SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3054B

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Superseding AMS 3054A

Oil, Lubricating, Low Temperature For -55 °C (-67 °F) Service

1. SCOPE:

1.1 Form:

This specification covers a petroleum-base lubricating oil.

1.2 Application:

This lubricant has been used typically for general purpose, low-temperature lubrication applications where low evaporation and rust-preventive characteristics are desired, but usage is not limited to such applications.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

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http://www.sae.org/technical/standards/AMS3054B

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2759/2	Heat Treatment, of Low-Alloy Steel Parts, Minimum Tensile Strength 220 ksi (1515 MPa) and Higher
AMS 4037	Aluminum Alloy Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn, (2024; T3 Flat Sheet, -T351 Plate), Solution Heat Treated
AMS 4377	Magnesium Alloy Sheet and Plate, 3.0Al - 1.0Zn, 0.20Mn (AZ31B-H24), Cold Rolled and Partially Annealed
AMS 4500	Copper Sheet, Strip, and Plate, Soft Annealed
AMS 4507	Copper Alloy (Brass) Sheet, Strip, and Plate, 70Cu - 30Zn, Half Hard (H02)
AMS 5040	Steel Sheet and Strip, 0.15 max Carbon, Deep Forming Grade
AMS 6440	Steel Bars, Forgings, and Tubing, 1.45Cr (0.98 - 1.10C), (SAE 52100), For Bearing Applications

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 91	Precipitation Number of Lubricating Oils
ASTM D 92	Flash and Fire Points by Cleveland Open Cup
ASTM D 97	Pour Point of Petroleum Products
ASTM D 130	Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test
ASTM D 445	Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)
ASTM D 664	Acid Number of Petroleum Products by Potentiometric Titration
ASTM D 972	Evaporation Loss of Lubricating Greases and Oils
ASTM D 1500	ASTM Color of Petroleum Products (ASTM Color Scale)
ASTM D 1748	Rust Protection by Metal Preservatives in the Humidity Cabinet

2.3 ANSI Publications:

Available from ANSI, 1430 Broadway, New York, NY 10018.

ASME B46.1	Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Material:

The oil shall be a fraction of refined crude petroleum, containing additives imparting corrosion protective and oxidation resisting properties, meeting the requirements of 3.2.

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3.2 Properties:

The oil shall conform to the following requirements, determined in accordance with specified test methods, insofar as practicable:

3.2.1 Color and Appearance: The oil shall be clear, transparent, and uniform in appearance and not darker than No. 5 (ASTM Color Scale), determined in accordance with ASTM D 1500.

3.2.2 Kinematic Viscosity: Shall conform to the values shown in Table 1, determined in accordance with ASTM D 445:

TABLE 1 - Kinematic Viscosity

Temperature, ±1 °C (±2 °F)	Value, centistokes (mm^2/s), max
38 °C (100 °F)	10
-40 °C (-40 °F)	4000

3.2.3 Flash Point: Shall be not lower than 130 °C (266 °F), determined in accordance with ASTM D 92 on the preproduction sample. Tests on subsequent lots for acceptance testing shall not differ from the preproduction flash point value by more than ±6 C (±10 F) degrees.

3.2.4 Pour Point: Shall be -57 °C (-71 °F) or below, determined in accordance with ASTM D 97.

3.2.5 Precipitation Number: Shall be 0.00, determined in accordance with ASTM D 91.

3.2.6 Corrosion: Shall be not greater than Class 1, determined in accordance with ASTM D 130 at 100 °C ± 1 (212 °F ± 2) for 3 hours ± 0.1.

3.2.7 Evaporation: Weight loss shall not exceed 22%, determined in accordance with ASTM D 972.

3.2.8 Humidity Resistance: Not more than one panel out of five, covered with a film of the lubricating oil and subjected to humidity testing in accordance with ASTM D 1748 for 100 hours ± 0.25, using the same steel and thickness of test panel as in 4.5.1.2, shall exhibit either a dot of rust larger than 2 mm in diameter or two or more dots of rust larger than 1 mm in diameter on the significant area of the panel.

