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SUPERSEDING

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(see 6.8)

MILITARY SPECIFICATION

ELECTRONIC EQUIPMENT, AIRBORNE, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for airborne electronic equipment for operation primarily in piloted aircraft. The detail performance and test requirements for a particular equipment shall be as specified in the detail specification for that equipment.

1.2 Classification. The electronic equipment for which the general requirements for design and manufacture are outlined shall be of the following classes, as specified (see 6.2):

- Class 1 - Equipment designed for 50,000 ft. altitude and continuous sea level operation over the temperature range of -54° to +55°C (+71°C intermittent operation).
- Class 1A - Equipment designed for 30,000 ft. altitude and continuous sea level operation over the temperature range of -54° to +55°C (+71°C intermittent operation).
- Class 1B - Equipment designed for 15,000 ft. altitude and continuous sea level operation over the temperature range of -40° to +55°C (+71°C intermittent operation).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to Commanding Officer, Naval Air Engineering Center, Engineering Specifications and Standards Department (Code 9313), Lakehurst, NJ 08733 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC GDRQ

- Class 2 - Equipment designed for 70,000 ft. altitude and continuous sea level operation over the temperature range of -54° to +71°C (+95°C intermittent operation).
- Class 3 - Equipment designed for 100,000 ft. altitude and continuous sea level operation over the temperature range of -54° to +95°C (+125°C intermittent operation).
- Class 4 - Equipment designed for 100,000 ft. altitude and continuous sea level operation over the temperature range of -54° to +125°C (+150°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 to the equipment.

2. APPLICABLE DOCUMENTS

* 2.1 Issues of documents. The documents listed in Appendix A of the issue in effect on the date of invitation for bids or request for proposals, form a part of this specification to the extent specified herein. Requirements of MIL-STD-454 invoked by this specification are limited to those documents appearing in Appendix A.

DOCUMENTS

See Appendix A

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

3. REQUIREMENTS

* 3.1 Parts, materials and processes. Parts, materials, and processes shall conform to applicable documents listed in Appendix A.

* 3.1.1 Selection of parts and materials. Parts and materials covered by documents listed in Appendix A are standard and shall be used whenever they are suitable for the purpose. Parts and materials shall be procured from QPL sources when qualification is a requirement of the part or material specification. Nonstandard parts and materials must be equivalent to or better than similar standard parts and materials. Parts selection and control shall be in accordance with MIL-STD-454, Requirement

22. When Appendix A fails to provide an applicable material specification or standard, the contractor shall use other established specifications or standards in the order of precedence set forth in MIL-STD-143. Materials selected from other than Appendix A are not standard, and approval must be obtained prior to their use in equipment. Each vendor source for a non-standard part or material, requires approval.

3.1.1.1 Approval of nonstandard parts and materials. In considering the approval of nonstandard parts and materials, 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 preproduction model.

3.1.1.1.1 Contracts under Category I. Approval of nonstandard parts and materials shall not be required under contracts or orders which fall under Category I.

* 3.1.1.1.2 Contracts for equipment which fall under Categories II and III. A request for the approval of the use of nonstandard parts and materials, except for metals, shall be submitted in accordance with applicable paragraphs herein. For a single contract covering like equipments which fall in both Categories II and III, parts and materials approval shall be required only for those items used in Category II equipments, and any new item sources or new nonstandard items used in Category III equipments. Approval of all nonstandard parts and materials used in the equipment shall be obtained by the contractor prior to delivery of any equipment required by the contract.

* 3.1.1.1.3 Reordered production equipment. A design review directed toward replacement of nonstandard parts and materials with standard parts and materials shall be performed on contracts for reordered equipment, whether reordered from the original contractor or from a different contractor.

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.

3.1.1.1.3.1 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 shall not be required.

* 3.1.1.1.4 Time schedule of material approval requests. The request for approval of nonstandard materials shall be made at the time that the material is selected for use in the equipment. 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.

* 3.1.1.1.5 Samples required for parts and material approvals. Samples of nonstandard parts and materials may be required by the procuring activity. These samples shall be submitted in quantities and to the destination specified by the procuring activity for tests and examination. Sample quantities to be specified will not exceed 1 ounce or 6 square inches of any material or 3 feet of wire or 3 units of any other part, except transformers, microcircuits, delay lines, blowers, and power tubes such as magnetrons and klystrons, where 1 unit is sufficient. Sample parts and materials may be tested to destruction by the procuring activity and will not be returned to the contractor. When there is more than one supplier for a part or material, parts or materials from each supplier shall be considered for separate submission.

3.1.1.2 Use of military part identifiers. Parts which require QPL approval, but which have no qualified vendors, shall not be identified with military part numbers.

3.1.1.3 Choice of parts and materials. Whenever an applicable specification provides more than one characteristic or tolerance for an item, the equipment manufacturer shall use in the equipment, items of broadest characteristics and of the greatest allowable tolerances that will fulfill the performance requirements of the equipment. When acceptable items of higher than minimum quality are readily available, the utilization of which would not increase the initial or life cycle cost to the procuring activity, they may be used. When maximum physical dimensions of an item are indicated in the applicable specification for the item, all new equipment shall be designed to accommodate the maximum physical size specified in order that all parts having the same type designation will be physically interchangeable in the equipment.

3.1.1.4 Replaceability by standard parts and materials. Whenever permission is granted by the procuring activity for a contractor to use items not in accordance with standard specifications for which approved

products exist, only because of nonavailability of standard items, the contractor shall arrange the equipment to permit replacement in the field of the nonstandard by the standard items. The standard item shall be listed in the technical manuals as the preferred replacement.

3.1.1.5 Equipment performance. The requirements of this specification with regard to the use of parts, materials, and processes, either standard or approved nonstandard, shall not relieve the contractor of the responsibility for complying with all equipment performance and other requirements set forth in the detail equipment specification or contract. Approvals for nonstandard parts and materials are contingent on subsequent satisfactory performance during preproduction and quality conformance tests and other required equipment tests.

* 3.1.1.6 Substitution of parts. The selection and application of substitute parts shall be in accordance with MIL-STD-454, Requirement 72.

* 3.1.2 Capacitors. Capacitors shall be in accordance with MIL-STD-454, Requirement 2.

3.1.3 Metal castings. Metal castings shall be in accordance with MIL-STD-454, Requirement 21.

3.1.4 Electrical connectors. Electrical connectors shall be in accordance with MIL-STD-454, Requirement 10.

3.1.4.1 Mounting of electric receptacles. Where practical, when receptacles are mounted on a vertical surface the largest polarizing or prime key or keyway of the receptacle shall be at the top center of the shell of the receptacle.

3.1.4.2 Adjacent locations. The use of identical connectors in adjacent locations shall be avoided. When the use of connectors of the same shell size in adjacent locations cannot be avoided, differences in keying arrangement shall be used to prevent mismatching.

3.1.5 Controls. Controls shall be in accordance with MIL-STD-454, Requirement 28.

* 3.1.5.1 Deleted.

3.1.5.2 Tuning dials. Tuning dials shall be in accordance with MIL-STD-454, Requirement 42.

3.1.5.3 Control panels. Control panels shall conform to MIL-C-6781. The design shall be approved by the procuring activity prior to fabrication. This design approval applies to panel layout only and does not authorize use of nonstandard parts on the panel.

3.1.5.4 Ranges of adjustable components. The electronic circuitry shall be designed to provide a reserve in the adjustment range from the normal adjustment setting of all variable components that require adjustment during operation or maintenance. This adjustment range shall 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 shall also be capable of compensating for variations resulting from replacement with parts within the tolerances specified.

3.1.6 Corrosion resistance. Materials shall be of corrosion-resistant types or shall be processed to resist corrosion.

3.1.6.1 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.

3.1.6.2 Ferrous alloys. Ferrous alloys shall be in accordance with MIL-STD-454, Requirement 15.

3.1.6.3 Aluminum alloy.

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

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

3.1.6.3.3 Aluminum surfaces, extreme wear resistant. Where bonding or grounding is not necessary, hard anodic finishes conforming to numbers E514, E515, or E516 of MIL-F-14072 may be applied to obtain extreme wear-resistant surfaces under Type II (MIL-F-14072) exposure on desired areas of aluminum alloys not subject to repeated high tensile stresses.

* 3.1.6.4 Cadmium-plating. Cadmium plating shall be in accordance with MIL-STD-454, Requirement 15.

3.1.6.5 Magnesium and magnesium alloys. Magnesium and magnesium alloys shall not be used except when approved or specified by the procuring 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.

3.1.6.6 Zinc and zinc-plated parts. Zinc and zinc-plated parts shall be given a dichromate treatment in accordance with QQ-Z-325, Type II, Class 2.

3.1.7 Dissimilar metals. Selection and protection of dissimilar metal combinations shall be in accordance with MIL-STD-454, Requirement 16.

3.1.8 Finishes. Unless contained in a hermetically sealed unit, part finishes (including hardware items of equipment not covered by subsidiary specifications) shall be resistant to corrosion. Finishes shall be capable of withstanding a 48 hour Salt Spray (Fog) test in accordance with ASTM B-117 without showing signs of corrosion beyond those established for the particular part, material, or finish specification. Where applicable, these parts shall have finishes providing suitable rates of heat transfer. Parts which are lubricated in equipment may be tested in a lubricated condition. Lusterless finishes shall be used on all surfaces visible to operating personnel. Where cleaning operations on metal parts are not specified in detail, they shall be in accordance with MIL-S-5002. It is not the intent that parts procured to the specifications listed in Appendix A must be refinished.

3.1.8.1 Cases and front panels. Equipment installed in the cockpit area shall be Lusterless Black, Color No. 37038 in accordance with FED-STD-595. Finish of all other equipment shall be Lusterless Gray Color No. 36231, in accordance with FED-STD-595.

3.1.8.2 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 shall 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 shall be finished in accordance with 3.1.8.1. Other external fasteners and assembly screws used for securing the internal parts to the chassis shall be similar in color to the surface upon which they appear.

3.1.8.3 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 shall be used.

3.1.9 Grounding. Grounding shall be in accordance with MIL-STD-454, Requirement 1.

3.1.10 Fastener hardware. Fastener hardware and techniques shall be in accordance with MIL-STD-454, Requirement 12.

3.1.11 Fungus-inert materials. Fungus-inert materials in accordance with MIL-STD-454, Requirement 4, shall be used.

3.1.12 Fuses, fuse holders, and associated hardware. Fuses, fuse holders, and associated hardware shall be in accordance with MIL-STD-454, Requirement 39. The insulating cap of a non-indicating fuse post shall have a hole 0.078 ± 0.002 inch in diameter and a maximum depth of 7/16 inch for contact with the metallic frame holding one end of the fuse to permit the insertion of a test prod. The fuse shall be wired so that voltage appearing at the test point will indicate that the fuse is good.

3.1.13 Insulators, insulating, and dielectric materials. Insulators, insulating, and dielectric materials shall be in accordance with MIL-STD-454, Requirement 11.

3.1.14 Arc-resistant materials. Arc-resistant materials shall be in accordance with MIL-STD-454, Requirement 26.

3.1.15 Jacks. Microphone jacks shall be type M641/5-1 and Headset jacks shall 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.

3.1.16 Marking. Items shall be marked in accordance with MIL-STD-454, Requirement 67. Marking shall not adversely affect the leakage path between conductors or any other factor of equipment performance.

3.1.16.1 Engineering design changes. To identify properly, deviations in articles of equipment resulting from engineering change proposals prepared by the contractor and approved by the procuring activity, marking of one of the following categories shall be assigned for use on each major or minor assembly in which the change has been incorporated:

- a. A change in the type designation of the article as included in a nameplate or other marking.
- b. The use of a modification symbol imprinted or affixed adjacent to but never on or to the right of the nameplate. A series of modification symbols shall be used for successive minor engineering changes not justifying a change in type designation.

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

* 3.1.16.3 Wire coding. Wires used for internal wiring shall be coded in accordance with MIL-STD-454, Requirement 20. Flat cable conductors may be identified at termination points. Hot or cold stamping shall be

allowed only on insulated wire which will not accept ink. Marking shall not be used on wires where the dielectric capability of the wire is reduced by such marking. Wire used for external wiring between units shall be coded in accordance with MIL-W-5088 (see 3.1.34).

3.1.17 Meters (electrical indicating and accessories). Meters shall be in accordance with MIL-STD-454, Requirement 51. External meter shunts shall be in accordance with MIL-STD-454, Requirement 40. Meters other than those in accordance with MIL-M-10304, color schemes W, B, Y, F and P, require procuring activity approval.

* 3.1.18 Relays. Relays shall be in accordance with MIL-STD-454, Requirement 57. Relays other than hermetically sealed types shall not be used. The selection and application of reed relays requires procuring activity approval.

3.1.19 Resistors. Resistors shall be in accordance with MIL-STD-454, Requirement 33.

3.1.19.1 Tapped resistors. The use of fixed and variable resistors having fixed taps, requires procuring activity approval.

3.1.20 Soldering. Soldering shall be in accordance with MIL-STD-454, Requirement 5.

3.1.20.1 Mechanical assemblies. Unless specifically approved by the procuring activity, no assembly shall depend solely on soft solder for mechanical strength, except for variable capacitor plates and sections and other relatively light parts that are in accepted commercial design and that have, by actual use, proved to be generally suitable for use in electronic equipment.

3.1.21 Springs. Springs shall be in accordance with MIL-STD-454, Requirement 41.

* 3.1.22 Switches. Switches shall be in accordance with MIL-STD-454, Requirement 58.

3.1.22.1 Rotary switches.

3.1.22.1.1 Indexing mechanism. Rotary switches shall have a positive mechanical index, locating each contact position. When operated normally, the switch indexing mechanism shall prevent the movable contact from coming to rest between contact positions.

3.1.22.1.2 Materials. Materials used in the construction of rotary switches shall be as follows:

- a. Contacts shall be silver alloy or silver plated, and shall be self-cleaning. Contacts using other metals are subject to approval of the procuring activity.
- b. Shafts shall be aluminum or corrosion-resistant material.
- c. Metal parts, other than contacts and shafts, shall be made of corrosion-resistant material, except that bushing and bearing assemblies may be brass suitably treated to prevent corrosion.

* 3.1.22.1.3 Mounting. Rotary switches with thru-panel shafts shall be designed for mounting to the panel by means of a single threaded bushing concentric with the shaft. A positive mechanical means, in addition to lock washers, shall be provided to prevent rotation of the switch body.

3.1.22.2 Toggle switches. The mounting of toggle switches shall be such that the handle of the switch operates in a vertical direction. The "off" position shall 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.

3.1.23 Terminals. Terminals shall be in accordance with MIL-STD-454, Requirement 19.

* 3.1.24 Deleted.

3.1.25 Tools (special). Special tools shall be in accordance with MIL-STD-454, Requirement 63.

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

3.1.27 Deleted.

* 3.1.28 Transformers and inductors. Transformers and inductors shall be in accordance with MIL-STD-454, Requirement 14.

* 3.1.29 Semiconductor devices and electron tubes.

* 3.1.29.1 Semiconductor devices. Semiconductor devices shall be in accordance with MIL-STD-454, Requirement 30.

