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SUPERSEDING
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MILITARY SPECIFICATION

CORROSION REMOVING AND METAL CONDITIONING COMPOUND (PHOSPHORIC ACID BASE)

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

1. SCOPE

1.1 Scope. This specification covers five types of concentrated phosphoric acid corrosion removing and metal conditioning compound which, when diluted with water and applied to metal surfaces, will remove rust from ferrous metal surfaces and provide a slight etching action for ferrous and nonferrous metals to promote the adhesion of paint or corrosion preventives (see 6.1).

1.2 Classification. The compound shall be of the following types, as specified (see 6.2).

Type I - Wash-off
Type II - Wipe-off
Type III - Inhibited
Type IV - Nonfoaming
Type V - Immersion-tank

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified (see 6.2), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specification and Standards (DODISS) specified in the solicitation, from a part of this specification to the extent specified herein.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, US Army Materials and Mechanics Research Center, ATTN: DRXMR-SSS, Watertown, MA 02172 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 6850

SPECIFICATIONS

FEDERAL

- FF-B-171 - Bearings, Ball, Annular (General Purpose)
- QQ-A-250/2 - Aluminum Alloy 3003, Plate and Sheet
- QQ-B-613 - Brass, Leaded and Non-Leaded, Flat Products
(Plate, Bar, Sheet and Strip)
- QQ-S-775 - Steel Sheet, Carbon, Zinc-Coated
- PPP-B-591 - Boxes, Fiberboard, Wood-Cleated
- PPP-B-601 - Boxes, Wood, Cleated-Plywood
- PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner
- PPP-B-636 - Box, Fiberboard

MILITARY

- MIL-G-10924 - Grease, Automotive and Artillery
- MIL-B-26701 - Bottles, Screw Cap and Carboys, Polyethylene
Plastic
- MIL-D-40030 - Drums, Plastic, Molded Polyethylene

STANDARDS

FEDERAL

- Fed. Test Method Std. No. 141 - Paint, Varnish, Lacquer, and
Related Materials; Methods
for Sampling, and Testing

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection
by Attributes
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-1188 - Commercial Packaging of Supplies and Equipment

(Copies of specifications and standards required by manufacturers in connection with specific acquisition functions should be obtained from the contracting 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. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DODISS and supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS

ASTM A109 - Steel, Carbon, Cold-Rolled Strip

ASTM D56 - Flash Point by Tag Closed Tester, Test for

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

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

CONSOLIDATED CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules

(Application for copies should be addressed to the Consolidated Classification Committee, 202 Chicago Union Station, Chicago, IL 60606.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Materials. The ingredient materials used in manufacturer of the compound shall be of high quality, intimately assembled and processed, suitable for the purpose intended, and shall conform to all the requirements of this specification.

3.2 Chemical requirements.

3.2.1 Composition. The compound shall have a phosphoric acid base, and shall contain no coloring agents. The compound is not required to conform to definite chemical composition requirements, except as specified in table I. The manufacturer is given wide latitude in the selection of raw materials and processes of manufacture, provided that the product meets all applicable requirements of this specification. All detergents used in the manufacture of this compound shall be at least 80 percent biodegradable. An affidavit to this effect shall be furnished by the manufacturer with each lot of compound submitted for acceptance.

TABLE I. Test compound chemical composition requirements

| Requirement | Type I | Type II | Type III | Type IV | Type V | Test paragraph |
|--------------------------------------|--|---------|----------|---------|--------|----------------|
| Phosphoric acid content gms/100ml | 68 min | 20-25 | 49 min | 68 min | 68 min | 4.3.1 |
| Flash point, min | | | | | | |
| °F | 135 | 135 | 135 | 135 | 135 | 4.3.2 |
| °C | 57 | 57 | 57 | 57 | 57 | |
| Appearance | Clear, free from cloudiness, sediment and sludge | | | | | 4.3.3 |

3.2.2 Homogeneity. The compound shall form an homogeneous solution with no apparent separation when diluted and tested as specified in 4.3.4. Type IV may be slightly cloudy on dilution, but no separation shall occur.

3.2.3 Toxicity. The compound shall not contain any mineral acids (except orthophosphoric) and shall not give off fumes or vapors in such concentration as to be injurious to the health of personnel, when reasonable ventilating conditions are observed.

