Designation: D5207 – 14

# Standard Practice for Confirmation of 20–mm (50–W) and 125–mm (500–W) Test Flames for Small-Scale Burning Tests on Plastic Materials[1]

This standard is issued under the fixed designation D5207; 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 practice covers the confirmation of test flames for small-scale burning tests on plastic materials using the laboratory burner described in Specification D5025. Back pressures and flow rates for methane, propane, and butane supply gases are given for specific test flames. This practice describes a procedure to confirm the heat evolution of the test flame.

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

1.3 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.*

NOTE 1—There is no similar ISO standard. This practice is equivalent in technical content to, but not fully corresponding in presentation with, the confirmatory procedures of IEC/TS 60695-11-3, Method A and IEC/TS 60695-11-4, Method A.

1.4 *Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.*

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 and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D883 Terminology Relating to Plastics
D3195 Practice for Rotameter Calibration
D5025 Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials
E176 Terminology of Fire Standards
E220 Test Method for Calibration of Thermocouples By Comparison Techniques
E230 Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples
E608 Specification for Mineral-Insulated, Metal-Sheathed Base Metal Thermocouples

2.2 *IEC Standards:*[3]

IEC/TS 60695-11-3 Ed. 1: Fire Hazard Testing-Part 11: Test Flames-Section 3: 500 W Flames: Apparatus and Confirmational Test Methods
IEC/TS 60695-11-4 Ed. 2: Fire Hazard Testing-Part 11: Test Flames-Section 4: 50 W Flame: Apparatus and Confirmational Test Methods

## 3. Terminology

3.1 *Definitions of Terms:*

3.1.1 For definitions of terms related to plastics used in this test method, refer to Terminology D883. For definitions of terms related to fire used in this test method, refer to Terminology E176.

## 4. Summary of Practice

4.1 A test flame of specified height and color is obtained with gas supplied at a suggested back pressure and flow rate. A thermal sensor is then positioned over the flame, and the time for the temperature of the sensor to increase from 100 to 700°C is determined. The time is used to confirm the heat-evolution profile of the test flame.

## 5. Significance and Use

5.1 The flame height and color (indicative of air-to-gas ratio) for a test flame have traditionally been specified in the individual test method. The energy content of the flame has also been addressed by reference to a specific supply gas. It has been determined that the supply-gas back pressure and flow rate can be varied without affecting the height and color of the

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[1] This practice is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.30 on Thermal Properties.

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

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

flame. However, the energy content of the flame is affected. This practice provides the back pressure and flow rate of the supply gas for a 20-mm (50–W) and a 125-mm (500–W) test flame, and a procedure for confirming the heat-evolution profile of the test flame.

5.2 Information is provided for test flames using methane, propane, or butane. Using this information, these supply gases can be used interchangeably with a standardized burner to produce essentially the same test flame.

## 6. Apparatus

6.1 *Test Chamber*, enclosure or laboratory hood, free of induced or forced draft, having an internal volume of at least 0.5 $m^3$ for the 20–mm (50–W) flame or 0.75 $m^3$ for the 125–mm (500–W) flame.

6.2 *Laboratory Burner*, constructed in accordance with Specification D5025.

6.3 *Manometer/Pressure Gauge*, capable of measuring to 800 mm of water, with increments of 5 mm.

6.4 *Flow Meter*—A rotameter calibrated in accordance with Practice D3195, with correlation curves appropriate for the gas, or a mass flow meter with at least 2 % accuracy.

6.5 *Thermal Sensor (Copper Slug and Thermocouple)*—A slug constructed of high conductivity (electrolytic) copper with dimensions as shown in Fig. 1. A 1.76 ± 0.01-g slug is used for the 20-mm (50–W) flame, and a 10.0 ± 0.05-g slug is used for the 125-mm (500–W) flame. A Type K thermocouple with a 0.5-mm diameter stainless steel sheath constructed in accordance with Specification E608 shall be peened into the top of the slug.

6.6 *Temperature Indicator*—A potentiometer or temperature indicator for Type K thermocouples capable of reading to 800°C. Calibrate the combination thermal sensor and temperature indicator in accordance with the general procedures outlined in Method E220. The initial calibration tolerance is defined in Tables E230.

6.7 *Ring Stand*, with a clamp or equivalent device, adjustable for positioning of the thermal sensor.

