

MIL-C-81904A(AS)

22 August 1973
SUPERSEDING
(See Section 6)

MILITARY SPECIFICATION

COATING COMPOUND, THERMAL INSULATION, ABLATIVE

This specification has been approved by the Naval
Air Systems Command, Department of the Navy.

1. SCOPE

1.1 Scope. This specification covers a two-component, solventless, sprayable, thermal insulating compound for coating the exterior surfaces of explosive-loaded ordnance to provide protection from high-flux thermal environments.

* 1.2 Classification. This specification covers one grade of thermal insulating compound furnished in the following colors as specified (see 6.2):

Olive Drab - FED-STD-595 Color No. 24087
Insignia White - FED-STD-595 Color No. 27875

* 2. APPLICABLE DOCUMENTS

2.1 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

QQ-A-250/5	Aluminum Alloy, Alclad 2024, Plate and Sheet
QQ-S-698	Steel, Sheet and Strip, Low Carbon
TT-C-490	Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings
PPP-D-729	Drums, Metal, 55 Gallon (For Shipment of Non-corrosive Materials)

FSC 8010

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SPECIFICATIONS

Federal (Continued)

PPP-P-704 Pail, Shipping, Steel (1 Through 12 Gallon)

Military

MIL-T-5624 Turbine Fuel, Aviation, Grades JP-4 and JP-5

MIL-A-8625 Anodic Coatings, For Aluminum and Aluminum Alloys

MIL-P-52192 Primer Coating, Epoxy

MIL-M-81351 Methyl Ethyl Ketone Peroxide

STANDARDS

FederalFed. Test Method
Std. No. 141 Paint, Varnish, Lacquer and Related Materials,
Methods of Inspection, Sampling and TestingFed. Test Method
Std. No. 406 Plastics, Methods of Testing

FED-STD-595 Colors

MilitaryMIL-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 Inch x 48 Inch Pallets, Skids, Runners,
or Pallet Type Base

MIL-STD-810 Environmental Test Methods

DRAWINGSDepartment of the Navy

4902393 Naval Air Systems Command, Body Assy, Bomb,
GP, 500 Pound, Thermally Protected MK 82
MOD 2, Loaded

PUBLICATIONSDepartment of the Navy

WR-50 Warhead Safety Tests, Minimum For Air, Surface
and Underwater Launched Weapons

OD-45406 Instructions for the H-6 Explosive Loading of the
Thermally Protected Bomb, MK 82, Mod 2, GP500

NWC TP4143 Storage Temperatures of Explosives in Hazard
Magazines, Part IV, Continental U. S. A.

(Copies of specifications, standards, drawings and publications required by suppliers 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 1748 Rust Protection By Metal Preservatives in the
Humidity Cabinet

ASTM D 2471 Gel Time and Peak Exothermic Temperature of
Reacting Thermosetting Plastic Compositions

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

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CODE OF FEDERAL REGULATIONS

49 CFR 171-179

Department of Transportation
Hazardous Materials Regulations

(The Department of transportation regulations are a part of the Code of Federal Regulations available from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402. Orders for the above publication should cite "49 CFR 171-179".)

3. REQUIREMENTS

3.1 Qualification. The coating compound(s) 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 4.3 and 6.3). Any change in the formulation of a qualified product will necessitate its requalification. The material supplied under the contract shall be identical, within manufacturing tolerances, to the product receiving qualification.

3.2 Composition. The coating compound furnished under this specification shall consist of two separately packaged components. Component I shall consist of a pigmented, solventless, sprayable polyester resin. Component II, the catalyst, shall consist of a modified methyl-ethyl-Ketone peroxide.

3.2.1 Formulation. When Component I and Component 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 (Resin)	55
II (Catalyst)	1

3.3 Toxicity. The material shall have no adverse effect on the health of personnel when used under the conditions specified in 5.3.1.1 and 5.3.1.2. 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.

3.4 Component requirements.

3.4.1 Component I (Resin). Component I shall conform to the requirements specified in Table I and 3.4.1.1 through 3.4.1.3.

* 3.4.1.1 Condition in container. Component I, when stored in a closed container at $65 \pm 25^{\circ}\text{F}$ at anytime within 3 months from the date of receipt of the material, shall be capable of being easily mixed by hand with a paddle to a smooth homogeneous condition. There shall be no trace of pigment flotation, grit, seeds, skins or lumps and no evidence of hard or objectionable settling which cannot be readily dispersed. When stored in bunkers as specified in 3.4.1.2, Component I shall be capable of being easily mixed during the 6 month storage period and shall

spray satisfactorily as specified in 3.5.2. Skinning will be permitted provided its removal or other imperfections do not effect the sprayability of the material.

