INCH-POUND
MIL-I-24092C
4 May 1989
SUPERSEDING
MIL-I-24092B
20 January 1976
(See 6.10)

MILITARY SPECIFICATION

INSULATING VARNISHES AND SOLVENTLESS RESINS FOR APPLICATION BY THE DIP PROCESS

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

1. SCOPE

1.1 Scope. This specification covers clear solvent type varnishes and clear solventless resin systems used to insulate and bond electrical coils and windings. These materials are applied by the dip and bake process without application of vacuum or pressure.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5970

1.2 Classification. Varnishes and resins shall be of the grades, classes, and compositions, as follows:

Grade (see 1.2.1)	Class (see 1.2.2)	Composition (see 1.2.3)
CA - Clear, solvent, air-dry	130 and 155	I, II
CB - Clear, solvent, baking, flexible	130 to 180	I, II
CBH - Clear, solvent, baking, semi-rigid	130 to 200	I, II
CBS - Clear, solvent, baking, silicone	180 to 220	I, II
SF - Solventless flexible	130 to 180	IV
SFT - Solventless flexible thixotropic	130 to 180	IV
SH - Solventless semi-rigid	155 to 200	IV
SHT - Solventless semi-rigid thixotropic	155 to 200	IV
SS - Solventless silicone	180 to 220	IV
WB - Water base flexible	130 to 200	III
WBH - Water base semi-rigid	130 to 200	III
PK - Patching kit	130 and 155	IV

1.2.1 Grade. Grades of material shall be classified according to composition and function (see 3.1).

1.2.2 Class. Classes shall be designated in degrees Celsius (°C) according to the maximum continuous operating temperature.

1.2.3 Composition. Compositions shall be classified according to the type of solvent or monomer in the varnish or resin, as follows:

I - Organic solvent system
II - Organic system in accordance with Rule 442(66)
III - Water reducible
IV - Organic monomer or diluent

1.3 Safety practice. This specification may require the use of hazardous material, operations and equipment. It is the responsibility of the user to establish appropriate safety practices and to determine the applicability of regulatory limitations prior to use.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

J-W-1177 - Wire, Magnet, Electrical.
P-D-680 - Dry Cleaning Solvent.
PPP-F-320 - Fiberboard; Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.
PPP-P-1892 - Paint, Varnish, Lacquer, and Related Materials; Packaging, Packing, and Marking of.

MILITARY

MIL-V-173 - Varnish, Moisture-and-Fungus-Resistant (For Treatment of Communications, Electronic, and Associated Equipment).
MIL-D-16791 - Detergent, General Purpose, (Liquid, Non-Ionic).
MIL-H-17672 - Hydraulic Fluid, Petroleum, Inhibited.
MIL-L-19140 - Lumber and Plywood, Fire-Retardant Treated.
MIL-L-23699 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base.

(See Supplement 1 for list of associated specification sheets.)

STANDARDS

FEDERAL

FED-STD-141 - Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing.
FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.

MILITARY

MIL-STD-129 - Marking for Shipment and Storage.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Tester. (DoD adopted)
D 115 - Standard Methods of Testing Varnishes Used for Electrical Insulation.

ASTM (Continued)

D 149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies. (DoD adopted)

D 150 - Standard Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials. (DoD adopted)

D 323 - Standard Test Methods for Vapor Pressure of Petroleum Products (Reid Method). (DoD adopted)

D 366 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled Commercial Quality. (DoD adopted)

D 374 - Standard Test Methods for Thickness of Solid Electrical Insulation.

D 618 - Standard Methods of Conditioning Plastics and Electrical Insulating Materials for Testing. (DoD adopted)

D 823 - Standard Methods of Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels. (DoD adopted)

D 1932 - Standard Test Method for Thermal Endurance of Flexible Electrical Insulating Varnishes.

D 1963 - Standard Test Method for Specific Gravity of Drying Oils, Varnishes, Resins, and Related Materials at 25/25°C.

D 2196 - Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer. (DoD adopted)

D 2240 - Standard Test Method for Rubber Property - Durometer Hardness. (DoD adopted)

D 2436 - Standard Specification for Forced-Convection Laboratory Ovens for Electrical Insulation.

D 2519 - Standard Test Method for Bond Strength of Electrical Insulating Varnishes by the Helical Coil Test.

D 3056 - Standard Test Method for Gel Time of Solventless Varnishes.

D 3145 - Standard Test Method for Thermal Endurance of Electrical Insulating Varnishes by the Helical Coil Method.

D 3251 - Standard Test Method for Thermal-Aging Characteristics of Electrical Insulating Varnishes Applied Over Film-Insulated Magnet Wire.

D 3418 - Standard Test Method for Transition Temperatures of Polymers by Thermal Analysis. (DoD adopted)

D 3850 - Standard Test Method for Rapid Thermal Degradation of Solid Electrical Insulating Materials by Thermogravimetric Method.

E 537 - Standard Test Method for Assessing the Thermal Stability of Chemicals by Methods of Differential Thermal Analysis.

F 74 - Standard Recommended Practice for Determining Hydrolytic Stability of Plastic Encapsulants for Electronic Devices.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Non-government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Varnishes and resins furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.3 and 6.4).

3.3 Material. The varnish or resin shall be suitable for coating electrical equipment using the dip and bake process. If the material is a solvent varnish or a solventless resin, it shall be clear and unpigmented, except for thixotropic compositions which may contain a small quantity of an opaque mineral filler. The cured film of insulation resulting from the dip and bake process shall be smooth, glossy, and free of surface defects (see 4.7.9).

3.3.1 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used products is allowed under this specification unless otherwise specifically specified.

3.3.2 Purity and uniformity. The packaged components shall be free from all foreign substances, such as grit, dirt, oil and water. The material shall show no phase separation, gel particles or skin. Ingredient lumps or agglomerates which do not become uniformly part of the compound on mild stirring are also prohibited.

3.3.3 Toxic products and formulations. The product shall have no adverse effect on the health of personnel when used for its intended purpose and applied in approved facilities with the use of approved safety equipment.

3.3.4 Material safety data sheet. The contracting activity shall be provided a material safety data sheet (MSDS) at the time of contract award. The MSDS shall be provided in accordance with the requirements of FED-STD-313. The MSDS shall be included with each shipment of the material covered by this specification (see 6.7).

