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**INTERNATIONAL STANDARD**



**2592**

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**Petroleum products – Determination of flash and fire points – Cleveland open cup method**

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**Descriptors :** petroleum products, tests, fire tests, flash point, fire point.

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## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2592 was drawn up by Technical Committee ISO/TC 28, *Petroleum products*, and circulated to the Member Bodies in July 1972.

It has been approved by the Member Bodies of the following countries :

Belgium	Iran	Romania
Brazil	Ireland	South Africa, Rep. of
Canada	Israel	Spain
Chile	Mexico	Sweden
Czechoslovakia	Netherlands	Thailand
Egypt, Arab Rep. of	New Zealand	Turkey
Germany	Norway	United Kingdom
Hungary	Poland	U.S.A.
India	Portugal	U.S.S.R.

The Member Body of the following country expressed disapproval of the document on technical grounds :

France

# Petroleum products – Determination of flash and fire points – Cleveland open cup method

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method, using the Cleveland open cup apparatus, of determining the flash and fire points of petroleum products. It is suitable for all petroleum products except for fuel oils and products having an open cup flash point (determined by this method) below 79 °C.

NOTE – Attention is drawn to the alternative method specified in ISO 2719, *Petroleum products – Determination of flash point – Pensky-Martens closed cup method*; this is recommended for determining the flash points of fuel oils and should be used when it is desired to determine the possible presence of small but significant concentrations of lower flash point substances which may escape detection when using ISO 2592.

## 2 PRINCIPLE

The test cup is filled to a specified level with the test portion. The temperature of the test portion is increased rapidly at first and then at a slow, constant rate as the flash point is approached. At specified temperature intervals a small test flame is passed across the cup. The lowest temperature at which application of the test flame causes the vapour above the surface of the liquid to ignite is taken as the flash point. To determine the fire point, the test is continued until the application of the test flame causes the oil to ignite and burn for at least 5 s.

## 3 APPARATUS

**3.1 Cleveland open cup apparatus**, consisting of a test cup, heating plate, test flame applicator, heater, and supports as described in the Annex.

NOTE – Automatic flash point testers are available and in use which may be advantageous in the saving of testing time, permit the use of smaller samples, and have other characteristics which may merit their use. If automatic testers are used, the user must be sure that all the manufacturer's instructions for calibrating, adjusting, and operating the instrument are followed.

In any cases of dispute, the flash point as determined manually shall be considered the referee test.

**3.2 Shield**, 46 cm square and 61 cm high, and having an open front.

**3.3 Thermometer**, partial immersion type conforming to the following specification :

Range	– 6 to + 400 °C
Immersion	25 mm
Graduation at each	2 °C
Longer lines at each	10 °C
Figured at each	20 °C
Scale error not to exceed	{ 1 °C up to 260 °C 2 °C over 260 °C
Expansion chamber permitting heating to	400 °C
Overall length	308 ± 5 mm
Stem diameter	6 to 7 mm
Bulb length	7,5 to 10,0 mm
Bulb diameter	4,5 to 6,0 mm
Distance from bottom of bulb to 10° C line	49 to 58 mm
Distance from bottom of bulb to 360° C line	237 to 254 mm

## 4 PREPARATION OF APPARATUS

**4.1** Support the apparatus on a level steady table in a draught-free room or compartment. Shield the top of the apparatus from strong light, by any suitable means, to permit ready detection of the flash point. Tests made in a laboratory hood (see Note) or any location where draughts occur are not to be relied upon. During the last 17 °C rise in temperature prior to the flash point, care must be taken to avoid disturbing the vapours in the test cup by careless movements or breathing near the cup.

NOTE – With some samples whose vapours or products of pyrolysis are objectionable, it is permissible to place the apparatus, with shield, in a hood, the draught of which is adjustable so that vapours may be withdrawn without causing air currents over the test cup during the final 56 °C rise in temperature prior to the flash point.

**4.2** Wash the test cup with an appropriate solvent to remove any oil or traces of gum or residue remaining from a previous test. If any deposits of carbon are present, remove them with steel wool. Flush the cup with cold water and dry for a few minutes over an open flame or a hot plate to remove the last traces of solvent and water. Cool the cup to at least 56 °C below the expected flash point before use.

4.3 Support the thermometer in a vertical position with the bottom of the bulb 6 mm from the bottom of the cup, and located at a point halfway between the centre and side of the cup on a diameter perpendicular to the arc (or line) of the sweep of the test flame, and on the side opposite to the test flame burner arm.

