and Associated Hardware, Selection and Use of
MIL-STD-1358	Waveguides, Rectangular, Ridge and Circular, Selection of
MIL-STD-1360	Fuses, Fuseholders and Associated Hardware, Selection and Use of
MIL-STD-1378	Requirements for Employing Standard Electronic Modules
MIL-STD-1389	Design Requirements for Standard Electronic Modules
MIL-STD-1390	Level of Repair Analysis (LORA)
MIL-STD-1395	Filters and Networks, Selection and Use of
MIL-STD-1399	Interface Standard for Shipboard Systems, Section 300 Electric Power, Alternating Current (Metric)
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-1498	Circuit Breakers, Selection and Use of
MIL-STD-1516	Unified Code for Coatings and Finishes of DOD Equipment
MIL-STD-1553	Digital Time Division Command/Response Multiplex Data Buss
MIL-STD-1562	Lists of Standard Microcircuits
MIL-STD-1595	Qualification of Aircraft, Missile and Aerospace Fusion Welders
MIL-STD-1629	Procedures for Performing a Failure Mode, Effects and Criticality Analysis
MIL-STD-1636	Adapters, Coaxial to Waveguide, Selection of
MIL-STD-1637	Dummy Loads, Electrical, Waveguide, Coaxial, and Stripline, Selection of

MIL-STD-1638	Waveguide Assemblies, Rigid and Flexible, Selection of
MIL-STD-1639	Power Dividers, Power Combiners, and Power Divider/ Combiners, Selection of
MIL-STD-1640	Mixer Stages, Radio Frequency, Selection of
MIL-STD-1646	Servicing Tools for Electric Contacts and Terminations, Selection and Use of
MIL-STD-1788	Avionics Interface Design Standard
MIL-STD-1812	Type Designation, Assignment and Method for Obtaining
MIL-STD-1861	Electrical and Electronic Assemblies, Boards, Cards and Associated Hardware, Selection and Use of
DOD-STD-1866	Soldering Process, General (Non-Electrical) (Metric)
MIL-STD-2038	Requirements for Employing Standard Power Supplies
MIL-STD-2113	Radio Frequency Circulators and Isolators, Selection of
MIL-STD-2120	Connectors, Electromagnetic Interference (EMI) Filter Contact
MIL-STD-2162	Amplifiers, Radio Frequency and Microwave, Solid State, Selection of
MIL-STD-2175	Castings, Classification and Inspection of
MIL-STD-2200	Requirements for Employing Standard Enclosure Systems
MIL-STD-2218	Thermal Design, Analysis, and Test Procedures for Airborne Electronic Equipment
MIL-STD-2219	Fusion Welding for Aerospace Applications
MS27212	Terminal Board Assembly, Molded-In Stud, Electric
MS33522	Rivets, Blind, Structural, Mechanically Locked and Friction Retainer Spindle (Reliability and Maintainability), Design and Construction Requirements for

MS33540	Safety Wiring and Cotter Pinning, General Practices for
MS33557	Nonstructural Rivets for Blind Attachment, Limitations for Design and Usage

MILITARY HANDBOOKS

MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structures
MIL-HDBK-216	RF Transmission Lines and Fittings
MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-218	Application of Electrical Resolvers
MIL-HDBK-225	Synchros, Descriptions and Operation
MIL-HDBK-231	Encoders, Shaft Angle to Digital
MIL-HDBK-246	Program Managers Guide for the Standard Electronic Modules Program
MIL-HDBK-248	Acquisition Streamlining
MIL-HDBK-251	Reliability/Design, Thermal Applications
MIL-HDBK-253	Guidance for the Design and Test of Systems Protected Against the Effects of Electromagnetic Energy
MIL-HDBK-263	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronics Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices) (Metric)
MIL-HDBK-274	Electrical Grounding for Aircraft Safety
MIL-HDBK-275	Guide for the Selection of Lubricant Fluids and Compounds for Use in Flight Vehicles and Components
MIL-HDBK-402	Guidelines for Implementation of DOD Parts Control Program
MIL-HDBK-454	General Guidelines for Electronic Equipment
MIL-HDBK-419	Ground, Bonding and Shielding for Electronic Equipments and Facilities

