METRIC
MIL-PRF-32490
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PERFORMANCE SPECIFICATION

ADDITIVE, LUBRICITY IMPROVER, DIESEL

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

1. SCOPE

1.1 Scope. This specification covers the requirements for two grades of diesel lubricity improver additives that are used in naval distillate fuels conforming to MIL-DTL-16884.

1.2 Classification. Lubricity improver additives will be of the following grades, as specified (see 6.2).

Grade	Description
A	Standard (acceptable down to 0 °C)
B	Cold weather compatible (acceptable down to -15 °C)

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 Specifications, standards, and handbooks. The following specifications, standards, and handbooks 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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-2104	-	Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service
MIL-DTL-5624	-	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-PRF-9000	-	Lubricating Oil, Shipboard Internal Combustion Engine, High-Output Diesel
MIL-DTL-16884	-	Fuel, Naval Distillate
MIL-PRF-17331	-	Lubricating Oil, Steam Turbine and Gear, Moderate Service
MIL-PRF-23699	-	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number O-156
MIL-PRF-25017	-	Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble (NATO S-1747)

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.

MIL-DTL-32353 - Hydraulic and Lubricating Oil, Synthetic Hydrocarbon Base

MIL-DTL-85470 - Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745

(Copies of these documents are available online at http://quicksearch.dla.mil.)

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.

ASTM INTERNATIONAL

ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

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

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

ASTM D482 - Standard Test Method for Ash from Petroleum Products

ASTM D664 - Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration

ASTM D971 - Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method

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

ASTM D2111 - Standard Test Methods for Specific Gravity and Density of Halogenated Organic Solvents and Their Admixtures

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 D4176 - Standard Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)

ASTM D5453 - Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel and Engine Oil by Ultraviolet Fluorescence

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 D5985 - Standard Test Method for Pour Point of Petroleum Products (Rotational Method)

ASTM D6079 - Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)

ASTM D6304 - Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration

ASTM D7039	-	Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
ASTM D7111	-	Standard Test Method for Determination of Trace Elements in Middle Distillate Fuels by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
ASTM D7261	-	Standard Test Method for Determining Water Separation Characteristics of Diesel Fuels by Portable Separometer
ASTM E29	-	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

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

DGMK GERMAN SOCIETY FOR PETROLEUM AND COAL SCIENCE AND TECHNOLOGY

DGMK Research Report 531	-	Establishing a Series of Criteria for Testing Lubricity Additives in Diesel Designed to be Used in Refineries
DGMK Research Report 663	-	Diesel Fuel Filterability

(Copies of these documents are available online at http://www.dgmk.de/.)

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 additives furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award (see 4.2 and 6.6).

3.1.1 Qualification requirements. All approved additives shall meet the requirements of 3.2 through 3.8 to be qualified for use in fuels conforming to MIL-DTL-16884.

3.1.2 Referee fuel. Specific to this performance specification, the referee fuel shall conform to MIL-DTL-16884, shall have a high frequency reciprocating rig (HFRR) wear scar in the range of 600 to 650 micrometers (µm) in accordance with ASTM D6079, and have a maximum sulfur concentration of 15 milligrams per kilogram (mg/kg). The referee fuel shall have a diesel micro-separability (DSEP) rating in accordance with ASTM D7261 equal to or greater than 90. The referee fuel shall contain no additives unless specified in this document. Samples of the referee fuel may be obtained by contacting NAVAIRSYSCOM, AIR 4.4.5.1, Bldg. 2360 PSEF, 22229 Elmer Road, Patuxent River, MD 20670-1534.

3.2 Materials. The composition of the finished additive is not limited, but is subject to review by the qualifying activity to ensure service compatibility with previously qualified products.

3.3 Minimum effective concentration. The minimum effective concentration shall be the amount of additive required to yield an average wear scar diameter equal to or less than 460 µm in the referee fuel when triplicate HFRR tests are performed in accordance with ASTM D6079.

