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Standard Test Methods for Flash-Point by Pensky-Martens Closed Cup Tester¹

This standard is issued under the fixed designation D 93; 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.

INTRODUCTION

This flash point test method is a dynamic test method and depends on definite rates of temperature increases to control the precision of the test method. The rate of heating may not in all cases give the precision quoted in the test method because of the low thermal conductivity of certain materials. To improve the prediction of flammability, Test Method D 3941, an equilibrium method, was developed in which the heating rate is slower. This allows the vapor above the test specimen and the test specimen to be at about the same temperature. If your specification requires Test Method D 93, do not substitute Test Method D 3941 or any other test method without obtaining comparative data and agreement from the specifier.

This test method contains two procedures: Procedure A for fuel oils, lubricating oils, and other homogeneous liquids, and Procedure B for non-homogeneous materials which are mixtures of liquids with solids, liquids that tend to form a surface film under test conditions or are liquids with a kinematic viscosity which is not capable of uniform heating under the stirring and heating conditions of Procedure A. Procedure B provides a reduced heating rate and an increased stirring rate to improve thermal equilibrium.

1. Scope

1.1 This test method describes the determination of the flash point of petroleum products by a manual Pensky-Martens closed-cup apparatus or an automated Pensky-Martens closed-cup apparatus.

1.2 This test method is applicable to fuel oils, lube oils, liquids with suspensions of solids, liquids that tend to form a surface film under test conditions, and other liquids with viscosities of 5.5 mm²/s (5.5 cSt) or more at 40°C (104°F).

NOTE 1—Liquids having kinematic viscosities less than 5.5 mm²/s (cSt) at 40°C (104°F), do not contain suspended solids, or do not have a tendency to form a surface film while under test conditions, can be tested in accordance with Test Method D 56.

1.3 This test method is applicable for the detection of contamination of relatively nonvolatile or nonflammable materials with volatile or flammable materials.

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

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.* For specific hazardous statements, see Notes 3, 4, 9, 11, 13, 14, 18, 20, 21, 22, 24, 25, 26, 28, and 29.

2. Referenced Documents

2.1 ASTM Standards:

- D 56 Test Methods for Flash Point by Tag Closed Tester²
- D 850 Test Method for Distillation of Industrial Aromatic Hydrocarbons and Related Materials³
- D 1015 Test Method for Freezing Point of High-Purity Hydrocarbons²
- D 1016 Test Method for Purity of Hydrocarbons from Freezing Points²
- D 1078 Test Method for Distillation Range of Volatile Organic Liquids³
- D 3941 Test Method for Flash Point by the Equilibrium Method with a Closed-Cup Apparatus⁴
- D 3798 Test Method for Analysis of *p*-Xylene by Gas Chromatography³
- D 4057 Practice for Manual Sampling for Petroleum and Petroleum Products⁵
- D 4177 Practice for Automatic Sampling of Petroleum and Petroleum Products⁵
- E 1 Specification for ASTM Thermometers⁶
- E 300 Practice for Sampling Industrial Chemicals⁷

3. Terminology

3.1 Definitions:

3.1.1 *flash point, n*—in petroleum products, the lowest temperature corrected to a barometric pressure of 101.3 kPa

¹ These test methods are under the joint jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and are the direct responsibility of Subcommittee D02.08 on Volatility.

In the IP, these test methods are under the jurisdiction of the Standardization Committee. Current edition approved Nov. 15, 1994. Published January 1995. Originally published as D 93 – 21 T. Last previous edition D 93 – 90^{ε1}.

² Annual Book of ASTM Standards, Vol 05.01.

³ Annual Book of ASTM Standards, Vol 06.04.

⁴ Annual Book of ASTM Standards, Vol 06.01.

⁵ Annual Book of ASTM Standards, Vol 05.02.

⁶ Annual Book of ASTM Standards, Vol 14.03.

⁷ Annual Book of ASTM Standards, Vol 15.05.



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(760 mm Hg), at which application of an ignition source causes the vapors of a specimen of the sample to ignite under specified conditions of test.

DISCUSSION—The test specimen is deemed to have flashed when a flame appears and instantaneously propagates itself over the entire surface of the test specimen.

DISCUSSION—When the ignition source is a test flame, the application of the test flame may cause a blue halo or an enlarged flame prior to the actual flash point. This is not a flash point and shall be ignored.

