Designation: D187 – 08

Standard Test Method for Burning Quality of Kerosine[1]

This standard is issued under the fixed designation D187; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This test method covers the qualitative determination of the burning properties of kerosine to be used for illuminating purposes. (**Warning—**Combustible. Vapor harmful.)

NOTE 1—The corresponding Energy Institute (IP) test method is IP 10 which features a quantitative evaluation of the wick-char-forming tendencies of the kerosine, whereas Test Method D187 features a qualitative performance evaluation of the kerosine. Both test methods subject the kerosine to somewhat more severe operating conditions than would be experienced in typical designated applications.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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.* Specific warning statements appear throughout the test method.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D91 Test Method for Precipitation Number of Lubricating Oils

D3699 Specification for Kerosine

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

2.2 *Energy Institute Standard:*[3]

IP 10 Determination of kerosine burning characteristics - 24 hour method

2.3 *Other Document:*[4]

Formulas for Denatured Alcohol and Rum Treasury Dept., U. S. Bureau of Alcohol, Tobacco, and Firearms, Publication No. 368

3. Summary of Test Method

3.1 The kerosine sample is burned for 16 h in a specified lamp under specified conditions. The average rate of burning, the change in the shape of the flame, and the density and color of the chimney deposit are reported.

4. Significance and Use

4.1 Since the information provided by this test method is largely qualitative in nature, specific limits covering the following characteristics are required in referring to this test method in specifications for kerosine:

4.1.1 Duration of the test: 16 h is understood, if not otherwise specified;

4.1.2 Permissible change in flame shape and dimensions during the test;

4.1.3 Description of the acceptable appearance of the chimney deposit.

5. Apparatus

5.1 *Lamp Assembly,*[5] conforming essentially to the shape and dimensions shown in Fig. 1. It is essential to ensure that the burner fits vertically into the oil reservoir and that the wick-guide has parallel sides and is centrally disposed in relation to the slot in the dome of the burner. Any distortion of the wick-guide or dome will hinder attainment of the prescribed flame shape and render subsequent qualitative ratings unreliable.

5.2 *Wick,*[5] 19-mm paraffin flat, super quality, containing approximately 43 ends of three-ply yarn, woven double plain weave with stitching ends, one blue stripe on one face and one

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.E0.01 on Burner Fuels.

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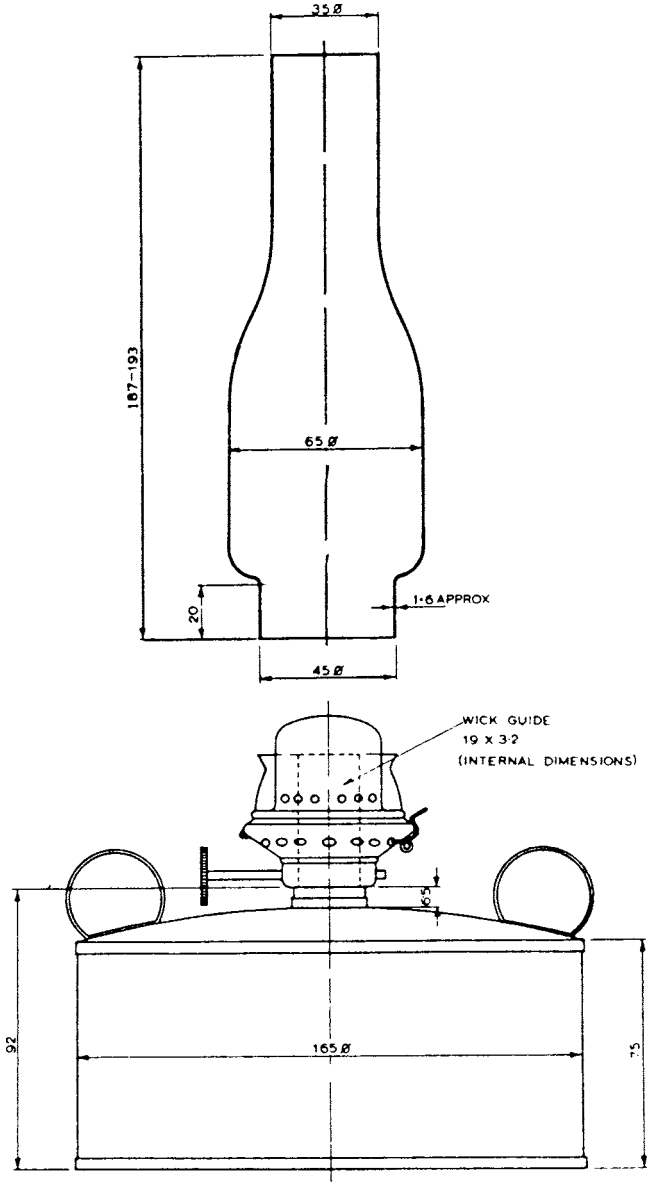
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Energy Institute, 61 New Cavendish St., London, WIG 7AR, U.K., http://www.energyinst.org.uk.