* TABLE I. COMPONENT I REQUIREMENTS

Characteristics	Requirements				Test Paragraph
	Olive Drab		Insignia White		
	Minimum	Maximum	Minimum	Maximum	
Viscosity, 150 ±2°F, Centipoises	50,000	100,000	20,000	45,000	4.6.2.1
Acid Number	5.0	9.0	5.0	9.0	4.6.2.2
Weight Per Gallon, Pounds	11.4	11.8	11.4	11.8	4.6.2.3
Ash Content, percent by Weight	27.5	31.5	27.5	31.5	4.6.2.4

* 3.4.1.2 Storage stability. The previously unopened packaged Component I product shall meet all the requirements specified in Table I and 3.4.1.1 when stored at 65 \pm 25°F for a minimum period of 3 months from the date the product is received by the procuring activity. The Component I packaged material shall also meet Table I and 3.4.1.1 requirements when stored for a minimum period of 6 months in bunkers having an average annual temperature of 55 to 60°F, with average maximums of 77°F and average minimums of 35°F as defined in publication NWC TP4143.

3.4.1.3 Accelerated stability. A full unopened can of Component I when exposed as specified in 4.6.2.7 shall meet the requirements of Table I and 3.4.1.1.

3.4.2 Component II (Catalyst). Component II shall conform to the requirements of 3.4.2.1 and MIL-M-81351 with the exceptions noted in Table II.

TABLE II. COMPONENT II REQUIREMENTS

CHARACTERISTICS	REQUIREMENTS
Active Oxygen (Minimum)	9.5 Percent
Specific Gravity, 25°C (Minimum)	1.1
Refractive Index, 25°C (Minimum)	1.45
Flash Point and Viscosity	Not Required

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- * 3.4.2.1 Storage stability (Component II). The previously unopened packaged Component II product shall meet all the requirements specified in 3.4.2 when stored at $65 \pm 25^{\circ}\text{F}$ for a minimum period of 3 months from the date the product is received by the procuring activity. Component II, when stored for a minimum period of 6 months in bunkers having an annual temperature of 55 to 60°F , with average maximums of 77°F and average minimums of 35°F as defined in publication NWC TP4143, shall meet all the requirements of MIL-M-81351 with the exceptions noted in Table II, except for the active oxygen. The active oxygen content shall be not less than 9.3 percent during the storage period from 3 to 6 months.

3.5 Working properties.

- * 3.5.1 Reaction time. Component I and Component II, when mixed at the ratio as specified in 3.2.1 shall have a reaction time of 6.5 to 11.5 minutes when tested in accordance with 4.6.4.1.

3.5.2 Application. When Components I and II are admixed at the ratio specified in 3.2.1, the coating compound shall spray to a minimum thickness of 0.08 inch without sag on a vertical surface (see 4.6.4.2). After a 30-minute cure at 125°F , the room temperature shore D hardness of the coating compound shall be a minimum of 50.

3.6 Coating properties.

3.6.1 Thermal efficiency. The thermal efficiency of the coating compound shall be a minimum of 0.7 seconds per mil to reach a backface temperature of 205°C (400°F) (see 4.6.5.1) before and after being subjected to the humidity test of 4.6.9.

- * 3.6.2 Tensile properties. The minimum tensile properties of the coating compound when tested as specified in 4.6.5.2 shall be as follows:

<u>TEMPERATURE</u> <u>($^{\circ}\text{F}$)</u>	<u>ULTIMATE STRENGTH</u> <u>(psi)</u>	<u>ELONGATION AT BREAK</u> <u>(percent)</u>
-40	5000	0.7
75	500	8.0
140	250	5.0

- * 3.6.3 Color.

3.6.3.1 Olive Drab. The color and gloss of the cured Olive Drab coating compound shall match color number 24087 of FED-STD-595 (see 4.6.5.3.1).

3.6.3.2 Insignia White. The color and gloss of the cured white coating compound shall match color number 27875 of FED-STD-595 (see 4.6.5.3.2). By photoelectric tristimulus, the minimum values shall be as follows:

A Value 75

B Value 75

C Value 75

3.6.4 Hardness. The cured coating compound shall have a minimum Shore D hardness of 55 (see 4.6.5.4).

3.6.5 Panel adhesion. The coated panel, when bent around a mandrel 1 \pm .003 inch in diameter, shall not exhibit adhesive failure (see 4.6.5.5). Cracking of the coating is acceptable and shall not be cause for rejection.