3.1.2 dynamic, adj—in petroleum products—the condition where the vapor above the test specimen and the test specimen are not in temperature equilibrium at the time that the ignition source is applied.

DISCUSSION—This is primarily caused by the heating of the test specimen at the constant prescribed rate with the vapor temperature lagging behind the test specimen temperature.

3.1.3 equilibrium, n—in petroleum products—the condition where the vapor above the test specimen and the test specimen are at the same temperature at the time the ignition source is applied.

DISCUSSION—This condition may not be fully achieved in practice, since the temperature may not be uniform throughout the test specimen, and the test cover and shutter on the apparatus can be cooler.

4. Summary of Test Method

4.1 A 75-mL test specimen is heated at a slow constant rate with continual stirring in a brass test cup of specified dimensions with a cover of specified dimensions. An ignition source is directed into the test cup at regular intervals with simultaneous interruption of the stirring. The flash point is the lowest liquid temperature at which application of the ignition source causes the vapor of the test specimen of the sample to ignite.

5. Significance and Use

5.1 The flash point temperature is one measure of the tendency of the test specimen to form a flammable mixture with air under controlled laboratory conditions. It is only one of a number of properties which must be considered in assessing the overall flammability hazard of a material.

5.2 Flash point is used in shipping and safety regulations to define *flammable* and *combustible* materials. One should consult the particular regulation involved for precise definitions of these classifications.

NOTE 2—The U.S. Department of Transportation (DOT)⁸ and U.S. Department of Labor (OSHA) have established that liquids with a flash point under 37.8°C (100°F) are flammable, as determined by this test method, for those liquids which have a kinematic viscosity of 5.8 mm²/s (cSt) or more at 37.8°C or 9.5 mm²/s (cSt) or more at 25°C (77°F), or that contain suspended solids, or have a tendency to form a surface film while under test. Other classification flash points have been established by these departments for liquids using this test method.

5.3 This test method should be used to measure and describe the properties of materials, products, or assemblies in response to heat and an ignition source under controlled

laboratory 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. However, results of this test method may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.

5.4 This test method provides the only closed cup flash point test procedures for temperatures up to 370°C (698°F).

6. Apparatus

6.1 Pensky-Martens Closed Cup Apparatus (manual)—This apparatus consists of the test cup, test cover and shutter, stirring device, heating source, ignition source device, air bath, and top plate described in detail in Annex A1. The assembled manual apparatus, test cup, test cup cover, and test cup assembly are illustrated in Figs. A1.1, A1.2, A1.3, and A1.4, respectively. Dimensions are listed respectively.

6.2 Pensky-Martens Closed Cup Apparatus (automated)—This apparatus is an automated flash point instrument that is capable of performing the test in accordance with Section 11, Procedure A, and Section 12, Procedure B, of this test method. The apparatus shall use the test cup, test cover and shutter, stirring device, heating source, and ignition source device described in detail in Annex A1.

6.3 Temperature Measuring Device—Is a thermometer having a range as shown as follows and conforming to the requirements prescribed in Specification E 1 or in Annex A3, or an electronic temperature measuring device, such as resistance thermometers or thermocouples. The device shall exhibit the same temperature response as the mercury thermometers.

Temperature Range	Thermometer Number	
	ASTM	IP
−5 to +110°C (20 to 230°F)	9C (9F)	15C
+10 to 200°C (50 to 392°F)	88C (88F)	101C
+90 to 370°C (200 to 700°F)	10C (10F)	16C

6.4 Ignition Source—Natural gas flame, bottled gas flame, and electric ignitors (hot wire) have been found acceptable for use as the ignition source. The gas flame device described in detailed in Fig. A1.4 requires the use of the pilot flame described in A1.1.2.3. The electric ignitors shall be of the hot-wire type and shall position the heated section of the ignitor in the aperture of the test cover in the same manner as the gas flame device.

NOTE 3: Warning—Gas pressure supplied to the apparatus should not be allowed to exceed 300 mm (11.8 in.) of water pressure.