3.3 Quantitative requirements.

3.3.1 Comparison formulae. A standard comparison corrosion removing and metal conditioning compound conforming to table II (see 4.3.5) shall be tested simultaneously with the test compound. The test compound shall be equal or superior in effectiveness in all respects to the standard formula.

Table II. Standard comparison compound formulae

| Materials | Type I ^{1/} | Type II ^{1/} | Type III ^{1/} | Type IV ^{1,2/} | Type V |
|---------------------------|----------------------|-----------------------|------------------------|-------------------------|--------|
| Phosphoric acid (85%) | 118 mL | 35 mL | 85 mL | 118 mL | 118 mL |
| Detergent ^{3/} | 5 mL | 5 mL | -- | -- | 5 mL |
| Diethyl thiourea | -- | -- | 0.50 g | -- | -- |
| Butyl cellosolve | 40 mL | 62.5 mL | -- | 40 mL | -- |
| Nacconol NRSF | -- | -- | 2.0 g | -- | -- |
| Pluronic L62 (see 6.4) | -- | -- | -- | 5 mL | -- |
| Pluronic L64 (see 6.4) | -- | -- | -- | 5 mL | -- |

^{1/}Water, sufficient to bring total volume to 250 mL, shall be added

^{2/}This formula should be aged 3 weeks before using, or diluted, when first prepared, to 1000 mL for use without further dilution.

^{3/}Triton X-100, ethoxylated primary or secondary alcohols, or straight-chain alkyl phenols.

3.3.2 Grease removal (applicable to types I, II, and IV). The diluted conditioner shall be equal or superior to the standard comparison formula of the same type (specified in table II) prepared and tested under the same conditions, in removing greasy films when tested as specified in 4.3.6.

3.3.3 Inhibiting agents. Types I, II, IV and V shall be noninhibited and free from agents which will tend to interfere with the free action of the conditioner on the metal being treated. Type III shall contain an inhibiting agent so that the attack on the base metal shall be held to a minimum. The corrosion removal properties of Type III compound shall not be impaired by the presence of the inhibiting agent. The compound shall be tested as specified in 4.3.7.

3.3.4 Etching action (applicable to types I, II, IV and V only). The diluted metal conditioner shall produce no more than a slight etching action when allowed to remain in contact with iron, galvanized iron, brass or aluminum at a temperature of 77 ± 9°F (25 ± 5°C). The etching action shall be essentially equal to that produced by the standard comparison compound (see table II) of the same type, when tested as specified in 4.3.8.

3.3.5 Foaming (applicable to type IV only). Test samples shall not produce more foam than the standard comparison formula at 150°F (66°C) or at room temperature when tested according to paragraph 4.3.9.

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 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 assure supplies and services conform to prescribed requirements.

4.2 Sampling and inspection.

4.2.1 Size of lot. For purposes of sampling, a lot shall consist of all material mixed or prepared at one time in one vessel with a maximum of 1,000 gallons. Material shall be identified by order of production or batch number.

4.2.2 Sampling procedure (lot acceptance tests). A minimum of two samples, each approximately 1 gallon, shall be taken from each lot for the tests specified in 4.3. For lots of 60 gallons or less one 1 gallon sample shall be taken.

4.2.2.1 Unless otherwise specified, procedure shall be in accordance with method 1022 of Fed. Test Method Std. No. 141 and the right is reserved to make any additional tests deemed necessary to determine that the compound meets the requirements of this specification. Failure to pass any test and noncompliance with the requirements of section 3 shall be cause for rejection of the lot.

4.2.3 Sampling (inspection of containers). A random sample of filled containers shall be selected by the inspector in accordance with MIL-STD-105, at inspection level 1 and acceptable quality level of 2.5 percent defective, to verify compliance with all requirements regarding fill, closure, marking and other requirements not requiring test.

4.2.3.1 Inspection of containers. Each sample filled container shall be examined for defects of construction of the container and closure, for evidence of leakage, and for unsatisfactory markings. Each filled container shall also be

weighed to determine the amount of contents. Any container in the sample having one or more defects or under required fill shall be rejected, and if the number of defective containers in any sample exceed the acceptance number of the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.3 Test methods.