3.7 Resistance properties.

3.7.1 Lubricating oil resistance. The cured coating compound shall withstand immersion in oil for a period of 4 hours at a temperature of 250 \pm 4°F. Four hours after removal, the film shall show no blistering, film softening or other film defects. Discoloration shall not be cause for rejection (see 4.6.6).

3.7.2 Fungus resistance. Coated panels shall be non-nutrient after subjection to the fungus test specified in 4.6.7.

* 3.7.3 Impact resistance. Coated panels when tested as specified in 4.6.8 shall require more than 160 inch-pounds on direct (coated surface) impact and 25 inch-pounds minimum on reverse impact before cracking or flaking is evident.

3.7.4 Humidity resistance. The coating on the panels, specified in 4.6.9 shall have a minimum Shore D hardness of 50 upon removal of the panels from the cabinet.

3.7.5 Resistance to temperature shock. There shall be no evidence of cracking, loss of adhesion, or film deterioration of the coating compound when tested as specified in 4.6.10.

* 3.7.6 Weather resistance. There shall be no evidence of cracking or loss of adhesion of the coating after the one year exposure period specified in 4.6.11. After exposure, the coated panels shall meet the thermal efficiency requirements of 3.6.1, except that subjection of the panels to the humidity test shall not be required.

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3.8 Environmental performance requirements.

3.8.1 Fast cook-off. Three MK 82, 500-pound bombs coated with the insulation compound in accordance with Naval Air Systems Command Drawing No. 4902393 shall be nine minutes minimum to reaction when tested as specified in 4.6.12.

3.8.2 Temperature and humidity cycling. Three MK 82, 500-pound bombs coated with the insulation compound in accordance with Naval Air Systems Command Drawing No. 4902393 shall show no evidence of loss of adhesion, excessive cracking or blistering when tested as specified in 4.6.13, and shall satisfactorily meet the fast cook-off test (4.6.12). Prior to the fast cook-off test, the coated bombs shall conform to the aircraft vibration requirements of 3.8.3.

3.8.3 Aircraft vibration. The three MK 82 bombs subjected to the temperature and humidity cycling test shall show no evidence of excessive cracking, flaking or loss of adhesion after being subjected to the aircraft vibration test specified in 4.6.14.

3.9 Workmanship. Components I and II shall be processed in a manner that will produce the highest quality material necessary to meet the requirements of this specification. Each component shall be free of solvents, uniform in quality and consistency after stirring, 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.

4. QUALITY ASSURANCE PROVISIONS

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

4.2 Classification of inspection. The inspection of the coating compound shall be classified as follows:

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

4.3 Qualification.

4.3.1 Inspection. The qualification inspection of the coating compound shall consist of examinations and tests for all the requirements of this specification and a review for approval of the suppliers report of tests.

4.3.1.1 Retention of qualification. In order to retain qualification of products approved for listing on the Qualified Products List (QPL), the manufacturer shall verify by certification to the qualifying activity that his product(s) comply with the requirements of this specification. Unless otherwise specified by the qualifying activity, the time of periodic verification by certification shall be in two-year intervals from the date of original qualification.

4.3.2 Samples. Qualification test samples shall be selected as specified in Method 1021 of Fed. Test Method Std. No. 141. The sample size for each color shall consist of one gallon of Component I and 1/2 pint of Component II for preliminary tests, identified as required in the letter of authorization. In addition, one quart samples of each ingredient used in the formulations shall accompany the qualification test samples. Qualification and ingredient samples shall be forwarded to the Commanding Officer, U.S. Naval Air Development Center, Johnsville, Warminster, Pennsylvania 18974, Attention: Code 30223. (See 6.3 for further information concerning submittal of samples.) Qualification test samples shall be legibly marked with the following information:

- a. Coating compound, thermal insulation, ablative
- b. Component (I or II as applicable).
- c. Color (Olive Drab or Insignia White).
- d. Specification MIL-C-81904A(AS).
- e. Name and address of manufacturer.
- f. Location and identity of the plant which produced the samples.
- g. Manufacturer's identification.
- h. Submitted by (name) (date) for qualification tests in accordance with MIL-C-81904A(AS) under authorization of (reference authorizing letter) (see 6.3).