7. Reagents and Materials

7.1 1,4—dimethylbenzene (p-xylene), conforming to the following requirements:

Specific gravity	0.860 min, 0.866 max (15.6/15.6°C) (60/60°F),	D 850 or Test Method D 1078 Test Method D 1016
Boiling range	2°C, max (include 138.4°C)	
Purity	99 % mol, min 12.44°C (54.4°F) min freezing point	Test Method D 1015
C6 and lighter	500 mg/kg, max (500 ppm)	Test Method D 3798 (modified)

7.2 Calibration Fluid—(to be determined)

⁸ For information on U.S. Department of Transportation regulations, see Codes of U.S. Regulations 49 CFR Chapter I and the U.S. Department of Labor, see 29 CFR Chapter XVII. Each of these items is revised annually and may be procured from the Superintendent of Documents, Government Printing Office, Washington, DC 20402.

NOTE 4—The Coordinating Committee on Flash Point S15 is currently evaluating suitable material for use as calibration fluids.

7.3 Cleaning Solvents—Use suitable solvent capable of cleaning out the specimen from the test cup and drying the test cup and cover. Some commonly used solvents are toluene and acetone.

NOTE 5: **Warning**—Toluene, acetone, and many solvents are flammable and a health hazard. Dispose of solvents and waste material in accordance with local regulations.

8. Sampling

8.1 Obtain a sample in accordance with instructions given in Practices D 4057, D 4177, or E 300.

8.2 At least 75 mL of sample is required for each test. Refer to Practice D 4057.

8.3 Erroneously high flash points may be obtained if precautions are not taken to avoid the loss of volatile material. To prevent loss of volatile material and possible introduction of moisture do not open containers unnecessarily. Do not make a transfer unless the sample temperature is at least the equivalent of 17°C (30°F) below the expected flash point. When possible, flash point should be the first test performed on a sample and the sample should be stored at low temperature.

8.4 Do not store samples in plastic (polyethylene, polypropylene, etc.) containers, since volatile material may diffuse through the walls of the enclosure. Samples in leaky containers are suspect and not a source of valid results.

8.5 Samples of very viscous materials can be warmed until they are reasonably fluid before they are tested. However, no sample should be heated more than is absolutely necessary. It shall never be heated above a temperature of 17°C (30°F) below its expected flash point.

8.6 Samples containing dissolved or free water may be dehydrated with calcium chloride or by filtering through a qualitative filter paper or a loose plug of dry absorbent cotton. Warming the sample is permitted, but it shall not be heated for prolonged periods or above a temperature of 17°C (30°F) below its expected flash point.

NOTE 6—If the sample is suspected of containing volatile contaminants, the treatment described in 8.5 and 8.6 should be omitted.

9. Preparation of Apparatus

9.1 Support the manual or automated apparatus on a level steady table.

9.2 Tests are to be performed in a draft-free room or compartment. Tests made in a laboratory hood or in any

location where drafts occur are not reliable.

NOTE 7—A shield, of the approximate dimensions 460 mm (18 in.) square and 610 mm (24 in.) high, or other suitable dimensions, and having an open front is recommended to prevent drafts from disturbing the vapors above the test cup.

NOTE 8—With some samples whose vapors or products of pyrolysis are objectionable, it is permissible to place the apparatus with shield in a hood, the draft of which is adjustable, so that vapors can be withdrawn without causing air currents over the test cup during the final 17°C (30°F) rise in temperature prior to the flash point.

9.3 Prepare the manual apparatus or the automated apparatus for operation in accordance with the manufacturer's instructions for calibrating, checking, and operating the equipment.

NOTE 9: **Warning**—Gas pressure should not be allowed to exceed 300 mm (11.8 in.) of water pressure.

9.4 Thoroughly clean and dry all parts of the test cup and its accessories before starting the test, to ensure the removal of any solvent which had been used to clean the apparatus.

10. Calibration and Standardization

10.1 Adjust the automated flash point detection system (when used) in accordance with the manufacturer's instructions.

10.2 Calibrate the temperature measuring device in accordance with the manufacturer's instructions.

10.3 Verify the performance of the manual apparatus or the automated apparatus by testing the calibration fluid 1,4-dimethylbenzene in accordance with Procedure A of this test method. When the apparatus is performing properly, the flash point of the calibration fluid, within the reproducibility stated, will be obtained: 27.2 ± 0.6°C (81 ± 1°F).