3.3.5 Marking of hazardous material. Hazardous materials, which may cause personal injury, property damage, or environmental deterioration through transportation, use or disposal, shall be marked in accordance with the requirements of public law and regulations. The marking shall include, as applicable: name of product, quantity, warning symbol, signal word designating degree of hazard, affirmative statement of hazards, precautionary measures covering actions to be followed or avoided, instructions in case of contact or exposure, antidotes and notes to physicians, instructions in case of fire, spillage, or leakage, instructions for handling and storage, and disposal instructions. Characteristics and operating hazards which require labeling include: toxic, high toxic, irritant, corrosive, strong sensitizer, combustible liquid, flammable, extremely flammable liquid, dangerously reactive, pressure-generation and explosive.

3.3.6 Prohibited material. Asbestos and organic silicone shall not be used in the formulation except for silicone in basic silicone varnish systems. Heavy metals such as lead, cadmium, mercury or arsenic shall not be present. Conformance to these requirements shall be verified by using analytical chromatographic or spectroscopic methods.

3.3.7 Unreactive volatiles. For solventless resins only, the product shall contain no unreactive volatile constituents. Conformance to this requirement shall be verified by using vacuum distillation and gas chromatography.

3.3.8 Surface properties. The product (see 6.5.5) shall cure in smooth, thin film. Examination of the cured film on steel panels without magnification shall show no surface defects such as blisters, cracks, pinholes or other irregularities that may trap moisture or particulate matter. Non-adhesion, blistering, or flaking shall not occur when the cured surface is coated with common varnish, or resin top coat.

3.3.9 Fungus resistance. Varnish or resin shall not readily support fungus when tested in accordance with MIL-V-173.

3.3.10 Material properties. Material properties of varnishes and resins shall be as specified in 3.3.10.1 through 3.3.10.21.

3.3.10.1 Storage life. Storage life shall be as specified (see 3.1 and 4.7.1).

3.3.10.2 Nonvolatiles. Nonvolatiles for solvent varnish shall be as specified (see 3.1 and 4.7.2).

3.3.10.3 Vapor pressure. Vapor pressure shall be as specified (see 3.1 and 4.7.3).

3.3.10.4 Weight loss. Weight loss on cure shall be as specified (see 3.1 and 4.7.4).

3.3.10.5 Flash point. Flash point shall be as specified (see 3.1 and 4.7.5).

3.3.10.6 Gel point. Gel point shall be as specified (see 3.1 and 4.7.6). For solventless, two-component varnishes, the cure time shall be the time required for the varnish to yield the specified Shore D hardness.

3.3.10.7 Drying time. Drying time shall be as specified (see 3.1 and 4.7.7).

3.3.10.8 Viscosity. Viscosity shall be as specified (see 3.1 and 4.7.8).

3.3.10.9 Build. Build shall be as specified (see 3.1 and 4.7.9).

3.3.10.10 Drainage. Drainage shall be as specified (see 3.1 and 4.7.10).

3.3.10.11 Specific gravity. Specific gravity shall be as specified (see 3.1 and 4.7.11).

3.3.10.12 Dielectric strength. Dielectric strength shall be as specified (see 3.1 and 4.7.12).

3.3.10.13 Dissipation factor. Dissipation factor shall be as specified (see 3.1 and 4.7.13).

3.3.10.14 Dielectric constant. Dielectric constant shall be as specified (see 3.1 and 4.7.13).

3.3.10.15 Hardness. Hardness shall be as specified (see 3.1 and 4.7.14).

3.3.10.16 Bond strength. Bond strength shall be as specified (see 3.1 and 4.7.15).

3.3.10.17 Thermal endurance. Thermal endurance shall be as specified (see 3.1 and 4.7.16).

3.3.10.18 Salt water proofness. Salt water proofness shall be as specified (see 3.1 and 4.7.17).

3.3.10.19 Hydrolytic stability. Hydrolytic stability shall be as specified (see 3.1 and 4.7.18).

3.3.10.20 Chemical resistance. Chemical resistance shall be as specified (see 3.1 and 4.7.19).

3.3.10.21 Varnish mix tolerance. Prior to mixing in the dip tank, varnishes within each grade shall be demonstrated to be compatible. Except for thixotropic varnishes, the mixture shall be clear and shall not separate or contain gelatinous material or precipitate (see 4.7.20).

3.3.11 Instruction sheet. Instruction sheets describing application of the varnish or resin using the dip process for electrical equipment shall be provided.

3.3.11.1 Instructions for solvent varnishes. Instruction sheet for solvent varnishes shall include the following:

(a) Explicit data and working curves for solvent adjustment, as required, to assure the user of a film build of 0.0009 to 0.003 inch. This may be any combination of viscosity, specific gravity, or percent solvent addition.
(b) The preheat temperature to use for the electrical equipment to be varnished in order to stress relieve wire enamel and remove residual moisture.
(c) The recommended temperature of the electrical equipment before dipping into varnish.
(d) The time cycle for submerging electrical equipment in the varnish, and the drainage time over the varnish tank.
(e) The temperature range to preheat the oven if other than a simple baking temperature.
(f) The specific temperatures to bake and post-cure varnish. This may involve more than one temperature level for optimizing smooth varnish surface.
(g) Allowance in time-temperature cycles for multiple dips and bakes (that is, less baking for first coat and longer bake for final coat).

3.3.11.2 Instructions for solventless resins. Instruction sheet for solventless resins shall include the following:

(a) Maximum storage life of uncatalyzed resin and catalyzed resin at various temperatures and recommended conditions for storing catalyzed and uncatalyzed resin.
(b) Recommended catalyst (if applicable) and catalyst percentage.
(c) Limiting values, minimum and maximum, for gel time (see ASTM D 3056) of catalyzed resin.
(d) Recommended optimum curing schedule for first and final coats if multiple treatments are involved.
(e) Emergency procedures in case of excessive temperature rise in resin processing equipment.
(f) Adjustments to make to achieve various coating thicknesses.

3.4 Workmanship. The insulating varnish or resin shall be suitable, in every respect, for use on electrical windings and coils or motors, generators and transformers, and on electrical apparatus in general. It shall preserve the initial dielectric strength of the insulation to which it is applied by the exclusion therefrom of moisture, lubricating oil and grease, acids, seawater, and other deleterious substances to which the electrical apparatus may be subjected in service. The varnish or resin shall conform to the qualification requirements as specified herein.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) Qualification inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command (NAVSEA). Qualification inspection shall consist of the tests specified in table I and table II. The contractor shall make no changes in the process or product formulation without first notifying the qualifying activity. Requalification may be required depending on the nature of these changes, and shall be at the discretion of the qualifying activity.

