Designation: D 5386 – 04

Standard Test Method for Color of Liquids Using Tristimulus Colorimetry[1]

This standard is issued under the fixed designation D 5386; 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.

1. Scope*

1.1 This test method covers an instrumental method for the CIE (Commission International de l'Eclairage) 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:* [2]

D 1193 Specification for Reagent Water

D 1209 Test Method for Color of Clear Liquids (Platinum-Cobalt Scale)

D 1686 Test Method for Color of Solid Aromatic Hydrocarbons and Related Materials in the Molten State (Platinum-Cobalt Scale)

D 2108 Test Method for Color of Halogenated Organic Solvents and Their Admixtures (Platinum-Cobalt Scale)

D 3437 Practice for Sampling and Handling Liquid Cyclic Products

E 179 Guide for Selection of Geometric Conditions for Measurement of Reflection and Transmission Properties of Materials

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

E 313 Practice for Calculating Yellowness and Whiteness Indices from Instrumentally Measured Color Coordinates

E 450 Method for Measurement of Color of Low-Colored Clear Liquids Using the Hunterlab Color Difference Meter[3]

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

2.2 *Other Document:*

OSHA Regulations, 29 CFR, paragraphs 1910.1000 and 1910.1200[4]

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 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.

[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] 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] Withdrawn.

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

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

5.1.2 The CIE X Y Z tristimulus color values shall be convertible to the instrumental yellowness index (YI) defined by Practice E 308 and Practice E 313. A correlation between measured yellowness index (YI) (Practice E 313) 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 ±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*, ($CoCl_2 \cdot 6H_2O$).

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

6.5 *Potassium Chloroplatinate*, (K_2PtCl_6).

6.6 *Platinum-Cobalt Stock Solution*—Dissolve 1.245 g of potassium chloroplatinate (K_2PtCl_6) and 1.00 g of cobalt chloride ($CoCl_2$ H_2O) 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 handling of liquid hydrocarbons analyzed by this test method.

10. Calibration

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

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

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 [5]

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.

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.

[5] Supporting data are available from ASTM International Headquarters. Request RR:D16-1012.

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

SUMMARY OF CHANGES

Committee D16.04 has identified the location of selected changes to this standard since the last issue (D 5386 – 93b (2000)$^{\epsilon 1}$) that may impact the use of this standard.

(1) Removed Test Method D 1925 from 2.1 and replaced with Practice E 313.

(2) Updated 5.1.2 to reference Practice E 313 in place of Test Method D 1925.