INTERNATIONAL

Designation: ~~C714 – 05 (Reapproved 2015)~~ C714 – 17

An American National Standard

Standard Test Method for Thermal Diffusivity of Carbon and Graphite by Thermal Pulse Method[1]

This standard is issued under the fixed designation C714; 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~~ Scope*

1.1 This test method covers the determination of the thermal diffusivity of carbons and graphite ~~to ±5 %~~ at temperatures up to 500 °C. It requires only a small easily fabricated specimen. Thermal diffusivity values in the range from 0.04 cm^2/s to 2.0 cm^2/s are readily measurable by this test method; however, for the reason outlined in Section ~~5~~7, for materials outside this range this test method may require modification.

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.*

1.3 *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]

C781 Practice for Testing Graphite and Boronated Graphite Materials for High-Temperature Gas-Cooled Nuclear Reactor Components

D7775 Guide for Measurements on Small Graphite Specimens

E1461 Test Method for Thermal Diffusivity by the Flash Method

3. Terminology

3.1 *Definitions:*

3.1.1 *thermal conductivity, n*—the rate at which heat passes through a material, expressed as the amount of heat that flows per unit time through a unit area with a temperature gradient of one degree per unit distance.

3.1.2 *thermal diffusivity, n*—a measure of the ability of a material to conduct thermal energy relative to its ability to store thermal energy; it is equal to the thermal conductivity divided by density and specific heat capacity at constant pressure.

4. Summary of Test Method

4.1 A high-intensity short-duration thermal pulse from a flash lamp is absorbed on the front surface of a specimen; and the rear surface temperature change as a function of time is observed on an oscilloscope. The pulse raises the average temperature of the specimen only a few degrees above its initial value. The ambient temperature of the specimen is controlled by a furnace or cryostat. Thermal diffusivity is calculated from the specimen thickness and the time required for the temperature of the back surface to rise to one half of its maximum value (**1**).[3]

4.2 The critical factors in this test method are:

4.2.1 $\tau/t_{1/2}$ must be 0.02 or less. τ is the pulse time as defined in Fig. 1 and $t_{1/2}$ is the time for the rear surface temperature to rise to one half of its maximum value (see Fig. 2).

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.F0 on Manufactured Carbon and Graphite Products.

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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] The boldface numbers in parentheses refer to the list of references at the end of this test method.