- * 3.1.29.2 Electron tubes. Electron tubes shall be in accordance with MIL-STD-454, Requirement 29.
- * 3.1.30 Deleted.
- 3.1.31 Structural welding. Structural welding shall be in accordance with MIL-STD-454, Requirement 13.
- * 3.1.32 Wire (hookup). Hookup wire shall be in accordance with MIL-STD-454, Requirement 20.
- * 3.1.33 Wiring (internal). Internal wiring shall be in accordance with MIL-STD-454, Requirement 69.
 - 3.1.33.1 Printed wiring. Printed wiring shall be in accordance with MIL-STD-454, Requirement 17. Printed wiring boards shall be connected into the equipment by means of connectors. Printed wiring boards utilizing the conductor pattern as the direct contact with the mating connector shall not be used.
 - 3.1.34 Wiring (external). Provisions shall be made for external wiring in accordance with MIL-STD-454, Requirement 71, and MIL-W-5088 as applicable.
- * 3.1.35 Deleted.
- * 3.1.36 Microelectronic devices. Microelectronic devices, including hybrids, shall be in accordance with MIL-STD-454, Requirement 64. Devices selected shall be soldered or welded into the circuit.
 - 3.1.37 Parts to meet reliability requirements. When the contract or equipment specification includes a reliability requirement that is based on a previous calculation and demonstration of the equipment reliability, the parts shall be equal to or more reliable than those used in the demonstration equipment.
 - 3.1.38 Bearings. Bearings shall be in accordance with MIL-STD-454, Requirement 6.
 - 3.1.39 Flammable materials. Flammable materials shall be in accordance with MIL-STD-454, Requirement 3.
 - 3.1.40 Derating. Derating of electronic parts and materials shall be in accordance with MIL-STD-454, Requirement 18.
 - 3.1.41 Adhesives. Adhesives shall be in accordance with MIL-STD-454, Requirement 23. The use of adhesives in electrical applications requires the approval of the procuring activity.

3.1.42 Batteries. Batteries shall be in accordance with MIL-STD-454, Requirement 27.

3.1.43 Quartz crystal units. Quartz crystal units shall be in accordance with MIL-STD-454, Requirement 38.

3.1.44 Motors, dynamotors, rotary power converters and motor generators. Motors, dynamotors, rotary power converters, and motor generators shall be in accordance with MIL-STD-454, Requirement 46.

3.1.45 Waveguides and related equipment. Waveguides and related equipment shall be in accordance with MIL-STD-454, Requirement 53.

3.1.46 Circuit breakers. Circuit breakers shall be in accordance with MIL-STD-454, Requirement 37.

3.1.47 Gears and cams. Gears and cams shall be in accordance with MIL-STD-454, Requirement 48.

3.1.48 Indicator lights. Indicator lights shall be in accordance with MIL-STD-454, Requirement 50.

3.1.49 Hydraulics. Hydraulics shall be in accordance with MIL-STD-454, Requirement 49.

3.1.50 Rotary servo devices. Rotary servo devices shall be in accordance with MIL-STD-454, Requirement 56.

* 3.1.51 Sockets, shields, and clamps. Sockets, shields, and clamps shall be in accordance with MIL-STD-454, Requirement 60, and require procuring activity approval for use.

3.1.52 Brazing. Brazing shall be in accordance with MIL-STD-454, Requirement 59.

3.1.53 Organic fibrous material. The use of organic fibrous material shall be in accordance with MIL-STD-454, Requirement 44.

3.1.54 Coaxial cable (RF). Coaxial cable (RF) shall be in accordance with MIL-STD-454, Requirement 65.

3.1.55 Multiconductor cable. Multiconductor cable, within the equipment, shall be in accordance with MIL-STD-454, Requirement 66.

3.1.56 Readouts. Readouts shall be in accordance with MIL-STD-454, Requirement 68.

* 3.1.56.1 Digital readout displays (LCD and LED types). Liquid Crystal Displays (LCD) exhibit limited operating temperature extremes and should not be used. Light emitting diode (LED) displays should not be used in cockpit areas or where sunlight may impinge upon the display. The use of LCD and LED type displays requires the approval of the procuring activity.

3.1.57 Electrical filters. Electrical filters shall be in accordance with MIL-STD-454, Requirement 70.

* 3.1.58 Electroluminescent panels. The use of electroluminescent panels shall require approval of the procuring activity.

3.2 Design and construction.

3.2.1 Detailed mechanical and electrical design. The detailed mechanical and electrical design of the equipment shall be accomplished by the contractor, subject to the requirements of this specification and any specification to which it is subsidiary. The requirements of this specification are 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 shall be such as to facilitate quantity production and to result in minimum size and weight.

3.2.1.1 Mechanized production (including printed circuits). When designing new equipment, contractors shall include, when possible, circuits that have been or can be reproduced by mechanized or semimechanized production facilities consistent with the state of the art. The procuring activity shall be kept informed of the types of circuits selected and the type of facility to produce such circuits. The following factors applicable to this type of construction shall govern.

3.2.1.1.1 Nonrepairable subassemblies. Subassemblies of high reliability or relatively low cost shall be constructed as nonrepairable.

3.2.1.1.2 Circuit approval (nonrepairable subassemblies). The contractor shall inform the procuring activity of those circuits which he proposes as nonrepairable subassemblies, and shall obtain approval therefor.

3.2.1.1.3 Larger assemblies and expensive repairable stages shall be constructed of standard or approved nonstandard parts or subassemblies as indicated above, and shall be capable of replacement either by subassembly or detail part, as applicable.

* 3.2.1.1.4 Approval requests. In the construction of nonrepairable subassemblies, detail parts need not be submitted for approval. Approval and control shall be in accordance with 3.1.1 for each individual nonrepairable subassembly considered as a single nonstandard part. The approval request

should include the electrical schematic, and information describing tests, performance, environmental capabilities, and mechanical details.

3.2.1.1.5 In the selection and layout of circuits, the contractor shall attempt to use circuits and methods of construction which may permit use of the same subassemblies in other equipment having similar circuits and functions.

3.2.1.1.6 Types of construction. The following types of construction are considered to be classed in the mechanized or semimechanized category, and shall be considered:

- a. Subassemblies using printed circuits, upon which the parts are printed or mechanically placed and electrically connected.
- b. Construction in which several ceramic or filled plastic wafers are placed one above the other and components printed or mounted thereon.
- * c. Three-dimensional, or folded-type construction, in which the parts are mechanically placed and electrically connected. Cordwood construction shall not be used for repairable items.
- d. Microcircuits using deposited or printed techniques, including circuits employing combinations of these processes and discrete parts.

3.2.1.1.7 In order to permit flexibility in the arrangement or assembly of modules and subassemblies, interconnecting leads involving circuits considered susceptible of radiated interference or capable of radiating interferences should be shielded and of low-impedance design. All other connections (such as power) should be well shielded or bypassed internally to prevent radiation or pickup of extraneous fields.

3.2.1.1.8 Welds, resistance, electrical interconnections. Electrical interconnection resistance welds shall be in accordance with MIL-STD-454, Requirement 24.

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

3.2.3 Enclosures. Enclosures shall be in accordance with MIL-STD-454, Requirement 55, except that performance for mounting bases

shall be met for the frequencies and amplitude shown in the specific curve of Figure 2, for the applicable equipment. Mounts and vibration isolators, whether integral or not, shall be subject to the approval of the procuring activity. Positive self-locking case mounting fasteners shall be used on all mountings. The fastener chosen shall be of a size specified for the weight of the equipment unit.

3.2.4 Accessibility. Accessibility shall be in accordance with MIL-STD-454, Requirement 36.

3.2.5 Thermal design. Thermal design shall be in accordance with MIL-STD-454, Requirement 52.

* 3.2.5.1 Cooling design data. Cooling design data shall be developed as soon as possible after major circuit parameters have been established. Initially, this data shall include calculations, drawings, and other information relating to the choice of a particular cooling system configuration. As part of this initial data, the first set of applicable thermal design evaluation data shall 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 shall be conducted.

3.2.6 Corona and electrical breakdown prevention. Corona and electrical breakdown prevention shall be in accordance with MIL-STD-454, Requirement 45.

* 3.2.7 Deleted.

3.2.8 Encapsulation and embedment. Encapsulation and embedment shall be in accordance with MIL-STD-454, Requirement 47.

3.2.9 Conformal coating. Conformal coating shall be reversion resistant and hydrolytically stable and shall retain its cured characteristics.

3.2.10 Lubrication. Lubrication shall be in accordance with MIL-STD-454, Requirement 43.

3.2.11 Electromagnetic interference characteristics. Electromagnetic interference control shall be in accordance with MIL-STD-454, Requirement 61.

3.2.12 Anti-jamming. The electronic system or equipment shall be designed to obtain the maximum inherent protection against possible

interfering signals caused by enemy jamming. The contractor shall solicit and obtain the approval of the procuring activity for the basic anti-jamming concepts before proceeding with the design of the models.

3.2.13 Maintainability. Maintainability shall be in accordance with MIL-STD-454, Requirement 54.

3.2.14 Reliability. Reliability shall be in accordance with MIL-STD-454, Requirement 35.

3.2.15 Test points, test facilities, and test equipment. Test points, test facilities, and test equipment shall be in accordance with MIL-STD-454, Requirement 32.

3.2.15.1 Operational checkout provisions. The equipment shall be designed to provide for connections at its face for such test equipment as may be required for operational checkout tests. The equipment shall be designed in such manner as to permit use of items of standard service test equipment to accomplish all necessary tests. The latest available list of standard service test equipment shall be obtained by the contractor from the procuring activity. If special test equipment is required, the procuring activity shall be supplied with recommendations therefor.

3.2.16 Microphonics. Microphonic effects shall not be detrimental to equipment performance.

3.2.17 Moisture pockets. Control of moisture pockets shall be in accordance with MIL-STD-454, Requirement 31.

3.2.18 Deleted.

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

3.2.20 Electrical overload protection. Electrical overload protection shall be in accordance with MIL-STD-454, Requirement 8.

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

*

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

- b. The case shall be of a type that will permit ready opening and clearing for access to the equipment for repair and maintenance. If practicable, the equipment shall be completely operable after removal from the case, and alignment shall be unaffected by replacement in the case.
- c. When possible and advantageous, external points shall be provided for check without removal from the case.
- d. A means shall 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. Measurement of the pressure by means of a Schrader type 3715 gage, or equivalent, shall be possible.
- e. Sealing instructions shall be placed on one side of the case, if practicable.
- f. Those parts of an equipment, including transmission lines, that are pressurized shall 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° to $+50^{\circ}\text{C}$, 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 shall 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 shall be provided.
- g. Unless specified or permitted in the detail specification, pressure shall be maintained without the use or need of a pressurization pump. When a pressurization pump is required, redundant barostatic switches, or similar automatic means, shall be provided to assure equipment is pressurized during flight, even though it is not being operated. The switch or automatic means shall be energized from a common point and shall be energized as part of the take-off procedure.

- h. The equipment shall maintain pressure to accommodate the maximum operating time; in addition, and where applicable for captive and nonoperating flight, the equipment shall maintain operating pressure for periods up to 24 hours. Unless otherwise determined as satisfactory, the loss of pressure shall not exceed 5 pounds in a 24-hour period at the altitude and temperature specified in the detail specification.
- i. If required, a desiccant shall be provided within the case.
- j. Parts used in pressurized container shall meet the requirements of this specification, except that the altitude requirements may differ.

3.2.22 Safety (personnel hazard). Provisions for personnel safety shall be in accordance with MIL-STD-454, Requirement 1.

3.2.22.1 Safety program. A safety program shall be established by the contractor if required by the detail equipment specification or contract. Safety programs shall conform to MIL-STD-882 (see 6.2).

* 3.2.23 Service conditions (electrical). The equipment shall be designed to operate from power sources with characteristics conforming to MIL-STD-454, Requirement 25.

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

3.2.24 Service conditions (environmental). The equipment shall be so designed and constructed that no fixed part or assembly shall become 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 individual specification for the particular equipment during operation or after storage in ambient conditions as follows.

3.2.24.1 Temperature. The equipment shall be exposed to the temperature conditions, for the applicable class, shown in Table I. 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.

3.2.24.1.1 Operating. The equipment shall operate under the conditions for the applicable class, and within the ranges listed in column I, II, III and VII of Table I.

3.2.24.1.2 Nonoperating. The equipment in a nonoperating condition shall withstand long periods of exposure to the temperature extremes and shock as listed in Table I.

3.2.24.2 Altitude. The equipment shall meet the altitude conditions, for the applicable class, listed in column VIII of Table I, 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.

3.2.24.3 Temperature-altitude combination. The equipment shall operate under the applicable temperature-altitude combinations shown on Figure 3.

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

3.2.24.5 Vibration.

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

3.2.24.5.1.1 Equipment designed for installation in propeller aircraft. Equipment of this type shall withstand sinusoidal excitation over the frequency range of 5 to 500 Hz with amplitude specified by the appropriate curve of Figure 2.

3.2.24.5.1.2 Equipment designed for installation in jet aircraft. Equipment of this type shall withstand either random, sinusoidal, or, in particular applications, both random and sinusoidal excitation as indicated below.

- a. Random excitation - The vibration spectrum shall extend from 15 to 2000 Hz with the amplitude specified in the detailed equipment specification or contract. Where actual measured data is not

available to establish random requirements, the mathematical formulae contained in MIL-STD-810 may be used to calculate applicable amplitudes when specifically permitted by the detail equipment specification or contract.

- b. Sinusoidal excitation - Sinusoidal vibration covering the frequency range of 5 to 2000 Hz with the amplitude specified by the appropriate curve of Figure 2 shall be used when random vibration requirements are not specified in the detail equipment specification or contract.
- c. Random and sinusoidal excitation - In particular applications, both random and sinusoidal excitations may be required to simulate the in-service use of the equipment. The detail equipment specification or contract will specify such requirements.

3.2.24.5.1.3 Equipment designed for installation in helicopters. Equipment of this type shall withstand sinusoidal excitation over frequency range of 5 to 2000 Hz with the amplitude specified by Curve IIIb of Figure 2.

3.2.24.5.2 Equipment with isolators removed. Equipment normally mounted on isolators shall not suffer damage or fail to meet specified performance with isolators removed when subjected to sinusoidal vibration within the frequency range and amplitude specified by the applicable curve of Figure 2. For equipment design for propeller aircraft, Curve II shall be used; for jet aircraft, Curve IIa shall be used; and for helicopters, Curve IIb shall be used.

3.2.24.6 Shock.

3.2.24.6.1 Equipment. Equipment (with vibration isolators in place, if any) shall not suffer damage or subsequently fail to provide the performance specified in the detail equipment specification when subjected to 18 impact shocks of 15g, consisting of 3 shocks in opposite directions along each 3 mutually perpendicular axes, each shock impulse having a time duration of 11 ± 1 milliseconds. The "g" value shall be within ± 10 percent when measured with a 0.2 to 250 Hz filter, and the maximum "g" shall occur at approximately 5-1/2 milliseconds.

3.2.24.6.2 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 shall withstand at least 12 impact shocks of 30g, consisting of 2 shocks in opposite directions along each of 3 mutually perpendicular axes. Each shock impulse shall have time duration of 11 ± 1 milliseconds. The "g" value shall be within ± 10 percent when measured with a 0.2 to 250 Hz filter,

and maximum "g" shall occur at approximately 5-1/2 milliseconds. Bending and distortion shall be permitted; however, there shall be no failure to the attaching joints and the equipment or dummy load shall remain in place.

3.2.24.6.3 Bench handling. The equipment shall withstand the shock environment encountered during servicing.

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

3.2.24.8 Fungus. The equipment shall withstand, in both an operating and nonoperating condition, exposure to fungus growth as encountered in tropical climates. In no case shall overall spraying of the equipment be necessary to meet this requirement (see 3.1.11).

