

MIL-C-81945A(AS)

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SUPERSEDING

MIL-C-81945(AS)

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MILITARY SPECIFICATION

COATING COMPOUNDS, WEAPON INSULATION, INTUMESCENT

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers intumescent coatings for the exterior surfaces of aircraft ordnance to provide protection from high-flux thermal environments.

1.2 Classification. Coating compounds shall be of the following types as specified herein:

Type I - Coating for spray application

Type II - Coating for hand trowelled application and use in the manufacture of intumescent sheet materials

Type III - Intumescent sheet materials

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Engineering Specifications and Standards Department (ESSD) Code 93, Lakehurst, N.J. 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 8010

MIL-C-81945A(AS)

The coating compounds may be provided as multi-component systems (resin and curing agent), or as single component systems. The intumescent sheet materials are provided as solid sheets for gluing to the object to be protected.

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

L-P-1040	Plastic Sheets and Strips (Polyvinyl Fluoride)
QQ-A-250/5	Aluminum Alloy Alclad 2024, Plate and Sheet
QQ-A-250/11	Aluminum Alloy 6061, Plate and Sheet
PPP-D-711	Drum: Metal, Shipping, Steel, Lightweight (55 Gallon)
PPP-D-729	Drums, Shipping and Storage, Steel 55 Gallon (208 Liters)
PPP-P-704	Pails, Metal: (Shipping, Steel, 1 Through 12 Gallons)

MILITARY

MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-A-8625	Anodic Coatings, For Aluminum and Aluminum Alloys

MIL-C-81945A(AS)

MIL-P-23377	Primer Coatings: Epoxy-Polyamide, Chemical and Solvent Resistant
MIL-C-81773	Coatings, Polyurethane, Aliphatic, Weather Resistant
MIL-C-81706	Chemical Conversion Materials For Coating Aluminum and Aluminum Alloys

STANDARDS

FEDERAL

FED-STD-141	Paint, Varnish, Lacquer, and Re- lated Materials; Methods for Testing of
FED-STD-406	Plastics: Methods of Testing

MILITARY

MIL-STD-2098	Ordnance Preparation and Application of Intumescent Sheet, Type III
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-147	Palletized and Containerized Unit Loads 40" x 48" Pallets, Skids, Runners, or Pallet - Type Base
MIL-STD-810	Environmental Test Methods
MIL-STD-1648	Criteria and Test Procedures for Ordnance Exposed to an Aircraft Fuel Fire

MIL-C-81945A(AS)

PUBLICATIONS

DEPARTMENT OF THE NAVY

WR-50

Warhead Safety Tests, Minimum for
Air, Surface and Underwater Launched
Weapons

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM D 1014	Conducting Exterior Exposure Tests of Paints on Steel
ASTM D 1475	Density of Paint, Varnish, Lacquer, and Related Products
ASTM D 1748	Rust Protection by Metal Preservatives in the Humidity Cabinet
ASTM D 2794	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 2196	Rheological Properties of Non-Newtonian Materials Test for
ASTM D 638	Tensile Properties of Plastics, Test for

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

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION, INC., AGENT

National Motor Freight Classification

(Application for copies should be addressed to the National Motor Freight Traffic, Tariff Order Section, 1616 P Street, N.W., Washington, DC 20036.)

MIL-C-81945A(AS)

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Qualification. Coating compounds furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.5 and 6.3).

3.2 Toxicity. The materials shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the procuring activity to the appropriate departmental medical service who will act as an advisor to the procuring agency (see 4.3).

3.3 Performance characteristics.

3.3.1 Application. When used according to the manufacturer's directions, the coating compounds shall be usable by the intended application method.

3.3.1.1 Application, Type I. The coating shall be sprayable and yield a minimum dry film thickness per coat of 0.060 +0.010 -0.000 inch [1.5 +0.25 -0.00 millimeter (mm)] on a vertical surface. The coating shall show no streaking, sag, cracking, or pronounced orange-peel (see 4.8.8.1).

3.3.1.2 Application, Type II. Type II material shall be easily worked with a putty knife and must be compatible with the manufacturing process used in the preparation of Type III sheet material. Type II materials are used in repairing Type III material.

MIL-C-81945A(AS)

3.3.1.3 Application, Type III. Type III materials shall be capable of being bonded to the curved surface of ordnance items.

3.3.2 Thermal efficiency. The thermal efficiency of the coating compound shall not be less than 2.0 seconds per 0.001 inch [25.4 micrometer, (μm)] to reach a backface temperature of 260° C (500° F), see 4.8.8, before and after being subjected to the humidity test of 4.8.15.

