

CRC Combustion Hazard Test Services - LIQUIDS

1. Flash Point of Liquids by Pensky-Martens Closed Cup Apparatus (ASTM D93)

This test method determines the flash point of liquids in the temperature range from 40°C to 370°C (104°F and 698°F) by the Pensky-Martens closed-cup apparatus.
(Sample Size, 250 mL)

A brass test cup is filled with the test specimen. The temperature of the test cup and test specimen are kept at least 18°C or 32°F below the expected flash point. The cover is placed on the test cup and the assembly is placed into the apparatus. The test flame is lit and adjusted to a diameter of 3.2 to 4.8 mm (0.126 to 0.189 in.). Heat is applied and a stirring device is started with a rotational speed of 90 to 120 rpm). The ignition source is applied according to the specific conditions of the expected flashpoint.

The sample is deemed to have flashed when a large flame appears and instantaneously propagates itself over the entire surface of the test specimen. The observed flash point is recorded based on a correction factor for barometric pressure. The sample is tested at incremental temperature increases of approximately 1°C.

2. Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus (ASTM D1310)

This test method determines the Flash Points of liquids in the temperature range from between -18°C and 163°C (0°F and 325°F.) by the Tag Open-Cup Apparatus.
(Sample size: 250 mL)

The determination of the flash and fire points of liquids are performed in a Tag Open-Cup Apparatus consisting of a copper bath, thermometer holder, glass test cup, liquid leveling device, variable electric heater, propane ignition taper, and a draft shield.

The test is performed differently depending on the anticipated flash point.

- a) For anticipated flash points of -18°C to 16°C, a quantity of 1+1 water-glycol solution is cooled in a stoppered 500 mL Flask to approximately -30°C. At the same time the water-glycol coolant is being chilled, a portion of the test sample is cooled to approximately -25°C in a second stoppered 500 mL flask.
- b) For anticipated flash points of 16°C to 93°C, the bath is filled with cold water or a water-glycol solution to a predetermined level 1/8 inch below the top when the cup is in place. The bath liquid should be at least 17°C below the anticipated flash point.
- c) For anticipated flash points of 93°C to 165°C, the bath is filled with a high boiling inert silicone fluid to a predetermined level 1/8 inch below the top when the cup is in place. The test sample is tested at room temperature.

The temperature of the specimen is allowed to increase spontaneously without applying any heat until the rate of temperature rise decreases to 1°C per minute (for flash points -18°C to 16°C). At this point, heat is applied to maintain an increase in temperature at a range of 1±0.25°C per minute. For other flash points, apply heat initially to maintain the 1°C rate increase. The flash point is determined by passing the flame across the specimen at intervals of 1°C.

Once the flash point is determined, the sample is heated at a rate of 1°C per minute to determine the fire point. At 1°C intervals, the flame is passed over the surface of the sample. The fire point is determined at the temperature at which burning is sustained for 5 seconds after ignition. This procedure is repeated a minimum of three times.

The flash point and fire point are reported as the average of the test runs, provided the difference between the extreme values does not exceed 7°F or 4°C.

3. Sustained Burning of Liquids using the Small Scale Open-Cup Apparatus (ASTM D-4206)

This test method determines the sustained burning characteristics of mixtures of flammable and nonflammable liquids, and mixtures containing liquids with widely different flash points.
(Sample Size, 100 mL)

The test is performed on an aluminum block which is placed on a hot plate in a draft free, low-light area. The thermocouples, temperature control unit, and the temperature indicator are connected and the temperature of the control unit is set at 49°C or corrected, if necessary, for the difference in barometric pressure from 101.3 kPa (760 mmHg). When the temperature indicates the set value ($\pm 1^\circ\text{C}$), the block is allowed to stabilize for five minutes to ensure there is no temperature fluctuation.

Two (2) ml of the sample are deposited into the depression on the block. The sample is timed according to the standard and the sustained combustion properties of the material are observed and recorded.

A product is considered to sustain burning if the specimen, (a) ignites when the flame is over the well and burning is sustained for more than 15 seconds after it is removed, or (b) flashes and burns when the test flame is in the "off" position prior to swinging it over the well.

