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MILITARY SPECIFICATION

TREATMENT, MOISTURE- AND FUNGUS-RESISTANT, OF COMMUNICATIONS, ELECTRONIC, AND ASSOCIATED ELECTRICAL EQUIPMENT

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

1. SCOPE

1.1 Scope. This specification covers the requirements for the application of moisture- and fungus-resistant varnish to those assembled communications, electronic, and associated electrical equipments and certain of their component subassemblies, individual parts, solder connections, and fungus-nutrient materials which are not moisture resistant or whose moisture- and fungus-resistant properties cannot be predicted. For purposes of this specification, the term "equipment" includes the above mentioned assembled communications, electronic, and associated electrical equipments and certain of their component subassemblies and individual parts. (See 6.1.)

1.2 Classification. The treatment shall be of the following types, and as specified (see 3.1 and 6.2):

Type I—Overall treatment—The application of varnish to all surfaces of the equipment. (See 3.3.3.1 and 3.3.3.1.1.)

Type II—Limited treatment—The application of varnish only to certain component subassemblies, individual parts, solder connections, nonmoisture resistant and fungus-nutrient materials. (See 3.3.3.2 to 3.3.3.2.2, incl.)

2. APPLICABLE DOCUMENTS

2.1 The following document, of the issue in effect on date of invitation for bids, forms a part of this specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-V-173—Varnish, Moisture-and-Fungus-Resistant (for the Treatment of Communications, Electronic, and Associated Electrical Equipment).

(Copies of specifications required by contractors in connection with specfic procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Statement of treatment. Prior to treatment, the supplier shall submit for approval to the Government, a statement of treatment or processing specification describing in detail the treatment type, and which equipment (including spare or repair parts, solder connections, and fungus-nutrient materials) is to be treated and the manner in which it is to be treated. (See 3.3.3. to 3.3.4, incl.) For Air Force procurements, the statement of treatment or processing specification shall be supplied only when specified. (See 6.2.)

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Approval of this statement of treatment shall not relieve the supplier from compliance with this specification; however, this approval will be his authority for deviating from the requirements specified in 3.3.1 to 3.3.3.2.2, inclusive, as applicable. If, at any time, the supplier desires to deviate from such approved treatment, he shall submit for approval to the Government, a statement of the deviation desired.

3.2 **Varnish.** The varnish shall be in accordance with Specification MIL-V-173.

3.2.1 *Thinning of varnish.* The varnish may be thinned for proper application. In such case, the thinner specified on the varnish container shall be used; however, the varnish shall not be thinned beyond the point recommended by the manufacturer for the specific method of application being used.

3.3 **Treatment.**

3.3.1 *Items to be treated in accordance with this specification.* Unless otherwise specified (see 3.3.2 and 6.2), the varnish shall be applied thoroughly and completely to all moisture- and fungus-susceptible exposed surfaces inside the chassis, such as, circuit elements (resistors, capacitors, coils, etc), surfaces supporting circuit elements, interconnecting wiring, and connections.

3.3.2 *Items to be protected against the varnish application.* The varnish shall not be applied to any surface or part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application. (See 6.6.) The following are examples of items and materials which shall be protected:

(a) Cable, wire, braids, and jackets flexed in operation, and cable with plastic insulation where treatment would reduce the insulation resistance below, or increase the loss factor above, the acceptable values.

(b) Components and materials such as:

1. Capacitors, variable, (air-, ceramic-, or mica- dielectric).
2. Resistors (when wattage dissipation would be undesirably affected, and when varnish may become carbonized).
3. Wirewound resistors.
4. Ceramic insulators subject to over 600 volts operating voltage where danger of flashover exists.
5. Painted, lacquered, or varnished surfaces, unless otherwise specified. (See 6.2.)
6. Rotating parts such as dynamotors, generators, motors, etc. (However, their associated electronic components such as filter units, etc, shall be treated in accordance with this specification.)
7. Waveguides (working surfaces).
8. Electron tubes.
9. Tube clamps.
10. Miniature tube shields.
11. Plug-in relays.
12. Pressure-contact grounds.
13. Coaxial test points or receptacles.
14. Windows, lenses, etc.
15. Transparent plastic parts.
16. Plastic materials of the following types: polyethylene, polystyrene, polyamide, acrylic, silicone, epoxy (other than printed-wiring boards), melamine-fiberglass, fluoro-carbon, vinyl, and alkyd.
17. Materials used for their specific arc-resistant properties and classified as "arc resistant" in applicable material specifications, such as:

    Mounting boards of a type material where treatment would reduce the insulation resistance below, or increase the loss factor above, the acceptable values, and decrease the arc-resistant value of the board.