3.3.3 Adhesion. Panels tested as specified in 4.8.11, when bent around a mandrel 1 ± 0.003 inch ($25.4 \pm 0.08\text{mm}$) in diameter, shall not exhibit adhesive failure from the epoxy polyurethane primer or topcoat. Cracking of the coating is acceptable and shall not be cause for rejection.

3.3.4 Impact resistance. The cured coating system (see 4.7) impact resistance when tested as specified in 4.8.14.2 shall not be less than 100 inch-pounds on direct (coated surface) impact.

3.3.5 Coated ordnance environmental performance. The coating system applied to ordnance items (see 4.7.7) shall pass the temperature and humidity cycling, transportation vibration and abrasion, and aircraft vibration environmental tests specified in 4.8.18 without evidence of loss of adhesion, blistering, flaking, or cracking to the substrate.

3.3.6 Fast cook-off. The ordnance specimen coated as specified in 4.7.7 shall meet the requirements of the fast cook-off test specified in MIL-STD-1648 (see 4.8.19).

3.4 Environmental requirements.

3.4.1 Storage stability. After storage in closed containers for six months from the date of manufacture, Type I and Type II coatings shall conform to the original chemical and physical properties (see 3.5). In addition, Type III coatings shall meet the requirements of 3.3.2 through 3.3.6 for a period of at least five years.

3.4.2 Lubricating oil resistance. The cured coating compound shall withstand immersion in oil for a period of 4 hours at a temperature of $60^\circ \pm 2^\circ\text{C}$ ($140^\circ \pm 4^\circ\text{F}$). Four hours after removal, the coating shall show no blistering, softening, or other defects (see 4.8.12).

3.4.3 Fungus resistance. The cured coating system (see 4.7) shall be non-nutrient (see 4.8.13).

MIL-C-81945A(AS)

3.4.4 Humidity resistance. The cured coating system (see 4.7) after testing as specified in 4.8.15, shall have a minimum Shore D hardness of 65 upon removal of the panels from the cabinet (see 4.8.10.2).

3.4.5 Temperature shock resistance. There shall be no evidence of cracking, loss of adhesion, or film deterioration of the coating system (see 4.7) when tested as specified in 4.8.16.

3.4.6 Weather resistance. There shall be no evidence of cracking or loss of adhesion of the coating after six months exposure as specified in 4.8.17. After exposure, the thermal efficiency of the coating shall not be less than 1.7 seconds per 0.001 inch (25.4 μm) to reach a back-face temperature of 260°C (500°F). Subjection of the panels to the humidity test after exposure shall not be required.

3.5 Chemical and physical properties.

3.5.1 Condition in container.

3.5.1.1 Type I and Type II. Components shall mix easily to a smooth homogeneous condition. There shall be no trace of grit, seeds, skins, or lumps and no evidence of hard or objectionable settling which cannot be readily dispersed. No more than 0.1% by weight of each component shall be retained on United States Standard Sieve (USSS) No. 40 (see 4.8.4).

3.5.1.2 Type III coatings. The intumescent sheets shall bend to conform to the curvature of the ordnance items they are to be applied to and shall have no curling, shrinkage, discoloration, lumps, or voids that would interfere with their application or effectiveness (see 4.8.6). The outside surface of the Type III coating shall be covered with .002 inch thickness of plastic, L-P-1040, Type II, Grade B, Class I.

3.5.2 Hardness. Panels prepared as specified in 4.8.8.1 shall be cured at 23° \pm 2°C (73° \pm 8°F) and the coating shall conform to the following hardness requirements:

<u>Time/Hours</u>	<u>Minimum Shore A Hardness</u>
6	25
24	80
48	92
72	94

MIL-C-81945A(AS)

3.5.3 Tensile properties. The minimum tensile properties of the coating compound when tested as specified in 4.8.9 shall be as follows:

<u>TEMPERATURE</u> <u>(°C)</u>	<u>ULTIMATE STRENGTH</u> <u>(psi)</u>	<u>ELONGATION AT BREAK</u> <u>(percent)</u>
-40	2550	1.7
20	450.0	3.2
60	70.0	7.0

3.5.4 Type III dimensional properties. Size shall be as specified in contract or purchase order (see 6.2.1).

3.6 Component requirements.

3.6.1 Composition. The coating compound furnished under this specification consists of two separately packaged components. Component I shall consist of an epoxy modifier and curing agent, with thermally activated fillers, diluent and a thixotrope. Component II shall consist of an epoxy resin with active fillers, thixotrope and diluent.