3.2.9 Corrosion and Oxidation Stability: The oil shall comply with the following requirements, determined in accordance with 4.5.1:

3.2.9.1 Corrosion: The change in weight of metal test specimens shall not exceed ±0.2 mg/cm^2 of surface for each specimen. There shall be no pitting, etching, or visible corrosion on the surfaces of any of the metals when examined at approximately 20X magnification. Slight discoloration of surfaces of the copper and cadmium specimens is permissible.

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3.2.9.2 Viscosity Change Due to Oxidation: The viscosity of the oil shall be within -5 to +20% of the original viscosity, determined in accordance with ASTM D 445 at 38 °C ± 1 (100 °F ± 2).

3.2.9.3 Acid Number Change Due to Oxidation: After the oxidation-corrosion test, the increase in the acid number shall be not greater than 0.20 and there shall be no evidence of separation of insoluble materials or gumming of the oil.

3.2.10 Low-Temperature Stability: There shall be no indication of low-temperature instability evidenced by gelling or separation of solid or liquid phases in the oil after completion of the test in 4.5.2. The presence of cloudiness, which does not settle out, is acceptable.

3.2.11 Corrosivity Test: Two of the three test assemblies shall show no signs of corrosion or pitting, and the third disc shall exhibit not more than three spots of corrosion within the area covered by the brass clip, determined in accordance with 4.5.3.

3.3 Quality:

Oil, as received by purchaser, shall be free of undissolved water, sediment, suspended matter, and other foreign materials detrimental to usage of the oil.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of oil shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and perform any confirmatory testing deemed necessary to ensure that the oil conforms to the specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: The following requirements shown in Table 2 are acceptance tests and shall be performed on each lot.

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TABLE 2

Requirement	Paragraph Reference
Color	3.2.1
Kinematic Viscosity	3.2.2
Flash Point	3.2.3
Pour Point	3.2.4
Precipitation Number	3.2.5
Corrosion, Copper Strip	3.2.6
Evaporation	3.2.7
Corrosion and Oxidation Stability	3.2.9

4.2.2 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of oil to a purchaser, when a change in material and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.3 Sampling:

Sufficient oil shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1 A lot shall be all oil produced in a single production run from the same batches of raw materials under the same fixed conditions and presented for vendor's inspection at one time and shall not exceed 10,000 gallons (37,854 L).

4.3.2 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3 and the report of 4.6 shall state that such plan was used.

4.4 Approval:

4.4.1 Sample oil shall be approved by purchaser before oil for production use is supplied, unless such approval be waived by purchaser. Results of tests on production oil shall be essentially equivalent to those on the approved sample.

4.4.2 Vendor shall use ingredients, manufacturing procedures, and methods of inspection on production oil which are essentially the same as those used on the approval sample oil. If necessary to make any change in ingredients or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample oil. Production oil made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Corrosiveness and Oxidation Stability:

4.5.1.1 Test Apparatus: Shall consist of the following:

4.5.1.1.1 Test tube of standard-wall with 50 mm ± 3 OD and 500 mm ± 10 long, with open end formed as a male ground-glass joint.

4.5.1.1.2 Allihn type condenser 40 mm, minimum, OD by 300 mm ± 20 long jacket, with the lower end formed as a female ground-glass joint to mate with the test tube.

4.5.1.1.3 Air tube of Pyrex, standard wall, 6 to 8 mm OD and length at least 50 mm longer than the combined length of the assembled test tube and condenser described above. The tube shall have one end drawn to an outside diameter of 0.063 inch ± 0.016 (1.60 mm ± 0.41).

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4.5.1.1.4 Constant temperature bath capable of maintaining a temperature 150 °C ± 1 (302 °F ± 2).