NOTE 10—The flash point temperature of 1,4-dimethylbenzene is a relatively low temperature and may not allow the specified rate of heating to be achieved. Cooling the material to the specified specimen insertion temperature may cause the material to crystallize. The ASTM Coordinating Committee on Flash Point is in the process of determining more suitable calibration fluids.

10.4 When the flash point obtained on 1,4-dimethylbenzene is not within the limits stated in 10.3, check the condition and operation of the apparatus to ensure conformity with the details listed in Annex A1, especially with regard to tightness of the lid (A1.1.2.2), the action of the shutter, the position of the ignition source (A1.1.2.3), and the angle and position of the temperature measuring device (A1.1.2.4). After adjustment, when necessary, repeat this test method, with special attention to the procedural details prescribed in this test method.

PROCEDURE A—DETERMINATION OF FLASH POINT OF FUEL OILS, LUBRICATING OILS AND OTHER HOMOGENEOUS LIQUIDS (see Introduction)

11. Procedure

11.1 Manual Apparatus:

11.1.1 Fill the test cup with the test specimen to the filling mark inside of the test cup. The temperature of the test cup and test specimen shall not exceed 17°C (30°F) below the expected flash point. If too much test specimen has been added to the test cup, remove the excess using a syringe or similar device for withdrawal of fluid. Bring the test spec-

imen to a temperature of 15 ± 5°C (60 ± 10°F), or bring the test specimen to a temperature at least 17°C below the expected flash point. Place the test cover on the test cup and place the assembly into the apparatus. Be sure the locating or locking device is properly engaged. Insert the temperature measuring device into its holder.

11.1.2 Light the test flame, and adjust it to a diameter of 3.2 to 4.8 mm (0.126 to 0.189 in.), or switch on the electric

igniter and adjust the intensity in accordance with the manufacturer's instructions.

NOTE 11: Warning—Gas pressure should not be allowed to exceed 40 kPa (300 mm) of water pressure.

NOTE 12: Caution—Exercise care when using a gas test flame. If it should be extinguished it will not ignite the vapors in the test cup, and the gas for the test flame that then enters the vapor space can influence the result.

NOTE 13: Warning—The operator should exercise and take appropriate safety precautions during the initial application of the ignition source, since test specimens containing low-flash material can give an abnormally strong flash when the ignition source is first applied.

NOTE 14: Warning—The operator should exercise and take appropriate safety precautions during the performance of this test method. The temperatures attained during this test method, up to 370°C (698°F), are considered hazardous.

11.1.3 Apply the heat at such a rate that the temperature, as indicated by the temperature measuring device, increases 5 to 6°C (9 to 11°F)/min.

11.1.4 Turn the stirring device at 90 to 120 rpm, stirring in a downward direction.

NOTE 15: Caution—Meticulous attention to all details relating to the ignition source, size of test flame or intensity of the electric ignitor, rate of temperature increase, and rate of dipping the ignition source into the vapor of the test specimen is desirable for good results.

11.1.5 *Application of Ignition Source:*

11.1.5.1 If the test specimen is known to have a flash point of 110°C (230°F) or below, apply the ignition source when the temperature of the test specimen is approximately 17°C (30°F) below the expected flash point and each time thereafter at a temperature reading that is a multiple of 1°C (2°F). Discontinue the stirring of the test specimen and apply the ignition source by operating the mechanism on the test cover which controls the shutter so that the ignition source is lowered into the vapor space of the test cup in 0.5 s, left in its lowered position for 1 s, and quickly raised to its upward position.

11.1.5.2 If the test specimen is known to have a flash point at or above 110°C (230°F), apply the ignition source in the manner just described at each temperature that is a multiple of 2°C (5°F), beginning at a temperature of 17°C (30°F) below the expected flash point.

11.1.6 When testing materials to determine if volatile material contamination is present, it is not necessary to adhere to the temperature limits for initial ignition source application as stated in 11.1.5.

11.1.7 When testing materials where the flash point temperature is not known, bring the material to be tested and the tester to a temperature of 15 ± 5°C (60 ± 10°F). Apply the ignition source, in the manner described, beginning at least 5°C above the starting temperature.

NOTE 16—Flash Point results determined in an “unknown expected flash point mode” should be considered approximate. This value can be used as the expected flash point when a fresh specimen is tested in the standard mode of operation.

