

Standardized Guidelines and Information regarding photometric Color measurement

The photometric colorimetry is like the turbidimetry an important parameter for the assessment of quality of liquids. Several different standards are published to guarantee the comparability of the measured values and to fit the requirements of the different applications. This page contains some information's regarding the most common color standards.

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APHA- color

DIN ISO 6271, ASTM D 1209

The American Public Health Association (APHA) published several testing methods for water, waste water and chemistry, so among to other things as well a procedure to measure yellow hues in liquids. The method is based on the optical comparison of the liquid with a platinum cobalt reference solution. Today the Platinum/cobalt color also named APHA color is one of the mostcommon standards for the color measurement of liquids. The third name "Hazen color" is as well very common, since the color values are typically measured in Hazen units and/or in mg/l Pt.

The standard ISO 2211 was published in the year 1973 (measurement of the color in Hazen units according to the platinum cobalt scale) and replaced the outdated DIN 53409 from the year 1967. The specifications in the standard ISO 2211 was still to imprecisely to fit the requirements of many industrial applications and and became therefore replaced 1981 by the more precise DIN ISO 6271.

[APHA \(American Public Health Association\) homepage](#)

[DIN \(deutsches Institut für Normung\) homepage](#)

[ISO \(International Organization for Standardization\) homepage](#)

Spectral absorption measurement (extinction), calibration standard with 500 mg/l Pt/Co 500 (500 Hazen)

Wavelength 430nm / optical path length 10mm	Extinction: 0,115
Wavelength 455nm / optical path length 10mm	Extinction: 0,135
Wavelength 480nm / optical path length 10mm	Extinction: 0,115
Wavelength 510nm / optical path length 10mm	Extinction: 0,06

Please take notice:

The Pt/Co calibration liquid can cause a chemical reaction with the nickel of a stainless steel flowcell during the calibration procedure of an inline- photometer. The calibration liquid will lose/change its color during this reaction.

Production of a calibration standard with 500 mg/l Pt/Co (500 Hazen)

Dissolve 1.245 g potassium hexachloroplatinate and 1.000 g cobalt (II) - chloride hexahydrate in 100 ml high concentrated chemically pure hydrochloric acid (d=1.19) (warm up if necessary). Dilute by using distilled water until you reach a total volume of 1 liter. Please make sure, these work has to be done in laboratories by qualified persons only, considering the safety requirements. Please take notice to the safety instructions before handling the APHA calibration liquid.

[Safety instructions Pt/Co- calibration liquid \(German language\)](#)

ASTM- Color

ASTM International (ASTM – American Society for Testing and Materials) is an international standardization organization with headquarter in the USA. It publishes technical standards for goods and services.

ASTM was founded 1898 by a group by scientists and engineers under the direction of Charles Benjamin Dudley. There were more than 12,000 ASTM standards published until the year 2005. Color scales such as Gardener-, Saybolt-, or Rosin are as well fixed in the ASTM standards. Some other institutions like e.g. the Institute OF petroleum (IP) or the Malaysian Standards for test of palm oils (MS) have published comparable specifications.

American Society for Testing and Materials [ASTM homepage](#)

Institute of Petroleum [IP homepage](#)

Malaysian Standards for test of palm oils: MS / Homepage: [Malaysian palm oil board](#)

International Organization for Standardization: [ISO homepage](#)

ASTM D1500

ASTM D 1500, ASTM D 6045, ISO 2049, IP196

The ASTM D 1500 color is used for petro chemical products and will be specified by using 16 glass standards with defined transmission and chromatic. The graduation of the standard glasses is 0,5 ASTM and starts with 0.5 ASTM for the brightest color and ends with 8.0 ASTM for the darkest color. The ASTM D 1500 standard is typically used as quality parameter for products such as lubricating oil, fuel oil, diesel or paraffin.

Saybolt Color

ASTM D 156, ASTM D 6045

The Saybolt color is e.g. used for the measurement of light dyed petro chemical products lower than a color of 0,6 ASTM (according ASTM D 1500) like aviation fuel, kerosene, etc. The scaling starts with -16 Saybolt (darkly) to +30 Saybolt (light) whereby the color is derived by the column height of the sample in visual comparison with three standardized glass standards.

Gardner Color

ASTM D 1544, ASTM D 6166, DIN EN ISO 4630-1, MS 817 Part 10

The Gardener color covers a range of light yellow to red and will be specified by using glass standards with defined transmission and chromatic. The glass standards have numbers from 1 to 18, whereby 1 represents the brightest color and 18 the darkest color. The DIN EN ISO 4630 defines the Gardener colors 1-8 by using potassium Chloroplatinate suspensions and the colors 9-18 by using iron (III) - chloride, cobalt (II) - chloride and hydrochloric acid suspensions. The Gardener color is used as quality parameter for chemicals, oils and resins. The disadvantage is the large color jump from 8 Gardener to 9 Gardener.

Rosin Color

ASTM D 509

The Rosin color is probably the most common method to determine the color quality of resins. The common scaling contains 15 color standards in colors from yellow to reddish- orange. A letter combination is assigned to each colored glass - XC (brightest color), XB, XA, X, WW, WG, N, M, K, I, H, G, F, E, D (darkest). FF is an additional color glass specially used for the resins of dark woods. The dyed glass standards are installed in cubes to allow the direct comparison with resin samples.

