MILITARY SPECIFICATION

ELECTRIC POWER EQUIPMENT, BASIC REQUIREMENTS

(NAVAL SHIPBOARD USE)

This amendment forms a part of Military Specification MIL-E-917D(NAVY), 28 January 1965.

Pages 1, 2 and 3, paragraph 2.1, Under Military Specifications: Delete reference to "MIL-E-1", MIL-T-7928" and "MIL-P-55110"

Page 1, paragraph 2.1, under Military Specifications: Add

"MIL-I-1361 - Instruments, Electrical Measuring: Shunts, Resistors and Transformers (Ship and Shore Use).
"MIL-C-2174 - Controllers, Direct-Current, Naval Shipboard.
"MIL-C-2212 - Controllers, Alternating-Current, Naval Shipboard.
"MIL-S-3950 - Switches, Toggle.
"MIL-T-15108 - Transformers, Power, Step-Down, Single Phase, 60 Cycle, IKVA Approximate Minimum Rating; and Reactors (Balance Coils)-Dry. Naval Shipboard.
"MIL-S-15291 - Switches, Rotary, Snap Action.
"MIL-F-15733 - Filters, Radio Interference: General Specification for.
"MIL-T-16315 - Transformers, Power, Step-Down, Miscellaneous, Naval Shipboard Use.
"MIL-S-18396 - Switches, Meter and Control, Naval Shipboard
"MIL-I-24178 - Insulation Tape, Electrical Semi-Cured, Thermosetting Resin Treated Glass Armature Banding, Naval Shipboard.
"MIL-I-46058 - Insulating Compound, Electrical (for Coating Printed Circuit Assemblies).

Page 3, paragraph 2.1, cont'd: Under Military Standards: Add:

"MIL-STD-454- Standard General Requirements for Electronic Equipment.
"MS21250- Bolt, 12 Point, External Wrenching, 180,000 PSI."

Page 5, paragraph 3.1.1.3, first sentence: Add "and 3.8.4"

Page 7, paragraph 3.2, add as item (h):

"(h) Maintenance and repair. - Equipment shall be designed for ease of maintenance and repair. Except where packaging of parts in non-repairable form is approved (see 3.7.2.9), equipment shall be capable of being repaired either by replacement of defective individual electrical, electronic or mechanical parts (resistors, capacitors, semiconductors, bearings and so forth) or by utilizing bulk materials (magnet wire, varnish, insulation and so forth) commonly available. The use of special design features that simplify maintenance and repair (examples, test jacks, indicating type fuseholders) is encouraged."

Page 7, paragraph 3.3(a), line 13: Delete "material" and substitute "material shall be"

Page 9, paragraph 3.3.2.1: Add "Metal-to-metal contact is not considered to exist if one of the contact surfaces is anodized aluminum."

Page 14, paragraph 3.3.2.3: Add as item (k):

"(k) Titanium"

Page 16, paragraph 3.4.8.2, last sentence: Delete and substitute: "Where used, filters and capacitors shall conform to MIL-F-15733, MIL-C-11693 or MIL-C-12889."

Page 16, paragraph 3.4.10.1, line 3: Delete "table II" and substitute "table IV"

Page 17, table IV: Delete and substitute:

