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Marshall Laboratory
April 9, 1954

MEMORANDUM REPORT NO. M-696

PREPARED BY: C. W. SECKER

# CUSTOM COLOR-MIX SYSTEM FOR TRADE SALES

## STATEMENT OF PROBLEM:

The trend toward greater diversity in colors for interior decorating has grown in recent years. This has been reflected in a demand on the part of the paint consuming public for a wider selection of colors in a variety of different gloss levels. The introduction of Americana colors in flat and "Duco" semi-gloss quality has partially answered the demand for variety but has not provided a means for custom color matching of colors desired by customers. Competition has provided a variety of tube and mixing machine systems, whereby a variety of colors from deep tone to pastel can be made in interior flat, semi-gloss, gloss and latex qualities, as well as exterior house paint and cement and stucco qualities. The absence of a color-mix system of our own has resulted in a loss of business to dealers carrying competitive systems, exp- especially on the West Coast where "color-mix" seems to be most popular. This project had as its objective, the development of a tube color mix system which would utilize products of our own manufacture, as is, or modified to meet the requirements of such a system.

## BENEFITS EXPECTED:

It is expected that the availability of such a system will provide our dealers with a wider variety of colors in flat, semi-gloss, gloss and latex qualities than is available in ready-mixed colors. This should also help to prevent loss of business to dealers carrying competitive color-mix systems.

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COMPETITIVE TUBE SYSTEMS:

There are currently three popular competitive tube color-mix systems on the market each representing a different approach to a tube color-mix system. They are:

1. Colorizer - representative of a multiple tube system.
2. National Lead - representative of a multiple pigment system.
3. Murphy - representative of a combination of both.

Colorizer (Multiple Tube System):

The Colorizer system is representative of a multiple tube system in which a basic color is packaged in various tube sizes, at various concentrations, with one or more of these tubes being added to a base white to produce a desired color.

Colorizer presently, packages 28 basic colors at three different concentrations of strength in 1/4, 1/2, 1, 2 and 4 ounce metal tubes (plus a pint can), one to four of these tubes being added to four base white qualities, Interior Gloss, Semi-Gloss, Flat and Rubber-Latex, each at three levels of hiding, to provide light and deep tints. Base whites are packaged in both quart and gallon containers.

This system is considered, technically, to be one of the best on the market from the standpoint of new additions and obsoletions and also has excellent reproducibility and color control. Their range, however, was considered to be too light in the pastel end and though not deep enough in the deep end, initially, this has been corrected by later additions of more concentrated color bases. Base whites show poor settling resistance, poor dry but excellent skinning resistance. In the Rubber-Latex system color uniformity and film appearance were rated fair to good, but excessive bodying was encountered after tinting.

Breakdown of Colorizer System is as follows:

| | |
|---|---|
| Number of basic colors | 28 |
| Tinting strength/color | 3 |
| Packages/color | 9 |
| Total color packages | 252 |
| Base white qualities | 4 |
| Levels of hiding | 3 |
| Number of packages | 2 |
| Total base white packages | 24 |
| Total packages/system | 276 |
| Total colors offered | over 3000 |

National Lead (Multiple Pigment System):

This system is representative of a multiple pigment system in which a composite pigmented basic color, designed to give a specific shade, is packaged in a single tube for use in a base white.

National Lead, presently, packages 112 shaded basic colors in 1 and 4 ounce metal tubes for use in quart and gallon containers, respectively; one tube per color per package size. The base whites in this system include 7 qualities; Gloss, Egg-shell, Flat and Rubberized Finish, Stucco and Concrete, House Paint and Porch and Floor, each at two levels of hiding. The last three are used to a limited extent only.

This system is not considered good from the standpoint of additions and obsoletions. Base whites exhibit very good settling resistance, excellent skinning resistance but poor dry. The Rubberized Finish shows good color uniformity and film appearance and only slight bodying is encountered after tinting.

Breakdown of National Lead System

| | |
|---|---|
| Number of basic colors | 112 |
| Tubes per color | 2 |
| Tinting strength per color | 1 |
| Total color packages | 224 |
| Base white qualities | 7 |
| Levels of hiding | 2 |
| Number of packages | 2 |
| Total base white packages | 28 |
| Total packages/system | 252 |
| Total colors offered | 112 |

Murphy (Multiple Pigment, Multiple Tube System):

The Murphy system is representative of a multiple tube, multiple pigment system in which a composite pigmented basic color, designed to give a specific shade, is packaged in more than one tube, one or more of these being added to a basic white to produce different chroma levels of the same color.

