



Standard Test Method for Volatilization Rates of Lubricants in Vacuum¹

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1. Scope

1.1 This test method covers the determination of the rates of volatilization of lubricants in a thermal-vacuum environment at pressures and temperatures necessary to obtain a measurable rate of evaporation, or evidence of decomposition.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

E296 Practice for Ionization Gage Application to Space Simulators

E297 Methods for Calibrating Ionization Vacuum Gage Tubes³

3. Summary of Test Method

3.1 A known quantity of specimen is placed in a thermal vacuum balance system and the evaporated material is condensed on a cold plate. The weight of the specimen is continually recorded as a function of time for nominal constant surface area.

4. Significance and Use

4.1 This test method provides data for comparison of the evaporation rate of lubricants used in unshielded bearings in the space environment.

5. Apparatus

5.1 *Recording Vacuum Microbalance*, with capacity of 1 g or more, sensitivity of 0.01 mg or less, zero stability of 0.025 mg or less for 8 h with ranges of weight change of 10 mg or more, and 0.1 mg or less, capable of being pumped to 10^{-5} Pa (10^{-7} torr) or less.

5.1.1 When Procedure B for the more volatile samples is used, the vacuum requirement shall be 10^{-2} Pa (10^{-4} torr) or less.

5.2 *Vacuum System*—A pumping system capable of maintaining a starting pressure of 10^{-6} to 10^{-5} Pa (10^{-8} to 10^{-7} torr) (5.1.1). An optically dense baffle system should be used to ensure freedom from back-streaming. A conventional bell jar system with an oil diffusion pump, a mechanical back-up pump, and an optically dense, liquid, nitrogen-cooled baffle has been found satisfactory on the configuration as shown in Fig. 1.

5.3 *Furnace*, with thermocouple indicator, capable of maintaining a constant sample temperature $\pm 3^\circ\text{C}$. All parts of this furnace must be proved to be usable at the highest temperature and vacuum contemplated.

5.4 *Recorder*, capable of recording weight changes continuously with the balance used, to the performance specified in 5.1.

5.5 *Specimen Container*, made of 300 series stainless steel in the form of a straight cylinder with an aspect ratio of height to diameter of approximately 1:14. Where chemical reactions are experienced with the container, alternative materials may be used.

5.6 *Contacting Thermocouple*, touching solid or immersed in liquid specimens, with the leads brought out in such a way as not to influence balance indication.

5.7 *Cold Plate*—A condensing shield cooled with liquid nitrogen to immobilize molecules evaporated from the lubricant which subtends, at least, a 160° arc from the center of the sample.

5.8 *Nude Ionization Gage*, installed as described in Practice E296 and calibrated as described in Methods E297.

5.9 *Optional Supplemental Equipment:*

5.9.1 *Mass Spectrometer*, to identify degassing products and evaporating species.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.L0.07 on Engineering Sciences of High Performance Fluids and Solids.

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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.

³ Withdrawn.