"Table IV - Electrical creepage and clearance distance 5/

| Voltage a.c. or d.c. | Set 1/ | Clearance | Creepage 4/ | |
|---|---|---|---|---|
| | | | Open 2/ | Enclosed 3/ |
| | | Inches | Inches | Inches |
| Up to 64 | A | 1/16 | 1/16 | 1/16 |
| | B | 1/8 | 1/8 | 1/8 |
| | C | 1/8 | 3/8 | 1/2 |
| Over 64-150 | A | 1/16 | 1/16 | 1/16 |
| | B | 1/8 | 1/4 | 1/8 |
| | C | 1/4 | 3/4 | 3/8 |
| Over 150-300 | A | 1/16 | 1/16 | 1/16 |
| | B | 1/8 | 1/4 | 1/8 |
| | C | 1/4 | 3/4 | 1/2 |
| Over 300-600 | A | 1/16 | 1/8 | 1/8 |
| | B | 1/8 | 1/4 | 1/4 |
| | C | 1/4 | 3/4 | 1/2 |
| Over 600-1000 | A | 1/8 | 1/2 | 3/8 |
| | B | 1/4 | 1 | 3/4 |
| | C | 1/2 | 2 | 1-1/2 |
| Over 1000-3000 | C | 2 | 4 | 2 |
| Over 3000-5000 | C | 3 | 5 | 3 |

1/ Set A - Normal operating volt-ampere rating up to 50.
Set B - Normal operating volt-ampere rating of 50 to 2000.
Set C - Normal operating volt-ampere rating over 2000.
2/ Open. - Equipment or parts with open enclosures as defined in MIL-STD-108.
3/ Enclosed. - Equipment or parts with enclosures defined in MIL-STD-108, except open enclosures.
4/ For top curved surfaces having a radius greater than 3 inches and for top flat surfaces, surface creepage distance shall be increased 33 percent where these surfaces have irregularities which permit the accumulation of dust and moisture.
5/ Use of electrical parts or assemblies (potentiometers, connectors, printed wiring assemblies, and so forth) having lesser creepage and clearance distances is permissible provided these parts and assemblies conform with applicable Military specifications, and their energized portions are so enclosed as to protect against the entry of dust, dirt, moisture and vapor."

Page 18, paragraph 3.4.11.2(e): Delete and substitute:

"(e) Where balance is to be achieved by use of tapped holes and movable screws, each hole shall be permanently numbered. Where balance is to be achieved by use of a continuous groove, the angular locations shall be permanently marked at intervals of not more than 10 degrees and the markings shall be permanently numbered at intervals of not more than 30 degrees. All markings and numbering shall be readily observable through access openings."

Page 18, paragraph 3.4.13.2.4: Delete and substitute:

"3.4.13.2.4 Inserts. - Metal inserts, where required in aluminum alloys or plastics shall be the bushing type or the helical coil type conforming to MS21208 or MS21209. The bushing type is recommended. The

use of helical-coil type inserts shall be limited to applications where the threaded hole permits full engagement of the insert. Bushing type inserts shall be the cast-in molded-in or screwed-in types. Screwed-in types shall be pin-, key-, sewage- or ring-locked to prevent backing out."

Page 19, paragraph 3.4.13.2.7.1: Delete and substitute:

"3.4.13.2.7.1 Electrical connections. - Nuts, bolts, studs and screws used for electrical connection shall be secured by lockwashers, except that lockwashers need not be provided with lug type terminals used on conductors smaller than 5000 cm or on terminal board/wire terminal combinations in accordance with MIL-T-16784. External-tooth flat lockwashers are recommended for electrical connections.

Page 19, paragraph 3.4.13.3.1, after listing: Add "12 point collar screws with head style as shown on MS21250 (Ferry Cap and Set Screw Co. "Counter-bor" or equal)"

Page 19, paragraph 3.4.13.3.1: Add "Drive screws may be used for securing equipment identification plates."

Page 20, table V, except footnote: Delete and substitute:

"Table V - Laminates

| Laminate | Form | Type | Specification | Max. temp. °C |
|---|---|---|---|---|
| Glass melamine | Sheet | GME | MIL-P-15037 | 130 |
| Glass silicone | Sheet | GSG | MIL-P-997 | 200 |
| Glass melamine | Rods, tubes | R, Tr | MIL-P-79 | 130 |
| Glass silicone | Rolled tubes | G-7 | NEMA LP-1 | 180 |
| Glass polyester 1/ | Sheet | GPO-3 | NEMA LP-1 | 130" |

Page 25, paragraph 3.5.5, cont'd, second column, opposite "Square and rectangular", lines 3 and 5: Delete "Table III" and substitute "table VIII".

