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TT-R-230B
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SUPERSEDING
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FEDERAL SPECIFICATION

REMOVER, PAINT (ALKALI-TYPE FOR HOT APPLICATION)

This specification was approved by the Commissioner,
Federal Supply Service, General Services Administra-
tion, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers alkali-type paint removers suitable for use in stripping paint coatings from ferrous and non-ferrous metals (see 6.1).

1.2 Classification.

1.2.1 Classes. The paint remover shall be of the following classes, as specified (see 6.2):

Class 1 - For use with ferrous and magnesium metals (general heavy duty stripper).

Class 2 - For use with aluminum and other non-ferrous metals (see 6.4).

2. APPLICABLE DOCUMENTS

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

Federal Specifications:

0-S-598 - Sodium Hydroxide, Technical.

0-S-604 - Sodium Metasilicate, Technical.

0-S-642 - Sodium Phosphate, Tri Basic, Technical, Anhydrous,
Dodecahydrate and Monohydrate.

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- QQ-A-250/1 - Aluminum Alloy 1100; Plate and Sheet.
- QQ-A-250/4 - Aluminum Alloy 2024; Plate and Sheet.
- QQ-S-698 - Steel, Sheet and Strip, Low Carbon.
- TT-E-485 - Enamel, Semi-Gloss, Rust Inhibiting.
- TT-E-527 - Enamel, Alkyd, Lustreless.
- TT-P-636 - Primer, Coating, Alkyd, Wood and Ferrous Metal.
- PPP-D-729 - Drums: Metal, 55-Gallon (For Shipment of Noncorrosive Material).

Federal Standards:

- Fed. Std. No. 123 - Marking for Domestic Shipment (Civilian Agencies .
- Fed. Test Method Std. No. 141 - Paint, Varnish, Lacquer and Related Materials, Methods of Inspection Sampling and Testing.
- Fed. Test Method Std. No. 536 - Soap and Soap Products (Including Synthetic Detergents); Sampling and Testing.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, Wash.)

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Specifications:

MIL-C-5541 - Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys.

MIL-L-11195 - Lacquer, Lustreless, Hot Spray.

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

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

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Materials. The raw materials used in the manufacture of the paint remover shall be intimately assembled and processed so as to produce a granular free-flowing product which is uniform in composition and which shall show no evidence of segregation or caking during handling or storage.

3.2 Composition. The removers are not required to conform to definite chemical composition requirements. The manufacturer is given wide latitude in the selection of raw materials and processes of manufacture, provided the product meets all applicable requirements of this specification.

3.2.1 Synthetic detergents. All anionic and nonionic detergents used in paint removers covered by this specification shall be at least 80 percent biodegradable. An affidavit to this effect shall be furnished by the manufacturer with each lot of paint remover.

3.3 Performance requirements. The paint remover shall be equal to or superior in effectiveness to the comparison formula of the same class (see 4.4.1) in all respects, when tested as specified in 4.4. The remover covered by this specification shall be tested simultaneously with the comparison paint remover of the same class as specified.

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3.3.1 Stripping ability. When tested as specified in 4.4.3 at boiling temperature and a concentration of 9.0 percent (9.0 grams of the remover in 100 ml. of solution) the paint remover shall be equal to or superior to the standard comparison remover of the same class (4.4.1), prepared and tested under the same conditions, in ability to remove or loosen paint coatings from ferrous and non-ferrous surfaces. Any paint loosened but not removed by the solution shall be readily washed off by steam or hot water spray. The stripping time of the test remover for each panel of the test paint systems (4.4.2.1) shall not be greater than the statistical upper limit as set forth in 4.4.3.3.

3.3.2 Stability. The paint remover, when boiled for 32 hours and tested as specified in 4.4.4, shall be equal or superior to the standard comparison remover of the same class (4.4.1), prepared and tested under the same conditions in ability to remove or loosen paint coatings from ferrous and non-ferrous surfaces.

3.4 Corrosiveness (class 2 only). The class 2 remover shall not attack aluminum in excess of the following limits: (a) when tested in accordance with 4.4.5, there shall be no decrease and a maximum of 3 milligrams increase in weight of the aluminum test panel; (b) the test panels shall show no evidence of corrosion other than a slight discoloration after test.

3.5 pH value. At a concentration of 9.0 percent (9.0 grams of the remover in 100 ml. of solution), the pH value of the class 1 remover shall not be less than 13.4, and class 2 remover not more than 12.2 when tested in accordance with 4.4.6.

