Designation: D1209 – 05 (Reapproved 2011)

Standard Test Method for Color of Clear Liquids (Platinum-Cobalt Scale)[1]

This standard is issued under the fixed designation D1209; 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 describes a procedure for the visual measurement of the color of essentially light colored liquids (Note 1). It is applicable only to materials in which the color-producing bodies present have light absorption characteristics nearly identical with those of the platinum-cobalt color standards used.

NOTE 1—A procedure for estimating color of darker liquids, described for soluble nitrocellulose base solutions, is given in Guide D365.

1.2 For purposes of determining conformance of an observed or a calculated value using this test method to relevant specifications, test result(s) shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specification limit, in accordance with the rounding-off method of Practice E29.

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

1.4 For specific hazard information, see the Material Safety Data Sheet.

1.5 *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.* For specific hazard statements see Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D156 Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)

D365 Guide for Soluble Nitrocellulose Base Solutions

D1193 Specification for Reagent Water

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E202 Test Methods for Analysis of Ethylene Glycols and Propylene Glycols

E346 Test Methods for Analysis of Methanol

3. Significance and Use

3.1 The property of color of a solvent varies in importance with the application for which it is intended, the amount of color that can be tolerated being dependent on the color characteristics of the material in which it is used. The paint, varnish, and lacquer solvents, or diluents commercially available on today's market normally have little or no color. The presence or absence of color in such material is an indication of the degree of refinement to which the solvent has been subjected or of the cleanliness of the shipping or storage container in which it is handled, or both.

3.2 For a number of years the term "water-white" was considered sufficient as a measurement of solvent color. Several expressions for defining "water-white" gradually appeared and it became evident that a more precise color standard was needed. This was accomplished in 1952 with the adoption of Test Method D1209 using the platinum-cobalt scale. This test method is similar to the description given in *Standard Methods for the Examination of Water and Waste Water*[3] and is referred to by many as "APHA Color." The preparation of these platinum-cobalt color standards was originally described by A. Hazen in the *American Chemical Journal*[4] in which he assigned the number 5 (parts per ten thousand) to his platinum-cobalt stock solution. Subsequently, in their first edition (1905) of Standard Methods for the Examination of Water, the American Public Health Association, using exactly the same concentration of reagents, assigned the color designation 500 (parts per million) which is the same ratio. The parts per million nomenclature is not used since color is not referred

[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.35 on Solvents, Plasticizers, and Chemical Intermediates.

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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] *Standard Methods for the Examination of Water and Waste Water*, M. Franson, Ed., American Public Health Assoc., 14th ed., 1975, p. 65 .

[4] Hazen, A., "New Color Standard for Natural Waters," *American Chemical Journal*, Vol XIV, 1892, p. 300–310.

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

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

Wavelength, nm	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
5	1	70	14
10	2	100	20
15	3	150	30
20	4	200	40
25	5	250	50
30	6	300	60
35	7	350	70
40	8	400	80
50	10	450	90
60	12	500	100[A]

[A] This is platinum-cobalt color No. 10 in Guide D365.

TABLE 3 Platinum-Cobalt Color Standards for Very Light Colors

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

directly to a weight relationship. It is therefore recommended that the incorrect term "Hazen Color" should not be used. Also, because it refers primarily to water, the term "APHA Color" is undesirable. The recommended nomenclature for referring to the color of organic liquids is "Platinum-Cobalt Color, Test Method D1209."

3.3 The petroleum industry uses the Saybolt colorimeter Test Method D156 for measuring and defining the color of hydrocarbon solvents; however, this system of color measurement is not commonly employed outside of the petroleum industry. It has been reported by various sources that a Saybolt color of +25 is equivalent to 25 in the platinum-cobalt system or to colors produced by masses of potassium dichromate ranging between 4.8 and 5.6 mg dissolved in 1 L of distilled water. Because of the differences in the spectral characteristics of the several color systems being compared and the subjective manner in which the measurements are made, exact equivalencies are difficult to obtain.

4. Apparatus

4.1 *Spectrophotometer,* equipped for liquid samples and for measurements in the visible region.

NOTE 2—The spectrophotometer used must be clean and in first-class operating condition. The instrument should be calibrated in accordance with the instructions given in the Standards for Checking the Calibration of Spectrophotometers (200 to 1000 nm).[5]

4.2 *Spectrophotometer Cells,* matched having a 10-mm light path.

4.3 *Color Comparison Tubes*—Matched 100-mL, tall-form Nessler tubes, provided with ground-on, optically clear, glass caps. Tubes should be selected so that the height of the 100-mL graduation mark is 275 to 295 mm above the bottom of the tube.

4.4 *Color Comparator*—A color comparator constructed to permit visual comparison of light transmitted through tall-form, 100-mL Nessler tubes in the direction of their longitudinal axes. The comparator should be constructed so that white light is passed through or reflected off a white glass plate and directed with equal intensity through the tubes, and should be shielded so that no light enters the tubes from the side.[6]

5. Reagents

5.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[7] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

5.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water conforming to Type IV of Specification D1193.

5.3 *Cobalt Chloride* ($CoCl_2 \cdot 6H_2O$).

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

5.5 *Potassium Chloroplatinate* (K_2PtCl_6).

