

P-C-111D
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SUPERSEDING
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FEDERAL SPECIFICATION
CARBON REMOVING COMPOUND

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

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers one grade of a single phase type liquid carbon removing compound for soak tank use in softening and facilitating effective removal of carbon, gum, and other surface contaminants (except rust and corrosion) from items such as automotive pistons, carburetors, fuel pumps and engine assemblies precleaned with degreasing solvent (see 6.1).

1.2 Classification.

1.2.1 Types. This specification covers carbon removing compound of the following types:

I - Concentrated liquid.

II - Ready to use liquid.

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.

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Federal Specifications:

- O-T-634 - Trichloroethylene, Technical.
- QQ-A-250/2 - Aluminum Alloy 3003, Plate and Sheet.
- QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet.
- QQ-B-613 - Brass, Leaded and Non-Leaded; Flat Products (Plate, Bar, Sheet, and Strip).
- QQ-B-750 - Bronze, Phosphor; Bar, Plate, Rod Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections.
- QQ-C-576 - Copper Flat Products with Slit and Edge Rolled, Sheared, Sawed, or machined Edges, (Plate, Bar, Sheet, and Strip).
- QQ-L-201 - Lead Sheet.
- QQ-M-44 - Magnesium Alloy Plate and Sheet (AZ31B)
- QQ-S-698 - Steel, Sheet and Strip, Low-Carbon.
- QQ-Z-301 - Zinc Sheet and Strip.
- TT-E-776 - Ethylene Glycol Monobutyl Ether (For Use in Organic Coatings).
- UU-P-556 - Paper, Toilet Tissue.
- PPP-D-729 - Drums: Metal, 55-gallon (For Shipment of Noncorrosive Materials).
- PPP-D-732 - Drums, Metal, 55 Gallon Reconditioned (For Shipment of Noncorrosive material).
- PPP-P-704 - Pails: Shipping, Steel (1 through 12 Gallon).

Federal Standards:

- Fed. Std. No. 123 - Marking for Shipment (Civil Agencies).
- Fed. Std. No. 313 - Material Safety Data Sheets, Preparation and the Submission of.

(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, US Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

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(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 Specification:

MIL-D-16791 - Detergents, General Purpose (Liquid, Nonionic).

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 suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

Code of Federal Regulations:

49 CFR 171-189 - Department of Transportation Rules and Regulations for the Transportation of Explosives and Other Dangerous Articles.

(The Code of Federal Regulations (CFR) are for sale on a subscription basis by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402.)

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) Standards:

D 56 - Flash Point by Tag Closed Tester, Test for.

D 92 - Flash and Fire Points by Cleveland Open Cup, Test for.

D 808 - Chlorine in New and Used Petroleum Products (Bomb Method).

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

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3. REQUIREMENTS

3.1 Qualification. The carbon removing compounds furnished under this specification shall be liquid products which are qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.4 and 6.3). The compound supplied under contract shall be identical to the material receiving qualification. Any change in formulation will necessitate requalification.

3.2 Composition. The compound will conform to all the requirements of Table I and 3.3 through 3.14. Type I compound is concentrated and shall be diluted with an equal volume of distilled water before testing for compliance with the requirements of Table I and 3.3 through 3.14.

TABLE I. Chemical requirements

Characteristics	Requirements	Test Paragraph
Chlorine derivatives	Negative	4.5.1
Aromatics, more volatile types ^{1/}	Negative	4.5.2
Water, percent by volume of compound	55 ± 3	4.5.3
Monoethanolamine, percent by volume	21.0 min.	4.5.4
Ethylene glycol monoethyl ether	Negative	4.5.5
Ethylene glycol monobutyl ether, percent by volume	9.0 min.	4.5.5
Diethylene glycol monomethyl ether, percent by volume	5.0 min.	4.5.5
Diethylene glycol monobutyl ether, percent by volume	3.0 min.	4.5.5

^{1/}

Benzene, toluene, xylene and highflash naphtha with flashpoint in range of 100° - 110°F. are not permitted. Certain high flash naphthas with relatively high flashpoint (140°F.) are permitted.

3.3 Condition in container.

3.3.1 Type I. Type I carbon removing compound shall be a liquid plus sediment. The sediment shall not be settled, caked, gelled, and/or thickened to such a degree that it cannot be easily redispersed to a uniform mixture when tested as in 4.5.6.1 (see 6.4). When diluted with an equal volume of distilled water and mixed as in 4.5.6.1, it shall be a free flowing liquid and shall not contain insoluble matter in excess of 0.020 grams/100 ml. of diluted compound when tested as described in 4.5.6.3.

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3.3.2 Type II. Type II carbon removing compound shall be a free flowing liquid when tested as in 4.5.6.2. Precipitate or insoluble matter shall not be in excess of 0.020 grams/100 ml. of compound when tested as described in 4.5.6.3.

3.4 Flashpoint. The flashpoint of the compound shall be above the initial boiling point (observed in the test cup) when tested as specified in 4.5.7 and in accordance with Fed. Std. 313.

3.5 Emulsification. When the compound is tested as specified in 4.5.8, the emulsion or solution formed shall show no sediment, curd, or scum. Creaming or opalescence shall be acceptable.