4.3.1 Phosphoric acid content. Pipet 5 mL aliquots of the sample into each of two separate 500 mL Erlenmeyer flasks allowing 30 minutes for complete drainage of the pipets. Add 200 mL of distilled water to each flask. To the first flask add 2 mL phenolphthalein indicator (prepared as 0.1 percent solution in 90 percent ethyl alcohol by dissolving 0.1 g of phenolphthalein powder in 100 mL of 90 percent ethyl alcohol). To the second flask add 2 mL of bromphenal blue indicator (prepared as 0.1 percent neutralized aqueous solution). Titrate each sample with standardized 2.0 N sodium hydroxide. Note burette reading at the end points for each. Calculate H_3PO_4 as follows:

$$H_3PO_4 \text{ (grams of orthophosphoric acid per 100 mL of compound) } = 1.96 N(A-B)$$

Where:

- N = normality of sodium hydroxide
- A = mL NaOH to phenolphthalein end point
- B = mL NaOH to bromphenol blue end point
- $1/2A = B \pm 0.5 \text{ mL}$

($1/2A$ must equal $B \pm 0.5 \text{ mL}$. Otherwise, the compound contains mineral acids contrary to the requirements of this specification.)

4.3.2 Flash point. The flash point shall be determined using the Tag Closed Tester in accordance ASTM D56.

4.3.3 Appearance. Thoroughly shake the sample. Place 100 mL of the compound in a graduate. Allow to stand for 24 hours and note whether any cloudiness, sediment, or sludge formation is apparent.

4.3.4 Homogeneity. Place 25 mL of the compound in a 100 mL graduate. For types I, II, IV, and V, dilute with water to 100 mL and shake. For type III, dilute to 50 mL and shake. Note if any separation occurs.

4.3.5 Comparison formulae. Prepare standard comparison compounds according to the formulae in table II. Perform tests in duplicate and simultaneously on these standard compounds and on the sample compounds.

4.3.6 Grease removal, applicable to types I, II and IV only). Test panels of 18 gage, cold-rolled steel (0.5 by 2 ins.) shall be prepared. Clean panels thoroughly, by sanding if necessary, and degrease with trichlorethylene. Panels shall be scored 1.25 ins. from one end. Apply a uniform coating of grease conforming to MIL-G-10924 to the lower 1.25 in. of surface of panels which have been weighed to the nearest mg. A spatula is used for the grease application. Wipe off the outer edges of the panels with a clean rag. The grease coating shall weight $35 \text{ mg} \pm 5 \text{ mg}$. Dilute, as specified in 4.3.4, a portion of the test sample and the standard comparison compound specified in table II. Transfer the diluted solutions to test tubes of suitable size. Immerse panels completely in the test tubes by means of hooks made of iron wire and let stand for 45 minutes. Remove each panel and rinse by gently immersing 5 times in a beaker of water. Place panels horizontally on absorbent paper and compare visually.

4.3.7 Inhibiting agents. Determine the presence of inhibiting agents as required in 4.3.7.1 and 4.3.7.2.

4.3.7.1 Type I, II, IV, and V conditioners. Dilute the test samples and comparison standards as specified in 4.3.4. Immerse a shiny degreased ball bearing conforming to FF-B-171 in each of the solutions. Allow to stand for 30 minutes, then remove and rinse with cold water. If the ball bearing in the test conditioner is dulled to a lesser degree than the ball bearing in the standard control solution it indicates the presence of inhibiting agents contrary to the requirements. (If the ball bearing retains its original luster in the control solution, a different kind of bearing should be obtained.)

4.3.7.2 Type III conditioner. Clean two panels of cold rolled steel (1 by 0.5 by 0.03 in.) with abrasive cloth and wash thoroughly with toluene or petroleum hydrocarbon solvent followed by rinsing with anhydrous methanol. Weigh the panels to 0.1 mg and place in test tubes each containing 50 mL of the compound diluted as specified in 4.3.4. Maintain the samples at 77°F (25°C) for 24 hours. Remove the panels, dry and weigh. Calculate the corrosion rate in mg/dm^2 per day. The corrosion rate for a satisfactorily inhibited conditioner should no exceed $35 \text{ mg}/\text{dm}^2$ per day.