(c) Organic materials which have otherwise been protected such as

bottoms of plastic skids (cotton fabric-phenolic resin), canvas, duck, cork, felt (wool or hair), fiber, leather, rope, wood, natural or synthetic rubber, etc, except that the materials need not be protected from treatment provided the operation and performance of the equipment are not adversely affected.

(d) Electrical contacts, contact portions or mating surfaces of binding posts, connectors, fuses, jacks, keys, plugs, relays, sockets (including tube sockets (see 6.6)), switches, and test points.

(e) Mechanical parts such as:

1. Bearing surfaces (including bearing surfaces of gaskets and sliding surfaces).
2. Gear teeth and gear trains or assemblies.
3. Pivots and pivot portion of hinges, locks, etc.
4. Screw threads and screw adjustments (those moved in the process of operation or adjustment).
5. Springs, except at base of pileup.

(f) Surfaces which rub together for electrical or magnetic contact such as those in bearings, contact fingers, potentiometers, shafts, shields, and variable autotransformers.

(g) Surfaces whose operating temperatures exceed 130° C., or whose operating temperatures will cause carbonization or smoking.

(h) The exterior or visible outside portion of indicating instruments (do not open or treat inside), control boxes, or equipments which mount in the cockpits of aircraft.

3.3.3 *Selection of treatment type.* Treatment shall be of type I or type II, as specified. (See 6.2) The selection of the treatment type shall be determined by the nature of the parts, materials, and finishes used in the equipment.

3.3.3.1 *Type I—overall treatment.* The type I treatment shall consist of the application of the varnish to all surfaces of the equipment.

3.3.3.1.1 *Items not requiring protection against the type I treatment.* Materials, component parts, or elements which are moisture and fungus resistant, or that have been treated at the point of manufacture or prior to assembly into the equipment, need not be protected against type I treatment.

3.3.3.2 *Type II—limited treatment.* The type II treatment shall consist of the application of the varnish only to certain component subassemblies, individual parts, solder connections, nonmoisture resistant and fungus-nutrient materials. If the materials and finishes used in the equipment are corrosion, moisture, and fungus resistant, or have been given a finish which is corrosion, moisture, and fungus resistant, the treatment shall consist of the application of the varnish only to the items and materials specified in 3.3.3.2.1 and 3.3.3.2.2.

3.3.3.2.1 *Solder connections.* All solder connections shall be brush treated for at least ½ inch back on the insulation. When glass-braid sleeving is used, solder connections shall be treated before covering with the sleeve. In constricted locations or when disassembly would be necessary in order to treat solder connections, the connections shall be treated before further assembly.

3.3.3.2.2 *Fungus-nutrient materials.* Unless otherwise specified (see 3.3.2(c)) or exempted from such treatment, equipment which contains fungus-nutrient materials shall be treated as specified herein. The following materials are among those known to be fungus nutrients: linen, cellulose nitrate, regenerated cellulose, untreated wood, jute, plastic materials (using cotton, linen, or wood flour as fillers), leather, cork, paper and cardboard, organic fiberboard, and organic felts.

3.3.4 *Spare or repair parts.* When it is required that spare or repair parts be fur-

nished with the equipment, they shall be treated as follows, unless otherwise specified (see 3.3.2 and 3.3.3.1.1): Spare or repair parts which are ordinarily treated before assembly into equipment shall be treated before being shipped, unless they can be readily treated after installation. The statement of treatment (see 3.1) shall cover in detail the treatment of spare or repair parts.

3.3.5 *Individual parts.* When components are required to be treated as individual parts not associated with any equipment or subassembly, they shall be considered equipments, and their elements shall be treated in accordance with the requirements specified in 3.3.1 to 3.3.3.2.2., inclusive, as applicable.

3.4 **Preparation for treatment.** The equipment to be treated shall be exposed so that the varnish may be applied effectively over the surfaces to be treated. On assemblies, the cases, cans, covers, shields, etc., shall be removed in order to expose the surfaces fully, unless the component parts have been previously treated in accordance with this specification (see 3.5) or by other approved methods prior to assembly. Where practicable, untreated cables and cords shall be bent back, and untreated terminal boards shall be loosened to expose the underside.

3.4.1 *Cleaning before treatment.* All surfaces to be treated shall be cleaned so that they are free from dirt, oil, grease, or other foreign matter which would interfere with the adherence or proper functioning of the varnish. All visible deposits of solder flux shall be cleaned off by scraping, chipping, wiping, or by the use of a suitable solvent. Suitable solvents may be used only on readily accessible surfaces and the surfaces must be dried immediately by wiping clean. Solvents, which will soften enamels or cause swelling of insulation, such as ketones, esters, and aromatic hydrocarbons, shall not be used.

3.4.2 *Drying before treatment.* The varnish shall be applied only on dry surfaces. When specified (see 3.4.2.1), the equipment shall be dried prior to the application of the varnish. The drying shall be accomplished at a temperature safely below that which may damage the equipment, and at a rate which will not cause shrinking, cracking, warping, or other deterioration. If there are waxed parts in the equipment, the drying temperature shall not exceed 60° C. After drying, the varnish shall be applied while the temperature of the equipment is at least 5° C. above room temperature.

