Designation: D892 – 18ε1

British Standard 5092

Standard Test Method for Foaming Characteristics of Lubricating Oils[1]

This standard is issued under the fixed designation D892; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

ε[1] NOTE—Editorially removed joint designation in February 2023.

1. Scope*

1.1 This test method covers the determination of the foaming characteristics of lubricating oils at 24 °C and 93.5 °C. Means of empirically rating the foaming tendency and the stability of the foam are described.

1.2 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website—http://www.epa.gov/mercury/faq.htm—for additional information. Users should be aware that selling mercury and/or mercury containing products into your state or country may be prohibited by law.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific warning statements, see Sections 7, 8, and 9.1.1.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

D6082 Test Method for High Temperature Foaming Characteristics of Lubricating Oils

E1 Specification for ASTM Liquid-in-Glass Thermometers

E128 Test Method for Maximum Pore Diameter and Permeability of Rigid Porous Filters for Laboratory Use

E1272 Specification for Laboratory Glass Graduated Cylinders

3. Terminology

3.1 *Definitions:*

3.1.1 *diffuser, n—for gas*, a device for dispersing gas into a fluid.

3.1.1.1 *Discussion*—In this test method the diffuser may be made of either metallic or non-metallic materials.

3.1.2 *entrained air (or gas), n—in liquids*, a two-phase mixture of air (or gas) dispersed in a liquid in which the liquid is the major component on a volumetric basis.

3.1.2.1 *Discussion*—Entrained air (or gas) may form micro size bubbles in liquids that are not uniformly dispersed and that may coalesce to form larger bubbles below or at the surface which break or form foam.

3.1.3 *foam, n—in liquids*, a collection of bubbles formed in or on the surface of a liquid in which the air or gas is the major component on a volumetric basis.

3.1.4 *lubricant, n*—any material interposed between two surfaces that reduces friction or wear between them. **D6082**

3.1.4.1 *Discussion*—In this test method, the lubricant is an oil which may or may not contain additives such as foam inhibitors.

[1] This test method is under the jurisdiction of Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.06 on Analysis of Liquid Fuels and Lubricants.

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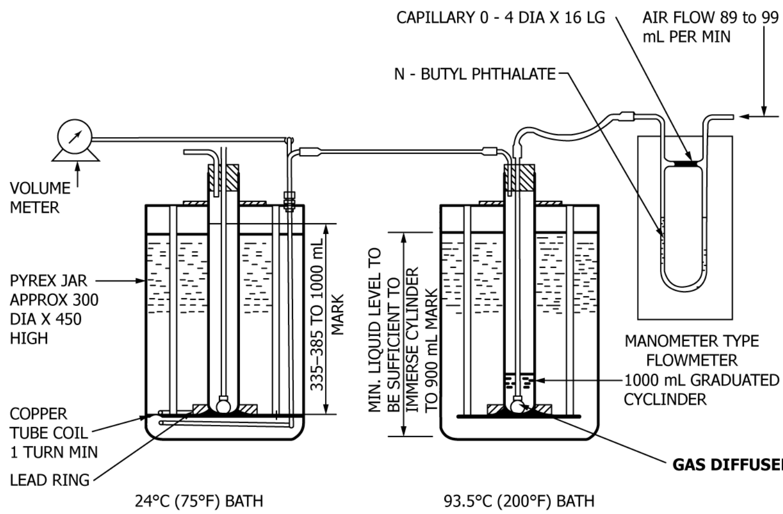
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**



All dimensions in millimetres.

FIG. 1 Foaming Test Apparatus

3.1.5 *maximum pore diameter, n—in gas diffusion*, the diameter of a circular cross-section of a capillary is equivalent to the largest pore of the diffuser under consideration.

3.1.5.1 *Discussion*—The pore dimension is expressed in micrometres (µm).

3.1.6 *permeability, n—in gas diffusion*, the rate of a substance that passes through a material (diffuser) under given conditions.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dynamic bubble, n*—the first bubble to pass through and escape from the diffuser followed by a continuous succession of bubbles when testing for the maximum pore diameter in Annex A1.