Murphy packages 54 shaded colors in 1/4, 1/2, 1 and 4 ounce metal tubes, one to four of these being added to a base white to produce the desired colors. The base whites include Gloss, Semi-Gloss, Flat, a Rubberized Finish, Floor and Deck, Outside White and Stucco in two levels of hiding.

Breakdown of Murphy System

| | |
|---|---|
| Number of basic colors | 54 |
| Tubes per color | 4 |
| Tinting strength per color | 1 |
| Total color packages | 216 |
| Base white qualities | 7 |
| Levels of hiding | 2 |
| Number of packages | 2 |
| Total base white packages | 28 |
| Total packages per system | 244 |
| Total colors offered | 597 |

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DuPont Custom Color System (Multiple Tube System):

After an examination of competitive tube systems, it was decided that we would adopt a multiple tube system as being one technically sound from the standpoint of flexibility and simplicity to the dealer, but yet being comprehensive enough to satisfy customer demands.

The Custom Color system consists of 15 basic colors in two strengths for a total of thirty different tintings)(made up from ten single pigment bases) each to be packaged in 1/4 ounce, 1 ounce, and 4 ounce metal tubes. In addition there will be four qualities of white "Blending Bases": gloss, semi-gloss, flat and a modified "Flow Kote". Each white quality will be manufactured in two strengths, light and deep, and packages in quarts and gallons short-filled to 7/8's of a quart or gallon to allow room for additions of tinting colors by the dealers. Tintings are accomplished in the following manner:

Prime Pigment Tintings: (9 Chroma steps)

| QUARTS | | | | GALLONS | | | |
|---|---|---|---|---|---|---|---|
| White | | Color | | White | | Color | |
| Light | Deep | Ext. | Conc. | Light | Deep | Ext. | Conc. |
| 28ozs | | 1/4oz | | 112ozs | | 1oz | |
| " | | 1/2 | | " | | 2 | |
| " | | 1 | | " | | 4 | |
| " | | 2 | | " | | 8 | |
| | 28ozs | | 1/4oz | | 112ozs | | 1oz |
| | " | | 1/2 | | " | | 2 |
| | " | | 1 | | " | | 4 |
| | " | | 2 | | " | | 8 |
| | " | | 4 | | " | | 16 |

There are 15 of these prime pigment tintings in the system, 8 bright, 6 earths and a black, each yielding 9 chroma steps, for a total of 135 colors. In addition, prime pigment tintings are intermixed with each other, bright with bright, earth with earth, bright with earth and earth with black, at equal chroma levels, for the most part, in a 1:1 ratio, with three being intermixed at a 1:4 ratio. These intermixes provide 437 more colors making a total of 572 colors in each of the alkyd qualities, with 320 of this total being recommended for use in Custom Color "Flow Kote". Intermix tintings are accomplished in the following manner:

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1:1 Prime Pigment Intermixes: (8 chroma steps)

| QUARTS | | | | | | GALLONS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| White | | Color A | | Color B | | White | | Color A | | Color B | |
| Light | Deep | Ext. | Conc. | Ext. | Conc. | Light | Deep | Ext. | Conc. | Ext. | Conc. |
| 28ozs. | | 1/4oz | | 1/4oz | | 112ozs | | 1oz | | 1oz | |
| " | | 1/2 | | 1/2 | | " | | 2 | | 2 | |
| " | | 1 | | 1 | | " | | 4 | | 4 | |
| " | | 2 | | 2 | | " | | 8 | | 8 | |
| | 28ozs | | 1/4oz | | 1/4oz | | 112ozs | | 1oz | | 1oz |
| | " | | 1/2 | | 1/2 | | " | | 2 | | 2 |
| | " | | 1 | | 1 | | " | | 4 | | 4 |
| | " | | 2 | | 2 | | " | | 8 | | 8 |

TINTING COLORS

1:½ Prime Pigment Intermixes: (7 chroma steps)

| QUARTS | | | | | | GALLONS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| White | | Color A | | Color B | | White | | Color A | | Color B | |
| Light | Deep | Ext. | Conc. | Ext. | Conc. | Light | Deep | Ext. | Conc. | Ext. | Conc. |
| 28ozs | | 1/4oz | | 1oz | | 112ozs | | 1ozs | | 4ozs. | |
| " | | 1/2 | | 2 | | " | | 2 | | 8 | |
| | 28ozs | 1 | | | 1/4oz | | 112ozs | 4 | | | 1oz |
| | " | 2 | | | 1/2 | | " | 8 | | | 2 |
| | " | | 1/4oz | | 1 | | " | | 1oz | | 4 |
| | " | | 1/2 | | 2 | | " | | 2 | | 8 |
| | " | | 1 | | 4 | | " | | 4 | | 16 |