NOTE — The immersion line engraved on the thermometer will be 2 mm below the level of the rim of the cup when the thermometer is properly positioned.

5 PROCEDURE

5.1 Fill the cup at any convenient temperature (see Note 1) so that the top of the meniscus is exactly at the filling line. If too much sample has been added to the cup, remove the excess, using a pipette or other suitable device; however, if there is sample on the outside of the apparatus, empty, clean, and refill it. Destroy any air bubbles on the surface of the sample (see Note 2).

NOTES

1 Viscous samples should be heated until they are reasonably fluid before being poured into the cup; however, the temperature during heating must not exceed 56 °C below the expected flash point.

2 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.

5.2 Light the test flame and adjust it to a diameter of approximately 4 mm, the size of the comparison bead if one is mounted on the apparatus.

5.3 Apply heat initially so that the rate of temperature rise of the sample is 14 to 17 °C per minute. When the sample temperature is approximately 56 °C below the expected flash point, decrease the heat so that the rate of temperature rise for the last 28 °C before the flash point is 5 to 6 °C per minute.

5.4 Starting at least 28 °C below the flash point, apply the test flame when the temperature read on the thermometer reaches each successive 2 °C mark. Pass the test flame across the centre of the cup, at right angles to the diameter which passes through the thermometer. With a smooth, continuous motion apply the flame either in a straight line or along the circumference of a circle having a radius of at least 150 mm. The centre of the test flame must move in a horizontal plane not more than 2 mm above the plane of the upper edge of the cup and passing in one direction only. At the time of the next test flame application, pass the flame in the opposite direction. The time taken to pass the test flame across the cup shall be about 1 s.

5.5 Record as the flash point the temperature read on the thermometer when a flash appears at any point on the surface of the oil, but do not confuse the true flash with the bluish halo that sometimes surrounds the test flame.

5.6 To determine the fire point, continue heating so that the sample temperature increases at a rate of 5 to 6 °C per minute. Continue the application of the test flame at 2 °C intervals until the oil ignites and continues to burn for at least 5 s. Record the temperature at this point as the fire point of the oil.

6 CORRECTION FOR BAROMETRIC PRESSURE

If the barometric pressure at the time of the tests is less than 953 mbar, record it and add the appropriate correction from the following table to the flash and fire points, as determined.

Barometric pressure, mbar	Correction °C
953 to 887	2
886 to 813	4
812 to 733	6

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7 PRECISION

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The following criteria shall be used for judging the acceptability of results (95 % probability).

7.1 Repeatability

Duplicate results by the same operator using the same apparatus shall be considered suspect if they differ by more than the following amounts :

Flash point . . . . . 8 °C

Fire point . . . . . 8 °C

7.2 Reproducibility

The results submitted by each of two laboratories shall be considered suspect if they differ by more than the following amounts :

Flash point . . . . . 16 °C

Fire point . . . . . 14 °C

NOTE — The precision limits shown are not derived from a correlation programme conducted in degrees Celsius but are calculated from the programme based on degrees Fahrenheit.

8 TEST REPORT

Report the corrected flash point or fire point, or both, as the Cleveland open cup flash point or fire point, or both, reference being made to this International Standard.

## ANNEX

## CLEVELAND OPEN CUP APPARATUS

The Cleveland open cup apparatus shall consist of a test cup, heating plate, test flame applicator, heater, thermometer support, and heating plate support, conforming to the following requirements :

**A.1 Test cup**, of brass, or other non-rusting metal of equivalent heat conductivity, conforming to the dimensional requirements shown in the Figure. The cup may be equipped with a handle.

**A.2 Heating plate**, of brass, cast iron, wrought iron, or steel plate with a centre hole surrounded by an area of plane depression, and a sheet of hard asbestos board which covers the metal plate except over the area of plane depression in which the test cup is supported. The essential dimensions of the heating plate are shown in the Figure; however, it may be square instead of round, and the metal plate may have suitable extensions for mounting the test flame applicator and the thermometer support. Also, a metal bead, as mentioned in A.3, may be mounted on the plate so that it extends through and slightly above a suitable small hole in the asbestos board.