The minimum effective concentration will be identified by the qualifying activity and cited on the QPL.

3.4 Maximum allowable concentration. The maximum allowable concentration shall be the lowest of the following:

a. One and a half times the minimum effective concentration.

b. The highest concentration that results in less than a 10-percent change in diesel micro-separability when tested in accordance with 4.4.6.1.

c. The highest concentration that will pass all requirements of 3.6.

The maximum allowable concentration will be identified by the qualifying activity and cited on the QPL.

3.5 Chemical and physical properties. The additive shall conform to the chemical and physical properties outlined in table I. To determine conformance to the specification requirement, a test result may be rounded to the same number of significant figures as in table I using ASTM E29. Where multiple determinations are made, the average result, rounded in accordance with ASTM E29, shall be used.

TABLE I. Chemical and physical properties.

Characteristic	Requirement Grade A	Requirement Grade B, Cold Weather Compatible	ASTM Test Method
Appearance at 25 °C	Clear and Bright, Free of Visible Particulates or Water	Clear and Bright, Free of Visible Particulates or Water	D4176 (Procedure 1)
Flash Point, °C (min)	60	60	D93
Viscosity, at -20 °C, mm^2/second (max)	___	400	D445
Viscosity, at 0 °C, mm^2/second (max)	400	___	D445
Water Content, mg/kg (max)	3000	3000	D6304
Ash Content, wt. % (max)	0.10	0.10	D482
Sulfur Content, mg/kg (max)	15	15	D5453, D7039

3.6 Performance characteristics.

3.6.1 Solubility. Twice the minimum effective concentration of additive, as defined in 3.3, shall be readily and completely soluble in the fuel for which it is qualified. There shall be no precipitation or cloudiness when tested as specified in 4.4.1.

3.6.2 Compatibility. The candidate additive shall be compatible with all those currently qualified under this specification (see 4.4.2.1), in addition to static dissipater additives, ignition improver additives, middle distillate flow improver additives, anti-oxidants, aviation corrosion inhibitor/lubricity improver additives, and fuel system icing inhibitor as prescribed in 4.4.2.2. The candidate additive shall also be tested for compatibility with the Navy's current shipboard lubricants as specified in 4.4.2.3. There shall be no precipitation, cloudiness, or color change when tested as specified in 4.4.2.

3.6.3 Impact on fuel properties. The blend of the additive in the referee fuel at twice the minimum effective concentration as defined in 3.3 shall meet all of the applicable requirements for MIL-DTL-16884 when tested in accordance with 4.4.3. Additionally, all properties, except lubricity at 60 °C, shall not change more than the prescribed ASTM method repeatability as compared to the referee fuel. Properties that change greater than the ASTM method's repeatability may be accepted at the discretion of the qualifying activity.

3.6.4 Storage stability. After being stored for 12 months in accordance with 4.4.4, the additive shall show no precipitation, color change, stratification, or cloudiness.

3.6.5 Temperature stability. The additive shall show no precipitation, color change, stratification, cloudiness, or other indication of degradation after being subjected to the temperature stability protocol (see 4.4.5).

3.6.6 Water separation. The additive, when blended at twice its minimum effective concentration in the referee fuel, shall have no significant effect on the water separation of the fuel, as defined below, when tested in accordance with 4.4.6.

3.6.6.1 Diesel micro-separability (DSEP). The candidate additive, when blended at twice its minimum effective concentration in the referee fuel, shall not vary by more than 10 percent from the DSEP rating, ASTM D7261, of referee fuel when tested in accordance with 4.4.6.1. To calculate this variation, the referee fuel shall be tested in accordance with ASTM D7261 concurrently to define the actual DSEP value without the presence of the lubricity improver additive. The referee fuel shall have a DSEP rating equal to or greater than 90.

3.6.6.2 Interfacial tension. The interfacial tension of the candidate additive, when blended at twice its minimum effective concentration in the referee fuel, shall be no less than 20 dyne/centimeter when tested in accordance with 4.4.6.2.