TABLE I. Qualification tests for solvent varnishes.

Characteristics	Requirement	Test
Storage life	3.3.10.1	4.7.1
Nonvolatiles	3.3.10.2	4.7.2
Flash point	3.3.10.5	4.7.5
Drying time	3.3.10.7	4.7.7
Viscosity at 20 revolutions per minute (r/min)	3.3.10.8	4.7.8
Build, as received	3.3.10.9	4.7.9
Drainage	3.3.10.10	4.7.10
Specific gravity	3.3.10.11	4.7.11
Dielectric strength: 1/ 96/23/50	3.3.10.12	4.7.12
96/23/96		
24/23/water		
Dissipation factor:	3.3.10.13	4.7.13
at 23°C		
at 150°C		

See footnote at end of table.

TABLE I. Qualification tests for solvent varnishes - Continued.

Characteristics	Requirement	Test
Dielectric constant: at 23°C at 150°C	3.3.10.14	4.7.13
Hardness	3.3.10.15	4.7.14
Bond strength: at 23°C at 150°C	3.3.10.16	4.7.15
Thermal endurance	3.3.10.17	4.7.16
Salt water proofness	3.3.10.18	4.7.17
Hydrolytic stability	3.3.10.19	4.7.18
Chemical resistance	3.3.10.20	4.7.19
Mix compatibility	3.3.10.21	4.7.20

1/ Indicates 96 hours at 23°C at 50 percent relative humidity (R.H.) (see 4.5.2).

TABLE II. Qualification tests for solventless resin.

Characteristics	Requirement	Test
Catalyzed storage life	3.3.10.1	4.7.1
Vapor pressure	3.3.10.3	4.7.3
Weight loss on cure	3.3.10.4	4.7.4
Flash point	3.3.10.5	4.7.5
Gel point	3.3.10.6	4.7.6
Curing time at 23°C	3.3.10.6	4.7.6.1
Viscosity: at 2 r/min at 20 r/min	3.3.10.8	4.7.8.1
Thixotropic index	3.3.10.8	4.7.8.1
Working life after mixing	3.3.10.8	4.7.8.2
Build	3.3.10.9	4.7.9
Drainage	3.3.10.10	4.7.10
Specific gravity	3.3.10.11	4.7.11
Dielectric strength: 96/23/50 96/23/96 24/23/water	3.3.10.12	4.7.12
Dissipation factor: at 23°C at 150°C	3.3.10.13	4.7.13
Dielectric constant: at 23°C at 150°C	3.3.10.14	4.7.13

TABLE II. Qualification tests for solventless resin - Continued.

Characteristics	Requirement	Test
Hardness	3.3.10.15	4.7.14
Bond strength:	3.3.10.16	4.7.15
at 23°C		
at 150°C		
Thermal endurance	3.3.10.17	4.7.16
Salt water proofness	3.3.10.18	4.7.17
Hydrolytic stability	3.3.10.19	4.7.18
Chemical resistance	3.3.10.20	4.7.19
Mix compatibility	3.3.10.21	4.7.20

4.3.1 Samples for qualification inspection. Qualification inspection samples shall consist of two 1-gallon cans of the varnish or resin and an appropriate amount of catalyst, as required.

4.3.2 Qualification inspection report. A qualification inspection report shall be prepared and shall include the following:

(a) Detailed description of sample preparation and curing schedule used for each test (see 4.6.1.2).
(b) Test results as specified herein.
(c) Material safety data sheet (see 3.3.4).
(d) Manufacturer's instruction sheet (see 3.3.11).
(e) Certification of product composition, including the following:

(1) The product is of the type specified on the applicable specification sheet.
(2) The material requirements of 3.3.6 and 3.3.7 have been met.

The certification shall be signed by a responsible agent of the manufacturer.

(f) Technical information package, including the following:

(1) Differential scanning calorimetry (DSC): DSC curves shall be measured on the uncured varnish or uncured catalyzed solventless resin, prepared as specified in 4.6.1.1. The test method and report shall be in accordance with ASTM E 537. Sample weight shall be approximately 5 milligrams (mg). The heating rate shall be 10°C per minute from 25 to 250°C in a dry nitrogen stream. The test report shall include two DSC curves on identically prepared specimens, sample weight, and all DSC conditions. No interpretive analysis is required.
(2) Glass transition temperature: Glass transition temperature of a cured specimen shall be determined using DSC. ASTM D 3418 shall be used. DSC conditions shall be identical to those specified in (1) above, except that the

sample shall consist of approximately 5 mg of cured resin, cast in accordance with 4.6.1.3. The test report shall include the DSC curve of two identically cured specimens, cure conditions, sample weight, DSC conditions, and the transition temperature taken from the midpoint in the thermogram measured from the extensions of the pretransition and post-transition baselines.

(3) Thermogravimetric analysis (TGA): A TGA shall be performed on two cast specimens, prepared and cured as specified in 4.6.1.3. Sample size shall be approximately 10 mg. The test procedure shall be in accordance with ASTM D 3850. The heating rate shall be 10°C per minute in a dry nitrogen stream over a temperature range of 25°C to a temperature where there is no further weight loss. The test report shall be as specified in ASTM D 3850 and shall include the TGA graphs.

(4) Infrared analysis: An infrared analysis shall be made on the solvent varnish or on the catalyzed solventless resin. The material shall be prepared as specified in 4.6.1.1. The final report shall include the complete infrared scan and details of sample preparation. No interpretive analysis is required.

4.4 Quality conformance inspection. The product sample shall be subjected to the tests specified in tables III and IV, as applicable (see 6.3).

TABLE III. Quality conformance tests for solvent varnishes.

Characteristics	Requirement	Test
Nonvolatiles	3.3.10.2	4.7.2
Drying time	3.3.10.7	4.7.7
Viscosity at 20 r/min percent change in viscosity from qualification value	3.3.10.8	4.7.8
Build	3.3.10.9	4.7.9
Specific gravity, percent change in specific gravity from qualification value	3.3.10.11	4.7.11
Hardness	3.3.10.15	4.7.14
Bond strength: at 23°C at 150°C	3.3.10.16	4.7.15
Thermal endurance	3.3.10.17	4.7.16

TABLE IV. Quality conformance tests for solventless resins.