3.6 Chemical corrosion. The compound, when tested as specified in 4.5.9, shall cause no greater etching, discoloration or pitting of metals than the comparison formula of 4.5.12.2. For each metal, no panel from the test compound shall show a weight change in excess of the weight change (c) calculated for a panel of the same metal after immersion in the comparison formula mixtures. Use the following formula to calculate weight change of metal specimens in comparison formula.

$$C = x + 1.32 w$$

x = average weight change in milligrams for each metal after test in the comparison formula.

w = range, difference between smallest and largest weight losses (or smallest and largest weight gains) for each metal in the comparison formula. Considering both losses and gains as greater than zero when both occur, range is the sum of the largest weight gain and the largest weight loss.

3.7 Galvanic corrosion. The compound, when tested as specified in 4.5.10, shall cause no greater etching discoloration or pitting of metals than the comparison formula of 4.5.12.2. For each metal, no panel from test compound shall show a weight change in excess of the weight change (C) calculated for a panel of the same metal after immersion in the comparison formula mixture. Use the following formula to calculate weight change of metal specimens in comparison formula.

$$C = X + 1.32w \text{ (see 3.6)}$$

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3.8 Inhibitor stability on evaporation. There shall be no significant deterioration in corrosion inhibition when the compound is tested as specified in 4.5.11.

3.9 Carbon loosening ability at room temperature. The compound shall loosen carbon at room temperature in 16 hours as effectively as the comparison formula of 4.5.12.2 when tested as specified in 4.5.12.

3.10 Carbon loosening ability at 130°F. The compound shall loosen carbon at 130°F. (54°C.) in 4 hours as effectively as the comparison formula of 4.5.12.2 when tested as specified in 4.5.13..

3.11 Storage stability. Type I compound: After 6 months storage (plus or minus 5 days), the difficulty in dispersing any precipitate and diluting the compound as determined by 4.5.14, shall be no greater than with type I comparison formula similarly stored. Type II compound: The compound shall show no separation, precipitation or gelation greater than that of type II comparison formula after 6 months' storage (plus or minus 5 days). In addition, after the six month storage period, the compounds shall be equal in performance to the comparison formula when tested as in 4.5.9, 4.5.10, 4.5.11 and 4.5.13.

3.12 Exposure stability. The compound shall not show evidence of gelation or separation into liquid phases before the comparison formula of 4.5.12.2 when tested as specified in 4.5.15.

3.13 Hazardous materials. When ingredients other than those present in the comparison formula of 4.5.12.2 are present in the submitted cleaning compound, a quantitative statement of composition must be submitted with the qualification sample. Questions pertinent to the adverse effects of the material on the health of personnel shall be referred by the procuring activity to the appropriate department medical service who will act as an advisor to the procuring activity. A favorable opinion from the department medical service is required and rejection without laboratory testing will be made in the event of an unfavorable opinion.

3.14 Paint stripping ability. The compound shall strip paint as effectively as the comparison formula of 4.5.12.2 when tested in accordance with 4.5.17

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 commercial laboratory acceptable to 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 that supplies and services conform to prescribed requirements.

4.2 Sampling for lot acceptance.

4.2.1 Lot. For the purpose of sampling and inspection, a lot shall consist of carbon removing compound from one manufacturer's batch offered for delivery at one time.

4.2.2 Sampling for inspection of filled containers (at the contractor's plant). A random sample of filled containers shall be selected in accordance with MIL-STD-105 at inspection level 1, and acceptable quality level (AQL) = 2.5 percent defective to verify compliance with all requirements of this specification regarding fill, closure, marking and other requirements not involving tests.

4.2.3 Sampling for tests.

4.2.3.1 From each inspection lot (see 4.2.1), select two 3-gallon samples at random. The two samples shall not be taken from the same container or containers. The samples taken shall be placed in separate clean, dry, metal or glass containers, sealed, marked and forwarded to the testing laboratory.

4.2.3.2 When requested by the procuring activity, sample specimens shall be selected in accordance with 4.2.3.1 and forwarded to the specified Government laboratory for verification testing.

4.3 Inspection.

4.3.1 Inspection of filled containers (at the contractor's plant). Each sample filled container as specified in 4.2.2 shall be examined for defects of construction of the container and the closure, for evidence of leakage, and for unsatisfactory markings. 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 of the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.3.2 Lot acceptance tests. The samples, selected in accordance with 4.2.3, shall be subjected to the test specified in 4.4.2. Failure of the samples to conform to any tests specified herein shall reject the lot (i.e. batch).

4.3.3 Packaging, packing and marking. The inspector shall inspect the packaging, packing, and marking for compliance with section 5.

4.4 Classification of tests. Testing under this specification shall be for the following:

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- (a) Qualification.
- (b) Acceptance of individual lots.

4.4.1 Qualification testing shall consist of all tests specified in this specification (see 6.3).

4.4.2 Acceptance testing of individual lots shall normally consist of the following tests:

Monoethanolamine	4.5.4
Glycol ethers	4.5.5
Flashpoint	4.5.7
Chemical corrosion	4.5.9
Carbon loosening ability at 130°F	4.5.13

The procuring activity reserves the right to make any additional tests deemed necessary to determine if the cleaning compound meets the requirements of the specification. The carbon loosening ability test on each individual lot may be omitted at the discretion of the Government laboratory when the production history and tests on previous lots indicate that a material with satisfactory carbon loosening ability is being supplied.

4.5 Test procedures. The following tests shall be conducted in accordance with the applicable methods of Fed. Test Method Std. No. 791 or as required in this specification.