3.6.7 Naval coalescence test (NCT). If the referee fuel, when additized to twice the minimum effective concentration, has 4 or more consecutive hours demonstrating poor coalescence, where the downstream free water concentration is 100 mg/kg or greater than that of the saturated fuel tanks, then the additized fuel under test shall be deemed a failure in accordance with 4.4.7.

3.6.8 Toxicity. When evaluated in accordance with 4.4.8 [the Health Hazard Assessment (HHA)], the additive shall have no adverse effect on the health of personnel when used for its intended purpose (see 4.4.8 and 6.5).

3.7 Identification of qualification data. The following properties of the finished additive shall be determined during qualification, but not limited to: density at 15 °C, metallic constituents, and total acid number (see 4.5). The permissible minimums and maximums of individual properties due to production variation shall be established at the time of qualification. Individual batches of additive subsequently subjected to qualification conformance inspections shall conform to the established minimums and maximums of properties. The minimums and maximums of individual properties shall not adversely affect any of the additive performance characteristics.

3.8 Workmanship. The finished additive in bulk or container shall be uniform in appearance in accordance with table I, clear and bright, and visually free from grit, un-dissolved water, insoluble components, and other foreign matter.

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 4.3).

4.2 Qualification inspection. Qualification tests shall be conducted at a laboratory acceptable to the Naval Sea Systems Command (NAVSEA). Qualification inspection shall be performed in accordance with the test conditions specified in table II and 4.4.

4.2.1 Qualification sampling. Unless otherwise specified by NAVSEA, an initial 3.78-liter (1-gallon) sample of finished additive shall be submitted for evaluation of all the tests required in 3.3 through 3.6.3, 3.6.5, 3.6.6, and 3.8 to an independent laboratory acceptable to NAVSEA. If the additive passes all the tests, an additional sample of finished additive consisting of two 1-liter aliquots shall be required for the storage stability test (see 3.6.4). These additional samples shall be identified as such and forwarded to NAVSEA (see 6.6). Upon request, samples of finished additive shall also be submitted for NCT evaluation (see 3.6.7) to the qualifying activity.

4.2.2 Change approval. Any change in formulation, ingredients, manufacturing processes, or manufacturing locations of the additive shall be approved by NAVSEA. Incorporation of any changes, which have not been so approved, shall require requalification of the item in question.

4.2.2.1 Requalification. Unless otherwise approved by NAVSEA, requalification shall consist of the tests specified in 4.4.

4.3 Conformance inspection. Conformance inspection of a bulk lot, prior to becoming a packaged lot, of additive shall consist of tests for conformance to the requirements in 3.5 and 3.7 as listed in table II.

TABLE II. Qualification tests and conformance inspections.

Tests	Requirement	Qualification Test	Conformance Test
Chemical and Physical Properties	3.5	Table I	Table I
Solubility	3.6.1	4.4.1	
Compatibility	3.6.2	4.4.2	
Impact on Fuel Properties	3.6.3	4.4.3	
Storage Stability	3.6.4	4.4.4	
Temperature Stability	3.6.5	4.4.5	
Diesel Micro-Separability	3.6.6.1	4.4.6.1	
Interfacial Tension	3.6.6.2	4.4.6.2	
NCT	3.6.7	4.4.7	
Toxicity	3.6.8	4.4.8	
Identification Qualification Data	3.7	4.5	4.5

4.3.1 Inspection lots.

4.3.1.1 Bulk lot. A bulk lot is defined as an indefinite quantity of a homogeneous mixture of material offered for acceptance in a single, isolated container manufactured through the same processing equipment with no change in ingredient material.

4.3.1.2 Packaged lot. A packaged lot is defined as an indefinite number of 208-liter (55-gallon) drums or smaller unit packages of identical size and type, or an indefinite number of 2080-liter (550-gallon) or less returnable containers, such as totes, offered for acceptance and filled with a homogenous mixture of material from a bulk lot.