EBC

The European Brewery Convention was founded in 1947 and supports the brew-scientific activities in Europe. The goal of the EBC is, the development of analytic methods to guarantee beer quality and to ensure a continuously high quality of raw materials and brewing procedures. Parameter like turbidity, color and the bitter value of beer are measured in EBC units. The current technology and engineering forum has been founded in 1990 by the EBC, with the task to develop simple technical procedures to optimize production and quality management in malt-houses and breweries. The successful work has caused the standardization of many processes as well as the optimization of the hygienic design of process equipment and therefore a rising product quality.

EBC Color

The color is an important parameter for the quality control of beer and wort during the brewing procedure. The light absorption is measured at a wavelength of 430nm (MEBAK 2.16.2, EBC 9,4) to determine the color of beer and wort. The laboratory method requires filtered samples with a turbidity of less than 1 EBC. Afterwards, the absorption (430nm) is measured in a 10mm cuvette. The sample diluted, until the absorption is below 2 extinction units (E430) if necessary. Finally the EBC color is calculated as follow:

EBC color = E430 x 25 x dilution factor

European Brewery Convention [EBC homepage](#)

Mitteleuropäische Brautechnische Analysenkommission

Central European brew-technical analysis commission [MEBAK homepage](#)

ASBC Farbzahl

American Society of Brewing Chemists [ASBC homepage](#)

The ASBC is like the EBC a publisher of standard procedures in the brew industry. The ASBC color can be derived directly from the EBC color: $1ASBC = 0,375 EBC \text{ color} + 0.46$. Today the EBC color is more typically used in the international breweries.

Lovibond®

AOCS Cc 13e, AOCS Cc 13j, ISO 15305, MS 252: Part 16, IP 17 Method A

American Oil Chemists Society [AOCS homepage](#)

International Organization for Standardization: [ISO homepage](#)

Malaysian Standards for test of palm oils: MS / Homepage: [Malaysian palm oil board](#)

Institute of Petroleum [IP homepage](#)

The Lovibond color is based on the comparison of 84 glass standards with different optical densities (neutral density N) and colors (Red, Yellow, Blue). The colored glasses are graduated from light tinted to fully colored. The color filters (R, Y, B) and the neutral density filters (N) will be combined until color and brightness fits with the product sample. The result is a set of RYBN of glasses which defines the Lovibond® color (RYBN units). Almost any color can be determined by using this procedure, since millions of filter combinations are possible. Major applications are the color definition of vegetable oils and fats, chemicals or pharmaceutical products.

The Lovibond color of vegetable oil is measured as well by using a photometric method. The typical application is the measurement of a specific red lovibond color and a specific lovibond yellow color of oil. The measurement results will be shown as numeric values.

Typical measurement ranges are:

0-5-20 Lovibond red

0-10-50 Lovibond yellow

ICUMSA Color

ICUMSA GS1-7, ICUMSA GS2/3-9

ICUMSA - International Commission for Uniform Method's of Sugar Analysis

[ICUMSA homepage](#)

The ICUMSA describes a photometric method for the colorimetric measurement of filtered sugar suspensions. These ICUMSA color standard is the quality parameter for the purity of sugar in solved form. The transmission of the sample is measured at specific sugar concentration (Brix value). The measurement wavelength is specified with 420nm for white and light colored sugar, and with 560nm for dark sugar. The ICUMSA color is measured in RBU. As lower the ICUMSA value in RBU, as whiter the sugar.

Example:

Sugar with an ICUMSA value of 46 RBU is a perfect white sugar of highest quality.

Sugar with an ICUMSA value of 150 RBU is a darker sugars with lower quality.

SAC_{436nm}

DIN EN ISO 7887-3

The SAC value - Spectral Absorption Coefficient describes the yellow coloring of potable-, used- or wastewater.

The measuring range is indicated in m-1.

(Extinction per meter optical path length [Ext/m]).

The unit is typically used in different water treatment processes.

Other Color Standards

Color evaluation according DAB 1996

DAB = deutsches Arzneibuch (German pharmacopeia)

Purity requirements of the German pharmacopeia

The German pharmacopoeia publishes standards, which supplement the European pharmacopeia. It contains e.g. standards for analysis methods or for the dealing of drugs, which are not common in all states of the European community. The European pharmacopeia specifies the definitions which are common in all states of Europe, or which require an uniform regulation.

Klett- Color (Cosmetic industry, raw material evaluation)

Hess- Ives Color (Cosmetic industry, color evaluation of fat derivatives)

Photometric measurement units

(Direct light measurement)

These photometric units are not based on comparative calibration standards. Transmission values as well as absorption values are derived directly by the light intensity.

The transmission defines in the physics the permeability of a substance with regard to waves. These waves can be e.g. acoustic waves or electromagnetic waves like IR, VIS, UV light etc..

A photometer will show a measurement value of 100% transmission in case 100% of the radiated light is detected by the receiver optics. If the light intensity (e.g. caused by turbidity in the product sample) halves itself, then also the transmission value halves itself to 50%.

The absorption is calculated by the logarithm of the reciprocal value of the transmission and describes, like the transmission, the attenuation of the radiated waves caused by substances. The measured absorption values correspond normally to the Lambert Beer law and will be proportional to the optical path length and to the quantity of the absorbing substances (concentration proportional).

Photometric units:

% (Percent transmission)

A* (Spectral Absorption value)

* The spectral absorption value is as well known as:

EXT (Extinction)

CU (Concentration Unit)

AU (Absorption Unit)

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