



Designation: D 3947 – 92

AMERICAN SOCIETY FOR TESTING AND MATERIALS

1916 Race St. Philadelphia, Pa 19103

Reprinted from the Annual Book of ASTM Standards. Copyright ASTM
If not listed in the current combined index, will appear in the next edition.

Standard Test Method for Specific Heat of Aircraft Turbine Lubricants by Thermal Analysis¹

This standard is issued under the fixed designation D 3947; 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 the determination of the specific heat of oil by differential scanning calorimetry (DSC).

1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety problems, 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.* For a specific hazard statement, see Note 1.

2. Terminology

2.1 Definition:

2.1.1 *specific heat, s , n* —a measure of the amount of energy required to produce a given temperature change within a unit quantity of that substance.

3. Summary of Test Method

3.1 Values for specific heats of oils are determined by the following two-step procedure. The differential scanning calorimeter is programmed first to heat an empty, unsealed sample pan over the desired temperature range while monitoring the heat supplied as a function of temperature. The program is repeated for the hermetically sealed sample pan containing a weighed sample of oil. The specific heat of the oil is calculated from the difference between these two sets of measurements.

3.2 A pure material with published specific heat values (for example, diphenyl ether) is used as a calibration standard. Calibration scans are made under the same experimental conditions as are used for the oil samples.

4. Significance and Use

4.1 The specific heat or heat capacity of a substance is a thermodynamic property. It is used in engineering calculations which relate to the manner in which a given system may react to thermal stresses.

5. Apparatus

5.1 *Differential Scanning Calorimeter*—The instrument²

¹ This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.11 on Engineering Sciences of High Performance Fluids and Solids.

Current edition approved Oct. 15, 1992. Published December 1992. Originally published as D 3947 – 80. Last previous edition D 3947 – 86.

² The DuPont Model 990 thermal analyzer with differential scanning calorimetry cell has been found satisfactory for this analysis, and is available from

should have a calorimetric sensitivity of 0.05 mcal/s (0.2 mJ/s), calorimetric precision of $\pm 1\%$, and a temperature range from room temperature to 600°C. The unit is operated in both isothermal and programmed heating modes, with the capability of holding at the final (limit) temperature. The recorder incorporates a T -axis with five range settings from 0.2 mV to 4 mV/in. and a Y axis with sensitivities from 0.05 to 50 mcal/s·in. (0.2 to 209 mJ/s·m).

5.2 *Liquid Sample Pans*, aluminum, with sample capacity of 0.01 mL and temperature capability up to 600°C.

5.3 *Hermetic Press* (for sealing liquid sample pans)—The press consists of a base platform and column, an adjustable lower die holder, and a movable upper die connected to a lever arm.

5.4 *Analytical Balance*, 0.1-mg sensitivity, ± 0.05 -mg precision.

5.5 *Syringe*, 50- μ L volume.

6. Reagents and Materials

6.1 *Diphenyl Ether*, reagent grade, freezing range from 299 to 301 K (see Table 1).

6.2 *Heat Sink Material*, silicone.

6.3 *Argon*. Minimum purity with a two-stage regulator sufficient to maintain a flow rate of 25 mL/min.

NOTE—: Warning

Gas can reduce oxygen available for breathing. See Annex A1.1 (99.997 %)

7. Standards

7.1 A pure material (reagent grade or higher purity) for which specific heat values have been published in the literature (for example, diphenyl ether).

8. Calibration

8.1 Determine the DSC cell calibration constant, E , by running a standard material of known specific heat (for example, diphenyl ether) following the preceding procedure, 9.2 to 9.7.

$$E = \frac{S \times R \times m}{60 Z \Delta Y} \quad (1)$$

where:

S = specific heat at the temperature of interest,

R = heating rate, °C/min,

m = sample mass, mg,

Z = y -axis range sensitivity, and

the DuPont Company; Analytical Instruments Div.; Concord Plaza—McKean Building; Wilmington, DE 19898.