

RETURN TO MARSHALL LABORATORY LIBRARY

INDEXED

Ja 28 '55

CC: R. T. Hucks, Parlin
E. T. Breuer, Chicago
R. J. Knake, Toledo
J. D. Pickens, Flint Lab.
F. E. Walter, Ft. Madison
R. A. DeWall, Wilm.
O. H. Bullitt, Exp. Sta., Wilm.
L. G. Glasser, Exp. Sta., Wilm.
W. D. Lawson, Lab.
R. B. Davis, Lab.
Library, Lab. (5)
Patent Section, Lab.
H. F. Ether, Phila.
M. L. Byron, S. San Francisco
R. E. Thomas, Newburgh Lab.

File: 1810

Marshall Laboratory
January 24, 1955

MEMORANDUM REPORT #M-755

PREPARED BY: M. P. MORSE

REFERENCE COPY
NOT FOR CIRCULATION

A COLOR INDEXING SYSTEM BASED ON COLORMASTER COLORIMETER VALUES AND PUNCHED INDEX CARDS

INTRODUCTION:

In attempting to formulate a paint to the color requested by a customer, considerable time can be saved if the chemist can determine quickly if a formula of a paint of approximately this color is already on file. At present, this is handled inadequately by using a Munsell color card index. The disadvantages to the Munsell index are (1) only large color steps are represented, (2) the chips frequently discolor from handling, and (3) their color drifts with age.

In Marshall Laboratory research report #1151, Cameron and Goldman proposed a color indexing system based on instrumental reflectance readings and IBM punched index cards. Their method is useful, but makes no provision for minimizing the effect of changes in reflectance level between instruments or within a single instrument. This report discusses a revision of their proposed method that decreases the effect of instrumental reflectance level changes encountered in Colormaster Colorimeters.

SUMMARY AND CONCLUSIONS:

The color indexing system proposed in Marshall Laboratory research report #1151, has been revised so that it is less susceptible to instrument differences in reflectance level and requires only simple measuring indexing and sorting equipment. G, R and B values

N35506

obtained from the Colormaster Differential Colorimeter are converted to G, m and n color coordinates. These values are punched on McBee Keysort file cards with an inexpensive hand punch.

An index card is prepared for each of the color standards that are in our standards files. When a color chip is submitted to a chemist with a request for a paint matching this color, the G, m and n values of this chip are determined with the colorimeter. The color standards in the files that are the closest match to the chip are located by sorting the card index for the G, m and n values obtained for the chip. An inexpensive hand needle sorter is the only apparatus required to sort the cards.

This method will work equally well for Beckman or G. E. Spectrophotometer readings, if the tristimulus values are converted to color coordinates.

ACTION PROPOSED:

This revised color indexing system will be called to the attention of the Finishes Division Plants Technical organization and the Sales Development Laboratories.

DISCUSSION & EXPERIMENTAL:

A color indexing system using reflectance measurements was proposed in Research Report #1151 by Cameron and Goldman. This system was based on punched IBM cards using Colormaster Colorimeter G, R and B values.

Because we have been unable to adjust all the Colormaster Colorimeters to give identical readings for the same set of standards, the use of filter readings is not adequate for indexing purposes. However, differences in Colorimeter reflectance levels can be minimized by using G, m and n color values, the m and n values being unaffected by a uniform change in the level of G, R and B values. The adoption of this system is also desirable because the color tolerances now being established in the Finishes Division are based on G, m and n values of the Colormaster Colorimeter.

The attached tables show the agreement obtained for six of the Colormaster Differential Colorimeters in use in the F & F Department. Three neutral samples and five saturated colors were used in the comparison tests. The equations used for determining G, m and n are:

$$\begin{aligned}G &= G \\m &= R-G \\n &= G-B\end{aligned}$$

where G, R and B are the green, red and blue filter readings, respectively, of the Colormaster.

It is proposed to use McBee Keysort cards for indexing instead of IBM punched cards because of the less expensive equipment

required. The McBee cards are punched with a hand punch and sorted with a simple needle sorter.

To set up the indexing system, the G, m and n values of all the color standards in our standards file must be determined with a Colormaster Colorimeter and then punched on McBee cards of different colors (e.g., red cards are used for red colors.) Then, when it is desired to determine if our files contain a color close to that of a submitted color chip, the G, m and n values of that chip are determined with the colorimeter and the card index sorted for the standards nearest to its color.

The method for sorting the index for color matches is as follows, using cards made up as that illustrated in the attached figure.