* 4.3.2.1 Test samples for qualification shall be submitted with a notarized report of all tests specified herein except for weather resistance and storage stability. Report of tests shall be as specified in 4.4.1.

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4.3.3 Qualification tests. The qualification tests of the coating compound shall consist of all the tests specified under 4.6 "Test methods".

4.4 Quality conformance inspection. Quality conformance inspection shall consist of all examinations of this specification and the tests specified in Table III under the column titled "Required Testing for Quality Conformance Inspection".

4.4.1 Report of tests. The manufacturer shall submit notarized test reports to the Government representative, in accordance with Method 1031 of Fed. Test Method Std. No. 141, for each batch showing the results, including numerical values when applicable, of all the tests specified herein. Reports of numerical tests listed as satisfactory are not acceptable.

4.4.2 Sampling.

* 4.4.2.1 Lot. An inspection lot shall consist of all the coating compound of the same color produced by one manufacturer during a period not to exceed 24 hours, at one plant, from the same materials, and under essentially the same manufacturing conditions provided the operation is continuous. In the event the process is a batch operation, each batch shall constitute a lot (see 6.4).

4.4.2.2 Sampling for tests. Quality conformance test samples shall consist of one gallon of Component I and 1/2 pint of Component II selected from each lot in accordance with Method 1021 of Fed. Test Method Std. No. 141. Each container shall be labeled with complete information regarding the lot and batch numbers, date of sampling, contract number and applicable specification.

4.4.2.2.1 Ingredient materials. When requested by proper authority, a sample from each lot of the ingredient materials shall be taken for test purposes.

4.4.2.3 Sampling 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 defective for examination as specified in 4.4.2.2.

4.4.3 Inspection procedures.

4.4.3.1 Tests. The quality conformance tests of the coating compound shall consist of all the tests specified in Table III and such other tests as are necessary to check the manufacturer's data. If a test specimen fails to meet any

of the tests required by this specification, the lot represented by the sample shall be rejected.

- * 4.4.3.1.1 In addition, the Government reserves the right to have any of the tests called for by this specification rerun at a Government laboratory at any time within 3 months from the date of receipt of the material by the procuring activity. For material stored in bunkers (see 3.4.1.2 and 3.4.2.1), the Government reserves the right to conduct tests at any time within 6 months from the date of receipt of the material. Samples for these tests shall be taken from a previously unopened container of the submitted acceptance sample, which shall have been stored as described in 4.6.2.6.

4.4.3.2 Examination of preparation for delivery. The samples selected in accordance with 4.4.2.3 shall be examined for packaging, packing, marking, leakage, and workmanship. Any package having one or more defects shall be rejected. If the number of defective packages exceeds the Acceptable Quality Level (AQL) of 2.5 percent defective in accordance with MIL-STD-105, the lot represented by the sample shall be rejected.

4.4.3.2.1 Examination for container fill. The size sample of 4.4.3.2 shall be adjusted to Inspection Level S-3 of MIL-STD-105 except that the sample size derived from MIL-STD-105 shall be rounded off to the next highest increment of five. At no time shall the sample size be less than five, unless the lot consists of less than five containers in which case all containers shall be used to determine the fill. The sample unit shall be one filled container. The lot shall be rejected if the average weight per container is less than that specified.

4.4.3.2.2 Examination of product. Conformance of the coating compound to the requirements for workmanship and any other requirements not covered by specific tests shall be determined by appropriate visual examination.

4.5 Test conditions. The laboratory testing conditions shall be in accordance with Fed. Test Method Std. No. 141, and as described herein.

4.5.1 Test panels. Except as otherwise specified herein, test panels 12 inches by 4 inches by 0.032 inches shall be cold-rolled carbon steel conforming to QQ-S-698, and coated with a zinc phosphate coating conforming to Type I, of TT-C-490.

4.5.1.1 Panel preparation. An epoxy primer conforming to MIL-P-52192 with the addition of 6 percent by weight of 2, 4, 6 Tri (dimethyl-amino methyl) phenol (Rohm and Haas DMP-30 or equal); based upon epoxy resin solids shall be applied to the panel to a dry film thickness of 0.6 to 0.8 mils and cured 1-1/2 hours at 275°F. The primer shall be lightly grit blasted with 80 mesh grit, or sanded with 280 mesh, wet or dry aluminum oxide paper prior to the application of the coating.