## TINTING COLORS

Based on the "Colorizer" color range and the color range exhibited by P. Rosbacks Toner System and considering the following requirements, acid and alkali resistance, tinting strength, brush sensitivity and flocculation resistance, light fastness and durability, the following 10 pigments were incorporated into the Custom Color system:

| | |
|---|---|
| W-300 | B.O.N. Dark Red |
| W-622 | Molybdate Orange |
| W-679 | Chrome Yellow Light |
| W-785 | Monastral Green |
| W-527 | Monastral Blue |
| W-895 | Red Iron Oxide |
| W-630 | Ferrite Yellow |
| W-303 | Red Iron Oxide |
| W-205 | Lampblack |
| W- 73 | Surfex Extender |

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"39-Line" dispersions of these pigments in EC-601, a 75% SBO/PE resin requiring H-638 Dimer Acids, were formulated in conjunction with the "Bgroup" and three Philadelphia Plant alignment batches of each were manufactured. Eight of these single pigment bases, including W-73 Extender base, were formulated for grinding on a high speed Lehmann 3-Roll "L" shaped mill. The remaining two, W-300 BON Maroon and W-785 Monastral Green, were formulated SUW. These "39-Line" bases are considered intermediates and are not checked for tone on reduction or tinting strength. To insure color uniformity, pigments for each batch will be blends of three different lot numbers. Selected lots are unnecessary, since run-of-the-mill production lot-to-lot variation is insignificant. In addition, strict fineness limits for these bases have been set up.

A breakdown of these bases, along with other pertinent information follows.

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BREAKDOWN OF "39 LINE" SINGLE PIGMENT BASES

| Code | Pigment | Experimental Code P-39-U- | Permanent Code | % 7.5% SBO/PE Resin Soln. 77% Solids RC-601 | % Odorless Mineral Spirits H-632 | % Pig. | % VM-1833 Thymol | % VM-7790 Soya Lecithin Soln. 50% | % H-555 Neofat | % H-609 Triton K-100 | Gallon Weight Lbs./Gal. | Type of Grind | Passes | Rate | Fineness #1 Gauge in Mils. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W-300 | BON Maroon | 46537 | 39-5058 | 40.6 | 25.4 | 30.8 | 1.2 | - | - | 2.0 | 8.36 | SUW | | | 0.25-0.75 |
| W-622 | Molybdate Orange | 46530 | 39-5051 | 33.6 | 1.4 | 63.4 | 0.2 | 1.4 | - | - | 16.41 | 3RHS | 1 | 960#/Hr. | 0.25-0.75 |
| W-679 | Lt. Chrome Yellow | 46532 | 39-5053 | 18.0 | 5.2 | 74.2 | 0.5 | 2.1 | - | - | 20.04 | 3RHS | 2 | 1140#/Hr | 0.5 - 1.0 |
| W-785 | Monastral Green | 46542 | 39-5059 | 44.6 | 28.4 | 26.3 | 0.7 | - | - | - | 8.41 | SUW | - | - | 0.25-0.75 |
| W-527 | Monastral Blue | 46535 | 39-5056 | 65.7 | 13.2 | 20.1 | 1.0 | - | - | - | 8.15 | 3RHS | 1 | 350#/Hr. | 0.25-0.75 |
| W-895 | Red Iron Oxide | 46534 | 39-5055 | 41.1 | 8.2 | 47.4 | 0.3 | 3.0 | - | - | 12.09 | 3RHS | 1 | 860#/Hr. | 0.25-0.75 |
| W-630 | Ferrite Yellow | 46531 | 39-5052 | 24.5 | 7.9 | 63.7 | 0.5 | 3.4 | - | - | 14.63 | 3RHS | 2 | 480#/Hr | 0.5 - 1.0 |
| W-303 | Red Iron Oxide | 46533 | 39-5054 | 25.2 | 2.6 | 70.2 | 0.6 | 1.4 | - | - | 18.02 | 3RHS | 2 | 840#/Hr. | 0.5 - 1.0 |
| W-205 | Lampblack | 46544 | 39-5060 | 61.4 | 16.0 | 22.4 | 0.2 | - | - | - | 8.35 | 3RHS | 1 | 210#/Hr. | 0.25-0.75 |
| W-73 | Surfex | 46536 | 39-5057 | 17.5 | 7.2 | 73.1 | 0.5 | 1.5 | 0.2 | - | 14.29 | 3RHS | 1 | 650#/Hr. | 0.25-0.75 |