Page 26, table IX, except footnotes: Delete and substitute:

"Table IX - Ground insulation

| Material | Specification | Type, class, grade | Maximum temperature - °C. |
|---|---|---|---|
| Pasted mica splitting | HH-I-538 | All types | As required 1/ |
| Reinforced mica splittings | MIL-I-3505 | Class B<br>Class H | 130<br>200 |
| Mica-paper composites | MIL-I-21070 | Class B<br>Class H | 130<br>200 |
| Pasted mica (silicone binder) | MIL-I-19526 | All types | 200 |
| Mica-paper (silicone binder) | MIL-I-19917 | All types | 200 |
| Polyester film-rag paper | MIL-I-19632 | All types | 105 |
| Polyester mat-polyester film | MIL-I-22834 | All types | 130 |
| Treated asbestos | MIL-I-3053 | All types | As required 1 . 2 |

"Table IX - Ground insulation (Cont'd)

| Material | Specification | Type, class, grade | Maximum temperature - °C |
|---|---|---|---|
| Polyester film 3/ | MIL-I-631 | Type G | 120 |
| Silicone rubber | - | 4/ | 4/ |
| Varnished glass cloth 5/ | MIL-I-17205 | Grade O | 130 |
| Epoxy-oriented glass filament | - | 6/ | 6/ |
| Polyamide paper | - | 7/ | 7/ |

Page 26, table IX, footnote 2, line 1: Delete "180°C" and substitute "220°C".

Page 26, table IX, footnote 7, line 2: Delete "200°C" and substitute "220°C".

Page 28, paragraph 3.5.19: Delete and substitute:

"3.5.19 Armature and coil banding using glass. - Semi-cured thermosetting resin treated glass insulation tape may be used for armature and coil banding in lieu of steel wire banding. The glass banding materials and methods of application shall be in accordance with MIL-I-24178."

Page 28, paragraph 3.6.2: Add "Slot cells shall be folded under the slot wedge if a flat wedge is used or slot cells shall be inserted inside the slot wedge if a formed (curved) wedge is used. The wedge shall extend the full length of the slot cell and shall be positioned so as to completely cover the slot cell."

Page 32, paragraph 3.6.7: Delete and substitute:

"3.6.7 Final condition. - The treated windings and coils shall be clean, smooth and glossy with good bending and filling. Good bending and adhesion is considered to be achieved when the coil conductors are secure, firm and immovable to the touch. (One method of judging bending and adhesion is to try to separate varnish layers with a fingernail or knife from a flat surface on the frame. More than 1/2 inch square is considered excessive peeling). Bubbles, air pockets and voids shall be kept to a minimum (questionable type windings shall be subjected to the insulation suitability test of the appendix). There shall be no dry (uncoated) spots on the surface. Treated windings shall not be soft or sticky to the touch."

Page 33, paragraph 3.7.2.6: Delete and substitute:

"3.7.2.6 Wire connections and terminals. - Wire connections and terminals shall be in accordance with requirement 19 of MIL-STD-454. Multi-pin connectors in connection with MIL-C-5015 may be used where approved by the command or agency concerned."

Page 33, Add as paragraph 3.7.2.6.1:

"3.7.2.6.1 Soldered connections. - Soldered wiring connections shall be in accordance with requirement 5 of MIL-STD-454."

Page 33, paragraph 3.7.2.7: Delete and substitute:

"3.7.2.7 Permanent internal connections of windings. - Where permanent type connections are made within windings, either soldering (see 3.9.3.1) or solderless pressure connectors may be used."