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4.5.1.2 Application of coating. Components I and II shall be mixed in the ratio as specified in 3.2.1 and, with a doctor blade, spread to a thickness of 0.060 ± 0.010 inch on the prepared surface of the test panel. Care shall be exercised to insure a uniform coating free from entrapped air bubbles or other film defects. The coated panels shall then be cured a minimum of 1/2 hour at room temperature followed by a minimum of 1 hour at $150 \pm 4^\circ\text{F}$.

NOTE

The pot life of the coating compound when admixed is approximately 4 minutes.

4.6 Test methods.

4.6.1 The tests of this specification shall be conducted as specified herein. A cross reference of requirements and applicable test methods is contained in Table III.

4.6.2 Component I (Resin) tests.

4.6.2.1 Viscosity. The viscosity of Component I shall be determined in accordance with Method 4287 of Fed. Test Method Std. No. 141 at a temperature of $150 \pm 2^\circ\text{F}$. Using a No. 6 spindle and a speed of 10 rpm, record the viscosity after 5 revolutions (30 seconds).

* 4.6.2.2 Acid number. Determine the acid number in accordance with Method 5072 of Fed Test Method Std No. 141 except for the following: The standard 0.1N potassium hydroxide solution shall be prepared by dissolving the KOH in ethyl alcohol and standardized against potassium hydrogen phthalate, and the test sample shall consist of 5 grams of material.

4.6.2.3 Weight per gallon. The weight per gallon shall be determined in accordance with Method 4184 of Fed. Test Method Std. No. 141.

4.6.2.4 Ash content. Determine the ash content in accordance with Method 5262 of Fed. Test Method Std. No. 141.

4.6.2.5 Condition in container. While stirring the material with a hand paddle, observe for smoothness and homogeneity. Observe for absence of pigment flotation, coarse particles or settling.

* 4.6.2.6 Storage stability (Component I or II). The unopened container shall be placed in an area where it will not be agitated or disturbed for a period of 3 months at $65 \pm 25^\circ\text{F}$ or when placed for 6 months in bunkers having an average annual temperature range of 55 to 60°F . After storage, Component I shall be checked for conformance to 3.4.1.2 and Component II to 3.4.2.1.

* TABLE III. REQUIREMENT AND TEST METHOD INDEX

Item	Requirement Paragraph	Paragraph Giving Further Reference	Required Testing for Quality Conformance Inspection
<u>COMPONENT I</u>			
Viscosity	Table I	4.6.2.1	Yes
Acid Number	Table I	4.6.2.2	Yes
Weight per gallon	Table I	4.6.2.3	Yes
Ash content	Table I	4.6.2.4	Yes
Condition in container	3.4.1.1	4.6.2.5	Yes
Storage stability	3.4.1.2	4.6.2.6	---
Accelerated stability	3.4.1.3	4.6.2.7	---
<u>COMPONENT II</u>			
Physical properties	3.4.2 and Table II	4.6.3.1	Yes
Storage stability	3.4.2.1	4.6.2.6	---
<u>ADMIXTURE</u>			
Reaction time	3.5.1	4.6.4.1	Yes
Application	3.5.2	4.6.4.2	---
Thermal efficiency	3.6.1	4.6.5.1	---
Tensile properties	3.6.2	4.6.5.2	---
Color	3.6.3	4.6.5.3	Yes
Hardness	3.6.4	4.6.5.4	Yes
Adhesion	3.6.5	4.6.5.5	Yes
Lubricating oil resistance	3.7.1	4.6.6	Yes
Fungus resistance	3.7.2	4.6.7	---
Impact resistance	3.7.3	4.6.8	---
Humidity resistance	3.7.4	4.6.9	---
Resistance to temperature shock	3.7.5	4.6.10	---
Weather resistance	3.7.6	4.6.11	---
Fast cook-off	3.8.1	4.6.12	---
Temperature and humidity cycling	3.8.2	4.6.13	---
Aircraft vibration	3.8.3	4.6.14	---

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4.6.2.7 Accelerated stability. A full unopened container of Component I shall be stored in an oven at $150 \pm 4^{\circ}\text{F}$ for a period of 6 hours and cooled to room temperature before checking for conformance to 3.4.1.3.

4.6.3 Component II (Catalyst) tests.

4.6.3.1 Physical properties. Determine the physical properties in accordance with MIL-M-81351 and the exceptions specified in 3.4.2 and Table II.

* 4.6.3.2 Storage stability. Test as specified in 4.6.2.6.