3.6.2 Formulation. When Components I and II are mixed in the following ratio, a coating compound meeting the requirements of this specification shall result.

<u>Component</u>	<u>Parts by Weight</u>
I	129
II	100

3.6.3 Toxicity. The materials shall have no adverse effect on the health of personnel when used under the conditions specified in 4.8.7. Questions pertinent to this effect shall be referred by the procuring activity to the appropriate department medical service who will act as an advisor to the procuring activity.

3.6.4 Component I. Component I shall conform to the requirements specified in 3.4.1, 3.5.1 and Table I.

3.6.5 Component II. Component II shall conform to the requirements specified in 3.4.1, 3.5.1 and Table II.

MIL-C-81945A(AS)

TABLE I. Component I requirements.

Characteristics	Requirements		Test Paragraph
	Minimum	Maximum	
Viscosity, Centipoises	13,000	35,000	4.8.1
Weight Per Gallon, Pounds	11.0	11.6	4.8.2
Nonvolatile Content, Percent by Weight	85.0	91.0	4.8.3

TABLE II. Component II requirements.

Characteristics	Requirements		Test Paragraph
	Minimum	Maximum	
Viscosity, Centipoises	13,000	29,000	4.8.1
Weight Per Gallon, Pounds	11.0	11.6	4.8.2
Nonvolatile Content, Percent by Weight	85.0	95.0	4.8.3

3.6.6 Color. The components shall be supplied in the manufactured color. When admixed in the ratio specified in 3.6.2, the resultant color of the coating shall range from light yellow to amber.

3.7 Data. The manufacturer shall prepare test reports for each lot showing the results for all of the tests specified in Table III (see 6.2.2).

3.8 Workmanship. Each coating shall be uniform in consistency and free of agglomerates or foreign particles. There shall be no other defects present that would render the end product unsuitable for its intended purpose (see 4.6.4).

MIL-C-81934A(AS)

TABLE III. Qualification and inspection.

Inspection	Requirement Paragraph	Test Method Paragraph	Qualification Testing	Quality Conformance Inspection
<u>EACH COMPONENT</u>				
Color	3.6.6		Yes	Yes
Viscosity	3.6.4	4.8.1	Yes	Yes
Density	3.6.5	4.8.2	Yes	Yes
Nonvolatile content	3.6	4.8.3	Yes	Yes
Condition in container	3.5.1	4.8.4	Yes	Yes
Storage stability	3.4.1	4.8.5	Yes	---
<u>AS USED</u>				
Physical characteristics 1/	3.5.1.2	4.8.6	Yes	Yes
Container fill		4.6.4.1	---	Yes
Workmanship	3.7	4.6.4.2	---	Yes
Packaging		4.6.5	---	Yes
Application	3.3.1	4.8.7	Yes	Yes
Thermal efficiency	3.3.2	4.8.8	Yes	---
Tensile properties	3.5.3	4.8.9	Yes	---
Hardness	3.5.2	4.8.10	Yes	Yes
Adhesion	3.3.3	4.8.11	Yes	Yes
Lubricating oil resistance	3.4.2	4.8.12	Yes	Yes
Fungus resistance	3.4.3	4.8.13	Yes	---
Impact resistance	3.3.4	4.8.14	Yes	---
Humidity resistance	3.4.4	4.8.15	Yes	---

MIL-C-81945A(AS)

TABLE III. Qualification and inspection. - Continued

Inspection	Requirement Paragraph	Test Method Paragraph	Qualification Testing	Quality Conformance Inspection
Temperature shock resistance	3.4.5	4.8.16	Yes	---
Weather resistance	3.4.6	4.8.17	Yes	---
Environmental performance tests:	3.3.5	4.8.18	Yes	---
Temperature and humidity cycling	3.3.5	4.8.18.1	Yes	---
Transportation vibration and abrasion	3.3.5	4.8.18.2	Yes	---
Aircraft vibration	3.3.5	4.8.18.3	Yes	---
Fast cook-off	3.3.6	4.8.19	Yes	---

1/ Type III material only.

MIL-C-81945A(AS)

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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 assure supplies and services conform to prescribed requirements.

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

- a. Qualification inspection (see 4.5).
- b. Quality conformance inspection (see 4.6).

4.3 Toxicological data and formulations. The contractor shall furnish the toxicological data and formulations required to evaluate the safety of the material for the proposed purpose (see 6.2.2).

4.4 Inspection conditions. All inspections shall be performed in accordance with the test conditions as described herein.

4.5 Qualification inspection. Qualification inspection shall be as specified in Table III and performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures to be used in production.