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## BLENDED TINTING COLOR BASES

With the intermediate "39-Line" bases, thirty "632-Line" blended color bases were formulated, 15 color bases, each in two strengths, concentrated and extended. Of these 15 bases, nine are single pigment bases plus W-73 extender base, five are blends of two single pigment bases plus W-73 extender, and one is a blend of three single pigment bases plus extender.

The degree of extension of extended color bases is accomplished by making 4 ounce letdowns of extended color in light tone white, equal for depth to 1/4 ounce letdowns of concentrated color in deep tone white.

Compositions of "632-Line" Tinting Color Bases are as follows:

| Concentrated Bright Colors: | | | | | Composition | | |
|---|---|---|---|---|---|---|---|
| 632-701 | Custom | Color | #11 | Color Base | 39-5058 | 97.8% | (W-300 |
| | | | | | 39-5057 | 2.2% | (W- 73 |
| 632-702 | " | " | #12 | " " | 39-5051 | 95.6% | (W-622 |
| | | | | | 39-5057 | 4.4% | (W- 73 |
| 632-703 | " | " | #13 | " " | 39-5053 | 86.4% | (W-679 |
| | | | | | 39-5051 | 8.8% | (W-622 |
| | | | | | 39-5057 | 4.8% | (W- 73 |
| 632-704 | " | " | #14 | " " | 39-5053 | 95.0% | (W-679 |
| | | | | | 39-5057 | 5.0% | (W- 73 |
| 632-705 | " | " | #15 | " " | 39-5053 | 92.7% | (W-679 |
| | | | | | 39-5059 | 2.6% | (W-785 |
| | | | | | 39-5057 | 4.7% | (W- 73 |
| 632-706 | " | " | #16 | " " | 39-5059 | 98.1% | (W-785 |
| | | | | | 39-5057 | 1.9% | (W- 73 |
| 632-707 | " | " | #17 | " " | 39-5056 | 98.6% | (W-527 |
| | | | | | 39-5057 | 1.4% | (W- 73 |
| 632-708 | " | " | #18 | " " | 39-5056 | 63.2% | (W-527 |
| | | | | | 39-5058 | 35.1% | (W-300 |
| | | | | | 39-5057 | 1.7% | (W- 73 |

| Concentrated Earth Colors: | | | | | Composition | | |
|---|---|---|---|---|---|---|---|
| 632-716 | Custom | Color | #21 | Color Base | 39-5055 | 96.5% | (W-895 |
| | | | | | 39-5057 | 3.5% | (W- 73 |
| 632-717 | " | " | #22 | " " | 39-5052 | 95.7% | (W-630 |
| | | | | | 39-5057 | 4.3% | (W- 73 |
| 632-718 | " | " | #23 | " " | 39-5052 | 84.3% | (W-630 |
| | | | | | 39-5056 | 11.6% | (W-527 |
| | | | | | 39-5057 | 4.1% | (W- 73 |
| 632-719 | " | " | #24 | " " | 39-5052 | 70.0% | (W-630 |
| | | | | | 39-5056 | 26.4% | (W-527 |
| | | | | | 39-5057 | 3.6% | (W- 73 |
| 632-720 | " | " | #25 | " " | 39-5056 | 55.5% | (W-527 |
| | | | | | 39-5060 | 34.5% | (W-205 |
| | | | | | 39-5058 | 8.4% | (W-300 |
| | | | | | 39-5057 | 1.6% | (W- 73 |

