

Central Notations for the Revised ISCC-NBS Color-Name Blocks

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Nickerson and Newhall published, in 1941, the central notations of the original ISCC-NBS (Inter-Society Color Council-National Bureau of Standards) color-name blocks which were used in the preparation of the soil and rock color-name charts. In 1955, the ISCC-NBS color-name blocks were revised to accord more closely with usage in the textile and other fields (NBS Circular 553). The central notations of these revised color-name blocks have been computed and are given in the present paper in tabular form. A color chart showing the central colors of the 267 ISCC-NBS color-name blocks would serve for rapid determination of the ISCC-NBS color designation, especially in field work where speed and ease of operation are more important than high accuracy.

1. Introduction

In 1941 Nickerson and Newhall published a paper [7]¹ entitled Central Notations for ISCC-NBS Color Names based on the first description of the ISCC-NBS method of describing colors published in 1939 [2]. Since then, the ISCC-NBS color-name charts have been revised to accord more closely with usage in the textile and other fields and have been published in 1955 under the title The ISCC-NBS Method of Designating Colors and a Dictionary of Color Names [3]. The present paper contains the central notations of the revised color-name blocks.

2. Computation of Centroids

The color-name blocks into which the color solid has been divided are bounded at top and bottom by planes of constant Munsell value, at two of the sides by planes of constant Munsell hue, and at the other two sides by concentric cylindrical surfaces of constant Munsell chroma. The shape of such a block might be called a sector of a right cylindrical annulus (like a piece of pie with the point bitten off). The simplest such block is thus defined by six limits: two-value, two-hue, and two-chroma limits; the most complicated of these blocks may be broken down into three blocks of this simplest or elementary shape. The general method is to find the centroid of each such block and then find the volume-weighted centroid of the set of one to three such elementary centroids.

The hue and value of such an elementary centroid are simply the averages of the hue and value limits, respectively. The chroma of the centroid is not entirely a function of the chroma limits, but depends on the number of Munsell-hue steps ΔH in the block. Let the cross section of the block at constant Munsell value be laid out in cylindrical coordinates with the radius being Munsell chroma, C , and since there are 100 Munsell-hue steps in the complete hue circuit, the angle $\Delta\theta$ in radians will be given in terms of Munsell hue, H , as $2\pi\Delta H/100$. Further let $H=0$ correspond to the Munsell hue, \bar{H} , of the centroid of the block.

The chroma, \bar{C} , of the centroid [1] is defined as:

$$\bar{C} \equiv \frac{\int_{-\frac{\theta}{2}}^{\frac{\theta}{2}} \int_{C_n}^{C_x} C^2 (\cos \theta) dC d\theta}{\int_{-\frac{\theta}{2}}^{\frac{\theta}{2}} \int_{C_n}^{C_x} C dC d\theta}, \text{ or}$$

$$\bar{C} = \frac{2(C_x^2 + C_x C_n + C_n^2) \sin(\pi\Delta H/100)}{3(C_x + C_n)(\pi\Delta H/100)},$$

where C_x and C_n are the upper and lower chroma limits of the block, respectively.

By this method, the central notation (\bar{H} , \bar{V}/\bar{C}) of an elementary block like moderate red, hue range $1R$ to $7R$, value range from 3.5 to 5.5, and chroma range from 7 to 11, is determined as:

$$\bar{H} = (1R + 7R)/2 = 4R; \quad \bar{V} = (3.5 + 5.5)/2 = 4.5,$$

and

$$\bar{C} = \frac{2(11^2 + 7 \times 11 + 7^2) \sin(6\pi/100)}{3(11 + 7)(6\pi/100)}$$

$$= \frac{2 \times 247 \times 0.1874}{3 \times 18 \times 0.1885} = 9.1$$

The central notation of a compound block, that is, one in which two or more elementary blocks are joined together along common constant-hue planes, such as yellowish white or moderate blue, is found by computing the volume-weighted mean of the central notations of the simple blocks. The centroid of a two-component block, for instance, will lie on the straight line joining the centroids of the component blocks. Therefore, it is necessary to graph the respective centroids on circular graph paper, connect them by a straight line divided inversely according to the two volumes, and read off the hue and chroma of the resultant centroid. For a three-component block, the resultant centroid for two of the adjacent blocks is found and then combined by the same method with the centroid of the third block. The value notation of the resultant centroid is computed as the volume-weighted mean of the value notations of the separate centroids.