4.5.1 Qualification samples. Qualification samples shall consist of wet samples and test panels necessary for performing the test specified in Table III. Test panels shall be prepared by the spraying method Type I, the casting method for Type II or the adhesive method Type III material, see 4.7.1 to 4.7.6. Wet samples shall consist of two gallons (7.5 liters) of coating compound. In addition, the contractor shall submit wet (one pint, 0.5 liter) and dry (one pound, 0.5Kg) samples of each ingredient material used in the formulation of the coating. The

MIL-C-81945A(AS)

samples shall be representative of the components and materials to be used during production. The samples shall be legibly marked with the following information:

- a. Coating, Weapon Insulation, Intumescent.
- b. Component Number (if applicable).
- c. Specification MIL-C-81945(AS).
- d. Type (I, II, or III as applicable).
- e. Coating thickness, Type III only.
- f. Name and address of manufacturer.
- g. Location and identity of the plant which produced the samples.
- h. Manufacturer's identification.
- i. Submitted by (name) (date) for qualification tests in accordance with MIL-C-81945(AS) under authorization of (reference authorizing letter) (see 6.3).

4.5.2 Failures. One or more failures of the test in Table III shall be cause for refusal to grant qualification approval.

4.5.3 Retention of qualification. Certification shall be requested from each manufacturer and forwarded to the preparing activity for those specifications which do not contain a requirement for retention of qualification by testing. Certification shall be at the time of the two year review and shall be signed by a responsible official of management, attesting that the listed product(s) is still available from the listed plant, can be produced under the same conditions as originally qualified; i.e., same process, materials, construction, design, manufacturer's part number or designation; and meets the requirements of the current issue of the specification. Failure to provide the certification will be cause for removal from the QPL (see 6.2.2).

4.6 Quality conformance inspection. Quality conformance inspection shall consist of data, examinations specified in 4.6.4 and 4.6.5, and the tests specified in Table III.

MIL-C-81945A(AS)

4.6.1 Inspection lot. An inspection lot shall consist of all the coating compound of the same type produced under essentially the same conditions during one days production.

4.6.2 Sampling.

4.6.2.1 Sampling plan. Sampling for quality conformance inspection shall be at random from filled containers. The sample shall be sufficient in size to conduct all required tests.

4.6.2.2 Sampling plan for visual inspection of filled containers. A random sample of filled containers shall be selected in accordance with MIL-STD-105, Inspection Level S-4, Acceptable Quality Level (AQL) of 2.5 percent for examination as specified in 4.6.4 and 4.6.5.

4.6.3 Failures. If a test specimen fails to meet any of the tests required by this specification, the lot represented by the sample shall be rejected.

4.6.4 Visual examinations.

4.6.4.1 Examination for container fill. The samples selected as specified in 4.6.2.1 shall be examined for package fill. Any package having less than the specified amount shall be rejected. If the number of defective packages exceeds the AQL of 2.5 percent, the lot represented by the sample shall be rejected.

4.6.4.2 Examination of product. The samples selected as specified in 4.6.2.2 shall be examined for workmanship. Defective packages shall be rejected.

4.6.5 Examination of packaging. The samples selected as specified in 4.5.1 shall be examined for packaging, packing, marking, and labeling. Any package having one or more defects shall be rejected. If the number of defective packages exceeds the AQL of 2.5 percent, the lot represented by the sample shall be rejected. The contractor may rework the lot to correct the defects or screen out the defective units, and resubmit for reinspection where applicable.

4.7 Test specimens.

4.7.1 Test panels. Except as otherwise specified herein, test panels shall be 6061 aluminum alloy conforming to QQ-A-250/11, condition T-6. The panels shall be 0.040 by 4 by 12 inches (1 by 100 by 300mm)

MIL-C-81945A(AS)

in size and treated with materials conforming to MIL-C-81706, Class 1A, to produce coatings conforming to MIL-C-5541, Class 1A.

4.7.2 Primer. Epoxy-polyamide primer conforming to MIL-P-23377 Type I shall be applied to the panels of 4.7.1 to a dry film thickness of 0.006 to 0.008 inch (15 to 20 μ m) and then cured for 1 to 1-1/2 hours at 70° \pm 3°C (160° \pm 5°F).

4.7.3 Insulating coating compound Type I (spray method). Application of the coatings and preparation of the panels shall be as follows:

- a. Test panels prepared as specified in 4.7.1.
- b. Epoxy primer applied as specified in 4.7.2.
- c. Insulating coating compound sprayed (Type I) to a film thickness 0.130 \pm 0.010 inch (3.30 \pm 0.25mm). Air dry 48 hours prior to application of the topcoat.
- d. Polyurethane topcoat applied as specified in 4.7.6.