11.1.8 Record as the observed flash point the reading on the temperature measuring device at the time ignition source application causes a distinct flash in the interior of the test cup.

NOTE 17—The sample is deemed to have flashed when a large flame appears and instantaneously propagates itself over the entire surface of the test specimen.

11.1.9 When the ignition source is a test flame, the application of the test flame may cause a blue halo or an enlarged flame prior to the actual flash point. This is not a flash and shall be ignored.

11.1.10 When a flash point is detected on the first application, the test shall be discontinued, the result discarded, and the test repeated with a fresh test specimen. The first application of the ignition source with the fresh test specimen shall be at least 17°C (30°F) below the temperature found when a flash point was detected on the first application.

11.1.11 When the apparatus has cooled down to a safe handling temperature, less than 55°C (130°F), remove the test cover and the test cup and clean the apparatus as recommended by the manufacturer.

NOTE 18—Exercise care when cleaning and positioning the lid assembly so not to damage or dislocate the flash detection system or temperature measuring device. See the manufacturer's instructions for proper care and maintenance.

11.2 *Automated Apparatus:*

11.2.1 The automated apparatus shall be capable of performing the procedure as described in 11.1, including control of the heating rate, stirring of the test specimen, application of the ignition source, detection of the flash point, and recording the flash point.

11.2.2 Fill the test cup with the test specimen to the filling mark inside of the test cup. The temperature of the test cup and test specimen shall not exceed 17°C (30°F) below the expected flash point. If too much test specimen has been added to the test cup, remove the excess using a syringe or similar device for withdrawal of fluid. Bring the test specimen to a temperature of 15 ± 5°C (60 ± 10°F), or bring the test specimen to a temperature at least 17°C (30°F) below the expected flash point. Place the test cover on the test cup and place the assembly into the apparatus. Be sure to have the locating or locking device properly engaged. Insert the temperature measuring device into its holder.

11.2.3 Light the test flame, when necessary, and adjust it to a diameter of 3.2 to 4.8 mm (0.126 to 0.189 in.).

NOTE 19: Warning—Gas pressure should not be allowed to exceed 40 kPa (300 mm) of water pressure.

NOTE 20: Caution—Exercise care when using a gas test flame. If it should be extinguished it will not ignite the vapors in the test cup and the gas for the test flame that then enters the vapor space can influence the result.

NOTE 21: Warning—The operator should exercise and take appropriate safety precautions during the initial application of the ignition source, since test specimens containing low-flash material may give an abnormally strong flash when the ignition source is first applied.

NOTE 22: Warning—The operator should exercise and take appropriate safety precautions during the performance of this test method. The temperatures attained during this test method, up to 370°C (698°F), are considered hazardous.

11.2.4 Start the automated apparatus in accordance with the manufacturer's instructions. The apparatus shall follow the procedural details described in 11.1.3 through 11.1.8.

PROCEDURE B—DETERMINATION OF FLASH POINT OF LIQUIDS THAT TEND TO FORM A SURFACE FILM, LIQUIDS WITH SUSPENSIONS OF SOLIDS AND NON-HOMOGENEOUS LIQUIDS (see Introduction)

12. Procedure

12.1 Manual Apparatus:

12.1.1 Fill the test cup with the test specimen to the filling mark inside of the test cup; the temperature of the test cup and test specimen shall not exceed 17°C (30°F) below the expected flash point. If too much test specimen has been added to the test cup, remove the excess using a syringe or similar device for withdrawal of fluid. Bring the test specimen to a temperature of $15 \pm 5^\circ\text{C}$ ($60 \pm 10^\circ\text{F}$), or bring the test specimen to a temperature at least 17°C below the expected flash point. Place the test cover on the test cup and place the assembly into the apparatus. Be sure the locating or locking device is properly engaged. Insert the temperature measuring device into its holder.

12.1.2 Light the test flame and adjust it to a diameter of 3.2 to 4.8 mm (0.126 to 0.189 in.), or switch on the electric igniter and adjust the intensity in accordance with the manufacturer's instructions.

NOTE 23: **Warning**—Gas pressure should not be allowed to exceed 40 kPa (300 mm) of water pressure.