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

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

3.2.25 Human engineering. Human engineering shall be in accordance with MIL-STD-454, Requirement 62.

3.3 Interchangeability. Interchangeability shall exist between all units and replaceable assemblies, subassemblies, and parts for all equipment delivered on the contract in accordance with MIL-STD-454, Requirement 7.

3.3.1 Interchangeability of reordered equipment. For reordered equipment, interchangeability shall exist between units and all replaceable assemblies, subassemblies, and parts of a designated model of any previously manufactured equipment supplied or designated by the procuring activity. Such interchangeability shall be measured against the designated model, manufacturing drawings, or other technical information provided for the purpose. In the event the contract or order does not stipulate whether the model, drawings, or other information shall govern, the designated model shall be used.

3.3.2 Interchangeability conflicts. Should any conflicts arise between any of the requirements of this specification or the detail specification and the requirement for interchangeability, the contractor should immediately inform the procuring service of such conflict. Unless advised otherwise, the interchangeability requirement shall govern.

* 3.4 Nomenclature assignment. Nomenclature assignment shall be in accordance with MIL-STD-454, Requirement 34, along with MIL-N-18307 for the Navy, MIL-N-7513 for the Air Force, and the contract for the Army.

3.5 Workmanship. Workmanship shall be in accordance with MIL-STD-454, Requirement 9.

4. QUALITY ASSURANCE PROVISIONS

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

4.2 Classification of inspections. The inspection of electronic equipment shall be classified as follows:

- a. First article (preproduction) tests (4.3)
- b. Quality conformance tests (4.4)

4.3 First article (preproduction) tests. First article (preproduction) tests shall be performed on one (more than one if required by the detail specification or by contract) equipment representative of the equipment to be supplied under the contract. Tests shall be performed in accordance with the approved test procedures of 4.5. The data obtained by the contractor in performing tests shall be submitted to the procuring activity at the completion of all tests and prior to shipping the equipment to the Government testing facility.

4.3.1 Accessory material. When the procuring activity requires the shipment of the equipment to a Government facility for tests, the contractor shall submit in addition to the complete equipment, all extra materials and design and test data necessary to test and evaluate the equipment (4.3.2). The design and test data supplied by the contractor shall indicate the physical and electrical characteristics of the equipment and establish that the equipment conforms to this specification.

4.3.2 Design data and material. The following design data and extra material shall be supplied with this preproduction equipment for tests.

- a. Design Data:
 - (1) Copies of brief operating instructions.
 - (2) Copies of a complete schematic diagram reduced to its simplest form, showing the circuits of all assemblies and subassemblies and of detail parts not internal therein individually in schematic form with electrical interconnection indicated.

- (3) Copies of a practical wiring diagram of each assembly or of each constructional unit thereof, whichever is practicable, showing the physical location and connections of detail parts and subassemblies with reference symbols and terminal numbers indicated.
- (4) Copies of a complete cabling diagram of the complete equipment.
- (5) Copies of outline dimensional sketches of all major and minor assemblies and of any detail external parts, showing projections.
- (6) Prior to submission of the preproduction sample equipment, three copies of a report by the contractor of his tests on the equipment. Included with this shall be an analysis of all failures which occurred and suggestions for improvements in design which may be incorporated in later productions.

b. Extra material:

- (1) Complete set of interconnecting cables.
- (2) One set of spare parts peculiar to the equipment. (Standard parts, such as resistors and capacitors in common use are not required.)

4.3.3 Scope of tests. First article (preproduction) tests shall include all tests deemed necessary by the procuring activity to determine that the equipment meets all the requirements of this specification and the contract. These tests shall include environmental tests in accordance with the procedures of MIL-T-5422 for the Navy, and MIL-STD-810^{1/} for the Air Force and Army, to the limits specified herein or in the detail equipment specification. Interference tests and test methods shall be in accordance with MIL-STD-454, Requirement 61.

^{1/} For MIL-STD-810, test methods and procedures will be specified in the detail equipment specification.

4.4 Quality conformance tests. Quality conformance tests shall consist of all tests deemed necessary to determine that the equipments submitted for acceptance under the contract are equivalent in performance and construction to the approved preproduction equipment. Quality conformance tests shall consist of the following:

- a. Individual tests: Individual tests shall be performed on each equipment submitted for acceptance under the contract.
- b. Sampling tests: Equipment submitted for sampling tests shall be selected by the contractor under the supervision of the Government inspector, shall be representative of current production, and shall first have passed the individual tests. The quantity of sample tests to be performed shall be as specified in the detail specification or the contract.

4.5 Test procedures. The procedures and methods for performing all tests specified herein shall be as stated in the detail equipment specification, or if not stated therein, shall be prepared by the contractor and sent to the procuring activity for approval. In the later case, the contractor shall have obtained approval from the procuring activity prior to submission of equipment for tests. The right is reserved by the procuring activity to require additional tests to determine compliance with the requirements of this and the detail equipment specifications when it is deemed necessary.

4.6 Presubmission testing. No item, part, or complete equipment shall be submitted to the Government inspector by the Contractor until it has been previously tested and inspected by the contractor and found to comply to the best of his knowledge and belief with all applicable requirements. With the consent of the contractor and at the discretion of the procuring activity, this prior test and inspection may be participated in or witnessed by the Government inspector with the object of eliminating the necessity of repeating such test and inspection after the equipment has been formally submitted to the Government inspector.

4.7 Rejection and retest. The electronic equipment which has been rejected may be reworked or have parts replaced to correct the defects, and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished by the Government inspector. Units rejected after retest shall not be resubmitted without the specific approval of the procuring activity.

5. PACKAGING

5.1 Packaging, packing, and marking. Requirements for packaging, packing, and marking for shipment shall be as specified in the detail equipment specification.

6. NOTES AND CONCLUDING MATERIAL

6.1 Intended use. This specification is intended for use to incorporate in detail equipment specifications, those requirements which are common to most airborne electronic equipments.

6.2 Ordering data. Procurement documents should specify:

- a. Title, number, and date of the detail specification relating to the electronic equipment to be furnished.
- b. Class and type of cooling as specified (see 1.2 and 6.2.1).
- * c. Data requirements:
 - 3.1.1 (See MIL-STD-965 Appendix). The selected data requirements in support
 - 4.3.1 of this specification will be reflected
 - 4.3.2 in a Contractor Data Requirements List (DD Form 1423) attached to the request for proposal, invitation for bid, or the contract, as appropriate.
- d. Preparation for delivery.
- e. Items of 6.7 not covered elsewhere.
- f. Safety Program (3.2.22.1) (Not for Army Use)
- * g. Parts Control program requirements (see MIL-STD-965).
- * h. Tailoring requirements. Appendix B is a sample tailoring guide.

6.2.1 Unless otherwise stated in equipment specifications, requisitions, drawings, contracts, and orders, Class 1 requirements will apply (see 1.2).

6.3 Definitions.

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

6.3.2 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.

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

6.3.4 Complete operating equipment. A complete operating equipment is defined as an 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.

6.3.5 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.

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

6.3.7 Removable assembly. A removable assembly is defined as an assembly which is easily removable from the aircraft. Examples: Dynamo motor unit, indicator unit, radio receiver, and radio transmitter.

* 6.3.8 Deleted.

6.3.9 Electronics. The term "electronics" is defined as a system, or equipment, the primary purpose of which is the transmission or reception of intelligence, and 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.

6.3.10 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.

* 6.3.11 Deleted.

6.3.12 Performance requirements of the equipment. Wherever referenced in this specification, the "performance requirements of 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 equipment specification for the purpose of simulating anticipated field service demands as closely as possible.

6.3.13 Intermittent and short-time operation. Intermittent and short-time operations are the alternating periods of operation for the specified time followed by 15 minutes of nonoperation.

6.3.14 Reordered production equipment. Reordered production equipment is equipment procured 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 procured on a second or subsequent contract is considered reordered production equipment, whether it is procured from contractor "X" or a new contractor.

6.3.15 Procuring activity. The Military or Federal agency contracting for equipment.

6.4 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.

* 6.5 Deleted.

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

- a. Handbook, Preferred Circuits NAVAIR-16-1-519,
Navy Aeronautical Electronic Vol. 2
Equipment
- b. Electronic Circuits MIL-STD-439

6.7 Detail equipment specifications. Since this specification covers only the general requirements for parts, materials, processes, design and construction, the detail equipment specification, contract, or order should specify actual requirements from the multiple choices or exceptions available in the following paragraphs:

- a. Classification requirements (1.2, 6.2, and 6.2.1)
- b. Exterior finish requirements (3.1.8)
- c. Cable terminations (3.1.34)
- d. Reliability (3.2.14)
- e. Maintainability (3.2.13)
- f. Equipment orientation (3.2.19)

- g. Methods of maintaining pressure (3.2.21(g))
- h. Altitude requirements in specifying air leakage (3.2.21(h))
- i. Warmup time (3.2.23.1)
- j. Vibration (3.2.24.5, 3.2.24.5.1, and 3.2.24.5.2)
- k. Shock (3.2.24.6.1)
- l. Meters (3.1.17)
- m. Thermal design (3.2.5, 3.2.5.1)
- n. Electromagnetic interference characteristics (3.2.11)
- * o. Human engineering requirements (3.2.25)
- * p. Applicable test specification and test procedures (4.3.3, 4.5)
- * q. Parts control program requirements (3.1.1)

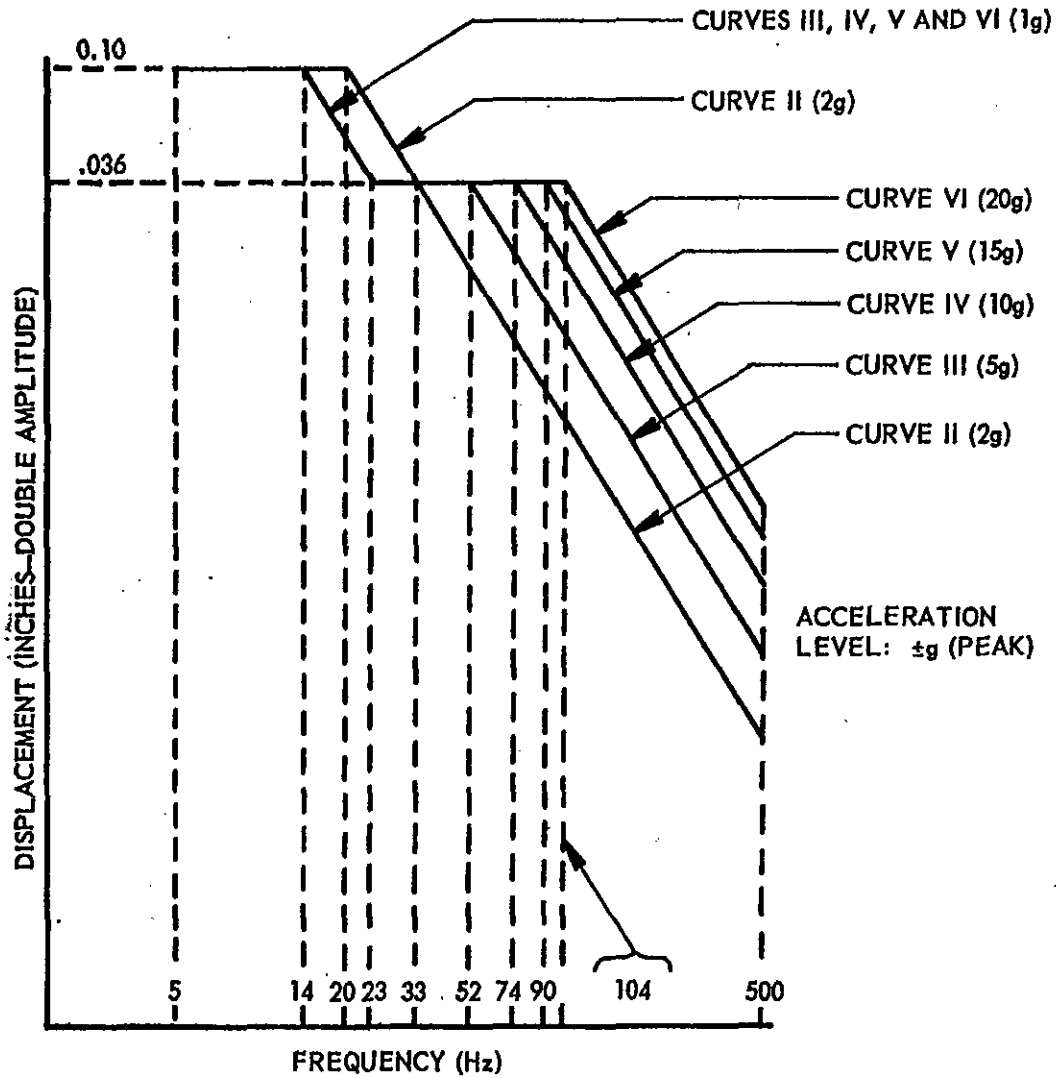
6.8 Supersession data. This issue of MIL-E-5400 supersedes all previous issues of MIL-E-5400 for new designs. Previous issues of MIL-E-5400 remain in effect to cover the procurement of previously designed equipment.

6.9 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes, from the previous issue have been made. This is done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content, irrespective of the marginal notations and relationship to the last previous issue.

* TABLE I. Environmental conditions.