6. Platinum-Cobalt Reference Standards

6.1 *Platinum-Cobalt Stock Solution*— Dissolve 1.245 g of potassium chloroplatinate (K_2PtCl_6) and 1.00 g of cobalt chloride ($CoCl_2 \cdot 6H_2O$) in water. Carefully add 100 mL of hydrochloric acid (HCl, sp gr 1.19) and dilute to 1 L with water. The absorbance of the 500 platinum-cobalt stock solution in a cell having a 10-mm light path, with reagent water in a matched cell as the reference solution,[8] must fall within the limits given in Table 1.

[5] See NIST Letter Circular LC-1017.

[6] The sole source of supply of the unit known to the committee at this time is Scientific Glass and Instruments, Inc., P.O. Box 6, Houston, TX 77001. 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.

[7] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals,* BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary,* U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

[8] See the manufacturer's instruction manual for complete details for operating the spectrophotometer.

TABLE 4 Precision Values for Greater than 25 Pt-Co Color

Color (Pt-Co units)	Repeatability, *r*	Reproducibility, *R*
25	3	10
75	5	15
165	7	22
265	10	31
385	13	41
475	16	49

NOTE 3—This stock solution is commercially available from reputable chemical suppliers.

6.2 *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 the Nessler tubes. Cap the tubes and seal the caps with shellac or a waterproof cement. When properly sealed and stored, these standards are stable for at least 1 year and do not degrade markedly for 2 years.[9]

6.2.1 For a more precise measurement of light colors below 15 platinum-cobalt, prepare color standards from the stock solution in accordance with Table 3 by diluting the required volumes to 100 mL with water in the Nessler tubes. Use a semi-microburet for measuring the required amount of stock solution.

7. Procedure

7.1 Introduce 100 mL of specimen into a Nessler tube, passing the specimen through a filter if it has any visible turbidity. Cap the tube, place in the comparator, and compare with the standards.

8. Report

8.1 Report as the color the number of the standard that most nearly matches the specimen. In the event that the color lies midway between two standards, report the darker of the two.

8.2 If, owing to differences in hue between the specimen and the standards, a definite match cannot be obtained, report the range over which an apparent match is obtained, and report the material as "off-hue."

9. Precision

9.1 *Color Samples with Pt-Co Color Greater than 25*[10]*:*

9.1.1 These precision statements are based upon an interlaboratory study in which six platinum-cobalt standards having values of 25, 75, 170, 265, 385, and 475 were prepared in accordance with the instructions given in Section 6 of this test method and were given coded labels. These solutions were tested by one analyst in each of ten different laboratories making a single observation on one day and then repeating the observation on a second day. The analysts were requested to estimate the color to the nearest one unit for solutions below 40 platinum-cobalt, to the nearest five units for solutions between 40 and 100 platinum-cobalt and to the nearest ten units for solutions above 100 platinum-cobalt. Based on the results of this interlaboratory study, the following criteria, calculated according to RR-D02-1007, should be used for judging the acceptability of results at the 95 % confidence level when the results are obtained under optimum conditions where the hue of the sample matches exactly the hue of the standards. Poor precision will be obtained in varying degrees as the hue of the sample departs from that of the standards.

9.1.1.1 *Repeatability*—Two results, obtained by the same analyst should be considered suspect if they differ by more than:

$$r = 0.027\ (X + 92)\ \text{platinum-cobalt units}$$

where X is the average of the two results.

9.1.1.2 *Reproducibility*—Two results, obtained by analysts in different laboratories, should be considered suspect if they differ by more than: $R = 0.087\ (X + 92)$ platinum-cobalt units where X is the average of the two results.

9.1.1.3 Table 4 shows precision values for samples with Pt-Co Color of greater than 25.

9.2 *Color Samples with Pt-Co Color Less than 25*[11]*:*

9.2.1 The results of two interlaboratory studies were pooled to give precision values calculated according to RR-D02-1007. One study of glycols included 4 samples and 7 laboratories; the other study included 5 samples and 6 laboratories. Based on the pooled repeatability and reproducibility standard deviations, the following criteria should be used for judging, at the 95 % confidence level, the acceptability of results obtained on samples with less than 25 Pt-Co Color.

9.2.1.1 *Reapeatability*—Two results, each the mean of duplicates, obtained by the same operator on different days should be considered suspect if they differ by more than two platinum-colbalt units.

9.2.1.2 *Reproducibility*—Two results, each the mean of duplicates, obtained by operators in different laboratories, should be considered suspect of they differ by more than seven platinum-cobalt units.

9.3 *Bias*—The test procedure has no bias because the value of the test result is defined only in terms of the test method.

10. Keywords

10.1 clear liquids; color; platinum-cobalt color scale

[9] Scharf, W. W., Ferber, K. H., and White, R. G., "Stability of Platinum-Cobalt Color Standards," *Materials Research and Standards*, Vol 6, No. 6, June 1966, pp. 302 –304.

[10] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Reports RR:D01-1024 and RR:D02-1007.

[11] These precision statements are based on interlaboratory studies conducted by Committee E15 on Industrial Chemicals on samples of ethylene glycol and methanol as reported in Test Methods E202, E346, and Research Reports RR:E15-0028 and RR:D01-1108. Research reports are available from ASTM International.

SUMMARY OF CHANGES

Committee D01.35 has identified the location of selected changes to this standard since the last issue (D1209 – 00) that may impact the use of this standard.

(1) Added reference to Practice E29 in 1.2 of the Scope section.
(2) Added Practice E29 to list of Referenced Documents.
(3) Removed self-reference in Section 2.