Characteristics	Requirement	Test
Weight loss on cure	3.3.10.4	4.7.4
Gel point	3.3.10.6	4.7.6
Curing time at 23°C	3.3.10.6	4.7.6.1
Viscosity, percent change from qualification value	3.3.10.8	4.7.8.1
Working life after mixing	3.3.10.8	4.7.8.2
Build	3.3.10.9	4.7.9
Specific gravity, percent change in specific gravity from qualification value	3.3.10.11	4.7.11
Hardness	3.3.10.15	4.7.14
Bond strength at 23°C	3.3.10.16	4.7.15

4.4.1 Lot. A lot shall consist of a varnish or resin from one process batch or numerous unchanged process batches, uniformly blended together in a tank and offered for delivery at one time. If the varnish or resin cannot be identified by batch or tank, a lot shall consist of not more than 1,000 gallons blended together and offered for delivery at one time.

4.4.2 Samples for quality conformance tests. The samples shall be made as representative as possible by agitation or circulation of the lot before sampling. From each lot, a representative sample consisting of two 1-quart containers of the resin and appropriate amount of catalyst shall be selected in accordance with method 1031 of FED-STD-141.

4.5 Conditioning, tolerances, designations and chambers. Conditioning, tolerances, designations and chambers shall be in accordance with 4.5.1 through 4.5.3.2.

4.5.1 Temperature and humidity tolerances. Unless otherwise specified herein, the temperature and R.H. shall be maintained within the tolerances shown in table V.

TABLE V. Tolerances for temperature and R.H.

Temperature		R.H.	
°C	Tolerance, plus or minus °C	Percent	Tolerance, plus or minus percent
0 to 180	2	50	5
181 to 300	3	95	2
301 to 325	4	--	-
326 to 500	5	--	-

4.5.2 Conditioning designations. Preconditioning, conditioning, curing, and aging conditions shall be designated in accordance with ASTM D 618.

4.5.3 Chambers and ovens. Chambers and ovens shall be as specified in 4.5.3.1 through 4.5.3.2.

4.5.3.1 High humidity chamber. The chamber shall be constructed of non-corroding materials and the R.H. shall be maintained as specified in ASTM F 74 using a saturated salt solution of K_2SO_4.

4.5.3.2 Oven. The oven shall be electrically heated, forced convection type as specified in ASTM D 2436.

4.6 Test specimens. Test specimens shall be as specified in the applicable test methods and in table VI.

TABLE VI. Standard test specimens for qualification and quality conformance of solvent varnishes and solventless resins.

Property	Test paragraph	Substrate and dimensions (inches)	Resin coats	Number of specimens
Storage life	4.7.1	---	---	1/
Vapor pressure	4.7.3	---	---	1
Weight loss on cure	4.7.4	---	---	3
Flash point	4.7.5	---	---	1
Gel point	4.7.6	---	---	3
Viscosity at 2 and 20 r/min	4.7.8.1	---	---	---
Thixotropic index	4.7.8.1	---	---	---
Build	4.7.9	Steel 6 x 3 x 0.032	1	5
Drainage	4.7.10	Steel 6 x 3 x 0.032	1	5
Specific gravity	4.7.11	---	---	1
Dielectric strength: 96/23/50, 96/23/96 and 24/23/water	4.7.12	Steel 6 x 3 x 0.032	2	3
Dissipation factor at 23 and 150°C	4.7.13	---	---	1
Dielectric constant at 23 and 150°C	4.7.13	---	---	1
Hardness	4.7.14	---	---	1
Bond strength at 23 and 150°C	4.7.15	M2 and K2 2/	1	3/5
Thermal endurance:				
semi-rigid varnish	4.7.16.2	M2 and K2 2/	1	1/
thixotropic resins	4.7.16.3	M2 and K2 2/	1	2
Salt water proof	4.7.17	Brass 0.59 x 5.9 2/	2	1/
Hydrolytic stability	4.7.18	M2 2/	1	5
Chemical resistance	4.7.19	M2 2/	1	30

See footnotes at top of next page.

1/ As required by the test paragraph.
2/ Size 18 AWG magnet wire, in accordance with J-W-1177.
3/ In accordance with magnet wire type.

4.6.1 Preparation of test specimens. Unless otherwise specified herein, test specimens shall be prepared as specified in 4.6.1.1 through 4.6.1.6.

4.6.1.1 Liquid varnish or resin. Product components shall be brought to laboratory temperature in a closed container at least 24 hours before use. Two-part products shall be brought to temperature, mixed thoroughly with catalyst, and allowed to stand in a closed container for 24 to 48 hours prior to use. Other than solvent or catalyst, no additions shall be made to the as-received varnish or resin. Unless otherwise specified (see 6.2), tests on uncured product shall be performed on the resin-catalyst mix.

4.6.1.2 Curing of test specimens. Instruction sheets shall be provided for the preparation of specimens, including curing time and temperature and, if required, the proper quantity of solvent or catalyst to add. Specimens for all property measurements shall be cured identically.

4.6.1.3 Cast specimens. Cast specimens shall be made by preparing the liquid product in accordance with 4.6.1.1, pouring into a 2- to 3-inch diameter aluminum weighing dish, and curing as specified in 4.6.1.2 in a preheated oven. Sufficient product shall be used to achieve a casting thickness of 1/8 ± 1/32 inch. If the resin and exotherm are such that 1/8-inch castings cannot be made without defect, thinner castings are permitted, provided that specimen thickness is reported.

4.6.1.4 Panel specimens. The varnish or catalyzed resin shall be coated and cured onto steel panels of the following type:

Designation - ASTM A 366, steel, sheet, carbon, cold-rolled.
Size - 3 by 6 by 0.032 inches

4.6.1.4.1 Materials. The liquid varnish or resin shall be prepared in accordance with 4.6.1.1, brought to 23 ± 1°C and poured slowly into a container to prevent entrapment of air. The steel panels specified in 4.6.1.4 shall be degreased before the varnish is applied.

4.6.1.4.2 Apparatus. A device, in accordance with ASTM D 823, that withdraws the steel panel from the liquid product at 4 inches per minute shall be used. A water bath or conditioned room shall be provided that shall maintain the liquid product at 23 ± 1°C.