Equipment operating Temperature extremes for the chamber (without external cooling provisions)		Equipment operating				Equipment nonoperating				
		Column I continuous	Column II intermittent	Column III short-time	Combined temperature-altitude	Temperature shock	Altitude	Temperature extremes		
Class 1	-54° C +55° C	30 min. +71° C	---	Column IV Defined by curve A, figure 3, (sheet 1).	Column V Defined by curve B, figure 3, (sheet 1).	Column VI ---	Column VII -54° C to +71° C	Column VIII Sea level (30.0 in. Hg.) (3.4 in. Hg.) 50,000 ft.	Column IX -57° C to +85° C	Column X -57° C to +85° C
Class 1A	-54° C +55° C	30 min. +71° C	---	Defined by curve A, figure 3, (sheet 1)	Defined by curve B, figure 3, (sheet 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 3, (sheet 1)	Defined by curve B, figure 3, (sheet 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 3, (sheet 2)	Defined by curve B, figure 3, (sheet 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, (sheet 3)	Defined by curve B, figure 3, (sheet 3)	Defined by curve C, figure 3, (sheet 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 3, (sheet 4)	Defined by curve B, figure 3, (sheet 4)	Defined by curve C, figure 3, (sheet 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

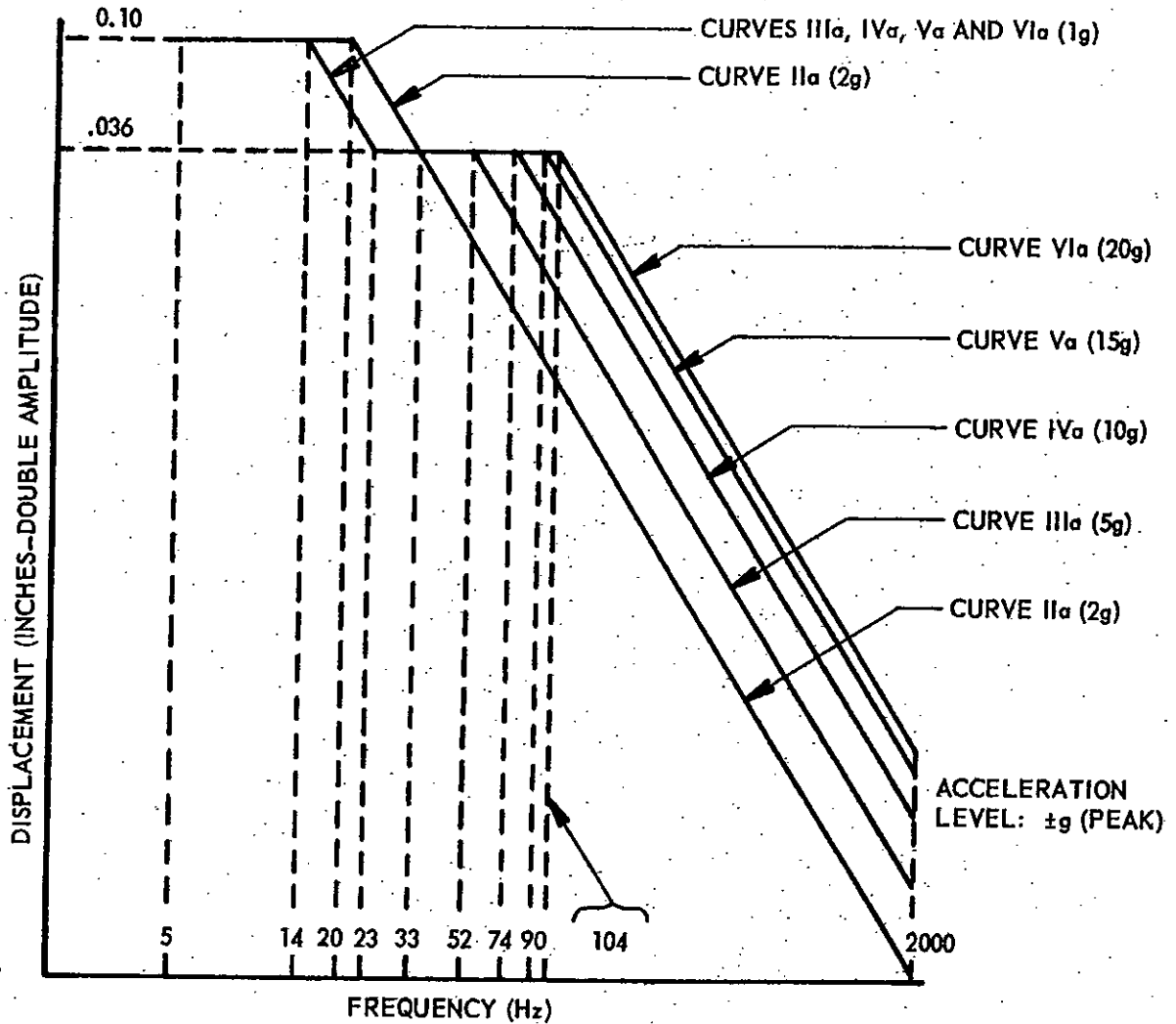
^{1/} Altitude range shown is for operation only.
Classes 1A and 1B equipment shall withstand a nonoperating altitude of 40,000 feet (5.5 in. Hg.).



- CURVE I (OF PREVIOUS ISSUE) - REPLACE BY CURVE IV
- CURVE II - EQUIPMENT DESIGNED FOR OPERATION ON ISOLATORS WITH ISOLATORS REMOVED
- CURVE III - EQUIPMENT MOUNTED IN FORWARD HALF OF THE FUSELAGE
- CURVE IV - EQUIPMENT MOUNTED IN REAR HALF OF FUSELAGE OR WING AREA
- CURVE V - EQUIPMENT MOUNTED IN ENGINE COMPARTMENT OR ENGINE PYLON
- CURVE VI - EQUIPMENT MOUNTED DIRECTLY ON ENGINE

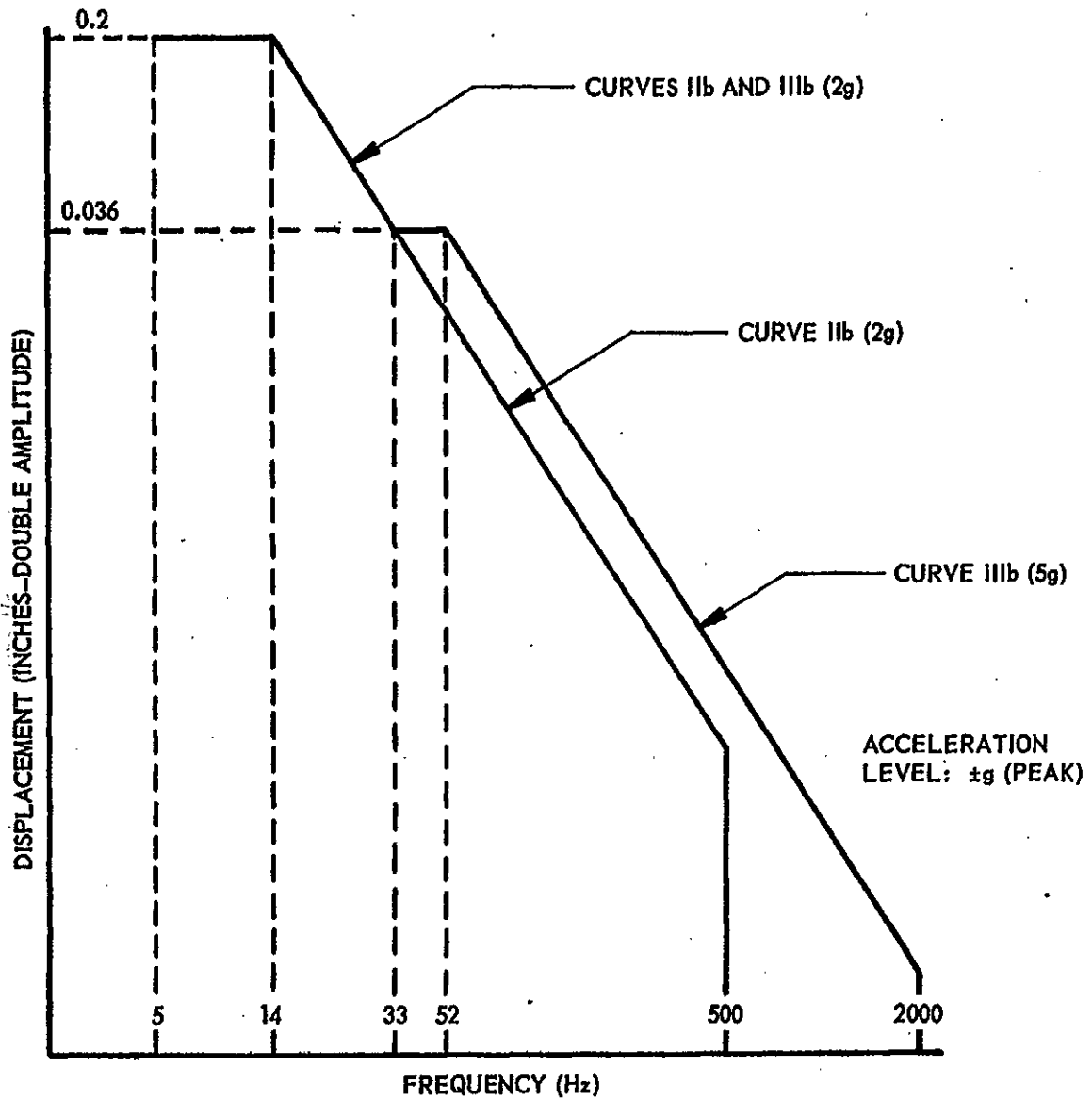
FIGURE 2 (Sheet 1 of 3). Sinusoidal vibration requirements for equipment designed for installation in propeller airplanes.

NOTE: Figure 1 of previous issues has been deleted



- CURVE I_a (OF PREVIOUS ISSUES) - REPLACED BY CURVE IV_a
- CURVE II_a - EQUIPMENT DESIGNED FOR OPERATION ON ISOLATORS WITH ISOLATORS REMOVED
- CURVE III_a - EQUIPMENT MOUNTED IN FORWARD HALF OF FUSELAGE OR IN WING AREA WITH ENGINES AT REAR OF FUSELAGE
- CURVE IV_a - EQUIPMENT MOUNTED IN REAR HALF OF FUSELAGE OR IN WING AREA WITH WING OR FRONT MOUNTED ENGINES
- CURVE V_a - EQUIPMENT MOUNTED IN ENGINE COMPARTMENT OR ENGINE PYLON
- CURVE VI_a - EQUIPMENT MOUNTED DIRECTLY ON ENGINE

FIGURE 2 (Sheet 2 of 3). Sinusoidal vibration requirements for equipment designed for installation in jet airplanes.



CURVE IIb - EQUIPMENT DESIGNED FOR OPERATION ON ISOLATORS WITH ISOLATORS REMOVED
 CURVE IIIb - EQUIPMENT MOUNTED IN ITS NORMAL CONFIGURATION

FIGURE 2 (Sheet 3 of 3). Sinusoidal vibration requirements for equipment designed for installation in helicopters.

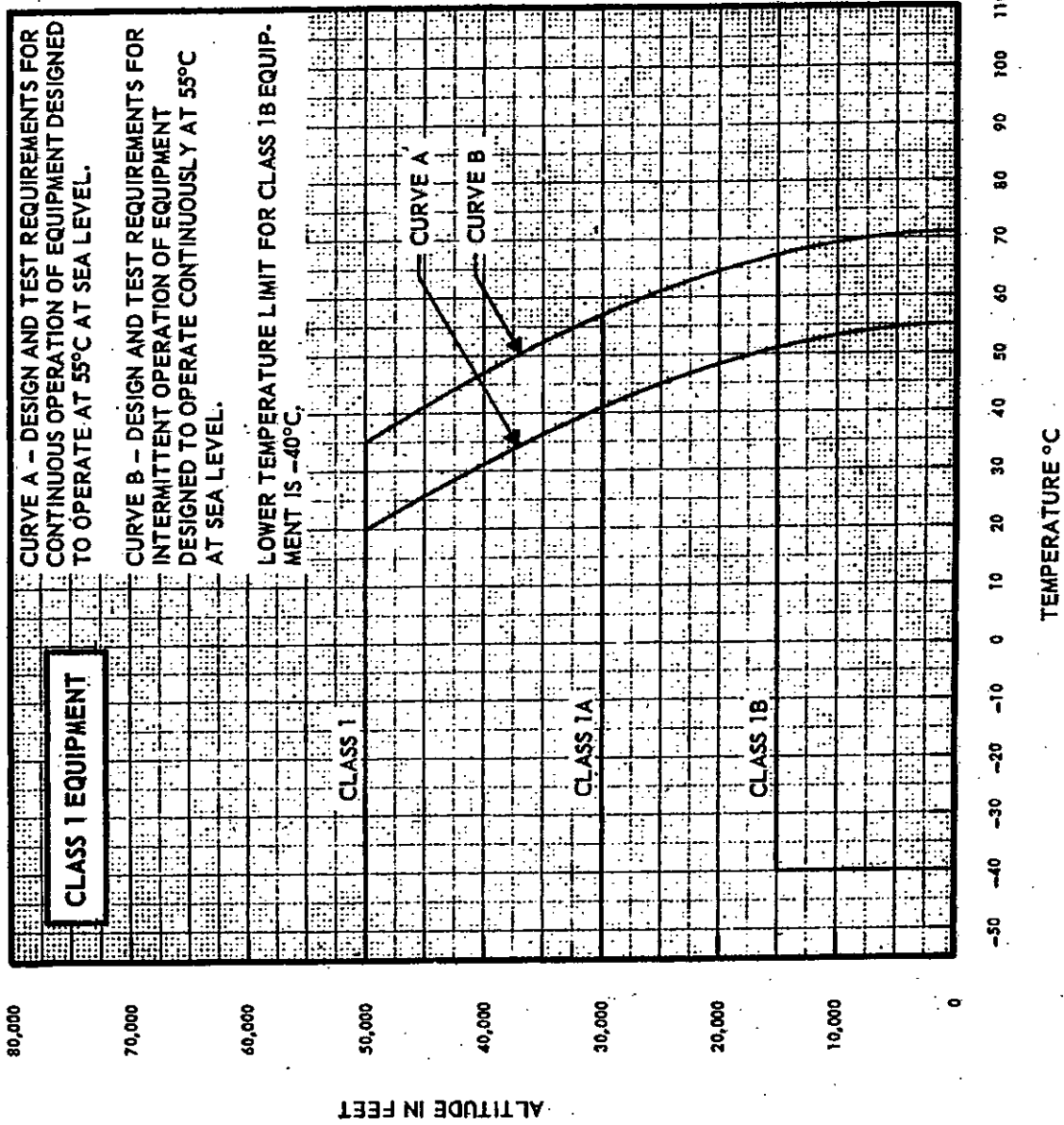


FIGURE 3 (Sheet 1 of 4). Operational requirements for class 1 airborne electronic equipment (temperature vs. altitude)

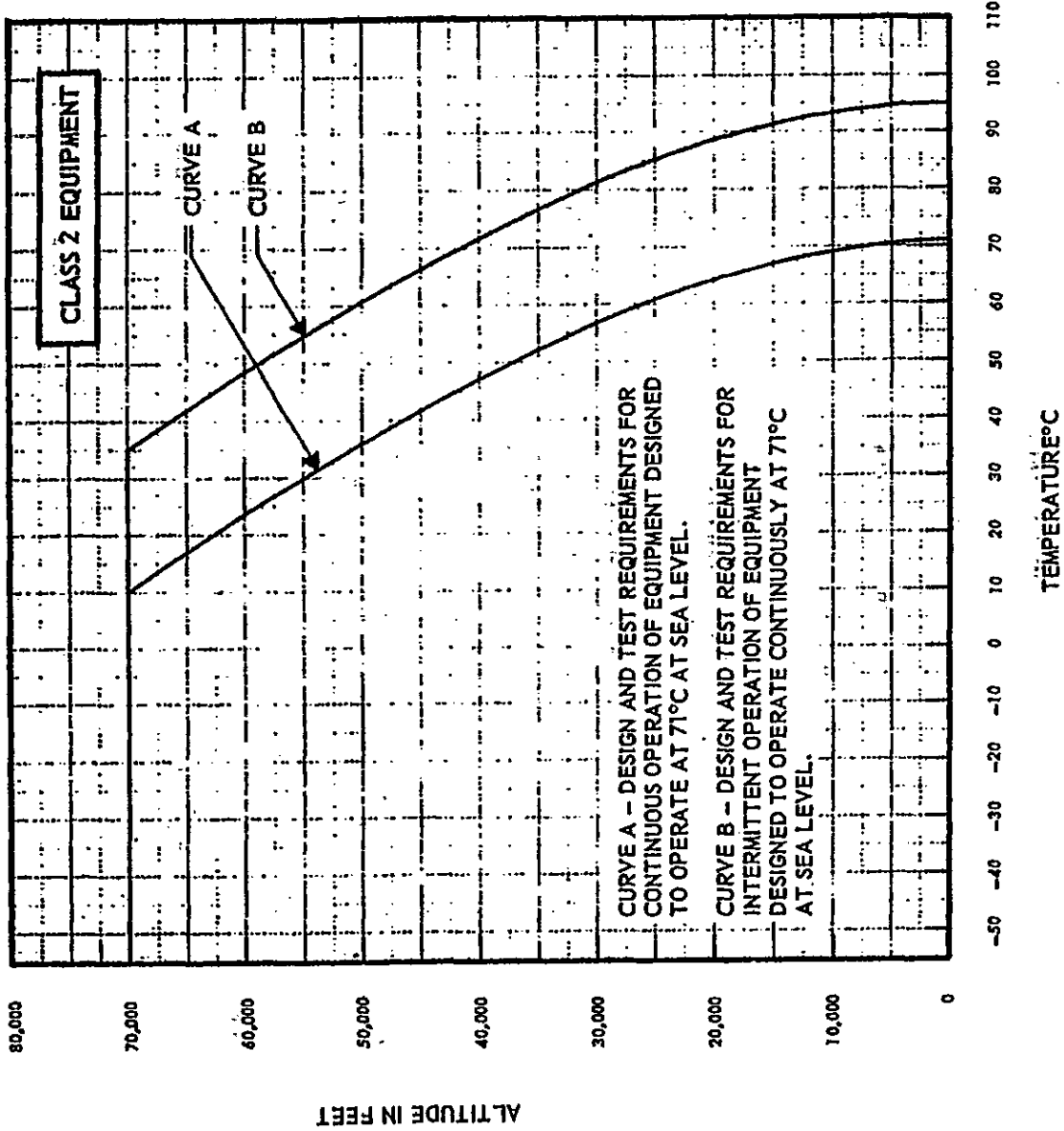


FIGURE 3 (Sheet 2 of 4). Operational requirements for class 2 airborne electronic equipment (temperature vs. altitude).