NOTE 24: **Caution**—Exercise care when using a gas test flame. If it should be extinguished it will not ignite the vapors in the test cup and the gas for the test flame that then enters the vapor space can influence the result.

NOTE 25: **Warning**—The operator should exercise and take appropriate safety precautions during the initial application of the ignition source, since test specimens containing low-flash material may give an abnormally strong flash when the ignition source is first applied.

NOTE 26: **Warning**—The operator should exercise and take appropriate safety precautions during the performance of this test method. The temperatures attained during this test method, up to 370°C (698°F), are considered hazardous.

12.1.3 Turn the stirring device at 250 ± 10 rpm, stirring in a downward direction.

12.1.4 Apply the heat at such a rate that the temperature as indicated by the temperature measuring device increases 1 to 1.5°C (2 to 3°F)/min.

12.1.5 Proceed as prescribed in Section 11, with the exception of the preceding requirements for rates of stirring and heating.

12.2 Automated Apparatus:

12.2.1 The automated apparatus shall be capable of performing the procedure as described in 12.1, including control of the heating rate, stirring of the test specimen, application of the ignition source, detection of the flash point, and recording the flash point.

12.2.2 Fill the test cup with the test specimen to the filling mark inside of the test cup. The temperature of the test cup and test specimen shall not exceed 17°C (30°F) below the expected flash point. If too much test specimen has been added to the test cup, remove the excess using a syringe or similar device for withdrawal of fluid. Bring the test specimen to a temperature of $15 \pm 5^\circ\text{C}$ ($60 \pm 10^\circ\text{F}$), or bring the test specimen to a temperature at least 17°C (30°F) below the expected flash point. Place the test cover on the test cup and place the assembly into the apparatus. Be sure the locating or locking device is properly engaged. Insert the temperature

measuring device into its holder.

12.2.3 Light the test flame, when necessary, and adjust it to a diameter of 3.2 to 4.8 mm (0.126 to 0.189 in.).

NOTE 27: **Warning**—Gas pressure should not be allowed to exceed 40 kPa (300 mm) of water pressure.

NOTE 28: **Caution**—Exercise care when using a gas test flame. If it should be extinguished it will not ignite the vapors in the test cup and the gas for the test flame that then enters the vapor space can influence the result.

NOTE 29: **Warning**—The operator should exercise and take appropriate safety precautions during the initial application of the ignition source, since test specimens containing low-flash material can give an abnormally strong flash when the ignition source is first applied.

NOTE 30: **Warning**—The operator should exercise and take appropriate safety precautions during the performance of this test method. The temperatures attained during this test method, up to 370°C (698°F), are considered hazardous.

12.2.4 Start the automated apparatus in accordance with the manufacturer's instructions. The apparatus shall follow the procedural details in accordance with 12.1.3 through 12.1.5.

13. Calculation

13.1 Observe and record the ambient barometric pressure (See Note 30) at the time of the test. When the pressure differs from 101.3 kPa (760 mm Hg), correct the flash point as follows:

$$\text{Corrected flash point} = C + 0.25 (101.3 - K) \quad (1)$$

$$\text{Corrected flash point} = F + 0.06 (760 - P) \quad (2)$$

$$\text{Corrected flash point} = C + 0.033 (760 - P) \quad (3)$$

where:

C = observed flash point, °C,

F = observed flash point, °F,

P = ambient barometric pressure, mm Hg, and

K = ambient barometric pressure, kPa.

NOTE 31—The barometric pressure used in this calculation is the ambient pressure for the laboratory at the time of the test. Many aneroid barometers, such as those used at weather stations and airports, are precorrected to give sea level readings and would not give the correct reading for this test.

13.2 When the ambient barometric pressure is below 101.3 kPa (760 mm), round up the corrected flash point to the nearest 0.5°C (1°F) and record. When the ambient barometric pressure is above 101.3 kPa (760 mm), round down the corrected flash point to the nearest 0.5°C and record.

14. Report

14.1 Report the corrected flash point as the ASTM D 93 – IP 34, Procedure A or Procedure B Pensky-Martens Closed Cup Flash Point of the test specimen.

15. Precision and Bias

15.1 **Precision**—*Procedure A*—The precision of this procedure as determined by the statistical examination of the interlaboratory test results, is as follows:

15.1.1 **Repeatability**—The difference between successive results, obtained by the same operator with the same