



Standard Practice for Confirmation of 20-mm (50-W) and 125-mm (500-W) Test Flames for Small-Scale Burning Tests on Plastic Materials¹

This standard is issued under the fixed designation D 5207; 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 D 5025. 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 should be used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions and should not be used to describe or appraise the fire-hazard or fire-risk of materials, products, or assemblies under actual fire conditions. Results, however, of the test may be used as elements of a fire-hazard assessment or a fire-risk assessment, which takes into account all of the factors, which are pertinent to an assessment of the fire hazard or fire risk of a particular end use.*

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 *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:

- D 883 Terminology Relating to Plastics²
- D 3195 Practice for Rotameter Calibration³
- D 5025 Specification for a Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials⁴

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 *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 11.03.

⁴ *Annual Book of ASTM Standards*, Vol 08.03.

E 176 Terminology of Fire Standards⁵

E 220 Test Method for Calibration of Thermocouples by Comparison Techniques⁶

E 230 Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples⁶

E 608 Specification for Metal-Sheathed Base-Metal Thermocouples⁶

2.2 IEC Standards:

IEC/TS 60695-11-3: Fire Hazard Testing-Part 11: Test Flames-Section 3: 500 W Flames: Apparatus and Confirmational Test Methods⁷

IEC/TS 60695-11-4 Ed. 2: Fire Hazard Testing-Part 11: Test Flames-Section 4: 50 W Flame: Apparatus and Confirmational Test Methods⁷

3. Terminology

3.1 Definitions—For definitions of terms used in this practice, refer to Terminology D 883.

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 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-flux profile of the test flame.

⁵ *Annual Book of ASTM Standards*, Vol 04.07.

⁶ *Annual Book of ASTM Standards*, Vol 14.03.

⁷ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

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

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 m³ for the 20-mm (50-W) flame or 0.75 m³ for the 125-mm (500-W) flame.

6.2 *Laboratory Burner*, constructed in accordance with Specification D 5025.

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

6.4 *Flow Meter*—A rotameter calibrated in accordance with Practice D 3195, with correlation curves appropriate for the gas, or a mass flow meter with at least 2 % accuracy.

6.5 *Thermal Sensory (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 E 608 should 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 tempera-

ture indicator in accordance with the general procedures outlined in Method E 220. The initial calibration tolerance is defined in Tables E 230.

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/m³ at 25°C. Natural gas with a certified heating value of 37 ± 1 MJ/m³ should provide similar results.

6.9.2 *Propane*, Technical grade, 98 % minimum purity, having a heating value of 94 ± 2 MJ/m³ at 25°C.

6.9.3 *Butane*, CP grade, 99 % minimum purity, having a heating value of 120 ± 3 MJ/m³ at 25°C.

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.