4.3.8 Etching action (applicable to types I, II, IV and V only). Dilute as specified in 4.3.4, 50 mL each of the test compounds and of the comparison standard. Immerse identical panels of the metals listed below in each of the diluted solutions for 10 minutes at a temperature of $77 \pm 9^{\circ}\text{F}$ ($25 \pm 5^{\circ}\text{C}$). Then remove the panels and examine for etching action.

Steel, low-carbon cold-rolled, conforming to ASTM A109
Galvanized steel conforming to QQ-S-775, Type I, Class d
Brass, half-hard, cold-rolled, conforming to QQ-B-613
Aluminum alloy, temper H14 or H24 conforming to
QQ-S-250/2

4.3.9 Foaming action (applicable to type IV only). Dilute a portion of the test sample and the standard comparison compound as specified in 4.3.4. Simultaneously shake 25 mL of each in a 100 mL glass-stoppered graduate and compare the foaming action. Vent the stoppers and heat for 20 minutes in a water bath at 150°F (66°C). Stopper tightly, shake simultaneously, and compare the foaming action of the warm solutions.

5. PACKAGING

5.1. Packaging. Packaging shall be level A or C as specified (see 6.2).

5.1.1 Level A. The compound shall be furnished in 1 or 2 gallon polyethylene plastic bottles conforming to MIL-B-26701 or in 5 to 15 gallon polyethylene plastic drums conforming to style B of MIL-D-40030 (see 6.2).

5.1.2 Level C. The compound, commercially supplied, shall be packaged in accordance with MIL-STD-1188.

5.2 Packing. Packing shall be level A, B, or C as specified (see 6.2).

5.2.1 Level A.

5.2.1.1 1 and 2 gallon containers. The compound packaged in 1 and 2 gallon polyethylene plastic bottles shall be packed in shipping containers conforming to PPP-B_621, class 2. Fiberboard fillers shall be placed between unit containers and between the unit containers and the sides, ends, tops, and bottoms of shipping containers to make a tight pack. Fiberboard fillers and pads shall conform to PPP-B-636, weather-resistant, W5c. The gross weight of boxes shall not exceed 70 lbs. The shipping containers shall be closed and strapped in accordance with the applicable box specification and appendix thereto.

5.2.1.2 5 and 15 gallon containers. The compound in 5 and 15 gallon polyethylene containers shall be packed in exterior shipping containers in accordance with the level A requirements of the appendix to MIL-D-40030.

5.2.2 Level B.

5.2.2.1 1 and 2 gallon containers. The compound packed in 1 or 2 gallon polyethylene bottles shall be packed in accordance with 5.2.1.1 except that shipping container shall conform to PPP-B-636, weather-resistant, W5c or W5s; PPP-B-621, class 1; PPP-B-601, domestic type; or PPP-B-591, class 1.

5.2.2.2 5 and 15 gallon containers. The compound in 5 or 15 gallon polyethylene containers shall be packed in exterior shipping containers in accordance with level B requirements of appendix to MIL-D-40030.

5.3 Marking. In addition to any special marking required by the contract or purchase order, shipping containers shall be marked in accordance with MIL-STD-129, with the exception that commercial marking in accordance with MIL-STD-1188 applies for commercial packaging only.

5.3.1 Special marking. In addition, each container shall be conspicuously marked in accordance with MIL-STD-129, with a caution warning and directions for use for the applicable type, as follows:

CAUTION: Compound contains a strong acid. Protect hands, face, and eyes. Wear rubber gloves, apron and goggles. If splashed on the skin, flush with plenty of water, followed by a water rinse containing 1 percent bicarbonate of soda. Avoid prolonged breathing of vapors.

DIRECTIONS FOR USE (as applicable for each particular type):

“Type I (Wash-off) material - Add 1 part of the concentrated material as received to 3 parts of water by volume. Use acid resisting steel, earthenware crocks or other suitable mixing tanks. Remove heavy rust by wire brush and heavy grease with a grease solvent before applying the compound.

After proper dilution, apply by spray, dip or flow-brush on clean metal surfaces. Allow the material to remain only long enough to wet the surface in order to cause etch. On rusted surfaces, allow material to remain long enough to loosen the rust (from 2 to 10 minutes depending on the degree of rusting). Then rinse surface with water, preferably hot; permit to dry thoroughly prior to application of rust preventive or paint.”