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

[5] The sole source of supply of the apparatus known to the committee at this time is Stanhope-Seta Limited, Park Close, Englefield Green, Egham, Surrey, England TW20 OXD. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

***A Summary of Changes section appears at the end of this standard.**



NOTE—All dimensions shown are in millimetres. Except where otherwise indicated, the tolerance for chimney dimensions is ±1 mm.

FIG. 1 Test Lamp

green stripe on the reverse face, woven with approximately 16 picks per 10 mm, and weighing normally 15 g/m. After weaving, the wick shall be boiled in distilled water and dried thoroughly.

5.2.1 The wick shall then be made into rolls and left for seven days before it is cut into 200-mm lengths. The lengths shall then be packed into suitable containers. The ash of the wick shall not exceed 0.4 weight %.

5.3 *Sight Gage*[5]—A suitable flame-size measuring device, accurate to 1 mm. The sight gage shown in Fig. 2 is satisfactory.

6. Reagents and Materials

6.1 *Formula 3A Denatured Ethanol*—See Formulas for Denatured Alcohol and Rum.

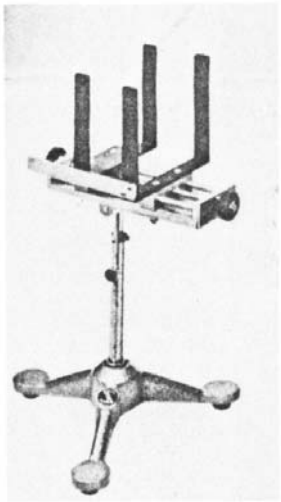


FIG. 2 Sight Gage

6.2 *Hydrochloric Acid*, Dilute (approximately 6 *N*).

6.3 *Kerosine*—See Specification D3699.

6.4 *Precipitation Naphtha*—See Reagent section in Test Method D91.

7. Hazards

7.1 *Specific Safety Hazards*:

7.1.1 *Formula 3A Denatured Ethanol*—(**Warning—** Flammable. Denatured—cannot be made nontoxic.)

7.1.2 *Hydrochloric Acid*—Dilute 6 *N*. (**Warning—**Causes burns. Vapor harmful.)

7.1.3 *Kerosine*—(**Warning—**Combustible. Vapor harmful.)

7.1.4 *Precipitation Naphtha*—(**Warning—**Extremely flammable. Harmful if inhaled. Vapors may cause flash fire.)

7.2 *Technical Precautions*:

7.2.1 *Test Room*—It is desirable to dedicate a suitable room for the exclusive conduct of kerosine burning tests. However, kerosine burning tests can be conducted in any part of a room that is adequately ventilated and reasonably free of drafts. When necessary, the test lamp should be surrounded with a suitable circular shield to protect from drafts. The circular shield is to be constructed of draft-proof material of about 600 mm diameter and height.

7.2.2 *Lamp Location*—Place the test lamps at least 300 mm apart and 300 mm from any wall or other obstruction.