4.5.1 Compounds of chlorine. Use ASTM D 808 with the following changes:

Change paragraph 6.5 Determination of Chlorine to read: "Acidify the solution by adding nitric acid (1:1), drop by drop, until acid to methyl red. Filter through qualitative paper and collect in a second 600-ml. beaker. Heat the solution to incipient boiling; then add 5 ml. of silver nitrate solution. Without further heating, allow the beaker and contents to stand in a dark place for 30 minutes. If no precipitate of silver chloride has occurred, chlorine shall be considered absent. Cloudiness shall be disregarded." Delete paragraphs 6.6 through 8.1.2 of the cited test method.

4.5.2 More volatile aromatics. Place 100 ml. of the compound into a tall form gas washing bottle of approximately 250-ml. capacity equipped with a fritted glass dispersion disk on the stopper. Attach the outlet to a washing bottle containing concentrated sulfuric acid to dry the air

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before it enters a gas washing bottle, approximately 250ml. capacity, containing 100 ml. of reagent. The reagent is made by adding 95 ml. concentrated sulfuric acid to 5 ml. of 40 percent formaldehyde solution. The use of a bottle here without fritted glass facilitates the washing of the tube after use. Draw air through the system for 5 minutes at the rate of approximately 180 ml. per minute, using suction. Observe the inside of the tube for discoloration (the solution discolors in the presence of more volatile aromatics). The addition of a silicone type antifoaming agent, free of benzene, to the compound prior to passing air through the system is recommended. For a blank, use 100 ml. of the comparison formula of 4.5.12.2. A definite brown discoloration of the tube shall be taken as evidence of benzene, toluene, or other undesired hydrocarbons, and the compound displaying such color reaction shall be judged as having failed the test. Coloration not essentially different from that obtained with the comparison formula shall be disregarded. The type of coloration undesired may be determined by using a solution of 0.5 ml. toluene dissolved in 100 ml of the comparison formula of 4.5.12.2.

4.5.3 Water content. Use a 250 ml. round bottom, short neck flask with one plain side inlet tube, a 10 ml. Barret distilling receiver and a 200 millimeter (mm.) condenser. All connections shall be by ground glass joints. Transfer 100 ml. of the compound to the flask, add a boiling stone and 25 ml. water-free normal butanol. Insert a thermometer, range 20° to 580°F., 76 mm. immersion, through the side tube until the bulb is approximately 1/4 inch above the surface of the liquid. Apply heat and distill slowly. Drain the lower layer in the receiver into a 100 ml. glass stoppered graduated cylinder. When the distillate becomes clear, increase the heat and continue the distillation until the temperature of the vapors reach 300°F. During this period, the distillate shall be drained into the graduate. Two graduates shall be used, dividing the layers between them. When cool, record the volume of distillate (TV). Add anhydrous potassium carbonate until the solution is saturated and a slight excess settles out. Record the combined volumes of the top layers (TL) after salting out.

$$\text{Percent water in compound} = \text{TV} - \text{TL}$$

4.5.4 Monoethanolamine.

4.5.4.1 Indicator. Prepare a 0.1 percent solution of methyl red in methanol and a 0.1 percent solution of bromocresol green in methanol. Mix 1 part of the methyl red solution with 5 parts of the bromocresol green solution. Discard this indicator after two weeks.

4.5.4.2 Titration. Pipette 1.0 ml. of the compound to a 250 ml. erlenmeyer flask and add approximately 50 ml. of distilled water. Add 3-5 drops of the indicator in 4.5.4.1. Titrate with standardized 0.1N HCl to the disappearance of green.

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Calculation:

$$\text{Percent monoethanolamine} = A \times N \times 6.02$$

A = ml of HCl solution

N = normality of HCl solution

Examine the chromatogram obtained in 4.5.5.1.4 to confirm the presence of monoethanolamine.

4.5.5. Glycol ethers.

4.5.5.1 Ethylene glycol monoethyl ether, ethylene glycol monobutyl ether, diethyleneglycol monobutyl ether, and diethyleneglycol monomethyl ether.

4.5.5.1.1 Preparation of sample. Place approximately 35 ml. of a strongly acidic, sulfonated polystyrene type cationic exchange resin, hydrogen form, medium porosity (Amberlite IR-120 or equal) in a column. Wash with water, then with absolute ethanol. Pass 5.0 ml. of the compound diluted with 20 ml. absolute ethanol through the column. Collect the effluent in a 100 ml. volumetric flask containing 0.35 g. of ethylene glycol monoethyl ether acetate, accurately weighed to the fourth decimal. Wash the column with absolute ethanol. Continue washing until the flask is filled to the mark. Do not let the level of the liquid drop below the top of the resin. The resin can be regenerated by washing with 3N hydrochloric acid, followed by water until washings are neutral, and then with absolute ethanol.

4.5.5.1.2 Column preparation. Pack a 6 foot column of 1/4 inch copper tubing with 20 percent diethylene glycol succinate on 60 to 80 mesh acid-washed Chromosorb W. Condition the column at 190°C. for 16 hours.

4.5.5.1.3 Apparatus. The apparatus shall be a gas chromatograph equipped with a suitable recorder and a flow-control assembly to provide constant mass flow-rate of helium gas through the detector during programmed temperature operation, and separate controls for injection port, detector, and column temperatures. The operating conditions shall be as follows:

Detector cell temperature, °C	300
Detector cell current, ma	150
Injection port temperature, °C	250
Helium flow at exit, ml./minute	85
Column heating rate, °C./minute	6.0
Starting column temperature, °C	60
Finishing column temperature, °C	185

4.5.5.1.4 Analysis of sample. With the gas chromatograph set at 60°C., inject 50 microliters of the effluent from the ion exchange column and

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engage the programming mechanism immediately. After the air peak has been recorded, change the attenuation to a point of low sensitivity; after 3 minutes, reset the attenuator at the millivolt position. After 4 more minutes, adjust the base line to zero and allow the chromatogram to develop completely, adhering to the operating conditions described in 4.5.5.1.3.