4.6.4 Working properties.

4.6.4.1 Reaction time. The test procedure shall be performed in accordance with ASTM D 2471 with the following exceptions:

- a. The mixture temperature shall be recorded with a continuously recording potentiometer equipped with a 20-gauge thermocouple. The overall accuracy of the thermocouple and potentiometer shall be within 0.5°F (0.28°C).
- b. The time required for the mixture to increase from 100 to 150°F (37.8 to 65.6°C) shall be determined to the nearest one-tenth and reported as the reaction time.

4.6.4.2 Application. Components I and II shall be admixed in the ratio specified in 3.2.1. Application of the components by spraying shall be in accordance with Naval Ordnance Systems Command Document OD-45406. Applied coating shall be checked for sag and hardness for conformance to 3.5.2.

4.6.5 Coating properties.

4.6.5.1 Thermal efficiency.

4.6.5.1.1 Panel preparation. Prepare ten panels each 3 by 3 by $1/16$ inches in size and six discs each $15/16$ inch in diameter by $1/16$ inch in thickness from cold rolled steel conforming to QQ-S-698. Cut a 1-inch 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 the thermal conductance effects from the edges of the specimen panel. The test panels shall be prepared as specified in 4.5.1 and 4.5.1.1. The top coat shall be spray-applied and subsequently machined to a uniform film thickness of 150 ± 5 mils. Save three panels for the humidity resistance test 4.6.9.

4.6.5.1.2 Procedure. This test exposes the coating to a fire environment where a total flux of 10 BTU/Ft² - sec 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 about 1/16 to 1/8 inch of the edges of the coated surface. The backside of the test panel shall be insulated with nominally 6 lbs/ft³ 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 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 in mils shall be recorded and a report made of the time, in seconds, to reach the temperature of 205°C (400°F) for the recorded mil thickness of the coating. The test results shall conform to 3.6.1 and the data reported shall be an average of three determinations.

4.6.5.2 Tensile properties. The tensile properties shall be determined in accordance with Method 1011, Fed. Test Method Std. No. 406 at -40, 75 and 140°F. The test specimen shall be Type I, 1/4-inch maximum sheet, Figure 1011A, 0.125 inch thick.

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4.6.5.3 Color.

4.6.5.3.1 Olive Drab. A coated panel shall be compared with Color No. 24087 of FED-STD-595 in accordance with Method 4250 of Fed. Test Method Std. No. 141.

4.6.5.3.2 Insignia White. The color of a coated panel shall be determined in accordance with Method 4252 of Fed. Test Method Std. No. 141. The gloss of the coated panel shall be compared with Color No. 27875 of FED-STD-595 in accordance with Method 4250 of Fed. Test Method Std. No. 141.

4.6.5.4 Hardness. Mix Component I and II at the ratio specified in 3.2.1 and prepare a sample casting 4 inches in diameter by 1/2 inch thick. Cure for a minimum of 1/2 hour at room temperature followed by a minimum of 1 hour at 150 ± 4°F. Cool samples to room temperature and test for hardness in accordance with Method 1083 of Fed. Test Method Std. No. 406.

4.6.5.5 Adhesion. Panels prepared as specified in 4.5.1 through 4.5.1.2 shall be tested in accordance with Method 6221 of Fed. Test Method Std. No. 141 and checked for conformance to 3.6.5.

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4.6.6 Lubricating oil resistance. Panels shall be prepared as specified in 4.5.1 through 4.5.1.2. The panels shall then be immersed in lubricating oil composed of 95 percent of di-2 ethyl-hexyl sebacate 1/, and 5 percent tricresyl phosphate, by weight, at a temperature of $250 \pm 4^{\circ}\text{F}$ for a period of 4 hours. Four hours after removal, the panels shall be examined for conformance to 3.7.1.

4.6.7 Fungus resistance. Panels shall be prepared as specified in 4.5.1 through 4.5.1.2 and tested for resistance to fungus in accordance with Method 508, Procedure I of MIL-STD-810. Upon completion of the fungus test, check for conformance to 3.7.2.

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4.6.8 Impact resistance.

4.6.8.1 Panel preparation. Panels shall be aluminum alloy conforming to QQ-A-250/5, T-0 Condition and anodized in accordance with MIL-A-8625, Type II. They shall be 0.020 by 5 by 12 inches in size, and finished as follows: Apply epoxy primer conforming to MIL-P-52192 to a dry film thickness of 0.6 to 0.8 mils and cured for 1-1/2 hours at 275°F . The primer shall be lightly grit blasted with 80 mesh grit, or sanded with 280 mesh wet or dry aluminum oxide paper. Over the epoxy film, apply the coating compound to a thickness of 0.3 inch.