3.6 Dust-forming properties. The dust-forming properties shall be such that, when tested as specified in 4.4.7, the dust shall settle within a period of five seconds.

3.7 Segregation. When tested as specified in 4.4.8, the difference of the percentage of an ingredient of the remover (such as silicates) taken from different portions of a container shall not exceed 2 percent of the average percentage of that ingredient in the remover. The remover shall be subjected to the test specified in 4.4.8, at the discretion of the inspection laboratory, when segregation of the ingredients appears to have occurred.

3.8 Rinsing. Solutions of the paint removers shall leave no residue when tested as specified in 4.4.9.

3.9 Workmanship. The paint remover shall be so manufactured as to produce a material which is stable and not subject to change during storage in a sealed container.

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 Sampling and testing.

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

4.2.2 Sampling for acceptance tests. A minimum of two samples, each weighing approximately one pound, shall be taken from each lot.

4.2.3 Sampling for examination of filled containers. A random sample of filled containers shall be taken from each lot in accordance with MIL-STD-105 at inspection level 1 and acceptable quality level (AQL) = 2.5 percent defective to verify compliance with all stipulations of this specification regarding fill, closure, marking, and other requirements not involving tests.

4.2.4 Examination of filled containers. Each sample filled container selected in accordance with 4.2.3 shall be examined for defects of the container and the closure, for evidence of leakage, and for unsatisfactory marking; each sample 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 exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.3 Tests. Testing under this specification shall be for the purpose of acceptance of individual lots.

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4.3.1 Acceptance inspection. Inspection for the acceptance of individual lots shall consist of examining and testing the acceptance samples for all the requirements specified in section 3. If any sample is found to be not in compliance with this specification, the entire lot which it represents, if produced by continuous run process, shall be rejected; or if the lot is produced in batches, all untested batches in the lot shall be rejected together with the batch from which the sample was taken.

4.4 Test methods.

4.4.1 Standard comparison paint removers. The composition of the standard comparison paint removers shall conform to table I and II. The test methods are based on the use of 86 percent active dodecyl benzene sodium sulfonate in the standard comparison paint removers. When using a dodecyl benzene sodium sulfonate greater than 86 percent active, a correspondingly smaller amount shall be used (see 6.5).

TABLE I. Composition of class 1 comparison compound

Component	Percent by Weight
Sodium hydroxide (Fed. Spec. 0-S-598)	63.0
Trisodium phosphate anhydrous (Fed. Spec. 0-S-642, type I)	35.0
Dodecyl benzene sodium sulfonate (not less than 86 percent active)	2.0

TABLE II. Composition of class 2 comparison compound

Component	Percent by Weight
Sodium metasilicate pentahydrate (Fed. Spec. 0-S-604, type I)	35.0
Trisodium phosphate dodecahydrate (Fed. Spec. 0-S-642, type II)	47.8
Dodecyl benzene sodium sulfonate (not less than 86 percent active)	5.0
Potassium chromate (ACS grade K_2CrO_4)	0.2
Sodium Phosphate monobasic (ACS grade $NaH_2PO_4 \cdot H_2O$)	12.0

4.4.2 Preparation of paint stripping test panels. For testing class 1 remover, steel panels shall be used. For testing class 2 remover, aluminum panels shall be used. The panels shall be prepared for painting as follows:

(a) Steel. Steel panels shall be 20 gage cold rolled steel, 3 by 5 inches, conforming to QQ-S-698, SAE 1010 or SAE 1020 composition, with a Rockwell "B" hardness of 55 to 65 and a No. 2 luster finish. The panels shall be free from corrosion and sharp edges shall be removed with emery cloth. The panels shall be liquid dip cleaned as specified in method 2011 of Fed. Test Method Std. No. 141 using the 3:1 mixture of aliphatic naphtha-ethylene glycol monoethyl ether mixture.

(b) Aluminum. Aluminum test panels conforming to QQ-A-250/1, H14 or H24 temper, and 0.034-inch thick, shall be cut to 3 by 5 inches in size. The sharp edges shall be removed with No. 150 aluminum polishing paper. The aluminum panels shall be cleaned for 5 minutes in an 8-ounce per gallon solution of trisodium phosphate (type II, O-S-642) at 180°F., water rinsed, dipped in 50 percent nitric acid for 30 seconds, water rinsed, and given the chemical conversion coating specified in MIL-C-5541, Class 2.

4.4.2.1 The following paint systems shall then be applied by spray, one system to each pair of panels, respectively. Each panel shall be sprayed on one side only to a dry film thickness of 0.7 to 1.0 ml. for each coat. Each material shall be olive drab color.

