Designation: D5800 – 15a

Standard Test Method for Evaporation Loss of Lubricating Oils by the Noack Method[1]

This standard is issued under the fixed designation D5800; 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.

1. Scope*

1.1 This test method covers three procedures for determining the evaporation loss of lubricating oils (particularly engine oils). Procedure A uses the Noack evaporative tester equipment; Procedure B uses the automated non-Woods metal Noack evaporative apparatus; and Procedure C uses Selby-Noack volatility test equipment. The test method relates to one set of operating conditions but may be readily adapted to other conditions when required.

1.2 Noack results determined using Procedures A and B show consistent differences. Procedure A gives slightly lower results versus Procedure B on formulated engine oils, while Procedure A gives higher results versus Procedure B on basestocks.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance

D6300 Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products and Lubricants

2.2 *DIN Standards:*[3]

DIN 1725 Specification for Aluminum Alloys

DIN 12785 Specifications for Glass Thermometers

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *evaporation loss—of a lubricating oil by the Noack method*, that mass of volatile oil vapors lost when the oil is heated in a test crucible through which a constant flow of air is drawn.

3.1.2 *volatility, n*—the tendency of a liquid to form a vapor.

4. Summary of Test Method

4.1 A measured quantity of sample is placed in an evaporation crucible or reaction flask that is then heated to 250 °C with a constant flow of air drawn through it for 60 min. The loss in mass of the oil is determined.

4.2 Interlaboratory tests have shown that Procedure A, Procedure B, and Procedure C yield essentially equivalent results, with a correlation coefficient of $R^2 = 0.996$. See the research report for the Selby-Noack interlaboratory study.

5. Significance and Use

5.1 The evaporation loss is of particular importance in engine lubrication. Where high temperatures occur, portions of an oil can evaporate.

5.2 Evaporation may contribute to oil consumption in an engine and can lead to a change in the properties of an oil.

5.3 Many engine manufacturers specify a maximum allowable evaporation loss.

5.4 Some engine manufacturers, when specifying a maximum allowable evaporation loss, quote this test method along with the specifications.

5.5 Procedure C, using the Selby-Noack apparatus, also permits collection of the volatile oil vapors for determination of their physical and chemical properties. Elemental analysis of

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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] Available from Deutsches Institut für Normunge, Beuth Verlag GmbH, Burggrafen Strasse 6, 1000 Berlin 30, Germany.

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

the collected volatiles may be helpful in identifying components such as phosphorous, which has been linked to premature degradation of the emission system catalyst.

Procedure A

6. Apparatus

6.1 *Noack Evaporative Tester,* comprising the following:

6.1.1 *Electrically Heated Block Unit,* made from a malleable aluminum alloy (see DIN 1725, Sheet 1), insulated at the jacket and base against loss of heat. (**Warning—**This block is heated to 250 °C.) The block is heated electrically by a base and jacket heater, having a total power consumption of 1 kW to 1.2 kW. In this respect the difference between both individual power consumption should not exceed 0.15 kW. In the center of the heating block, there is a circular recess to insert the evaporating crucible, the space between block and crucible being filled with Woods alloy or a suitable equivalent. Two catches on the block prevent the crucible from rising in the liquid metal bath. Two additional circular recesses at equal intervals from the center of the block are provided for the thermometers (see Fig. 1).

6.1.2 *Evaporating Crucible,* with screw cover. The crucible is made of stainless steel (see Fig. 2). Above the support ring is the thread for the cover. The nickel-plated brass cover is hermetically sealed to the crucible by an internal conical sealing surface (see Fig. 3). Three nozzles of hardened steel permit the air stream to pass through the cover. The extraction tube, which slopes downward, leads from a threaded and sealed connection in the center of the cover.

6.2 *Balance,* capable of weighing at least 200 g to the nearest 0.01 g.

6.3 *Crucible Clamp and Spanner.*

6.4 *Reamer,* 2 mm diameter.

6.5 *Ball Bearing,* 3.5 mm diameter.

6.6 *Thermometer,* M260 (see DIN 12785) or temperature sensing device capable of reading temperature to 0.1 °C. The thermometer should be calibrated with appropriate procedure at appropriate frequency (generally every six months).

6.7 *Contact Type Control Thermometer* (for manual).

6.8 *Glass Y-piece,* an internal diameter of 4 mm. The upright arms, each 45 mm long, should form an angle such that the arm connected to the crucible extraction tube and the Y-piece form a straight line. The vertical arm is 60 mm long and beveled at 45°.

6.9 *Glass Delivery Tubes,* an internal diameter of 4 mm, each arm length 100 mm, beveled at 45° at ends entering and leaving the bottles.

6.9.1 Bent at an angle of approximately 80°.

6.9.2 Bent at an angle of approximately 100°, length to 20 mm of bottle base.

6.9.3 Bent at an angle of approximately 90°.

6.10 *Two Glass Bottles,* approximately 2 L capacity, fitted with rubber bungs bored to receive inlet and outlet tubes (see Fig. 4).

6.11 *Manometer,* inclined form, water-filled, precision 0.2 mm H_2O or suitable pressure sensor capable of measuring 20 mm ± 0.2 mm of H_2O (a 0 mm to 50 mm H_2O pressure transducer has been found to be satisfactory).

NOTE 1—Some manometers use water as the reference fluid, others may use a lower density fluid correlated to read in millimetres of water. Users should ensure that the manometer is filled with the correct density reference fluid.

6.12 *Glass T-Piece,* with bleed valve attached.

6.13 *Vacuum Pump.*

6.14 *Timer,* with accuracy of 0.2 s.

6.15 *Silicone Rubber Tubing,* cut to size, with an internal diameter of 4 mm.

