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An American National Standard

Standard Consumer Safety Specification for Lighters[1]

This standard is issued under the fixed designation F400; 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 consumer safety specification covers all flame-producing consumer products commonly known as cigarette lighters, pipe lighters, and cigar lighters and such similar devices as defined in 3.1.7. Matches are specifically excluded from this safety specification; flame-producing products intended solely for igniting apparatus other than cigars, pipes, and cigarettes are also specifically excluded from this safety specification. Lighters are specifically not intended for use as a candle, flashlight, or for other uses requiring an extended burn time.

1.2 This specification establishes requirements for lighters to ensure a reasonable degree of safety for normal use or reasonably foreseeable misuse of such lighters by users.

1.3 Lighters, being flame-producing devices, can, as do all flame sources, present a potential hazard to the consumer. This specification cannot eliminate all hazards, but is intended to minimize potential hazards of lighters to users.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 Disposable and novelty lighters as defined at 16 CFR Part 1210 are subject to the mandatory child resistance standard found therein.

1.6 The following precautionary caveat pertains only to the test methods portion, Section 8, of this specification: *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 *Federal Standard:*[2]

16 CFR Part 1210 Safety Standard for Cigarette Lighters

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *burner valve*—component of a gas lighter that controls the release of fuel.

3.1.2 *burner valve orifice*—tip of the burner valve from which fuel is released.

3.1.3 *flame*—result of combustion of fuel that produces heat and often light which could be visible with the naked eye under normal or subdued lighting conditions.

3.1.4 *flame height*—linear distance from the tip of the visible flame to the top of the shield or, in the absence of a shield, from the tip of the visible flame to the top of the burner valve orifice or to the bottom of the exposed wick.

3.1.4.1 *Discussion*—Flame heights shall be measured in accordance with 8.1.

3.1.5 *flaring*—variance of flame height from the steady-state flame condition.

3.1.6 *ignite*—to produce a flame with a lighter by activating the self-contained ignition and fuel release systems of that lighter in the intended manner.

3.1.7 *lighter*—manually operated flame-producing device employing a petrochemical derivative as a fuel. It is normally used for deliberately igniting cigarettes, pipes, and cigars, and may foreseeably be used to ignite materials such as paper, wicks, candles, and lanterns.

3.1.8 *lighter, adjustable*—lighter that is received by the consumer with a mechanism for the user to vary the height of the flame manually.

3.1.9 *lighter, automatic adjusting pipe*—lighter designed and merchandised specifically for the purpose of lighting pipes and characterized by an automatic increase in flame height when tilted from an upright position.

3.1.10 *lighter, disposable*—lighter that is received by the user with a supply of fuel and that is not intended to be refueled.

3.1.11 *lighter, fluid*—lighter that utilizes a hexane-type fluid such as petrol or naphtha whose vapor pressure at 24°C (75°F) does not exceed a gage pressure of 34 kPa (5 psi).

[1] This specification is under the jurisdiction of ASTM Committee F15 on Consumer Products and is the direct responsibility of Subcommittee F15.02 on Safety Standards for Lighters.

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[2] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

3.1.12 *lighter, gas*—lighter that utilizes a butane, isobutane, propane, or other liquefied hydrocarbon mixture whose vapor pressure at 24°C (75°F) exceeds a gage pressure of 103 kPa (15 psi).

3.1.13 *lighter, nonadjustable*—lighter that has a flame height preset by the manufacturer and is not provided with a mechanism to adjust the flame height.

3.1.14 *lighter, non-self-extinguishing*—lighter that, once ignited, does not require intentional or positive action by the user to maintain a flame and requires a subsequent, deliberate user action to extinguish the flame.

3.1.15 *lighter, postmixing burner*—gas lighter in which fuel and air is mixed at the point of combustion.

3.1.16 *lighter, premixing burner*—gas lighter in which fuel and air is mixed before being supplied for combustion.

3.1.17 *lighter, refillable*—lighter that is intended to be refueled either by decanting fuel from an external container or by inserting a new prepackaged fuel reservoir.

3.1.18 *lighter, self-extinguishing*—lighter that, once ignited, requires continuous intentional and positive action to maintain a flame and that is subsequently extinguished upon the termination of such positive action.

3.1.19 *shield*—structure that totally or partially surrounds the burner valve orifice of a gas lighter or the wick of a fluid lighter.

3.1.20 *sustained self-ignition*—propagation of a flame by other than deliberate manual operation, such as by dropping the lighter, so as to cause the ignition element to be activated and the flame to continue to burn.

3.1.21 *spitting or sputtering*—flame phenomenon of a gas lighter wherein escape of nonevaporated or liquid fuel produces a shower of burning liquid droplets which separate from the main flame.

4. General Requirements

4.1 *Flame Generation (*Table 1)—In order to minimize the possibility of inadvertent or self-ignition, lighters shall require a deliberate manual operation to produce a flame. These operations shall conform to at least one of the following requirements:

4.1.1 A system such that positive action on the part of the consumer is required to generate and maintain a flame.

4.1.2 A system that requires two or more independent motions to generate a flame.

4.1.3 A system that requires an actuating force equal to or greater than 15 N (3.4 lbf) to generate a flame (see Fig. X2.1 or Fig. X2.2 for an example of test equipment).

4.2 *Flame Control*—The maximum attainable flame height for lighters shall be limited with a setting or by product design, or both. For adjustable flame-height lighters, the maximum flame height that a user will obtain on first striking the lighter without adjustment shall also be limited. These limits shall comply with the following requirements when tested in accordance with 8.1:

4.2.1 Nonadjustable fluid lighters, in accordance with 3.1.13 and 3.1.11, shall not be capable of producing a flame height greater than 120 mm (4.75 in.) when tested in accordance with 8.1. See also Annex A1 on AQL's and Appendix X1 on sampling scheme references.

4.2.2 Nonadjustable, postmixing and premixing burner lighters, in accordance with 3.1.13, 3.1.15, and 3.1.16, in the users hands shall have a maximum attainable flame height of no more than 50 mm (2 in.) when tested in accordance with 8.1. See Annex A1 for mandatory AQL's and Appendix X1 on sampling scheme references.

4.2.3 Adjustable postmixing burner lighters, in accordance with 3.1.8 and 3.1.15, shall not be capable of producing a flame height greater than 120 mm (4.75 in.) when deliberately adjusted by the user to the manufacturer's design limit for maximum flame height and when tested in accordance with 8.1. See Annex A1 for mandatory AQL's and Appendix X1 on sampling scheme references.

4.2.4 Adjustable premixing burner lighters, in accordance with 3.1.8 and 3.1.16, shall not be capable of producing a flame height greater than 75 mm (3 in) when deliberately adjusted by the user to the manufacturer's design limit for maximum flame height and when tested in accordance with 8.1. See Annex A1 for mandatory AQL's and Appendix X1 on sampling scheme references.

4.2.5 Adjustable postmixing burner lighters, in accordance with 3.1.8 and 3.1.15, shall have the flame height adjusted by the manufacturer in such a manner that the lighter, when first ignited by the user without changing the adjustment, will not produce a flame height in excess of 100 mm (4 in.) when tested in accordance with 8.1. See Annex A1 for mandatory AQL's and Appendix X1 on sampling scheme references.

4.2.6 Adjustable premixing burner lighters, in accordance with 3.1.8 and 3.1.16, shall have the flame height adjusted by the manufacturer in such a manner that the lighter, when first ignited by the user without changing the adjustment, will not produce a flame height in excess of 60 mm (2.5 in.) when tested in accordance with 8.1. See Annex A1 for mandatory AQL's and Appendix X1 on sampling scheme reference.

4.2.7 All adjustable flame height lighters, in accordance with 3.1.8, shall be capable of producing a flame not in excess of 50 mm (2 in.) when set at the lowest possible flame height when tested in accordance with 8.1.

4.3 *Flame-Height Adjustment* (Table 1)—Adjustable flame height lighters in accordance with 3.1.8 shall require a deliberate action on the part of the user to increase the flame height when the lighter is used in the normal fashion.

4.3.1 If flame control actuators protrude from the body of the lighter it shall require a minimum actuating force of 1 N (0.25 lbf) applied over the entire range of adjustment in a tangential direction (see Fig. X2.3 for an example of the test equipment).

4.3.2 Adjustable gas lighters having rotary movement flame control actuators approximately at right angles to the flame shall perform as follows:

4.3.2.1 When the flame control actuator is at the top of the lighter and the lighter held so the flame is oriented vertically upward, and the user is facing the flame control actuator, moving the actuator to the left shall produce a decrease in flame height.

TABLE 1 Specification Requirements

Characteristic	Requirement	Test Method Section
	GENERAL REQUIREMENTS	
Flame generation	(*1*) positive action to generate and maintain a flame, or (*2*) two or more independent motions to generate flame, or (*3*) an actuating force equal to or greater than 15 N (3.4 lbf) (Appendix X2) (*4*) or any combination thereof	
Flame control	Annex A1	8.1
Flame height adjustment	(*1*) deliberate action to adjust, (*2*) minimum actuating force of 1 N (0.25 lbf) if mechanism protrudes from lighter (Appendix X2), (*3*) indication of direction of movement for higher and lower flame heights	
Spitting or sputtering	none allowed	8.2
Flaring	maximum of 50-mm (2-in.) variation from the steady-state flame condition	8.2
Flame extinction:		
All postmixing burner lighters	(*1*) complete extinction of exposed flame within 2 s, or (*2*) additional 2 s if flame height during this time does not extend above shield	8.3
Non-self-extinguishing lighters	packaged with statement (see Section 7)	
All premixing burner lighters	(*3*) complete extinction of exposed flame in no more than 5 s	8.3
	STRUCTURAL INTEGRITY REQUIREMENTS	
Drop:		8.4
Gas lighters	three separate 1.5-m (5-ft) drops without fuel reservoir fragmentation, sustained self-ignition or gas escape exceeding 15 mg/min	
Fluid lighters	three separate 1.5-m (5-ft) drops without fuel tank fragmentation or sustained self-ignition	
All lighters	if still able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive	
Temperature:		8.5
All lighters	withstand 65°C (149°F) for 4 h	
Gas lighters	after stabilization at 23°C (73°F) gas escape not to exceed 15 mg/min	
All lighters	if still able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive	
Burning		
All lighters	(*1*) withstand 5-s burn with flame at maximum directed 45°C below horizontal without burning or distortion of components[A] (*2*) withstand 10-s burn with flame set at 50 mm (2 in.) or the maximum flame height the adjustment allows, if lower than 50 mm, on adjustable gas lighters, or preset flame heights on nonadjustable gas lighters and fluid lighters with the lighter 45° below the horizontal, without burning or distortion of components[A]	
Continuous burn		8.6
All lighters	withstand 2-min burn with flame set at 50 mm (2 in.) or the maximum flame height the adjustment allows, if lower than 50 mm, on adjustable lighters, or preset flame heights on nonadjustable gas lighters and fluid lighters, with the flame directed vertically upward without continued burning of component parts, expulsion of valve mechanism or fuel reservoir rupture	
Cycling burn	(*1*) withstand 20-s burn with flame set at 50 mm (2 in.) or the	
All lighters	maximum flame height the adjustment allows, if lower than 50 mm, on adjustable gas lighters, or preset flame heights on nonadjustable gas lighters and fluid lighters, repeated 10 times (*2*) if still able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive	8.7
External finish	no sharp edges	
Compatibility:		
Gas lighters	no deterioration of components that come in contact with the fuel recommended by the manufacturer, or gas escape exceeding 15 mg/min	8.8
Fluid lighters	no deterioration of components that come in contact with the fuel recommended by the manufacturer	8.9
All lighters	if still able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive	
Pressure		
Gas lighters	withstand internal pressure of two times the vapor pressure occurring at 55°C (131°F) without rupture	8.10
Refilling:		
Fluid lighters, sealed reservoirs	lighter sealing closures and fuel reservoirs shall be free of leakage	8.11, 8.12
Gas lighters	lighter refill valves shall not allow gas escape exceeding 15 mg/min	8.13
Volumetric displacement	liquid portion of fuel shall not exceed 85 % of the volumetric capacity of the fuel reservoir	8.14

[A] Except those intended to burn during flame propagation.

4.3.2.2 When the flame control actuator is at the bottom of the lighter and the lighter held so that the user is looking at the actuator, a clockwise movement shall result in a decrease in flame height.

4.3.3 Adjustable gas lighters requiring motion of the flame control actuator approximately parallel to the flame axis shall decrease or increase the flame height according to the direction of the movement.

4.3.4 Adjustable flame height lighters shall indicate the direction of movement to produce a higher or lower flame height. On lighters whose adjusting mechanisms conform to 4.3.2 and 4.3.3, the direction of movement shall be permanently imprinted or engraved on the lighter. Such permanent information shall be placed on the lighter in the vicinity of the adjusting mechanism and be readily visible and understandable.

4.4 *Spitting or Sputtering and Flaring* (Table 1)—Gas lighters as defined in 3.1.12 when set at the maximum flame height, shall exhibit no spitting or sputtering as defined in 3.1.21 or flaring as defined in 3.1.5, when tested in accordance with 8.2.

4.5 *Flame Extinction* (Table 1)*:*

4.5.1 Adjustable postmixing burner lighters, after a 5-s burn at maximum flame height, when extinguished in the intended manner, such as by closing a cover or releasing a button or lever, shall have any exposed flame completely extinguished within 2 s after such action is completed when tested in accordance with 8.3. In the case of postmixing burner lighters that have shields, an additional 2-s afterburn is acceptable if the flame height during this additional 2-s period does not extend above the shield.

4.5.2 Adjustable postmixing burner lighters at a flame height of 50 mm (2 in.), or the maximum height the adjustment allows, if lower than 50 mm (2 in.) or nonadjustable postmixing burner lighters at their permanently set flame heights, after a 10-s burn, when extinguished in the intended manner, such as by closing a cover or releasing a button or lever, shall have any exposed flame completely extinguished within 2 s after such action is completed, when tested in accordance with 8.3. In the case of gas lighters that have shields, an additional 2-s afterburn is acceptable if the flame height during this additional 2-s period does not extend above the shield.

4.5.3 Adjustable premixing burner lighters, after a 5-s burn at maximum flame height, when extinguished in the intended manner, such as by closing a cover or releasing a button or lever, shall have any exposed flame completely extinguished in no more than 5-s, when tested in accordance with 8.3.

4.5.4 Adjustable premixing burner lighters, when set at a flame height of 50 mm (2 in.) or the maximum flame height the adjustment allows if lower than 50 mm, or nonadjustable premixing burner lighters at their permanently set flame heights, after a 10-s burn, when closed in the intended manner, such as by closing a cover or releasing a button or lever, shall have any exposed flame completely extinguished in no more than 5 s, when tested in accordance with 8.3.

NOTE 1—In the case of premixing burner lighters, the total afterburn time of 5 s in this specification will be reconsidered periodically with a view to gradual reduction in line with technological progress.

4.6 *Volumetric Displacement* (Table 1)—For gas lighters shipped with fuel, the liquid portion of the fuel shall not exceed 85 % of the volumetric capacity of the fuel chamber when tested in accordance with 8.14.

5. Structural Integrity Requirements

5.1 Lighters shall have structural integrity as specified in requirements 5.2 – 5.9 (Table 1).

5.2 *Drop Test:*

5.2.1 Postmixing and premixing burner lighters as defined in 3.1.15 and 3.1.16 must be capable of withstanding three separate 1.5-m (5-ft) drops conducted in accordance with 8.4, without fuel reservoir fragmentation, without resulting in sustained self-ignition as defined in 3.1.20, without gas escape exceeding 15 mg/min and without impairing the subsequent safe operation of the lighter.

5.2.2 Fluid lighters as defined in 3.1.11 must be capable of withstanding three separate 1.5-m (5-ft) drops conducted in accordance with 8.4, without fuel reservoir rupture, without resulting in sustained self-ignition as defined in 3.1.20, and without impairing the subsequent safe operation of the lighter.

5.2.3 Lighters that meet the requirements of 5.2.1 or 5.2.2, and that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

5.3 *Temperature Test*—Lighters shall be capable of withstanding a temperature of 65°C (149°F) for 4 h when tested in accordance with 8.5.

5.3.1 Lighters that meet the requirements of 5.3 and that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

5.4 *Burning Test*—Adjustable gas lighters with the flame height set at maximum, nonadjustable gas lighters at their permanently set flame heights, or fluid-type lighters shall be capable of withstanding a burning time of 5 s with the lighter in a position 45° below horizontal without evidence of any burning or distortion of components so as to cause a hazardous condition.

5.4.1 Adjustable gas lighters with the flame height set at 50 mm (2 in.) or the maximum flame height the adjustment allows, if lower than 50 mm, nonadjustable gas lighters at their permanently set flame heights, or fluid-type lighters shall be capable of withstanding a total burning time of 10 s in two different attitudes (*a*) with the flame directed vertically upward and (*b*) with the flame directed 45º below horizontal, without evidence of any burning or distortion of components so as to cause a hazardous condition.

5.5 *Continuous Burn*—Adjustable gas lighters with the flame set at 50 mm (2 in.) or the maximum flame height the adjustment allows, if lower than 50 mm, nonadjustable gas lighters at their permanently set flame heights, or fluid-type lighters shall be capable of withstanding a continuous burning time of 2 min with the flame in a vertical attitude without causing a hazardous condition, when tested in accordance with 8.6.

5.6 *Cycling Burn*—Adjustable gas lighters with the flame set at 50 mm (2 in.) or the maximum flame height the adjustment allows, if lower than 50 mm, nonadjustable gas lighters at their permanently set flame height, or fluid-type lighters shall be capable of withstanding a burning time of 20 s, repeated 10 times, when tested in accordance with 8.7.

5.6.1 Gas and fluid lighters that meet this requirement, and that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

5.7 *External Finish*—Lighters shall have no external sharp edges that could cause accidental cuts or abrasions to the consumer when handled or used in the intended manner.

5.8 *Compatibility:*

5.8.1 Components of gas lighters as defined in 3.1.12 that come in contact with the fuel recommended by the manufacturer shall not deteriorate after the exposure to the fuel, so as to cause the lighter to fail any of the criteria contained in this specification or allow gas escape exceeding 15 mg/min when tested in accordance with 8.8.

5.8.2 Components of fluid lighters as defined in 3.1.11 that come in contact with the fuel recommended by the manufacturer shall not deteriorate after extended contact with that fuel, so as to fail any of the criteria contained in this specification when tested in accordance with 8.9.

5.8.3 Gas and fluid lighters that meet this requirement, and that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

5.9 *Pressure Tests*—Gas lighters shall be capable of withstanding an internal pressure of two times the vapor pressure occurring at 55°C (131°F) of the fuel recommended by the manufacturer when tested in accordance with 8.10.

6. Refilling of Lighters

6.1 Refillable fluid lighters, as defined in 3.1.11 and 3.1.17, shall include specific instructions and warnings as applicable in accordance with Section 7.

6.2 Refillable fluid lighters having a sealed fuel reservoir shall be free of fuel leakage from both the sealed reservoir and the sealing closure when tested in accordance with 8.11, when such sealing closure is installed in the lighter by the user in the intended manner.

6.3 Refillable gas lighters, as defined in 3.1.12 and 3.1.17, shall have specific training instructions and warnings as applicable in accordance with Section 7.

6.4 *Refillable Gas Lighters*—The refilling valve in a pressurized fuel reservoir lighter shall be secure enough so as not to allow an escape of gas exceeding 15 mg/min when tested in accordance with 8.13.

7. Instructions and Warnings

7.1 All lighters shall be accompanied by the appropriate safety information (instructions or warnings, or both) communicating the proper method of use.

7.2 This safety information shall be either on the lighters themselves, or on a separate brochure or pamphlet packaged with the lighters, or on the product packaging at the point of sale. The format for this information should emphasize the warnings that are most appropriate to the type of lighter. This safety information shall be conspicuously placed with contrasting background color, type size, or style that makes it distinct from other information.

7.3 For all lighters, the safety information shall be accompanied by the specific signal word "**WARNING**" in close proximity to the safety information.

7.4 For all lighters, the safety information shall contain the following statements:

7.4.1 "**KEEP AWAY FROM CHILDREN**" or "**KEEP OUT OF REACH OF CHILDREN**." (The statement used shall be emphasized and distinctive.)

7.4.2 Ignite lighter away from face and clothing.

7.5 For all lighters, the safety information shall include the substance of the following as appropriate to the type of lighter:

7.5.1 Be sure the flame is out after use.

7.5.2 This lighter does not self-extinguish; close cover to put out. (This statement shall accompany all non-self-extinguishing lighters.)

7.5.3 Contains flammable gas under pressure.

7.5.4 When filled, will contain flammable gas under pressure.

7.5.5 Contains flammable fluid.

7.5.6 When filled, will contain flammable fluid.

7.5.7 Never expose to heat above 50°C (122°F) or to prolonged sunlight.

7.5.8 Never puncture or put in fire.

7.5.9 Extreme heat is present above the visible flame. Extra care should be taken to prevent burn injury or fire. (This statement shall accompany all premixing burner lighters.)

7.5.10 Do not keep lit for more than 10 s. (This statement shall accompany all premixing burner lighters.)

7.6 *Refilling Instructions for Gas Lighters*—Refillable gas lighters, as defined in 3.1.12 and 3.1.17, shall be accompanied by specific instructions as to the correct procedure to accomplish the refill operation. These instructions shall include the fuel recommended by the manufacturer and the appropriate information to ensure the proper mating between the refill container and the fuel tank of the lighter.

7.7 *Refilling Instructions for Fluid Lighters:*

7.7.1 Fluid lighters, as defined in 3.1.11, shall be accompanied by the substance of the following:

7.7.1.1 Fill only with the type of fluid recommended by the manufacturer.

7.7.1.2 Fill slowly; never overfill.

7.7.1.3 Wipe lighter and hands dry before igniting. (This is a special instruction and should also be attached to the lighter or it may be printed directly on the lighter. It may also be printed in the safety information.)

8. Test Methods

8.1 *Flame-Height Measurement*—The purpose of this procedure is to define the method of measurement of lighter flame height.

8.1.1 *Apparatus*—A nonflammable board scribed in 5-mm (0.25-in.) increments. The board should be fitted with a standoff at the base point that positions the lighter at least 25 mm (1 in.) from the board. The board can be supported vertically by any convenient means and tests conducted inside a draft-free chamber constructed from suitable nonflammable materials.

8.1.2 *Test Specimens*—The test specimens shall consist of lighters that are fueled in accordance with the manufacturer's specifications.

8.1.3 *Procedure:*

8.1.3.1 Standardize the lighter flame-height measurements by stabilizing all lighters at 23 ± 2°C (73 ± 4°F) for at least 10 h prior to each flame-height measurement.

8.1.3.2 Place the lighter against the standoff with the flame directed vertically upward.

NOTE 2—In case of premixing burner lights, it is recommended this test be conducted under subdued lighting conditions.

8.1.3.3 Ignite the lighter, allow the flame to stabilize for approximately 1.0 s, then measure the flame height to the nearest 5 mm (0.25 in.) by determining where the tip of the visible flame registers in relation to the scribed marks on the board behind the lighter, during a 5-s burn.

8.2 *Spitting, Sputtering, and Flaring Tests*—The purpose of these tests is to verify that gas lighters do not spit, sputter, or flare.

8.2.1 *Test Specimens*—The test specimens shall consist of lighters that are fueled in accordance with the manufacturer's specifications.

8.2.2 *Procedure:*

8.2.2.1 Stabilize all lighters at 23 ± 2°C (73 ± 4°F) for at least 10 h prior to performing the test described in 8.2.2.3.

8.2.2.2 If lighters are adjustable as defined in 3.1.8, adjust the flame to maximum position.

8.2.2.3 Ignite the lighter and observe for spitting or sputtering as defined in 3.1.21 during a 5-s burn in any handheld position. Any evidence of spitting or sputtering constitutes a failure. If lighter does not fail, restabilize for a minimum of 5 min at 23 ± 2°C (73 ± 4°F) before continuing with 8.2.2.4.

8.2.2.4 Ignite the lighter with the flame directed vertically upward and observe the flame height, and invert the lighter to a position 45° below the horizontal. Any variation in flame height exceeding 50 mm (2 in.) during a total elapsed time of 5 s or a flame height exceeding the requirements specified in 4.2 constitutes a failure. If lighter does not fail, restabilize for a minimum of 5 min at 23 ± 2°C (73 ± 4°F) before continuing with 8.2.2.5. Automatic adjusting pipe lighters as defined in 3.1.9 shall be excluded from this test.

NOTE 3—Measure the downward flame height in accordance with Fig. 1.

NOTE 4—If different lighters are used to conduct the tests described in 8.2.2.3 – 8.2.2.5 stabilize these in accordance with 8.2.2.1.

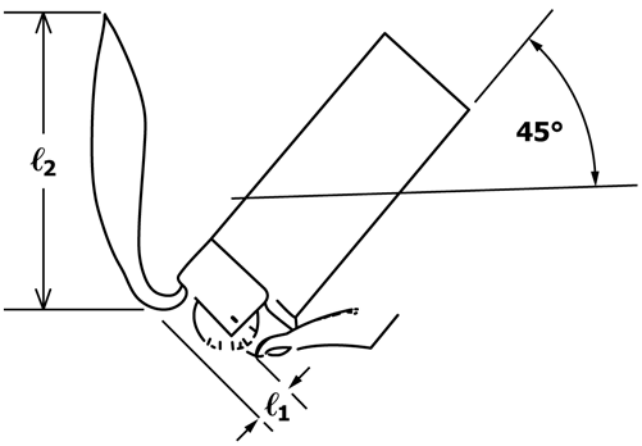

FIG. 1 Flame Height Measurement

8.2.2.5 Invert the lighter for a period of 10 s. Return the lighter to an upright position and ignite the lighter. Observe the flame height during a 5-s burn. Any variation of flame exceeding 50 mm (2 in.) or a flame height exceeding the requirements specified in 4.2 constitutes a failure. Automatic adjusting pipe lighters as defined in 3.1.9 shall be excluded from this test.

8.2.2.6 Automatic adjusting pipe lighters as defined in 3.1.9, when placed in any position, shall not produce a flame height greater than 100 mm (4 in.).

8.3 *Flame Extinction Test*—The purpose of this test is to verify that lighters extinguish safely.

8.3.1 *Test Specimens*—The test specimens shall consist of lighters that are fueled in accordance with the manufacturer's specifications.

8.3.2 *Apparatus*—The same as for flame height measurement as described in 8.1.1.

8.3.3 *Procedure:*

8.3.3.1 Stabilize all test specimens at 23 ± 2°C (73 ± 4°F) for at least 10 h.

8.3.3.2 Place lighters against the flame height measurement apparatus in a normal operating position, ignite, and adjust to the flame heights specified in 4.5.1 – 4.5.4, then extinguish and allow to cool for at least 1 min. Then, ignite the lighters for the amount of time specified in 4.5.1 – 4.5.4 and extinguish in the normal manner. Measure and record the time of any burning occurring after the extinguishing action. Afterburns in excess of the amount of time specified in 4.5.1 – 4.5.4 shall constitute a failure.

8.3.3.3 If the flame extinction test needs to be repeated on the same test specimen, restabilize it to a temperature of 23 ± 2°C (73 ± 4°F) for at least 10 h.

8.4 *Drop Test*—The purpose of this test is to determine if dropping a gas lighter onto a hard surface will result in fuel reservoir fragmentation, sustained self-ignition, gas escape exceeding 15 mg/min, or impair subsequent operation in a safe manner, and to determine if dropping a fluid lighter onto a hard surface will result in fuel reservoir rupture, sustained self-ignition, or impair subsequent operation in a safe manner.

8.4.1 *Significance*—The drop test provides information on the ability of the lighter to withstand safely a drop that is possible during the use of the lighter.

8.4.2 *Apparatus:*

8.4.2.1 A concrete surface,

8.4.2.2 A measuring device marked to a height of 1.5 m (5 ft), and

8.4.2.3 For gas lighters, a scale capable of reading within 0.1 mg if gas escape is measured over an elapsed time of 1 min, or 1.0 mg if gas escape is measured over an elapsed time of 10 min.

8.4.3 *Test Specimens*—The specimens shall consist of new, complete, normally fueled lighters and shall be initially free of mechanical damage. Lighters used in testing for the requirements of 4.1 – 4.5 may be used for these drop tests.

8.4.3.1 *Test Specimen 1*—The lighter shall be stabilized at 23 ± 2°C (73 ± 4°F) for at least 10 h, and if it incorporates a flame height adjustment feature, the flame shall be adjusted to its maximum height.

8.4.3.2 *Test Specimen 2*—The lighter shall be maintained at a temperature of −10 ± 2°C (14 ± 4°F) for 24 h and then stabilized at a temperature of 23 ± 2°C (73 ± 4°F) for at least 10 h. For an adjustable lighter, the flame height shall be set at 50 mm (2 in.) maximum.

8.4.4 *Procedure:*

8.4.4.1 Allow the specimen to fall freely from 1.5 m (5 ft) onto the concrete surface, by initially orienting in the following three modes: base down, base up, and horizontal.

8.4.4.2 Drop test the lighters fitted with a cover with the cover closed.

8.4.4.3 *Gas Lighters*—Observe the specimen during each drop for fuel reservoir fragmentation that will present a hazard to anyone in proximity or for sustained self-ignition. Either condition constitutes a failure.

8.4.4.4 *Gas Lighters*—Within 5 min after the three drops, determine by weighing whether the gas loss exceeds 15 mg/min. Weight loss exceeding this amount constitutes a failure.

8.4.4.5 *Fluid Lighters*—Observe the specimen during each drop for fuel reservoir rupture that will present a hazard to anyone in proximity or for sustained self-ignition. Either condition constitutes a failure.

8.4.4.6 Gas and fluid lighters that do not fail the tests in 8.4.4.3 – 8.4.4.5 and that are still able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

8.4.4.7 Gas and fluid lighters that are not able to be ignited in the intended manner do not constitute a failure.

8.5 *Elevated Temperature Test for Gas and Fluid Lighters*—The purpose of this test is to determine if a fuel reservoir, including closures, will withstand elevated temperatures.

8.5.1 *Significance*—This test provides information on the ability of a fuel reservoir, including closures, to withstand elevated temperatures without fuel reservoir rupture or impairing subsequent operation of the lighter in a safe manner.

8.5.2 Gas lighters must be capable of withstanding this test without gas escape exceeding 15 mg/min.

8.5.3 *Apparatus:*

8.5.3.1 An enclosure, vented to prevent accumulation of gas, capable of maintaining a temperature of 65 ± 2°C (149 ± 4°F).

8.5.3.2 A device for measuring the temperature to within ±2°C (3°F).

8.5.3.3 For gas lighters, a weighing device capable of reading within 0.1 mg.

8.5.4 *Test Specimens*—The specimens shall consist of new, normally fueled lighters and shall be initially free of mechanical damage. Lighters used for testing for the requirements of 4.1 – 4.5 may be used for this temperature test.

8.5.5 *Procedure for Gas Lighters:*

8.5.5.1 Stabilize the enclosure at 65 ± 2°C (149 ± 3°F).

8.5.5.2 Ignite each specimen to assure the lighter is not empty of fuel.

8.5.5.3 Place the extinguished specimens in the enclosure for 4 h.

8.5.5.4 Remove the specimens and stabilize at 23 ± 2°C (73 ± 4°F) for at least 10 h.

8.5.5.5 After temperature stabilization, determine by weighing over an elapsed period of time of 1 min if the leakage rate exceeds 15 mg/min. A leakage rate exceeding 15 mg/min constitutes a failure.

8.5.5.6 If the fuel reservoir is totally or partially transparent, observe visually the presence of liquid fuel inside the reservoir. The absence of liquid fuel indicates the lighter is empty which constitutes a failure.

8.5.5.7 If the fuel reservoir is not transparent, attempt to ignite the lighter. If ignition in the intended manner is achieved, proceed to 8.5.5.8, if not:

(1) Weigh the lighter with a weighing device capable of reading within 0.1 mg.

(2) Open the reservoir (pushing the sealing ball, or opening the burner valve for a non-refillable lighter or open the refilling valve for a refillable lighter) to empty the fuel reservoir.

(3) Weigh the lighter again with all its components.

(4) If mass is unchanged (within ±10 mg) the lighter was an empty lighter, which constitutes a failure.

8.5.5.8 Gas lighters that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

8.5.5.9 Gas lighters that are not able to be ignited in the intended manner and are not empty of fuel do not constitute a failure.

8.5.6 *Procedure for Fluid Lighters:*

8.5.6.1 Fuel the lighter in accordance with the manufacturer's instructions.

8.5.6.2 Stabilize the enclosure at 65 ± 2ºC (149 ± 3ºF).

8.5.6.3 Ignite each specimen to assure the lighter is not empty of fuel.

8.5.6.4 Place the extinguished specimens in the enclosure for 4 h.

8.5.6.5 Remove the specimens and stabilize at 23 ± 2ºC (73 ± 4ºF) for at least 10 h.

8.5.6.6 After temperature stabilization, if the fluid lighters are empty of fuel, refuel the specimens in accordance with the manufacturer's instructions.

8.5.6.7 Fluid lighters that cannot be ignited in the intended manner do not constitute a failure.

8.5.6.8 Fluid lighters that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

8.6 *Continuous Burn Test*—The purpose of this test is to determine if lighters can withstand continuous burning for 2 min without causing a hazardous condition.

8.6.1 Lighters must be able to withstand this test without continued burning of component parts or expulsion of valve components or fuel reservoir rupture either with or without a flame.

8.6.2 *Test Specimens*—The test specimens shall consist of new, normally fueled lighters and shall be initially free of mechanical damage. Lighters used for testing for the requirements of 4.1 – 4.5 may be used for this burning test.

8.6.3 *Apparatus*—Any draft-free chamber constructed from a suitable nonflammable material.

8.6.4 *Procedure:*

8.6.4.1 Test adjustable gas lighters with the flame set at 50 mm (2 in.) or the maximum flame height the adjustment allows, if lower than 50 mm (2 in.). Test nonadjustable gas lighters and fluid-type lighters with flames at their permanently set flame heights.

8.6.4.2 Stabilize lighters at a temperature of 23 ± 2°C (73 ± 4°F) for at least 10 h.

8.6.4.3 Ignite the lighter so that the flame will be directed vertically upward and allow to burn for 2 min.

8.6.4.4 At any time during the 2-min burn, the appearance of any of the conditions enumerated in 8.6.1 will constitute a failure.

8.6.4.5 Lighters that fail to complete this test do not constitute a failure of this test.

8.6.4.6 Lighters used for the continuous burn test shall not be used for any other tests in this consumer safety specification.

8.7 *Cycling Burn Test*—The purpose of this test is to determine if lighters can withstand a burning time of 20 s repeated 10 times with a 5-min rest period between burnings.

8.7.1 *Significance*—Lighters must be able to withstand this test without impairing subsequent operation of the lighter in a safe manner.

8.7.2 *Test Specimens*—The specimens shall consist of new, normally fueled lighters and shall be initially free of mechanical damage. Lighters used for testing for the requirements of 4.1 – 4.5 may be used for this burning test.

8.7.3 *Procedure:*

8.7.3.1 Test adjustable gas lighters with the flame set at 50 mm (2 in.) or the maximum flame height the adjustment allows, if lower than 50 mm. Test nonadjustable gas lighters and fluid-type lighters with flames at their permanently set flame heights.

8.7.3.2 Stabilize lighters at a temperature of 23 ± 2°C (73 ± 4°F) for at least 10 h.

8.7.3.3 Ignite the test specimen so that the flame will be directed vertically upward and allow to burn for 20 s.

8.7.3.4 Allow the extinguished lighter to rest for 5 min.

8.7.3.5 Repeat 8.7.3.3 and 8.7.3.4 nine more times making a total of 10 cycles.

8.7.3.6 Stabilize test specimen at a temperature of 23± 2°C (73 ± 4°F) for at least 10 h.

8.7.3.7 Lighters that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

8.8 *Compatibility Test for Gas Lighters*—The purpose of this test is to determine if gas lighter components coming in contact with the fuel recommended by the manufacturer deteriorate in any fashion or allow gas escape exceeding 15 mg/min.

NOTE 5—Reproducibility of this test is dependent on the life history of the product(s) and therefore should be performed with newly manufactured lighters.

8.8.1 *Test Specimens*—The test specimens shall consist of new, normally fueled gas lighters and shall be initially free of mechanical damage. Lighters used for testing for the requirements of Section 4 may be used for this compatibility test.

8.8.2 *Apparatus:*

8.8.2.1 An enclosure, ventilated to prevent accumulation of gas, capable of maintaining a temperature of 40 ± 2°C (104 ± 4°F).

8.8.2.2 A temperature measuring device accurate to ±1°C (2°F) in the range of 35 to 45°C (95 to 113°F).

8.8.2.3 A weighing device capable of reading within 0.1 mg.

8.8.3 *Procedure for Gas Lighters:*

8.8.3.1 Stabilize the enclosure at a temperature of 40 ± 2°C (104 ± 4°F).

8.8.3.2 Ignite each specimen to assure the lighter is not empty of fuel.

8.8.3.3 Place the extinguished specimens in the enclosure for 28 days.

8.8.3.4 Remove the specimens and stabilize at 23 ± 2°C (73 ± 4ºF) for at least 10 h.

8.8.3.5 After temperature stabilization, determine by weighing over an elapsed period of time of 1 min if the leakage rate exceeds 15 mg/min. A leakage exceeding 15 mg/min constitutes a failure.

8.8.3.6 If the fuel reservoir is totally or partially transparent, observe visually the presence of liquid fuel inside the reservoir. The absence of liquid fuel indicates the lighter is empty which constitutes a failure.