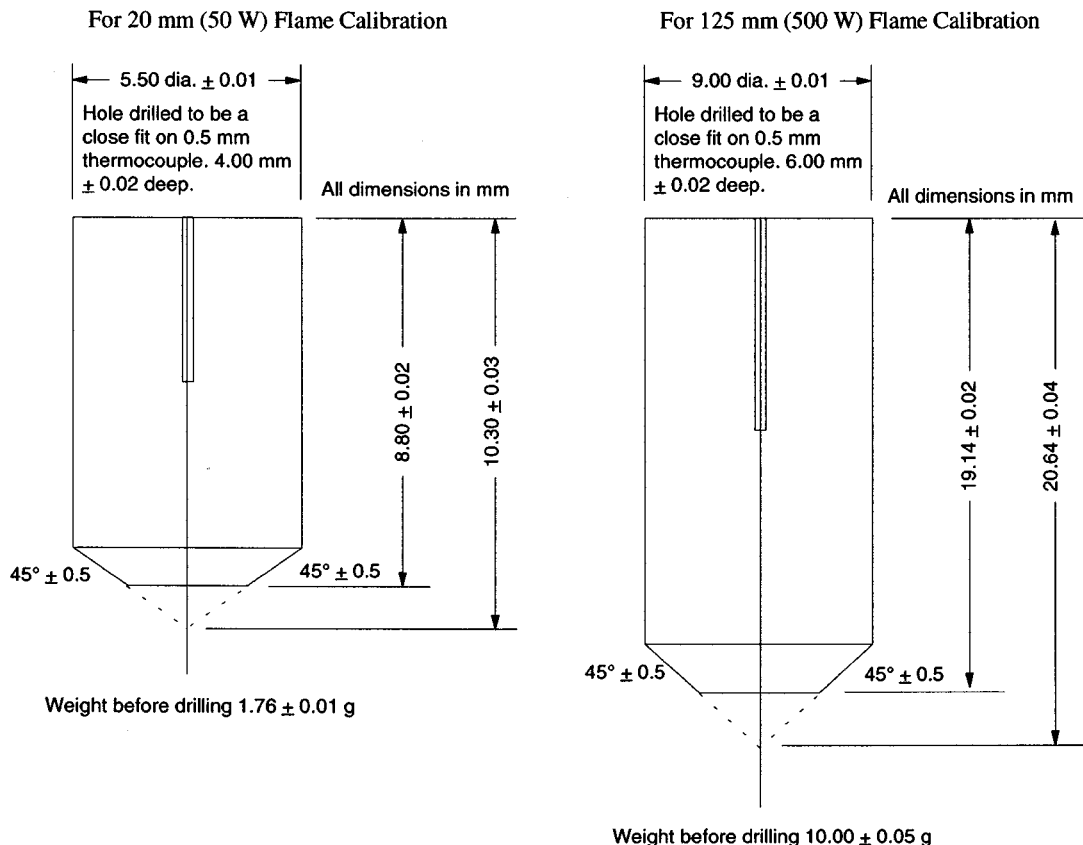


FIG. 1 Copper Slug for Thermal Sensor

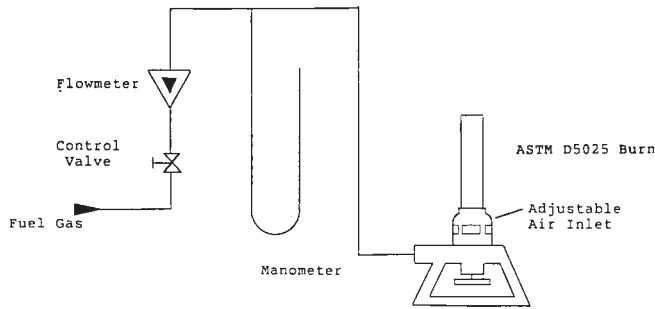


FIG. 2 Burner Supply Arrangement

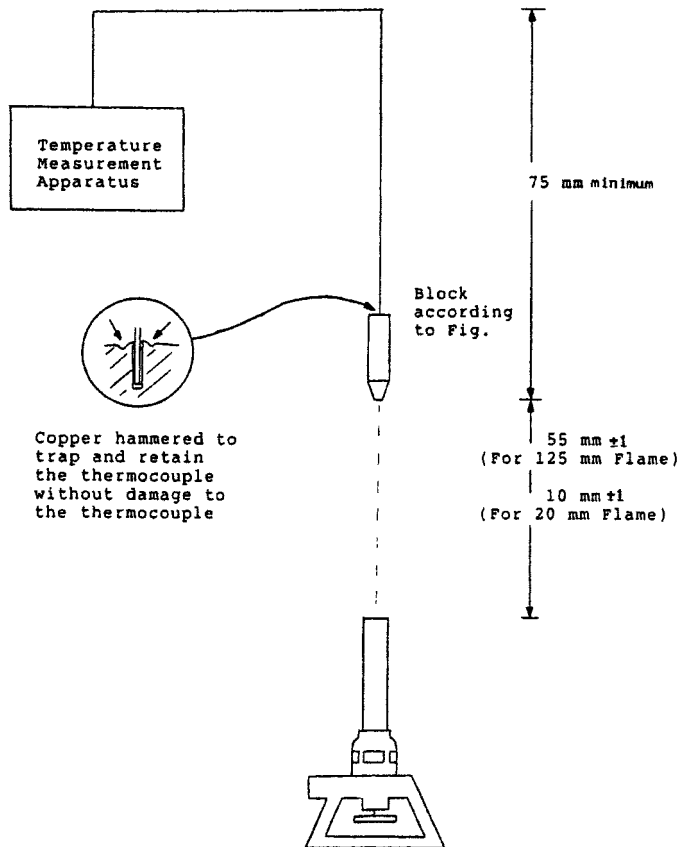


FIG. 3 Confirmatory Test Arrangement

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 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.