3.2.1.1 *Discussion*—When a diffuser is immersed in a liquid, air can be trapped in the pores. It can escape eventually or as soon as a pressure is applied to the diffuser. When testing for maximum pore diameter (Annex A1) the escape of such bubble shall be ignored.

3.2.2 *foam stability, n*—in foam testing, the amount of foam remaining at the specified time following the disconnecting of the air supply.

3.2.2.1 *Discussion—In this test method,* foam stability is determined from measurements made 10 min ± 10 s after disconnecting the air supply. In cases after the air supply has been disconnected, where the foam collapses to 0 mL before the 10 min settling time has elapsed, the test may be terminated and the foam stability result recorded as 0 mL.

3.2.3 *foaming tendency, n*—in foam testing, the amount of foam determined from measurements made immediately after the cessation of air flow.

4. Summary of Test Method

4.1 *Sequence I*—A portion of sample, maintained at a bath temperature of 24 °C ± 0.5 °C is blown with air at a constant rate (94 mL/min ± 5 mL/min) for 5 min, then allowed to settle for 10 min (unless the case described in 3.2.2.1 applies, in which case, the time duration can be shortened). The volume of foam is measured at the end of both periods.

4.2 *Sequence II*—A second portion of sample, maintained at a bath temperature of 93.5 °C ± 0.5 °C, is analyzed using the same air flow rate and blowing and settling time duration as indicated in 4.1.

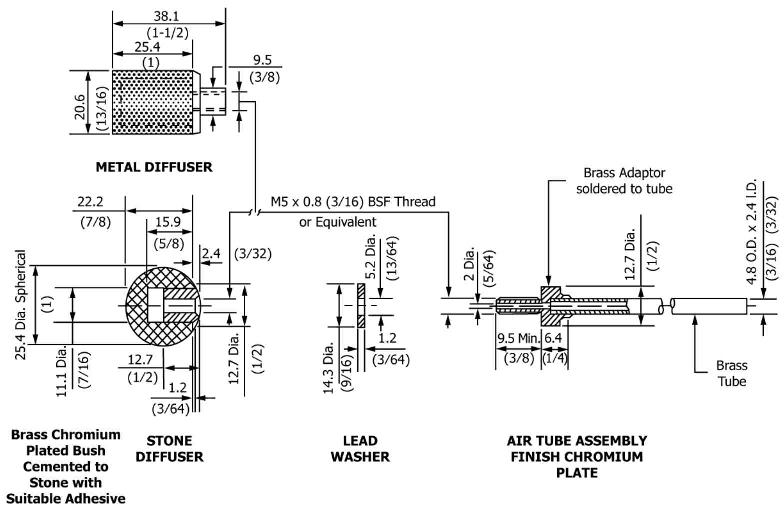
4.3 *Sequence III*—The sample portion used in conducting Sequence II is used for Sequence III, where any remaining foam is collapsed and the sample portion temperature cooled below 43.5 °C by allowing the test cylinder to stand in air at room temperature, before placing the cylinder in the bath maintained at 24 °C ± 0.5 °C. The same air flow rate and blowing and settling time duration as indicated in 4.1 is followed.

5. Significance and Use

5.1 The tendency of oils to foam can be a serious problem in systems such as high-speed gearing, high-volume pumping, and splash lubrication. Inadequate lubrication, cavitation, and overflow loss of lubricant can lead to mechanical failure. This test method is used in the evaluation of oils for such operating conditions.

6. Apparatus

6.1 *Foaming Test Apparatus,* an example of a suitable set-up is shown in Fig. 1, consisting of a 1000 mL graduated cylinder or cylinders (meeting Specification E1272 class B tolerance requirement of ±6 mL and at least graduations of 10 mL) held in position when placed in the baths, such as fitted with a heavy ring or clamp assembly to overcome the buoyancy, and an air-inlet tube, to the bottom of which is fastened a gas diffuser. The gas diffuser can be either a 25.4 mm (1 in.) diameter spherical gas diffuser stone made of fused crystalline alumina grain, or a cylindrical metal diffuser made of sintered five micron porous stainless steel (Note 1). The cylinder shall have a diameter such that the distance from