6.8 *Timer*, stop watch or other suitable timing device capable of timing to the nearest 0.1 s.

6.9 *Gas Supply*—A supply of methane, propane, or butane, with suitable regulator and meter for uniform gas flow.

6.9.1 *Methane*, Technical grade, 98 % minimum purity, having a heating value of 37 ± 1 MJ/$m^3$ at 25°C. Natural gas with a certified heating value of 37 ± 1 MJ/$m^3$ will likely provide similar results.

6.9.2 *Propane*, Technical grade, 98 % minimum purity, having a heating value of 94 ± 2 MJ/$m^3$ at 25°C.

6.9.3 *Butane*, CP grade, 99 % minimum purity, having a heating value of 120 ± 3 MJ/$m^3$ at 25°C.

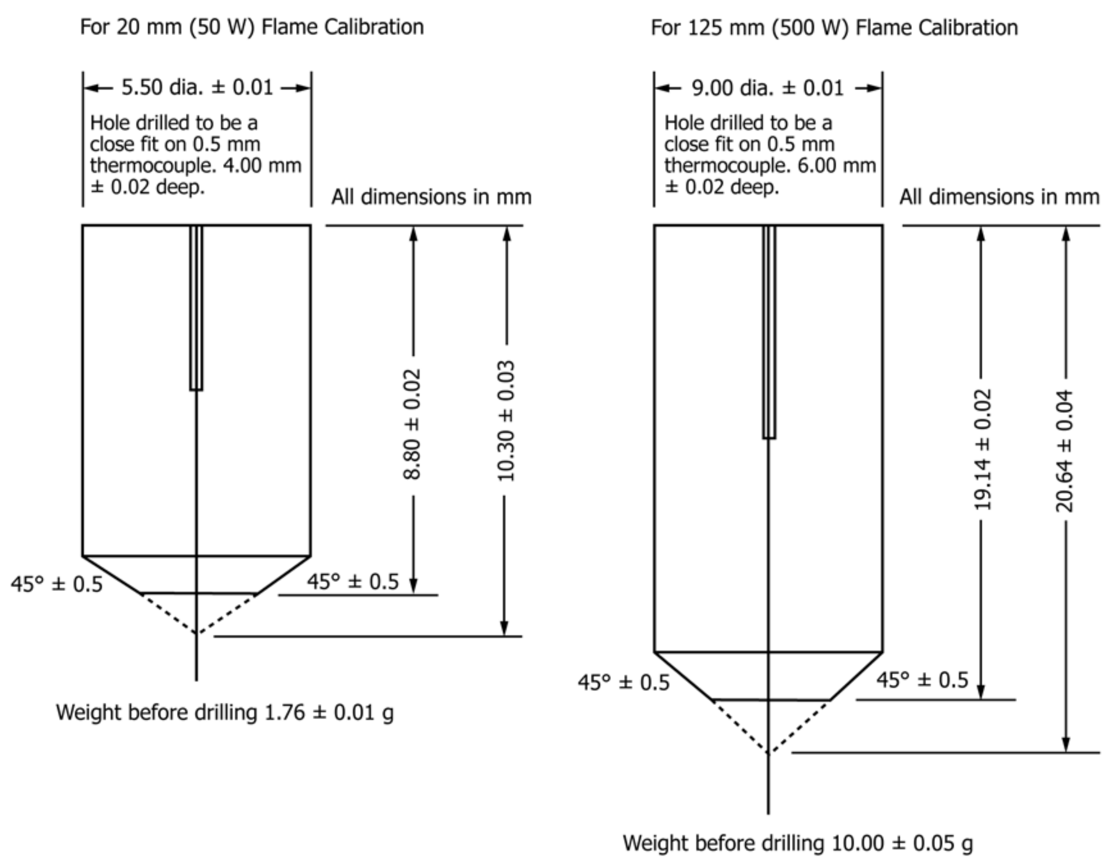


**FIG. 1 Copper Slug for Thermal Sensor**

## 7. Confirmation Procedure

7.1 Locate the burner in a draft-free enclosure or hood. Connect the burner to the gas supply, in line with a control valve, flowmeter and manometer. See Fig. 2.