4.7.4 Insulating coating compound Type II (casting method). Coating compounds shall be mixed in accordance with the manufacturer's instructions. With a doctor blade, spread to a thickness of 0.060 inch \pm 0.010 -0.000 inch [1.5 \pm 0.25 -0.00 (mm)] on the prepared surface of the test panels. Except for panels prepared for the determination of hardness (3.5.2), all other panels shall be conditioned for a minimum of 7 days at 23° \pm 2°C (73° \pm 8°F) prior to test.

4.7.5 Insulating coating compound Type III (adhesive method). The Type III material shall be adhered to test panels prepared as specified in 4.7.1 and 4.7.2 using manufacturer approved methods or methods required by the procuring activity (see 6.2.1).

4.7.6 Topcoat. Test panels of 4.7.1 requiring topcoating for tests specified herein shall be coated by conventional spray application with coating conforming to MIL-C-81773, Type II, insignia white (color number 17875). Apply the topcoat to produce a dry film thickness of 0.001 to 0.002 inch (30 to 51 μ m).

4.7.7 Application of coatings to the ordnance specimen. Application of the coating to the ordnance specimen shall be in accordance with applicable drawings, specifications and standards for the ordnance item being tested.

MIL-C-81945A(AS)

4.8 Test methods.

4.8.1 Viscosity. Each separate component (and the mixed component of multi-component coatings) shall be tested in accordance with ASTM D 2196. The test shall be conducted within ten minutes after mixing (before settling or solvent migration can occur).

4.8.2 Density. The density of each component shall be determined in accordance with ASTM D 1475.

4.8.3 Nonvolatile content. The nonvolatile content of each component shall be determined in accordance with Method 4042 of FED-STD-141, except use an oven temperature of $50^{\circ} \pm 1^{\circ}\text{C}$ ($122^{\circ} \pm 2^{\circ}\text{F}$) for 30 minutes and omit the addition of the solvent toluene.

4.8.4 Condition in container.

4.8.4.1 Type I and Type II coatings. Each component shall be stirred. The presence of coarse particles shall be determined by pouring a weighed sample of the material into a No. 40 sieve and washing it through the screen with ample amounts of toluene. The weight of the solid particles retained on the sieve shall be compared to the weight of the original sample.

4.8.4.2 Type III intumescent sheet. The sheets shall show no shrinkage, curling, warping, delamination, or surface changes that prevent them from being applied using approved methods (see 4.7.5 and 6.1).

4.8.5 Storage stability. Unopened containers of each component shall be stored for six months at temperatures of $18^{\circ} \pm 14^{\circ}\text{C}$ ($65^{\circ} \pm 25^{\circ}\text{F}$), remixed thoroughly, and tested for conformance to component requirements (see 3.6).

4.8.6 Physical characteristics of Type III coating. Unless otherwise specified in the contract or purchase order, inspection, test and repair procedures for assurance of physical characteristics shall be prepared by the contractor. Inspect the sheets to verify material size and conformance as specified in the contract or purchase order. The procedures shall include those necessary to ensure that Type III sheets meet the requirements of 3.5.1.2 (see 3.5.4 and 6.2.2).

MIL-C-81945A(AS)

4.8.7 Application.

4.8.7.1 Type I (sprayable coating). Component I and II material shall be spray applied in the ratio specified in 3.6.2 with the two component high pressure airless spray equipment manufactured by the Gray Company (GRACO), model No. FSQ-1700 or equivalent in performance thereto.

CAUTION:

Do not attempt to mix Components I and II for spray-up as a one component system.
Do not attempt to adjust viscosity by addition of solvent, thinner or any other diluent or material.

4.8.7.2 Type II (trowellable coating). Type II material shall be easily worked with a putty knife and must be compatible with the manufacturing process used in the preparation of Type III sheet material. Type II materials are used in repairing Type III material and filling gaps during the application process.

4.8.7.3 Type III (adhesive bonded). Type III material shall adhere to ordnance items using methods as specified in MIL-STD-2098(AS).