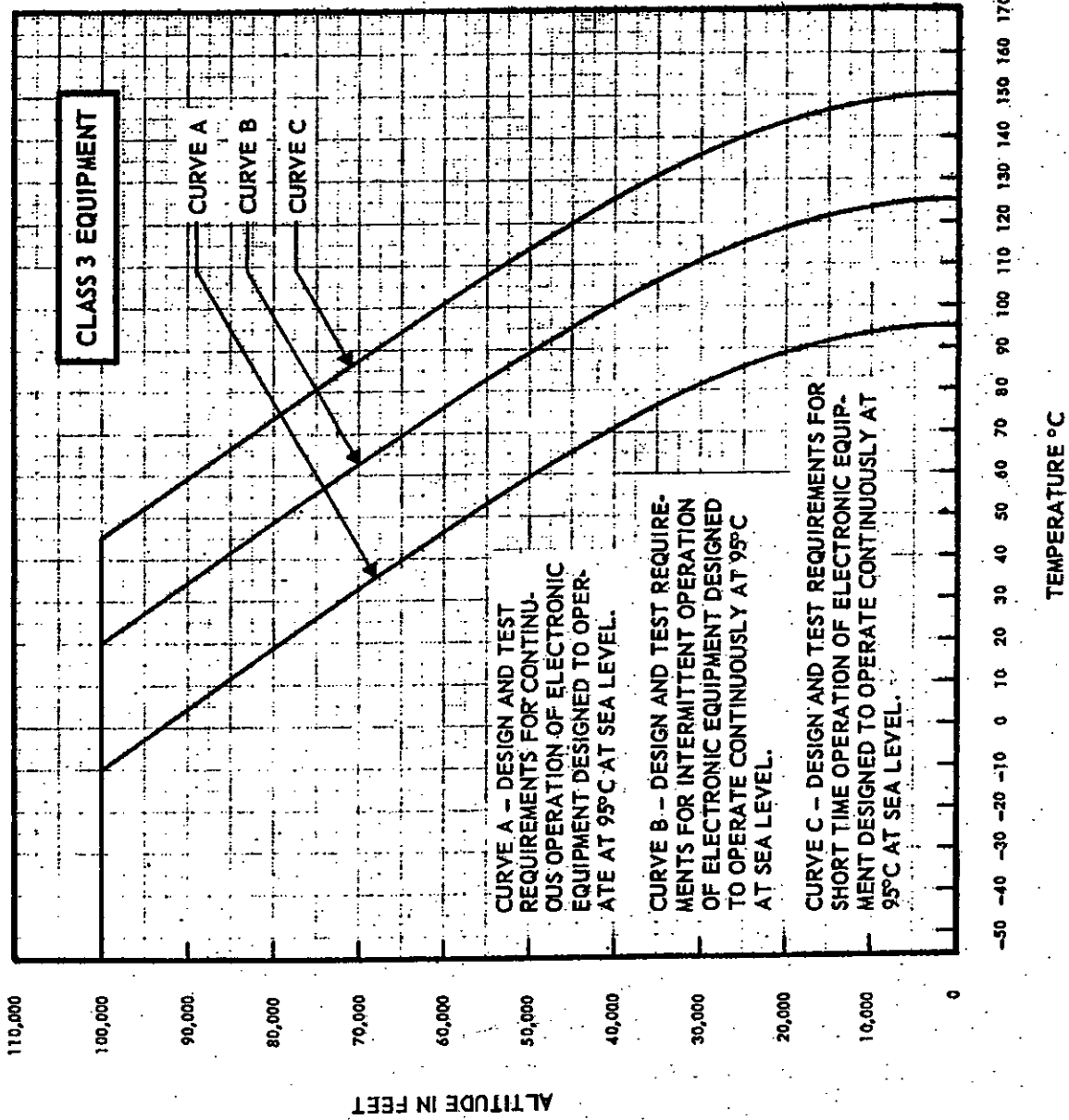


FIGURE 3 (Sheet 3 of 4). Operational requirements for class 3 airborne electronic equipment (temperature vs. altitude)

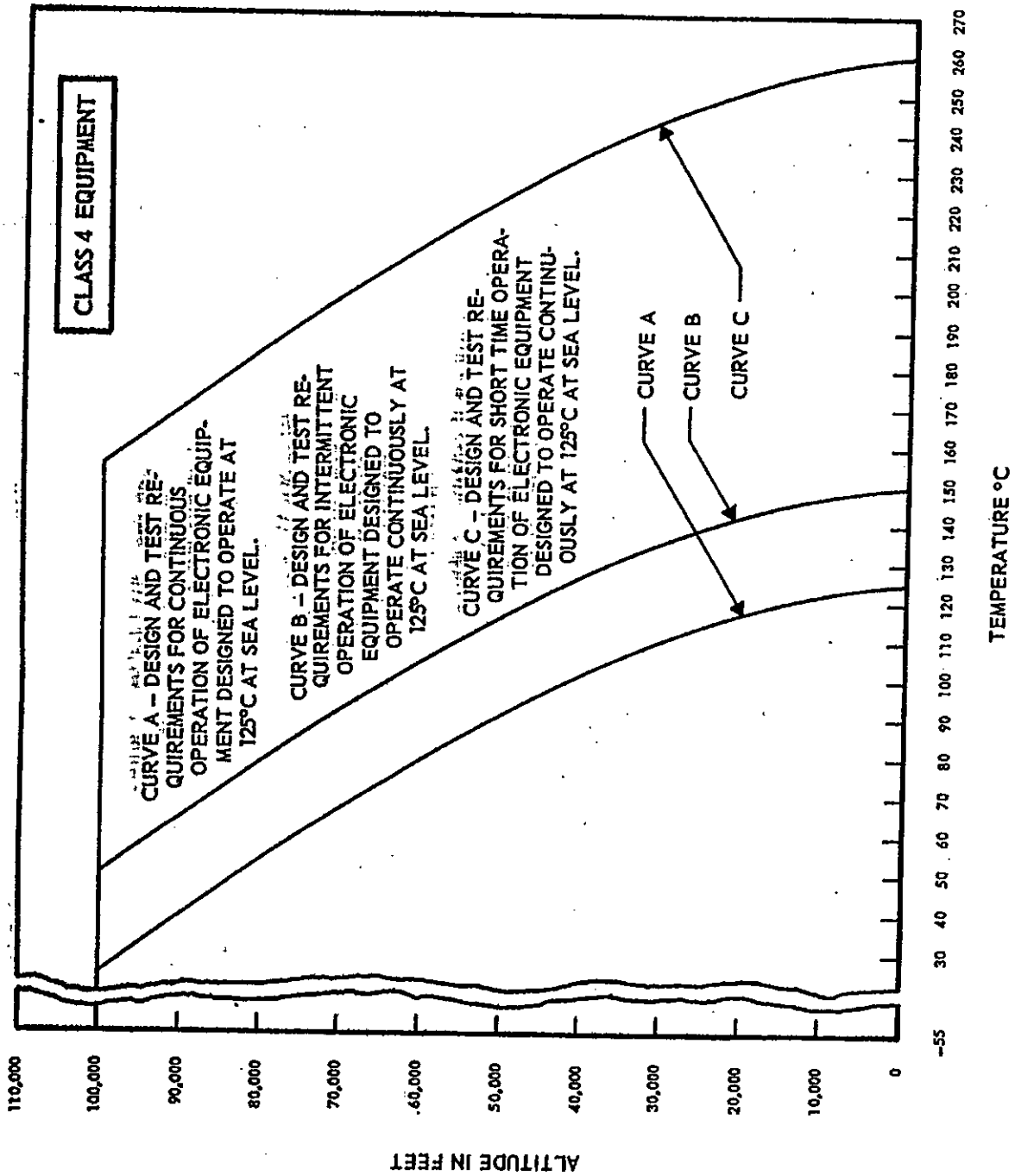


FIGURE 3 (Sheet 4 of 4). Operational requirements for class 4 airborne electronic equipment (temperature vs. altitude)

Custodians:

Army - CR

Navy - AS

Air Force - 11

Preparing activity:

Navy - AS

(Project No. GDRQ-0001)

Reviewer activities:

Army - MI, AR

Navy - EC

Air Force - 99

User activity:

Army - AV

APPENDIX A

AIRBORNE ELECTRONIC EQUIPMENT, APPLICABLE DOCUMENTS

10. SCOPE

10.1 Scope. This appendix lists selected specifications, standards and publications recommended for use in the design and construction of airborne electronic equipment.

20. APPLICABLE DOCUMENTS

See Alphabetical and Numerical lists

20.1 Document titles. Document titles, in some cases, have been rearranged for more practical use in locating information.

Examples:

"Application of Electrical Resolvers"

rearranged to read

"Resolvers, Electrical, Application of"

"List of Standard Semiconductor Devices"

rearranged to read

"Semiconductor Devices, List of Standard"

"List of Standard Microcircuits"

rearranged to read

"Microcircuits, List of Standard"

30. REQUIREMENTS

30.1 Effective issue. The issue of the selected specification, standard, or publication that applies is the issue of that document in effect on the date of invitation for bids or request for proposals. Later revisions, amendments, Qualified Products Lists, and documents superseding documents listed in Appendix A may be used when preferred by the contractor. When a later issue is used, all applicable requirements of the later issue shall be used.

MIL-E-5400T
Appendix A

30.2 Application of selected documents. Before proceeding with the application of any document listed in this appendix, all specification and contractual requirements must be reviewed by the contractor, and the extent of the application determined.

30.3 Supersession. This appendix supersedes all issues of MILITARY/ANA BULLETIN 400 as related to MIL-E-5400, for new designs. Previous issues of MILITARY/ANA BULLETIN 400 remain in effect for the procurement of previously designed equipment.

30.4 Part selection standards. When part selection standards are referenced in this appendix, the documents listed in those standards have the same status as being listed in this appendix, and the parts they cover are considered standard.

MIL-E-5400T
Appendix A

ALPHABETICAL LIST

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
*Abbreviations for Use on Drawings, Specifications, Standards, and In	MIL-STD-12	67
Accident Prevention Signs, Specifications for	ANSI-Z-35.1-1968	1
*Aerospace Welder Performance Qualification (Supplement to ASME Boiler and Pressure Vessel Code, Section	MIL-STD-1595	13
Adapter, Connector, Coaxial, Radio Frequency, General Specification for	MIL-A-55339	10
Adapters, Coaxial to Waveguide, General Specification for	MIL-A-22641	53
Adhesives	MIL-HDBK 691	23
Adhesive, Glass to Metal (for Bonding)	MMM-A-131	23
Adhesive, Heat Resistant, Air-Frame Structural Metal to Metal	MMM-A-132	23
Adhesive, Optical, Thermosetting	MIL-A-3920	23
Adhesive, Rubber Base, General Purpose	MMM-A-1617	23
Adhesive, Synthetic Rubber, Thermoplastic General Purpose	MMM-A-189	23
Air Transportability Requirements, General Specification for	MIL-A-8421	
Anodic Coatings, for Aluminum and Aluminum Alloys	MIL-A-8625	
Barrier Coating of Anti-Friction Bearings, Process for	MIL-STD-1334	3
*Batteries and Cells, Storage, Nickel-Cadmium, Aircraft, General	MIL-B-81757	27
Batteries, Storage, Sealed, Nickel-Cadmium	MIL-B-55130	27
Battery, Dry	MIL-STD-688	27
Bearing, Ball, Annular, Instrument Precision	MIL-B-23063	6
Bearing, Ball, Precision, for Instruments and Rotating Components	MIL-B-81793	6
Bearing, Roller, Needle, Air-Frame, Anti-Friction	MIL-B-3990	6
Bearing, Roller, Tapered	FF-B-187	6
Bearing, Sleeve, (Bronze, Plain or Flanged)	FF-B-195	6
Bearings, Ball, Annular (General Purpose)	FF-B-171	6
Bearings, Roller, Cylindrical; and Bearings, Roller, Self-Aligning	FF-B-185	6
Bearings, Sleeve, Washers, Thrust Sintered, Metal Powder, Oil-Impregnated	MIL-B-5687	6

* Indicates the document was added in this issue.