MIL-HDBK-472	Maintainability Prediction
MIL-HDBK-660	Fabrication of Rigid Waveguide Assemblies (Sweep Bends and Twists)
MIL-HDBK-691	Adhesive Bonding
MIL-HDBK-730	Materials Joining
MIL-HDBK-1553	Multiplex Application Handbook
MIL-HDBK-2000	Soldering of Electrical and Electronic Assemblies
MIL-BUL-103	List of Standardized Military Drawings (SMDS)

OTHER GOVERNMENT DOCUMENTS

NAVAIR-16-1-519, Vol. 2	Handbook, Preferred Circuits Navy Aeronautical Electronic Equipment
10 CFR 20	Code of Federal Regulations, Title 10, Chapter 1, 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

VHSIC Interoperability Standards. Includes specifications for the TM-bus, ETM bus, Pi bus, and VHSIC Electrical Specification. (Copies available from Naval Research Laboratory, Code 5305, Washington, DC 20375-5000.)

Tester Independent Support Software System (TISSS) Specifications (Copies available from TISSS Program Office, RADC/RBR, Griffiss Air Force Base, NY 13441-5700).

NON-GOVERNMENT DOCUMENTS

SAE AMS 3638E	Plastic Tubing, Electrical Insulation, Irradiated Polyolefin, Pigmented, Semi-Rigid, Heat-Shrinkable 2 to 1 Shrink Ratio
SAE AMS 3653D	Tubing, Electrical Insulation, Standard Wall, Extruded Polytetrafluoroethylene (PTFE)
SAE AMS 3654B	Tubing, Electrical Insulation, Light Wall, Extruded Polytetrafluoroethylene (PTFE)

SAE AMS 3655A	Tubing, Electrical Insulation, Thin Wall, Extruded Polytetrafluoroethylene (PTFE)
ASTM A29/A29M	Steel Bars, Carbon and Alloy, Hot Wrought and Cold Finished, General Requirements for
ASTM A228/A228M	Steel Wire, Music Spring Quality
ASTM A313	Chromium-Nickel Stainless and Heat Resisting Steel Spring Wire
ASTM A588/A558M	Steel, Structural, High-Strength Low Alloy Structural, with 50 KSI (345 MPA), Minimum Yield Point to 4 In. (100 MM) Thick
ASTM A682	Steel, Strip, High Carbon, Cold Rolled, Spring Quality, General Requirements for
ASTM A684/A684M	Steel, Strip, High Carbon, Cold Rolled, Standard Specification for
ASTM B134	Wire, Brass
ASTM B159	Wire, Phosphor Wire (Metric)
ASTM B194	Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B196/B196M	Copper-Beryllium Alloy Rod and Bar
ASTM B197/B197M	Copper-Beryllium Alloy Wire
ASTM B206	Copper-Nickel-Zinc Alloy (Nickel Silver) Wire and Copper Nickel Alloy Wire (Metric)
ASTM B522	Gold-Silver-Platinum Electrical Contact Alloy
ASTM B633	Electrodeposited Coatings of Zinc on Iron and Steel
ASTM D495	Insulation, Solid Electrical, High Voltage, Low Current, Dry Arc Resistance of
ASTM D635	Plastics, Self-Supporting, in a Horizontal Position, Rate of Burning and/or Extent of Time of, Burning of
ASTM D1000	Pressure-Sensitive Adhesive Coated Tapes Used for Electrical Insulation, Methods of Testing

