Designation: E2021 – 15 (Reapproved 2023)

Standard Test Method for Hot-Surface Ignition Temperature of Dust Layers[1]

This standard is issued under the fixed designation E2021; 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 a laboratory procedure to determine the hot-surface ignition temperature of dust layers, that is, measuring the minimum temperature at which a dust layer will self-heat. The test consists of a dust layer heated on a hot plate.[2,3]

1.2 Data obtained from this test method provide a relative measure of the hot-surface ignition temperature of a dust layer.

1.3 This test method should be used to measure and describe the properties of materials in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire hazard risk of materials, products, or assemblies under actual fire conditions. However, results of this test method may be used as elements of a fire risk assessment that takes into account all of the factors that are pertinent to an assessment of the fire hazard risk of a particular end use product.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Section 8.

1.6 *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:*[4]

E771 Test Method for Spontaneous Heating Tendency of Materials (Withdrawn 2001)[5]

E1445 Terminology Relating to Hazard Potential of Chemicals

E1491 Test Method for Minimum Autoignition Temperature of Dust Clouds

2.2 *IEC Standard:*[6]

IEC 1241-2-1 Electrical Apparatus for Use in the Presence of Combustible Dust; Part 2: Test Methods—Section 1: Methods for Determining the Minimum Ignition Temperatures of Dusts, Method A

3. Terminology

3.1 *Definitions*—For definitions of other terms used in this standard, see Terminology E1445.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *hot-surface ignition temperature of a dust layer, n*—lowest set temperature of the hot plate that causes ignition of the dust layer.

3.2.2 *ignition of a dust layer, n*—initiation of self-heating or combustion in a material under test.

3.2.3 *ignition time, n*—time between the start of heating and the point at which the maximum temperature or flaming combustion is reached.

3.2.4 *temperature rise, ΔT, n*—the difference between T_{max} and the initial set temperature of the hot plate.

3.2.5 T_{max}, *n*—maximum temperature measured during test.

4. Summary of Test Method

4.1 The test material is placed within a metal ring on top of a hot plate, that is at a preset constant temperature.

[1] This test method is under the jurisdiction of ASTM Committee E27 on Hazard Potential of Chemicals and is the direct responsibility of Subcommittee E27.04 on the Flammability and Ignitability of Chemicals.

Current edition approved May 1, 2023. Published May 2023. Originally approved in 1999. Last previous edition approved in 2015 as E2021 – 15. DOI: 10.1520/E2021-15R23

[2] This test method is based on recommendations of the National Materials Advisory Board of the National Academy of Sciences (**1**).[3]

[3] The boldface numbers in parentheses refer to the list of references at the end of this standard.

[4] 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.

[5] The last approved version of this historical standard is referenced on www.astm.org.

[6] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

4.2 The sample temperature is monitored to determine temperature rise due to oxidative reactions or decomposition reactions, or both.

4.3 Ignition is considered to have taken place when either of the following occurs:

4.3.1 Temperature in the dust layer at position of thermocouple rises at least 50 °C above the hot plate temperature, or

4.3.2 Visible evidence of combustion is apparent, such as red glow or flame.

4.4 Hot plate surface temperature is varied from test to test, as necessary, until the hot-surface ignition temperature is determined.

5. Significance and Use

5.1 This test method is applicable to dusts and powders, and provides a procedure for performing laboratory tests to evaluate hot-surface ignition temperatures of dust layers.

5.2 The test data can be of value in determining safe operating conditions in industrial plants, mines, manufacturing processes, and locations of material usage and storage.

5.3 Due to variation of ignition temperature with layer thickness, the test data at one thickness may not be applicable to all industrial situations (see Appendix X1). Tests at various layer thicknesses may provide a means for extrapolation to thicker layers, as listed in the following for pulverized Pittsburgh bituminous coal dust (**2**). Mathematical modeling of layer ignition at various layer thicknesses is described in Ref. (**3**).

Layer Thickness, mm	Hot-Surface Ignition Temperature, °C
6.4	300
9.4	260
12.7	240
25.4	210

5.4 This hot plate test method allows for loss of heat from the top surface of the dust layer, and therefore generally gives a higher ignition temperature for a material than Test Method E771, which is a more adiabatic system.

5.5 This test method for dust layers generally will give a lower ignition temperature than Test Method E1491, which is for dust clouds. The layer ignition temperature is determined while monitoring for periods of minutes to hours, while the dust cloud is only exposed to the furnace for a period of seconds.

NOTE 1—Much of the literature data for layer ignition is actually from a basket in a heated furnace (**4**), known as the modified Godbert-Greenwald furnace test. Other data are from nonstandardized hot plates (**5-9**).

5.6 Additional information on the significance and use of this test method may be found in Ref. (**10**).

6. Limitations and Interferences

6.1 This test method should not be used with materials having explosive or highly reactive properties.

6.2 If the metal (for example, aluminum) plate or ring reacts with the test material, choose another type of metal that does not react.

7. Apparatus

7.1 The complete apparatus, shown in Fig. 1, consists of a circular metal (for example, aluminum) plate centrally positioned on top of a hot plate. The dust layer is confined within a metal ring on top of the metal plate. An example of an apparatus that has been found suitable is given in Appendix X2.

7.1.1 *Heated Surface,* consisting of a metal plate of approximately 200 mm diameter and at least 20 mm thick. This plate is centrally placed on top of a commercial hotplate. A thermocouple is mounted radially in the metal plate, with its junction in contact with the plate within 1.0 mm ± 0.5 mm of the upper surface. This thermocouple is connected to a temperature controller. The plate and its thermocouple-controller assembly, in conjunction with the commercial hotplate, should satisfy the following requirements:

7.1.1.1 The plate should be capable of attaining a maximum temperature of 450 °C without a dust layer in position,

7.1.1.2 The temperature controller must be capable of maintaining the temperature of the plate constant to within ±5 °C throughout the time period of the test,

7.1.1.3 When the temperature of the plate has reached a constant value, the temperature across the plate should be uniform to within ±5 °C, as shown in Fig. 2,

7.1.1.4 The temperature control should be such that the recorded plate temperature will not change by more than ±5 °C during the placing of the dust layer and will be restored to within 2 °C of the previous value within 5 min of placing the dust layer, and

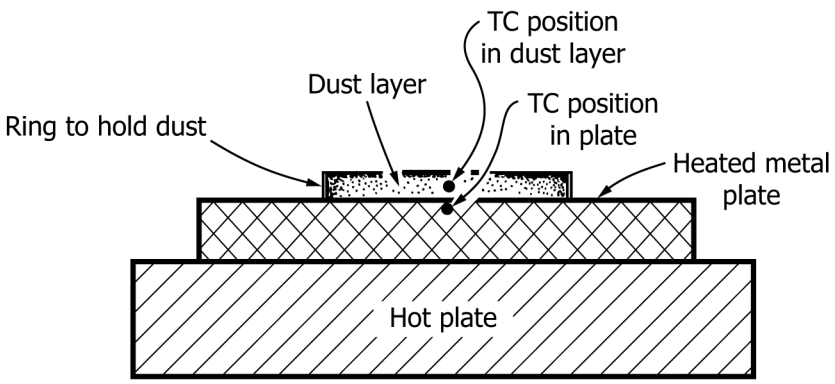

FIG. 1 Schematic of Hotplate Layer Ignition Apparatus