**A.3 Test flame applicator**. The device for applying the flame may be of any suitable type, but it is suggested that the tip be approximately 1,6 mm in diameter at the end, and that the orifice be 0,8 mm in diameter. The device for operating the test flame may be mounted in such a manner as to permit automatic duplication of the sweep of the test flame, the radius of swing being not less than 150 mm, and

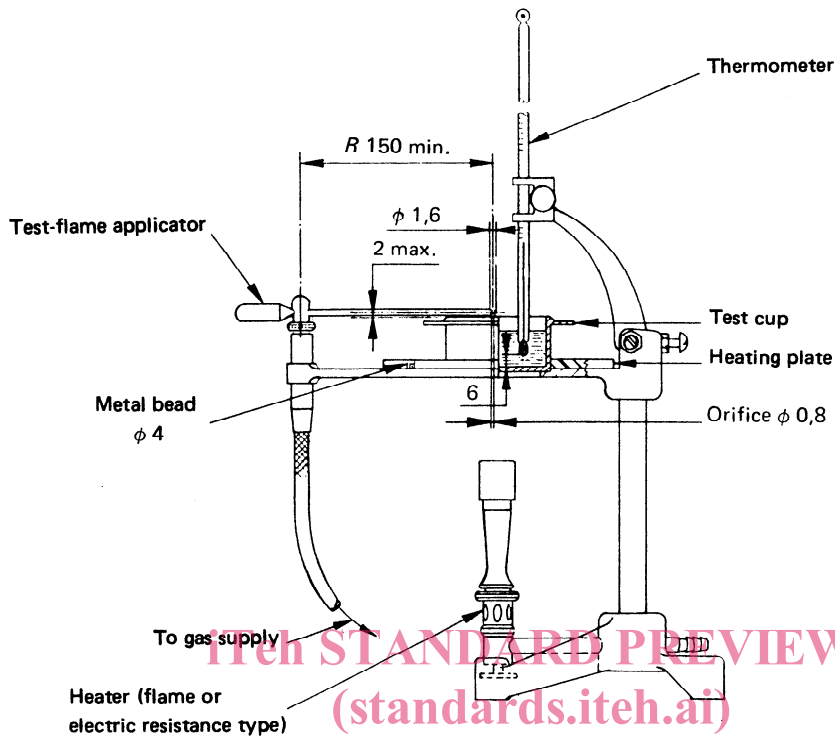
the centre of the orifice being supported so that it swings in a plane not more than 2 mm above the plane of the rim of the cup.

It is desirable that a bead, having a diameter of 3,2 to 4,8 mm, be mounted in a convenient position on the apparatus so that the size of the test flame can be compared to it.

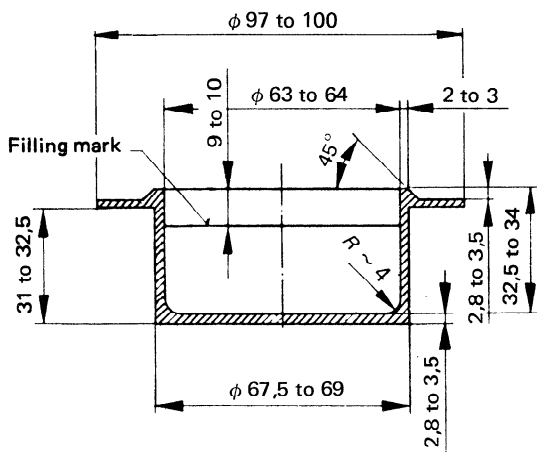
**A.4 Heater**, supplied from any convenient source. The use of a gas burner or alcohol lamp is permitted, but under no circumstances are products of combustion or free flame to be allowed to come up around the cup. An electric heater controlled by a variable voltage transformer is preferred. The source of heat shall be centered under the opening of the heating plate with no local superheating. Flame-type heaters may be protected from draughts or excessive radiation by any suitable type of shield that does not project above the level of the upper surface of the asbestos board.

**A.5 Thermometer support**, which will hold the thermometer in the specified position during a test and which will permit easy removal of the thermometer from the test cup upon completion of a test.

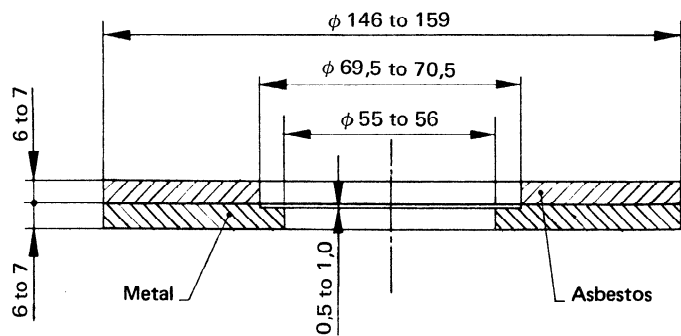
**A.6 Heating plate support**, which will hold the heating plate level and steady.



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Cleveland open cup



Heating plate

FIGURE – Cleveland open cup apparatus

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