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**Binders for paints and varnishes —  
Estimation of colour of clear liquids  
by the Gardner colour scale**

*Liants pour peintures et vernis — Évaluation de la couleur des liquides non opaques au moyen de l'échelle Gardner*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 4630 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 10, *Test methods for binders for paints and varnishes*.

This second edition cancels and replaces the first edition (ISO 4630:1981), which has been technically revised. The main change is that liquid standards are now used as reference standards rather than the glass standards used previously.

Annexes A and B form an integral part of this International Standard.

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# Binders for paints and varnishes — Estimation of colour of clear liquids by the Gardner colour scale

## 1 Scope

This International Standard specifies a method for estimating, by means of the Gardner colour scale, the colour of clear liquids used as binders for paints and varnishes.

It is applicable to drying oils, varnishes and solutions of fatty acids, polymerized fatty acids and resins. Its applicability to other materials has not been established.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 842:1984, *Raw materials for paints and varnishes — Sampling*.

ISO 3696:1987, *Water for analytical laboratory use — Specifications and test methods*.

CIE Publication No. 15.2, *Colorimetry*.

## 3 Principle

The colour of a sample of the product under examination is viewed in a glass tube of standard diameter and visually compared with the colours of arbitrarily numbered colour standards. The standard that most closely matches the colour of the test sample is identified and the result is expressed in terms of a number on the Gardner colour scale.

## 4 Apparatus and materials

### 4.1 Gardner colour standards

#### 4.1.1 Reference standards

Eighteen liquid standards having chromaticity coordinates and luminous transmittances as specified in table 1 are required as reference standards for calibration.

Before being used, liquid standards shall be checked by the method specified in annex A.

Colour standards that do not conform to the requirements in table 1 shall be rejected.

#### 4.1.2 Working standards

Used as working standards are 18 glass or liquid standards having chromaticity coordinates that differ from those of reference standards by not more than one-third of the difference in  $x$  or  $y$  (see table 1) between adjacent reference standards.

In any one set of working standards, no two standards shall be closer together than two-thirds of the difference in  $x$  or  $y$  between the corresponding reference standards.

The luminous transmittance shall be as specified in table 1.

In case of dispute, only reference standards shall be used.

The standards shall be mounted in such a way that they can be conveniently handled and allow simultaneous viewing of two adjacent standards in the colour comparator (4.3).

When using liquid working standards — coloured solutions contained in glass tubes (4.2) — the reference standards described in 4.1.1 can be used directly.

When glass working standards are used, they shall be checked against liquid reference standards. If the deviation is greater than that specified in the second paragraph of this subclause, change the number of the glass standard to correspond to the number of the nearest reference standard.

NOTE 1 The chromaticity coordinates of glass standards and liquid standards differ slightly. However, the difference does not affect the accuracy of the estimation.

Potassium hexachloroplatinate solutions are used for the lighter standards (1 to 8), and solutions of iron(III) chloride and cobalt(II) chloride in hydrochloric acid are used for the darker standards (9 to 18).

The compositions of the liquid standards are specified in annex B.

**Table 1 — Colour specifications for reference standards**

Gardner colour standard number	Chromaticity coordinates		Luminous transmittance, $Y$ %	Tolerance on transmittance ( $\pm$ ) %
	$x$	$y$		
1	0,317 7	0,330 3	80	7
2	0,323 3	0,335 2	79	7
3	0,332 9	0,345 2	76	6
4	0,343 7	0,364 4	75	5
5	0,355 8	0,384 0	74	4
6	0,376 7	0,406 1	71	4
7	0,404 4	0,435 2	67	4
8	0,420 7	0,449 8	64	4
9	0,434 3	0,464 0	61	4
10	0,450 3	0,476 0	57	4
11	0,484 2	0,481 8	45	4
12	0,507 7	0,463 8	36	5
13	0,539 2	0,445 8	30	6
14	0,564 6	0,427 0	22	6
15	0,585 7	0,408 9	16	2
16	0,604 7	0,392 1	11	1
17	0,629 0	0,370 1	6	1
18	0,647 7	0,352 1	4	1

**4.2 Glass test tubes**, clear, colourless, round, preferably of inside diameter  $(10,65 \pm 0,025)$  mm, outside diameter about 12,5 mm and outside length about 114 mm.

Glass test tubes with an inside diameter of at least 10 mm and not more than 11 mm may also be used. In this case, the results have to be multiplied by the factor  $10,65/d$  where  $d$  is the inside diameter of the test tube.

**4.3 Colour comparator**, providing uniform illumination and permitting simultaneous visual comparison of light transmitted through two colour standards and through a sample in a test tube in the transverse direction.

The apparatus may be of any design but shall have the following characteristics:

#### 4.3.1 Illumination

CIE illuminant C.

#### 4.3.2 Surrounding field

The surrounding field shall not differ significantly in brightness from the samples and standards and shall be essentially achromatic.

#### 4.3.3 Field of view

The field of view shall be wide enough to enable two standards and a test sample to be viewed.

#### 4.3.4 Arrangement of standards and sample

There shall be a perceptible gap between the test sample and each standard, but this shall be as small as possible.

## 5 Sampling

Take a representative sample of the product to be tested, as described in ISO 842.

## 6 Procedure

**6.1** Fill a clean test tube (4.2) to a height of at least 70 mm with a test sample, passing the test sample through a sintered-glass filter if there is any visible turbidity.