Page 33, paragraph 3.7.2.8: Delete and substitute:

"3.7.2.8 Printed wiring. - Printed wiring may be used for plug in assemblies or assemblies having 6 or fewer external electrical connections. In general, the use of printed wiring should be limited to low power control circuits where speed and ease of restoring normal operation of malfunctioning equipment is an important consideration. Equipment repair usually is simplified by the grouping of parts into assemblies (or

subassemblies) that may be easily replaced. Defective assemblies are expected to be repaired later; therefore, the assemblies shall be designed to permit replacement of all individual parts without special tools or techniques. Printed wiring assemblies shall be in accordance with requirement 17 of MIL-STD-454 and the following:

(a) Insofar as practicable, printed wiring assemblies shall be designed as functional units, with each assembly serving a specific circuit function.
(b) Assemblies, with their connectors, shall be so designed that they may be inserted only with proper orientation.
(c) Each type of plug-in assembly shall be plainly marked with an identifying number, and the equipment in which plug-in assemblies are used shall be plainly marked near each connector to show identifying number of the plug-in assembly required.
(d) A means shall be provided for securely fastening assemblies in place. Connectors alone shall not be relied upon.
(e) The printed wiring board material shall be a non-flammable glass base laminate in accordance with MIL-P-13949.
(f) To simplify repair, it is preferred that a conformal coating not be used; however, such coatings may be applied where a significant improvement in reliability or protection against environmental effects is expected to result. Coatings, where used, shall be grade 5 of MIL-I-46058 or shall be a clear coating easily removable with a soldering iron without damage to the printed wiring board.
(g) Electrical creepage and clearance distances shall be in accordance with 3.4.10 except that the spacings of MIL-STD-275 apply to those portions of printed wiring assemblies that are enclosed or protected in such a way as to exclude dust, dirt, moisture and oil vapor.
(h) It is preferred that the conductor pattern be limited to one side of the board with parts mounted on the opposite side. Conductor patterns on both sides of the board are acceptable to facilitate design as functional units, improve overall simplicity of the pattern or improve reliability (such as by elimination of connectors).
(i) Circuit component designations, polarities (where applicable) and connection points shall be marked on the side of the board where parts are mounted. Marking shall be visible with all parts mounted.
(j) Unless otherwise approved by the command or agency concerned, the design and content of printed wiring assemblies shall be such that the cost of a complete assembly does not exceed $300. (Assuming direct Government purchase of assemblies for replacement purposes in quantities of 10.)
(k) Printed wiring boards that are damaged shall not be repaired during manufacture except upon specific approval of the command or agency concerned.
(l) Equipment technical manuals shall contain printed wiring master drawings as described in MIL-STD-275."

Page 33, paragraph 3.7.2.9: Delete and substitute:

"3.7.2.9 Non-repairable assemblies. - A printed wiring assembly or other group of electrical or electronic parts may be packaged as a non-repairable assembly when specifically approved by the command or agency concerned and upon compliance with the minimum requirements specified herein. A non-repairable assembly is intended to be discarded in case of failure instead of being repaired. Approval of packaging in non-repairable form normally will be limited to those cases where the cost of a replacement assembly is less than the average cost of repair (considering prorated parts provisioning cost, repair time required, training requirements, test equipment, etc.) and the reliability of the non-repairable assembly is equivalent to that of a repairable assembly. Approval of non-repairable assemblies will be at the discretion of the command or agency concerned, after consideration of information submitted by the contractor or supplier. As a general rule, the content of non-repairable assemblies shall be limited so that the assembly cost (to the Government) will not exceed $100. In accordance with the standard definition of the term "part", a non-repairable assembly is, in fact, a part. Nevertheless, component pieces of a non-repairable assembly, which in a repairable assembly would be classified as parts, shall comply with the parts requirements of this specification, except that the choice of parts is not limited to the types and ratings called out in preferred and guidance lists, although the use of such parts is preferred. Non-repairable assemblies may be coated, encapsulated, potted or embedded.