4.3.2 Sampling. Each bulk or packaged lot of material shall be sampled for verification of product quality and compliance in accordance with ASTM D4057.

4.4 Methods of inspection.

4.4.1 Solubility. The additive shall be mixed with the referee fuel, at twice its minimum effective concentration, and then stored in a sealed, clear glass bottle at 25 °C in the dark. Samples shall be visually inspected for precipitation, cloudiness, or color change both before (at ambient temperature) and after being stored at 25 °C in the dark for 24 hours.

4.4.2 Compatibility.

4.4.2.1 Additional QPL additives. The referee fuel that contains twice the minimum effective concentration of the candidate additive and no other additives shall be mixed in equal proportions with samples of the referee fuel which contains twice the minimum effective concentration of the individual additives currently on the QPL for this specification and then stored in a sealed, clear glass bottle at 25 °C in the dark for 24 hours. At the end of a 24-hour period, the sample shall be visually inspected for precipitation, cloudiness, or color change.

4.4.2.2 Other additives. The candidate additive shall also be evaluated for compatibility with other additives commonly seen in fuels used by the Navy. The candidate additive shall be blended with the referee fuel at four times its minimum effective concentration, in addition to the additives and concentrations specified below.

Step 1. A 250- milliliter (mL) sample of the referee fuel with candidate additive at four times its minimum effective concentration and containing no other additives shall be prepared in a clear glass container (control sample). After additization, the sample shall be split equally into two samples in clear glass containers.

Step 2. A 250-mL sample shall be prepared in a clear glass container of the referee fuel with candidate additive at four times its minimum effective concentration and containing the following additives at the specified concentration:

a. One approved anti-oxidant in accordance with the formulation requirements of MIL-DTL-5624, 48 milligrams per liter (mg/L).

b. N,N'-disalicylidene-1,2-propanediamine (metal deactivator additive), 11 mg/L.

c. One corrosion inhibitor/lubricity improver at a concentration of twice the maximum allowable limit as specified in MIL-PRF-25017.

d. Fuel system icing inhibitor in accordance with MIL-DTL-85470 at a concentration of twice the maximum limit for Grade JP-5 as specified in MIL-DTL-5624.

e. Static dissipater additive, in accordance with the requirements of MIL-DTL-5624, 10 mg/L.

f. 2-ethylhexylnitrate (cetane improver), 0.8-percent volume.

After additization, the sample shall be split equally into two samples in clear glass containers.

Step 3. One of the control samples from Step 1 and one of the additized fuel samples from Step 2 shall be placed into dark, cold storage at 0 °C for 24 hours. At the end of the 24 hours, the samples shall be removed from cold storage and immediately inspected for indication of precipitation, cloudiness, or color change. The samples shall be allowed to passively warm to ambient room temperature (15 °C to 25 °C) and again inspected for indication of precipitation. The second inspection shall take place no more than 1 hour after reaching ambient room temperature.

Step 4. The other control sample from Step 1 and other additized fuel from Step 2 shall be placed into dark, heated storage at 38 °C and the temperature shall be maintained for 24 hours. This step may be run concurrently with Step 3. At the end of the 24 hours, the samples shall be allowed to cool to ambient room temperature (15 °C to 25 °C). The samples shall be inspected for indication of precipitation, cloudiness, or color change.

Step 5. If incompatibility is documented at any point during the procedure, it is acceptable to repeat Steps 1 through 4 by testing individual additives for compatibility one at a time rather than mixing all of the additives into one sample.

NOTE: All samples shall be stored in the dark during conditioning and between inspections.