4.8.8 Thermal efficiency.

4.8.8.1 Panel preparation. Prepare eight panels each 0.040 by 8 by 8 inches (1 by 200 by 200mm) in size and eight discs each 1-15/16 inch (48mm) in diameter by 0.040 inch (1mm) in thickness from aluminum (6061) sheets conforming to QQ-A-250/11, Condition T-6. Cut a 2-inch (50mm) hole in the center of each panel and cement the discs in the holes with a metal-to-metal type epoxy bonding compound capable of withstanding high temperatures. (Cementing the discs in the panels reduces thermal conductance effects from the edges.) The test panels shall be primed as specified in 4.7.2 and coated with the insulating coating compound by spraying (Type I), trowelling (Type II), or adhesive bonding (Type III). Type I coating shall be machined to uniform film thickness of 0.130 ± 0.010 inch (3.30 ± 0.25 mm). Prior to testing, spray the topcoat over the (Type I or Type II) compound as specified in 4.7.6. Type III compound does not require a topcoat. Save three panels for the humidity resistance test (4.8.15) and two panels for the weather resistance test (4.8.17).

MIL-C-81945A(AS)

4.8.8.2 Procedure. This test exposes the coating to a fire environment where a total flux of $10 \text{ BTU/Ft}^2 - \text{sec}$ [$113.5 \text{ kilowatt per meter}^2$ (kW/m^2)] as measured by an asymptotic calorimeter is 90 percent radiative in a slightly fuel rich condition. The average emissivity of the source of the radiant heat flux shall be at least equal to 0.9. Aviation fuel (JP-4 or JP-5) conforming to MIL-T-5624 shall be used to fire the unit. The coated panel thickness shall be measured and recorded. When ready to test, the panel shall be inserted in a transite mask or any thermally insulated holder which allows the panel to rest on the outer $1/16$ to $1/18$ inch (1.5 to 3mm) of the coated surface. The backside of the test panel shall be insulated with 6 lbs/ft^3 [$96 \text{ kilogram per meter}^3$ (kg/m^3)] refractory fiber insulation. At time, $T = 0$, the masked panel shall be placed over the fire box and a thermocouple in contact with the back of the disc records the temperature rise on the panel. The maximum initial panel temperature prior to fire testing shall be 32°C (90°F). The flux shall be uniform over the entire panel and the center disc shall be approximately 8-10 percent of the exposed area and shall be representative of a larger, semi-infinite panel. The time-temperature data and the film thickness shall be recorded and a report made of the time, in seconds, to reach a backface temperature of 260°C (500°F) for the recorded thickness of the coating. The test results shall conform to 3.3.2 and the data reported shall be an average of three determinations (see 6.2.2).

4.8.9 Tensile properties. The tensile properties shall be determined in accordance with ASTM D 638 at -40° , 25° , and 60°C (-40° , 75° , and 140°F). The tension test specimen dimensions shall meet the requirements of Type I for a $1/4$ -inch maximum sheet, Figure 1011A, 0.125 inch thick.

4.8.10 Hardness.

4.8.10.1 Shore A hardness. Two panels shall be prepared as specified in 4.7.1 through 4.7.3 except disregard the 48-hour cure period of 4.7.3. The casting method shall be employed to form a uniform coating thickness of $0.060 +0.010 -0.000$ ($1.50 +0.25 -0.00\text{mm}$). The coated panels shall be cured at $20^\circ \pm 3^\circ\text{C}$ ($70^\circ \pm 5^\circ\text{F}$) and the hardness determined at each time interval of 3.5.2 in accordance with Method 1082 of FED-STD-406.

4.8.10.2 Shore D hardness. Three coated panels of 4.8.15 shall be cooled to room temperature, and the Shore D hardness shall be determined in accordance with Method 1083 of FED-STD-406. Check for conformance to 3.4.4.

MIL-C-81945A(AS)

4.8.11 Adhesion. Panels shall be aluminum alloy conforming to QQ-A-250/5, 0 Condition, and anodized in accordance with MIL-A-8625, Type II. They shall be 0.020 by 5 by 12 inches (0.5 by 125 by 300mm) in size and finished with the primer and coating compounds specified in 4.7. The panels shall be tested in accordance with Method 6221 of FED-STD-141 using and checked for conformance to 3.3.3.

4.8.12 Lubricating oil resistance. Panels shall be prepared as specified in 4.7. The panels shall then be immersed in lubricating oil composed of 95 percent of di-2 ethyl-hexyl sebacate, and 5 percent tricresyl phosphate, by weight, at a temperature of $60^{\circ} \pm 2^{\circ}\text{C}$ ($140^{\circ} \pm 4^{\circ}\text{F}$) for a period of 4 hours. Four hours after removal, the panels shall be examined for conformance to 3.4.2.

4.8.13 Fungus resistance. Panels shall be prepared as specified in 4.7 and tested for resistance to fungus in accordance with Method 508.1, Procedure I of MIL-STD-810. Upon completion of the fungus test, check for conformance to 3.4.3.