3.4.2.1 *Drying.* Prior to application of the varnish, at the option of the supplier or when any of the conditions specified in (a) to (c) exist, the equipment shall be dried at approximately 60° C. for a length of time sufficient for substantial dehydration, but for not longer than 3 hours. If necessary, an alternate method, such as drying over silica gel in a cabinet, shall be used.

(a) When specified. (See 6.2.)
(b) When the equipment is obviously wet or damp.
(c) When the humidity conditions are so severe that without preheating, the equipment will not meet the electrical requirements after treatment.

3.5 **Methods of treatment.** The varnish shall be applied by spraying, brushing, or dipping, or any combination thereof. (See 3.5.5 to 3.5.7, incl.) The varnish (see 3.2) shall be applied to the assembled equipment or, at the option of the supplier, to subassemblies prior to installation in the assembled equipment, provided that fixed electrical connections are subsequently treated.

3.5.1 *Temperature.* The temperature of the varnish, when ready for application, shall be not less than room temperature.

3.5.2 *Thickness.* Where practicable, the thickness of the dried varnish coating shall be 0.0020 to 0.0025 inch, inclusive.

3.5.3 *Coverage.* When the treated equipment is examined as specified in 4.3.2.2, the varnish coverage shall be complete.

3.5.4 *Individual parts.* Individual parts and materials requiring treatment which cannot be properly treated after assembly shall be treated prior to assembly. Individual parts and materials which require treatment,

but from which the varnish was protected, shall be treated after the protective device is removed.

3.5.5 *Spraying*. When spraying is used to apply the varnish, a pressure-point spray gun with a tip regulated to give a wet spray shall be used; for small compact equipment, a pencil spray tip regulated to give a narrow wet spray shall be used. The varnish shall be applied in a wet coat (this prevents the formation of fuzz or filaments on fabric insulation). A dry spray which forms spray dust shall not be used. The surfaces shall be sprayed from as many directions and angles as are necessary to insure complete coverage with a wet coat. All parts requiring coverage not accessible to the overall spray shall be coated as completely as practicable using a brush. If, because of overspray, there is any varnish on metal parts not requiring treatment, the entire metal surface shall be coated, unless specifically exempted (see 3.3.2), to avoid a spotty or undesirable appearance.

3.5.6 *Brushing*. When the application of the varnish by spraying or dipping may require extensive protection, it may be more efficient to use the brush method of application.

3.5.7. *Dipping*. When the application of the varnish by dipping is selected, the dried film shall be in accordance with 3.9.

3.6 Final drying. When tested as specified in 4.3.2.3, the varnish coating on metal surfaces shall be "dry-hard" before alinement of equipment, acceptance inspection, or packaging; on other surfaces, the varnish coating shall not be tacky to the touch.

3.7 Repairs to damaged varnish coating. If the coating is broken during adjustment, handling, or replacement of parts, such breaks shall be recoated. Resoldering of wire connections shall be made only after cleaning the ends of wires and terminals with a suitable solvent to remove old varnish. After resoldering, connections shall be recoated in accordance with the requirements of this specification.

3.8 Identification protection. Identification marking or color coding of equipment or its component parts shall not be adversely affected by the varnish. Changes in appearance caused by the varnish, which have no deleterious effect on function, durability, marking or color coding, shall not be cause for rejection.

3.9 Marking of treated equipment. Each treated unit of equipment, each treated plug-in assembly, and all containers in which they are packed for shipment, shall be permanently and legibly marked with the symbol "MFP."

3.10 Workmanship. The varnish coating shall be applied in such a manner that the dried film will present a clear, smooth finish. The finish shall be free from bubbles, wrinkles, filaments, spray dust, or entrapment of moisture (as indicated by blushing or darkening of film, poor adherence, etc), running, lumping droplets, and other defects that will affect life, serviceability, or apperance.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection.

4.1.1 *Supplier*. The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. 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.

4.1.1.1. *Test equipment and inspection facilities*. Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government.

4.2 Inspection conditions. Unless otherwise specified herein, all inspections shall be made

at room ambient temperature, relative humidity, and pressure.

4.3 **Acceptance inspection.** Acceptance inspection shall consist of inspection of methods and visual examination.

4.3.1 *Inspection of methods.* The procedure for the treatment shall be checked to verify that the varnish, treatment type, preparation for treatment, and methods of treatment are in accordance with the statement of treatment (see 3.1) and the applicable requirements of this specification, (See 3.2 to 3.5.7, incl.)

