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Standard Test Method for Selection and Use of ASTM Standards for the Determination of Flash Point of Chemicals by Closed Cup Methods[1]

This standard is issued under the fixed designation E502; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the flash point of liquid and solid chemical compounds flashing from below – 10 to 370°C (16 to 700°F). The procedures and apparatus in Test Methods D56, D93, D3278, D3828, and D3941 are to be used. Modification to these procedures are specified for tests on solids and viscous liquids. The significance of the results obtained is discussed along with possible sources of error and factors that might cause interference.

1.2 Suggestions for adapting this procedure to mixtures of chemicals are included (see Appendix X2).

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

1.4 **Warning—**Mercury has been designated by EPA and many state agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website – http://www.epa.gov/mercury/faq.htm - for additional information. Users should be aware that selling mercury and/or mercury containing products into your state may be prohibited by state law.

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.* See also Section 8.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D56 Test Method for Flash Point by Tag Closed Cup Tester
D92 Test Method for Flash and Fire Points by Cleveland Open Cup Tester
D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
D270 Methods of Sampling Petroleum and Petroleum Products (Withdrawn 1984)[3]
D1310 Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus
D3278 Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
D3827 Test Method for Estimation of Solubility of Gases in Petroleum and Other Organic Liquids
D3828 Test Methods for Flash Point by Small Scale Closed Cup Tester
D3934 Test Method for Flash/No Flash Test—Equilibrium Method by a Closed-Cup Apparatus
D3941 Test Method for Flash Point by the Equilibrium Method With a Closed-Cup Apparatus
E681 Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)
E1232 Test Method for Temperature Limit of Flammability of Chemicals

3. Terminology

3.1 *Definitions:*

3.1.1 *flash point*—the lowest temperature, corrected to a pressure of 760 mm Hg (101.3 kPa) (1013 mbar) at which application of an ignition source causes the vapors of a specimen to ignite under specified conditions of test.

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

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

4. Summary of Test Method

4.1 The specimen is placed in a closed cup and in the small scale method equilibrated at a test temperature, in the Pensky-Martens Method heated at a controlled rate with stirring, and in the Tag Method also heated at a controlled rate but without stirring. A small flame is directed into the vapor space of each cup at specified intervals, with simultaneous interruption of stirring in the Pensky-Martens Method, to determine whether a flash occurs or not. In Test Method D3941, the specimen is heated at a slower rate than in the other controlled heating methods, maintaining a small temperature differential between bath and specimen.

5. Significance and Use

5.1 The flash point measures the response of the sample to heat and flame under controlled laboratory conditions. It is only one of a number of properties that must be considered in assessing the overall flammability hazard of a material.

5.2 As a result of physical factors inherent in the apparatus and procedure, the closed cup flash point does not necessarily represent the minimum temperature at which a material can evolve flammable vapors, and the absence of a flash point does not guarantee nonflammability (see Appendix X1 and Appendix X2).

5.3 Flash point is used in shipping and safety regulations to define flammable and combustible materials. Test Methods D56, D93, and D3278 are specified as test methods for determining the flash point of these materials.

5.4 If the process or handling conditions dictate the usage of a flammable material at temperatures ranging upward from 5 to 10°C below the closed-cup flash point, then a flammable vapor might be present above the liquid. In such cases, it may be more appropriate to use the temperature limit of flammability (as determined by Test Method E1232) instead of flash point.

5.5 Small scale methods involving equilibrium procedures and only one flame pass per specimen are preferred.

6. Interferences

6.1 Incorrect flash points can be obtained when testing chemicals corrosive to the materials of construction of the cup. (For example, certain amines and acid chlorides react with the standard aluminum small scale cup causing erroneously low flash points, perhaps due to hydrogen formation.) Cups employing alternative materials of construction, electroplating or plastic coating can provide corrosion resistance. Results in non-standard cups, particularly in non-equilibrium tests, may differ slightly from those obtained in this test method.

7. Apparatus

7.1 *Tag Closed-Cup Tester,* including thermometers, shall be as shown in Test Methods D56 and D3941.