4.8.14 Impact resistance.

4.8.14.1 Panel Preparation. Panels shall be aluminum alloy conforming to QQ-A-250/5, 0 Condition, and anodized in accordance with MIL-A-8625, Type II. They shall be 0.020 by 5 by 12 inches (0.5 by 125 by 300mm) in size, and finished as follows: Apply epoxy primer, coating compound and topcoat as specified in 4.7.7.

4.8.14.2 Impact Test. The impact resistance shall be determined in accordance with ASTM D 2794. Panels from 4.8.14 shall be used with the film side up. Check for conformance to 3.3.4.

4.8.15 Humidity resistance. Three panels prepared as specified in 4.8.7.1 shall be subjected to 336 hours of exposure at 100 percent relative humidity at 49°C (120°F) in accordance with the method specified in ASTM D 1748. Determine the Shore D hardness in accordance with 4.8.10.2.

4.8.16 Temperature shock resistance. Three panels prepared as specified in 4.7 shall be tested in accordance with Method 503.1 of MIL-STD-810 except as follows:

- a. The internal hot chamber shall be maintained at 60°C (140°F) and 95 percent relative humidity.

MIL-C-81945A(AS)

- b. The internal cold chamber temperature shall be -40°C (-40°F).
- c. Panels shall be cycled every 24 hours in lieu of every 4.
- d. The complete test period shall be 28 days.

4.8.17 Weather resistance. Two panels shall be prepared as specified in 4.7.1 through 4.7.6 and exposed outdoors in accordance with ASTM D 1014 in the vicinity of Miami, Florida for 12 continuous months. The panels shall be mounted at 45 degrees facing south. After exposure, the panels shall be checked for conformance to 3.4.6 and subjected to the thermal efficiency test.

4.8.18 Environmental performance. The coated ordnance items, configured as all up rounds, of 3.3.5 shall be subjected to the tests of 4.8.18.1 through 4.8.18.3 and checked for conformance to 3.3.5.

4.8.18.1 Temperature and humidity cycling. Ordnance items shall be in the shipping configuration when tested. Testing shall be in accordance with WR-50 except that the temperatures shall be modified to 60°C (140°F), 95 percent relative humidity and -40°C (-40°F).

4.8.18.2 Transportation vibration and abrasion test. Ordnance items shall be in the shipping configuration when tested. Testing shall be in accordance with MIL-STD-810, Method 514.2, equipment category g, Procedure X, Table 514.2-VII, Figure 514.2-7, and Curve (AV:AW). The ordnance items shall be tested at standard ambient conditions (MIL-STD-810), 60°C and -40°C (140°F and -40°F), in that order.

4.8.18.3 Aircraft vibration test. The ordnance items shall be in the flight configuration and tested at standard ambient conditions (MIL-STD-810) and at -40°C (-40°F). The test procedure and time schedule shall be in accordance with MIL-STD-810, Method 514.2, equipment category (b.1), Procedure I, Table 514.2-II, and Curve H of Figure 514.2-2.

4.8.19 Fast cook-off. The fast cook-off test shall be conducted in accordance with MIL-STD-1648, except that the pass/fail criteria shall

MIL-C-81945A(AS)

be established by the procuring activity. In addition, the following shall apply:

- a. The quantity of fuel shall be sufficient to cause reaction of the ordnance or to ensure a 15-minute fire. Test fuel shall be JP-4 or JP-5 conforming to MIL-T-5624.
- b. The test pit shall not be less than 20 by 20 feet (6.1 by 6.1 meters).
- c. Flame temperature to the ordnance shall reach 538°C (1000°F) within 30 seconds after fire ignition.
- d. The ordnance specimen shall be suspended from its suspension lugs with its center 30 to 40 inches (.75 to 1.0 m) above the fuel.
- e. The test shall not be performed when the wind velocity exceeds 5 knots (2.5 meters per second).

4.8.20 Color. The coating compound shall be visually examined for conformance to 3.6.6.

5. PACKAGING

5.1 Packaging. Packaging shall be Level A or C as specified in the contract or purchase order (see 6.2).

5.1.1 Level A. Coating compound components shall be packaged in pails conforming to PPP-P-704, Type II, Class 3; or Type III, Class 3 or 4; or in drums conforming to PPP-D-729, Type IV; or in drums conforming to PPP-D-711, Type III, as specified by the procuring activity (see 6.2). The inside surface of the pail or drum shall be treated as required to preclude content contamination.

5.1.2 Level C. Coating compound components shall be packaged in unit capacity containers in accordance with the supplier's commercial practice.

