Designation: D 1500 – 02

An American National Standard

Designation: 196/97

Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)[1]

This standard is issued under the fixed designation D 1500; 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 visual determination of the color of a wide variety of petroleum products such as lubricating oils, heating oils, diesel fuel oils, and petroleum waxes.

NOTE 1—Test Method D 156 is applicable to refined products that have an ASTM color lighter than 0.5. IP Method 17 includes a procedure for measuring the color of undyed, refined products such as gasoline, white spirit, and kerosine by comparison with a series of IP Standard glasses. It also includes a procedure by which petroleum products, except black oils and bitumens, may be measured for tint and depth of color in terms of Lovibond units by a series of red, yellow, and blue glasses.

1.2 This test method reports results specific to the test method and recorded as "ASTM Color."

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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 155 Test Method for Color of Lubricating Oil and Petrolatum by Means of ASTM Union Colorimeter[2]

D 156 Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)[3]

D 938 Test Method for Congealing Point of Petroleum Waxes, Including Petrolatum[3]

D 2500 Test Method for Cloud Point of Petroleum Products[3]

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products[4]

2.2 *IP Standard:*

IP 17 Color by the Lovibond Tintometer[5]

3. Summary of Test Method

3.1 Using a standard light source, a liquid sample is placed in the test container and compared with colored glass disks ranging in value from 0.5 to 8.0. When an exact match is not found and the sample color falls between two standard colors, the higher of the two colors is reported.

4. Significance and Use

4.1 Determination of the color of petroleum products is used mainly for manufacturing control purposes and is an important quality characteristic since color is readily observed by the user of the product. In some cases the color may serve as an indication of the degree of refinement of the material. When the color range of a particular product is known, a variation outside the established range may indicate possible contamination with another product. However, color is not always a reliable guide to product quality and should not be used indiscriminately in product specifications.

5. Apparatus

5.1 *Colorimeter*, consisting of light source, glass color standards, sample container housing with cover, and viewing piece as listed in Annex A1.

5.2 *Sample Container*—For referee work, use the glass sample jar as shown in Fig. 1. For routine tests, it is permissible to use a cylindrical, clear glass jar with a flat bottom of 30 to 32.4 mm internal diameter and 115 to 125 mm in external height and a wall thickness no greater than 1.6 mm as specified

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.05.0C on Color and Reactivity Color and Reactivity.

Current edition approved Nov. 10, 2002. Published January 2003. Originally approved in 1957. Last previous edition approved in 1998 as D 1500–98.

This is also a standard of the Institute of Petroleum issued under the fixed designation IP 196. The final number indicates the year of last revision. This test method was adopted as a joint ASTM-IP standard in 1966. In the IP, this test method is under the jurisdiction of the Standardization Committee.

[2] *1958 Book of ASTM Standards*, Part 7; see also the compilation of "ASTM Standards on Petroleum Products and Lubricants," October 1959, p. 91.

[3] *Annual Book of ASTM Standards*, Vol 05.01.

[4] *Annual Book of ASTM Standards*, Vol 05.02.

[5] "Methods for Analysis and Testing," available from Institute of Petroleum (IP), 61 New Cavendish St., London, WIG 7AR, U.K.

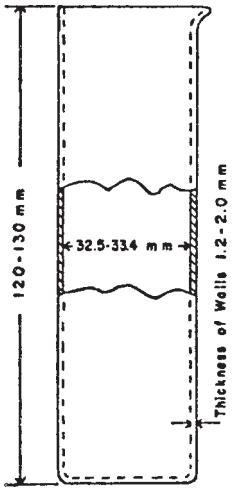

FIG. 1 Standard Glass Sample Jar

in Test Method D 2500, or an ordinary 125-mL oil sample bottle if it meets these requirements.

6. Sampling

6.1 Samples shall be taken in accordance with the instructions in Practice D 4057.

7. Diluent

7.1 *Solvent Kerosene*—(**Warning**—Combustible. Vapor harmful.) Having a color lighter than + 21 Saybolt color by Test Method D 156 or 1.5 by Method B of IP 17, this material is used for diluting dark samples for the test. As an alternative, other solvents, such as white oil or solvent neutral 100 of satisfactory purity that meet the color requirements specified above, are also acceptable.

NOTE 2—Solvent kerosine complies with this requirement if it is lighter in color than potassium dichromate ($K_2Cr_2O_7$) solution formed by dissolving 4.8 mg of pure anhydrous $K_2Cr_2O_7$ in 1 L of distilled water.

8. Preparation of Sample

8.1 *Liquid Petroleum Products such as Lubricating Oils*—Fill the sample container to a depth of 50 mm or more and observe the color. When the sample is not clear, heat it 6°C (10°F) above its cloud point (see Test Method D 2500) and observe the color at that temperature. When the sample is darker than 8 color, mix 15 volumes of sample into 85 volumes of the solvent kerosine and observe the color of the mixture.

8.2 *Petroleum Waxes, Including Petrolatum*—Heat the sample to a temperature 11 to 17°C (20 to 30°F) above its congealing point as determined in accordance with Test Method D 938 and test at that temperature. When the sample is darker than 8 color, mix 15 volumes of melted sample with 85 volumes of solvent kerosine brought to the same temperature and test the mixture at that temperature.

9. Procedure

9.1 Place a sample container or containers, filled to a depth of at least 50 mm with distilled or deionized water in the compartment or compartments, of the colorimeter through which the standard glasses will be observed. Place the sample in its container in the other compartment. (When using a three field comparator this will be the middle compartment.) Cover the containers to exclude all exterior light.

9.2 Switch on the light source and compare the color of the sample with that of the standard glasses. When using a three field comparator the sample must be bracketed by darker and lighter discs or by an exact match and a darker disc. Determine for two field comparators which glass matches the color of the sample; or if an exact match is not possible, then use that glass which possesses the next darker color.

10. Report

10.1 Report as the color of the sample, the designation of the glass producing a matching color, for example; "7.5 ASTM Color."

10.2 If the color of the sample is intermediate between those of two standard glasses, record the designation of the darker glass preceded by the letter "L," for example: "L7.5 ASTM Color." Never report the color as being darker than a given standard except those darker than 8, for example: "D8 ASTM Color."

10.3 If the sample has been diluted with kerosine, report the color of the mixture followed by the abbreviation "Dil," for example: "L7.5 Dil ASTM Color."

11. Precision and Bias [6]

11.1 *Precision*—The precision of this test method as obtained by statistical examination of interlaboratory test results is as follows:

11.1.1 *Repeatability*—The difference between successive 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 value only in one case in twenty: 0.5 color units.

11.1.2 *Reproducibility*—The difference between two single and independent test 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 value only in one case in twenty: 1 color unit.

11.2 *Bias*—The procedure in this test method has no bias because the value of ASTM Color is subjective and can only be defined in terms of this test method.

12. Keywords

12.1 ASTM color; color; petroleum products

[6] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: D02-1234.

ANNEX

(Mandatory Information)

A1. DESCRIPTION OF COLORIMETER AND ASSOCIATED APPARATUS

A1.1 *Colorimeter*—Use an instrument that will illuminate and permit observation of the sample and any one of the color standards (or in the case of a three-field instrument, any two of the color standards) simultaneously, either by direct viewing or with an optical eyepiece.

A1.1.1 A two-field instrument must show two illuminated areas of equal size and shape, one filled with light transmitted by color standard, the other with light transmitted by the sample. These illuminated areas shall be disposed symmetrically about a vertical median line and shall be separated in a horizontal direction so that the horizontal separation of the closest portions subtends the eye of the observer not less than 2° nor more than 3.6°.

A1.1.2 A three-field instrument shall show three illuminated areas in the field of view. Two areas shall be filled with light transmitted by two different color standards, and these shall be disposed symmetrically about the third area which shall be filled with light transmitted by the sample. The rectangular dimensions of each of the three areas shall be the same, and the left and right hand corners of the full field of view shall be rounded with radius not exceeding half the vertical dimension. The illuminated areas shall be separated in a horizontal direction by vertical lines so that the closest portion of the sample area and any one of the color standards illuminated areas subtends the eye of the observer not less than 0.3° nor more than 0.6°.

A1.1.3 Each illuminated area in the two-field instrument shall cover a circle of diameter subtending at least 2.2° and may be enlarged to any size provided that no two illuminated points in the field of view are separated by a distance subtending more than 10°. In the case of the three-field direct viewing instrument, the subtending angles become 2.6° and 6.4° respectively.

A1.1.4 The angle subtended by a line of length d, in a plane perpendicular to the line of sight, and separated from the eye of the observer by a distance D, is given in degrees by 57.3 d/D. The angle subtended by the image of this line, seen by viewing it through an eyepiece of magnification M, is given in degrees by 57.3 Md/D_i, where $D_i$is the distance between the eye of the observer and the plane of the image.

A1.2 *Artificial Daylight Source*—This may be a separate unit or an integral part of the colorimeter where the combined system of a source lamp (A1.2.1), daylight filter glass (A1.3), and flashed opal glass (A1.2.2) are capable of producing spectral characteristics similar to northern daylight (that is, color temperature of 6700 ± 300 K) for use in the test.

NOTE A1.1—When electric current is not available, the colorimeter may be designed to use diffused daylight provided that direct sunlight is avoided. Colored objects should be excluded from the immediate foreground when using diffused DAYLIGHT.

TABLE A1.1 Filter Characteristics

Characteristic	Lamp Color Temperature, K	
	2750	3300
T	0.107 to 0.160	0.075 to 0.125
x	0.314 to 0.330	0.300 to 0.316
y	0.337 to 0.341	0.325 to 0.329
z	0.329 to 0.349	0.355 to 0.375

A1.2.1 *Source Lamp*—Consisting of a lamp of color temperature of approximately 2750 K (or if a quartz halogen lamp is used, approximately 2900 K). A source lamp providing a translucent or opaque diffuse background of 900 ± 100 lx brightness against which the color standards and samples are viewed has been found satisfactory to produce the necessary spectral characteristics. The source lamp shall be designed so that there is no extraneous light interfering with the observation.

A1.2.2 *Flashed Opal Glass*—The background of illuminated opal glass shall be free from glare or shadows.

A1.3 *Filter*—An acceptable daylight filter, which has been used in combination with the artificial daylight source and flashed opal glass to produce the spectral characteristics similar to northern daylight, is one where a spectrometric test indicates a transmittance of radiant energy of not less than 0.60 at 410 nm with a smooth curve down to a transmittance below 0.10 at 700 nm without the pronounced bump that is characteristic of excess cobalt having an increased transmittance at 570 nm above a straight line drawn between the points indicating transmittance at 540 and 590 nm, and also a transmittance band above 660 nm. The transmittance of an acceptable filter shall not, at 570 nm, exceed by more than 0.03 that indicated by a straight line drawn between the points indicating transmittance at 540 and 590 nm, nor shall the transmittance for 700 nm exceed that for any shorter wavelength (such as 660 nm) by more than 0.03.

A1.3.1 An acceptable daylight filter shall also possess such characteristics that the chromaticity coordinates, x, y and z, and luminous transmittance, T, when calculated from the spectral transmittance data using the 1931 CIE Standard Illuminant A[7] shall be as shown in Table A1.1.

A1.4 *Glass Color Standards*—Use color standards as specified in Table A1.2. The standards shall be mounted in such a way that they may be conveniently manipulated. The width of the glass color standards shall not be less than 14 mm.

[7] Judd, Deane B., "The 1931 ICI Standard Observer and Coordinate System for Colorimetry," *Journal of the Optical Society of America*, Vol 23, No. 10, October 1953.