**6.2** Place the test tube with the test sample in the sample compartment of the colour comparator (4.3). Switch on the light source and compare simultaneously the colour of the test sample with the colours of two adjacent standards, at a viewing distance of between 30 cm and 50 cm.

**6.3** Determine which standard most closely matches the test sample in colour, ignoring any differences of hue.

## 7 Expression of results

Express the colour of the test sample as the number of the Gardner colour standard most closely matching the colour of the test sample. If more precise colour numbers are needed, report as lighter than, matching or darker than the standard, for example report as 5, 5+, 6- or 6 if the colour of the test sample is between 5 and 6.

## 8 Precision

### 8.1 Repeatability ( $r$ )

The value below which the absolute difference between two single test results obtained on identical material by one operator in one laboratory using the same equipment within a short interval of time, using the standardized test method, may be expected to lie with 95 % probability is 1 colour number.

### 8.2 Reproducibility ( $R$ )

The value below which the absolute difference between two single test results obtained on identical material by operators in different laboratories, using the standardized test method, may be expected to lie with a 95 % probability is 2 colour numbers.

## 9 Test report

The test report shall contain at least the following information:

- a) all details necessary to identify the product examined;
- b) a reference to this International Standard (ISO 4630);
- c) whether glass standards or liquid standards were used;
- d) whether filtering was necessary (see 6.1);
- e) the result of the test as indicated in clause 7;
- f) any deviation from the test method specified;
- g) the date of the test.

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## Annex A (normative)

### Checking Gardner colour standards

**A.1** Select a dual-beam spectrometer with a sufficiently narrow light beam at the sample position so that all rays pass through the standards to be checked. Alternatively, equip the spectrometer with a condensing lens to achieve this.

**A.2** Place the standards in turn in the sample position of the spectrometer. If the colour comparator is provided with a separate green filter in front of the light source, place this filter in the reference beam of the dual-beam spectrometer during calibration of each standard.

**A.3** Obtain spectral transmittance values for each reference standard by following the procedure given in CIE Publication No. 15.2.

**A.4** From the spectral transmittance values for each standard, calculate the CIE tristimulus values  $X$ ,  $Y$ ,  $Z$  and the chromaticity coordinates  $x$ ,  $y$  for CIE illuminant C.

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## Annex B (normative)

### Liquid Gardner colour standards

#### B.1 Reagents

In preparing these standards, use only reagents of recognized analytical grade and only water of at least grade 3 purity as defined in ISO 3696.

##### B.1.1 Hydrochloric acid, diluted 1 + 17.

Mix 1 volume of concentrated hydrochloric acid, 38 % (m/m),  $\rho = 1,19$  g/ml, with 17 volumes of water.

##### B.1.2 Potassium hexachloroplatinate solution.

Dissolve 790 mg of potassium hexachloroplatinate ( $K_2PtCl_6$ ) in dilute hydrochloric acid (B.1.1) in a 100 ml one-mark volumetric flask. Warm the solution until all the potassium hexachloroplatinate has dissolved. Cool to 20 °C, dilute to the mark with the same hydrochloric acid and mix well.

##### B.1.3 Cobalt(II) chloride solution.

Dissolve 40 g of cobalt(II) chloride hexahydrate ( $CoCl_2 \cdot 6H_2O$ ) in 120 g of dilute hydrochloric acid (B.1.1).

##### B.1.4 Iron(III) chloride solution.

Dissolve 1 000 g of iron(III) chloride hexahydrate ( $FeCl_3 \cdot 6H_2O$ ) in 240 g of dilute hydrochloric acid (B.1.1), heating gently if necessary. Adjust the concentration so that the solution has exactly the same colour as a freshly prepared 30 g/l solution of potassium dichromate ( $K_2Cr_2O_7$ ) in concentrated sulfuric acid ( $\rho = 1,84$  g/ml). Determine the colour by spectrometer.

#### B.2 Preparation of liquid colour standards

##### B.2.1 Gardner colour standards 1 to 8

Into each of a series of one-mark volumetric flasks of the capacities indicated in table B.1, transfer from a microburette the volume of potassium hexachloroplatinate solution (B.1.2) shown in table B.1, make each up to the mark with dilute hydrochloric acid (B.1.1) and mix well.

Table B.1 — Composition of Gardner colour standards 1 to 8

Gardner colour standard number	Volume of potassium hexachloroplatinate solution	Volume of volumetric flask
	ml	ml
1	3,48	50
2	5,47	50
3	8,42	50
4	6,58	25
5	9,60	25
6	5,35	10
7	8,10	10
8	10,00	10

### B.2.2 Gardner colour standards 9 to 18

Into a series of 100 ml one-mark volumetric flasks, introduce from burettes the volumes of iron(III) chloride solution (B.1.4) and cobalt(II) chloride solution (B.1.3) shown in table B.2. Make each up to the mark with dilute hydrochloric acid (B.1.1) and mix well.

### B.2.3 Storage

Gardner colour standards are stable for 6 months when stored in the dark but should preferably be prepared immediately before use.

**Table B.2 — Composition of Gardner colour standards 9 to 18**

Gardner colour standard number	Volume of iron(III) chloride solution	Volume of cobalt(II) chloride solution	Volume of hydrochloric acid
	ml	ml	ml
9	3,8	3,0	93,2
10	5,1	3,6	91,3
11	7,5	5,3	87,2
12	10,8	7,6	81,6
13	16,6	10,0	73,4
14	22,2	13,3	64,5
15	29,4	17,6	53,0
16	37,8	22,8	39,4
17	51,3	25,6	23,1
18	100,0	0,0	0,0

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