4.6.1.4.3 Procedure. The procedure shall be as follows: Lower the test panel slowly into the product. Place the container with the liquid and panel in a constant temperature water bath or in a conditioned room held at 23 ± 1°C. For non-thixotropic materials to stand in this condition without vibration for 60 minutes or until bubbling stops, whichever comes first. For thixotropic resins, allow to stand 60 minutes. At the end of this interval, move the specimen under the dip coater which had been previously adjusted to withdraw the specimen at a

rate of 4 inches per minute. Attach the specimen without disturbing the container or the panel. When the panel has been raised from the resin, stop the dip coater and allow the specimen to drain between 30 and 32 minutes. Laboratory conditions during draining shall be 23 ± 2°C and 50 ± 5 percent R.H. Move the container away from the specimen so that it can hang freely without detriment to the coating. Place specimen in a preheated oven and cure in accordance with 4.6.1.2. The specimen shall not be vibrated during draining or curing. For dielectric test specimens, two steel panels may be taped back-to-back so that only one side is coated; the uncoated side provides an electrode surface. The number of cured coats per specimen shall be as defined in the particular test description.

4.6.1.5 Helical coil specimens. Helical coil specimens shall be prepared in accordance with 4.6.1.5.1 and 4.6.1.5.2.

4.6.1.5.1 Helical coil specimens for solvent varnishes. Test specimens shall be prepared in accordance with ASTM D 2519.

4.6.1.5.2 Helical coil specimens for solventless resins. Test specimens shall be prepared in accordance with ASTM D 2519 and in accordance with 4.6.1.1 with the following exceptions:

(a) Two coats shall be applied to the test coil for resins having an as-received film build less than 1.0 mil as specified in 4.7.9.
(b) Only one coat shall be applied to the test coil for resins having an as-received film build greater than 1.0 mil as specified in 4.7.9.

4.6.1.6 Rod specimens. Specimens shall consist of nine brass rods, 0.59 inch in diameter, 5.9 inches long, and carefully rounded at one end to a radius of 0.295 inch. Rods shall be thoroughly cleaned by polishing to a bright finish with rough polishing media on a high speed buffing wheel. After buffing, the rods shall be polished with fine alumina powder, washed with soap and water, rinsed thoroughly, and wiped dry with untreated lens tissue. Rods having any visible surface imperfections such as nicks, pit marks, and fingerprints shall not be coated. Contact with contaminating objects shall be avoided. After cleaning, rods shall be dipped, drained and baked in a vertical position with rounded ends down, leaving approximately 1.25 inches of the rod exposed at the top. The varnish or resin shall be prepared for dipping in accordance with 4.6.1.1. Each rod shall be given two coats, dipping the rod in the same direction. Between coats, the rods shall be drained and cured as specified in 4.6.1.2. Coated rods having discontinuities, insufficient coating or other coating imperfections not related to the product itself shall be discarded. Only rods having a smooth uniform coating shall be tested.

4.7 Test procedures.

4.7.1 Storage life. The product shall have a storage life such that all of the requirements shall be met after storage in a closed container at 23°C for the specified time period (see 3.1).

4.7.2 Nonvolatiles for solvent varnish. The percentage of nonvolatiles in the as-received condition shall be determined in accordance with ASTM D 115. Oven requirements shall be in accordance with 4.5.3.2. The varnish shall meet the requirements specified in 3.3.10.2.

4.7.3 Vapor pressure of solventless resins. For solventless resins, the vapor pressure of the catalyzed resin, prepared in accordance with 4.6.1.1, shall be measured in accordance with ASTM D 323 (Reid method). The resin shall meet the requirements specified in 3.3.10.3.

4.7.4 Weight loss on cure of solventless resins. For solventless resins, the catalyzed resin shall be prepared in accordance with 4.6.1.1. A specimen weighing 2 to 4 grams shall be transferred to a weighed aluminum drying dish which was previously heated for 30 minutes at 150°C and cooled in a desiccator to laboratory temperature. The dish with specimen shall be weighed and placed in a forced convection oven in accordance with 4.5.3.2, preheated to the curing temperature, and cured in accordance with 4.6.1.2. After cure, the dish and specimen shall be cooled in a desiccator to laboratory temperature before weighing. The percent weight loss shall be calculated using the following formula:

$$\text{Percent weight loss on cure} = 100 \times \frac{A-B}{A-C}$$

Where:

A = weight of uncured resin plus dish
B = weight of cured resin plus dish
C = weight of dish

Three resin specimens shall be tested. The resin shall meet the requirements specified in 3.3.10.4.

4.7.5 Flash point. Flash point of the varnish or catalyzed resin shall be measured in accordance with ASTM D 93. The varnish or resin shall meet the requirements specified in 3.3.10.5.

4.7.6 Gel point of solventless resins. For solventless resins, the gel time shall be measured on three catalyzed resin specimens in accordance with ASTM D 3056. A bath temperature of 100, 125 or 150°C shall be employed, and shall be chosen to give a gel time between 10 and 60 minutes. Repetitive gel point measurements for resin re-qualification or quality conformance shall be made at the same temperature as the initial qualification tests. The resins shall meet the requirements specified in 3.3.10.6.

4.7.6.1 Curing time for solventless, two-component varnishes. After mixing the two components thoroughly, the two-component varnish shall meet the requirements specified in 3.3.10.6.

4.7.7 Drying time for solvent varnishes. When measured according to ASTM D 115, and at the temperature indicated, the drying time shall not exceed the maximum value specified (see 3.1).

4.7.8 Viscosity for solvent and non-thixotropic solventless varnishes. Viscosity shall be measured at 23 ± 1°C on varnishes prepared in accordance with 4.6.1.1. The viscosity shall be determined at a spindle speed of 20 r/min in accordance with ASTM D 115, and shall meet the requirements specified in 3.3.10.8.