Establish detector response correction factors by calibrating with known weights of glycol ethers and the internal standard. The following relative retention times are given only as a guide and for information: Ethylene glycol methyl ether-0.66; ethylene glycol monoethyl ether-0.71; ethylene glycol ethyl ether acetate-1.0; ethylene glycol monobutyl ether-1.10; diethylene glycol monobutyl ether-2.16; monoethanolamine-2.8; diethylene glycol monomethyl ether - 1.86".

Calculation:

$$(1) \text{ Percent EGMBE} = \frac{A \times W \times 20}{S \times 0.903}$$

$$(2) \text{ Percent DGMME} = \frac{B \times W \times 20}{S \times 0.943}$$

$$(3) \text{ Percent DGMBE} = \frac{C \times W \times 20}{S \times 0.955}$$

EGMBE - Ethylene glycol monobutyl ether

DGMBE - Diethylene glycol monobutyl ether

DGMME - Diethylene glycol monomethyl ether

A - Corrected area of EGMBE peak

B - Corrected area of DGMME peak

C - Corrected area of DGMBE peak

S - Area of internal standard peak

W - Weight of internal standard, ethylene glycol monoethyl ether acetate

The chromatogram shall be examined to determine absence of ethylene glycol monoethyl ether and the presence of monoethanolamine.

4.5.6 Condition in container.

4.5.6.1 Type I. The compound as received shall be thoroughly mixed by hand, stirring for 5 minutes with a rod or spatula reaching to the bottom of the original container. Examine the contents for undispersed solids and note whether any material adheres to the bottom or sides of the container or has caked or failed to redisperse. Promptly transfer 1 liter of the mixed compound to a container and observe whether gelation or thickness of the compound makes pouring difficult. Add 1 liter of distilled water and stir gently for 15 minutes. Note ease with which precipitate is dispersed. Determine quantity of insoluble matter as in 4.5.6.3.

4.5.6.2 Type II. The compound as received shall be thoroughly mixed. Transfer to a 2 liter bottle, noting ease of pouring. Determine quantity of insoluble matter as in 4.5.6.3.

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4.5.6.3 Insoluble matter. Filter 100.0 ml. of the thoroughly mixed compound, Type I diluted or Type II as received, through a medium porosity fritted glass crucible. Prepare the crucible with a glass fiber filter disc or with an asbestos mat, wash with distilled water, then ethanol, and dry for 30 minutes at 110°C. Weigh to 0.1 mg. When all the compound has been filtered, wash container and crucible with about 30 ml. distilled water, transferring insoluble matter to the crucible. Wash crucible with 50 ml. ethanol, using small portions in both cases. Dry crucible at 110°C., cool in a desiccator and weigh. The increase in weight shall be reported as grams insoluble matter per 100 ml. compound. Check for compliance with 3.3.1 or 3.3.2.

4.5.7 Flashpoint. Determine the flashpoint as specified in ASTM D 92. Check for compliance with 3.4.

4.5.8 Emulsification. Add 90 ml. of 15 grain per gallon hard water to 10 ml. of compound in a 100-ml. glass-stoppered graduated cylinder. Close the cylinder and shake it for 30 seconds at a rate of 4 cycles per second. Allow the emulsion or solution to stand undisturbed for 4 hours. Without disturbing the graduated cylinder, observe for the presence of scum, curd, or a definite layer of sediment. The hard water shall be prepared by dissolving 0.156 g. of anhydrous calcium chloride and 0.236 g. of magnesium chloride, hexahydrate, in 1 liter of distilled water.

4.5.9 Chemical corrosion.

4.5.9.1 Preparation of test panels. Test panels 3- by 1/2- by 1/32- to 1/16-inch size of the following metals shall be used: Aluminum alloy, temper H14 or H24 conforming to QQ-A-250/2; magnesium alloy conforming to QQ-M-44; bronze conforming to QQ-B-750, composition D, hard; zinc conforming to QQ-Z-301, type 1; brass conforming to QQ-B-613, composition 1, cold rolled, half-hard. Polish eight test panels of each metal, 4 for the comparison formula of 4.5.12.2 and 4 for the compound, by stroking each face approximately 25 times with No.50 aluminum oxide cloth followed by 25 strokings with No. 150 aluminum oxide paper on each face. Polish edges smooth. Wash the panels with ethyl alcohol, dry with paper towelling; and weigh to nearest 0.1 milligram (mg.). Then place panels into test tubes approximately 19 by 150mm. in size.

4.5.9.2 Test procedure. Add approximately 25 ml. of the compound to each test tube. Stopper the test tubes with cork stopper, and place in an oven or bath at 54° + 2°C. for 4 hours. At the end of this period, remove the panels from the tubes, wash thoroughly under running water, then with ethyl alcohol, dry with paper towelling and reweigh. Discoloration, pitting, and etching shall be noted. Check for compliance with 3.6.