“Type II (Wipe-off) material - Add 1 part of the concentrated material as received to 3 parts of water by volume. Use acid resisting steel, earthenware crocks or other suitable mixing tanks. Remove heavy rust by wire brush and heavy grease with a grease solvent before applying the compound.

After proper dilution, apply by brush, rag, or sponge. Allow the compound to remain on metal surface about one-half minute. Wipe off residue first with damp rags, then with dry rags. No more than a light film of gray-white coating shall remain before application of paint.”

“Type III (Inhibited) material - Add 1 part of the concentrated material as received to 1 part of water by volume. Remove heavy rust by wire brush and grease with a grease solvent before applying the compound.

After proper dilution, apply by spray, dip or flow-brush. Allow the conditioner to remain on the metal surfaces long enough so that the rust is loosened or dissolved and may be removed by rinsing with hot water. When the surface is dry, it may be coated, preserved with a corrosion preventative or put directly into service, as circumstances may indicate.

“Type IV (Nonfoaming) material - Add 1 part of the concentrated material as received to 3 parts of water by volume. Use acid resisting steel, earthenware crocks or other suitable mixing tanks. Remove heavy rust by wire brush and heavy grease with a grease solvent before applying the compound.

After proper dilution, apply by spray, rinse with water, preferably hot; permit to dry thoroughly prior to application of rust preventive or paint.”

“Type V (Immersion tank) material - Add 1 part of the concentrated material as received to 3 parts of water by volume. Use acid resisting steel, earthenware crocks or other suitable mixing tanks. Remove heavy rust by wire brush and remove all grease with solvent or alkali bath before immersion in the compound.

After immersion, wash metal surfaces thoroughly with water or alkali solution followed by water, permit to dry thoroughly prior to application of rust preventative or paint.”

6. NOTES

6.1 Intended use. Types I and II materials are suitable for use as rust removers for ferrous metal parts and as metal conditioners for ferrous and nonferrous metals prior to application of paints and/or corrosion preventatives. Very heavy rust incrustations should be mechanically removed and heavy grease should be removed by adequate grease solvents or grease removal methods. Type I material will remove more rust and greas than type II. Type I material should always be rinsed off with water but may be wiped off with clean rags prior to painting.

Type III conditioner is intended for use on chromium plated ferrous surfaces and on those ferrous surfaces which require very close tolerances. The articles should first have very heavy rust incrustations mechanically removed and have grease removed by vapor degreasing. The article is left in the conditioner until the rust is dissolved or loosened sufficiently to permit easy removal. It is then removed, rinsed and dried. It is then ready for further corrosion preventive treatments or for use.

Type IV is similar to type I, except that nonfoaming detergents are used. It is intended for use in pressurized spray systems at temperatures up to 150°F (66°C) after which it is washed off with water.

Type V material is similar to type I, except that grease removing solvents are not used and the material is suitable for use on surfaces from which grease and oil have been previously removed by solvent or alkali cleaning. It may be used in immersion tanks at ambient temperatures or at temperatures not exceed 140°F (60°C).

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification
- b. Type of compound required (see 1.2)
- c. Size of containers (see section 5)
- d. Level of packaging and level of packing (see section 5)
- e. The compound covered by this specification should be purchased by the pound.

6.3 It is an added advantage to add to the final rinse a small amount of chromic acid or a mixture of phosphoric and chromic acids.

6.4 "Tritron X-100" is manufactured by Rohm and Haas; "Pluronic L62" and "Pluronic L64" are manufactured by BASF Wyandotte Chemical Corporation (see paragraph 3.3.1).

6.5 Special caution. Toxic fumes are formed when acid metal conditioners are used on ferrous articles containing arsenic, antimony or phosphorus. Adequate ventilation and precaution should be practiced at all times, even after objects have been removed from the bath prior to rinsing.

Custodians:

Army -- MR

Navy -- AS

Air Force -- 68

Preparing activity:

Army -- MR

Project No. 6850-0700

Review activities:

Army -- GL, MI, AR

Navy -- SA, SH

Air Force -- 11, 85

DLA -- GS

User activities:

Army -- AT, CR, ER

Navy -- MC

Agent:

Army -- ME