7.4.1 *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—Alternate fuel gases such as propane or butane may be used if

TABLE 1 20-mm (50-W) Test Flame

Gas Type	Methane	
Flow rate	mL/min	105
Back pressure	mm water	<10

a stable flame is obtained and the heat-evolution profile complies with 7.9.1. The yellow tip may not disappear when using propane or butane.

7.4.2 *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.

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

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

7.7 The initial temperature of the slug should be less than 50°C .

7.8 Reposition the burner under the slug. Start the timer when the temperature of the slug reaches $100 \pm 2^\circ\text{C}$. Stop the timer when the temperature of the slug reaches $700 \pm 3^\circ\text{C}$. Record this time. Remove the burner and allow the slug to cool in air to less than 50°C between determinations.

NOTE 3—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 should 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.

NOTE 4—A small fan may be used to reduce the time to cool the slug.

NOTE 5—To avoid damage to the thermocouple, the flame should be removed immediately or extinguished once the slug has reached 700°C .

7.9 Repeat the heating procedure (see 7.7) two additional times, and report the average of the three determinations.

7.9.1 *20-mm (50-W) Test Flame*—The time for the temperature to rise from 100 ± 2 to $700 \pm 3^\circ\text{C}$ shall be 44 ± 2 s.

7.9.2 *125-mm (500-W) Test Flame*—The time for the temperature to rise from 100 ± 2 to $700 \pm 3^\circ\text{C}$ shall be 54 ± 2 s.

7.10 If the temperature-rise time falls outside the specified range, adjust the gas-flow rate and repeat the calibration procedure from 7.4.

7.11 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

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

125-mm Flame Test Averages

w/ Various Gas Sources

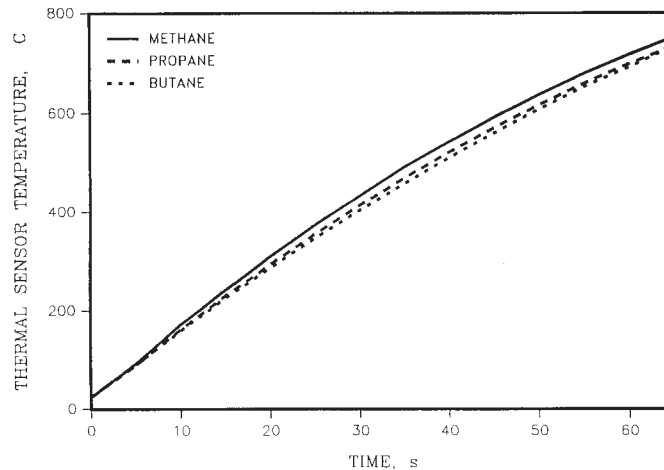


FIG. 4 Typical Temperature Response

SUMMARY OF CHANGES

This section identifies the location of selected changes to this practice. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this practice. This section may also include descriptions of the changes or reasons for the changes, or both.

D 5207 - 03:

- (1) Title changed to coordinate with IEC versions and to reflect changes in other ASTM standards using this standard.
- (2) Internal volume of test chamber added as per IEC standards.
- (3) Tolerances for copper slugs added as per IEC standards.
- (4) Purity of propane upgraded as per IEC standards.
- (5) Tolerances added to figures as per IEC standards.

- (6) Tables updated and aligned.

D 5207 – 98:

- (1) Added ISO equivalency statement.
- (2) Updated Referenced Documents section.
- (3) Added Terminology section.
- (4) Added tolerances to numeric specifications.
- (5) Revised flame adjustment procedure in Section 7.
- (6) Added procedural notes in Section 7.

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