¹ Figures in brackets indicate the literature references at the end of this paper.

3. Peripheral Color-Name Blocks

The shape of the psychological color solid may be described as a grossly misshapen grapefruit, set so that the pithy core is vertical with an irregular outer surface or skin, determined by the MacAdam theoretical pigment limits [4]. The bounding surface has been determined in Munsell renotation terms by Nickerson and Newhall [8]. This solid, cut into 267 blocks each with a color name attached, forms the ISCC-NBS system of color names. Now consider the outermost or peripheral blocks, those that extend to the outer surface or skin. These represent colors of maximum saturation, maximum lightness or minimum lightness as determined from the MacAdam limits. These peripheral blocks, of which there are 120, have several simple boundary surfaces (plane and cylindrical) and are closed by the outer complicated curved surface of the color solid. The centroids of these peripheral blocks have been estimated graphically by plotting the MacAdam limits on the color-name charts.

4. Table of Central Notations of Color-Name Blocks

In table 1 the ISCC-NBS color-name blocks are identified by number and name, and the Munsell renotation of each centroid is given. The central notation of each of the 120 peripheral blocks, less certain because it was estimated rather than computed by formula, is marked with an asterisk. The numbers used to identify and order the color designations in table 1 are taken from table 1 of NBS Circular 553 [3]. Thus, for any hue name, the order of modifiers is vivid; brilliant, strong, deep, very deep; very light, light, moderate, dark, very dark; very pale (very light grayish), pale (light grayish), grayish, dark grayish, blackish; -ish white, light -ish gray; -ish gray, dark -ish gray, and -ish black. Not all of these modifiers are required with every hue name, as for instance there is no very dark pink or very pale olive. The notations of the centroids are given to one decimal place except that the value or chroma notations of the centroids of some of the peripheral blocks are given as whole numbers followed by a plus or minus sign, such as 4.5 YR 6.8/16+, indicating uncertainty in the next decimal place.

TABLE 1. Central notations of ISCC-NBS color-name blocks.

C553 number	ISCC-NBS color name	Central notation
1	vivid pink	1.5R 7 /13+*
2	strong pink	1.5R 7.5/9.1*
3	deep pink	1.9R 6.0/11.1
4	light pink	2.5R 8.6/5.2*
5	moderate pink	2.5R 7.2/5.2
6	dark pink	2.5R 6.0/6.0
7	pale pink	2.5R 8.8/2.3*
8	grayish pink	2.5R 7.2/2.3
9	pinkish white	7.6R 9.2/1.0*
10	pinkish gray	7.6R 7.5/1.0

