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PERFORMANCE SPECIFICATION

LUBRICATING OIL, SHIPBOARD INTERNAL COMBUSTION ENGINE, HIGH-OUTPUT DIESEL

This specification is approved for use by the Naval Sea Systems Command and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers one grade (SAE International 40) of lubricating oil for use in shipboard internal combustion diesel engines, such as advanced design high-output shipboard main propulsion and auxiliary diesel engines, using fuel conforming to MIL-DTL-16884 and MIL-DTL-5624. This lubricating oil is identified as Military Symbol 9250 and NATO Code 0-278.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9510-AB-ATM-010 - Nuclear Powered Submarine Atmosphere Control Manual

(Copies of the chapter titled “Material Control Program” are available by email request to CommandStandards@navy.mil.)

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy mil, with the subject line “Document Comment”. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A FSC 9150

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN PETROLEUM INSTITUTE (API)

API 1509 - Engine Oil Licensing and Certification System

(Copies of this document are available online at www.api.org.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

ASQ Z1.4 - Sampling Procedures and Tables for Inspection by Attributes

(Copies of this document are available online at www.asq.org.)

ASTM INTERNATIONAL

ASTM D92 - Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D97 - Standard Test Method for Pour Point of Petroleum Products

ASTM D129 - Standard Test Method for Sulfur in Petroleum Products (General Bomb Method)

ASTM D130 - Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

ASTM D287 - Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)

ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)

ASTM D874 - Standard Test Method for Sulfated Ash from Lubricating Oils and Additives

ASTM D892 - Standard Test Method for Foaming Characteristics of Lubricating Oils

ASTM D1091 - Standard Test Methods for Phosphorus in Lubricating Oils and Additives

ASTM D1298 - Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

ASTM D1552 - Standard Test Method for Sulfur in Petroleum Products (High-Temperature Method)

ASTM D2270 - Standard Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100 °C

ASTM D2622 - Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-Ray Fluorescence Spectrometry

ASTM D2896 - Standard Test Method for Base Number of Petroleum Products by Potentiometric Perchloric Acid Titration

ASTM D3228 - Standard Test Method for Total Nitrogen in Lubricating Oils and Fuel Oils by Modified Kjeldahl Method

ASTM D4047 - Standard Test Method for Phosphorus in Lubricating Oils and Additives by Quinoline Phosphomolybdate Method

ASTM D4052	-	Standard Test Method for Density, Relative Density and API Gravity of Liquids by Digital Density Meter
ASTM D4057	-	Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D4485	-	Standard Specification for Performance of Active API Service Category Engine Oils
ASTM D4628	-	Standard Test Method for Analysis of Barium, Calcium, Magnesium, and Zinc in Unused Lubricating Oil by Atomic Absorption Spectrometry
ASTM D4629	-	Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection
ASTM D4927	-	Standard Test Methods for Elemental Analysis of Lubricant and Additive Components - Barium, Calcium, Phosphorus, Sulfur, and Zinc by Wavelength-Dispersive X-Ray Fluorescence Spectroscopy
ASTM D4951	-	Standard Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry
ASTM D5182	-	Standard Test Method for Evaluating the Scuffing Load Capacity of Oils (FZG Visual Method)
ASTM D5762	-	Standard Test Method for Nitrogen in Petroleum and Petroleum Products by Boat-Inlet Chemiluminescence
ASTM D5949	-	Standard Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)
ASTM D5950	-	Standard Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)
ASTM D6443	-	Standard Test Method for Determination of Calcium, Chlorine, Copper, Magnesium, Phosphorus, Sulfur, and Zinc in Unused Lubricating Oils and Additives by Wavelength Dispersive X-ray Fluorescence Spectrometry (Mathematical Correction Procedure)
ASTM D6481	-	Standard Test Method for Determination of Phosphorus, Sulfur, Calcium, and Zinc in Lubrication Oils by Energy Dispersive X-ray Fluorescence Spectroscopy
ASTM D6557	-	Standard Test Method for Evaluation of Rust Preventive Characteristics of Automotive Engine Oils
ASTM E29	-	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

(Copies of these documents are available online at www.astm.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The lubricating oils furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Material. Lubricating oils shall consist of virgin refined mineral stocks. The stocks shall be blended with additives as is necessary to meet the specification requirements.

3.3 Lubrication. The oil shall lubricate oil-lubricated high-output marine diesel engine parts, engine-driven generator bearings, and associated equipment.

3.4 Performance. The oil shall perform when used with all types of diesel engine bearing materials, shall cause neither excessive ring sticking nor clogging of oil channels, shall keep cylinder and ring wear down to a minimum, and shall not cause excessive lacquer, carbon, or sludge deposits on any part of the engines in which it is intended for use. Oils qualified under this specification shall comply with the acceptance criteria in ASTM D4485 for American Petroleum Institute (API) Category CH-4 at a minimum when tested in accordance with the engine tests of 4.6.1 (see 6.4).

