



Standard Test Method for Color of Liquids Using Tristimulus Colorimetry¹

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^{ε1} NOTE—Editorial changes made throughout in March 2000.

1. Scope

1.1 This test method covers an instrumental method for the CIE (Commission International de l'Éclairage) tristimulus measurement of the color of near-clear liquid samples. The measurement is converted to color ratings in the platinum-cobalt system.

1.2 This test method has been found applicable to the color measurement of clear, liquid samples, free of haze, with nominal platinum cobalt color values in the 0 to 30 range. It is applicable to nonfluorescent liquids with light absorption characteristics similar to those of the platinum cobalt color standard solutions. Test Methods D 1686, D 2108, and E 450 deal with the visual and instrumental measurement of near-clear liquids.

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 1193 Specification for Reagent Water²
- D 1209 Test Method for Color of Clear Liquids (Platinum-Cobalt Scale)³
- D 1686 Test Method for Color of Solid Aromatic Hydrocarbons and Related Materials in the Molten State (Platinum-Cobalt Scale)³
- D 1925 Test Method for Yellowness Index of Plastics⁴
- D 2108 Test Method for Color of Halogenated Organic Solvents and Their Admixtures (Platinum-Cobalt Scale)⁵
- D 3437 Practice for Sampling and Handling Liquid Cyclic Products³
- E 179 Guide for Selection of Geometric Conditions for

Measurement of Reflectance and Transmission Properties of Materials⁶

E 308 Practice for Computing the Colors of Objects by Using the CIE System⁶

E 450 Method for Measurement of Color of Low-Colored Clear Liquids Using the Hunterlab Color Difference Meter⁷

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of Test Methods⁸

2.2 Other Document:

OSHA Regulations, 29 CFR, paragraphs 1910.1000 and 1910.1200⁹

3. Summary of Test Method

3.1 Color is measured by tristimulus values of light transmitted by a sample as percent of light transmitted by distilled water. Convert the measured tristimulus values by appropriate equations to the platinum-cobalt scale.

4. Significance and Use

4.1 The major objective of the visual platinum-cobalt (Pt-Co) method of color measurement, as defined in Test Method D 1209, is to rate specific materials for yellowness. This yellowness is frequently the result of the undesirable tendency of liquid hydrocarbons to absorb blue light due to contamination in processing, storage or shipping.

4.2 Clear liquids can be rated for light absorbing yellowish or brownish contaminants, using scales that simulate the long-established visual-comparison method just cited. Where needed, dimensions of color can be reported to identify any pinkness or greenness (one dimension), or grayness.

5. Apparatus

5.1 *Instrument*, with the following provisions:

5.1.1 *Instrument Sensor*, shall provide a beam for illuminating the sample cell in transmission. The instrument shall be capable of converting light measured in total transmission

¹ This test method is under the jurisdiction of ASTM Committee D16 on Aromatic Hydrocarbons and Related Chemicals and is the direct responsibility of Subcommittee D16.04 on Instrumental Analysis.

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² *Annual Book of ASTM Standards*, Vol 11.01.

³ *Annual Book of ASTM Standards*, Vol 06.04.

⁴ *Annual Book of ASTM Standards*, Vol 08.01.

⁵ *Annual Book of ASTM Standards*, Vol 15.05.

⁶ *Annual Book of ASTM Standards*, Vol 06.01.

⁷ Discontinued 1993; see 1992 *Annual Book of ASTM Standards*, Vol. 15.05.

⁸ *Annual Book of ASTM Standards*, Vol 14.02.

⁹ Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

through the sample cell to CIE X Y Z tristimulus color values for the measurement conditions of CIE illuminant C and the CIE 1931 2 degree standard observer as described in Guide E 179 and Practice E 308.

5.1.2 The CIE X Y Z tristimulus color values shall be convertible to the instrumental yellowness index (YI) defined by Test Method D 1925 and Practice E 308. A correlation between measured yellowness index (YI) (Test Method D 1925) values and the Pt-Co standard solutions shall be used to yield an equivalent instrumental Pt-Co rating for liquid hydrocarbon samples.

5.1.3 *Sample Cells*, shall have clear, colorless, parallel entrance and exit windows. Internal distance between faces shall be selectable. Pathlengths from 20 mm to 150 mm have been used for near-clear liquid hydrocarbons. If measuring samples using cells of the same pathlength, a pathlength tolerance of $\pm 3\%$ or less would be appropriate. Matched cells would be beneficial but not required.