4.5.10 Galvanic corrosion.

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4.5.10.1 Preparation of panels. The panels shall be 1 by 1 inch square and approximately 0.03 inch thick except that the lead shall be approximately 1/16 inch thick. Metals shall include copper conforming to QQ-C-576, temper, cold rolled, light; magnesium alloy conforming to QQ-M-44; aluminum alloy 2024 temper T4 conforming to QQ-A-250/4; steel conforming to QQ-S-698, cold rolled, SAE 1020, half hard; and lead conforming to QQ-L-201. Make two holes in each panel, so that they may be fastened together, as shown in Figure 1. After the plates are polished, washed, dried, and weighed (as prescribed in 4.5.9.1), fasten them together by means of cotton string, making sure of good contact between metals. There shall be no contact between magnesium and lead or between aluminum and copper plates. Place each set of assembled panels in a 250-ml. beaker. Use four sets of assembled panels for the comparison formula of 4.5.12.2 and four for the compound under test.

4.5.10.2 Test procedure. Add approximately 200 ml. of the compound to each set of assembled panels. Cover beakers and place in an air oven bath at $54^{\circ} \pm 2^{\circ}\text{C}$. for 24 hours. At the end of this time, remove the panels from the beakers and rinse with water. Cut the strings and separate the panels. Wash panels under running water, then with ethyl alcohol, dry with paper towelling and reweigh. Discoloration, pitting, and etching shall be noted. Check for compliance with 3.7.

4.5.11 Inhibitor stability on evaporation. Place 50 ml. of the compound in a 100-ml. Griffin beaker containing a short stirring rod. Mark the level on the beaker. Let stand, uncovered, for 6 days, making up to the mark each day with distilled water. At the end of this period, filter the compound through shark skin filter paper to remove solid matter. Prepare one aluminum panel of QQ-A-250/2 as in 4.5.9.1. Immerse panel in the filtered cleaner in a test tube and observe after 30 minutes and also after 2 hours. Evolution of gas shall be considered as evidence of significant deterioration of corrosion inhibition.

4.5.12 Carbon loosening ability at room temperature. In the selection, cleaning and evaluation of pistons for the carbon loosening test, the top surface only of the piston sections shall be considered.

4.5.12.1 Preparation of soil control compound. Combine solution K with solution L and mix thoroughly. Avoid skin contact. This compound is used in selecting valid test pistons. Mix 1 part of the compound with 3 parts distilled water for use in the cleaning tests.

Solution K:

*KOH (85 percent assay)	5.4 g.
H ₂ O (distilled)	6.0 g.

Solution L:

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Cresol (U.S.P.) 65.2 ml.
Oleic acid (technical) 25.0 ml.

*If lower assay is used, calculate equivalent KOH content. Do not use less than 83 percent assay.

4.5.12.2 Preparation of comparison formula. Prepare the comparison carbon removing compound as specified in Table II. Mix all ingredients together except the sodium silicate solution. Stir the mixture into the sodium silicate solution. Caution: Use goggles and avoid skin contact.

TABLE II Comparison formula

Components	Percent by Volume	
	Type I ^{1/}	Type II
Ethylene glycol monobutyl ether, conforming to TT-E-776	18.0	9.0
Diethylene glycol monobutyl ether (sp. gr. 0.953-0.958 at 20/20°C.; boiling range 220°-235°C. at 760 mm.; acidity not over 0.02 percent as acetic acid)	7.8	3.9
Diethylene glycol monomethyl ether (sp. gr. 1.020-1.030 at 20/20°C.; boiling range 188°-198°C. at 760 mm.; acidity not over 0.02 percent as acetic acid)	12.0	6.0
Detergent, nonionic conforming to MIL-D-16791, type 1	4.0	2.0
Oleic acid, technical	4.0	2.0
Monoethanolamine (sp. gr. 1.017-1.027 at 20/20°C.; boiling range 160°-176°C. at 760 mm.)	43.0	21.5
Sodium silicate solution (0.25 percent by volume of 40° Baumé solution ^{2/} in distilled water)	--	55.6
Sodium silicate solution (2.48 percent by volume of 40° Baumé solution ^{2/} in distilled water)	11.2	--

^{1/}Mix the type 1 formulation with an equal volume of distilled water.
^{2/}Sodium silicate, 40° Baume, with a ratio of 1 Na₂O:3.2 SiO₂ has proved satisfactory.

4.5.12.3 Preparation of piston for testing. Aluminum pistons taken from internal combustion engines shall be cleaned with hard bristle brush and mineral spirits or Stoddard solvent. Dry them with paper towelling. Select six pistons which have at least three-fourths of the surface covered with heavy crusty soil. Cut each piston into 12 equal sections, leaving an uncut center section approximately 1/2 to 3/4 inch in diameter (see fig. 2). From each piston select not less than 4 pair of matched adjacent sections, that is sections which are soiled as similarly as possible. Pistons larger than 4-1/2 inches in diameter may be cut into 16 sections.

4.5.12.4 Cleaning procedure. Test the soil control compound, the comparison formula and the submitted carbon remover at the same time. Place the uncut center of each piston into soil control compound (4.5.12.1), one of each matched pair of sections into the comparison formula (4.5.12.2) and the other into the carbon removing compound being tested. The same amount of each compound should be used, each sections should be completely submerged and held off the bottom by means of a small glass rod, and each pair of matched sections should be kept as a distinct unit. Allow the sections to remain in the cleaning compound for 16 hours at room temperature. Then remove the sections (using rubber gloves) and scrub them with hard bristle brush and cool water (about 85°F.). Make sure that each section is cleaned thoroughly and in a similar manner. Place the original matched sections on paper towelling keeping each piston separate, and allow them to air dry.