ASTM D3295	PTFE Tubing, Specification for
ASTM D4956	Sheeting, Retroreflective, For Traffic Control
ASTM F872	Filter Unit, Air Conditioning, Viscous Impingement Type, Cleanable
ANSI/IPC-D322	Guidelines for Selecting Printed Wiring Board Sizes Using Standard Panel Sizes
ANSI C95.1	Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 KHz to 100 GHz
ANSI C95.2	Radio Frequency Radiation Hazard Warning Symbol
ANSI N2.1	Radiation Symbol
EIA RS-310-C	Cabinets, Racks, Panels and Associated Equipment
IEEE 200	Electrical and Electronic Parts and Equipments, Reference Designations for
IEEE 1076	Manual, VHDL Language Reference
NAS498	Bolts, Shear, 95 KSU FSU
NAS547	Fastener, Rotary, Quick-Operating, High Strength
NAS1686	Rivet, Blind, Aluminum Sleeve, Mechanically Locked, Spindle, Bulbed
NAS1687	Rivet, Blind, Monel and Inconel Sleeve, Mechanically Locked Spindle, Bulbed
NFPA 70	National Electrical Code
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

Metals Handbook (Vol I) (ASM)

American Gear Manufacturers Association (AGMA)

APPENDIX B

SAMPLE TAILORING GUIDE

10. SCOPE

10.1 Scope. THIS APPENDIX IS NOT A MANDATORY PART OF THIS HANDBOOK. THE INFORMATION CONTAINED HEREIN IS INTENDED FOR GUIDANCE.

10.2 This appendix provides a sample tailoring guide for MIL-HDBK-5400 based on the relationship of tailoring specific guidelines during various development and production phases as defined in MIL-HDBK-248. This guide is not intended to be restrictive as to the methods/factors to be considered for tailoring applications. Examples of other methods/factors concerned with tailoring of MIL-HDBK-5400 requirements are shown in paragraph 40.

20. APPLICABLE DOCUMENTS (Reference Only)

MIL-HDBK-248 Acquisition Streamlining

30. APPLICATION OF SAMPLE TAILORING GUIDE

30.1 The sample tailoring guide contained herein cross-references indications of tailoring applicability for MIL-HDBK-5400 requirements to various phases of item development and production as defined in MIL-HDBK-248. Codes and abbreviations used in the sample tailoring guide table are as follows:

Tailoring Requirements

N-	Not applicable this phase
A-	Applicable this phase
T-	Essentially a "tailoring" paragraph
G-	General statement - tailoring not required

Program Phases

CON-	Conceptual (Research)
D&V-	Demonstration & Validation
FSED-	Full Scale Engineering Development
PROD-	Production

30.2 Guide for the extent of tailoring to be effected during program phases.

Conceptual (Research) - Specifications and standards requirements should be tailored and limited to minimum technical design objectives and broad basic performance and functional requirements. Application of "cost driver" requirements should be very limited.

Demonstration & validation - Specifications and standards requirements should be tailored again to upgrade and more clearly define the technical objectives relating to design, performance and functional demonstration requirements for the prototype item. Consideration of "cost driver" requirements should be expanded.

Full scale engineering development - Specifications and standards requirements should be tailored for maximum compatibility of the ultimate engineering design with the operational system requirements. The application of "cost driver" requirements such as configuration control, quality assurance, reliability, data and documentation, packaging, packing, preservation and transportation should be given special consideration and definition in anticipation of future procurement. Pertinent general military design requirements should be critically tailored for each application. A tailored configuration and product baseline should be established prior to entering the production phase.

Production - Proper application of tailored requirements during the engineering design/prototype phase should preclude the necessity for application of additional military requirements and tailoring during the production phase, except for possible refinement of some requirements.

40. OTHER CONSIDERATIONS FOR TAILORING

40.1 This appendix is limited to guidance for tailoring MIL-HDBK-5400 guidelines to the development and production phases of a program. There are, however, many other factors which can provide the basis for tailoring to modify, limit, combine, or eliminate specific requirements consistent with the minimum level necessary to provide cost effective system performance and program management. Below is a list of some other areas which may provide basis for tailoring of specific requirements relative to those areas of consideration. Refer to MIL-HDBK-248 for additional guidance relative to acquisition streamlining and tailoring of requirements.