4.3.2 *Visual examination.* The treated equipment shall be examined to verify that the coverage, final drying, repairs (when applicable), identification protection, marking, and workmanship are in accordance with the statement of treatment (see 3.1) and the applicable requirements of the specification. (See 3.5.2 to 3.10, incl.)

4.3.2.1 *Visual-examination sampling plan.* The visual-examination sampling plan shall be in accordance with the applicable equipment or component specification referencing this specification.

4.3.2.2 *Coverage.* To determine completeness of coverage, the treated equipment shall be examined for fluorescence under an ultraviolet lamp having a filtered emission of approximately 3,600 Angstrom units. An untreated unit may be used for comparison. (See 3.5.3 and 4.3.2.)

4.3.2.3 *Final drying.* To determine final drying, the test shall be as follows: Treated metal surfaces have reached a "dry-hard" condition when the maximum pressure that can be exerted between the fleshy part of the thumb and index finger sliding along the treated metal surfaces in a pinching motion does not mar the varnish coating nor leave a mark which remains noticeable after the spot is lightly polished. Other surfaces shall be considered "dry" when the varnish coating is not tacky to the touch. (See 3.6 and 4.3.2.) Care shall be taken to insure sufficient drying to prevent the presence of solvent vapors in any enclosure. At the option of the supplier, the treated equipment or part may be dried in a circulating air oven (force-dried) at a temperature not exceeding 65° C.; however, extra precautions shall be taken to thoroughly force-dry equipment which will be enclosed in sealed cases (gasketed, pressurized, or both).

5. PREPARATION FOR DELIVERY

5.1 Not applicable to this specification.

6. NOTES

6.1 **Intended use.** Treatment of equipment (see 1.1) in accordance with this specification is intended to protect the equipment against the moisture and fungus conditions encountered in service. The treatment is intended to accomplish the following:

(a) Impart nonwettability to surfaces.
(b) Retard the absorption of moisture.
(c) Inhibit the occurrence of corrosion.
(d) Inhibit the growth of fungi.

This specification is not intended to cover treatment of individual parts and materials prior to inclusion in the assembled equipment or subassembly, or treatment of parts, materials, and finishes covered by applicable military documents, or to cover materials known to be moisture and fungus resistant.

6.2 **Ordering data.** Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Treatment type. (See 1.2 and 3.3.3.)
(c) If, for Air Force procurements, a statement of treatment or processing specification is to be supplied. (See 3.1)
(d) Specific items, other than those listed in 3.3.2, that do not require protection against the varnish application. (See 3.3.1.)
(e) If painted, lacquered, or varnished surfaces do not require protection against the varnish application. (See 3.3.2.(b)5.)
(f) If drying, prior to the application of the varnish, is required. (See 3.4.2.1.)

6.3 Fungus-inert materials. The following types of materials are generally considered nonnutrients and shall be used, where practicable, for component fabrication:

(a) Metals
(b) Ceramics
(c) Mica
(d) Glass
(e) Nylon
(f) Polyacrylonitrile
(g) Vinylidene chloride
(h) Polyethylene
(i) Polytetrafluoroethylene
(j) Monochlorotrifluoroethylene
(k) Natural rubber, compounded
(l) Synthetic rubbers:
  1. Neoprene
  2. Buna N
  3. Buna S
  4. Silicone
  5. Butyl
  6. Thiokol
(m) Plastics without fillers or laminates with glass, nylon, mica, or asbestos fillers:
  1. Melamine-formaldehyde
  2. Polymethyl methacrylate
  3. Urea-formaldehyde
  4. Phenol-formaldehyde
  5. Silicone resin
(n) Chemically altered cotton:
  1. 12.6±0.4 percent acetylated cotton
(o) Polyvinyl chloride (fungus-resistant grades only)
(p) Epoxy resin (fungus-resistant grades only).

6.4 Technique of treatment. All questions regarding technique of treatment or other questions arising from inspection should be referred to the Government.

6.5 Handling of varnish. The precautions furnished by the varnish manufacturer, and the precautions normally exercised in handling and storing varnishes and thinners, should be observed.

6.6 Protection against varnish. Any items or materials which are not to be treated may be protected by the use of any suitable method or device such as masking tape, jigs, fixtures of metal or cardboard, etc. Tube sockets may be masked by using dummy tubes, but they must not be removed until the varnish has "dried hard", to prevent the tube prongs from drawing the varnish through the sockets. (See 3.3.2.(d))

6.7 Drift. There may be an initial drift of equipment characteristics, due to evaporation of the solvent from the varnish coating. Stabilization of these characteristics may require a few hours, or may require several days, depending upon the amount of solvent used, the drying temperature, and other factors. If necessary, the permissible drift, inspection of methods, and the visual examination should be included in the applicable equipment specification.

Custodians:
Army—Signal Corps
Navy—Bureau of Naval Weapons
Air Force

Preparing activity:
Army—Signal Corps

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