4.5.12.5 Evaluation of test results. Compare the center sections cleaned with the soil control compound (4.5.12.1) and the sections cleaned with the comparison formula (4.5.12.2). The ones in the comparison formula must be more free of carbon than the ones in the soil control to be considered as valid test pistons. Use six valid tests pistons for the evaluation of the test compound. Compare the matched sections of each valid test piston. Consider the section superior which has the most area free of any soil or smudge when examined visually. The test compound fails the carbon loosening requirement if there is more than one piston in which it is inferior that is not balanced by a piston in which it is superior and shall pass in all other cases. The test compound shall be considered as inferior in the individual piston test when there is more than one section in which it is inferior that is not balanced by a section in which it is superior. The test compound shall be considered as superior in the individual piston test when there is more than one section in which it is superior that is not balanced by a section in which it is inferior. In all other cases, the compound shall be considered equal for individual piston test.

4.5.13 Carbon loosening ability at 130°F. Conduct the test outlined in 4.5.12 on another group of pistons using a temperature of 130°F. (54°C.) and an immersion time of $4 \pm 1/4$ hour.

4.5.14 Storage stability. The compound when received shall be thoroughly mixed by stirring for 5 minutes with a rod or spatula reaching to the bottom of the original container. Fill a two liter glass stoppered bottle with a representative sample. Examine the contents for undispersed solids or gel and note whether any material adheres to the bottom or sides of the container or has caked and fails to redisperse.

It shall be kept together with two liters of the comparison formula of the same type in a place relatively free of vibration at room temperature. After six months, plus or minus 5 days, type II compound shall be compared to the comparison formula for evidence of separation,

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precipitation or gelation. For type I compounds, shake the bottles and transfer the liquid to a large container. Add two liters of distilled water to the bottle and add to the concentrate and stir gently for 15 minutes. Note ease with which silicate is dispersed. Compare the precipitate in the compound with that in the diluted comparison formula. The compounds shall then be compared for performance in the tests of 4.5.9, 4.5.10, 4.5.11, and 4.5.13.

4.5.15 Exposure stability. Place 50 ml. of the compound in a 100 ml. Griffin beaker containing a short stirring rod. Use two for the compound under test and two for the comparison formula. Mark the level on the beaker. Let stand, uncovered, in an area relatively free of drafts. Each day make up to the mark with distilled water, stir gently and examine for gelation or separation. Continue the test until separation of liquid phases occurs. Check for compliance with 3.12.

4.5.16 Hazardous materials. The supplier shall furnish the toxicological data and formulations required to evaluate the safety of the material for the proposed use.

4.5.17 Paint stripping ability.

4.5.17.1 Preparation of test panels. Perform test on panels of SAE 1020, 20 gage, cold worked steel. Panels 3 by 6 inches or larger are satisfactory. Degrease the panels in trichloroethylene vapor conforming to O-T-634, type II, then wipe with lint-free rags, removing all rust with No. 0 emery cloth. Degrease the panels again in trichloroethylene vapor and then dry. Apply one coat of material conforming to TT-E-485, type IV, by spray to one side of the panels to a dry film thickness of 0.7 to 1.0 mil. Bake the sprayed panels 30 minutes at 300°F., condition 24 hours at room temperature and then age for 24 hours at 120°F. The panels may be used at any time subsequent to this treatment if the paint is undamaged.

4.5.17.2 Test procedure. On the painted surface, not closer than 2 centimeters (cm) from the edge, place about 1/2 ml. of the compound. Immediately cover with a 2.5 cm. watchglass. The space under the watchglass should be filled with the compound. On another area of the same panel, perform the test using the comparison formula of 4.5.12.2, similarly spaced, and not closer than 2.5 cm. to the compound under test. Perform the test in duplicate. After 30 minutes, remove watchglass and rub with the moistened tissue described below. Cup this tissue on the index finger, and rub using pressure and 20 circular strokes. Use pressure as identical as possible for both test compound and comparison formula. If panels are correctly prepared and test is properly done, paint will be stripped by the comparison formula. Prepare the tissue paper (conforming to UU-P-556) by taking two sheets, folding them at the perforation, and then refolding in halves, quarters, eights, and

finally sixteenths. The final edge should be about 3 cm. Moisten the tissue, pressing out excess water with the thumb and fingers while holding the tissue relatively flat. Cup moist tissue over the index finger.

5. PREPARATION FOR DELIVERY.

5.1 Packaging. The packaging shall be level A, B, or C as specified (see 6.2) and in accordance with Department of Transportation - 49CFR 171-189.

5.1.1 Level A. The carbon removing compound shall be furnished in 5- or 55-gallon drums as specified in the contract or order (see 6.2). Five-gallon pails shall conform to type 1, class 3 or 8 of PPP-P-704. Each pail shall be equipped with spout or nozzle closure, with outer seal. The color of the exterior coating shall be olive drab. Fifty-five-gallon drums shall conform to type II of PPP-D-729.

5.1.2 Level B. The carbon removing compound shall be furnished in 5- or 55-gallon drums as specified in the contract or order (see 6.2). Five gallon pails shall conform to type 1, class 3 or 8 of PPP-P-704. Each pail shall be equipped with spout or nozzle closure, with outer seal. Fifty-five gallon drums shall conform to PPP-D-732 type II or PPP-D-729, type II.

5.1.3 Level C. The carbon removing compound shall be packaged in accordance with supplier's commercial practice. Protection shall be such as to prevent deterioration during shipment and insure safe delivery at destination.

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

5.2.1 Levels A and B. Five- and 55-gallon drums will require no over-packing.

5.2.2 Level C. The carbon removing compound shall be packed for shipment in compliance with common carrier regulations applicable to that mode of transportation to ensure safe delivery at destination at lowest transportation costs without assessment of penalty charges for improper packing.