System 1 - One coat of material conforming to TT-E-485, type II. Bake for 30 minutes at 300°F. Air dry 24 hours, then age for 24 hours at 120°F.

System 2 - One coat of material conforming to TT-E-485, type II, modified with 20 percent urea-formaldehyde. Process like system 1.

System 3 - One coat of material conforming to TT-P-636. Bake for 30 minutes at 300°F. Cool to room temperature and then apply one coat of material conforming to TT-E-527 over it. Bake for 30 minutes at 300°F. Air dry for 24 hours, then age for 24 hours at 120°F.

System 4 - One coat of material conforming to MIL-L-11195. Air dry for 24 hours, then age for 24 hours at 120°F.

4.4.3 Stripping test.

4.4.3.1 Solutions. In a one-liter tall-form beaker prepare 800 ml. of a 9.0 percent (9.0 grams of the remover in 100 ml. of solution) distilled water solution of the submitted sample. Heat to a boil and maintain at this temperature throughout the tests. Maintain the solution level by additions of distilled water. Prepare similar solutions for the equivalent comparison formula as specified in 4.4.1.

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4.4.3.2 Stripping of panels. Using test solution of submitted sample prepared as specified in 4.4.3.1 and test panels prepared as specified in 4.4.2 and 4.4.2.1 determine separately stripping time for one panel of each system in numerical sequence; i.e., systems 1, 2, 3, and 4. Immerse each panel vertically in the boiling solution. Remove periodically and examine to determine extent of paint stripping by removing loosened material with a brush and rinsing with a stream of hot water. The time required for completely stripping each panel shall be noted. Repeat the procedure using three additional series of panels in the same sequence. Develop data for control purposes by using test solution of standard comparison compound and determining sequence. Employ this data in developing the upper statistical limit in 4.4.3.3.

4.4.3.3 Statistical upper limit. The statistical upper limit at the .05 level in the stripping ability and stability tests of 3.3.1 and 3.3.2 are determined with the following formula:

$$\text{Upper limit} = X + 0.72W$$

where:

X = average of 4 stripping times per paint system by the comparison compound

W = difference between the maximum and minimum stripping times in the 4 stripping tests per paint system by the comparison compound

4.4.4 Stability test.

4.4.4.1 Solutions. In two-liter beakers, prepare 800 ml. solutions each of submitted sample and the equivalent comparison formula, as described in 4.4.3.1. Boil the solutions for 32 hours, replacing water lost by evaporation as necessary. Transfer the solutions to 1-liter tall-form beakers and adjust to the original pH (at 25°C.), using C.P. grade sodium hydroxide solution. Bring solutions to a boil, keep at that temperature throughout the test.

4.4.4.2 Using the solutions prepared in 4.4.4.1, repeat the stripping test procedures specified in 4.4.3.2 and 4.4.3.3.

4.4.5 Corrosion test (class 2 remover only).

4.4.5.1 Preparation of test panels. Aluminum test panels shall be as specified in 4.4.2, except that they shall measure 3 inches by 3/4-inch each. Sharp edges shall be smoothed with No. 150 alundum polishing paper. Both faces of each panel shall be polished, stroking in one direction only. The panels shall then be cleaned with C.P. grade acetone using a swab of absorbent cotton. They shall then be wiped dry with paper toweling, dipped in absolute ethyl alcohol, U.S.P. grade, or absolute methanol, and again wiped with paper toweling.

4.4.5.2 Test procedure. The clean test panel shall be weighed to the nearest 0.0001 gram and immersed completely in 200 ml. of boiling 9.0 percent (9.0 grams of the remover in 100 ml. of solution) distilled water solution of the class 2 remover, contained in a 500 ml., tall-form beaker. The solution shall be kept at a boil throughout the test, the solution level being maintained by additions of distilled water as required. After 60 minutes, the test panel shall be removed from the boiling solution, rinsed under flowing tap water (cold) rinsed in distilled water (22° to 28°C.), dipped in U.S.P. absolute ethyl alcohol or absolute methanol, wiped dry with paper toweling, and reweighed. The presence of corrosion products shall be noted. All tests shall be run in duplicate.

4.4.6 pH value.

4.4.6.1 Apparatus. The test shall be made with a pH electrometer having a sensitivity and readability of at least 0.05 pH. A sealed type, alkali-resistant glass electrode shall be used with a calomel reference electrode. The meter shall be standardized against a pH 10 buffer solution immediately before making a test. The instrument to be used shall be the Beckman pH Meter Laboratory Model G, or equal, and the electrode shall be the Beckman "Type E" high pH glass electrode, or equal.