TABLE 1. Central notations of ISCC-NBS color-name blocks.—Continued

C553 number	ISCC-NBS color name	Central notation
11	vivid red	5-R 4 /15+*
12	strong red	4.0R 4.5/12.0
13	deep red	5.0R 2.8/9.9
14	very deep red	5.0R 1.4/9.0*
15	moderate red	4.0R 4.5/9.1
16	dark red	4.5R 2.8/6.8
17	very dark red	3.5R 1.2/4.9*
18	light grayish red	4.9R 6.0/3.4
19	grayish red	4.6R 4.5/4.7
20	dark grayish red	3.5R 2.7/2.2
21	blackish red	3.5R 1.1/1.6*
22	reddish gray	6.5R 5.5/1.1
23	dark reddish gray	6.0R 3.5/1.1
24	reddish black	6.0R 0.9/0.8*
25	vivid yellowish pink	8.0R 7 /13+*
26	strong yellowish pink	8.0R 7.5/9.0*
27	deep yellowish pink	5.6R 6.0/12.4
28	light yellowish pink	0.7YR 8.6/4.8*
29	moderate yellowish pink	0.7YR 7.2/4.8
30	dark yellowish pink	7.0R 6.0/6.0
31	pale yellowish pink	2.1YR 8.8/2.2*
32	grayish yellowish pink	0.5YR 7.2/2.3
33	brownish pink	6.5YR 7.2/2.2
34	vivid reddish orange	9.5+R 5.5/15.5+*
35	strong reddish orange	9.5R 5.5/12.0
36	deep reddish orange	9.5R 4.0/12.0
37	moderate reddish orange	9.5R 5.5/9.1
38	dark reddish orange	9.5R 4.0/9.1
39	grayish reddish orange	0.5YR 5.5/6.0
40	strong reddish brown	0.5YR 3.0/11.2*
41	deep reddish brown	9.8R 1.5+/7.5+*
42	light reddish brown	0.5YR 5.5/4.1
43	moderate reddish brown	9.6R 3.4/5.2
44	dark reddish brown	9.5R 1.3/3.6*
45	light grayish reddish brown	3.0YR 5.5/2.3
46	grayish reddish brown	9.9R 3.4/2.3
47	dark grayish reddish brown	9.5R 2.0/2.0
48	vivid orange	4.5YR 6.6/16+*
49	brilliant orange	4.5YR 8.0/12.1*
50	strong orange	4.5YR 6.5/12.1
51	deep orange	4.5YR 5.0/12.1
52	light orange	4.5YR 8 /8.1*
53	moderate orange	4.6YR 6.5/8.1
54	brownish orange	4.5YR 5.0/8.2
55	strong brown	5.0YR 3.5+/8+*
56	deep brown	5.0YR 2.1/6+*
57	light brown	5.5YR 5.5/4.6
58	moderate brown	5.5YR 3.5/3.9
59	dark brown	5.5YR 1.6/3.6*
60	light grayish brown	6.5YR 5.5/2.2
61	grayish brown	5.6YR 3.5/2.0
62	dark grayish brown	5.5YR 2.0/1.7
63	light brownish gray	6.8YR 5.5/1.0
64	brownish gray	6.4YR 3.5/0.9
65	brownish black	7.5YR 0.8/0.8*
66	vivid orange yellow	9.0YR 7.2/16+*
67	brilliant orange yellow	9.0YR 8.4/12.1*
68	strong orange yellow	9.0YR 7.2/12.1
69	deep orange yellow	9.0YR 6.0/12.1
70	light orange yellow	9.0YR 8.6/8.1*