5.3 Marking.

5.3.1 Civil agencies. Containers shall be marked in accordance with Fed. Std. No. 123. Each container shall also be labeled as specified in 5.3.3.

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5.3.2 Military activities. Containers shall be marked in accordance with MIL-STD-129. Each container shall also be labeled as specified in 5.3.3.

5.3.3 Instruction label. A suitable label with the following instructions printed thereon shall be attached to each container.

For type I compounds:

Directions For Use

1. This compound is to be diluted with water before use. Vigorously shake can or stir to mix contents thoroughly. Transfer compound to cleaning bath and add an equal volume of water. Stir bath for 15 minutes.

2. Fill cleaning bath to a reference mark with fresh compound.

3. Before soaking item in compound, remove all loose grease, dirt and oil with a degreasing solvent (kerosene, Stoddard solvent, etc.). Place objects to be cleaned in a wire basket or hang them by a wire so as to be off the bottom and completely immersed.

4. Soak for 2 to 16 hours as necessary to remove or loosen carbon. Raise items slowly, allowing for drainage. Rinse with water, kerosene or solvent. To effectively remove carbon, brush with a stiff bristle brush under running hot water.

5. Make-up liquid and drag out replacement:

a. Fill tank with fresh cleaner and mark level permanently after reaching operating temperature (do not use at temperatures above 130°F.).

b. After work is completed for the day, add make-up liquid (see paragraph (e) for composition) in the amount calculated by multiplying the number of hours of operation by the factor determined in (f).

c. After adding make-up liquid, add original cleaner until liquid is at original tank level to correct for drag out.

d. Before starting operations for the day, when bath reaches operating temperature add make-up liquid if needed.

e. Make-up liquid consists of 3 gallons ethyleneglycol monobutyl ether, and 3 pints monoethanolamine to every 45 gallons water. Mix thoroughly. This must be used to restore cleaner to original composition and maintain activity.

f. Determine loss by evaporation to be replaced by make-up liquid by the following procedure:

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- (1) Bring tank with cleaner to operating temperature. Mark original tank level permanently.
- (2) Maintain at operating temperatures for 4 hours.
- (3) Determine number of gallons of make-up liquid needed to restore tank to marked level.
- (4) Divide this number by 4, to determine number of gallons of make-up liquid to be added per every hour of operation.

6. **Warning!** Harmful or fatal if swallowed. Avoid contact with skin, eyes and clothing. In case of contact, immediately flush with plenty of water for at least 15 minutes, for eyes, obtain medical attention. Avoid prolonged breathing of vapor. Use with adequate ventilation. The use of gloves and protective equipment is recommended.

7. Ingredients. This carbon removing compound contains - (The manufacturer shall list ingredients. "Glycol ethers" may be used instead of listing individual ingredients of the glycol ether type.)

8. The compound is formulated to clean soiled pistons in 16 hours at room temperature or in 4 hours at 130°F.

9. This carbon removing compound will also remove paint.

For type II compounds:

DIRECTION FOR USE

1. This compound is ready for use. Do not add solvent or water.
2. Fill cleaning bath to a reference mark with fresh compound.
3. Before soaking item in compound, remove all loose grease, dirt and oil with a degreasing solvent (kerosene, Stoddard solvent, etc.). Place objects to be cleaned in a wire basket or hang them by a wire so as to be off the bottom and completely immersed.
4. Soak for 2 to 16 hours as necessary to remove or loosen carbon. Raise items slowly, allowing for drainage. Rinse with water, kerosene or solvent. To effectively remove carbon, brush with a stiff bristle brush under running hot water.
5. Make-up liquid and drag out replacement:
 - a. Fill tank with fresh cleaner and mark level permanently after reaching operating temperature (do not use at temperature above 130°F.).

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b. After work is completed for the day, add make-up liquid (see paragraph (e) for composition) in the amount calculated by multiplying the number of hours of operation by the factor determined in (f).

c. After adding make-up liquid, add original cleaner until liquid is at the original tank level to correct for drag out.

d. Before starting operations for the day, when bath reaches operating temperature add make-up liquid if needed.

e. Make-up liquid consists of 3 gallons ethyleneglycol monobutyl ether, and 3 pints monoethanolamine to every 45 gallons water. Mix thoroughly. This must be used to restore cleaner to original composition and maintain activity.

f. Determine loss by evaporation to be replaced by make-up liquid by the following procedure:

(1) Bring tank with cleaner to operating temperature. Mark original tank level permanently.

(2) Maintain at operating temperature for 4 hours.

(3) Determine number of gallons of make-up liquid needed to restore tank to marked level.

(4) Divide this number by 4, to determine number of gallons of make-up liquid to be added per every hour of operation.

6. Warning! Harmful or fatal if swallowed. Avoid contact with skin, eyes and clothing. In case of contact, immediately flush with plenty of water for at least 15 minutes; for eyes, obtain medical attention. Avoid prolonged breathing of vapor. Use with adequate ventilation. The use of gloves and protective equipment is recommended.

7. Ingredients. This carbon removing compound contains - (The manufacturer shall list ingredients. "Glycol ethers" may be used instead of listing individual ingredients of glycol ether type.)