Dimensions in millimetres (inches)

FIG. 2 Attachment of Gas Diffusers to Air-Inlet Tubes

the inside bottom to the 1000 mL graduation mark is 360 mm ± 25 mm. It shall be circular at the top (Note 2) and shall be fitted with a stopper, such as those made of rubber, having one hole at the center for the air-inlet tube and a second hole off-center for an air-outlet tube. The air-inlet tube shall be adjusted so that, when the stopper is fitted tightly into the cylinder, the gas diffuser (Note 3) just touches the bottom of the cylinder and is approximately at the center of the circular cross section. Gas diffusers shall meet the following specification when tested in accordance with the method given in Annex A1:

Maximum pore diameter, μm	Not greater than 80
Permeability at pressure of 2.45 kPa (250 mm) water, mL of air/min	3000 to 6000

NOTE 1—Gas diffuser permeability and porosity can change during use; therefore, it is recommended that diffusers be tested when new and periodically thereafter preferably after each use.

NOTE 2—Graduated cylinders with circular tops can be prepared from cylinders with pouring spouts by cutting them off below the spouts. The cut surface is to be smoothed before use by fire polishing or grinding.

NOTE 3—Gas diffusers may be attached to air-inlet tubes by any suitable means. A convenient arrangement is shown in Fig. 2.

NOTE 4—It may be necessary to confirm the volume of the cylinder.

6.2 *Test Baths,* large enough to permit the immersion of the cylinder at least to the 900 mL mark and capable of being maintained at temperatures constant to 0.5 °C (1 °F) at 24 °C (75 °F) and 93.5 °C (200 °F), respectively. Both bath (Note 6) and bath liquid shall be clear enough to permit observation of the graduations on the cylinder.

NOTE 5—Air baths may also be utilized for heating purposes. Limited data has shown that both liquid and air baths give equivalent results. However, the precision estimates given in Section 13 are based on using only liquid baths.[3]

NOTE 6—Heat-resistant cylindrical glass jars approximately 300 mm (12 in.) in diameter and 450 mm (18 in.) in height make satisfactory baths.

6.3 *Air Supply,* from a source capable of maintaining an air flow rate of 94 mL/min ± 5 mL/min through the gas diffuser. If the dew point of the air supply does not meet the –60 °C or lower requirements as stated in 7.3, the air shall be passed through a drying tower 300 mm in height packed as follows: just above the constriction place a 20 mm layer of cotton, then a 180 mm layer of indicating desiccant, and a 20 mm layer of cotton. The cotton serves to hold the desiccant in place. Refill the tower when the indicating desiccant begins to show presence of moisture. The use of the drying tower described above is optional if the dew point of the air supply meets the –60 °C or lower requirements as stated in 7.3. A flowmeter sensitive to the required tolerances can be used to measure the air flow (Note 7).

NOTE 7—A manometer type flowmeter, in which the capillary between the two arms of the U-tube is approximately 0.4 mm in diameter and 16 mm in length, and in which *n*-butylphthalate is the manometric liquid, is suitable.

6.3.1 The total volume of air leaving the foaming test apparatus shall be measured by a volume measuring device (Note 9) capable of accurately measuring gas volumes of about 470 mL. The air shall be passed through at least one loop of copper tubing placed around the inside circumference of the cold bath so that the volume measurement is made at approximately 24 °C (75 °F). Precautions are to be taken to avoid leaks at any point in the system.

NOTE 8—Alternatively, a 1 L cylinder (with 10 mL graduation marks) full of water is inverted in a tall, large beaker also filled with water. There should be no air bubbles inside. Air leaving the copper loop in the bath is connected below the cylinder. When the test is started, air will flow into the cylinder, displacing the water. At the end of the test, the volume of air in the cylinder is measured by equalizing the water levels inside and outside the cylinder. Alternatively, the total volume of air passed would be the difference between the final and the initial volumes of water in the cylinder.

NOTE 9—A wet test meter calibrated in hundredths of a litre is suitable.

6.4 *Timer,* graduated and accurate to 1 s or better.

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1516. Contact ASTM Customer Service at service@astm.org.