Mission requirements
Equipment application
Environmental/test requirements
Interface requirements with other systems/equipment
Operational./logistics requirements
Software and technical data requirements
Human factors requirements
Configuration management requirements
Reliability/maintainability requirements
Quality assurance requirements
Packaging, packing, handling, storage and transportation requirements

APPENDIX B

PARAGRAPH	DESCRIPTION	CON	D&V	FSED	PROD
4.1.1	Tailoring of MIL-HDBK-454 guidelines	G	G	G	G
4.1.2	Standard hardware acquisition and reliability program (SHARP)	N	N	A	A
4.1.3	Requirements, tables and figures	G	G	G	G
4.2	Design and construction	G	G	G	G
4.2.1	Untitled	G	G	G	G
TABLE I	General design and construction				
4.2.2	Accessibility	N	N	A	A
4.2.3	Anti-jamming	N	A	A	A
4.2.4	Castings, metal	N	N	N	A
4.2.5	Corona and electrical breakdown prevention	A	A	A	A
4.2.6	Derating	N	A	A	A
4.2.7	Electrical overload protection	N	N	A	A
4.2.7.1	Resettable circuit protectors	N	N	A	A
4.2.7.2	Spare fuses	N	N	A	A
4.2.8	Electrical power	N	N	A	A
4.2.8.1	Warm-up time	N	N	A	A
4.2.8.2	Untitled	N	N	A	A
4.2.9	Electromagnetic interference control	N	N	A	A
4.2.10	Electrostatic discharge control	A	A	A	A
4.2.11	Enclosures	N	N	A	A
4.2.11.1	Standardized avionics enclosures	N	N	A	A
4.2.11.2	Other enclosures	N	N	A	A
4.2.12	Fabrication	N	N	A	A
4.2.13	Grounding, bonding and shielding	A	A	A	A
4.2.14	Human engineering	N	N	A	A
4.2.15	Interchangeability	N	N	N	A
4.2.15.1	Interchangeability of reordered equipment	N	N	N	A
4.2.16	Maintainability	N	N	A	A
4.2.17	Marking	N	N	A	A
4.2.17.1	Labels	N	N	N	A
4.2.17.2	Wire coding for identification	N	N	N	A
4.2.17.3	Operational program marking	N	N	N	A
4.2.18	Microphonics	G	G	G	G
4.2.19	Moisture pockets	N	N	N	A
4.2.20	Multiplexing	N	N	A	A
4.2.21	Nomenclature assignment	N	N	N	A
4.2.22	Orientation	N	N	A	A
4.2.23	Panels	N	A	A	A
4.2.23.1	Control panels	N	A	A	A
4.2.23.2	Electroluminescent panels	N	A	A	A
4.2.23.3	Ranges of adjustable parts	N	A	A	A

PARAGRAPH	DESCRIPTION	CON	D&V	FSED	PROD
4.2.24	Pressurization	N	N	A	A
4.2.25	Reliability	N	N	A	A
4.2.26	Repairability	N	N	A	A
4.2.27	Safety	G	G	G	G
4.2.27.1	System safety	G	G	G	G
4.2.27.2	Personnel Safety	A	A	A	A
4.2.28	Test provision	N	N	A	A
4.2.28.1	Built-in test devices	N	N	A	A
4.2.28.2	External test points	N	N	A	A
4.2.28.3	Failure effect	N	N	A	A
4.2.29	Testability program	N	N	A	A
4.2.30	Thermal design	N	N	A	A
4.2.30.1	Cooling design data	N	N	A	A
4.2.31	Tools	N	N	N	A
4.2.31.1	Setscrew wrenches	N	N	N	A
4.2.31.2	Special tool	N	N	N	A
4.2.31.3	Furnishing and stowing	N	N	A	A
4.2.32	Standardized power supplies	N	N	A	A
4.2.33	Workmanship	N	N	A	A
4.3	Parts selection	N	A	A	A
4.3.1	Government-furnished baseline (GFB)	N	A	A	A
4.3.1.1	Choice of parts	N	A	A	A
4.3.2	Nonstandard parts	N	A	A	A
4.3.3	Parts control program	N	A	A	A
4.3.4	Approval of parts	N	A	A	A
4.3.4.1	Contracts under category I	T	T	T	T
4.3.4.2	Contracts for equipment which fall under categories II and III	T	T	T	T
4.3.4.3	Reordered production equipment	T	T	T	T
4.3.4.3.1	Continuation of production	T	T	T	T
4.3.4.4	Replacing of approved parts	N	A	A	A
4.3.4.5	Equipment performance	G	G	G	G
TABLE II	Parts selection				
4.3.5	Substitution of parts	N	A	A	A
4.3.6	Batteries	N	A	A	A
4.3.7	Bearings	N	N	A	A
4.3.8	Capacitors	N	A	A	A
4.3.8.1	Fixed, tantalum electrolytic	N	A	A	A
4.3.8.2	Aluminum electrolytic	N	A	A	A
4.3.9	Circuit breakers	N	A	A	A
4.3.9.1	Manual operation	N	A	A	A
4.3.9.2	Position identification	N	A	A	A
4.3.9.3	Orientation	N	N	A	A