MIL-E-5400T

Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Bolt, Aircraft	MIL-B-6812	12
Bolt, Hexagon and Square	FF-B-575	12
Bolt, Internal Wrenching, 160 KSI Ft _u	MIL-B-7838	12
Bolts, Internal Wrenching	NAS496	
Bolts, Shear	NAS498	12
Bonding, Electrical, and Lighting Protection, for Aerospace Systems	MIL-B-5087	1
Brass, Leaded and Nonleaded, Flat Products (Plate, Bar, Sheet and Strip)	QQ-B-613	
Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum Alloys	MIL-B-7883	59
Cable, Electric, Aerospace Vehicle, General Specification for	MIL-C-7078	66, 71
Cable, Radio Frequency, Semi-Rigid, Coaxial, Semi-Air-Dielectric, General Specification for	MIL-C-22931	65
Cable, Special Purpose, Electrical 34, 36, 37, 39, 40, 42, 46, 47 and 52 Conductors	MIL-C-13777	66, 71
Cable, Special Purpose, Electrical Multiconductor	MIL-C-27072	66, 71
Cables, Radio Frequency, Coaxial, Dual Coaxial, Twin Conductor, and Twin Lead	MIL-C-17	65, 66, 71
Cap, Dust, Plastic, Electrical Connectors	MS90376	
Capacitors, Selection and Use of	MIL-STD-198	2
Cases, Bases, Mounting, and Mounts, Vibration (for Use With Electronic Equipment in Aircraft)	MIL-C-172	55
Casting, Classification and Inspection	MIL-C-6021	21
Cellular Elastomeric Materials, Fabricated Parts	MIL-C-3133	
Chemicals Films and Chemical Film Materials for Aluminum and Aluminum Alloys	MIL-C-5541	
Chromium Plating (Electrodeposited)	QQ-C-320	
Circuit Breakers, Selection and Use of	MIL-STD-1498	37
Cleaning Method and Pretreatment of Ferrous Surfaces for Organic Coatings	TT-C-490	
*Configuration Control, Engineering Changes, Deviations, and Waivers	MIL-STD-480	72
Colors	FED-STD-595	

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Conduit, Electrical, Flexible, Shielded, Aluminum Alloy, for Aircraft Installations	MIL-C-6136	
Conduit, Metal, Flexible, Electrical, Shielded	MIL-C-13909	
Control Panel, Aircraft Equipment, Rack or Console Mounted	MIL-C-6781	
Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed or Machined Edges (Plate, Bar, Sheet and Strip)	QQ-C-576	
Cord, Electrical (Audio, Miniature)	MIL-C-10392	
Cord, Electrical, Shielded (Audio Frequency)	MIL-C-3883	
Coupler Directional (Coaxial and Waveguide), Selection of	MIL-STD-1328	53
Cover, Electrical, Connector Plug, AN Type	MS25042	
Cover, Electrical, Connector Receptacle, AN Type	MS25043	
Cover, Protective, Electric Connector, Plug, Push-Pull Coupling	MS3182	
Cover, Protective, Electric Connector, Receptacle, Ball Coupling	MS3183	
Crystal Units, Quartz, and Holders, Crystal	MIL-STD-683	38
Definition of and Basic Requirements for Enclosure for Electric and Electronic Equipment	MIL-STD-108	55, 69
Definitions of Effectiveness Terms for Reliability, Maintainability, Human Factors and Safety	MIL-STD-721	36
Definitions of Item Levels, Item Exchangeability, Models and Related Terms	MIL-STD-280	7, 8, 36, 67
*Dissimilar Metals	MIL-STD-889	16
Drawing, Engineering and Associated List	DOD-D-1000	
*Dummy Load, Electrical, Coaxial, General Specification for	MIL-D-39030	53
Dummy Load, Electrical, Waveguide, General Specification for	MIL-D-3954	53
Electrical Power, Aircraft, Characteristics and Utilization of	MIL-STD-704	25
Electric Voltages Alternating and Direct Current	MIL-STD-255	25

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Connectors, Electrical and Associated Hardware, Selection and Use of	MIL-STD-1353	10
Electromagnetic Interference Characteristics, Measurement of	MIL-STD-462	61
Electromagnetic Interference Characteristics, Requirements for Equipment	MIL-STD-461	61
Electromagnetic Interference Technology, Definition and System of Units	MIL-STD-463	
Enamel, Equipment, Light-Gray (Formula No. 111)	MIL-E-15090	
*Encoder, Shaft Position to Digital, Contact Type, Altitude Reporting, General Specification for	MIL-E-81512	56
*Encoders, Shaft Angle to Digital, General Specification for	MIL-E-85082	56
*Encoder, Shaft Angle to Digital	MIL-HDBK-231	56
Engineering Drawing Practices	MIL-STD-100	
Environmental Test Methods	MIL-STD-810	
*Fabrication of Rigid Waveguide Assemblies (Sweep Bends and Twists)	MIL-HDBK-660	53
Fastener, Externally Threaded, 250 Deg. F., Self-Locking, Element for	MIL-F-18240	12
Fastener, Positive, Self-Locking Case Mounting, Electronic Equipment	MS14108	
Fastener, Positive, Self-Locking Case Mounting, Electronic Equipment (with Holding Clamp)	MS14109	
Fastener, Rotary, Quick-Operating High Strength	NAS547	12
Fasteners, Panel	MIL-F-5591	12
Filter, Air Conditioning, Viscous Impingement and Dry Types, Cleanable	F-F-300	52
Filter, Air Conditioning, Viscous Impingement and Dry Types Replaceable	F-F-310	
Filter, Air Environmental Control System, Cleanable, Impingement (High Velocity Type)	MIL-F-16552	52
Filters and Networks, Selection and Use of	MIL-STD-1395	
Finish for Ground Signal Equipment	MIL-F-14072	
Fittings, Lubrication	MIL-F-3541	
Flange, Coaxial and Waveguide and Coupling, Assemblies Selection of	MIL-STD-1327	53

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Flux, Soldering, Liquid (Rosin Base)	MIL-F-14256	5
Foil, Copper, Cladding for Printed Wiring Boards	MIL-F-55561	17
Frequency for Electric Power	MIL-STD-205	25
Fuse, Fuseholders and Associated Hardware, Selection and Use of	MIL-STD-1360	39
Glass Cloth, Resin Preimpregnated (B Stage)-(For Multilayer Printed Wiring Boards)	MIL-G-55636	17
Glass, Laminated, Flat, (Except Aircraft)	MIL-G-3787	
Gold Plating, Electrode Deposited	MIL-G-45204	
Grease, Aircraft and Instrument, Gear and Actuator Screw	MIL-G-23827	43
Grease, Aircraft, General Purpose, Wide Temperature Range	MIL-G-81322	43
Grommet, Elastic, Hot-Oil and Coolant Resistant	MIL-G-3036	
Human Engineering Design Criteria for Military Systems, Equipment and Facilities	MIL-STD-1472	50, 62
Human Engineering Requirements for Military Systems, Equipment and Facilities	MIL-H-46855	62
Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance	MIL-H-5606	
*Hydraulic Systems, Aircraft, Type I and II, Design, Installation, and Data Requirements for	MIL-H-5440	49
*Hydraulic Systems, Manned Flight Vehicles, Type III, Design, Installation, and Data Requirements for	MIL-H-8891	49
Identification Coding and Application of Hookup and Lead Wire	MIL-STD-681	20, 67
Identification Marking of U.S. Military Property	MIL-STD-130	67
Impregnation of Porous Non-ferrous Metal Castings	MIL-STD-276	21
Indicator, Elapsed Time, Electrochemical	MIL-I-81219	51
Insert - Threaded Metal, Heavy Duty Self-Locking, Non-Self-Locking	NAS1395	
Insert - Threaded Metal, Light Weight, Self-Locking, Non-Self-Locking	NAS1394	

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Insulating Compound, Electrical Embedding	MIL-I-16923	47
Insulating Compound, Electrical Embedding, Reversion Resistant Silicone	MIL-I-81550	47
Insulating Compound, Electrical, (for Coating Printed Circuit Assemblies)	MIL-I-46058	17
Insulating Materials, Electrical, Ceramic, Class L	MIL-I-10	11, 26
Insulating Sleeving, Electrical, Heat Shrinkable, General Specification for	MIL-I-23053	11, 69
Insulating Varnish, Electrical Impregnating	MIL-I-24092	11
Insulation, Electrical, Synthetic-resin Composition, Nonrigid	MIL-I-631	11, 69
Insulation Sleeving, Electrical, Flexible, Treated	MIL-I-3190	11, 69
Insulation Tape, Glass Fabric, Polytetrafluoroethylene Coated	MIL-I-18746	11, 69
Insulation Tubing, Electrical Nonrigid, Vinyl, Very Low Temperature Grade	MIL-I-22076	11
Insulation Tubing, Electrical, Polytetrafluoroethylene Resin, Nonrigid	MIL-I-22129	11
Insulator, Ceramic, Electrical and Electronic, General Specification for	MIL-I-23264	11
Item Identification, Standard Guides for Preparation	FED-STD-NO. 5	
Jack, Telephone, General Specification for	MIL-J-641	10
*Joint Electronics Type Designation Systems	MIL-STD-196	34
*Joint Photographic Type Designation System	MIL-STD-155	67
Knob, Control, Equipment, Aircraft	MIL-K-25049	28
Knob, Control, Selection of	MIL-STD-1348	
Lamp, Glow	MIL-L-15098	50
Lampholder, Indicator Lights, Edge Lights, and Associated Hardware	MIL-STD-1368	
Lamps, Incandescent, Aviation Service, General Requirements for	MIL-L-6363	50
Legends for Use in Aircrew Stations and on Airborne Equipment	MIL-STD-783	67
Light, Panel, Plastic Plate Lighting	MIL-L-7806	50

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Light, Radio Frequency Transmission (Coaxial, Air Dielectric)	MIL-L-3890	65
Lubrication of Military Equipment	MIL-STD-838	
*Maintainability Prediction	MIL-HDBK-472	54
Maintainability Program, Requirements (for) Systems and Equipments	MIL-STD-470	54
*Maintainability Verification/Demonstration/Evaluation	MIL-STD-471	
*Marking of Connections for Electrical Assemblies	MIL-STD-195	67
Marking of Electrical and Electronic Parts	MIL-STD-1285	67
*Metallic Materials and Elements for Aerospace Vehicle Structures	MIL-HDBK-5	13
Meter, Electrical Indicating, (Switchboard and Portable Types)	MIL-M-16034	51
Meter, Electrical Indicating, Panel Type, Ruggedized, General Specification for	MIL-M-10304	
*Meters, Electrical Indicating, Selection and Use of	MIL-STD-1279	51
Meter, Time Totalizing	MIL-M-7793	51
Method of Salt Spray (Fog) Testing	ASTM B117.1-74	
*Microcircuits, General Specification for	MIL-M-38510	64
Microcircuits, Lists of Standard	MIL-STD-1562	64
Microcircuits, Packaging of	MIL-M-55565	
Military Communication System Technical Standards	MIL-STD-188	
Molding and Potting Compound, Chemically Cured Polyurethane (Polyether Based)	MIL-M-24041	47
Molding Plastics and Molding Plastic Parts, Thermosetting	MIL-M-14	11, 26
Molding Plastic, Polyamide (Nylon) Rigid	MIL-M-20693	
Motor, Alternating Current, 400-Cycle, 115/200-Volt System, Aircraft, General Specification for	MIL-M-7969	46
Motors, Direct Current, 28-Volt System, Aircraft, General Specification for	MIL-M-8609	46
Networks, Pulse Forming, Radar	MIL-N-23182	
Nickel Plating (Electrodeposited)	QQ-N-290	

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Nomenclature and Identification for Electronic, Aeronautical, and Aeronautical Support Equipment Including Ground Support Equipment	MIL-N-18307	
Nomenclature Assignment, Contractors Method for Obtaining	MIL-N-7513	
Numerical and Letter, Aircraft Instrument Dial, Standard Form of	MS33558	42
Nut, Self-Locking, 250 Deg. F, 450 Deg. F, and 800 Deg. F, 125 Ksi Ft _u , and 30 Ksi Ft _u	MIL-N-25027	12
Nut Square, Hexagon, Cap, Slotted Castellated, Clinch, Knurled and Welding	FF-N-836	12
Packing, Preformed, Hydrocarbon Fuel Resistant	MIL-P-5315	
Parameter to be Controlled for the Specifications of Microcircuits	MIL-STD-1331	
*Parts Control Program	MIL-STD-965	22
Pins, Grooved, Headless, Longitudinal Groove	MIL-P-20700	
Pins, Spring, Tubular (Coiled and Slotted)	MIL-P-10971	
Plastic Material, Laminated, Thermosetting, Electric Insulation, Sheets, Glass Cloth, Silicone Resin	MIL-P-997	11, 26
Plastic-Material, Molding, Rigid Thermoplastic, Polydichlorostyrene, for Use in Electronic, Communications, and Allied Electrical Equipment	MIL-P-3409	
Plastic, Method of Testing	FED-STD-NO. 406	26
Plastic Molding Material, Polystyrene, Glass Fiber Reinforced	MIL-P-21347	
Plastic Molding Material, Vinylidene Chloride, Copolymer	L-P-1041	
Plastic, Polyamide (Nylon), Flexible Molding and Extrusion Material	MIL-P-22096	
Plastic, Polyamide (Nylon), Rigid, Rods, Tubes, Flats, Molded and Cast Parts	L-P-410	
Plastic Rod and Tube, Thermosetting, Laminated	MIL-P-79	11, 26
Plastic, Sheet, Acrylic, Heat Resistant	MIL-P-5425	

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Plastic Sheet, Acrylic, Modified	MIL-P-8184	
Plastic Sheet and Plastic Rod, Thermosetting, Cast	L-P-516	11, 26
Plastic Sheet, Fep-fluorocarbon (Un-filled) Copper Clad (for Printed Wiring)	MIL-P-27538	17
Plastic Sheet, Laminated, Copper Clad (for Printed Wiring)	MIL-P-13949	17
Plastic Sheet, Laminated, Thermosetting, Glass Fiber Base, Epoxy-Resin	MIL-P-18177	11
Plastic Sheet, Rod and Tube, Laminated Thermosetting	L-P-509	
Plastic Sheet, Thin Laminate, Copper-Clad (for Printed Wiring, Primarily for Multilayer)	MIL-P-55617	17
Plates, Tags and Bands for Identification of Equipment	MIL-P-15024	67
Plates, Identification, Metal Foil, Adhesive Backed	MIL-P-19834	
Plating, Cadmium (Electrodeposited)	QQ-P-416	12, 15, 51
*Plating, Tin-Lead (Electrodeposited)	MIL-P-81728	5
Plug, Telephone, and Accessory	MIL-P-642	10
Screws, General Specification for Power Supply Voltages, Regulated, DC Within Electronic Equipment	MIL-STD-706	
Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity	TT-P-1757	
*Printed Wiring Assemblies	MIL-P-28809	5, 17
Printed Wiring Boards	MIL-P-55110	17
Printed Wiring Boards, Multilayer (Plated-Through Hole)	MIL-P-55640	17
Printed Wiring for Electronic Equipment	MIL-STD-275	5, 17, 36
Printed-Wiring and Printed-Circuits, Terms and Definitions	MIL-STD-429	
Racks, Electrical Equipment, 19-inch and Associated Panels	MIL-STD-189	55
Radar Engineering Design Requirements, Electromagnetic Compatibility	MIL-STD-469	61
*Radioactive Materials: Marking and Labeling of Items, Packages and Shipping Containers for Identification, In Use, Storage and Transportation	MIL-STD-1458	1

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
*Readouts, Incandescent Type, General Specification for	MIL-R-39027	68
*Readouts, Segmented, General Specification for	MIL-R-28803	68
Reference Designations for Electrical And Electronics Parts and Equipment	IEEE 200-1975	67
Relay, Selection and Application	MIL-STD-1346	57
Reliability Assurance Program for Electronic Parts Specification	MIL-STD-790	
Reliability Program for Systems and Equipment Development and Production	MIL-STD-785	35
*Reliability Stress and Failure Rate Data for Electronic Equipment	MIL-HDBK-217	15, 64
Reliability Tests Exponential Distribution	MIL-STD-781	35
Resistor, Selection and Use of	MIL-STD-199	33
*Resistors, Fixed, Film, Chip, Established Reliability, General Specification for	MIL-R-55342	33
Resolver, Electrical, Application of	MIL-HDBK 218	56
Resolver, Electrical, Selection of	MIL-STD-1451	56
Rf Transmission Lines and Fittings	MIL-HDBK 216	53, 65
Rubber, Fabricated Parts	MIL-R-3065	
Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes	MIL-R-6855	
Safety Wiring and Cotter Pinning, General, Practices for	MS33540	12
Screw, Cap, Slotted and Hexagon Head	FF-S-85	12
Screw, Cap, Socket Head	FF-S-86	12
Screw-Installation and Limitations for Usage of Thread Cutting and Thread Forming	MS33749	
Screw, Machine, Slotted or Cross Recessed	FF-S-92	12
Screw, Tapping and Drive	FF-S-107	12
Screw, Tapping - Thread Forming, Type Ab, Flat 82 Deg. Countersunk Head, Cross Recessed	MS51862	
Screw-Thread Standards for Federal Services	FED-STD-H28	12
Screw Threads, Standard, Optimum Selected Series, General Specification for	MIL-S-7742	12
Sealing Compound, Electrical, Silicone Rubber, Accelerator Required	MIL-S-23586	47