4.5.1.2 Preparation of Specimens: Metal specimens, one each, nominally 0.032 inch (0.81 mm) thick by 1 inch (25 mm) square, with two holes (Figure 1) cut from the following materials: AMS 4500 copper, AMS 4037 aluminum alloy, AMS 4377 magnesium alloy, AMS 5040 low carbon steel, and cadmium anode material. Remove burrs from the edges of the specimens and from around drilled holes. Remove surface defects from both surfaces and all edges using progressively finer grades of abrasive paper. After this operation, all subsequent handling of the specimens shall be carried out with clean filter paper or tongs. Use a 240 grit (60 µm) silicon carbide paper for the final sanding operation, making sure all marks produced by previous abrasive papers are removed. Clean the specimens and store separately immersed in acetone. Remove the specimens from the acetone and polish both flat surfaces and edges, using 150 mesh (100 µm) silicon carbide grains applied with an acetone moistened pad. Wipe the specimens with clean absorbent cotton pads, changing pads until the pad no longer exhibits a soil when the specimen is wiped. Wash the specimens in a warm (approximately 55 °C (131 °F)) suitable solvent and allow them to air dry. Weigh and record the weight of each specimen to an accuracy of 0.1 milligram.

4.5.1.3 Test Procedure: Determine the neutralization number of the oil sample in accordance with ASTM D 664. Determine the viscosity of the oil in accordance with ASTM D 445 at 38 °C ± 1 (100 °F ± 2). Arrange the prepared metal specimens in a wooden or plastic fixture in the pattern shown in Figure 1, making sure the magnesium and copper specimens do not touch. Tie the squares together using a clean light-weight cotton or nylon cord. Wear latex surgical gloves or nylon gloves when handling the cord and tying the knots. Using forceps, place the assembled specimens in the bottom of the test tube with the squares positioned vertically (so the air tube can be inserted to the bottom of the test tube). Weigh the test tube with metal specimens and the air tube together to the nearest 0.1 gram. Add 100 mL ± 1 of the sample oil to the test tube containing the metal specimens, reweigh the air tube, test tube, and contents together to the nearest 0.1 gram and determine the weight of the oil sample added. Assemble the test tube and condenser and mount the assembly so that 300 mm ± 50 of the test tube is submerged in the constant temperature bath previously stabilized at 150 °C ± 1 (302 °F ± 2). Start the flow of cooling water through the condenser jacket. Insert the air tube, orifice end down, through the condenser and into the oil sample, and support it so the orifice is within 0.125 inch (3.18 mm) of the bottom of the test tube. Connect the air tube to a supply of low pressure, filtered, dry air, and adjust the flow through the tube to 5 liters/hour ± 0.5. Continue the test for 68 hours ± 1. At the end of the test period, stop the flow of air, remove the air tube, and separate the condenser from the test tube containing the specimens. Remove the test tube from the constant temperature bath, allow to cool to room temperature, and wipe the outside with a cloth dampened with suitable solvent. Reweigh the air tube, test tube, and contents to the nearest 0.1 gram, determine the weight of sample remaining, and compute the percentage of weight loss resulting from evaporation of the sample. If the weight loss exceeds 8%, the seal is inadequate and the cause of leak shall be determined and the test repeated using a new oil sample and fresh metal specimens. If the oil sample has lost less than 8% of its initial weight, proceed to remove the metal specimens using forceps. Retain the oil sample for additional testing and visual examination. Remove the cords holding the specimens together and wash the metal specimens individually in a warm suitable solvent (approximately 55 °C (131 °F)). Repeat the operation using fresh solvent and scrubbing the surface of the metal specimens with a stiff, short-bristled

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4.5.1.3 (Continued):

brush until the solvent shows no discoloration. Allow the squares to dry. Reweigh the metal specimens to the nearest 0.1 mg and compute the weight change for each specimen. Visually inspect the metal specimens at 20X magnification and report the presence of pitting or etching and specifically note the color of any stains visible on the surface of the copper specimen. Determine the neutralization number of the residual oil sample in accordance with ASTM D 664 and determine the viscosity in accordance with ASTM D 445 at 38 °C ± 1 (100 °F ± 2).