The following is observed and recorded:

- a) Identification of the material under test.
- b) The test temperature and barometric pressure in kPa (mmHg).
- c) Whether there is ignition and sustained combustion or flashing and if so, how long combustion is sustained after the test flame is returned to the "off" position.
- d) A statement of the sustained burning characteristics.

4. Sustained Combustion of Liquid Mixtures using UN Test L.2: Sustained Combustibility

This test method determines the sustained burning characteristics of mixtures of flammable and nonflammable liquids.
(Sample size, 100 mL)

The test is performed on an aluminum block or other corrosion resistant metal of high thermal conductivity with a concave well and a pocket drilled in it to take a thermometer. A small gas jet assembly on a swivel is attached to the block.

The apparatus is set up in a draft free area and a gauge is used to check that the gas jet is 2.2 mm above the top of the well when in the test position. Once the cup is within $\pm 1^\circ\text{C}$ of the corrected test temperature, 2 mL of the sample is transferred to the cup and the timer is started and the test flame is lit. The wait time is 60 seconds or 30 seconds if testing a new test temperature. The pilot flame is moved to the "on" position after 60 seconds and the sequence is timed for 15 seconds. After 15 seconds, the pilot flame is moved to the "off" position. The duration of sustained burning is observed and recorded. The test is repeated with a fresh specimen for a total of three runs to determine the mean time of burning.

- a) The following is observed and recorded:
- b) Whether there is ignition and sustained combustion or flashing, or neither, of the test sample before the test flame is moved into the test position.
- c) Whether the test sample ignites while the flame is in the test position, and if so, how long combustion is sustained after the test flame is returned to the "off" position.

If sustained combustion is not found, repeat the complete procedure with new test portions but with a heating time of 30 seconds.

If sustained combustion is not found at a test temperature of 60.5°C, repeat the complete procedure with new test portions, but at a test temperature of 75°C.

For reporting purposes, the test sample should be assessed either as “not sustaining combustion” or as “sustaining combustion”.

Sustained combustion should be reported at either of the heating times, or temperatures if one of the following occurs with any of the test portions:

- a) Ignites when the flame is over the well and burning is sustained for more than 15 seconds after it is removed, or
- b) Flashes and burns when the test flame is in the “off” position prior to swinging it over the well.

Intermittent flashing should not be interpreted as sustained combustion. Normally, at the end of 15 seconds, the combustion has either clearly ceased or continues. In cases of doubt, the substance should be deemed to sustain combustion.

Reference: http://www.unece.org/fileadmin/DAM/trans/danger/publi/manual/Rev5/English/03en_part3.pdf
See Section 32.5.2 (page 348 of linked document).

5. Sustained Burning of Liquids using the Small Scale Open-Cup Apparatus per 49 CFR 173 Appx H

This test method determines the sustained burning characteristics of mixtures of flammable and nonflammable liquids, and mixtures containing liquids with expected flash points below 80°C (175°F). (Sample Size, 50 mL)

The test is performed on an aluminum block which is placed on a hot plate in a draft free, low-light area. Thermocouples, temperature control unit, and a temperature indicator are connected and the temperature of the control unit is set at 60.5°C which is corrected (if necessary) for the difference in barometric pressure from 101.3 kPa (760 mmHg). When the temperature indicates the set value (+/- 1°C), the block is allowed to stabilize for five minutes to ensure there is no temperature fluctuation.

Two (2) ml of the sample is deposited into the depression on the block and the timer is started. The test is timed according to the standard and the sustained combustion properties of the material are observed and recorded.

The material under test is considered to sustain burning if the material: a) ignites when the flame is over the well and burning is sustained for more than 15 seconds, or b) flashes and burns when the test flame is in the “off” position prior to swinging it over the well. The test is carried out three times.

If the sustained combustion is not observed per the criteria stated above, the complete procedure is repeated with new test portions and a new heating time of 30 seconds. If the sustained combustion is not found at the test temperature of 60.5°C, the complete procedure is repeated with new test portions at a test temperature of 75°C. In the case of material having a flash point of between 60.5°C and 93°C, if the sustained combustion is not found at a temperature 5°C above its flash point, repeat the complete procedure with new test portions at a test temperature 20°C above its flash point.

Reference: <https://www.gpo.gov/fdsys/pkg/CFR-2011-title49-vol2/xml/CFR-2011-title49-vol2-part173-appH.xml>