TABLE 1. Central notations of ISCC-NBS color-name blocks.—Continued

C553 number	ISCC-NBS color name	Central notation
71	moderate orange yellow	9.0YR 7.2/8.1
72	dark orange yellow	9.0YR 6.0/8.1
73	pale orange yellow	9.1YR 8.6/4.4*
74	strong yellowish brown	9.0YR 4.6/9.6*
75	deep yellowish brown	9.5YR 2.9/6+*
76	light yellowish brown	9.2YR 6.6/4.7
77	moderate yellowish brown	9.5YR 4.5/4.0
78	dark yellowish brown	9.5YR 2.2/3.7*
79	light grayish yellowish brown	9.5YR 6.4/2.4
80	grayish yellowish brown	9.5YR 4.6/2.1
81	dark grayish yellow brown	9.5Y R 2.4/1.8
82	vivid yellow	4.0Y 7.8/14.5+*
83	brilliant yellow	4.0Y 8.8/9.5*
84	strong yellow	4.0Y 7.2/9.5
85	deep yellow	4.0Y 6.0/9.5
86	light yellow	4.0Y 8.8/6.6*
87	moderate yellow	4.0Y 7.2/6.6
88	dark yellow	4.0Y 6.0/6.6
89	pale yellow	4.2Y 8.9/3.6*
90	grayish yellow	4.2Y 7.2/3.6
91	dark grayish yellow	4.0Y 6.0/4.1
92	yellowish white	4.1Y 9.2/1.3*
93	yellowish gray	4.1Y 7.5/1.3
94	light olive brown	2.5Y 5.0/8.4*
95	moderate olive brown	2.5Y 3.5+/6+*
96	dark olive brown	2.5Y 1.8/2.5+*
97	vivid greenish yellow	9.5Y 7.8/14.5+*
98	brilliant greenish yellow	9.5Y 8.8/9.5*
99	strong greenish yellow	9.5Y 7.2/9.5
100	deep greenish yellow	9.5Y 6.0/9.5
101	light greenish yellow	9.5Y 8.8/6.6*
102	moderate greenish yellow	9.5Y 7.2/6.6
103	dark greenish yellow	9.5Y 6.0/6.6
104	pale greenish yellow	9.5Y 8.9/4.1*
105	grayish greenish yellow	9.5Y 7.2/4.1
106	light olive	8.1Y 5.1/8.0*
107	moderate olive	8.0Y 3.5+/5.8+*
108	dark olive	8.0Y 1.7/3.2*
109	light grayish olive	8.3Y 5.5/2.4
110	grayish olive	8.1Y 3.5/2.3
111	dark grayish olive	8.0Y 2.0/2.0
112	light olive gray	7.4Y 5.5/1.3
113	olive gray	8.1Y 3.5/1.0
114	olive black	9.0Y 0.9/0.8*
115	vivid yellow green	5.0GY 7.5/14.5+*
116	brilliant yellow green	5.0GY 8.5/9.1*
117	strong yellow green	5.0GY 6.0/9.1
118	deep yellow green	5.0GY 4.0/9.1
119	light yellow green	5.0GY 8.6/5.2*
120	moderate yellow green	5.0GY 6.0/5.2
121	pale yellow green	3.5GY 8.7/2.2*
122	grayish yellow green	4.4GY 6.1/2.2
123	strong olive green	5.0GY 3.2/7.8+*
124	deep olive green	5.0GY 2.4+/7.1+*
125	moderate olive green	5.0GY 3.5/5.2
126	dark olive green	5.0GY 1.8/3.7*
127	grayish olive green	5.0GY 3.5/2.2
128	dark grayish olive green	5.0GY 2.0/2.0
129	vivid yellowish green	0.5G 7 /15.5+*
130	brilliant yellowish green	0.5G 8.0/9.1*