8. The compound is formulated to clean soiled pistons in 16 hours at room temperatures or in 4 hours at 130°F.

9. This carbon removing compound will also remove paint.

6. NOTES

6.1 Intended use. The carbon removing compound covered by this

specification is intended for soak-tank use in softening and facilitating effective removal of carbon, gum and other surface contaminants (except rust and corrosion) from items such as automotive pistons, carburetors, fuel pumps and engine assemblies. (These items should be precleaned with degreasing solvent before immersing in carbon removing compound). This material will not effectively remove carbon from the hot sections (or parts) of jet engines. Type II compound is in a ready-to-use form while type I compound is concentrated and must be reduced with 1 part water to 1 part compound for use. This carbon removing compound will remove some organic coatings from metal surfaces.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Type (see 1.2.1).
- (c) Levels of packaging and packing required (see section 5).
- (d) Unit and exterior package quantities, when applicable.
- (e) Carbon removing compound should be purchased by volume, the unit being the US gallon of 231 cubic inches at 68°F. (20°C.).

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 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. The activity responsible for the Qualified Products List is the US Army Mobility Equipment Research & Development Command, Materials Technology Lab, Fort Belvoir, VA 22060 and information pertaining to qualification of products covered by this specification may be obtained from that activity.

6.4 The sediment, which is redispersible, is the inhibitor and forms an essential part of the type I compound. The small amount remaining on dilution does not interfere with the performance of the compound.

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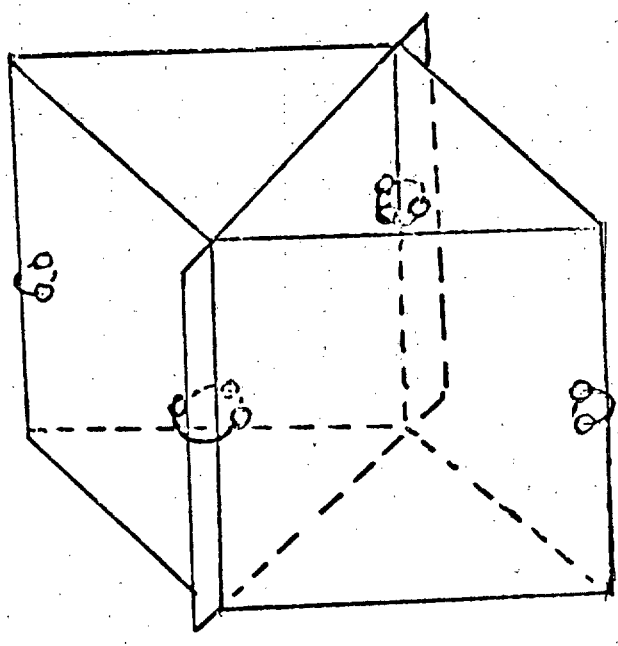
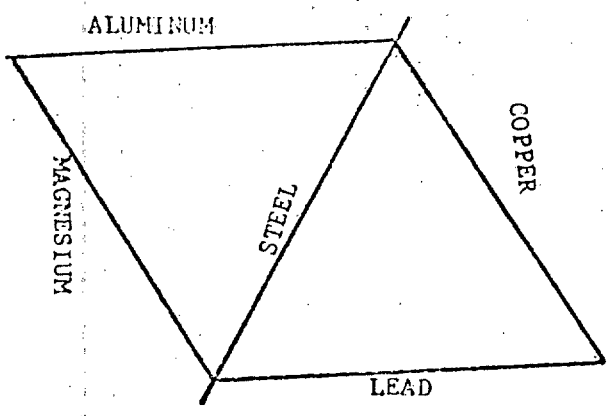


FIGURE 1
ARRANGEMENT OF PANELS FOR GALVANIC CORROSION

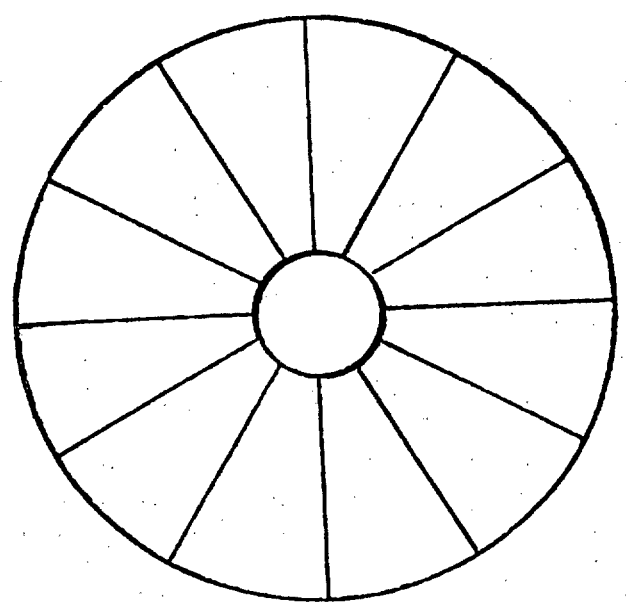


FIGURE 2
SECTIONED PISTON, TOP VIEW

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MILITARY CUSTODIANS:

Army - MR
Navy - AS
Air Force - 11

CIVIL AGENCY COORDINATING ACTIVITY:

GSA - FSS
Preparing activity:

Review activities:

Army - MR

Army - MD, ME, SM, WC
Air Force - 68
DSA - GS

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Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein. Price 50 cents each.

SPECIFICATION ANALYSIS SHEET

Form Approved Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity.

SPECIFICATION

P-C-111D, Carbon Removing Compound

ORGANIZATION

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

 DIRECT GOVERNMENT CONTRACT SUBCONTRACT

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

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

 YES NO IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

DATE

DD FORM 1426
1 APR 63

REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE