

1-GP-32a
10 November 1955
CANCELLATION
August 1971.

CANADIAN GOVERNMENT SPECIFICATIONS BOARD

Standard
for

CONVERSION TABLE
for
COLORIMETRIC INSTRUMENTS AND SOLUTIONS

CGSB Conversion Table 1-GP-32a, dated 10 November 1955, is cancelled as of August 1971. The table had become obsolete because of changes in colorimetric measurements, and was of limited use.

1-GP-32a
10 November 1955
AMENDMENT NO. 1
9 March 1956

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In Para. 2.1 add a period after the word "brightness" in the last line, and add the following sentence: "The different scales will have very different spectral transmission curves."



CANADIAN GOVERNMENT SPECIFICATIONS BOARD

① CONVERSION TABLE

FOR

② COLORIMETRIC INSTRUMENTS AND SOLUTIONS

1-GP-32A

10 NOVEMBER 1955

SUPERSEDES 1-GP-32
20 JUNE 1946

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THIS CONVERSION TABLE GIVES THE APPROXIMATE CO-RELATION BETWEEN VARIOUS COMMONLY USED SINGLE DIMENSION COLOR SCALES (TABLE I).

NATIONAL RESEARCH COUNCIL, OTTAWA, CANADA

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* see Acknowledgement page 3

CANADIAN GOVERNMENT SPECIFICATIONS BOARD

CONVERSION TABLE

FOR

COLORIMETRIC INSTRUMENTS AND SOLUTIONS

1. DEFINITION

1.1 This Conversion Table gives the approximate co-relation between various commonly used single-dimension color scales (TABLE I).

2. GENERAL

2.1 As the actual hue of each scale is slightly different from the others (since each was designed for a specific purpose), it must be understood that the relationship shown is an approximation for intensity (saturation) of color only, and does not necessarily refer to hue or brightness transmission curves.

2.2 The relationship shown refers to the color of a given sample when measured according to the procedure appropriate to that method. For example, an oil which has a color of 7 on the Gardner scale in a Gardner tube of 10.75 mm. diameter, should in normal circumstances show an approximate color of 2 on the ASTM scale when transferred to the ASTM standard sample bottle, which has a diameter of 33 mm.

2.3 As not all solutions follow the popular interpretation of the Beer-Lamert laws, there will be occasions when the relationship shown does not hold, as some solutions will behave anomalously and not conform when transferred from one depth to another.

2.4 The systems shown in TABLE I are explained in more detail in the following paragraphs. Tables showing their colorimetric value in terms of Lovibond equivalents have been added.

3. LOVIBOND EQUIVALENTS

3.1 Gardner Color Standards 1933

3.1.1 In making these standards, solutions of ferric chloride and cobalt chloride in 2 percent hydrochloric acid are mixed in the proportions by volume shown in TABLE I. The ferric chloride solutions contains 5.0 grams $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ and 1.2 grams HCl (2 percent); the cobalt chloride solution contains 1.0 grams $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ and 3.0 grams HCl (2 percent)

3.1.2 The colors are compared in tubes having a diameter of 10.75 mm. similar to the Gardner Holdt Bubble Viscometer tubes, at 27°C (77°F). Determinations between 20°C (68°F) and 30°C (86°F) are substantially correct, and any variation of color at more extreme temperatures is merely temporary and will be restored on return to normal temperature. The Lovibond Analysis of these color standards is given in TABLE II.

3.1.3 Owing to the brightness of the solutions, colorless glasses were placed in front of the rectangular cell containing the sample, so that the same number of colorless glasses were used in the light path of the sample as Lovibond color standards in the other path.

3.2 Gardner Color Standards 1953

3.2.1 In the 1953 Gardner scale, the first 8 standards are made from a solution of potassium chloroplatinate (K_2PtCl_6) in tenth-normal hydrochloric acid, the amounts being shown in TABLE I as grams per litre.

3.2.2 The 1933 standards 9 to 18 remain unchanged.

3.2.3 It is stated by the Gardner Laboratories that the change in composition of standards 1 to 8 has not changed the color, but only improved the stability.

3.3 Potassium Dichromate - Sulfuric Acid

3.3.1 These may be used as temporary standards in the laboratory for reference purposes or check readings. Their concentration has been chosen to match the Gardner Color Standards when compared in 10.75 mm. Gardner Holdt tubes. The solutions should not be heated higher than 50°C (122°F) during preparation, and owing to reduction to green chromic compounds, they should be renewed at frequent intervals. Very pure analytical reagent quality chemicals should be used.

3.4 Iodine Solution

Iodine is used in conjunction with nickel sulphate to give a series of colors closely matching the Gardner Color Standards when compared in 10.75 mm. Gardner Holdt tubes. A stock solution is made by dissolving 1 gram iodine, 27.2 grams nickel sulfate ($NiSO_4 \cdot H_2O$) and 12 grams potassium iodide (KI) in water and making up the volume to 100 ml. Dilution is made on the basis of the iodine content as shown in TABLE I, the upper limit being the maximum limit of color for spar varnish according to British Standard No. 257: Exterior Oil Varnish.

3.5 Union Colorimeter (ASTM)

This instrument is used for color determinations of petroleum products, in accordance with ASTM Procedure D 155: Method of Test for Color of Lubricating Oil and Petrolatum by means of ASTM Union Colorimeter. Glasses are used as standards, the Lovibond Analysis of which is given in TABLE III. The sample is placed in a 33 mm. (1-1/4 inch) diameter tube or bottle for examination.

3.6 U. S. Official Rosin Standards

The U. S. Rosin Scale is frequently quoted in connection with plasticizers and synthetic resins. The samples are cut into 3/4-inch cubes for comparison with the glass standards as specified in ASTM Procedure D 155.

3.7 British Paint Research Station Varnish Scale

This scale is being increasingly quoted in many countries, and is in accordance with British Standard No. 1284: Bleached Lac. The Lovibond equivalents when measured in a 1 cm. cell are given in TABLE IV.

ACKNOWLEDGEMENT

Mr. G. J. Chamberlin, Managing Director, The Tintometer Limited, very kindly supplied data for the Conversion Table. His assistance and co-operation is gratefully acknowledged.