3.5 Compatibility. The addition of a new diesel engine lubricating oil to any other new lubricating oil conforming to this specification shall not cause separation of components (see 4.6.2).

3.6 Homogeneity. Additive agents, when used, shall remain uniformly distributed throughout the oil at all temperatures above the pour point up to 180 °C. If the oil is cooled below its pour point, it shall regain its homogeneity at a temperature of 6 °C above its pour point within 24 hours (see 4.6.3).

3.7 Chemical and physical requirements. The oils shall conform to the chemical and physical requirements shown in table I.

TABLE I. Chemical and physical requirements.

Characteristics	Requirements	Methods (ASTM unless otherwise noted)
Appearance	Clear, homogenous, and free from visible water, particles, and sediments	Visual examination
Ash, sulfated, wt %	1/	D874
Corrosion test at 100 °C, (copper strip) appearance, maximum	1b	D130 2/
Flash point, °C, minimum	225	D92
Foam (stability only), mL maximum		D892 3/
Sequences I & III (at 24 °C)	30	
Sequence II (at 93.5 °C)	5	
Gravity, degree API	1/	D287, D1298, D4052
Metals/Elements		
Barium, milligrams per kilogram (mg/kg)	1/	D4628, D4927, D4951
Calcium, mg/kg	1/	D4628, D4927, D4951, D6443, D6481
Magnesium, mg/kg, maximum	100	D4628, D4927, D4951, D6443
Nitrogen, mg/kg	1/	D3228, D4629, D5762
Phosphorus, mg/kg	1/	D1091, D4047, D4927, D4951, D6443, D6481
Zinc, mg/kg	1/, 4/	D4628, D4927, D4951, D6443, D6481
Pour point, °C, maximum	-12	D97, D5949, D5950
Rust prevention, rating, minimum	100	D6557
Scuffing load capacity (FZG), failure load stage, minimum	11	D5182
Sulfur, wt %	1/	D129, D1552, D2622, D4927, D4951, D6443, D6481
Total base number, mg KOH/g, minimum	12	D2896
Viscosity index, minimum	95	D2270
Viscosity, millimeters squared per second (mm^2/sec) at 100 °C	12.5 to 16.3	D445
Viscosity, mm^2/sec at 40 °C, minimum	1/	D445

NOTES:

1/ No limiting requirements. In conformance testing, values are compared to qualification results (see 4.5).

2/ Test shall be run for 3 hours at specified temperature.

3/ The use of Option A in ASTM D892 is only allowed if the oil has been blended for at least a week and results are not being used to meet testing requirements at origin. A ring of bubbles around the edge of the graduate shall be considered complete collapse or 0 mL.

4/ The contractor shall certify that if zinc is present, it is present as zinc dialkyl dithiophosphate, as zinc diaryl dithiophosphate, or as a combination of the two.

3.8 Toxicity. When evaluated in accordance with 4.6.4 [the Health Hazard Assessment (HHA)], the lubricating oil shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.6.4 and 6.8).

3.9 Off-gassing. The oil shall be tested for off-gassing in accordance with the requirements of 4.6.5. The Navy will review the results and assign a usage category. The required usage category is "Permitted" or "Limited" (see 4.6.5 and 6.9).

3.10 2,6-Di-tert-butylphenol (DTBP). The intentional addition of DTBP (Chemical Abstract Service Number 128-39-2) in any lubricating oil produced under this specification is prohibited. This applies to both surface ship and submarine use. The level of DTBP, if detected, shall not exceed 10 mg/kg (see 4.6.6).

3.11 Ozone depleting substances (ODSs). The use of ODSs in the composition of the lubricating oil under this specification directly or referenced in any federal test method is hereto prohibited. Environmentally safe and non-ODS alternative solvents shall be substituted in test methods for any previously specified ODS.

3.12 Engine tests. Engine tests for lubricating oils shall be in compliance with API category CH-4 tests (see 4.6.1).

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.5).

4.2 Qualification inspection. Qualification tests shall be conducted at a laboratory acceptable to NAVSEA. Qualification inspection shall consist of all of the tests specified herein to satisfy the requirements in section 3 and table I.

4.2.1 Change approval. Any change in product composition, formulation, ingredients, production processes, or production location used in the manufacture of lubricating oil, which has been qualified, shall require written approval of NAVSEA. Incorporation of any changes, which have not been so approved, shall require requalification of item in question.

4.2.1.1 Requalification. Unless otherwise approved by NAVSEA, requalification shall consist of the tests specified in 4.2.