4.4.2.3 Lubricant oils. The candidate additive shall be tested for compatibility with the Navy's current shipboard lubricants: MIL-PRF-23699, MIL-PRF-9000, MIL-PRF-2104, MIL-PRF-17331, MIL-DTL-32353, Shell Gadinia or other commercial equivalent approved by NAVSEA, and Mobil Delvac 1640 or other commercial equivalent approved by NAVSEA. Samples of these lubricants may be obtained by contacting NSWCCD Philadelphia, Code 615, Philadelphia, PA, 19112. The referee fuel and candidate additive shall be tested in accordance with the test procedure in Section I-A of DGMK Research Report 531. This test shall be conducted twice, once using the specified filter material and again using the filter material specified in DGMK Research Report 663. Acceptance criteria for the testing shall be in accordance with section I-A.7 of DGMK Research Report 531. Test results for the two filter media will be assessed independently in the determination of additive acceptance (passing performance), recognizing that some lubricity additives may interact with filter media leading to erroneous test results. Both test procedures will be individually repeated for all six lubricant oils; however, all six test samples may be stored concurrently. Final inspection shall take place no more than 1 hour after reaching ambient room temperature.

4.4.3 Impact on fuel properties. Fuel properties of the referee fuel containing twice the minimum effective concentration of the candidate additive shall be measured as specified in MIL-DTL-16884.

4.4.4 Storage stability test. Two 1-liter or 1-quart clear glass bottles shall each be filled with 850 mL of the candidate additive and shall be tightly capped by means of a screw cap that has a conical polyethylene liner. Each bottle shall be wrapped in a minimum amount of opaque packing materials sufficient for protection against mechanical damage, but minimal in thermal insulation qualities. The wrapped bottles shall be enclosed in a tight wooden or metal box for further protection against breakage and sunlight. The crated samples shall be stored at ambient outdoor conditions at Naval Air Station Patuxent River, Maryland. The box shall be kept off the ground and protected from direct sunlight and precipitation under a canopy, open shed roof, or similar ventilated shelter. The crated samples shall be stored undisturbed in an upright position. One of the samples shall be stored for exactly 12 months and then removed for examination and testing; the other sample shall be stored for 12 months or less and may be removed for examination and testing at any time, at the option of the qualifying activity. Whenever a sample is removed for examination and testing, it shall be uncrated with minimum disturbance; the bottle shall not be shaken, inverted, or otherwise agitated. The top half of the contents of the bottle shall be visually inspected for precipitation or separation into layers. Candidate additive shall be tested for conformance to properties in table I.

4.4.5 Temperature stability protocol. For procedures specifying a lowest temperature, 0 °C and -15 °C shall be used for Grades A and B, respectively. Each sample bottle shall be wrapped in a minimum amount of opaque packing materials sufficient for protection against mechanical damage, but minimal in thermal insulation qualities. For temperature stability test protocols, 4.4.5.1 through 4.4.5.4, the sample shall be stored in a dark environment and shall not be shaken, inverted, or otherwise agitated during testing and inspection.

4.4.5.1 Stability at low temperature. Two 100-mL samples of the test additive shall then be cooled to 0 °C for Grade A (one of the samples) and -15 °C for Grade B (the second sample) and held for 1 week. For passing additives, the test samples may be returned to their respective temperatures for continued aging to assess the robustness of the passing additive candidate. The test additive shall be inspected immediately out of cold soak and found free of precipitation and gelling.

4.4.5.2 Cold/heat cycling. A 100-mL sample of the candidate additive shall be held at the temperature conditions defined in 4.4.5 for 16 hours, removed from the cold chamber, and held at ambient room temperature (15 °C to 25 °C) for 8 hours, inspected for any precipitation and gelling, then placed back in the cold chamber. This process shall be repeated three times.

4.4.5.3 Stability at elevated temperatures. A 100-mL sample of candidate additive shall be stored at 38 °C for 6 weeks. Every week the sample shall be checked for precipitation, cloudiness, color change, or other indication of degradation. For passing additives, the test samples may be returned to their respective temperatures for continued aging to assess the robustness of the passing additive candidate.