TABLE I
CONVERSION TABLE FOR COLORIMETRIC INSTRUMENTS AND SOLUTIONS

1-CP-32a

Gardner Colour Standards, sample in 10.75 mm. Gardner Holdt tube	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Chemical Composition of Gardner 1933 Standards																		
Fe Liquid ml.	0.13	0.19	0.29	0.43	0.65	1.00	1.7	2.5	3.3	5.1	7.5	10.8	16.6	22.2	29.4	37.8	51.3	100.0
Co Liquid ml.	0.19	0.29	0.43	0.65	0.97	1.3	1.7	2.0	2.6	3.6	5.3	7.6	10.0	13.3	17.6	22.8	25.6	0.0
2% HCl. ml.	99.68	99.52	99.28	98.92	98.35	97.7	96.6	95.5	94.1	91.3	87.2	81.6	73.4	64.5	53.0	39.3	23.1	0.0
Chemical Composition of Gardner 1953 Standards (A.S.T.M. D.154-53 Revised)	0.550	0.865	1.330	2.080	3.035	4.225	5.590	7.185	Unaltered from above									
Potassium Chloroplatinate g. per litre 0.1N HCl.																		
Gardner Standards 1953 Chromaticity Co-ordinates																		
X	0.3190	0.3241	0.3315	0.3433	0.3578	0.3750	0.3927	0.4118	0.4300	0.4490	0.4686	0.4884	0.5095	0.5324	0.5570	0.6060	0.6275	0.6475
Y	0.3271	0.3344	0.3456	0.3632	0.3820	0.4047	0.4235	0.4432	0.4620	0.4775	0.4805	0.4639	0.4451	0.4295	0.4112	0.3933	0.3725	0.3525
Gardner Holdt Colour Standards 1921	1	2	3	4	5	6	7	8	9									
Grams $K_2Cr_2O_7$ per 100 ml. H_2SO_4 (S.G.1.84) measured in 10 mm. rectangular cell or Gardner Holdt tube (see schedule)	0.0039	0.0048	0.0071	0.0112	0.0205	0.0322	0.0384	0.0515	0.0780	0.164	0.250	0.380	0.572	0.753	1.041	1.280	2.220	3.000
Grams I_2 per 100 ml. distilled water (see schedule) measured in 10 mm. cell or Gardner Holdt tube	0.0013	0.0019	0.0024	0.0031	0.0043	0.0072	0.0090	0.0120	0.0204	0.0403	0.0703	0.105	0.133	0.152	0.243	0.344	0.425	0.540
A.S.T.M. Union Colorimeter, sample measured in 33 mm. depth (see schedule)	-1	1+	1-1½	1½	1½-2	1½-2	2+	2-2½	2½	2½-3	3-3½	3½-4	4-4½	4½+	5	6	7-8	8+
U.S. OFFICIAL ROSIN STANDARDS 3/4" cubes										X	W	W	H	K-H	H	G	F-G	F
British Paint Research Station Varnish Scale in 10 mm. cell.	3/8	3/8-1/2	1/2-5/8	3/4	1	1½-1½	1½-1-3/4	1-3/4-2	2½	2½-3	3½	4½	5½-6	6½-6½	7½-7½	7½-8	8½	9

TABLE II

GARDNER COLOR STANDARDS 1933

Matched in a

B. D. H. Pattern Lovibond Tintometer

With White Light Cabinet

Gardner No.	Red	Yellow	Neutral Tint Superimposed over sample (excess brightness of sample)
1	0.1	0.5	-
2	0.2	0.9	-
3	0.3	1.2	-
4	0.4	1.8	-
5	0.5	2.5	-
6	0.6	4.0	-
7	0.7	7.0	-
8	0.9	10.0	-
9	1.0	13.0	-
10	1.7	20.0	0.2
11	3.0	30.0	0.3
12	4.6	40.0	0.5
13	7.0	50.0	0.5
14	9.8	50.0	0.6
15	13.0	50.0	-
16	17.0	60.0	-
17	24.0	90.0	-
18	44.0	90.0	-

TABLE III

GLASS COLOR STANDARDS OF ASTM UNION COLORIMETER

ASTM & NPA Color No.	National Petroleum Association Name	Lovibond Values		
		Red	Yellow	Blue
1	Lily White	0.12	2.4	-
1-1/2	Cream White	0.60	8.0	-
2	Extra Pale	2.5	26.0	-
2-1/2	Extra Lemon Pale	4.6	27.0	-
3	Lemon Pale	6.9	32.0	-
3-1/2	Extra Orange Pale	9.4	45.0	-
4	Orange Pale	14.0	50.0	0.55
4-1/2	Pale	21.0	56.0	0.55
5	Light Red	35.0	93.0	-
6	Dark Red	60.0	60.0	0.55
7	Claret Red	60.0	106.0	1.8
8	--	166.0	64.0	-

TABLE IV

PAINT RESEARCH STATION VARNISH SCALE

Scale No.	Lovibond Values		
	Red	Yellow	Blue
1	0.46	2.0	-
2	1.2	6.0	-
3	1.75	14.75	-
4	3.2	28.6	-
5	5.0	45.2	-
6	7.8	68.4	-
7	11.0	77.5	-
8	16.0	75.0	0.08
9	33.5	22.0	2.3

Correspondence regarding this specification should be addressed to the Secretary, Canadian Government Specifications Board, National Research Council, Ottawa, Canada.