4.7.8.1 Viscosity for solventless thixotropic resins. Viscosity shall be measured at 23 ± 1°C on catalyzed resin prepared in accordance with 4.6.1.1. Viscosity shall be determined at spindle speeds of 2 and 20 r/min in accordance with method B of ASTM D 2196. The product shall be placed in a 1-quart container to within 1 inch of the top. Using a water bath, the sample shall be adjusted to 23 ± 1°C. The required temperature shall be maintained for 90 plus 5 minus 0 minutes before the first measurement is made at 2 r/min. The 20 r/min measurement shall then be made immediately after the 2 r/min measurement. Two specimens shall be tested and the average value recorded, provided the deviation of a single measurement from the average is not greater than 10 percent. If a deviation is greater than 10 percent, the viscometer shall be recalibrated and the procedure repeated. A thixotropic index shall be calculated as follows:

$$\text{Thixotropic index} = \frac{\text{Average viscosity at 2 r/min}}{\text{Average viscosity at 20 r/min}}$$

4.7.8.2 Working life for solventless, two-component varnishes. After mixing the two components thoroughly, the working life shall be that time beyond which the varnish can no longer be satisfactorily applied by brush, or beyond which it no longer flows evenly and is too viscous to wet the area to be patched.

4.7.9 Build. Build, or thickness of a single coat of varnish or resin on a steel panel, shall be determined in accordance with ASTM D 115 using five specimens as specified in 4.6.1.4. Thickness measurements shall be made after cure on the 1-inch center width section of a steel strip as specified in table VI, to avoid edge effects. Thickness measurements shall be made with a micrometer in accordance with ASTM D 374, method A. The average of the thickness measured at points 2 and 4 inches from the top of the steel strip, with the average thickness of the steel subtracted and remainder divided by 2, shall be taken as the film build per specimen. The varnish or resin shall meet the requirements specified in 3.3 and 3.3.10.9.

4.7.10 Drainage. Drainage shall be measured in accordance with ASTM D 115 on five specimens prepared as specified in 4.6.1.4. Drained varnish or resin, from the 30-minute drainage period and the cure period, shall be collected in a clean pre-weighed aluminum pan. The steel panel shall also be weighed before coating. After oven cure, the aluminum pan with drained-off varnish, resin, and the cured panel specimens shall be weighed. Percent drainage shall be calculated as follows:

$$\text{Percent drainage} = \frac{(A - B)}{(C - D) + (A - B)} \times 100$$

Where:

A = Weight of aluminum pan plus cured collected varnish or resin
B = Weight of clean aluminum pan
C = Weight of steel panel and cured coating
D = Weight of clean steel panel

Identical specimens may be used to measure build and drainage. Resin or varnish shall meet the requirements specified in 3.3.10.10.

4.7.11 Specific gravity. Specific gravity shall be measured at 23°C in accordance with ASTM D 115 for solvent varnishes and ASTM D 1963 for solventless varnishes. Individual values are required for the resin and catalyst for a two-part system. Specific gravity shall be as specified in 3.3.10.11.

4.7.12 Dielectric strength. The voltage gradient at which dielectric failure of the varnish or resin occurs shall be measured on specimens prepared in accordance with 4.6.1.4, except that after curing the first coat, the panel shall be inverted and reverse dipped to apply a second coat. The test specimens shall be prepared by placing two steel panels together and sealing the edges so that a coating is obtained on one side of each panel only. The double panels shall be baked in an oven in accordance with the manufacturer's instructions (see 3.3.11). After baking and cooling they shall be separated into single panels coated on one side only. Three test panels shall be subjected to each of the following conditions after cure (see ASTM D 618):

96/23/50
96/23/96
24/23/distilled water

Breakdown voltage measurements shall be made using an electrode set 1/4 inch in diameter with edges rounded to a 1/32-inch radius. Circular gaskets shall be placed over the end of each electrode to prevent flashover. After placing the test specimens between the electrodes connected to a test apparatus, voltage shall be increased from zero to breakdown at a rate of 500 volts per second in accordance with ASTM D 149. A minimum of 5 voltage breakdown determinations shall be made per panel. Thickness measurements shall be made using a micrometer in accordance with ASTM D 374 near the breakdown point. The average thickness of the uncoated panel shall also be measured. The differences in these measurements shall be used to calculate breakdown volts per mil. Dielectric strength of the varnish or resin shall be as specified in 3.3.10.12.

4.7.13 Dissipation factor and dielectric constant. Dissipation factor and dielectric constant shall be measured on a cast cured specimen prepared in accordance with 4.6.1.3 and conditioned 96/23/50. Measurements shall be made at 23 and 150°C in accordance with the two-terminal system as specified in ASTM D 150. Testing shall be at 60 hertz (Hz) and 100 volts. Dissipation factor and dielectric constant shall be as specified in 3.3.10.13 and 3.3.10.14.

4.7.14 Hardness. Hardness measurements shall be made on a cast sample, prepared in accordance with 4.6.1.3 and tested in accordance with ASTM D 2240 (Shore A or Shore D) at 23°C. Hardness of the varnish or resin shall be as specified in 3.3.10.15.

4.7.15 Bond strength. The bond strength test shall be conducted in accordance with ASTM D 2519 with the exception that the specimen shall be prepared as specified in 4.6.1.5. Specimens of each magnet wire type (see table VI) shall be

conditioned at 96/23/50 and then tested at temperatures of 23 and 150°C. Five identical helical coil specimens shall be tested for each variation in magnet wire and test temperature. Bond strength of the varnish or resin shall be as specified in 3.3.10.16.

4.7.16 Thermal endurance. Thermal endurance shall be tested in accordance with 4.7.16.1 through 4.7.16.5, and shall meet the requirements specified in 3.3.10.17.

4.7.16.1 Thermal class, flexible varnish, resin. The thermal class for grades CA, CB, CBS, SF, SFT, SS, and WB shall be determined in accordance with ASTM D 1932 on glass cloth using the curved electrode for breakdown test.

4.7.16.2 Thermal class, semi-rigid varnish, resin. The thermal class for grades CBH, SH, and WBH shall be determined in accordance with ASTM D 3251 on twisted pairs of varnish coated magnet wires (see table VI). The individual thermal index shall be recorded for each wire type.

4.7.16.3 Thermal class, thixotropic resins. The thermal class for grade SHT shall be determined in accordance with ASTM D 3145 using the bond strength of coated helical coils as the thermal index.

4.7.16.4 Requalification. For requalification, or to establish that a minor change in processing or formulation does not affect thermal endurance, a thermogravimetric analysis as specified in 4.3.2(f)(3) shall be performed. The plots of weight loss versus temperature shall not vary by more than plus or minus 5°C at any weight percent from the curves obtained on the qualified product.