PARAGRAPH	DESCRIPTION	CON	D&V	FSED	PROD
4.3.10	Connectors, electrical	N	N	A	A
4.3.10.1	Mounting of electrical receptacles	N	N	N	A
4.3.10.2	Adjacent locations	N	N	N	A
4.3.10.3	Jacks	N	A	A	A
4.3.11	Controls (knobs, handles, dials)	N	A	A	A
4.3.12	Crystals (quartz and oscillator)	N	A	A	A
4.3.13	Fastener hardware	N	N	A	A
4.3.14	Filters, electrical	N	A	A	A
4.3.15	Fuses, fuseholders and associated hardware	N	N	A	A
4.3.16	Gears	N	N	A	A
4.3.17	Hydraulics	N	N	A	A
4.3.17.1	Aircraft	N	N	A	A
4.3.17.2	Missiles	N	N	A	A
4.3.17.3	Untitled	N	N	A	A
4.3.18	Lights and associated items	N	N	A	A
4.3.18.1	Indicator lights	N	A	A	A
4.3.18.2	Press to test indicator lights	N	A	A	A
4.3.18.3	Instrument lights	N	A	A	A
4.3.18.4	Lamps	N	A	A	A
4.3.18.5	Visual display and legend lights	N	A	A	A
4.3.18.6	Night vision compatibility	N	A	A	A
4.3.19	Meters	N	N	A	A
4.3.20	Microelectronic devices	N	N	A	A
4.3.21	Motors	N	A	A	A
4.3.21.1	Motors, alternating current	N	A	A	A
4.3.21.2	Motors, direct current	N	A	A	A
4.3.22	Readouts and displays	N	A	A	A
4.3.22.1	Readouts	N	A	A	A
4.3.22.2	Displays	N	A	A	A
4.3.23	Relays	N	A	A	A
4.3.24	Resistors	N	A	A	A
4.3.25	Semiconductor devices	N	A	A	A
4.3.26	Servodevices, rotary	N	A	A	A
4.3.27	Sockets, shields and pads	N	N	A	A
4.3.27.1	Sockets	N	N	A	A
4.3.27.2	Shields	N	N	A	A
4.3.27.3	Mounting pads	N	N	A	A
4.3.28	Springs	N	N	A	A
4.3.29	Standard electronic modules (SEMS)	N	N	A	A
4.3.30	Switches	N	N	A	A
4.3.30.1	Mounting	N	N	A	A
4.3.30.1.1	Rotary switches	N	N	A	A
4.3.30.1.2	Toggle switches	N	N	A	A