5.2 Packing. Packing shall be Level A or C as specified in the contract or purchase order (see 6.2).

MIL-C-81945A(AS)

5.2.1 Level A. Coating compound components packaged in pails or drums as specified in 5.1.1 shall be palletized in accordance with MIL-STD-147.

5.2.2 Level C. Material packaged as specified in paragraph 5.1.2 shall be packed in such a manner that will ensure acceptance by common carrier at lowest rates and safe delivery at destination. Shipping containers shall comply to the Uniform Freight Classification Rules or National Motor Freight Classification Rules, as applicable.

5.2.3 Storage of Type III material. MIL-C-81945 Type III pre-cured sheet shall be stored flat, horizontal with release film covering the entire area between stacked sheets. Storage and shipping shall be maintained between 16°C to 32°C (60°F to 89°F) at all times.

5.3 Labeling. Individual containers of Type I and Type II coating shall be labeled with the following warning label:

WARNING

Contact may cause skin irritation and should be avoided. Wash thoroughly with soap and water if contact occurs. If contact with eyes occurs, flush repeatedly with water and obtain medical attention.

5.4 Marking. Marking for shipment shall be in accordance with MIL-STD-129 and shall include the following nomenclature and information:

Component Identification, as applicable
Manufacturer's Name or Trademark
Date Manufactured, Month and Year
Lot Number
Net Contents
Specification MIL-C-81945(AS)
Flash Point (In accordance with ICC Regulations) (Type I and Type II only)
Dimensions, Type III only

6. NOTES

6.1 Intended use. The thermal insulating coating compounds are intended for use as exterior protective coatings on aircraft ordnance

MIL-C-81945A(AS)

items. These coatings are formulated to meet applicable environmental conditions and also to delay an explosive reaction when coated ordnance items are exposed to high flux thermal environments. Usage of the coating compounds requires a topcoat in the specified color. Type I compound is intended for spray application. Type II compound is intended for use as a hard trowelled repair compound and for use in manufacturing. Type III coating is a solid sheet material manufactured from Type II coating or other intumescent materials. Type III coating is intended to be adhered to the ordnance item in accordance with MIL-STD-2098(AS).

6.2 Ordering data.

6.2.1 Procurement requirements. Procurement documents should specify the following:

- a. Title, number and date of this specification
- b. Type of compound (see 1.2 and 6.1)
- c. Level of packaging and packing (see Section 5)
- d. Quantity in gallons (liters), Type I and Type II materials only (see 5.1.1)
- e. Size (length, width, thickness), Type III materials only (see 3.5.4)
- f. The manufacturer's approved application instructions for Type III materials shall be obtained if such instructions have not been provided by other activities (see 4.7.5).
- g. Fast cook-off pass/fail criteria (see 4.8.19).

6.2.2 Data requirements. When this specification is used in a procurement which incorporates a DD Form 1423 and invokes the provisions of 7-104.9(n) of the Defense Acquisition Regulations, the data requirements identified below will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (DD Form 1423) incorporated into the contract. When the provisions of DAR-7-104.9(n) are not invoked, the data specified below will be delivered by the contractor

MIL-C-81945A(AS)

in accordance with the contract requirements. Deliverable data required by this specification is cited in the following paragraphs:

Paragraph	Data Requirement	Applicable DID
3.7, 4.8.8.2	Data, test reports	DI-T-2072
4.3	Toxicological data and formulations	UDI-R-23584
4.5.3	Retention of qualification	UDI-T-23937
4.8.6	Inspection, test and repair procedures	DI-T-5248

(Copies of data item descriptions required by the contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, 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 orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command; however, information pertaining to qualification of products may be obtained from the Commanding Officer, U.S. Naval Air Development Center, Warminster, Pennsylvania 18974, Attention: Code 60622.

6.4 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing Activity
Navy - AS
(Project 8010-N-179)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(MIL) Approval
No. 22-R255

INSTRUCTIONS: The purpose of this form is to solicit beneficial comments which will help achieve procurement of suitable products at reasonable cost and minimum delay, or will otherwise enhance use of the document. DoD contractors, government activities, or manufacturers/vendors who are prospective suppliers of the product are invited to submit comments to the government. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements. Attach any pertinent data which may be of use in improving this document. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity.

DOCUMENT IDENTIFIER AND TITLE

MIL-C-81945A(AS) Coating Compounds, Weapon Insulation, Intumescent

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?

☐ YES ☐ NO (If "Yes", in what way?)

4. REMARKS

SUBMITTED BY (Printed or typed name and address - Optional)

TELEPHONE NO.

DATE

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