Page 33, add as paragraphs 3.7.2.9.1 and 3.7.2.9.2:

"3.7.2.9.1 When non-repairable assemblies have printed wiring, the requirements of 3.7.2.8 shall apply, except that:

(a) Limitations on conformal coatings do not apply.
(b) Both sides of printed wiring boards may be used for conductor patterns and parts mounting.
(c) Marking of circuit component designations, polarities and connection points is not required.

"3.7.2.9.2 Requests for approval of non-repairable assemblies shall include:

(a) A description of advantages offered by the non-repairable assembly, as opposed to a repairable assembly to perform the same function. This description shall include comparisons of reliability and economy.
(b) Details of proposed construction, materials and parts identification.
(c) Approximate unit cost of replacement assemblies (assuming direct Government purchase in quantities of 10).

Page 34, table XV, column 2: Delete "MIL-C-62 1/" and substitute "MIL-C-62 2/".

Page 34, table XV, column 3: Delete "nylon" and substitute "mylar".

Page 35, paragraph 3.8.4, line 1: Delete "Semiconductor rectifiers" and substitute "Rectifiers".

Page 35, paragraph 3.8.4.1, next to last sentence: Delete and substitute "The special specification shall be in the form of a drawing, shall invoke the requirements of the most nearly applicable device type under the guide specification, and shall specify changes in, and additions to those requirements as necessary to define the required device. The detail and completeness shall be sufficient to enable direct government procurement of entirely acceptable devices from any device manufacturer who has the production capability and willingness to comply with the special specification."

Page 36, paragraph 3.8.7: last two sentences: Delete and substitute: "Terminal boards, in accordance with requirement 19 of MIL-STD-454, (when selected to provide proper electrical creepage and clearance, see 3.4.10) are satisfactory types. Terminals shall be plainly marked, by the use of terminal board marking strips or adhesive marker strips installed adjacent to the board. These markings shall be visible when wiring connections are completed."

Page 36, add as paragraphs 3.8.8 and 3.8.9:

"3.8.8 Switches. - Switches shall be in accordance with one of the following:

(a) Master switches - MIL-C-2212 or MIL-C-2174.
(b) Rotary snap switches - MIL-S-15291.
(c) Meter and control switches - MIL-S-3950.
(d) Toggle switches - MIL-S-3950.

Rotary snap switches should be used in preference to toggle switches where space for either type is available.

"3.8.9 Transformers and reactors. - Transformers and reactors shall conform to MIL-I-1361, MIL-T-15108 or MIL-T-16315. Other transformers and reactors constructed in accordance with the requirements (wire types, electrical insulation, insulation procedures and so forth) of this specification may also be used."

Page 36, paragraph 3.9.1, line 3: Delete "table XVI" and substitute "table XVI-A and XVI-B".

Page 36, paragraph 3.9.2.1: Add "When specified (see 6.2) and even though the surfaces may be corrosion-resistant without painting, the exterior of the equipment, except parts listed in 3.9.2.2 shall be painted for the purpose of producing a grey appearance."

Page 37, table XVI: Delete and substitute:

"Table XVI-A - Processing of metals for corrosion-resistance — treatments not requiring painting for corrosion-resistance 1/

| Metal | Treatment | Treatment specification |
|---|---|---|
| Corrosion-resisting metals (see 3.3.2.3) | Not required | --- |
| Ferrous metals | Zinc coating (hot-dip galvanizing) | ASTM A153 |
| | Electrodeposited zinc 2/ | QQ-Z-325, type II, class 2 or ASTM A164 or ASTM B201 |
| | Electrodeposited chromium over nickel undercoat | QQ-C-320<br>QQ-N-290, type I (DS) or ASTM A166, type DS |
| | Electrodeposited nickel | QQ-N-290, type I (DS) or ASTM A166, type DS |
| | Electrodeposited silver | QQ-S-365 |
| | Electrodeposited cadmium 3/ | QQ-P-416, type II, class 1 except QQ-P-416, type II, class 3 for fasteners |
| Aluminum and Aluminum alloys | Anodic treatment | MIL-A-8625 |

