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An American National Standard

Standard Test Method for Specific Heat of Aircraft Turbine Fuels by Thermal Analysis[1]

This standard is issued under the fixed designation D 4816; 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 fuels by differential scanning calorimetry (DSC).

1.2 *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.* For specific hazard statements, see 5.1 and 5.2.

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

2. Summary of Test Method

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

2.2 A pure material with published specific heat values is used as a calibration standard. Calibration scans are made under the same experimental conditions as are used for the fuel test specimens.

3. Significance and Use

3.1 The specific heat or heat capacity of a substance is a thermodynamic property which is a measure of the amount of energy required to produce a given temperature change within a unit quantity of that substance. It is used in engineering calculations which relate to the manner in which a given system may react to thermal stresses.

4. Apparatus

4.1 *Differential Scanning Calorimeter*—The instrument[2] should have a calorimetric sensitivity of 0.05 mcal/s (0.2 mJ/s), calorimetric precision of ±1 %, and a temperature range from −60°C to 200°C. The unit shall be 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).

4.2 *Liquid Specimen Pans*, stainless steel or gold with ability to seal fuel through the temperature range with a test specimen capacity of 0.01 mL.

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

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

4.5 *Syringe*, 50-μL.

5. Reagents and Materials

5.1 *n-Heptane*, reagent grade.

NOTE 1: **Warning**—Flammable. See Annex A1.2.

5.2 *Nitrogen and Argon*—UPC grade minimum purity with a two-stage regulator sufficient to maintain a flow rate of 25 mL/min.

NOTE 2: **Warning**— Gas may reduce oxygen available for breathing. See Annex A1.1.

6. Standards

6.1 A pure material (reagent grade or higher purity) for which specific heat values have been published in the literature (for example, *n*-heptane or aluminum oxide) as shown in Table 1.

7. Procedure

7.1 Hermetically seal with the hermetic press a clean, empty specimen pan to be used as a reference. Place this pan on the reference platform of the DSC cell.

7.2 Place a second specimen pan (a top and a bottom, unsealed) on the sample platform in the same manner. Close the DSC cell and adjust the argon source to provide a flow of 25 mL/min through the cell. This purge remains on continuously during the temperature programs.

7.3 Adjust the starting temperature to a temperature 30°C below that at which specific heat data are desired. Set the limit temperature dial to a value 30°C above that for which

TABLE 1 Specific Heat of *n*-Heptane and Aluminum Oxide[A]

Temperature, K	Specific Heat, J/mol K	Specific Heat, J/mol K
300	225.43	79.41
350	246.07	88.88
400	270.13	96.18
370	255.26	92.06
420	280.74	98.55

[A] Ginnings, D. C., and Furukawa, G. T., J. American Chemical Society, Vol 75, 1953, pp. 523 and 525.

[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.

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[2] The DuPont Model 990 thermal analyzer with differential scanning calorimetry cell has been found satisfactory for this analysis, and is available from the DuPont Company; Analytical Instruments Div.; Concord Plaza—McKean Building; Wilmington, DE 19898.