The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3159E

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Superseding AMS 3159D

Submitted for recognition as an American National Standard

LEAK TEST SOLUTION
Liquid Oxygen Compatible

1. SCOPE:

1.1 Form:

This specification covers a liquid oxygen compatible gas-leak detecting compound in the form of a liquid.

1.2 Application:

This solution has been used typically in detecting leaks in liquid oxygen propulsion systems where a leak test solution (bubble fluid) is desirable, 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 following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

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

AMS 2400 Plating, Cadmium
AMS 2825 Material Safety Data Sheets
AMS 4037 Aluminum Alloy, Sheet and Plate, 4.4Cu - 1.5Mg - 0.60Mn, 2024 -T3 Flat Sheet, -T351 Plate, Solution Heat Treated
AMS 4375 Magnesium Alloy, Sheet and Plate, 3.0Al - 1 .OZn - 0.20Mn (AZ31 B-O), Annealed and Recrystallized
AMS 4500 Copper Sheet, Strip, and Plate, Soft Annealed
AMS 5040 Steel, Sheet and Strip, 0.15 Carbon maximum, Deep Forming Grade

2.2 ASTM Publications:

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

ASTM D 1173 Foaming Properties of Surface-Active Agents
ASTM D 1331 Surface and Interfacial Tension of Solutions of Surface-Active Agents

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-P-116 Preservation, Methods of

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Composition of the solution is optional with the manufacturer. It shall not contain oils, fats, or other materials capable of reacting with gaseous or liquid oxygen.

3.1.1 Leak Detecting Properties: This solution shall detect various sizes of leaks by a readily visible formation of foam or bubbles at the location of the leak when used on surfaces within the temperature range 35 to 160 °F (2 to 71 °C).

3.1.2 Appearance: The solution shall be essentially colorless. A light yellow color is acceptable provided the color is no deeper than a 0.2% aqueous solution of potassium chromate (K_2CrO_4).

3.1.3 Odor: The solution shall not have an objectionable odor.

3.1.4 Toxicity: The solution shall be free from vapors that are harmful or discomforting to personnel and shall not cause skin irritation.

3.1.5 Flammability: The solution and its evaporation residue shall be noncombustible.

3.1.6 (R) Fungus Growth: The solution shall not support fungus growth within the container during use or storage.

3.2 Properties:

Solution shall conform to the following requirements:

3.2.1 Turbidity: A freshly agitated solution shall be free of sediment and suspended matter when examined with transmitted light.

3.2.2 Evaporation Residue: The solution residue shall be not greater than 1.00% of the solution by weight when evaporated to dryness at a temperature not higher than 212 °F (100 °C) and dried to constant weight at a temperature not higher than 230 °F (110 °C).

3.2.3 Foaming Ability: Solution shall meet either the requirements of 3.2.3.1 or 3.2.3.2; in case of dispute, results of the test of 3.2.3.1 shall govern.

3.2.3.1 The solution shall exhibit an initial foam height of not less than 200 mm and a foam height of 200 mm or more after standing for 5 minutes ± 0.5, determined in accordance with ASTM D 1173 except that the temperature shall be 68 to 86 °F (20 to 30 °C).

3.2.3.2 The solution shall exhibit an initial foam volume of not less than 100 mL which shall persist to not less than 85 mL when tested as follows: Place 15 mL ± 0.5 of the solution in a clean, dry, glass-stoppered 250 mL graduated glass cylinder; cylinder, stopper, and solution shall be at 68 to 86 °F (20 to 30 °C). Stopper the cylinder and shake by inversion, rotating the cylinder, in a vertical plane, about the mid-point of its longitudinal axis, without translational motion, for 60 seconds ± 5 so that 30 inversions are completed; one inversion consists of rotating the cylinder 180 degrees in one direction and then 180 degrees in the opposite direction to its original, upright position. Place the cylinder on a table, remove the stopper, and wait approximately 5 seconds. Determine the net volume of foam (total volume minus volume of liquid). This is the initial foam volume. Wait 5 minutes ± 0.5 and again determine the net volume of foam. This is the final foam volume.