7.2 *Penksy-Martens Closed-Cup Tester,* including thermometers, shall be as shown in Test Methods D93.

7.3 *Small scale Closed Tester,* including thermometers, shall be as shown in Test Methods D3278 or D3828.

NOTE 1—Some automatic flash point testers may save testing time and permit the use of small samples. If automatic testers are used, the user must be certain that all instructions for calibration and operation are followed to ensure that the results are equivalent to those obtained on the ASTM standard equipment. For regulation purposes or in cases of dispute, the flash point as determined on the manual tester shall be the accepted value.

NOTE 2—ASTM thermometers 33C or 33F may be used in the Tag Tester instead of those specified in Test Method D56 when conducting tests at temperatures below – 10°C (14°F). Slight stem corrections may be necessary and care should be taken to avoid freezing the mercury in the thermometer by cooling below – 40°C (–40°F).

7.4 *Shield*, as described in Test Method D3941 or Test Method D1310.

8. Hazards

8.1 *Toxicity of Chemical and Combustion Products:*

8.1.1 Isolate or control operations on toxic or corrosive materials to prevent exposure to any personnel.

8.1.2 Since flash point tests are conducted in still air, the use of forced circulation for removal of toxic or nuisance fumes or combustion products is restricted. However, a laboratory fume hood equipped with an exhaust damper that can be completely closed provides an ideal location for maintaining draft-free conditions and provides the ability to readily exhaust dangerous vapors and combustion products when necessary.

8.1.3 Use respiratory and splash protective devices as appropriate with toxic or corrosive materials. In most cases, approved cartridge respirators are adequate respiratory protection for the concentrations normally encountered in flash-point testing. Certain toxic or unusual materials, however, may require an air-supplied respirator and extreme cases may require complete protective coverage such as an air-supplied plastic suit. (Two examples of the latter type of material are dimethyl sulfate and pure mercaptans.) Tests on these highly toxic or obnoxious materials may also be conducted in completely isolated, closed systems, such as glove boxes. In this case, procedures should ensure an uncontaminated air system in the box, and should prevent a buildup of vapors from the material under test.

8.2 *Dry Ice Use:*

8.2.1 Exercise care in the use of dry ice for sample and apparatus cooling. Avoid contact with dry ice to prevent frostbite. Glass bottles or vials of chemicals should not be placed directly in dry ice or dry ice baths because of the possibility of breakage due to thermal shock.

8.3 *Tests of Explosives and Propellants:*

8.3.1 Flash tests should not be conducted on potential or known explosive or propellant materials without complete prior knowledge that burning will not result in propagation to an explosive decomposition. Properly barricaded or remotely operated automatic testers should be used if precise flash points are needed.

8.4 *Pyrophoric Materials:*

8.4.1 Flash point apparatus is not applicable for the evaluation of pyrophoric materials and should not be used for this purpose.

9. Preparation of Sample

9.1 Obtain samples representative of the batch under test. Methods D270 can be used as a reference on sampling techniques. With mixtures and with samples containing

impurities, take care to avoid the loss of volatile components during sampling and handling for testing. When heating viscous or solid materials for ease of pouring, samples must be held at temperatures below, or as close as possible to, those specified in the various test methods. Discard samples from leaking or contaminated containers. Samples that are hygroscopic should not be exposed to moisture or moist air.

9.2 Samples should not be stored in plastic (polyethylene, polypropylene, etc.) bottles, since volatile materials may diffuse through the walls of the bottle.

10. Preparation of Apparatus

10.1 Support the appropriate flash-point tester on a level, steady work surface in a draft-free location. If a draft-free location is not available, use a shield surrounding the tester on three sides. The shield should be approximately 460 mm (18 in.) wide and 610 mm (24 in.) high.

NOTE 3—An area capable of being partially darkened is advantageous since it aids in the detection of the relatively nonluminous flames sometimes encountered in flash-point testing.

NOTE 4—Test Method D1310 gives a design for a draft shield suitable for standard flash-point testers.

11. Calibration

11.1 Check the condition and operation of the Tag, Pensky-Martens and small scale testers as specified in Test Methods D56, D93, D3278, or D3828, respectively.