4.7.16.5 Thermal endurance, two-component varnishes. After thoroughly mixing the two components and curing the material according to the manufacturer's instructions, the weight loss shall be measured after exposure to 150°C for 5 days. This loss shall not exceed the value specified (see 3.1).

4.7.17 Salt water proofness. Nine test specimens, prepared in accordance with 4.6.1.6, shall be subjected to a condition of 24/23/50 plus 100/23/salt water. The specimen shall be suspended, rounded end down in salt water (3-1/2 percent sodium chloride by weight) to a depth of 3-1/2 inches. Direct current (dc) voltage (120 volts) shall be applied with the rod as a cathode and a nichrome wire suspended in the solution as an anode. The electrodes shall be connected to the power supply with one lead in series with a standard 7.5-watt incandescent lamp to indicate breakdown of the film. Breakdown shall be reported in number of hours to failure. The test shall be discontinued after the sample passes 100 hours without failure. Data obtained in the salt water proof test shall be interpreted as follows:

No more than six of nine specimens fail - Pass
Seven or more of nine specimens fail - Retest (nine additional specimens shall be prepared for retest)
On retest, a total of no more than 12 of 18 specimens fail - Pass
On retest, a total of 13 or more of 18 specimens fail - Reject

The specimens shall meet the requirements specified in 3.3.10.18.

4.7.18 Hydrolytic stability. Moisture resistance shall be determined by measuring the percent change in helical bond strength after conditioning for 200 hours at 97°C and 95 percent R.H. in the humidity chamber specified in 4.5.3.1. Helical bond specimens, five per test condition, shall be tested at 23°C, in accordance with 4.7.15, after the following conditioning:

96/23/50
200/97/95

After humidity aging, specimens shall be allowed to equilibrate at 23 ± 2°C and 50 ± 5 percent R.H. for a minimum of 1 hour and a maximum of 2 hours before testing. Procedures given in ASTM F 74 shall apply, except that the determination of aging time shall not apply. Specimens shall meet the requirements specified in 3.3.10.19.

4.7.19 Chemical resistance. Chemical resistance shall be measured by the change in helical bond strength after 168 hours immersion in various media at 23°C. Helical bond specimens, five per test condition, shall be tested at 23°C, in accordance with 4.7.15, after exposure to 96/23/50 and after 168 hours immersion in the following liquids at 23°C:

(a) Hydraulic fluid in accordance with MIL-H-17672.
(b) Lubricating oil in accordance with MIL-L-23699.
(c) Cleaning fluid in accordance with P-D-680, type I. (1, 1, 2-trichloro 1, 2, 2-trifluoroethane)
(d) Distilled water.
(e) Detergent solution in accordance with MIL-D-16791, general purpose non-ionic detergent, a solution using 1 pound of detergent with 2-1/4 gallons of water.

The immersed specimens shall be tested within 3 minutes after removal from the immersion medium. The specimens shall show no sign of varnish or resin softening or tackiness, as determined by gently wiping the surface of the helical coil specimen with cotton prior to physical testing. Cotton fibers shall not be retained on the surface of the specimen. The varnish and resin shall meet the requirements specified in 3.3.10.20.

4.7.20 Varnish, resin, mix compatibility test. The compatibility of the replacement varnish or resin with the in-use tank varnish shall be tested with 5 mix ratios in accordance with ASTM D 115. With both materials at 23°C, while stirring steadily, the replacement varnish shall be slowly added to 50 milliliters (mL) of the tank varnish until mixtures of 1:9, 1:3, 1:1, 3:1, and 9:1 are obtained. These mixes shall be examined for curdling, precipitation or separation and shall be examined again after standing for 24 hours and the appearance recorded. A sample of each thoroughly stirred mixture shall then be placed in a flat-bottomed aluminum weighing dish, approximately 2-3/4 inches in diameter, and three-fourths full. These samples shall be cured in an oven as specified in 4.5.3.2. After curing, the sample shall be cooled to room temperature and examined for cloudy or murky appearance. The resins and varnishes shall meet the requirements specified in 3.3.10.21.

4.8 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment, stowage and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 General.

5.1.1 Navy fire-retardant requirements.

(a) Lumber and plywood. When specified (see 6.2), all lumber and plywood including laminated veneer material used in shipping container construction members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Levels A and B - Type II - weather resistant.
Category 1 - general use.
Level C - Type I - non-weather resistant.
Category 1 - general use.

(b) Fiberboard. Unless otherwise specified (see 6.2), fiberboard used in the construction of class-domestic, non-weather resistant fiberboard and cleated fiberboard boxes including interior packaging forms shall meet the flamespread and the specific optic density requirements of PPP-F-320.

5.2 Packaging, packing, and marking. Packaging, packing, and marking for shipment shall be in accordance with PPP-P-1892 and as specified in 5.3. Packaging shall be level A, B, or C as specified (see 6.2). Packing shall be level A, B, or C as specified (see 6.2). Packaging shall be in 1-gallon cans, 5-gallon pails, or 55-gallon drums as specified (see 6.2). One-gallon cans shall be for grade CA or PK only, other grades shall be supplied in 5-gallon pails or 55-gallon drums.

5.3 Marking. In addition to the markings required by PPP-P-1892 (see 6.2), each unit container, intermediate and shipping container shall contain the following markings:

(a) Specification number, which shall include grade, class, and composition (I through IV).
(b) Shelf life and storage conditions.
(c) "CAUTION: This varnish may not be compatible with varnish in the dip tank. Check mixing before use."

5.3.1 Marking for drums and 5-gallon pails. The markings required shall be stenciled on the top and on the sides of these containers in accordance with MIL-STD-129 requirements for visibility, size and durability.

5.4 Material safety data sheet. A copy of the material safety data sheet shall be attached to the shipping document for each destination (see 3.3.4).

6. NOTES

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

6.1 Intended use. The insulating products covered by this specification are intended for impregnation or coating of all types of electrical coils and windings. They are rated for continuous operation at the maximum operating temperature specified for each class. Products may also be used at temperatures lower than the thermal class. Products covered by this specification are intended for use in the dip process except for brush applied patching materials and coatings applied over identification markings. The primary purpose of the varnish is to protect the coils from the operating environment.

