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MIL-F-16884G
7 March 1973
SUPERSEDING
MIL-F-16884F
3 November 1965
(See 6.4)

MILITARY SPECIFICATION

FUEL OIL, DIESEL, MARINE

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

1. SCOPE

1.1 This specification covers one grade of marine Diesel fuel (NATO symbol F-76).

2. APPLICABLE DOCUMENTS

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

STANDARDS

FEDERAL

FED-STD-791 - Lubricants, Liquid Fuels, and Related Products; Method of Testing.

MILITARY

MIL-STD-290 - Packaging, Packing and Marking of Petroleum and Related Products.

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

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 86 - Distillation of Petroleum Products.
D 93 - Flash Point by Pensky-Martens Closed Tester.
D 97 - Pour Point.
D 129 - Sulfur in Petroleum Products by the Bomb Method.
D 130 - Copper Corrosion by Petroleum Products.
D 287 - API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method).
D 445 - Viscosity of Transparent and Opaque Liquids (Kinematic and Dynamic Vicosities).
D 482 - Ash from Petroleum Products.
D 524 - Ramsbottom Carbon Residue of Petroleum Products.
D 611 - Aniline Point and Mixed Aniline Point of Petroleum Products and Hydrocarbon Solvents.
D 613 - Ignition Quality of Diesel Fuels by the Cetane Method.
D 665 - Rust-Preventing Characteristics of Steam-Turbine Oil in the Presence of Water.
D 974 - Neutralization Number by Color-Indicator Titration.
D 976 - Calculated Cetane Index of Distillate Fuels.
D 1500 - ASTM Color of Petroleum Products (ASTM Color Scale).
D 1552 - Sulfur in Petroleum Products (High-Temperature Method), Test for.
D 2274 - Test for Stability of Distillate Fuel Oil (Accelerated Method).
D 2500 - Test for Cloud Point of Petroleum Oils.
D 2622 - Test for Sulfur in Petroleum Products (X-Ray Spectrographic Method).
D 2709 - Water and Sediment in Distillate Fuels by Centrifuge, Test for.
E 29 - Recommended Practice for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values.

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

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

3. REQUIREMENTS

3.1 Requirements contained herein are not subject to corrections for tolerance of test methods. If multiple determinations are made by the inspecting labboratory, average results will be used except for those test methods where repeatability data are given. In those cases, the average value derived from the individual results that agree within the repeatability limits given may be used at the discretion of the inspection authority, provided an indication is given of the total number or results obtained and the number falling outside the repeatability limits. For purposes of determining conformance with each requirement, and observed value or calculated value shall be rounded off "to the nearest unit" in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding-off procedure given in ASTM E 29.

3.2 Material. The fuel supplied under this specification shall be distillate fuel and may contain only those additives specified in 3.4.

3.3 Chemical and physical requirements. The diesel fuel shall conform to the physical and chemical requirements specified in table I.

Table I - Chemical and physical requirements.

Characteristics	Requirements	FED-STD-791 test method	ASTM test method
Ignition quality, cetane number (min) (see 4.3.1)	45		D 613
Appearance 1/	Clear, bright, and free from visible particulate matter.		
Distillation:			
50 percent point, °F	Record		
90 percent point, °F (max)	675°F (357.2°C)		D 86
End point, °F (max) 2/	725°F (385°C)		
Residue plus loss, percent (max)	3.0		
Flash point °F (min)	140°F (60°C)		D 93
Pour point, °F (max)	20°F (-6.7°C)		D 97
Cloud point, °F (max)	30°F (-1.1°C)		D 2500
Viscosity at 100°F (37.8°C) Kinematic, centistokes	1.8 - 4.5		D 445
Carbon residue, on 10 percent bottoms, percent (max) (see 4.6.2)	0.20		D 524
Sulfur, percent (max)	1.00		D 129 3/
Corrosion (max) at 212°F (100°C)	No. 1 ASTM		D 130
Color (max)	5		D 1500
Ash, percent (max)	0.005		D 482
Gravity (hydrometer)	Record		D 287
Demulsification, minutes (max) (see 4.6.3)	10	3201	-----
Acid number (max)	0.30		D 974
Neutrality	Neutral	5101	-----
Aniline point, °F	Record		D 611
Accelerated stability, total insolubles mg/100 ml (max)	2.5 4/		D 2274

1/ A slight haze is acceptable providing a maximum water and sediment of 0.01 percent is obtained using procedure ASTM D 2709.
2/ As the end point of the distillation is approached, if either a thermometer reading 725°F (385°C) or a decomposition point is observed, discontinue the heating and resume the procedure as directed in ASTM D 86.
3/ ASTM D 1552 and ASTM D 2622 may be used as alternate methods.
4/ Average of three determinations is acceptable.

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3.4 Additives. The additives listed herein may be used singly or in combination in amounts not to exceed those specified.