4.4.5.4 Freeze/thaw cycling. The candidate additive pour point shall be measured in accordance with ASTM D97, ASTM D5949, ASTM D5950, or ASTM D5985. A room temperature, homogeneous sample of the candidate additive shall be placed into a cold chamber/liquid bath set to 3 °C lower than the measured pour point. The sample shall be held at this temperature for 1 hour, then the candidate additive sample shall be removed from cooling, and allowed to warm at room temperature (15 °C to 25 °C) until solid crystals are no longer visible in the sample. The additive shall be checked for stratification and permanent separation. This process shall be repeated three times.

4.4.6 Water separation.

4.4.6.1 Diesel micro-separometer rating (DSEP). The candidate additive, at twice its minimum effective concentration, shall be blended into the referee fuel and DSEP shall be tested in accordance with ASTM D7261. The referee fuel without the candidate additive shall also be tested.

4.4.6.2 Interfacial tension. The test additive, at twice its minimum effective concentration, shall be blended into the referee fuel and interfacial tension shall be tested in accordance with ASTM D971.

4.4.7 NCT. The NCT is a Navy-unique coalescence test rig. The NCT shall be operated in accordance with the operating requirements specified in Appendix A. The referee fuel shall contain twice the minimum effective concentration of the candidate additive.

4.4.8 Toxicity. An HHA shall be conducted to ensure conformance to 3.6.8, as required by the qualifying activity. The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the additive using the administrative HHA data provided by the manufacturer/distributor to the NMCPHC.

4.5 Identification tests. Identification tests of the finished additive shall be conducted in accordance with the following methods:

a. Density at 15 °C – ASTM D1298, ASTM D2111, or ASTM D4052.

b. Metallic constituent – ASTM D7111 (Emission spectrograph, not applicable for materials with ash contents of 0.05 weight percent or lower).

c. Total acid number – ASTM D664.

d. Sulfur – ASTM D5453 or ASTM D7039 (maximum concentration 15 mg/kg).

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 additives covered by this specification are used, when specifically authorized, in F-76 fuels conforming to MIL-DTL-16884 to improve the lubricating qualities when required.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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

b. Grade (see 1.2).

c. Quantity required.

d. Packaging requirements (see 5.1).

6.2.1 Amount of additive use. When Government procurement documents specify the use of these additives in fuels and related petroleum products, the concentration of the additive should be specified in grams of additive per cubic meter of fuel and should not be less than the minimum effective concentration nor more than the maximum allowable concentration as listed on the QPL. Since the additive is intended for use under many different environments, it is not possible to establish a single, optimum concentration for all uses. Therefore, when the Government does not require a specific concentration, the quantity of the additive used may vary to meet specific conditions.

6.3 Additive for addition to fuels. A test report that shows compliance of the product with the requirements of 4.3 should be supplied to the purchaser. Additional data may be required by the purchasing activity to establish compliance with this specification.

6.4 Material safety data sheets (MSDSs). Contracting officers should identify those activities that require copies of complete MSDSs prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

6.5 Toxicity. The Navy and Marine Corps Public Health Center (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.

6.6 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 No. 32490 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.

6.6.1 Qualification test report. The qualifying activity will request a certified test report from the independent laboratory. The test report should contain laboratory data which detail the results required by 3.3 through 3.8. In addition, complete formulation data should be supplied to the qualifying activity. This data should include chemical composition (International Union of Pure and Applied Chemistry [IUPAC] nomenclature and structural diagrams of each ingredient), the percentages of each ingredient, the manufacturer and trade names of each ingredient, and, where available, the purity of each ingredient. The contractor will be required to furnish toxicological data and formulations necessary to evaluate the safety of the material for the proposed use.

6.6.2 Provisions governing qualification. Copies of SD-6, “Provisions Governing Qualification”, are available online at http://quicksearch.dla.mil/ or https://assist.dla.mil.

6.7 Conversion of metric units. Units of measure have been converted to the International System of Units (metric) in accordance with ASTM E380. If test results are obtained in units other than metric, or there is a requirement to report dual units, ASTM E380 or, in the case of volume measurements, ASTM D1250 Volume XI/XII should be used to convert the units.