6. Reagents

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests.

6.2 *Purity of Water*—References to water shall be understood to mean colorless distilled water, conforming to Type IV of Specification D 1193.

6.3 *Cobalt Chloride*, (CoCl₂·6H₂O).

6.4 *Hydrochloric Acid* (sp gr 1.19)—Concentrated hydrochloric acid (HCl).

6.5 *Potassium Chloroplatinate*, (K₂PtCl₆).

6.6 *Platinum-Cobalt Stock Solution*—Dissolve 1.245 g of potassium chloroplatinate (K₂PtCl₆) and 1.00 g of cobalt chloride (CoCl₂·H₂O) in water. Carefully add 100 mL of hydrochloric acid (HCl sp gr 1.19) and dilute to 1 L with distilled water. The absorbance of the 500 platinum-cobalt stock solution in a cell having a 10-mm light path with distilled water in a matched cell as the reference solution must fall within the limits given in Table 1.

7. Materials

7.1 *Platinum-Cobalt Standards*—From the stock solution prepare color standards in accordance with Table 2 by diluting the required volumes to 100 mL with water in volumetric flasks. When properly sealed and stored these standards are stable for at least one year.

8. Hazards

8.1 Consult current OSHA regulations, suppliers' Material Safety Data Sheets, and local regulations for all materials used in this test method.

9. Sampling and Handling

9.1 Refer to Practice D 3437 for proper sampling and

TABLE 1 Absorbance Tolerance Limits for No. 500 Platinum-Cobalt Stock Solution

Wavelength	Absorbance
430	0.110 to 0.120
455	0.130 to 0.145
480	0.105 to 0.120
510	0.055 to 0.065

TABLE 2 Platinum-Cobalt Color Standards

Color Standard Number	Stock Solution, mL	Color Standard Number	Stock Solution mL
1	0.20	10	2.00
2	0.40	11	2.20
3	0.60	12	2.40
4	0.80	13	2.60
5	1.00	14	2.80
6	1.20	15	3.00
7	1.40	20	4.00
8	1.60	25	5.00
9	1.80	30	6.00

handling of liquid hydrocarbons analyzed by this test method.

10. Calibration

10.1 Prepare instrument for operation by following the instrument manufacturer's instructions.

10.2 Use instrument standardizing adjustments or program to obtain a Pt-Co value of 0 for a sample of distilled water.

10.3 Measured on a regular basis an intermediate Pt-Co standard solution in the Pt-Co range of the samples being analyzed, would verify instrumental performance. It is desirable for the user to be able to adjust the instrument to match the Pt-Co standard solutions as defined in 7.1.

11. Procedure

11.1 Check to be sure that the instrument is operating in accordance with the manufacturer's operations manual.

11.2 Take three (3) instrumental readings without sample replacement, with the average taken as being a representative Pt-Co measurement of the sample. Exercise care to avoid sample contamination.

12. Report

12.1 Report the following information:

12.1.1 Sample identification, and

12.1.2 Instrumental Pt-Co measurement to nearest whole unit.

13. Precision and Bias ¹⁰

13.1 *Precision*—The data for determining the precision of this test method are based on the analyses of o-xylene, styrene, and toluene at approximate values of 4, 8 and 12 respectively. Solutions prepared at levels of approximately 5, 10, 15 and 25 Pt-Co units were also included in the round robin.

13.2 Under the guidelines of Practice E 691, the following criteria should be used to judge the acceptability (95 % probability) of results obtained by this test method. The criteria were derived from a round robin between ten laboratories. Each one of the seven samples was run on two different days in each laboratory.

13.2.1 *Intermediate Precision (formerly called Repeatability)*—Two single test results obtained from the same laboratory should not be considered suspect unless they differ by more than 0.9 Pt-Co units.

¹⁰ Supporting data are available from ASTM International Headquarters. Request RR:D16-1012.

13.2.2 *Reproducibility*—Two single test results obtained from different laboratories should not be considered suspect unless they differ by more than 2.0 Pt-Co units.

13.3 *Bias*—The bias of this test method cannot be determined because no referee method is available to determine the true value.

14. Keywords

14.1 color; hydrocarbons; platinum-cobalt; tristimulus

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