3.4.1 Antioxidants. The following active inhibitors may be blended separately or in combination into the fuel in total concentration not in excess of 8.4 pounds of inhibitor (not including weight of solvent) per 1,000 barrels of fuel (9.1 grams (g)/100 gallons (gal) (U.S.), 24 milligrams (mg)/liter or 109 mg/gal (U.K.)) in order to prevent the formation of gum:

(a) N,N' - diisopropyl-para-phenylenediamine
(b) N,N' - disecondary butyl-para-phenylenediamine
(c) 2,6 - ditertiary butyl-4-methylphenol
(d) 2,4 - dimethyl-6-tertiary butylphenol
(e) 2,6 - ditertiary butylphenol
(f) 75 percent min. 2,6-ditertiary butylphenol
25 percent min. tertiary and tritertiary butylphenols

3.4.2 Metal deactivator. A metal deactivator, N, N' - disalicyclidene-1, 2 propanediamine may be blended into the fuel in an amount not to exceed 2 pounds of active ingredient per 1,000 barrels of fuel (2.2g/100 gal (U.S.), 5.8 mg/liter or 25 mg/gal (U.K.)).

3.4.3 Ignition improver. The following additives, to raise the ignition quality of the fuel, may be used as required to conform to this specification:

Amyl nitrate (mixed primary nitrates).
Hexyl nitrate (N-hexyl nitrate).
Cyclohexyl nitrate.

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 Lot.

4.2.1 Bulk lot. Bulk lot shall be considered an indefinite quantity of a homogenous mixture of material offered for acceptance in a single isolated container.

4.2.2 Packaged lot. Packaged lot shall be considered an indefinite number of 55-gallon drums or smaller unit containers of identical size and type, offered for acceptance, and filled with a homogenous mixture of material from one isolated container; or filled with a homogenous mixture of material manufactured in a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

4.3 Sampling.

4.3.1 Sampling for examination of the preparation for delivery.

4.3.1.1 Packaged lot. A random sample of packed containers shall be taken from each lot in accordance with MIL-STD-105, at inspection level II, and acceptable quality level (AQL) equals 2.5 percent defective. Examine the sample in accordance with 4.4.1.

4.3.2 Sampling for tests. Take samples for tests in accordance with ASTM D 270. Test the samples in accordance with table I and 4.6.

4.4 Inspection. Perform inspection in accordance with method 9601 of FED-STD-791.

4.4.1 Examination of the preparation for delivery. Samples taken in accordance with 4.3.1 shall be examined for compliance with MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing, and marking requirements. Reject any container having one or more defects, or under the required fill. If the number of defective or underfilled containers exceeds the acceptance number for the appropriate plan of MIL-STD-105, the lot represented by the sample shall be rejected.

4.5 Classification of tests. All tests are quality conformance tests.

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4.6 Test methods.

4.6.1 Ignition quality. When the apparatus specified in ASTM D 613 is not available for product inspection purposes, the cetane index may be authorized in lieu of the cetane number, provided that sufficient data are available to establish the cetane index number correlation for a finished product or a blend of products from the same manufacturing process or processes and the same specific crude source. In all instances the product submitted shall be of sufficiently high cetane index to assure a cetane number at least as high as that shown in table I. In no case shall the cetane index be less than 45. The calculated cetane index shall not be used in determining the ignition quality of fuel containing ignition improvers. The cetane index shall be determined by ASTM D 976.

4.6.2 Carbon residue. When the finished fuel contains a cetane improver the carbon residue requirement specified in table I shall apply to the base fuel without the cetane improver.

4.6.3 Demulsification. The test for demulsification shall be conducted in accordance with method 3201 of FED-STD-791 with the following exceptions:

(a) Synthetic sea water prepared in accordance with ASTM D 665 shall be used as the emulsifying fluid.
(b) The test temperature shall be 77° ± 2°F (25° ± 1.1°C).
(c) The demulsification time shall be that required for separation into two layers with no cuff at the interface. A lacy emulsion which does not form a band or cuff on the wall of the cylinder shall be disregarded.

4.7 Inspection of preparation for delivery. The packaging, packing, and marking shall be inspected for compliance with section 5 of this specification.

5. PREPARATION FOR DELIVERY

5.1 Packaging, packing, and marking. Packaging, packing, and marking shall be in accordance with MIL-STD-290. The level of packaging, level of packing, type, and size shall be as specified (see 6.2).

6. NOTES

6.1 Intended use. This grade of marine Diesel fuel is intended for use in Diesel engines in submarines and for such other uses as may be specified at temperature above 30°F (-1.1°C).

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Applicable level of packaging and packing required (see 5.1).
(c) Unit container quantity (see 5.1).

6.3 Certain provisions of this specification are the subject of international standardization agreement NATO STANAG-1135. When amendment, revision, or cancellation of this specification is proposed which will affect or violate the international agreement concerned, the preparation activity will take appropriate reconciliation action through international standardization channels including departmental standardization offices, if required.

6.4 THE MARGINS OF THIS SPECIFICATION ARE MARKED "#" TO INDICATE WHERE CHANGES (ADDITIONS, MODIFICATIONS, CORRECTIONS, DELETIONS) FROM THE PREVIOUS ISSUE HAVE BEEN MADE. THIS WAS DONE AS A CONVENIENCE ONLY AND THE GOVERNMENT ASSUMES NO LIABILITY WHATSOEVER FOR ANY INACCURACIES IN THESE NOTATIONS. BIDDERS AND CONTRACTORS ARE CAUTIONED TO EVALUATE THE REQUIREMENTS OF THIS DOCUMENT BASED ON THE ENTIRE CONTENT IRRESPECTIVE OF THE MARGINAL NOTATIONS AND RELATIONSHIP TO THE LAST PREVIOUS ISSUE.

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International interest (see section 6)

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