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| Concentrated Earth Colors: (cont) | | | Composition | |
|---|---|---|---|---|
| 632-721 Custom Color | #26 Color Base | | 39-5054 | 95.4% (W-303) |
| | | | 39-5057 | 4.6% (W- 73) |
| 632-722 " " | #27 " " | | 39-5060 | 29.3% (W-205) |
| | | | 39-5057 | 70.7% (W- 73) |

| Extended Bright Colors: | | | Composition | |
|---|---|---|---|---|
| 632-733 Custom Color | #31 Color Base | | 39-5058 | 6.4% (W-300) |
| | | | 39-5057 | 93.6% (W- 73) |
| 632-734 " " | #32 " " | | 39-5051 | 11.7% (W-622) |
| | | | 39-5057 | 88.3% (W- 73) |
| 632-735 " " | #33 " " | | 39-5053 | 13.4% (W-679) |
| | | | 39-5051 | 1.2% (W-622) |
| | | | 39-5057 | 85.4% (W- 73) |
| 632-736 " " | #34 " " | | 39-5053 | 14.9% (W-679) |
| | | | 39-5057 | 85.1% (W- 73) |
| 632-737 " " | #35 " " | | 39-5053 | 13.7% (W-679) |
| | | | 39-5059 | 0.3% (W-785) |
| | | | 39-5057 | 86.0% (W- 73) |
| 632-738 " " | #36 " " | | 39-5059 | 6.4% (W-785) |
| | | | 39-5057 | 93.6% (W- 73) |
| 632-739 " " | #37 " " | | 39-5056 | 5.9% (W-527) |
| | | | 39-5057 | 94.1% (W- 73) |
| 632-740 " " | #38 " " | | 39-5056 | 4.0% (W-527) |
| | | | 39-5058 | 2.2% (W-300) |
| | | | 39-5057 | 93.8% (W- 73) |

| Extended Earth Colors: | | | Composition | |
|---|---|---|---|---|
| 632-751 Custom Color | #41 Color Base | | 39-5055 | 9.1% (W-895) |
| | | | 39-5057 | 90.9% (W- 73) |
| 632-752 " " | #42 " " | | 39-5052 | 10.3% (W-630) |
| | | | 39-5057 | 89.7% (W- 73) |
| 632-753 " " | #43 " " | | 39-5056 | 1.2% (W-527) |
| | | | 39-5052 | 9.4% (W-630) |
| | | | 39-5057 | 89.4% (W- 73) |
| 632-754 " " | #44 " " | | 39-5056 | 2.4% (W-527) |
| | | | 39-5052 | 7.1% (W-630) |
| | | | 39-5057 | 90.5% (W- 73) |
| 632-755 " " | #45 " " | | 39-5058 | 0.5% (W-300) |
| | | | 39-5060 | 2.2% (W-205) |
| | | | 39-5056 | 3.4% (W-527) |
| | | | 39-5057 | 93.9% (W- 73) |
| 632-756 " " | #46 " " | | 39-5054 | 13.6% (W-303) |
| | | | 39-5057 | 86.4% (W- 73) |
| 632-757 " " | #47 " " | | 39-5060 | 2.6% (W-205) |
| | | | 39-5057 | 97.4% (W- 73) |

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Manufacture of the intermediate "39-Line" bases and "632-Line" final color bases is being handled, presently, at the Chicago Plant. All "632-Line" color bases are controlled for tinting strength with W-73 extender base per TM-44, with tinting strength limits being ± 2% of standards. Tone on reduction will not be controlled for the nine single pigment plus extender "632-Line" bases, since it is felt that testing of this type would be impractical from a production standpoint and because it is expected that variations of this type will be minimized by the blending of three different pigment lots. Tone on reduction of "632-Line" bases, where two or more single pigments plus extender are blended, will be controlled in a narrow range by normal shading practices.

Release of these color bases for a six-month trial marketing period to obtain customer reaction and field experience has been written and approved under Marshall Laboratory Release Letter #1514.

## FILLING AND PACKAGING OF COLOR BASES

All thirty "632-Line" color bases will be filled in 1/4 ounce, 1 ounce and 4 ounce one-shot, collapsible metal tubes. Aluminum will be used for the 1 ounce and 4 ounce sizes, with lead being used for the 1/4 ounce size. Filled tubes are to be packaged in individual boxes and interior cartons containing six boxes each. Presently, all filling and packaging is being done by Paket, a custom packaging outfit in Chicago. The Chicago Plant will be responsible for supplying material to the packager and for setting up checks for accuracy of filling and color. Accuracy limits have been set at ± 1% by weight.

Alltubes will be coded under a simple system of numbering tinting colors for dealer use set up by D. V. Bauder of the Sales Department. These numbers will identify the various bases and tube sizes and will appear both on the crimped end of each tube and on the individual boxes.