4.4.6.2 Procedure. Prepare 100 ml. of a 9.0 percent (9.0 grams of the remover in 100 ml. of solution) distilled water solution. Determine the pH at 25°C. No correction for sodium ion concentration shall be made.

4.4.7 Dusting. The inside walls of a 250 ml., glass-stoppered graduate shall be rendered completely free of any grease and moisture. A 25 gram sample of the remover shall then be placed on the bottom of the clean graduate. The graduate shall then be stoppered, inverted and immediately returned to its original position. After any suspended dust has been allowed to settle for 5 seconds, the stopper shall be removed and a moistened piece of red litmus paper suspended in the graduate without touching the walls so that the lower end of the litmus paper strip coincides with the 210 ml. mark at the upper end of the graduate. After 60 seconds immersion, the litmus paper shall be removed and examined for any color change. Excessive dusting is indicated by any change in the litmus paper from red to blue.

4.4.8 Segregation. Samples taken from different portions of the container shall be analyzed for one constituent of the remover, such as silicates, by the appropriate method prescribed in Fed. Test Method Std. No. 536.

4.4.9 Rinsing.

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4.4.9.1 Preparation of test panels. For testing class 1 remover, steel panels shall be used. For testing class 2 remover, aluminum panels shall be used. The panels shall measure 2-1/2 by 2-1/2 inches in size and shall have a 1/4-inch hole placed 1/8-inch from one corner.

(a) Steel. Steel panels shall be 20 gage cold rolled steel conforming to QQ-S-698, SAE 1010 or SAE 1020 composition. Both faces shall be polished with coarse emery cloth, stroking in one direction only. The panels shall then be cleaned with C.P. acetone using a swab of absorbent cotton. They shall then be wiped dry with paper toweling, dipped in U.S.P. absolute ethyl alcohol and again wiped dry with paper toweling.

(b) Aluminum. Aluminum panels shall be cut from approximately 0.030 inch thick 2024 T3 aluminum sheet conforming to QQ-A-250/4. Both faces shall be polished with No. 150 aluminum polishing paper, stroking in one direction only. The panels shall then be cleaned with C.P. acetone using a swab of absorbent cotton. They shall then be wiped dry with paper toweling, dipped in U.S.P. absolute ethyl alcohol and again wiped dry with paper toweling.

4.4.9.2 Test procedure. Prepare 400 ml. of a 9.0 percent (9.0 grams of the remover in 100 ml. of solution) distilled water solution of the remover in a 600 ml. beaker. Adjust the temperature of the solution to $95 \pm 2^{\circ}\text{C}$ and maintain this temperature throughout test. Maintain the solution level by the additions of distilled water. Immerse a panel prepared as specified in 4.4.9.1 for 5 minutes. By means of a wire hook withdraw panel through floating material, if present. Let panel drain 10 seconds, and then rinse panel by suspending for 10 seconds, without agitation, in approximately 900 ml. of distilled water at $70 \pm 2^{\circ}\text{C}$ contained in a 1-liter beaker. Remove panel and let drain 5 seconds. Then suspend panel as before in a fresh 900 ml. sample of distilled water at $70 \pm 2^{\circ}\text{C}$ for 10 seconds. Remove panel, let dry and examine visually for residue. Tests shall be run in duplicate.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Preservation and packaging shall be level A or C as specified (see 6.2).

5.1.1 Level A. The paint remover shall be packaged in 400 pound capacity, 18 gage metal drums conforming to type III of PPP-D-729.

5.1.2 Level C. The paint remover shall be packed in a manner which will ensure arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers shall conform to the common carrier rules and regulations as applicable to the mode of transportation and shall be of the weight and capacity specified by the procuring agency.

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5.2 Packing, levels A, B, or C. Unless otherwise specified, no overpacking is required.

5.3 Marking. In addition to marking in accordance with MIL-STD-129 or Fed. Std. No. 123 as applicable, each drum shall be marked with the following information:

Class 1 shall be marked with:

WARNING! This compound contains caustic soda (sodium hydroxide). For technical use only. Keep out of reach of children. Do not take internally. Avoid contact with body or clothing. When handling this compound wear goggles and face shield and avoid all contact with skin. In case of accidental contact with skin, immediately flush affected parts with water and wash with vinegar. For eyes, flush freely with water while holding lids open for at least 15 minutes, and get medical attention.