12. Procedure

12.1 Follow the procedures outlined in Test Methods D56 or D3941 (Tag Closed Cup), D3278 or D3827 (Small scale Closed Cup), and D93 (Pensky Martens Closed Cup), as is necessary. Certain explanatory notes and procedure modifications not contained in the individual methods are given below. Occasionally, particularly near the temperature of the actual flash point, the application of the test flame will cause a halo or test flame enlargement that should be ignored. In some cases this test flame enlargement will not lead to a flash point on an increase in temperature.

12.2 For liquids with a viscosity less than 5.8×10^{-6} m^2/s (5.8 cSt) at 38°C (100°F), or 9.5×10^{-6} m^2/s (9.5 cSt) at 25°C (77°F), observe the following:

NOTE 5—The first viscosity threshold point is stated either as "5.8×10^{-6} m^2/s (5.8 cSt) at 100°F (38°C)", or as "5.5×10^{-6} m^2/s (5.5 cSt) at 40°C (104°F), in different flash point test standards. The choice is indicative of only the unit system preferred by individual test standards. In practice the two forms are considered equivalent.

12.2.1 If the flash point is below 93°C (200°F), use the small scale (Test Method D3278 or D3828) or Tag (Test Method D56) apparatus and procedures.

12.2.2 If the flash point is 93°C (200°F) or above, use the small scale (Test Method D3828) or Pensky-Martens (Test Methods D93) apparatus and procedures.

NOTE 6—The electric heaters on some Tag Testers may be of insufficient capacity to maintain the specified heating rates when operating in the upper ranges of this practice. Heat input can be increased slightly by using a variable transformer to increase the voltage slightly on the heaters. Insulation can be applied to the exterior of the bath to reduce heat losses.

NOTE 7—With low temperature operation in the small scale methods, equilibrium may be difficult to maintain due to heating by natural convection. It, therefore, will be necessary to cool the cup and sample below the anticipated flash point before specimen introduction (see Test Methods D3278).

NOTE 8—In the Tag Method (Test Method D56), natural warming rates sometimes exceed 1°C (2°F)/min. These rates can be reduced by insulating the outside of the bath container. A laboratory refrigerated circulator may be used. One advantage of this system is that circulation of the refrigerant bath with the system gradually warming up can serve as a control on heating rate.

NOTE 9—With low-temperature operation in the Tag and Small scale Methods, difficulties can be created by the formation of frost on the surface of the tester. If precise flash points are needed in the temperature range where frost conditions are encountered, tests can be conducted in a dry box or a room of very low humidity. When ice formation on the lid and cover parts cannot be avoided, the results will be unreliable. Sticking of the slide due to ice formation can be minimized by carefully lubricating the slide with a high vacuum silicone lubricant. Portions of the cover and slide in the vicinity of the pilot flame and openings should be wiped free of frost just prior to the initial flame insertion at 5°C (10°F) below the flash point.

12.3 For liquids with a viscosity equal to or greater than 5.8×10^{-6} m^2/s (5.8 cSt) at 38°C (100°F), or 9.5×10^{-6} m^2/s (9.5 cSt) at 25°C (77°F) and less than 15×10^{-3} m^2/s (150 St) at 25°C (77°F), and a flash point below 110°C (230°F), the following procedure applies:

12.3.1 Use of Pensky-Martens Method (Test Methods D93) or the small scale (Test Method D3278 or D3828) apparatus and procedure.

12.4 For liquids with a viscosity equal to or greater than 5.8×10^{-6} m^2/s (5.8 cSt) at 38°C (100°F) or 9.5×10^{-6} m^2/s (9.5 cSt) at 25°C (77°F) and a flash point of 93°C (200°F) or above, the following procedure applies:

12.4.1 Use the Pensky-Martens (Test Methods D93) and the small scale (Test Method D3828) apparatus and procedure.

NOTE 10—Testing time may be reduced by initially heating samples at higher rates than those specified in the test procedures, provided that the specified heating rates are maintained in the temperature range in the vicinity of the flash point. This is permissible provided that, during the fast heat-up period, the highest temperature of the material (next to the cup wall) never exceeds a temperature 11°C (20°F) below the flash point for the Pensky-Martens method. Use extreme care when using fast heat-up in the Pensky-Martens method since there are no provisions for bath temperature measurement.