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Regt. No.</u>
Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured	MIL-S-8516	47
Sealing, Locking and Retaining Compounds, Single-Component	MIL-S-22473	12
Semiconductor Devices, Lists of Standard	MIL-STD-701	30
Servomotor, General Specification	MIL-S-22432	56
Servomotor-Tachometer Generator A.C., General Specification for	MIL-S-22820	56
Setscrew, Hexagon Socket and Spline Socket Headless	FF-S-200	12
Setscrews, Square Head and Slotted Headless	FF-S-210	12
Shaft Assembly, Flexible	MIL-S-3644	42
Shunt, Instrument, External, 50 Millivolt (Lightweight Type)	MIL-S-61	40
Silicone Compound	MIL-S-8660	
Solder, Tin Alloy, Lead-Tin Alloy And Lead Alloy	QQ-S-571	5
Soldering Process, General Specification for	MIL-S-6872 -	(Note: For Mechanical Assemblies Only)
Solenoid, Electrical (Rotary-Stepping) Specification, Preparation of Installation and Acceptance Testing of Electronics Equipment in Aircraft	MIL-S-4040/2 MIL-S-55556	
*Splices, Clips, Terminals, Terminal Boards, Binding Posts, Electrical Spring, Helical, Compression and Extension	MIL-STD-1277 MIL-S-13572	19 41
Standards and Specifications, Order of Precedence for the Selection of Strap, Tie Down, Electrical Components	MIL-STD-143 MIL-S-23190	 69
*Studs, Continuous Thread (Bolt Studs); Nuts, Plain, Hexagon; and Steel Bars, Round - High Temperature Service craft	MIL-S-1222	12
Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapon Systems	MIL-S-5002	15
Switch and Associated Hardware, Selection and Use of	MIL-STD-1132	58
Switch, Rf Coaxial, Selection of	MIL-STD-1329	53
Switch, Rotary, Enclosed	MIL-S-15743	58

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Switch, Rotary, Multiple Selector Type, 1 to 10	MIL-S-21604	58
*Switches, Waveguide	MIL-S-55041	53
Synchros, 60 and 400 Cycle	MIL-STD-710	56
*Standard General Requirements for Electronic Equipment	MIL-STD-454	
Synchros	MIL-HDBK 214	56
Synchros, Description and Operation	MIL-HDBK-225	56
System Safety Program for Systems and Associated Subsystems and Equipment, Requirements for	MIL-STD-882	
Tachometer Generator, A.C., General Specification	MIL-T-22821	56
Terminal, Lug, Solder, Copper and Phosphor Bronze	MIL-T-15659	19
Terminals, Lug and Splice, Crimp-style, Copper	MIL-T-7928	69
Test for High Voltage, Low Current, Arc Resistance of Solid Electrical Insulating Materials	ASTM-D-495-73	26
Test Methods for Electronic and Electrical Component Parts	MIL-STD-202	5
Test Methods and Procedures for Microelectronics	MIL-STD-883	5, 64
Test Methods for Semiconductor Devices	MIL-STD-750	5
Test Provisions for Electronic Systems and Associated Equipment, Design Criteria for	MIL-STD-415	32
Testing, Environmental, Airborne, Electronic and Associated Equipment	MIL-T-5422	
Thermistor (Thermally Sensitive Resistor), Insulated, General Specification for	MIL-T-23648	33
Thread Compound, Antiseize, Zinc Dust-Petrolatum	MIL-T-22361	
Tin Plating, Electrodeposited or Hot-Dipped, for Ferrous and Nonferrous Metals	MIL-T-10727	
Transformer, Inductors, and Coils, Selection and Use of	MIL-STD-1286	14
*Transformers, General Specification for	MIL-T-83727	56
Twine, Impregnated, Lacing and Tying Vials, Level	MIL-T-713 MIL-V-3144	69

MIL-E-5400T
Appendix A

<u>Document Title</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
Washer, Lock (Spring)	FF-W-84	12
Washer, Lock (Tooth)	FF-W-100	12
Waveguide Assembly, Flexible, Twistable and Nontwistable	MIL-W-287	53
Waveguide Assemblies, Rigid, General Specification for	MIL-W-3970	53
Waveguides, Rectangular, Rigid and Circular, Selection of	MIL-STD-1358	
Welded Joint Designs	MIL-STD-22	13
*Welding and Brazing Procedure and Performance Qualification Technical Documents	MIL-STD-248	13
Welding, Metal Arc and Gas, Steels and Corrosion and Heat Resistant Alloys, Process for	MIL-W-8611	13
Welding of Aluminum Alloy, Process for	MIL-W-8604	13
Welding Procedures for Construction Steels	MIL-STD-1261	13
Welding, Resistance, Aluminum, Magnesium, Non-Hardening Steels or Alloys, Nickel Alloys, Heat-Resisting Alloys, and Titanium Alloys, Spot and Seam	MIL-W-6858	13
Welding Resistance, Electronic Circuit Modules	MIL-W-8939	24
Wire, Electric, Crosslinked Polyalkene Insulated, Copper	MIL-W-81044	20, 66, 71
Wire, Electric, Fluorocarbon Insulated, Copper or Copper Alloy	MIL-W-22759	20, 66, 71
Wire, Electric, Polyimide-Insulated, Copper and Copper Alloy	MIL-W-81381	20, 66, 71
Wire, Electrical, Chromel and/or Alumel, Thermocouple	MIL-W-5846	20, 66, 71
Wiring, Aerospace Vehicle	MIL-W-5088	
Zinc Coating, Electrodeposited, Requirements for	QQ-Z-325	15, 41

MIL-E-5400T
Appendix A

NUMERICAL LIST

MILITARY SPECIFICATIONS

<u>Document Number</u>	<u>Referenced in MIL-STD-454 Regt. No.</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Regt. No.</u>
MIL-I-10	11, 26	MIL-W-5486	20, 66, 71
MIL-M-14	11, 26	MIL-C-6021	21
MIL-C-17	65, 66, 71	MIL-C-6136	
MIL-S-61	40	MIL-L-6363	50
MIL-P-79	11, 26	MIL-C-6781	
MIL-C-172	55	MIL-B-6812	12
MIL-W-287	53	MIL-R-6855	
MIL-I-631	11, 69	MIL-W-6858	13
MIL-J-641	10	MIL-S-6872	
MIL-P-642	10	MIL-C-7078	66, 71
MIL-T-713	69	MIL-N-7513	
MIL-P-997	11, 26	MIL-S-7742	12
DOD-D-1000		MIL-M-7793	51
*MIL-S-1222	1	MIL-L-7806	50
MIL-G-3036		MIL-B-7838	12
MIL-R-3065		MIL-B-7883	59
MIL-C-3133		MIL-T-7928	69
MIL-V-3144		MIL-M-7969	46
MIL-I-3190	11, 69	MIL-P-8184	
MIL-P-3409		MIL-A-8421	
MIL-F-3541		MIL-S-8516	47
MIL-S-3644	42	MIL-W-8604	13
MIL-G-3787		MIL-M-8609	46
MIL-C-3883		MIL-W-8611	13
MIL-L-3890	65	MIL-A-8625	
MIL-A-3920	23	MIL-S-8660	
MIL-D-3954	53	*MIL-H-8891	49
MIL-W-3970	53	MIL-W-8939	24
MIL-B-3990	6	MIL-M-10304	
MIL-S-4040/2		MIL-C-10392	
MIL-S-5002	15	MIL-T-10727	12
MIL-B-5087	1	MIL-P-10971	
MIL-W-5088		MIL-S-13572	41
MIL-P-5315		MIL-C-13777	66, 71
MIL-T-5422		MIL-C-13909	
MIL-P-5425		MIL-P-13949	17
*MIL-H-5440	49	MIL-F-14072	
MIL-C-5541		MIL-F-14256	5
MIL-F-5591	12	MIL-P-15024	67
MIL-H-5606		MIL-E-15090	
MIL-B-5687	6	MIL-L-15098	50

MIL-E-5400T
Appendix A

<u>Document Number</u>	<u>Referenced in MIL-STD-454 Req. No.</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Req. No.</u>
MIL-T-15659	19	*MIL-D-39030	53
MIL-S-15743	58	MIL-G-45204	
MIL-M-16034	51	MIL-I-46058	17
MIL-F-16552	52	MIL-H-46855	62
MIL-I-16923	47	*MIL-S-55041	53
MIL-P-18177	11	MIL-P-55110	17
MIL-F-18240	12	MIL-B-55130	27
MIL-N-18307		*MIL-R-55342	33
MIL-I-18746	11	*MIL-A-55339	10
MIL-P-19834		MIL-S-55556	
MIL-M-20693		MIL-P-55561	17
MIL-P-20700		MIL-M-55565	
MIL-P-21347		MIL-P-55617	17
MIL-S-21604	58	MIL-G-55636	17
MIL-I-22076	11, 69	MIL-P-55640	17
MIL-P-22096		MIL-W-81044	20, 66, 71
MIL-I-22129	11	MIL-I-81219	51
MIL-T-22361		MIL-G-81322	43
MIL-S-22432	56	MIL-W-81381	20, 66, 71
MIL-S-22473	12	*MIL-E-81512	56
MIL-A-22641	53	MIL-I-81550	47
MIL-C-22759	20, 66	*MIL-P-81728	5
MIL-S-22820	56	*MIL-B-81757	27
MIL-T-22821	56	MIL-B-81793	6
MIL-C-22931	65	*MIL-T-83727	56
MIL-I-23053	11, 69	*MIL-E-85082	56
MIL-N-23182			
MIL-S-23190	69		
MIL-I-23264	11		
MIL-S-23586	47		
MIL-T-23648	33		
MIL-G-23827	43		
MIL-M-24041	47		
MIL-I-24092	11		
MIL-N-25027	12		
MIL-K-25049	28		
MIL-C-27072	66, 71		
MIL-P-27538	17		
*MIL-R-28803	68		
*MIL-P-28809	5, 17		
*MIL-M-38510	64		
*MIL-R-39027	68		
		<u>FEDERAL SPECIFICATIONS</u>	
		F-F-300	52
		F-F-310	
		L-P-410	
		L-P-509	
		L-P-516	11, 26
		L-P-1041	
		FF-B-171	6
		FF-B-185	6
		FF-B-187	6
		FF-B-195	6
		FF-B-575	12
		FF-N-836	12

MIL-E-5400T
Appendix A

<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
FF-S-85	12	MIL-STD-280	7, 8, 36, 67
FF-S-86	12	MIL-STD-415	32
FF-S-92	12	MIL-STD-429	
FF-S-107	12	*MIL-STD-454	
FF-S-200	12	MIL-STD-461	61
FF-S-210	12	MIL-STD-462	61
FF-W-84	12	MIL-STD-463	
FF-W-100	12	MIL-STD-469	61
QQ-B-613		MIL-STD-470	54
QQ-C-320		*MIL-STD-480	72
QQ-C-576		*MIL-STD-889	16
QQ-N-290		MIL-STD-681	20, 67
QQ-P-416	12, 15, 41	MIL-STD-683	38
QQ-S-571	5	MIL-STD-688	27
QQ-Z-325	15, 41	MIL-STD-701	30
*TT-C-490		MIL-STD-704	25
*TT-P-1757		MIL-STD-706	
MMM-A-131	23	MIL-STD-710	56
MMM-A-132	23	MIL-STD-721	36
MMM-A-189	23	MIL-STD-750	5
MMM-A-1617	23	MIL-STD-781	35
		MIL-STD-783	67
		MIL-STD-785	35
		MIL-STD-790	
		MIL-STD-810	
		MIL-STD-838	
		MIL-STD-882	
		MIL-STD-883	64
		*MIL-STD-965	22
		MIL-STD-1132	58
		*MIL-STD-1277	19
		*MIL-STD-1279	51
		MIL-STD-1285	67
		MIL-STD-1286	14
		MIL-STD-1327	53
		MIL-STD-1328	53
		MIL-STD-1329	53
		MIL-STD-1331	
		MIL-STD-1334	6
		MIL-STD-1346	57
		MIL-STD-1348	
		MIL-STD-1352	53
		MIL-STD-1353	10
		MIL-STD-1358	53
<u>MILITARY STANDARDS</u>			
*MIL-STD-12	67		
*MIL-STD-471	54		
MIL-STD-22	13		
MIL-STD-100			
MIL-STD-108	55, 69		
MIL-STD-130	67		
MIL-STD-143			
*MIL-STD-155	67		
MIL-STD-188			
MIL-STD-189	55		
*MIL-STD-195	67		
*MIL-STD-196	34, 67		
MIL-STD-198	2		
MIL-STD-199	33		
MIL-STD-202	5		
MIL-STD-205	25		
MIL-STD-248	13		
MIL-STD-255	25		
MIL-STD-275	5, 17, 36		
MIL-STD-276	21		

MIL-E-5400T
Appendix A

<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>	<u>Document Number</u>	<u>Referenced in MIL-STD-454 Reqt. No.</u>
MIL-STD-1360	38	<u>AWS - AMERICAN WELDING SOCIETY</u>	
MIL-STD-1368		AWS-A2.0-68	
MIL-STD-1395	70	AWS-A3.0-76	13
MIL-STD-1451	56	<u>ASTM - AMERICAN SOCIETY FOR TESTING AND MATERIAL</u>	
*MIL-STD1458	1	ASTM B-117.1-74	
MIL-STD-1472	1, 50, 62	ASTM D-495-73	26
MIL-STD-1498	37	<u>ANSI - AMERICAN NATIONAL STANDARDS INSTITUTE</u>	
MIL-STD-1562	64	ANSI Y32.3-69	
*MIL-STD-1595	13	ANSI Z35.1-72	1
MS3182		<u>IEEE - INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS</u>	
MS3183		IEEE 200-1975	67
MS14108			
MS14109			
MS25042			
MS25043			
MS33540	12		
MS33558	42		
MS33749			
MS51862			
MS90376			
<u>FEDERAL STANDARDS</u>			
FED-STD-5			
FED-STD-406	26		
FED-STD-595			
FED-STD-H28	12		
<u>MILITARY HANDBOOKS</u>			
*MIL-HDBK-5	13		
MIL-HDBK-214	56		
MIL-HDBK-216	53, 65		
*MIL-HDBK-217	15, 64		
MIL-HDBK-218	56		
*MIL-HDBK-225	56		
*MIL-HDBK-231	56		
*MIL-HDBK-472	54		
*MIL-HDBK-660	53		
MIL-HDBK-691	23		

APPENDIX B

SAMPLE TAILORING GUIDE

10. SCOPE

10.1 Scope. This appendix provides guidance information only and is not intended to be invoked as a contractual requirement.

10.2 This appendix provides a sample tailoring guide for MIL-E-5400 based on the relationship of tailoring specific MIL-E-5400 requirements during various development and production phases as defined in MIL-STD-280A. 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-E-5400 requirements are shown in paragraph 40.

20. APPLICABLE DOCUMENTS (Reference Only)

MIL-STD-280A -Definitions of Item Levels, Item Interchangeability, Models, and Related Terms

30. APPLICATION OF SAMPLE TAILORING GUIDE

30.1 The sample tailoring guide contained herein cross-references indications of tailoring applicability for MIL-E-5400 requirements to various phases of item development and production as defined in MIL-STD-280A. 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

Program Phases

EXP DEV- Exploratory Development
ADV DEV- Advance Development
ENG DEV- Engineering Development
PREPROD (PROTO)- Preproduction (Prototype)
PROD- Production

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

Exploratory Development - Specifications and standards requirements should be tailored and limited to minimum technical design objectives and broad

MIL-E-5400T
Appendix B

basic performance and functional requirements. Application of "cost driver" requirements should be very limited.

Advanced Development - 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.