6.8 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a materiel quality storage standard for Type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD 4140.27-M, Shelf-life Management Manual. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website at https://www.shelflife.hq.dla.mil/.

6.9 Subject term (key word) listing.

Qualification testing

NAVAL COALESCENCE TEST (NCT)

A.1 SCOPE

A.1.1 Scope. This appendix outlines the protocol used to simulate water coalescence effects in aviation and naval distillate fuels. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.1.2 Summary of the method. The NCT is a fit-for-purpose test, which allows for fuel flow through a fuel coalescer while using a small amount of fuel. The objective of this test is to determine the water shedding, or coalescence properties, of the candidate additive on the filter. A known amount of free (undissolved) water will be injected upstream of the test element and upstream and downstream free and dissolved (total) water levels will be measured and compared to the saturated water level in the fuel. A passing test shall give downstream free water measurements that are comparable to that of the saturated water level of the fuel.

A.2 MATERIALS AND APPARATUS

A.2.1 Apparatus. The test apparatus is shown schematically in figure A-1. It consists of the following:

a. Nitrogen sparger
b. Test capsule
c. Syringe pump
d. Control system and panel
e. Localized valves, including the rotameter control valve, fuel feed valves, discharge valves, and air supply valve

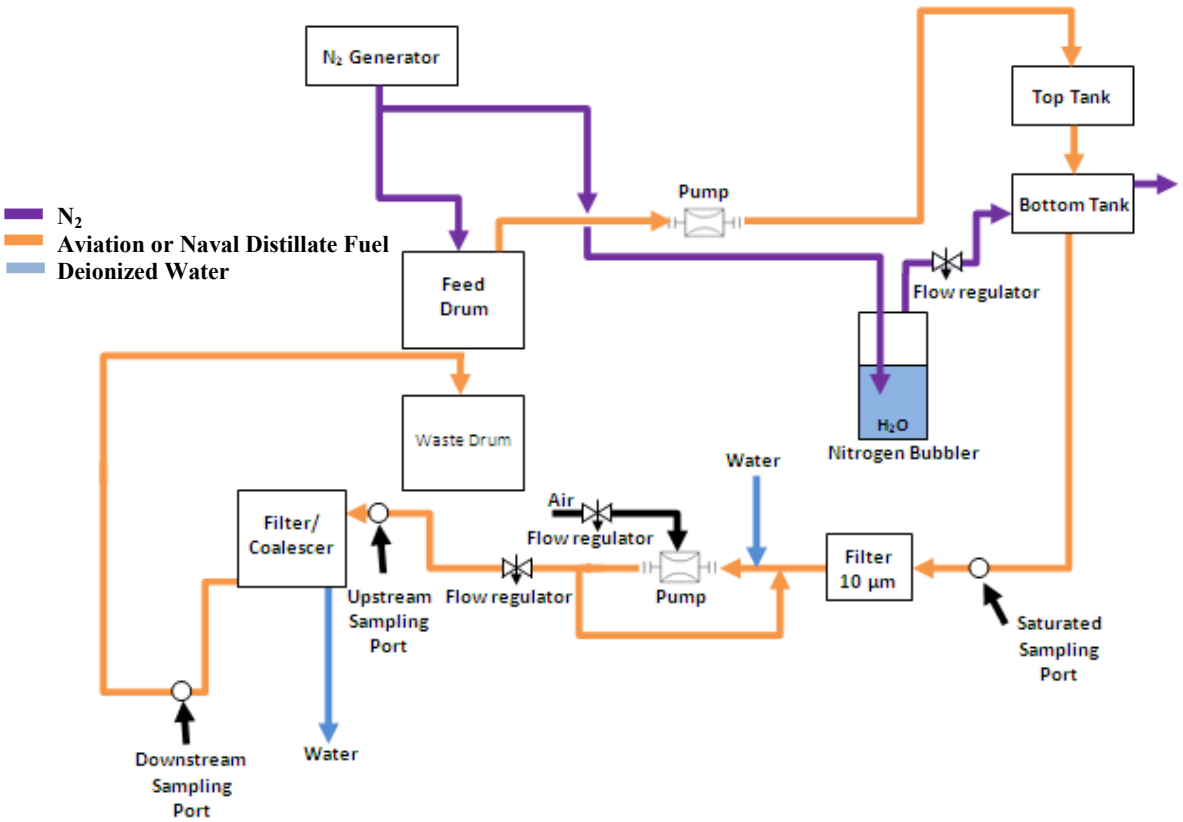

FIGURE A-1. NCT schematic.

A.2.2 Materials. The materials shall consist of the following:

a. 378 liters (100 gallons) of referee fuel with candidate additive
b. Latex gloves
c. Syringes, 1 mL and 50 mL
d. Solvent dispenser squeeze bottle, 500 mL
e. Graduated cylinder, 500 mL
f. Water injection needle, #33
g. Tweezers, flat tipped
h. Distilled water

A.3 TEST PROCEDURE

A.3.1 Test preparation. A new, epoxy/phenolic lined 208-liter (55-gallon) drum is filled with filtered test fuel. A steel 8-inch extender tube is attached to the large bung of the drum and a stainless steel, air driven pump is placed into the extender tube. The drum pump outlet line is then attached onto the 90-degree stainless steel fitting on the small bung of the drum and the additized referee fuel is recirculated through the drum pump at 26.5 liters per minute (7 gallons per minute) for 3 hours. If no flowmeter is available, then the air on the pump is turned halfway on and then slowly closed until the flow contains no bubbles. The inlet and outlet drum lines are then attached to the portable filter separator apparatus and the additized referee fuel is recirculated for 16 hours. Finally, a 3.78-liter (1-gallon) sample of additized referee fuel is collected and submitted to a laboratory for filtration time and particulate matter analysis.