Directions for use. Use remover in a concentration of 12-ounces per gallon of water. For stripping paint, use in an open tank at boiling temperature. Add water as necessary to maintain the solution at a constant level. Keep all parts to be stripped completely submerged. A soft-bristle brush may be used to facilitate removal of the loosened finish. Rinse parts thoroughly in hot water, preferably by spray.

Class 2 shall be marked with:

WARNING! This compound contains caustic material. Do not take internally. Keep out of reach of children. Avoid contact with skin, eyes and clothing. In case of contact, immediately flush with plenty of water; for eyes, flush with plenty of water while holding lids open. When adding hexylene glycol, a well ventilated room should be used.

Directions for use. Use remover in concentration of 12 ounces per gallon of water. For stripping paint use in an open tank at boiling temperature. Add water as necessary to maintain the solution at a constant level. Keep all parts to be stripped completely submerged. A soft-bristle brush may be used to facilitate removal of the loosened finish. Rinse parts thoroughly in hot water, preferably by spray. An improved class 2 stripper can be made by adding 1 part by volume of hexylene glycol to 9 parts of the solution (see TT-R-230, section 6 for control tests).

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6. NOTES

6.1 Intended use. The alkali-type paint removers covered by this specification are intended to remove alkyd resin, modified urea-formaldehyde alkyd resin, oleoresinous, and nitrocellulose-base finishes from ferrous metals, aluminum and other nonferrous alloys (see 1.2). Items to be stripped are limited to those of such a size and shape as can conveniently be immersed in a boiling solution. Large items may be cleaned by repeated flushing with the hot solution when necessary equipment is available. Surfaces stripped with this material should be thoroughly flushed with large quantities of hot water prior to repainting.

6.1.1 Magnesium and aluminum. Magnesium parts that contain no aluminum inserts may be stripped in the class 1 heavy duty (high alkalinity) remover. When coupled with aluminum, magnesium must be stripped in the class 2 remover, preferably in the single phase, water-organic modification described in paragraph 6.4.

6.2 Ordering data. Purchasers should exercise any desired options offered herein and procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Class of paint remover required (see 1.2.1).
- (c) Size containers, if applicable (see 5.1.2).
- (d) Level of packaging and level of packing required (see section 5).
- (e) Special marking (see 5.3).

6.3 Paint stripping effectiveness. Test panels, coated and stripped as specified herein by the standard comparison removers, have given the following results (these times are cited as an indication of the performance which can be expected, and are not to be used for evaluation in 4.4.3):

(a) Class 1 - Standard comparison remover: TT-E-485 material stripped within 35 seconds. TT-E-485 material modified with urea-formaldehyde stripped within 50 seconds. TT-P-636 plus TT-E-527 material stripped within 40 seconds. MIL-L-11195 material stripped within 40 seconds.

(b) Class 2 - Standard comparison remover: TT-E-485 material stripped within 5 minutes. TT-E-485 material modified with urea-formaldehyde stripped within 8 minutes. TT-P-636 plus TT-E-527 material stripped within 10 minutes. MIL-L-11195 material stripped within 6 minutes.

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6.4 Improved aluminum stripper. The effectiveness of the class 2 remover in stripping paint from aluminum basis metals can be increased from 50 to 75 percent by conversion of the aqueous solution of the class 2 compound into a stable, single phase, water-organic solvent solution, which is operated at a boil. The change is accomplished by adding 1 gallon of hexylene glycol (boiling point 192°-200°C., and specific gravity at 20°/20°C., 0.922-0.925 to 9 gallons of a 12 ounce per gallon water solution of the class 2 remover. The hexylene glycol content is maintained by a periodic test (see 6.4.1). Rinse parts with hot water after stripping.

6.4.1 Control of hexylene glycol. To 50 ml. of the modified class 2 remover solution containing hexylene glycol, contained in a 100 ml. graduated cylinder, add an excess of anhydrous potassium carbonate, analytical reagent grade. The hexylene glycol collects as the top liquid layer. The ml. in the top layer multiplied by two gives the percent by volume of hexylene glycol, which should be maintained at 9.0 to 11.0 percent.

6.5 Biodegradable dodecyl benzene sodium sulfonate is available from:

Monsanto Company - Santomerse 85-b (86 percent active).

Alcolac Chemical Corp. - Siponate LDS-10 (98 percent active).

Custodians:

Army - MR

Civil agency - GSA

Preparing activity:

Army - MR

Review activities:

Army - MD, MR, WC

DSA - IS

User activities:

Navy - YD

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