12.5 For liquids with a viscosity equal to or greater than 15×10^{-3} m^2/s (150 St at 25°C) (77°F) and solid materials that flash while solid (Note 12), the following procedures apply:

12.5.1 Use the Small Scale Test Methods D3278 or Test Method D3828 with the following modification:

12.5.1.1 Determine the flash point in the small scale unit using a holding time of 6 min at the test temperature instead of 1 or 2 min normally employed.

12.5.1.2 Methods for loading the sample cup with highly viscous liquids or solids are given in Test Methods D3278. Solid materials can be loaded with a spoon.

12.6 For equilibrium flash point method using the Tag Closed Cup Tester, the following applies:

12.6.1 For liquids with a viscosity equal to or greater than 5.8×10^{-6} m^2/s (5.8 cSt at 38°C (100°F) or 9.5×10^{-6} m^2/s (9.5 cSt) at 25°C (77°F) and a flash point below 93°C (200°F), Test Method D3941 may be used using the Tag Closed Cup.

12.6.2 Test Method D3941 may also be used for the high viscosity liquids and solids covered in 12.6 (Note 12). Observe the temperature differences between bath and sample specified in Test Method D3941. (The Tag tester is very inefficient for testing these materials since large sample quantities and very long testing times are required.)

NOTE 11—With highly viscous materials it may be advantageous to fill the tag closed cup vessel directly to a 50-mL line on the sample cup rather than to use the graduated cylinder specified in Test Method D56. Significant quantities of a viscous material may adhere to the walls of the graduated cylinder when the transfer is made. Certain manufacturers supply tag cups with a 50-mL line inscribed on the inner cup wall.

NOTE 12—The small scale procedure is the preferred method for solid materials.

NOTE 13—The intent of the low heat rate specified in Test Method D3941 is to ensure that misleading results are not obtained because of the poor heat transfer characteristic of viscous materials. The test thermometer should closely reflect the highest temperature to which the specimen throughout the cup is being subjected. If a small temperature difference between the temperature of the bath and the specimen is not maintained, warm materials next to the cup walls will evolve vapors resulting in a positive flash test while the test thermometer registers the temperature of the cooler materials near the center of the cup.

12.7 Follow the procedures outlined in Test Methods D56, D3278, D93, D3828, and D3941 pertaining to recording of flash point, discarding of results, number of samples to be run, etc.

13. Corrections for Barometric Pressure

13.1 Observe and record the ambient barometric pressure at the time and place of the test.

NOTE 14—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 If the pressure differs from 760 mm Hg (101.3 kPa), correct the flash point as follows:

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

$$\text{Corrected flash point } (°F) = F + 0.06\,(760 - B)$$

$$\text{Corrected flash point } (°C) = C + 0.033\,(760 - B)$$

where:

F = observed flash point, °F,
C = observed flash point,° C,
B = ambient barometric pressure, mm Hg, and
A = ambient barometric pressure, kPa.

NOTE 15—The above barometric correction is an approximation based on a material of average lower explosive limit having a vapor pressure curve of average slope. Theoretically, a separate barometric adjustment would be required for each material; however, the above approximation is adequate for most cases. For "non-standard" materials, for flash point measurements made at high altitudes (Denver, CO, for example) or for data being used to evaluate hazards at high altitudes, corrections might better be based on the actual vapor pressure and explosive limit data of the material in question.