1/ Corrosion-resisting metal or metals processed for corrosion-resistance may be painted for appearance.
2/ Unpainted zinc coatings should not be used on equipment or parts to be packed in unventilated containers made of unseasoned wood unless desiccant is enclosed.
3/ Unpainted cadmium coatings shall be avoided in nonventilated electrical equipment where unstable materials, phenolic resinous substances and other materials containing unsaturated carbon-to-carbon linkages are present. Unpainted cadmium coatings shall not be used for parts to be placed in contact with wood or cardboard packing materials. These materials may have a deleterious effect on cadmium coatings, especially in the presence of moisture. Cadmium coatings shall not be used in contact with grease or oil lubricants.

"Table XVI-B - Painting of metal for corrosion-resistance 1/

| Metal | Pretreatment | | Primer 2/ | | Topcoats | |
|---|---|---|---|---|---|---|
| | Specification | Thickness 3/ Inch | Specification | Thickness 3/ Inch | Specification | Thickness 3/ Inch |
| Ferrous metal | | | MIL-P-8585 | 0.0004-0.001 | | |
| | | | | or | | |
| | | | TT-P-664 | 0.001 minimum | | |
| | | | | or | | |
| | | | TT-P-666 | 0.001 minimum | | |
| | | | | or | | |
| | | | TT-P-645 5/ | 0.001 minimum | | |
| Ferrous metals with treatments other than those listed in table XVI-A | MIL-P-15328 | 0.0003 to 0.0005 | | | | |
| | or | | | | | |
| | TT-C-490, type I | | | | | |
| Ferrous metals and aluminum alloys both used in same assembly 4/ | | | MIL-P-8585 | 0.0004-0.001 | MIL-E-15090, type I, II or III, class 2 6/ | 2 coats, each 0.001 inch minimum; second coat may be omitted on inside of enclosures and equipment to be installed in interior of ships |
| | | | | or | | |
| | | | TT-P-666 | 0.001 minimum | | |
| | | | | or | | |
| | | | TT-P-645 5/ | 0.001 minimum | | |
| Aluminum and aluminum alloys | MIL-C-5541 | | | | MIL-E-15090, type I, II or III, class 2 6/ | 1 coat 0.001 minimum |
| | or | | | | | |
| | MIL-P-15328 | 0.003 to 0.0005 | | | | |

1/ For details on painting procedures, see 3.9.2.
2/ One coat primer. Primer other than those listed may be used if suitable evidence can be provided to show by experience or tests that the primer is the equivalent in performance to those listed. When MIL-P-15328 pretreatment is used and where it is known definitely that the equipment will be used only in shipboard interior spaces and will not be exposed to the weather, either as described in 3.9.2.4 or other storage, the coat of primer may be omitted.
3/ Minimum dry film thickness.
4/ For metals in direct contact, see 3.3.2.
5/ TT-P-645 primer may be lifted when top coats of MIL-E-15090, types II or III enamel are applied. If lifting occurs cleaning and repainting is required. To prevent lifting of TT-P-645 primer, the use of MIL-E-15090, type I enamel top coat(s) is recommended.
6/ MIL-E-15090, types I, II or III, class 1 may be used for portable equipment."

Page 38, lines 1 through 13: Delete.

Page 38, paragraph 3.9.3: Delete and substitute:

"3.9.3 Soldering. -"

Page 39, table XVII, column 2: Delete "S65" in both places and substitute "Sb5".

Page 39, paragraph 3.9.3.2: Add "Soldering shall be in accordance with requirement 5 of MIL-STD-454."

Page 43, paragraph 6.2, add as item (n):

"(n) Painting of equipment exterior, if grey appearance is required (see 3.9.2.1).

Page 49, table XIX, column 2, after "Magnet wire" add "type_____".

Custodian:
Navy - SH

Review activity:
Navy - WP

Preparing activity:
Navy - SH
(Project MISC-N023(NAVY))