7.2.3 *Test Temperature*—Maintain test room temperature above 15°C and allow the temperature of the kerosine to approach equilibrium room temperature within at least 5°C.

8. Sampling

8.1 The fundamental objective of sampling is to obtain a sample for testing purposes that is truly representative of the entire quantity of a given bulk product tank, batch, shipment, and so forth, at the time and place of sampling.

8.2 Thus, the sampling procedures employed are to ensure initial procurement of a representative sample and also preclude subsequent contamination or deterioration of the sample during handling prior to testing. To this end, kerosine samples for burning quality testing are to be obtained and handled in

strict accordance with Practices D4057 and D4177. Rigorous compliance with stipulated provisions for precautions, care, and cleanliness during sample handling is an essential requirement.

9. Preparation of Apparatus

9.1 Drain the lamp reservoir completely of any previous kerosine sample (**Warning**—Combustible. Vapor harmful), and rinse successively several times with a small portion of the kerosine sample to be tested.

9.2 Clean the lamp burner thoroughly with ASTM precipitation naphtha solvent (**Warning**—Extremely flammable. Harmful if inhaled: vapors may cause flash fire), removing completely any deposits from the wick-guide, air holes, and ducts.

9.3 Soak the new chimneys for 24 h in dilute HCl (**Warning**—Causes burns. Vapor harmful) (approximately 6 *N*), clean with a test tube brush, rinse thoroughly with distilled water, and dry completely. Then subject the prepared new chimneys to at least three preliminary 16-h burning periods. Clean chimneys with detergent and hot water, rinse thoroughly with distilled water, and completely dry between each preliminary burning period. New chimneys are satisfactory for use only if the last of the preliminary burning periods results in deposits essentially similar to those obtained when burning the same kerosine for 16 h with *seasoned* chimneys. Continue preliminary 16-h burning periods and cleanings until *seasoned* chimney performance is achieved.

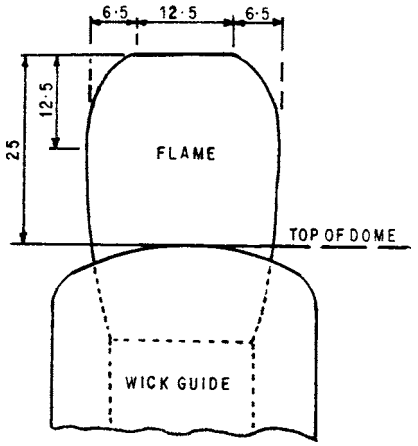
9.4 Place several wicks into an insulated Soxhlet extraction apparatus in such a manner as to prevent distortion and extract with boiling water (**Warning**—Avoid skin contact with exposed hot surfaces by use of protective equipment) for 3 h from the end of the first siphoning cycle. Remove the wicks from the Soxhlet extraction apparatus, lay flat between sheets of filter paper, and press gently to remove excess moisture. Extract the wick with Formula 3A denatured ethanol (**Warning**—Flammable. Denatured—cannot be made nontoxic) for 3 h in an uninsulated Soxhlet extraction apparatus, drain the ethanol as completely as possible from the Soxhlet extractor and continue the extraction with ASTM precipitation naphtha (**Warning**—Extremely flammable. Harmful if inhaled. Vapors may cause flash fire) for 1 h.

10. Procedure

10.1 Dry the wick in an oven (**Warning**—Avoid skin contact with exposed hot surfaces by use of protective equipment) at 105°C for 1 h. While still hot, soak the wick in the sample and insert the wick into the wick guide. Rinse the reservoir several times with the sample. Filter the sample through a coarse-textured filter paper, to remove suspended matter and pour 900 mL into the reservoir and assemble the lamp.

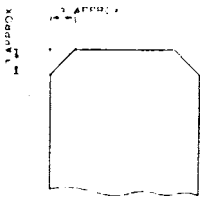
10.2 Hinge back the dome and chimney, and trim the wick carefully with sharp scissors to produce a smooth and symmetrical flame of the standard dimensions shown in Fig. 3.