13.3 Round the final average-corrected flash point downward to the nearest whole number.

TABLE 1 Repeatability

Tester	Range	Repeatability
Tag closed cup (Test Method D56)	Below 60°C (140°F)	1.1°C (2°F)
Tag closed cup (Test Method D56)	60 to 93°C (140 to 199°F)	1.7°C (3°F)
Small scale (Test Method D3278)		
Viscosity at or below 5.8 × 10^{-6} m^2/s (5.8 cSt) at 38°C (100°F)		1.7°C (3°F)
Viscosity above 5.8 × 10^{-6} m^2/s (5.8 cSt) at 38°C (100°F)		3.3°C (6°F)
Small scale (Test Method D3828)[A]	20 to 70°C (68 to 158°F)	0.5°C (1°F)
where: M = mean of two results	above 70°C (158°F)	0.022M (0.9°C)
Pensky-Martens (Test Methods D93 A)	104°C (220°F) and under	2°C (4°F)
(Test Methods D93 B)	above 104°C (220°F)	5.5°C (10°F))
	Viscous materials[B]	5°C (9°F)

[A] Test Method D3828 is identical to British Institute of Petroleum Method IP303. The above precision figures for this test method were taken from the British round-robin tests.
[B] Repeatability and reproducibility figures have not been determined for viscous materials requiring syringe backloading or for solid materials. Tests have shown that thermal equilibrium for solid materials is reached in small scale Tester in approximately 5 min.

14. Report

14.1 The report shall specify the following:

14.1.1 Flash point rounded downward to the nearest 1°C (or 1°F),

14.1.2 Test method used,

14.1.3 Date,

14.1.4 Purity of the material if known (commercial grade, reagent grade, chemically pure, etc.), and

14.1.5 Special preparation of sample (for example, the degree and method of evaporation if a mixture is so treated).

14.2 A report shall be issued for those samples tested that do not flash. This latter report shall state either "no flash to boiling at__° C (°F)" or "No flash to __°C (°F)."

15. Precision and Bias[4]

15.1 The following criteria shall be used for judging the acceptability of results as shown in the respective test methods.

15.1.1 The precision and bias of these methods of measuring flash point are as specified in Test Methods D56, D92, D93, D3278, D3828, D3934, and D3941.

15.1.2 *Repeatability*—Duplicate results by the same operator shall not be considered suspect unless they differ by more than the amount in Table 1.

15.1.3 *Reproducibility*—The results submitted by each of two laboratories shall not be considered suspect unless they differ by more than the amount in Table 2.

[4] Supporting data obtained from an interlaboratory test on chemicals, of insufficient magnitude to establish limits of precision, have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:E27-1000. These data indicate that, for chemicals, precision limits are within those of Test Methods D56, D93, D3278, and D3828. Contact ASTM Customer Service at service@astm.org.

TABLE 2 Reproducibility

Tester	Range	Reproducibility
Tag closed cup (Test Method D56)	Below 13°C (55°F)	3.3°C (6°F)
Tag closed cup (Test Method D56)	13 to 59°C (55 to 139°F)	2.2°C (4°F)
Tag closed cup (Test Method D56)	60 to 93°C (140 to 199°F)	3.3°C (6°F)
Small scale (Test Methods D3278)		
Viscosity at or below 5.8 $\times 10^{-6}$ m^2/s (5.8 cSt) at (100°F)		3.3°C (6°F)
Viscosity above 5.8 $\times 10^{-6}$ m^2/s (5.8 cSt) at 38°C (100°F)		5°C (9°F)
Small scale (Test Method D3828)[A]	20 to 70°C (68 to 158°F)	0.03 (M + 29)°C
where: M = mean of two results	above 70°C (158°F)	0.083M (0.9°C)
Pensky-Martens (Test Methods D93 A)	104°C (220°F) and under	3.5°C (6°F)
(Test Methods D93 B)	above 104°C (220°F)	8.5°C (15°F)
	Viscous materials[B]	10°C (18°F)

[A] Test Method D3828 is identical to British Institute of Petroleum Method IP303. The above precision figures for this test method were taken from the British round-robin tests.

[B] Repeatability and reproducibility figures have not been determined for viscous materials requiring syringe backloading or for solid materials. Tests have shown that thermal equilibrium for solid materials is reached in Small scale Tester in approximately 5 min.

APPENDIXES

(Nonmandatory Information)

X1. COMMENTARY ON THE FLASH POINT TEST

X1.1 While the flash point can be used to indicate the flammability of liquid and solid chemicals for certain end uses, flash point does not represent the minimum temperature at which a material can evolve flammable vapors.