4.3 Sampling for conformance.

4.3.1 Lot. For purposes of sampling, a lot shall consist of all lubricating oil manufactured as one batch and offered for delivery at one time.

4.3.2 Sampling for examination of filled containers. A random sample of filled containers shall be selected from each lot in accordance with ASQ Z1.4 at inspection level II to verify compliance regarding fill, closure, marking, and other requirements not involving tests.

4.3.3 Sampling for tests. A composite sample from the blending tank sufficient for testing with at least 3.78 liters (1 gallon) shall be taken from each lot by the manufacturer and retained at their facility for possible future testing in accordance with the applicable procedure of ASTM D4057. This sample shall be retained by the manufacturer for a period of 5 years and will be stored in a 1-gallon container that is sealed and labeled with information identifying the lot.

4.4 Examination of filled containers. Each sample filled container selected in accordance with 4.3.2 shall be examined for defects of the container and the closure, for evidence of leakage, and for unsatisfactory markings. Each container shall also be weighed to determine quantity. Any container in the sample having one or more defects or under required fill shall be cause for rejection of the container.

4.5 Conformance tests. Each sample selected as specified in 4.3.3 shall be tested for those parameters listed in table II and according to the methods in table I. To ensure that the material is essentially the same as that given qualification under this specification, it is required that, in addition to conforming to this specification, the results of conformance tests listed in table II shall not vary from the analysis of the sample submitted for qualification to an extent greater than the tolerances, if any, shown. If a sample of lubricating oil fails any of the tests, the entire lot represented by that sample shall be rejected.

TABLE II. Conformance tests with tolerances.

Test	Tolerances, if applicable
Appearance	---
Gravity, API	±1.0
Viscosity, mm^2/sec at 100 °C	±0.5 [1/]
Viscosity, mm^2/sec at 40 °C	±10
Viscosity index	---
Flash point, °C	±18 [1/]
Pour point, °C	---
Foam test, mL	---
Sulfur, wt %	±20% of original value [2/]
Phosphorus, mg/kg	±10% [2/]
Zinc, calcium, and magnesium, mg/kg	±10% [2/]
Total base number, mg KOH/g	---

NOTES:
[1/] Shall meet specification requirements.
[2/] Results to two significant figures.

4.6 Test procedures. Tests shall be run as specified in table I and the following procedures. For purposes of determining conformance with each requirement, an 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 E29.

4.6.1 Engine tests. The qualifying activity shall waive engine performance testing of the SAE International 40 grade oil if the SAE International 15W40 oil is tested to meet the requirements of 3.4. The SAE International 40 grade oil shall be formulated using the same performance additive package, at the same treat rate, as formulated for the SAE International 15W40 oil. A test report for the oil shall document compliance with SAE International 15W40 requirements. Engine tests shall be conducted in accordance with ASTM D4485. Documentation showing previous satisfactory performance of qualifying product(s) in CF and CF-2 category testing will be accepted as proof of meeting these respective engine testing requirements. The use of API Base Oil Interchangeability Guidelines as defined in API 1509 is permitted (see 3.4 and 6.4).

4.6.2 Compatibility. Precipitation or separation of insoluble materials from mixtures of the test oil with representative (see 6.10) approved SAE International 40 grade (MS 9250) reference oil shall be determined as follows:

a. Five different mixes of the test oil and the representative approved SAE International 40 (MS 9250) oil shall be created: one at 100:0, one at 90:10, one at 50:50, one at 10:90, and one at 0:100. Each mixture shall be placed in a separate 100-mL centrifuge tube.

b. The tubes containing the mixtures of oils shall be placed in a vibrator machine or manually shaken for 15 minutes at room temperature.

c. At the completion of the shaking period, all of the tubes shall be placed in an oven and heated at 60 °C for a period of up to 2 weeks in accordance with 4.6.2d.

d. The tubes shall be examined not less than once per 2 calendar days for evidence of separation in the oil such as a haze or sediment. The test shall continue until evidence of separation occurs or 2 weeks have passed.

4.6.3 Homogeneity. After determining the pour point of the oil, the oil shall be allowed to sit at 6 °C above the pour point and the test oil shall be examined visually for sediment or separation of insoluble material. The oil shall regain homogeneity within 24 hours. Next, the jar and oil shall be placed in an oil bath and the temperature of the bath shall be brought to 180 °C and held at test temperature for 1 hour. The test oil shall be examined visually during this process for sediment or separation of insoluble material (see 3.6).

4.6.4 Toxicity. The HHA shall be conducted to ensure conformance to 3.8, as required by the qualifying activity. The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the lubricating oil using the administrative HHA data provided by the manufacturer/distributor to the NMCPHC.