8.8.3.7 If the fuel reservoir is not transparent, attempt to ignite the specimen. If ignition in the intended manner is achieved, proceed to 8.8.3.8, if not:

(1) Weigh the lighter with a weighing device capable of reading within 0.1 mg.

(2) Open the reservoir (pushing the sealing ball, or opening the burner valve for a non-refillable lighter, or open the refilling valve for a refillable lighter) to empty the fuel reservoir.

(3) Weigh the lighter again with all its components.

(4) If mass is unchanged (within ±10 mg), the lighter was an empty lighter, which constitutes a failure.

8.8.3.8 Gas lighters that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

8.8.3.9 Gas lighters that are not able to be ignited in the intended manner and are not empty of fuel do not constitute a failure.

8.9 *Compatibility Test for Fluid Lighters*—The purpose of this test is to determine if fluid lighter components coming in contact with the fuel recommended by the manufacturer deteriorate in any fashion, or result in any fuel leakage.

NOTE 6—Reproducibility of this test is dependent on the life history of the product(s) and therefore should be performed with newly manufactured lighters.

8.9.1 *Apparatus:*

8.9.1.1 A container capable of being hermetically sealed.

8.9.1.2 An enclosure, ventilated to prevent the accumulation of gas or vapor, that will maintain a temperature of 40 ± 2°C (104 ± 4°F).

8.9.2 *Procedure for Fluid Lighters:*

8.9.2.1 Fuel the specimens according to the manufacturer's instructions.

8.9.2.2 Stabilize the enclosure at 40 ± 2ºC (104 ± 4ºF).

8.9.2.3 Ignite each specimen in the intended manner to assure the lighter is an operable lighter prior to placing the specimen in the sealable container. Caps and closures should be in the open position. Fill the container with the fuel recommended by the manufacturer so that the specimens are submerged in the fuel. Seal the container.

8.9.2.4 Place the container in the enclosure for 28 days.

8.9.2.5 After 28 days, remove the container from the enclosure and the specimens from the container. Let the specimens dry thoroughly.

8.9.2.6 Refuel the specimens according to the manufacturer's instructions and stabilize at a temperature of 23 ± 2°C (73 ± 4°F) for at least 10 h.

8.9.2.7 Check visually for leakage with lighter in all orientations. Any leakage constitutes a failure.

8.9.2.8 Fluid lighters that are able to be ignited in the intended manner shall subsequently meet all the applicable requirements of 4.1 – 4.5, inclusive.

8.9.2.9 Fluid lighters that are not able to be ignited in the intended manner do not constitute a failure.

8.10 *Pressure Test*—The purpose of this test is to determine if the gas reservoir, including closures, will safety withstand abnormally high internal pressure.

8.10.1 *Significance*—This test provides information on the ability of a gas lighter, including closures, to withstand safely an internal pressure of two times the vapor pressure occurring at 55°C (131°F).

8.10.2 *Apparatus*—Any apparatus capable of producing an internal gage pressure of 2 MPa (300 psi).

8.10.3 *Test Specimens*—The specimens shall consist of new lighters that have been drained of fuel and shall be free of mechanical damage. Lighters used in testing for the requirements of 4.1 – 4.5 may be used for the pressure test.

8.10.4 *Procedure:*

8.10.4.1 Conduct the test at a temperature of 23 ± 2°C (73 ± 4°F).

8.10.4.2 Subject the specimen to an internal pressure of two times the vapor pressure occurring at 55°C (131°F), with a pressure rise not exceeding a rate of 60 kPa (10 psi)/s.

8.10.4.3 If there is no sudden dropping of pressure during the course of the test, the lighter fuel tank and closures are considered acceptable.

8.11 *Sealed Fluid Fuel Reservoir Leakage Test*—The purpose of this test is to ensure that no dangerous fuel leak occurs from either the sealing closure or the sealed fuel reservoir.

8.11.1 Fill the sealed reservoir of a fluid lighter by the method and fuel recommended by the manufacturer and replace the sealing closure. Wipe the lighter dry and observe for fuel leakage from either the vicinity of the sealing closure or from the fuel reservoir itself. Any evidence of fuel leakage shall constitute a failure.

8.12 *Refilling Plug Test*—The purpose of this test is to ensure that no dangerous fluid fuel leak occurs from the refill plug of a fluid lighter.

8.12.1 Fill a fluid lighter by the method and fuel recommended by the manufacturer and replace the refill plug. Wipe the lighter dry and observe for fuel leakage in the vicinity of the refill plug. Any evidence of fuel leakage will constitute a failure.

8.13 *Refilling Valve Test*—The purpose of this test is to ensure that no dangerous gas leak occurs from the refilling valve of a refillable gas lighter.

8.13.1 Empty and refuel a refillable gas lighter by the method and fuel recommended by the manufacturer. Measure by weighing whether the gas escape exceeds 15 mg/min. Gas escape exceeding this value constitutes a failure.

8.14 *Fuel Volumetric Displacement Test*—The purpose of this test is to determine the amount of volumetric displacement of the liquid portion of the fuel relative to the volumetric capacity of the fuel reservoir.

8.14.1 *Apparatus*—A weighing device capable of reading within 0.1 mg.

8.14.2 *Test Specimens*—The test specimens shall consist of lighters as prepared for shipment.

8.14.3 *Procedure:*

8.14.3.1 Stabilize all test specimens at 23 ± 2°C (73 ± 4°F) for at least 10 h prior to each test.

8.14.3.2 Determine the mass of the fuel by weighing the full unused lighter, draining the fuel, and reweighing the empty lighter after 30 min.

8.14.3.3 Calculate the volume of the liquid portion of the fuel ($V1$) using the density of the fuel at 23 ± 2°C (73 ± 4°F) as follows:

$$V1 = \text{mass of fuel (g)}/\text{density of fuel at } 23 \pm 2°\text{C } (73 \pm 4°\text{F}) \text{ (g/cm}^3\text{)} \quad (1)$$

NOTE 7—If the fuel type and formulation is known, use the density of that fuel; if not known, use 0.54 g/cm^3 for the density.

8.14.3.4 Drill a hole no larger than 6 mm in the fuel reservoir and then weigh the lighter.

8.14.3.5 Fill the fuel reservoir with distilled water at a temperature of 23 ± 2°C (73 ± 4°F) using a syringe or other device, ensuring that there are no air bubbles within the reservoir.

NOTE 8—Depending upon the design of the lighter and its fuel reservoir (size, shape, and wall thickness), a vent hole may need to be drilled into the fuel reservoir to facilitate the removal of trapped air during the filling. If a vent hole is used, weigh the lighter after drilling both the fill and vent holes.