4.6.8.2 Impact test. Place one prepared panel from 4.6.8.1, film side up over the hole of the cylindrical base of a Gardner Heavy Duty Impact Tester 1G-1120. Determine the maximum impact resistance in inch-pounds at which no failure occurs. Repeat the test on the reverse side of another panel from 4.6.8.1 with the film side down. Check for conformance to 3.7.3.

4.6.9 Humidity resistance. Three panels prepared as specified in 4.6.5.1.1 shall be subjected to 336 hours of exposure at 100 percent relative humidity at 120°F in accordance with the method specified in ASTM D 1748.

4.6.10 Resistance to temperature shock. Three panels prepared as specified in 4.5.1 through 4.5.1.2 shall be tested in accordance with Method 503 of MIL-STD-810B except as follows:

- a. The internal hot chamber shall be maintained at 140°F and 95 percent RH.
- b. The internal cold chamber temperature shall be -40°F .
- c. Panels shall be cycled every 24 hours in lieu of 4.
- d. The complete test period shall be 28 days.

1/ di-2 ethyl hexyl sebacate may be obtained commercially as "Plexol 201" from Rohm and Haas.

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- * 4.6.11 Weather resistance. Four panels shall be prepared as specified in 4.6.5.1 and exposed outdoors for one year in the vicinity of Miami, Florida in accordance with ASTM Test Method D 1014. After exposure, the panels shall be checked for conformance to 3.7.6 and subjected to the thermal efficiency test.
- * 4.6.12 Fast cook-off. The fast cook-off test shall be conducted in accordance with the procedures of Naval Weapons Requirement WR-50 on three MK 82, 500-pound bombs of 3.8.1 and on three MK 82, 500-pound bombs of 3.8.2. In addition, the following shall apply:
 - a. The quantity of fuel shall be sufficient to cause reaction of the ordnance or to insure a 15-minute fire. Test fuel shall be JP-5 or JP-4 conforming to MIL-T-5624.
 - b. The test pit shall be a minimum of 24 feet by 24 feet.
 - c. Flame temperature to the bomb shall reach 1000°F within 30 seconds after fire ignition.
 - d. The bomb shall be suspended from its suspension lugs with its center 30 to 40 inches above the fuel.
 - e. The test shall not be performed when the wind velocity exceeds 5 knots.
- 4.6.13 Temperature and humidity cycling. Temperature and humidity cycling shall be accomplished in accordance with WR-50 except that the temperature range shall be -40°F to +140°F.
- * 4.6.14 Aircraft vibration. The aircraft vibration test procedure and time schedule shall be in accordance with Method 514.1, Table 514.1-II, and Curve H of Figure 514.1-2 of MIL-STD-810.

5. PREPARATION FOR DELIVERY

- 5.1 Packaging. Packaging shall be Level A or C as specified (see 6.2).
- 5.1.1 Level A.
 - 5.1.1.1 Component I (Resin) unit package. The resin 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 III or IV, 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.
 - 5.1.1.2 Component II (Catalyst) unit package. Component II shall be packaged in clean, dry, new polyethylene containers. Net capacity of polyethylene containers shall be 1, 8, or 40 pounds as specified by the procuring activity

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(see 6.2). The wall thickness of the 40-pound polyethylene containers shall conform to specification 2U of 49 CFR 178.24.

5.1.1.3 Kit unit package. When specified by the procuring activity, the components of the coating compound packaged as specified in 5.1.1 and 5.1.2 shall be supplied as a kit, consisting of pigmented resin compound marked "Component I", and the catalyst component marked "Component II". The quantity of each component shall be in the proportion 55 to 1 by weight respectively.

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

5.2 Packing. Packing shall be Level A or C as specified (see 6.2).

5.2.1 Level A.

5.2.1.1 Component I. Resin packaged in pails as specified in 5.1.1.1 shall be palletized in accordance with MIL-STD-147.

5.2.1.2 Component II. Catalyst packaged in polyethylene containers as specified in 5.1.1.2 shall be packed in corrugated or solid fiberboard boxes conforming to Specifications 12B or 49 CFR 178.205 and 12B of 49 CFR 173.221. Quantity of unit and packages per shipping container shall be as specified by the procuring activity (see 6.2) and the following:

<u>Unit (Component II) Package Capacity (lbs)</u>	<u>Unit Quantity Per Shipping Container</u>
1	1 or 25
8	1, 2 or 4
40	1

5.2.2 Level C. Material packaged as specified in 5.1.2 shall be packed in such a manner that will insure 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.