Engineering Development/Preproduction (Prototype) - 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-E-5400 requirements to the engineering 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 these areas of consideration:

- 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

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.1 Parts, Materials and Processes	N	A	A	A	A	
3.1.1 Selection of parts and materials	N	A	A	A	A	Taiforing req'd for MIL-STD-965 also.
3.1.1.1 Approval of nonstandard parts and materials	N	A	A	A	A	
3.1.1.1.1 Category I Contracts	T	T	T	T	T	
3.1.1.1.2 Category II and Category III Contracts	T	T	T	T	T	
3.1.1.1.3 Reordered Production Equipment	T	T	T	T	T	
3.1.1.1.3.1 Continuation of production	T	T	T	T	T	
3.1.1.1.4 Time Schedule of material App. Requests	N	A	A	A	A	
3.1.1.1.5 Samples required for part and mtl. approval	N	A	A	A	A	
3.1.1.2 Use of Military part identifiers	G	G	G	G	G	
3.1.1.3 Choice of part and materials	N	A	A	A	A	
3.1.1.4 Replaceability by standard parts & materials	N	A	A	A	A	
3.1.1.5 Equipment Performance	G	G	G	G	G	
3.1.2 Capacitors	N	A	A	A	A	
3.1.3 Metal castings	N	N	N	A	A	

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.1.4 Electrical Connectors	N	N	A	A	A	
3.1.4.1 Mounting of Electrical receptacles	N	N	N	X	A	
3.1.4.2 Adjacent locations	N	N	N	A	A	
3.1.5 Controls	N	A	A	A	A	
3.1.5.2 Tuning Dials	N	A	A	A	A	
3.1.5.3 Control Panels	N	A	A	A	A	
3.1.5.4 Ranges of Adjustable Components	N	N	A	A	A	
3.1.6 Corrosion Resistance	N	N	A	A	A	
3.1.6.1 Materials	G	G	G	G	G	
3.1.6.2 Ferrous alloys	N	N	A	A	A	
3.1.6.3 Aluminium Alloy						
3.1.6.3.1 Surface, General	G	G	G	G	G	
3.1.6.3.2 Surfaces, bonded and grounded	G	G	G	G	G	
3.1.6.3.3 Aluminium Surfaces, extreme wear resistance	G	G	G	G	G	
3.1.6.4 Cadmium plating	G	G	G	G	G	
3.1.6.5 Magnesium and Mag. alloys	G	G	G	G	G	
3.1.6.6 Zinc and Zinc plated parts	G	G	G	G	G	

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.1.7 Dissimilar Metals	N	N	A	A	A	
3.1.8 Finishes	N	N	A	A	A	
3.1.8.1 Gases and Front Panels	N	N	A	A	A	
3.1.8.2 Fasteners and Assembly Screws	N	N	A	A	A	
3.1.8.3 Other Standard Finishes	G	G	G	G	G	
3.1.9 Grounding	A	A	A	A	A	
3.1.10 Fastener Hardware	N	N	A	A	A	
3.1.11 Fungus Inert Materials	N	A	A	A	A	
3.1.12 Fuses - Fuseholders & Assoc. Hardware	N	N	A	A	A	
3.1.13 Insulators, insulating & dielectric Methods	N	A	A	A	A	
3.1.14 ARC resistant materials	A	A	A	A	A	
3.1.15 Jacks	N	A	A	A	A	
3.1.16 Marking	N	N	A	A	A	
3.1.16.1 Engineering Design Change	N	N	N	A	A	
3.1.16.2 Labels	N	N	N	A	A	
3.1.16.3 Wire Coding	N	N	N	A	A	
3.1.17 Meters (Elect. indicating and accessories)	N	N	A	A	A	

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.1.18 Relays	N	A	A	A	A	
3.1.19 Resistors	N	A	A	A	A	
3.1.19.1 Tapped resistors	N	A	A	A	A	
3.1.20 Soldering	N	N	A	A	A	
3.1.20.1 Mechanical Assemblies	N	N	A	A	A	
3.1.21 Springs	N	N	A	A	A	
3.1.22 Switches	N	N	A	A	A	
3.1.22.1 Rotary Switches						
3.1.22.1.1 Indexing Mechanism	N	N	A	A	A	
3.1.22.1.2 Materials	N	N	A	A	A	
3.1.22.1.3 Mounting	N	N	A	A	A	
3.1.22.2 Toggle Switches	N	N	A	A	A	
3.1.23 Terminals	N	N	A	A	A	
3.1.25 Tools (Special)	N	N	N	A	A	
3.1.26 Set screw wrenches	N	N	N	A	A	
3.1.28 Transformer and Inductors	N	A	A	A	A	
3.1.29 Semiconductor devices & Elect. tubes	G	A	A	A	A	

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev.	Eng Dev	Pre- Prod (Proto)	Prod	Remarks
3.1.31. Structural Welding	N	N	A	A	A	
3.1.32 Wire (hook-up)	N	N	A	A	A	
3.1.33 Wire (internal)	N	N	A	A	A	
3.1.33.1 Printed Wiring	N	N	N	A	A	
3.1.34 Wiring (External)	N	N	A	A	A	
3.1.36 Microelectronic Devices	N	N	A	A	A	
3.1.37 Parts to meet reliability require- ments	N	N	A	A	A	
3.1.38 Bearings	N	N	A	A	A	
3.1.39 Flammable Materials	N	N	A	A	A	
3.1.40 Derating						
3.1.41 Adhesives	N	N	A	A	A	
3.1.42 Batteries	N	A	A	A	A	
3.1.43 Quartz Crystal Units	N	A	A	A	A	
3.1.44 Motors, dynamotors, rotary power converters & motor generators.	N	A	A	A	A	
3.1.45 Waveguides and related equipment	N	N	A	A	A	
3.1.46 Circuit Breakers	N	A	A	A	A	
3.1.47 Gears and Cams	N	N	A	A	A	

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.1.48 Indicator lights	N	A	A	A	A	
3.1.49 Hydraulics	N	N	A	A	A	
3.1.50 Rotary Servo devices	N	A	A	A	A	
3.1.51 Sockets, Shields & Clamps	N	N	A	A	A	
3.1.52 Brazing	N	N	A	A	A	
3.1.53 Organic fibrous material	N	N	A	A	A	
3.1.54 Coaxial Cable (rf)	N	N	A	A	A	
3.1.55 Multiconductor Cable	N	N	A	A	A	
3.1.56 Readouts	N	A	A	A	A	
3.1.56.1 Digital readout displays (LCD & LED)	N	A	A	A	A	
3.1.57 Electrical Filters	N	A	A	A	A	
3.2.1 Detailed mechanical & Electrical Design	G	G	G	G	G	
3.2.1.1 Mechanized production (incl. printed circuits)	G	G	G	G	G	
3.2.1.1.1 Nonrepairable subassemblies	G	G	G	G	G	
3.2.1.1.2 Circuit Approval (non-rep. assemblies)	N	N	A	A	A	

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.2.1.1.3 (No title)	G	G	G	G	G	
3.2.1.1.4 Approval Requests	N	N	A	A	A	
3.2.1.1.5 (No title)	G	G	G	G	G	
3.2.1.1.6 Types of Construction	G	G	G	G	G	
3.2.1.1.7 (No title)	G	G	G	G	G	
3.2.1.1.8 Welds, resistance, electrical interconnections	N	N	A	A	A	
3.2.2 Fabrication	N	N	A	A	A	
3.2.3 Enclosures	N	N	A	A	A	
3.2.4 Accessibility	N	N	A	A	A	
3.2.5 Thermal design	N	N	A	A	A	
3.2.5.1 Cooling design data	N	N	A	A	A	
3.2.6 Corona and electrical breakdown prevention	A	A	A	A	A	
3.2.8 Encapsulating and embedment	N	N	N	A	A	
3.2.9 Conformal Coating	N	N	A	A	A	
3.2.10 Lubrication	N	N	A	A	A	
3.2.11 Electromagnetic interference characteristics	N	N	N	A	A	

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.2.12 Anti-jamming	N	A	A	A	A	
3.2.13 Maintainability	N	N	A	A	A	
3.2.14 Reliability	N	N	A	A	A	
3.2.15 Test Points, test facilities and test equipment	N	N	A	A	A	
3.2.15.1 Operational Checkout provisions	N	N	A	A	A	
3.2.16 Microphonics	G	G	G	G	G	
3.2.17 Moisture pockets	N	N	N	A	A	
3.2.19 Orientation	N	N	A	A	A	
3.2.20 Electrical Overload Protection	N	N	A	A	A	
3.2.21 Pressurization	N	N	A	A	A	
3.2.22 Safety (personnel hazard)	A	A	A	A	A	
3.2.22.1 Safety program	G	G	G	G	G	
3.2.23 Service conditions (electrical)	N	N	A	A	A	
3.2.23.1 Warm-up time	N	N	A	A	A	
3.2.24 Service conditions (environmental)	N	N	A	A	A	
3.2.24.1 Temperature	N	N	A	A	A	
3.2.24.1.1 Operating	N	N	A	A	A	

MIL-E-5400T
Appendix B

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.2.24.1.2 Non-operating	N	N	A	A	A	
3.2.24.2 Altitude	N	N	A	A	A	
3.2.24.3 Temp.-Altitude Combination	N	N	A	A	A	
3.2.24.4 Humidity	N	N	A	A	A	
3.2.24.5 Vibration						
3.2.24.5.1 Equipment normally mtd.	N	N	N	A	A	
3.2.24.5.1.1 Equipment des. for install in prop a/c	N	N	N	A	A	
3.2.24.5.1.2 Equipment des. for install in jet a/c	N	N	N	A	A	
3.2.24.5.1.3 Equipment des. for install helicopters	N	N	N	A	A	
3.2.24.5.2 Equipment with isolators removed	N	N	N	A	A	
3.2.24.6 Shock						
3.2.24.6.1 Equipment	N	N	N	A	A	
3.2.24.6.2 Mounting base (crash safety)	N	N	N	A	A	
3.2.24.6.3 Bench handling	N	N	A	A	A	
3.2.24.7 Sand and dust	N	N	N	A	A	
3.2.24.8 Fungus	N	N	A	A	A	

MIL-E-5400T PARAGRAPH NUMBER AND DESCRIPTION	Exp Dev	Adv Dev	Eng Dev	Pre-Prod (Proto)	Prod	Remarks
3.2.24.9 Salt Atmosphere	N	N	N	A	A	
3.2.24.10 Explosive conditions	N	N	N	A	A	
3.2.25 Human Engineering	N	N	A	A	A	
3.3 Interchangeability	N	N	N	A	A	
3.3.1 Int. of reordered equipment	N	N	N	A	A	
3.3.2 Interchangeability conflicts	G	G	G	G	G	
3.4 Nomenclature Assignments	N	N	N	A	A	
3.5 Workmanship	N	N	A	A	A	
4. Workmanship Assurance Provisions	N	N	N	A	A	

INDEX

CONTENTS	PARAGRAPH
Accessibility	3.2.4
Adhesives	3.1.41
Anti-jamming	3.2.12
Approval requests	3.2.1.1.4
Arc-resistant materials	3.1.14
Batteries	3.1.42
Bearings	3.1.38
Brazing	3.1.52
Capacitors	3.1.2
Castings	3.1.3
Circuit breakers	3.1.46
Coaxial cable (RF)	3.1.54
Conformal coating	3.2.9
Connectors, electrical	3.1.4
Controls	3.1.5
Tuning dials	3.1.5.1
Control panels	3.1.5.3
Corona	3.2.6
Corrosion resistance	3.1.6
Ferrous alloys	3.1.6.2
Derating	3.1.40
Detailed mechanical and electrical design	3.2.1
Mechanized production (including printed circuits)	3.2.1.1
Nonrepairable subassemblies	3.2.1.1.1
Welds, resistance, electrical interconnections	3.2.1.1.8
Dissimilar metals	3.1.7
Electrical overload protection	3.2.20
Electromagnetic interference characteristics	3.2.11
Electron tubes	3.1.29.2
Encapsulating and embedment	3.2.8
Enclosures	3.2.3
Fabrication	3.2.2
Fastener hardware	3.1.10
Filters, electrical	3.1.57
Finishes	3.1.8
Aluminum alloy	3.1.6.3
Cadmium-plating	3.1.6.4
Cases and front panels	3.1.8.1
Magnesium and magnesium alloys	3.1.6.5
Zinc and zinc-plated parts	3.1.6.6
Flammable materials	3.1.39
Fungus-inert materials	3.1.11
Fuses, fuse holders and associated hardware	3.1.12
Gears and cams	3.1.47
Grounding	3.1.9
Human engineering	3.2.25
Hydraulics	3.1.49

INDEX (Continued)

CONTENTS	PARAGRAPH
Indicator lights	3.1.48
Insulators, insulating, and dielectric materials	3.1.13
Interchangeability	3.3
Jacks (microphone and headset)	3.1.15
Lubrication	3.2.10
Maintainability	3.2.13
Marking	3.1.16
Labels	3.1.16.2
Wire coding	3.1.16.3
Materials	3.1
Approval of nonstandard	3.1.1.1
Choice of materials	3.1.1.3
Nonstandard	3.1.1
Replaceability	3.1.1.4
Samples	3.1.1.1.5
Selection and control	3.1.1
Standard	3.1.1
Meters (electrical indicating and accessories)	3.1.17
Microelectronic devices	3.1.36
Microphonics	3.2.16
Moisture pockets	3.2.17
Motors	3.1.44
Multiconductor cable	3.1.55
Nomenclature	3.4
Organic fibrous material	3.1.53
Orientation	3.2.19
Parts	3.1
Approval of nonstandard	3.1.1.1
Choice of parts	3.1.1.3
Military part identifiers	3.1.1.2
Nonstandard	3.1.1
Reliability	3.1.37
Replaceability	3.1.1.4
Samples	3.1.1.1.5
Selection and control	3.1.1
Standard	3.1.1
Substitution	3.1.1.6
Pressurization	3.2.21
Processes	3.1
Quartz crystal units	3.1.43
Readouts	3.1.56
Relays	3.1.18
Reliability	3.2.14
Resistors	3.1.19
Rotary servo devices	3.1.50

MIL-E-5400T

INDEX (Continued)

CONTENTS	PARAGRAPH
Safety, personnel hazard	3.2.22
Safety program	3.2.22.1
Semiconductor devices	3.1.29
Service conditions, electrical	3.2.23
Service conditions, environmental	3.2.24
Altitude	3.2.24.2
Explosive conditions	3.2.24.10
Fungus	3.2.24.8
Humidity	3.2.24.4
Salt atmosphere	3.2.24.9
Sand and dust	3.2.24.7
Shock	3.2.24.6
Temperature	3.2.24.1
Temperature altitude combination	3.2.24.3
Vibration	3.2.24.5
Servo devices, rotary	3.1.50
Sockets, shields and clamps	3.1.51
Soldering	3.1.20
Springs	3.1.21
Structural welding	3.1.31
Substitute parts	3.1.1.6
Switches	3.1.22
Terminals	3.1.23
Test points, test facilities and test equipment	3.2.15
Thermal design	3.2.5
Tools - special	3.1.25
Transformers and inductors	3.1.28
Tuning dials	3.1.5.2
Vibration	3.2.24.5
Waveguides	3.1.45
Welding, structural	3.1.31
Welds, resistance, electrical interconnections	3.2.1.1.8
Wire (hookup)	3.1.32
Wiring, external	3.1.34
Wiring, internal	3.1.33
Printed wiring	3.1.33.1
Workmanship	3.5