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

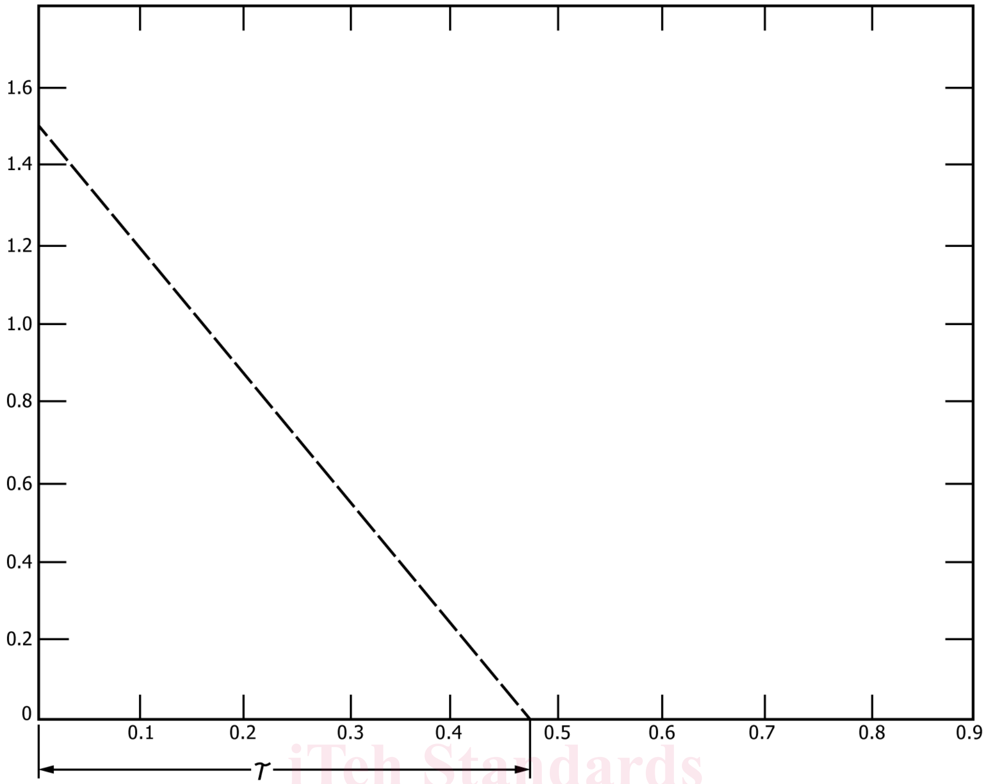

FIG. 1 Flash Tube Response

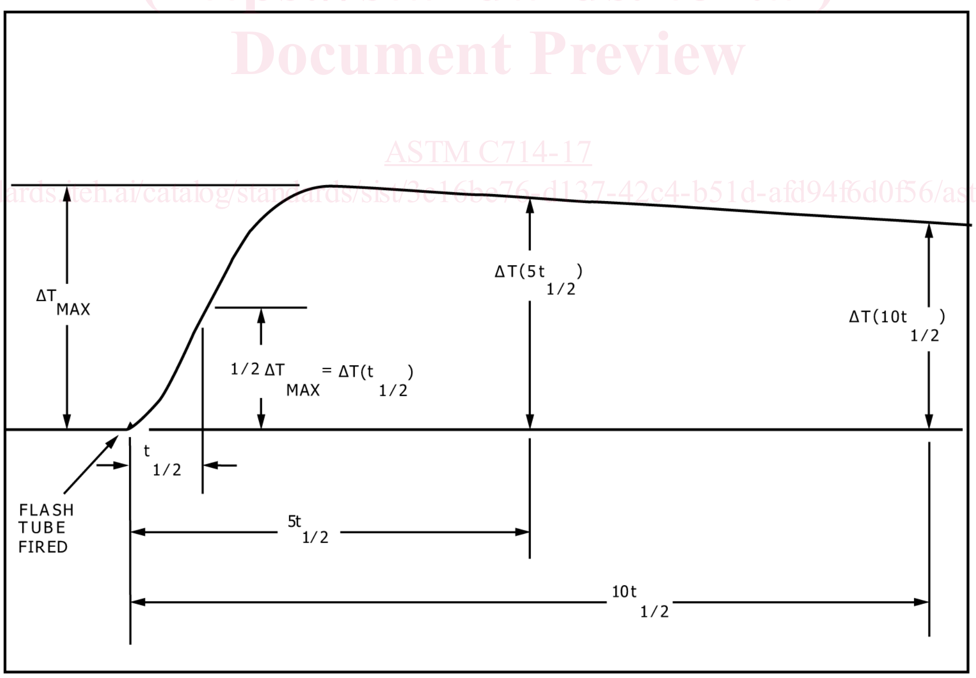

FIG. 2 Example of Oscilloscope Trace Showing Parameters Used to Calculate Thermal Diffusivity

4.2.2 Heat losses from the specimen via radiation, convection, or conduction to the specimen holder must be small. Whether or not this condition is violated can be determined experimentally from the oscilloscope trace, an example of which is shown in Fig. 2. If $\Delta T(10\, t_{1/2})/\Delta T(t_{1/2}) > 1.98$, the heat losses are assumed to be zero.

4.2.3 The oscilloscope trace must be such that ΔT_{max}, $\Delta T(10\, t_{1/2})$, and $t_{1/2}$ can be determined to ±2 %.

4.2.4 The other conditions are less critical, and the experimenter is left to his discretion.