7.2 Connect the leads of the Type K thermocouple to the temperature indicator. Clamp the thermocouple sheath above the burner, along its central axis, so that the copper slug is suspended 75 mm minimum from the clamp. See Fig. 3.

7.2.1 *20-mm (50–W) Test Flame*—Position the slug 10 ± 1 mm from the top of the burner.

7.2.2 *125-mm (500–W) Test Flame*—Position the slug 55 ± 1 mm from the top of the burner.

7.3 Move the burner away from the copper slug to ensure no influence of the flame on the slug during the preliminary adjustment of the test flame.

7.4 If the copper slug has not been used before, conduct a preliminary run to condition the surface of the slug. Discard this first result. The slug shall not be polished or cleaned for subsequent use. The presence or absence of an oxide coating affects the thermal response of the slug to the flame. It is recommended that laboratories maintain a standard reference slug and a working slug to compare their thermal response working and verify that the oxide coating is not affecting the working slug's thermal response.

7.5 Start with the needle valve on the burner completely open, and the air-inlet openings closed or reduced to the smallest setting. Set the gas-flow rate and back pressure for the type of flame and gas supply. Ignite the flame.

7.5.1 *20-mm (50–W) Test Flame*—Set the gas flow rate as shown in Table 1. Adjust the needle valve so that the back pressure is also as shown in Table 1. Adjust the barrel air supply so that a blue flame with no inner cone and an overall height of 20 ± 1 mm is produced, when viewed in subdued light.

NOTE 2—If alternate fuel gases such as propane or butane are used, ensure that a stable flame is obtained and the heat-evolution profile complies with 7.10.1. It is possible the yellow tip will not disappear when using propane or butane.

7.5.2 *125-mm (500–W) Test Flame*—Set the gas flow rate as shown in Table 2. Adjust the needle valve so that the back pressure is also as shown in Table 2. Adjust the barrel air supply so that a flame having an inner blue cone of 40 ± 2 mm and an overall height of 125 ± 10 mm is produced, when viewed in subdued light.