10.3 Trim the wick as follows: With sharp scissors cut the wick level with the wick guide, raise the wick, and cut a triangular portion from each corner as illustrated in Fig. 4. Round off very slightly the sharp corners produced. Remove



NOTE—All dimensions shown are in millimetres.

FIG. 3 Standard Dimensions for Shape and Size of Flame



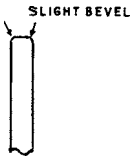
NOTE—All dimensions shown are in millimetres.

FIG. 4 Wick Trimming. Front View of Wick

any ragged projections by slight beveling of the top edges as illustrated in Fig. 5. Be careful not to compress or squeeze the wick with the fingers. Trimming should produce a smooth, symmetrical flame, free of peaks or ears. Check this by lighting the lamp from time to time and inspecting the flame during the trimming operation.

10.4 After the wick is trimmed to yield a flame of standard shape and dimensions, allow the lamp to burn for 0.5 h, extinguish; and trim again, removing any uneven points and charred fiber. Relight the lamp and again check the shape and dimensions of the flame. Extinguish the flame, allow the chimney to cool, wash it with hot water, and dry with a clean lint-free cloth.

10.5 After the wick has been trimmed and the chimney washed, allow the lamp to burn for 0.5 h and readjust the flame to the standard dimensions. At the end of this period weigh the lamp, while burning, to the nearest 1 g on a platform balance. Weigh again after 1 h. If the rate of sample consumption differs from 22 ± 4 g/h, check the flame dimensions and wick condition for further trimming. Normally, the measurement of sample consumption is needed only as a check on standard



NOTE—All dimensions shown are in millimetres.

FIG. 5 Wick Trimming. Side View of Wick

burning conditions, since with the specified flame size and shape, the initial rate of sample consumption will always be within these limits.

10.6 Allow the sample to burn continuously without further adjustment of any kind for the duration of the test, which shall be 16 h (or other specified period) of continuous burning after the first weighing. At the end of this period reweigh to the nearest 1 g and record any changes in height, width, or shape of the flame to the nearest 1 mm.

10.7 Examine the density and color of the chimney deposit.

11. Report

11.1 The report shall include the following:

11.1.1 Average burning rate of the sample to the nearest 1 g/h.

11.1.2 Initial dimensions of the flame to the nearest 1 mm.

11.1.3 Final dimensions of the flame to the nearest 1 mm.

11.1.4 Density of the chimney deposit (none, light, medium, or heavy) and its color (none, white, yellow, or brown).

12. Precision and Bias [6]

12.1 The precision of the test method as determined by statistical examination of interlaboratory results is as follows:

12.1.1 *Repeatability*—The difference between two test results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material, would in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in twenty:

Measurement	Repeatability
Flame height, mm	$(36.2/\bar{X})^3$
Flame width, mm	$(37.8/\bar{X})^3$
Burning rate, g/h	$(26.5/\bar{X})^3$
Chimney deposit color	any difference
Chimney deposit density	any difference

where:

$\bar{X}$ = average of two test results.

12.1.2 *Reproducibility*—The difference between two single and independent results obtained by different operators working in different laboratories on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in twenty:

Measurement	Reproducibility
Flame height, mm	$(42.7/\bar{X})^3$
Flame width, mm	$(45.2/\bar{X})^3$
Burning rate, g/h	$(36.2/\bar{X})^3$
Chimney deposit color	one category
Chimney deposit density	one category

where:

$\bar{X}$ = average of two test results.

12.2 *Bias*—A program to obtain additional data for precision and bias is under discussion. When developed, the additional data will be included.

13. Keywords

13.1 burning quality; kerosine

[6] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report D02-1160.

SUMMARY OF CHANGES

Subcommittee D02.E0.01 has identified the location of selected changes to this standard since the last issue (D187–94(2003)$^{\varepsilon 1}$) that may impact the use of this standard.

(*1*) Added 1.2 on units of measure and renumbered Scope sections.

(*2*) Added IP 10 to Referenced Documents.