1. If the submitted chip is red, all the red cards in the index file will be assembled and placed on the sorter, top edge up, with the master card placed in front.
2. On top edge of card, insert needle in G hole whose range in value covers the value of the chip.
3. Insert needle in m hole whose range in values covers the m value for the chip.
4. Insert needle in n hole whose range in values covers the n value for the chip.
5. Insert needle in either plus or minus hole for m and another in plus or minus hole for n depending upon the signs of these values for the chip.
6. Let cards drop. If not more than ten cards fall out, no additional sorting is necessary. Obtain the standard color chips corresponding to these cards from the standards file and visually select the best match to the submitted chip.
7. If more than ten cards fall out, take these cards and place them in the sorter with their right edge up.
8. Place a needle in the G hole closest in value to that of the submitted chips. Let cards drop.
9. If more than ten cards fall out, further sorting is necessary.
10. Place fallen cards in the sorter with their bottom edge up.
11. Place needles in the m and n holes closest in value to that of the submitted chip. Let cards drop and obtain the standard color chips corresponding to these cards from the standards files.

12. Visually select the best match to the submitted chip.

MP Morse
M. P. MORSE

MPM:mtm
1/20/55

TABLE I

Porcelain Standard

G Values
Colorimeter Serial Number

Designation	Color	#12	#16	#30	#37	#45	#50	Range
KB 834-00	White	75.3	75.4	75.6	75.5	75.5	75.5	0.3
61 BV	White	66.7	66.7	67.1	67.0	66.5	66.8	0.6
NBS 20-4	Gray	19.1	19.3	19.2	19.6	19.4	19.3	0.5
KB 834-35	Yellow	57.8	57.2	57.3	56.9	57.0	55.8	2.0
KB 834-40	Lt. Blue	23.8	23.8	23.9	24.6	24.1	24.5	0.8
KB 834-41	Med. Blue	16.4	16.4	16.4	17.4	16.8	17.4	1.0
KB 834-70	Red	8.3	7.3	7.4	7.3	7.3	6.5	1.8
KB 834-45	Dk. Blue	4.3	4.4	4.5	4.8	4.7	4.8	0.5

TABLE II

Porcelain Standard

m Values
Colorimeter Serial Number

Designation	Color	#12	#16	#30	#37	#45	#50	Range
KB 834-00		0.0	0.0	0.0	-0.2	-0.1	-0.2	0.2
61 BV		-0.7	-0.6	-0.8	-0.8	-0.8	-0.9	0.3
NBS 20-4		-0.2	+0.1	-0.1	-0.4	-0.7	-0.4	0.8
KB 834-35		+7.9	+7.4	+8.1	+8.4	+7.8	+8.8	1.4
KB 834-40		-3.2	-2.7	-3.6	-3.5	-4.0	-4.0	1.3
KB 834-41		-4.0	-3.4	-4.4	-4.4	-4.7	-5.1	1.7
KB 834-70		+11.1	+9.2	+10.2	+10.2	+9.0	+10.1	2.1
KB 834-45		-1.3	-1.2	-1.5	-1.4	-1.7	-1.7	0.5

TABLE III

Porcelain Standard

n Values
Colorimeter Serial Number

Designation	Color	#12	#16	#30	#37	#45	#50	Range
KB 834-00		+1.5	+1.5	+1.3	+1.4	+1.5	+1.8	0.5
61 BV		-2.4	-2.2	-2.2	-2.2	-2.4	-1.9	0.5
NBS 20-4		-2.5	-2.7	-2.3	-2.4	-2.4	-2.2	0.5
KB 834-35		+35.5	+35.5	+35.3	+34.6	+35.3	+34.5	0.8
KB 834-40	-13.8	-13.8	-14.4	-13.4	-13.5	-13.8	-13.1	1.3
KB 834-41		-23.3	-23.0	-22.8	-22.7	-22.8	-22.0	1.3
KB 834-35		+7.4	+6.3	+6.4	+6.0	+5.9	+5.5	1.9
KB 834-45		-15.2	-15.5	-14.6	-15.2	-15.1	-14.9	0.6

Colormaster Colorimeter Color Indexing System

0	10	20	30	40	50	60	70	80	0	10	20	30	40	50	60	70	0	10	20	30	40	50	60	70	+	-	+
G								m								m											
Color Standard																Alternates											
Code - P-8707																621-903											
Date - 1-16-53																670-817											
																621-817											
Colormaster Colorimeter																											
Date - 8-3-53																											
G - 62																											
R - 72																											
B - 43																											
m - +10																											
m - +29																											
w														w													
9	8	7	6	5	4	3	2	1	0	9	8	7	6	5	4	3	2	1	0	9	8	7	6	5	4	3	2