4.6.5 Off-gassing. The oil shall be tested for off-gassing at a Government-approved testing facility in accordance with S9510-AB-ATM-010 chapter titled "Material Control Program" (see 3.9 and 6.9).

4.6.6 2,6-Di-tert-butylphenol (DTBP). A report, with the method indicated, from a NAVSEA-approved laboratory, shall document relative absence of DTBP, and, if it is detected, it shall not exceed 10 mg/kg, as specified (see 6.2).

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The lubricating oils covered by this specification are intended for use in shipboard internal combustion diesel engines, such as advanced design high-output shipboard main propulsion and auxiliary diesel engines, using fuel conforming to MIL-DTL-16884 and MIL-DTL-5624.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Requirement for documentation of relative absence of DTBP (see 4.6.6).

c. Packaging requirements (see 5.1).

d. The material should be purchased by volume at 15.6 °C.

e. Activities requiring copies of completed Material Safety Data Sheets (MSDSs) (see 6.7).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL 9000 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, 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. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.3.1 Oil tests. Requests for tests of oil will be considered only under the conditions that the manufacturer submits the following information regarding composition of the oil proposed for qualification:

a. Crude source, manufacturing process for each stock, types of base or blending stocks, and percentages used in the finished oil.

b. Type of additive agents, typical chemical analysis, and percentages used in the finished oil.

c. Typical analysis of the blending stocks, the base oil, and the finished oil, including percentage of metallic elements contributed by the additive.

6.3.2 Oil sample. Each sample of oil, rebrand or experimental, submitted for qualification should be designated by the exhibitor by a different name, number, or letter to denote any changes in base oil components or the amounts or type of additive percent.

6.3.3 Provisions governing qualification. Copies of SD-6, "Provisions Governing Qualification", are available online at https://assist.dla.mil.

6.4 Engine tests. The American Petroleum Institute (API) has made the heavy duty engine oil categories CF and API CF-2 obsolete and engine tests supporting those categories, the Caterpillar 1MPC single cylinder engine test and the Detroit Diesel 6V-92TA, six cylinder, two-stroke cycle engine test, are no longer available. As a consequence of these actions, there is no current category or engine testing available for mono-grade engine oils. The only recourse for manufacturers of mono-grade oils is to test an additive package in a multi-grade formulation and use the same additive package at the same treat rate to manufacture a mono-grade formulation. The U. S. Army has used this approach in the MIL-PRF-2104 specification.

6.5 Subject term (key word) listing.

Engine oil

Main reduction gears

Marine diesel engines

Petroleum-base

Qualification

SAE International 40

6.6 International standardization agreement implementation. This specification implements international standardization agreement NATO STANAG 1135, Interchangeability of Fuels, Lubricants and Associated Products Used by the Armed Forces of the North Atlantic Treaty Nations. When amendment, revision, or cancellation of this specification is proposed, the preparing activity must coordinate the action with the U.S. National Point of Contact for the international standardization agreement, as identified in the ASSIST database at https://assist.dla.mil.

6.7 Material safety data sheets (MSDSs). Contracting officers will identify those activities requiring copies of completed MSDSs prepared in accordance with FED-STD-313 as specified (see 6.2). In order to obtain the MSDS, FAR clause 52.223-3 must be in the contract.

6.8 Toxicity evaluation. The NMCPHC requires sufficient information to permit an HHA of the product. Upon completion of the HHA, a copy will be provided by the NMCPHC to the Government for evaluation.

6.9 Material certification. Materials to be installed in submarines are to be controlled to prevent off-gassing, which contaminates the submarine's atmosphere and can result in health hazards to personnel or deleterious effects on machinery. These controls are administered through the Submarine Material Control Program, which is described in the Nuclear Powered Submarine Atmosphere Control Manual, S9510-AB-ATM-010 chapter titled "Material Control Program". Under the Submarine Material Control Program, all materials considered for use on submarines require certification and assignment of a usage category. Under the certification process, candidate materials are selected by Navy activities or contractors, and a request for certification is submitted to the Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Ave., SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy mil. The certification request is accompanied by detailed information, including descriptions of the material, method of application, usage, and storage. A chemical analysis is conducted, which is normally accomplished through off gas testing. The off gas test is required to be conducted in a Government-approved laboratory designated by the preparing activity. Information pertaining to this test requirement may be obtained from the Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Ave., SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy.mil. Based on the chemical analysis results, a usage category is assigned to the material defining whether, and to what extent, the material may be used on submarines.

6.10 Compatibility testing. Representative samples for compatibility testing are provided on request and are shipped to an approved laboratory or contractor at Government expense. Information pertaining to obtaining representative samples may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy mil.

6.11 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Preparing activity:
Navy – SH
(Project 9150-2012-005)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.