6.15.1 40 mm long; three pieces required,

6.15.2 300 mm long, and

6.15.3 100 mm long.

NOTE 2—The use of automated equipment is permissible as long as it gives equivalent results specified in this test method. All hardware dimensions, make-up of the block, crucible, heat capacity, and so forth, and glassware must conform to the specifications given in this test method.

7. Reagents and Materials

7.1 *Cleaning Solvent*—A mixture of naphtha and toluene is recommended for the cleaning of the crucible. (**Warning—** Flammable, vapor harmful.) Overnight soaking may be necessary.

7.2 Oils having a known evaporative loss, the value of which is provided by the oil supplier. Some examples of such oils include RL-N, RL 172, and RL 223, supplied by CEC. Other oils supplied by other vendors may also be used.

7.3 *Insulated Gloves.*

7.4 *Paint Brush,* such as a tinnerps acid brush (15 mm to 25 mm width).

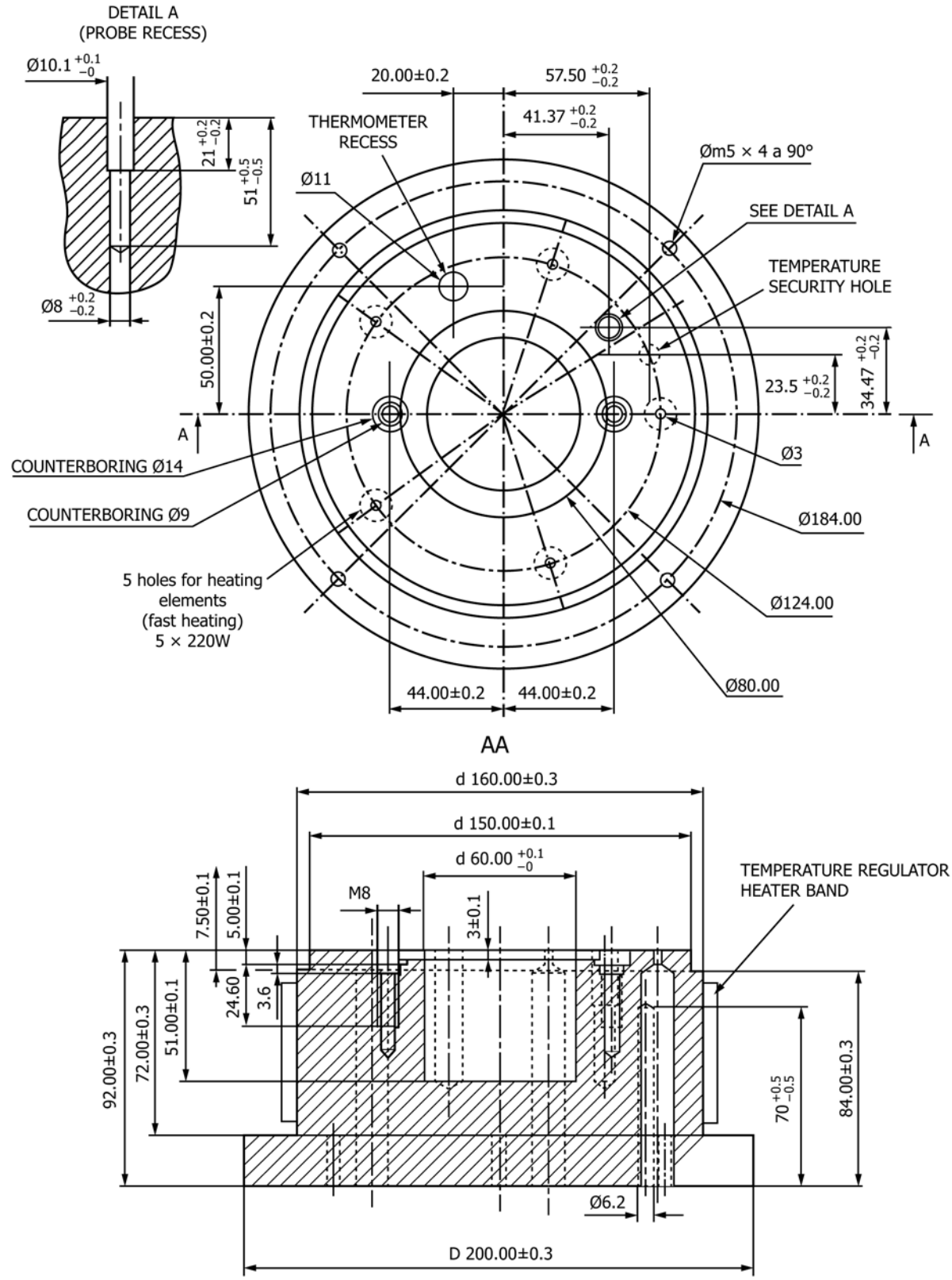
7.5 *Woods Metal*[4] *or Suitable Heat Transfer Material*—(**Warning—**Woods metal contains lead (25 %), bismuth (50 %), antimony (12.5 %), and cadmium (12.5 %); these have been found to be health hazardous. Avoid contact with skin at all times.)

8. Hazards

8.1 *Safety Hazards*—It is assumed that anyone using this test method will either be fully trained and familiar with all normal laboratory practices, or will be under the direct supervision of such a person. It is the responsibility of the operator to ensure that all local legislative and statutory requirements are met.

8.2 (**Warning—**Though the test method calls for a draft-free area, the exhaust fumes from the evaporating oil must be

[4] The sole source of supply of Woods metal known to the committee at this time is Sigma-Aldrich, Customer Support, P.O. Box 14508, St. Louis, MO 63178. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.



NOTE 1—All dimensions in millilitres.

FIG. 1 Heating Block