TABLE 1. Central notations of ISCC-NBS color-name blocks.—Continued

C553 number	ISCC-NBS color name	Central notation
131	strong yellowish green	0.5G 5.5/9.1
132	deep yellowish green	0.5G 3.5/11.5+*
133	very deep yellowish green	0.5G 2.0/9.2+*
134	very light yellowish green	0.5G 9.1/5.1*
135	light yellowish green	0.5G 7.5/5.1
136	moderate yellowish green	0.5G 5.5/5.1
137	dark yellowish green	0.5G 3.5/5.1
138	very dark yellowish green	0.5G 1.5/4.9*
139	vivid green	6.5G 5.2/18+*
140	brilliant green	6.0G 7.4/9.1*
141	strong green	6.0G 4.5/9.1
142	deep green	6.0G 2.3/9.1*
143	very light green	6.0G 8.6/5.1*
144	light green	6.0G 6.5/5.1
145	moderate green	6.0G 4.5/5.1
146	dark green	6.0G 2.7/5.0
147	very dark green	6.0G 1.3/4.9*
148	very pale green	9.0G 8.7/1.8*
149	pale green	9.0G 6.5/1.8
150	grayish green	9.0G 4.5/1.8
151	dark grayish green	9.0G 2.8/1.6
152	blackish green	9.0G 1.1/1.4*
153	greenish white	7.0G 9.2/0.8*
154	light greenish gray	7.0G 7.5/0.8
155	greenish gray	7.0G 5.5/0.8
156	dark greenish gray	7.0G 3.5/0.8
157	greenish black	7.5G 0.9/0.7*
158	vivid bluish green	4.5BG 5.3/15.5+*
159	brilliant bluish green	4.5BG 7.3/9.0*
160	strong bluish green	4.5BG 4.5/9.0
161	deep bluish green	4.5BG 2.3/9.0*
162	very light bluish green	4.5BG 8.5/5.0*
163	light bluish green	4.5BG 6.5/5.0
164	moderate bluish green	4.5BG 4.5/5.0
165	dark bluish green	4.5BG 2.7/5.0
166	very dark bluish green	4.5BG 1.3/4.9*
167	vivid greenish blue	4.5B 5.2/13+*
168	brilliant greenish blue	4.5B 6.8/9.0*
169	strong greenish blue	4.5B 4.5/9.0
170	deep greenish blue	4.5B 2.5/9.0*
171	very light greenish blue	4.5B 8.2/5.2*
172	light greenish blue	4.5B 6.5/5.2
173	moderate greenish blue	4.5B 4.5/5.2
174	dark greenish blue	4.5B 2.7/5.0
175	very dark greenish blue	4.5B 1.3/4.9*
176	vivid blue	3.0PB 4.2/15+*
177	brilliant blue	3.0PB 6.4/11.0*
178	strong blue	3.0PB 4.2/11.0
179	deep blue	3.0PB 2.0/9.0*
180	very light blue	2.4PB 8.2/7.2*
181	light blue	2.7PB 6.5/7.3
182	moderate blue	2.9PB 4.2/7.2
183	dark blue	2.8PB 1.7/5.0*
184	very pale blue	0.9PB 8.4/3.0*
185	pale blue	0.9PB 6.5/3.0
186	grayish blue	0.9PB 4.2/3.0
187	dark grayish blue	9.5B 2.6/1.9
188	blackish blue	9.5B 1.1/1.5*
189	bluish white	9.5B 9.1/1.0*
190	light bluish gray	9.5B 7.5/1.0

TABLE 1. Central notations of ISCC-NBS color-name blocks—Continued

C553 number	ISCC-NBS color name	Central notation
191	bluish gray	9.5B 5.5/1.0
192	dark bluish gray	9.5B 3.5/1.0
193	bluish black	9.5B 1.0/0.7*
194	vivid purplish blue	8.0PB 2.5/22+*
195	brilliant purplish blue	8.0PB 6.0/10.8*
196	strong purplish blue	8.0PB 4.1/11.4
197	deep purplish blue	8.0PB 1.6/9.1*
198	very light purplish blue	7. PB 7.8+/6.1+*
199	light purplish blue	7.5PB 6.0/6.8
200	moderate purplish blue	8.0PB 3.5/6.9
201	dark purplish blue	7.9PB 1.1/4.7*
202	very pale purplish blue	7.0PB 8.2/4.1*
203	pale purplish blue	7.0PB 6.0/4.1
204	grayish purplish blue	7.2PB 3.3/4.0
205	vivid violet	1.0P 2.7/21+*
206	brilliant violet	1.0P 5.9/11.1*
207	strong violet	1.0P 3.5/11.1
208	deep violet	1.0P 1.4/10.3*
209	very light violet	1.0P 7.9/7*
210	light violet	1.0P 6.0/7.2
211	moderate violet	1.0P 3.5/7.2
212	dark violet	1.0P 1.3/5.0*
213	very pale violet	1.0P 8.2/4.1*
214	pale violet	1.0P 6.0/4.1
215	grayish violet	1.0P 3.3/4.1
216	vivid purple	6.0P 3.5/20+*
217	brilliant purple	6.0P 6.7/11.1*
218	strong purple	6.0P 4.5/11.1
219	deep purple	6.0P 2.8/10.2
220	very deep purple	6.0P 1.2/10.2*
221	very light purple	6.0P 8.0/7.2*
222	light purple	6.0P 6.5/7.2
223	moderate purple	6.0P 4.5/7.2
224	dark purple	6.0P 2.7/5.1
225	very dark purple	6.0P 1.1/4.9*
226	very pale purple	5.4P 8.4/3.3*
227	pale purple	6.8P 6.4/3.0
228	grayish purple	7.8P 4.5/2.9
229	dark grayish purple	10.0P 2.8/2.0
230	blackish purple	10.0P 1.0/1.4*