3.2.4 Spreading and Wetting Ability: The solution shall have wetting and spreading properties as evidenced by a surface tension of less than 30 dynes/cm, determined in accordance with ASTM D 1331, Method A.

3.2.5 pH Value: The pH value of the leak test solution shall be between 6 and 8.

3.2.6 Impact Sensitivity: The evaporation residue shall not be sensitive to impact when in contact with liquid oxygen and tested under hammer impact energy of 356 foot pounds/square inch (748 kJ/m^2) obtained by dropping a 20 pound (9 kg) weight onto a hammer having a diameter of 0.50 inch (12.7 mm) using a testing procedure acceptable to purchaser. The impact test sample shall be obtained by evaporating a sufficient quantity of solution to dryness as in 3.2.2 to produce not less than 0.010 inch (0.25 mm) thickness of residue under the hammer. An equivalent alternate procedure may be used when acceptable to purchaser.

3.2.7 Corrosiveness: The solution shall not be corrosive to metals when tested in accordance with 3.2.7.1 through 3.2.7.3 using the metals specified as follows:

AMS 4037 Aluminum Alloy Sheet
AMS 5040 Low Carbon Steel Sheet or Strip, cadmium plated in accordance with AMS 2400
AMS 4500 Copper Sheet or Strip
AMS 4375 Magnesium Alloy Sheet

3.2.7.1 Two panels, approximately 0.040 x 2 x 4 inches (1.02 x 51 x 102 mm), shall be prepared of each metal specified in 3.2.7. Panels shall exhibit clean uniform surfaces when examined under 10X magnification prior to test. Panels shall be degreased in a suitable solvent. A clean bristle brush shall be used to apply leak test solution to one of each pair of panels. Approximately one-half of the area of each panel shall be covered with the solution in an irregular manner. Similar panels shall be placed together in sandwich style with the leak test solution between them.

3.2.7.2 The sandwiched panels shall be exposed individually in a horizontal position at alternate intervals of 16 hours in a humidity cabinet and 8 hours in air at approximately 100 °F (38 °C) for a total of 7 days. Humidity cabinet shall be maintained at 120 °F ± 2 (49 °C ± 1) and 95 to 100% relative humidity.

3.2.7.3 Panels shall be washed with warm tap water and a bristle brush and dried with a clean cloth. Panel surfaces which were in contact with the leak test solution shall be examined under 10X magnification for corrosion. Staining of panels is acceptable.

3.3 Quality:

The solution, as received by purchaser, shall be uniform in quality and condition, homogeneous, and free from contaminants and foreign materials detrimental to usage of the solution.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of the solution 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 to perform any confirmatory testing deemed necessary to ensure that the solution conforms to specified requirements.

4.2 Classification of Tests:

(R) All technical requirements are acceptance tests and shall be performed on each lot.

4.3 Sampling and Testing:

(R) Sufficient leak test solution 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 leak test solution produced in a single production run from the same batches of raw materials under the same fixed conditions or all material subjected to the same unit chemical or physical process intended to make the final solution homogeneous, and presented for vendor's inspection at one time.

4.4 Reports:

The vendor of leak test solution shall furnish with each shipment a report showing the results of tests to determine conformance to the technical requirements. This report shall include the purchase order number, lot number, AMS 3159E, and quantity.

4.4.1 (R) A material safety data sheet conforming to AMS 2825, or equivalent, shall be supplied to each purchaser with the first shipment of solution for production use. Each request for modification of solution formulation shall be accompanied by a revised data sheet for the proposed formulation.

4.5 Resampling and Retesting:

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

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Each container of solution shall be legibly marked with not less than AMS 3159E, purchase order number, manufacturer's identification, lot number, and quantity.

5.2 Packaging:

5.2.1 A lot of leak test solution may be packaged in small quantities and delivered under the basic lot approval provided lot identification is maintained.