A.3.2 Test operation. The NCT shall be cleaned and built up prior to running each additized fuel and a new NCT element shall be inserted into the capsule holder prior to beginning a new test. The separator is tested for water beading efficiency, and the system is flushed with additized referee fuel for 60 minutes. The nitrogen generator must be properly configured and distilled water shall be filled to the 800-mL mark in the 1000-mL graduated cylinder nitrogen sparger. The injection needle is inspected and the fuel flow set to 33 mL/minute. The water injection valve is then opened and observed until water drops appear at the outlet of the filter separator. Time is recorded as soon as the first drop is seen. The syringe pump is set to approximately 8.25 µL/minute and the fuel flow is maintained at 33 mL/minute using the appropriate valves. This results in an undissolved water concentration of 250 mg/kg in the test fuel. Normal test duration is 80 hours. The following shall be collected:

a. The inlet total water content shall be measured, in triplicate, in accordance with ASTM D6304, once per hour from a sample obtained from upstream sampling port.

b. The outlet total water content shall be measured, in triplicate, in accordance with ASTM D6304, once per hour from a sample obtained from downstream sampling port.

c. The total water content shall be measured, in triplicate, in accordance with ASTM D6304, once per hour by extracting a sample from the saturated water port. Differential pressure across the filter/separator and fuel temperature shall be recorded every hour. Accumulated water in the housings shall be drained and bled off as needed, and documentation shall continue for 80 test hours.

A.4 DATA EVALUATION

A.4.1 Acceptance criteria. The test shall be considered passing if the difference between the outlet total water concentration and saturated total water concentration does not exceed 100 mg/kg for 4 consecutive hours. A differential pressure across the filter/separator shall remain less than 3 pounds per square inch (psi) during the entire 80-hour test.

Custodians:
Army – AT
Navy – SH
Air Force – 68

Preparing activity:
Navy – SH
(Project 6850-2013-007)

Review activities:
Army – AV, CR4, EA, MI, MR
Navy – AS, CG, MC
Air Force – 11, 99
DLA – PS
NGA – MP

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