8.14.3.6 Weigh the water-filled lighter.

8.14.3.7 Determine the mass of the water by subtracting the mass of the empty lighter from the mass of the water-filled lighter, or by measuring the amount of water required to fill the lighter, or by any other convenient means.

8.14.3.8 Calculate the volume of the lighter reservoir ($V0$) as follows:

$$V0 = \text{mass of water (g)}/\text{density of water (1 g/cm}^3\text{)} \quad (2)$$

Lighters with a ratio of $V1/V0$ greater than 0.85 constitute a failure.

9. Product Marking

9.1 All lighters shall bear a permanent logo or name that identifies the manufacturer or distributor.

10. Keywords

10.1 fluid lighters; gas lighters; premixing burner lighters; postmixing burner lighters

ANNEXES

(Mandatory Information)

A1. MANUFACTURERS' ACCEPTABLE QUALITY LEVELS FOR SPECIFICATION AND INSET LIMITS FOR FLAME CHARACTERISTICS IN 4.2.1 – 4.2.6

A1.1 Finished lighters should comply with the following acceptable quality levels (AQL's). These AQL's call for measurements of flame height at the specification limit and a narrow (or inset) limit just below the specification limit.

A1.2 For this purpose AQL means the maximum percentage of finished product lying between or exceeding the specified limits, acceptable as a process average. Manufacturers should ensure that percentages of finished product lying between or exceeding the specified limits are no greater than the following:

A1.3 For nonadjustable, fluid lighters as in 4.2.1:

A1.3.1 The AQL for maximum flame height greater than 120 mm (4.75 in.), 1 %.

A1.3.1.1 The AQL for maximum flame height between 115 and 120 mm (4.5 and 4.75 in.), 10 %.

A1.4 For nonadjustable, postmixing burner and premixing burner lighters as in 4.2.2:

A1.4.1 The AQL for maximum flame height greater than 50 mm (2.0 in.), 1 %.

A1.4.2 The AQL for maximum flame height between 40 and 50 mm (1.5 and 2.0 in.), 10 %.

A1.5 For adjustable postmixing burner lighters as in 4.2.3:

A1.5.1 The AQL for maximum flame height above 120 mm (4.75 in.), 1 %.

A1.5.2 The AQL for maximum flame height between 115 and 120 mm (4.5 and 4.75 in.), 10 %.

A1.6 For adjustable premixing burner lighters as in 4.2.4:

A1.6.1 The AQL for maximum flame height above 75 mm (3 in.), 1 %.

A1.6.2 The AQL for maximum flame height between 65 and 75 mm (2.5 and 3 in.), 10 %.

A1.7 For adjustable postmixing burner lighters as in 4.2.5:

A1.7.1 The AQL for first strike flame height 100 mm (4.0 in.), 1 %.

A1.7.2 The AQL for first strike flame height between 90 and 100 mm (3.5 and 4.0 in.), 10 %.

A1.8 For all adjustable, premixing burner lighters as in 4.2.6

A1.8.1 The AQL for first strike flame height above 60 mm (2.5 in.), 1 %.

A1.8.2 The AQL for first strike flame height between 50 and 60 mm (2.0 and 2.5 in.), 10 %.

A2. MANUFACTURER'S REQUIREMENTS

A2.1 Disposable and novelty lighters as defined in 16 CFR Part 1210 are subject to the mandatory child resistance requirements found therein.

APPENDIXES

(Nonmandatory Information)

X1. MANUFACTURERS' SAMPLING SCHEME REFERENCES

X1.1 In order to meet the AQL's in Annex A1, methods from (but not limited to) the following published documents may be used. Other custom designed plans and statistical methods may be used at the manufacturer's discretion.

X1.2 For inspection at the specification and inset limits concurrently:
Trinomial Sampling Plans to Match MIL-STD-105D, 1983 ASQC Quality Congress Transaction, ASQC Milwaukee.

X1.3 For inspection at the specification or insert limits, or both, separately:
MIL-STD-105D (ISO 2859) Sampling Procedures and Tables for Inspection by Attributes, Department of Defense, Washington, DC.

X1.4 Where good process history has been established, and nonconforming units are removed from rejected lots, see AOQL Tables of:
Sampling Inspection Tables—Single and Double Sampling, Dodge and Romig, J. Wiley and Sons, Inc., New York, NY.

X1.5 Where flame height measurements are recorded and a stable normal distribution of product is established:
MIL-STD-414 (ISO 3951) Sampling Procedures and Tables for Inspection by Variables for Percent Defective, Department of Defense, Washington, DC.

X1.6 For controlling the mean and spread of the product distribution:
Manual on Presentation of Data and Control Chart Analysis, ASTM STP 15D, ASTM, 1976.
Glossary and Tables for Statistical Quality Control, American Society for Quality Control.

X2. TYPICAL TEST EQUIPMENT

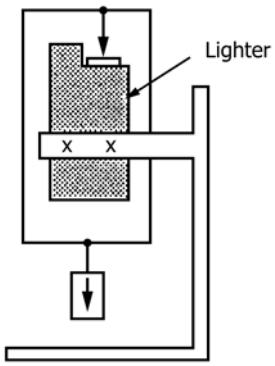

FIG. X2.1 Block Diagram for a Typical Example of Test Equipment Measuring the Flame Generation Actuating Force as Specified in 4.1.3

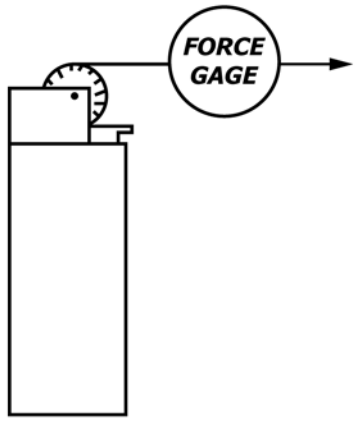

FIG. X2.2 Force as Specified in 4.1.3

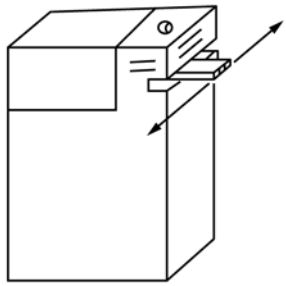

FIG. X2.3 Block Diagram for a Typical Example of Test Equipment Measuring the Flame Control Actuating Force as Specified in 4.3.1