5. Applications

For nonborderline colors it is much easier to determine the ISCC-NBS color name from a color chart containing 267 samples, one for each of the central notations of the 267 ISCC-NBS color-name blocks, than it is to determine the Munsell renotation of the color and then to find the ISCC-NBS designation from the color-name charts. In using such a color chart, the observer simply picks out the particular color most closely duplicating that of the specimen to be designated; he does not have to check for conformity to hue, lightness, and saturation limits separately. The production of such a color chart is now under consideration. It should be pointed out, however, that if the specimen color falls about equally near to two or more of the 267 central colors, it would be impossible to determine

TABLE 1. Central notations of ISCC-NBS color-name blocks.—Continued

C553 number	ISCC-NBS color name	Central notations
231	purplish white	9.0P 9.1/1.0*
232	light purplish gray	9.0P 7.5/1.0
233	purplish gray	10.0P 5.5/1.0
234	dark purplish gray	10.0P 3.5/1.0
235	purplish black	10.0P 1.0/0.7*
236	vivid reddish purple	1.0RP 4+/19+*
237	strong reddish purple	1.0RP 4.5/11.1
238	deep reddish purple	1.0RP 2.8/10.3!
239	very deep reddish purple	1.0RP 1.3/10.3*
240	light reddish purple	1.0RP 6.0/7.2
241	moderate reddish purple	1.0RP 4.5/7.2
242	dark reddish purple	1.0RP 2.7/5.1
243	very dark reddish purple	1.0RP 1.1/5.0*
244	pale reddish purple	1.0RP 6.0/4.1
245	grayish reddish purple	1.0RP 4.5/4.1
246	brilliant purplish pink	4.0RP 7.9+/11+*
247	strong purplish pink	4.0RP 7-/14.5*
248	deep purplish pink	4.0RP 6.0/12.0
249	light purplish pink	4.0RP 8.3/7.1*
250	moderate purplish pink	4.0RP 7.0/7.1
251	dark purplish pink	6.0RP 6.0/7.2
252	pale purplish pink	4.0RP 8.5/3.5*
253	grayish purplish pink	4.0RP 7.0/3.5
254	vivid purplish red	7.0RP 4+ /17+*
255	strong purplish red	7.0RP 4.5/11.9
256	deep purplish red	7.0RP 2.8/11.0
257	very deep purplish red	7.0RP 1.3/9.0*
258	moderate purplish red	7.0RP 4.5/9.0
259	dark purplish red	7.0RP 2.7/6.3
260	very dark purplish red	7.0RP 1.2/4.9*
261	light grayish purplish red	7.0RP 6.0/4.0
262	grayish purplish red	7.0RP 4.5/5.2
263	white	3.0Y 9.25/0.06
264	light gray	3.0Y 7.5/0.06
265	medium gray	3.0Y 5.5/0.06
266	dark gray	N 3.5/
267	black	N 1.25/

accurately which ISCC-NBS designation to apply to it. If necessary, such borderline cases would have to be resolved by recourse to the method described in NBS Circular 553 [3].

These central notations have a number of applications. Those published by Nickerson and Newhall [7] were used in designing the color-name charts used in the description of the colors of soils [5] and rocks [6]. In both of these color charts, the Munsell Color Company painted samples representing the central notations of each of the color-name blocks used. Matching to one central color rather than to several limit colors is a less exact but quicker method and was developed for field use where speed and ease of operation are more important than high accuracy.

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6. References

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