4.5.2 Low-Temperature Stability: Place approximately 100 mL of the lubricating oil in a glass-stoppered flask and hold at -55 °C ± 3 (-67 °F ± 5) for 72 hours ± 0.5. At the end of the test, examine the oil for evidence of gelling, separation of ingredients, or crystal formation in the oil.

4.5.3 Corrosivity Test:

4.5.3.1 Preparation of Specimens:

4.5.3.1.1 Steel Discs: Cut three discs, approximately 0.5 inch (13 mm) thick, from a 1 inch (25 mm) diameter bar of AMS 6440 alloy steel. Heat treat the discs in accordance with AMS 2759/2 to a hardness not lower than 62HRC. Wet grind one of the flat surfaces to a surface texture not rougher than 20 microinches (0.5 µm), determined in accordance with ANSI B46.1. Remove grinding coolant by washing the discs in clean methanol. Finish the ground surface by using successively finer grades of metallographic polishing papers 1/0, 2/0, 3/0, and finally 4/0 ((80 grit (200 µm), 100 grit (150 µm), 125 grit (125 µm), 150 grit (100 µm)). Scratches produced by each polishing paper shall be removed by the next finer grade. Finished discs shall have no scratches coarser than those produced by the 4/0 (150 grit (100 µm)) polishing paper. Polishing papers incorporating iron oxide as a polishing medium shall not be used. Wipe the discs clean using sterile cotton and examine under 10X magnification. Discs which evidence any corrosion shall not be used. Store the completed discs in a desiccator containing silica gel until ready for use.

4.5.3.1.2 Brass Clips: Three clips shall be fabricated from 0.0225 inch (0.572 mm) AMS 4507 brass sheet as illustrated in Figure 2. Remove any oil using a suitable solvent and etch the clips by immersing in the following solution for approximately 20 seconds at room temperature:

450 mL water
225 mL nitric acid, concentrated
300 mL sulfuric acid, concentrated
8 mL hydrochloric acid, concentrated

4.5.3.1.2.1 Observe normal precautions in mixing concentrated sulfuric acid and water. Pour the acid into the water slowly, stirring to prevent excessive local heating. After etching, wash the clips in flowing water to ensure removal of the etchant. Rinse in acetone and dry thoroughly. After drying, store the clips in a desiccator containing silica gel until ready for use.

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4.5.3.2 Test Procedure: Remove the discs and clips from the desiccator and coat the discs with the test oil by dipping a glass stirring rod in the oil and then allowing it to drop from the rod onto the polished surface of the discs. The oil shall be spread to ensure complete coverage of the discs' surfaces. Place the brass clips over the coated surfaces of the discs and put the assembled specimens in a test chamber maintained at 26 °C ± 1 (79 °F ± 2) and 50% ± 3 relative humidity. Continue the test for not less than 10 days. Remove the specimens from the chamber on completion of the test, and outline the area covered by the brass clips using the clip as a template. Remove the clips and carefully wipe the oil from the test surface of the discs. Examine the area outlined on the test surface for corrosion or pitting under 10X magnification.

4.6 Reports:

The vendor of oil shall furnish with each shipment a report showing the results of tests on each lot to determine conformance to the acceptance test requirements and stating that the oil conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 3054B, formula number, lot number, and quantity.

4.7 Resampling and Retesting:

If any sample used in the above tests fails to meet the specified requirements, disposition of the oil may be based on the results of testing three additional specimens for each original nonconforming sample. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the oil represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 The oil shall be packaged in airtight containers of such size and design as to keep ullage to a minimum.

5.1.2 A lot may be packaged in small quantities and delivered under the basic lot approval provided lot identification is maintained.

5.1.3 Each container of oil shall be identified, with not less than the following information, by an attached label, using characters of such size as to be legible and which will not be obliterated by normal handling.

OIL, LUBRICATING, LOW TEMPERATURE, FOR -55 °C (-67 °F) SERVICE
AMS 3054B
MANUFACTURER'S IDENTIFICATION_____
PURCHASE ORDER NUMBER _____
LOT NUMBER _____
QUANTITY _____
APPROPRIATE WARNINGS OR PRECAUTIONARY NOTICES _____

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