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

Component Identification:
 Component I - Pigmented Resin
 (or Component II Catalyst, as applicable)
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Manufacturer's Name or Trademark
 Date Manufactured, Month and Year
 Lot Number and Batch Number
 Net Contents
 Flash Point (In accordance with ICC Regulations)

5.3.1 Caution Labeling.

5.3.1.1 Component I (Resin) containers. In addition to the labeling as specified in the Department of Transportation Regulations 49 CFR 171-178, the following labeling shall appear on each component container and on each exterior shipping container:

"Caution: Vapor Harmful.
 Keep away from heat and open flame.
 Use only with adequate ventilation.
 Avoid prolonged breathing of vapor.
 Avoid prolonged or repeated contact with skin.
 Storage Conditions: Store in bunkers with annual average temperature of 55-60°F for 6 months storage life. Storage at higher temperatures (up to 90°F) will limit storage life to 3 months.

5.3.1.2 Component II (Catalyst) containers. In addition to the labeling as specified in the Department of Transportation Regulations 49 CFR 171-178, the following labeling shall appear on each component container and on each exterior shipping container:

"CAUTION! OXIDIZING MATERIAL, STRONG IRRITANT, HARMFUL
 IF SWALLOWED.

Store in original container in bunkers with annual average temperature of 55-60°F for 6 months storage life. Storage at higher average temperatures (up to 90°F) will limit storage life to 3 months.
 Protect from all sources of heat, including radiators, steam pipes and direct sunlight.
 Keep away from sparks and open flames.
 Do not add to hot materials; vigorous decomposition may result.
 Only glass, polyethylene, or ceramic containers, funnels, or measuring devices should be used with this material; metals contacting this material will cause decomposition.
 Avoid contact with skin and eyes. In case of contact, flush immediately with plenty of water. For eyes, get medical attention.
 In case of ingestion, call a physician immediately.
 In case of container leakage, remove to a safe place out of doors.
 Do not store in the same room with Component I or other resin systems."

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5.3.2 Application instructions. In addition to the labels specified in 5.3.1.1 and 5.3.1.2, each component unit shall contain a printed label with the following instructions:

"Application instructions: This is a two component coating which is designed for spraying one part Component II with 55 parts of Component I, by weight. CAUTION: Component I and II may be mechanically mixed in a container. Only that amount of mixture which can safely be mixed using a ratio of Component I to II of 100:1."

Note: This material requires special spray equipment in accordance with Naval Ordnance Systems Command Document No. OD-45406."

6. NOTES

6.1 Intended use. The thermal insulating compound is intended for use as an exterior protective coating on explosive-loaded ordnance items. This coating is formulated to meet applicable environmental conditions and also to delay an explosive reaction when the coated ordnance item is exposed to high flux thermal environments.

6.2 Ordering data. Procurement should specify the following:

- a. Title, number and date of this specification
- b. Color (see 1.2)
- c. Components (see 3.2)
- d. Level of packaging and packing (see Section 5)
- e. Quantity in pounds (avoirdupois)

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 suppliers 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. Requests for information pertaining to qualification of products covered by this specification may be obtained from the Commanding Officer, U.S. Naval Air Development Center, Johnsville, Warminster, Pennsylvania 18974, Attention: Code 30223.

6.4 Batch. A batch is defined as that quantity of material which has been manufactured by some unit chemical process or subjected to some physical mixing operation intended to make the final product substantially uniform.

6.5 Storage.

6.5.1 Component I. The recommended storage temperature range for Component I is from 40 to 90°F (see 3.4.1.2). It is also recommended, if conveniently possible, that storage temperatures near the lower end of the above temperature limits be used if longer than 3 months storage life is required.

6.5.2 Component II. Component II, when stored in its original unopened container, ordinarily does not require refrigeration; but where refrigerated storage is available, it should be used, especially if prolonged storage is contemplated. Component II contains an organic peroxide whose strength cannot be warranted after lengthy storage. A three-month inventory combined with the practice of rotation of stock is recommended. Storage at the lower end of the 40 to 90°F storage range should also extend storage life.

6.6 Supersession data. This specification, MIL-C-81904A(AS), supersedes MIL-C-81904(AS) dated 14 June 1972 and Naval Air Systems Command Purchase Descriptions AS-3476 dated 2 October 1972, and AS-2969 dated 17 August 1971.

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

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