PARAGRAPH	DESCRIPTION	CON	D&V	FSED	PROD
4.3.31	Terminations	N	N	A	A
4.3.31.1	Number of wires per terminal or lug	N	N	A	A
4.3.31.2	Number of lugs per terminal	N	N	A	A
4.3.31.3	Number of wires in a connector contact	G	G	G	G
4.3.32	Transformers, inductors and coils	N	A	A	A
4.3.33	Tubes, electron	N	A	A	A
4.3.34	Waveguides and related items	N	N	A	A
4.3.35	Wire and cable	N	N	A	A
4.3.35.1	Wire and cable, internal	N	N	A	A
4.3.35.2	Wiring practices, internal	N	N	A	A
4.3.35.3	Wire and cable, external interconnection	N	N	A	A
4.3.35.4	External wiring practices	G	G	G	G
4.3.35.5	Cable, coaxial (RF)	N	N	A	A
4.3.35.6	Printed wiring	N	N	A	A
4.4	Material selection	N	N	A	A
4.4.1	Choice of materials	N	A	A	A
4.4.2	Polyvinyl chloride (PVC) materials	N	A	A	A
4.4.3	Standard materials	N	A	A	A
4.4.4	Nonstandard materials	N	A	A	A
4.4.4.1	Approval of nonstandard materials	N	A	A	A
TABLE III	Materials selection				
4.4.5	Adhesives	N	N	A	A
4.4.6	Arc-resistant materials	A	A	A	A
4.4.7	Conformal coating	N	N	A	A
4.4.8	Dissimilar metals	N	N	A	A
4.4.9	Encapsulation and embedment materials	N	N	N	A
4.4.10	Fibrous material, organic	N	N	A	A
4.4.11	Flammability of materials	N	N	A	A
4.4.12	Fungus-inert materials	N	A	A	A
4.4.13	Insulators, insulating and dielectric materials	N	A	A	A
4.4.14	Lubricants	N	N	A	A
4.4.15	Metals, corrosion-resistant	N	N	A	A
4.5	Processes and finishes	G	G	G	G
TABLE IV	Processes and finishes				
4.5.1	Protective platings and coating	G	G	G	G
4.5.1.1	Materials	G	G	G	G
4.5.1.2	Aluminum alloy	G	G	G	G
4.5.1.2.1	Surface, general	G	G	G	G
4.5.1.2.2	Surfaces, bonded and grounded	G	G	G	G
4.5.1.2.3	Surfaces, extreme wear-resistant	G	G	G	G
4.5.2	Magnesium and magnesium alloys	G	G	G	G
4.5.3	Zinc and zinc-plated parts	G	G	G	G
4.5.4	Finishes	N	N	A	A
4.5.4.1	Cases and front panels	N	N	A	A

APPENDIX B

PARAGRAPH	DESCRIPTION	CON	D&V	FSED	PROD
4.5.4.2	Fasteners and assembly screws	N	N	A	A
4.5.4.3	Other standard finishes	G	G	G	G
4.6	Environmental service guidelines	N	N	A	A
4.6.1	MIL-STD-810 environmental tests	T	T	T	T
4.6.1.1	Untitled	T	T	T	T
4.6.2	Equipment operational requirements	N	N	A	A
4.6.2.1	Temperature	N	N	A	A
4.6.2.1.1	Operating	N	N	A	A
TABLE V	Environmental conditions				
4.6.2.1.2	Nonoperating	N	N	A	A
4.6.2.2	Altitude	N	N	A	A
4.6.2.3	Temperature-altitude combination	N	N	A	A
4.6.2.4	Humidity	N	N	A	A
4.6.2.5	Vibration	N	N	A	A
4.6.2.5.1	Equipment normally mounted	N	N	A	A
4.6.2.5.1.1	Equipment designed for installation in propeller aircraft	N	N	A	A
4.6.2.5.1.2	Equipment designed for installation in jet aircraft	N	N	A	A
4.6.2.5.1.3	Equipment designed for installation in helicopters	N	N	A	A
4.6.2.5.1.4	Minimum integrity test	N	N	A	A
4.6.2.6	Shock	N	N	A	A
4.6.2.6.1	Equipment	N	N	A	A
4.6.2.6 2	Mounting base (crash safety)	N	N	A	A
4.6.2.6 3	Bench handling	N	N	A	A
4.6.2.7	Sand and dust	N	N	A	A
4.6.2.8	Fungus	N	N	A	A
4.6.2.9	Salt atmosphere	N	N	A	A
4.6.2.10	Explosive conditions	N	N	A	A

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