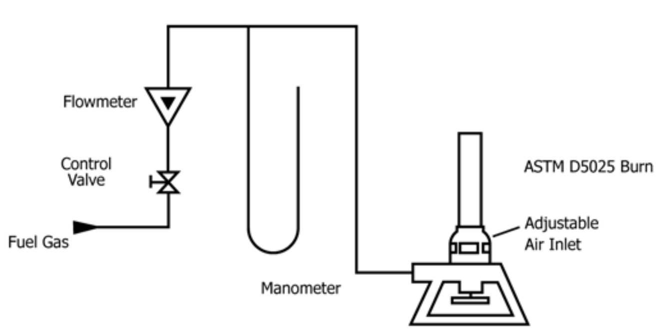


**FIG. 2 Burner Supply Arrangement**

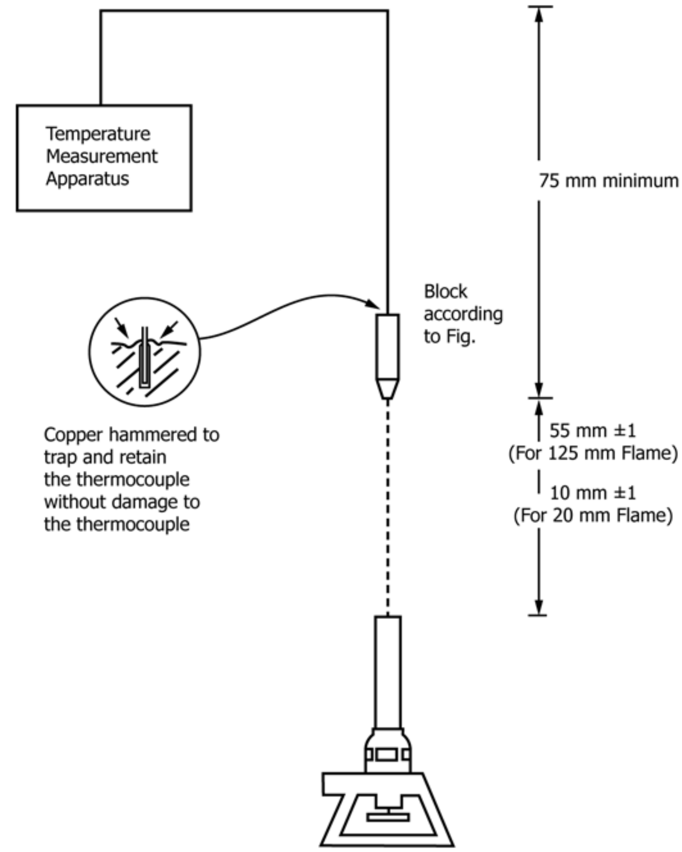


**FIG. 3 Confirmatory Test Arrangement**

**TABLE 1 20-mm (50–W) Test Flame**

| Gas Type | | Methane |
|---|---|---|
| Flow rate | mL/min | 105 ± 5 |
| Back pressure | mm water | <10 |

**TABLE 2 125-mm (500–W) Test Flame**

| Gas Type | | Methane | Propane | Butane |
|---|---|---|---|---|
| Flow rate | mL/min | 965 ± 30 | 380 ± 15 | 300 ± 10 |
| Back pressure | mm water | 125 ± 25 | 550 ± 100 | 600 ± 125 |

7.6 Extinguish the flame and reposition the copper slug, if necessary.

7.7 Reignite the flame and allow the burner to operate for 5 min to stabilize the working temperature.

7.8 The initial temperature of the slug shall be less than 50°C.

7.9 Reposition the burner under the slug. Start the timer when the temperature of the slug reaches 100 ± 2°C. Stop the timer when the temperature of the slug reaches 700 ± 3°C. Record this time. Remove the burner and allow the slug to cool in air to less than 50°C between determinations.

NOTE 3—It is optional to use a small fan to reduce the time to cool the slug.

NOTE 4—To avoid damage to the thermocouple, immediately remove or extinguish the flame once the slug has reached 700°C.

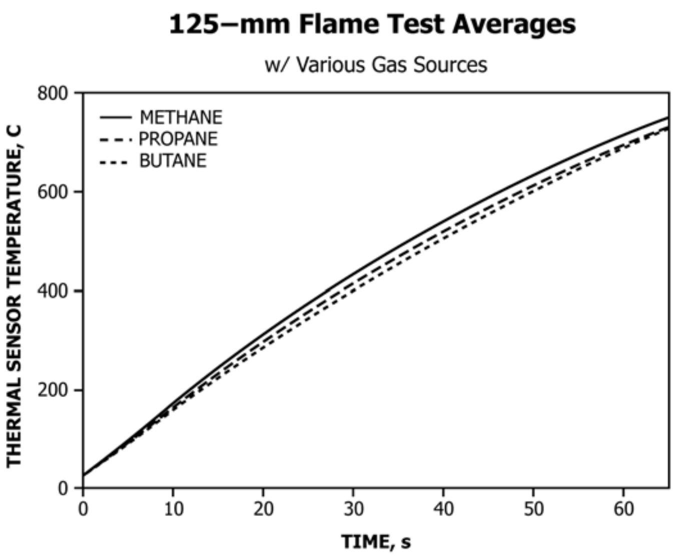


FIG. 4 Typical Temperature Response

7.10 Report the individual determinations.

7.10.1 *20-mm (50–W) Test Flame*—The time for the temperature to rise from 100 ± 2 to 700 ± 3°C shall be 44 ± 2 s.

7.10.2 *125-mm (500–W) Test Flame*—The time for the temperature to rise from 100 ± 2 to 700 ± 3°C shall be 54 ± 2 s.

7.11 If the temperature-rise time falls outside the specified range, adjust the gas-flow rate and repeat the calibration procedure from 7.5. If the temperature-rise time is within the specified range, repeat the heating procedure (see 7.7) two additional times to confirm the heat-evolution profile of the test flame.

7.12 An example of a typical temperature response is shown in Fig. 4.

## 8. Keywords

8.1 confirmation; flammability; laboratory burner; small-scale burning tests; test flames

## SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D5207 - 09) that may impact the use of this standard. (May 1, 2014)

*(1)* Added standard edition number to IEC/TS60695-11-3 (2.2).
*(2)* Revised 3.1.
*(3)* Revised the term "heat flux" to "heat evolution" (5.1) to align with 1.1, 4.1, and 7.11.
*(4)* Added the replacement criteria for copper slug to minimize variation in results (7.4).