6.1.1 Grade CA varnish. Grade CA varnishes are clear, air-drying varnishes which are used for spot patching and emergency repairs where baking facilities are not available. This category includes certain coatings such as lacquers which are used as environmental protection for identification markings.

6.1.2 Grade CB varnish. Grade CB varnishes are clear, flexible, baking varnishes which are for application on stationary coils and windings and satisfy the requirements of ASTM D 1932.

6.1.3 Grade CBH varnish. Grade CBH varnishes are clear, semi-rigid, baking varnishes which have higher bond strengths at elevated temperatures than the CB grades. They are not intended to satisfy the requirements of ASTM D 1932 as required for CB grade (see 6.1.2). They are primarily used for rotating windings such as armatures, rotors, and similar constructions.

6.1.4 Grade CBS varnish. Grade CBS varnishes are clear, silicone, baking varnishes primarily used for insulating equipment operating at temperatures in excess of 180°C. These varnishes can usually satisfy the requirements of ASTM D 1932. They do not have high bond strengths at their designated classes of 200 and 220°C, and are, therefore, used for stationary windings which operate continuously at these temperatures.

6.1.5 Grade SF varnish. Grade SF varnishes are clear, flexible, solventless, baking varnishes which are used for impregnating and coating stationary coils and windings. These varnishes meet the requirements of ASTM D 1932.

6.1.6 Grade SFT varnish. Grade SFT varnishes are clear, flexible, solventless, thixotropic, baking varnishes which are similar to grade SF except they yield heavier coatings per varnish dip. Since they normally contain powdered mineral fillers to obtain thixotropy, heavy coatings of these materials are usually translucent.

6.1.7 Grade SH varnish. Grade SH varnishes are clear, solventless, semi-rigid, baking varnishes which have higher bond strengths than grade SF and are not intended to meet the requirements of ASTM D 1932. These materials are used on rotary windings.

6.1.8 Grade SHT varnish. Grade SHT varnishes are clear, solventless, semi-rigid, thixotropic, baking varnishes used on rotary windings because of high elevated temperature bond strengths. Since they normally contain powdered mineral fillers to obtain thixotropy, heavy coatings are usually translucent.

6.1.9 Grade SS varnish. Grade SS varnishes are clear, solventless, silicone, baking varnishes used primarily for high temperature impregnation and coating applications.

6.1.10 Grade WB varnish. Grade WB varnishes are clear, flexible, baking varnishes which are for application on stationary coils and windings and satisfy the requirements of ASTM D 1932.

6.1.11 Grade WBH varnish. Grade WBH varnishes are clear, semi-rigid, baking varnishes which offer high bond strengths at elevated temperatures and are not intended to satisfy the requirements of ASTM D 1932. They are primarily used for rotation windings such as armatures, rotors, and similar constructions.

6.1.12 Grade PK varnish. Grade PK varnishes are clear, room temperature cure varnishes, used for spot patching and emergency repairs where baking facilities are not available. The final properties can be improved through the careful application of local heat, for example, by heat gun or heat lamp.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of this specification.
(b) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(c) Title, number, and date of the applicable specification sheet and the grade, class and composition of the material.
(d) Tests on uncured products, if other than as specified (see 4.6.1.1).
(e) When fire-retardant treatment is not required (see 5.1).
(f) Level of packaging and packing required (see 5.2).
(g) Size of can, pail, or drum required (see 5.2).
(h) Special marking required (see 5.3).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/ provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.4	DI-T-5329	Inspection and test reports	---

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL 24092 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests must be made in accordance with "Provisions Governing Qualification SD-6" (see 6.4.1).

6.4.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.5 Definitions.

6.5.1 Electrical insulating solvent varnish. Electrical insulating solvent varnish is a mixture of an organic film-forming material and a suitable solvent capable of forming a smooth coating after solvent evaporation and generally yielding optimum insulation properties after baking at elevated temperatures.

6.5.2 Electrical insulating solventless resin. Electrical insulating solventless resin is a polymeric liquid containing a catalyst or hardener for conversion to a solid insulating material. When properly cured or polymerized, normally by baking at elevated temperatures, the solid material provides a dielectric and environment barrier as well as mechanical bonding.

6.5.3 Dip processing or treatment. Dip processing or treatment is the process of submerging electrical equipment into a tank of solvent varnish or solventless resin followed by drainage of excess material back into the process tank. The equipment is usually held for a brief period at room temperature then placed in an oven for baking at temperatures between 38 and 163°C from several hours to as long as 20 hours, depending on the manufacturer's recommendations.

6.5.4 Flexible varnish. Flexible varnishes are varnishes having bond strengths between 1 and 4 pounds at 150°C, as defined by ASTM D 2519, and satisfying the requirements of ASTM D 1932 at their temperature class.

6.5.5 Product. Product, as used herein, designates a distinct varnish or resin and catalyst system, either one- or two-part, manufactured from a specific formula in one or more plants. Changes in varnish, resin or catalyst composition, composition percentages or manufacturing processes requires requalification of the product. Changes in raw material supplier requires notification of the qualifying activity.

6.5.6 Semi-rigid varnishes. Semi-rigid varnishes are varnishes defined by ASTM D 2519 as having bond strengths greater than 4 pounds at 150°C.

6.6 Quality conformance lot rejection. If any sample (see 4.4.2) is found to be not in conformance to the requirements of this specification, this should be cause for the rejection of the lot represented by the sample.

6.7 Material safety data sheets (MSDS). Contracting officers must identify those activities requiring copies of MSDS's. Additional required Government information is contained in FED-STD-313. In order to obtain the MSDS, FAR clause 52.223-3 must be in the contract.

6.8 International interest. Certain provisions of this specification are the subject of international standardization agreement ABC-NAVY-STD-17. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices to change the agreement or make other appropriate accommodations.

6.9 Subject term (key word) listing.

Diluent
Monomer
Silicone
Solvent
Thixotropic

6.10 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army - ER
Navy - SH
Air Force - 20

Review activities:
Army - MI, AR
Navy - EC, YD, OS
Air Force - 99
DLA - GS, DS

User activities:
Army - ME
Navy - MC, AS

Preparing activity:
Navy - SH
(Project 5970-0661)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-I-24092C	INSULATING VARNISHES AND SOLVENTLESS RESINS FOR APPLICATION BY THE DIP PROCESS

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* — Optional	b. WORK TELEPHONE NUMBER *(Includes Area Code)* — Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* — Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)