X1.1.1 With the exception of Test Method D3934 and Test Method D3941 and the small scale methods, most flash point tests are run at a finite heating rate, and therefore, vapor concentrations are not representative of equilibrium conditions.

X1.1.2 Flash point testing employs downward and horizontal propagation of flame. Flame propagation in these directions generally requires slightly higher vapor concentrations than is required for upward flame propagation.

X1.1.3 In the flash point test, the flame is introduced at a finite distance above the liquid surface. Since the vapors are more dense than air, the vapor concentration is generally slightly higher at the liquid surface than at the flame position.

NOTE X1.1—If process or handling conditions dictate the usage of a flammable material at temperatures ranging upward from 5 to 10°C below the closed-cup flash point, then a flammable vapor might be present above the liquid, and the potential hazard might be more precisely defined by determining such properties as temperature limit of flammability (Test Method E1232) or flammable limit concentrations (Test Method E681), or both, at the contemplated conditions.

X1.2 There are instances with pure materials where the absence of a flash point does not ensure freedom from flammability. Included in this category are materials that require large diameters for flame propagation, such as trichloroethylene. This material will not propagate a flame in apparatus the size of a flash-point tester, however, its vapors are flammable and will burn when ignited in apparatus of adequate size.

X1.3 Some materials having very dense vapors, a narrow range of flammability, or the requirement for being somewhat superheated to burn, will not exhibit a flash point as defined herein, but can form flammable vapor - air mixtures if heating and mixing are optimum and the temperatures are raised.

X1.4 In specific instances, contrary to usual behavior, the open-cup flash point (Test Method D1310 or Test Method D92) may be at a lower temperature than the closed-cup flash point, thereby indicating the greatest flammability hazard of the material. Materials hydrolyzing with the moisture in the air to form flammable byproducts are examples of this type of behavior. Special procedures reflecting actual conditions to be encountered are needed for evaluating materials of this type.

NOTE X1.2—For the above reasons, a single test such as a flash point should not be relied upon to characterize completely the flammability of a material. Process and handling conditions should be carefully considered and additional tests may be warranted.

X2. COMMENTARY ON THE FLAMMABILITY OF MIXTURES

X2.1 This test method primarily covers the determination of the flash point of pure liquid (or solid) compounds; however, if the following interferences and procedures relating to mixtures and impurities are considered, mixtures can be evaluated.

X2.1.1 When a liquid contains flammable and nonflammable components, there are cases where this liquid can evolve flammable vapors under certain conditions and yet will not exhibit a closed-cup flash point. This phenomenon is noted when a nonflammable component is sufficiently volatile and present in sufficient quantity to inert the vapor space of the closed cup, thus preventing a flash. In many instances, liquids of this type will exhibit an open-cup flash point. In addition, there are certain instances where an appreciable quantity of the nonflammable component will be present in the vapor, and the material will exhibit no flash point, either open or closed. On spillage of a quantity of this latter liquid, the voltatile nonflammable impurity can evaporate over a period of time and the residue remaining becomes flammable.

X2.2 To evaluate mixtures of flammable and nonflammable components properly, flash-point tests should be run on the original materials, and then samples should be allowed to partially evaporate under conditions approximating those to be encountered in usage. Flash-point test should then be run on the residues remaining after various degrees of evaporation. Both open and closed-cup tests might be advisable depending on contemplated usage of the material.

X2.3 Liquids containing a highly volatile nonflammable impurity, which exhibit no flash point because of the influence of the nonflammable material, may form flammable mixtures if totally flash vaporized in air in the proper proportions. These materials can be evaluated for potential flammability using flammable limit apparatus (Test Method E681) operated at the conditions approximating those of the contemplated usage.

X2.4 Some mixtures of water and hydrocarbons, or low volatility halogenated hydrocarbons and volatile hydrocarbons, may have low flash points but will not of themselves sustain burning. These materials can present explosion hazards in closed vessels but will not “pool” burn if spilled in the open.