The numbering system for the tinting colors is as follows:

| TINTING COLORS | MASTER COLOR NO. | 1/4OZ TUBE | 1OZ TUBE | 4OZ TUBE |
|---|---|---|---|---|
| Concentrated Bright Colors | | | | |
| W-300 BON Red Dark | 11 | 11 | 111 | 411 |
| W-622 Molybdate Orange | 12 | 12 | 112 | 412 |
| W-679/W-622 (92:8) Red Yellow | 13 | 13 | 113 | 413 |
| W-679 Chrome Yellow Light | 14 | 14 | 114 | 414 |
| W-679/W-785 (99:1) Chartreuse | 15 | 15 | 115 | 415 |
| W-785 Monastral Green | 16 | 16 | 116 | 416 |
| W-527 Monastral Blue | 17 | 17 | 117 | 417 |
| W-527/W-300 (49.2:50.8) Violet | 18 | 18 | 118 | 418 |

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| | MASTER COLOR NO. | 1/4OZ TUBE | 1OZ TUBE | 4OZ TUBE |
|---|---|---|---|---|
| **Concentrated Earth Colors** | | | | |
| W-895 Red Iron Oxide | 21 | 21 | 121 | 421 |
| W-630 Ferrite Yellow | 22 | 22 | 122 | 422 |
| W-630/W-527(95.8:4.2)Gray Chartreuse | 23 | 23 | 123 | 423 |
| W-630/W-527(89.4:10.6) Gray Green | 24 | 24 | 124 | 424 |
| W-527/W-205/W-300 Gray Blue | 25 | 25 | 125 | 425 |
| W-303 Red Iron Oxide | 26 | 26 | 126 | 426 |
| W-205 Lampblack | 27 | 27 | 127 | 427 |
| **Extended Bright Colors** | | | | |
| W-300 BON Red Dark | 31 | 31 | 131 | 431 |
| W-622 Molybdate Orange | 32 | 32 | 132 | 432 |
| W-679/W-622 (92:8) Red Yellow | 33 | 33 | 133 | 433 |
| W-679 Chrome Yellow Light | 34 | 34 | 134 | 434 |
| W-679/W-785 (99:1) Chartreuse | 35 | 35 | 135 | 435 |
| W-785 Monastral Green | 36 | 36 | 136 | 436 |
| W-527 Monastral Blue | 37 | 37 | 137 | 437 |
| W-527/W-300 (49.2:50.8) Violet | 38 | 38 | 138 | 438 |
| **Extended Earth Colors** | | | | |
| W-895 Red Iron Oxide | 41 | 41 | 141 | 441 |
| W-630 Ferrite Yellow | 42 | 42 | 142 | 442 |
| W-630/W-527 (95.8:4.2)Gray Chartreuse | 43 | 43 | 143 | 443 |
| W-630/W-527 (89.4:10.6) Gray Green | 44 | 44 | 144 | 444 |
| W-527/W-205/W-300 Gray Blue | 45 | 45 | 145 | 445 |
| W-303 Red Iron Oxide | 46 | 46 | 146 | 446 |
| W-205 Lampblack | 47 | 47 | 147 | 447 |

## Stability of Tube Tinting Colors

The Marshall Laboratory will be responsible for the stability follow-up of all tube tinting colors. Tubes of all single pigment bases and the various blends will be put aside on the shelf and stored in a 120° oven for periodic checks on settling, separation, seeding and loss of tinting strength on aging.

## Alternate Packages

Vinyl-coated aluminum, heat-sealed bags produced by the Dobeckmun Company of Cleveland and "Rado" Vinyl packages were examined as possible containers for the Custom Color tinting bases. Both have excellent qualifications, both technically and from a sales standpoint and are being considered as possible replacements for metal tubes.

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## WHITE BLENDING BASES

There are four qualities of white "Blending Bases" included in the Custom Color System, gloss, semi-gloss, flat and a modified "Flow Kote". Each white quality is untinted and is manufactured in two strengths, light and deep tone. Light tone whites are tinted with extended color bases, being formulated high in $TiO_2$, to provide a range of pastel colors having sufficient hiding. Deep tone whites are tinted with concentrated color bases and are, essentially, low $TiO_2$ analogues formulated to conserve $TiO_2$ in the deep tints while still maintaining a reasonable level of hiding.

The gloss, semi-gloss and flat qualities are all full alkyd, low odor products and have been placed in "639-Line", being coded as follows:

| | | |
|---|---|---|
| 639-775 | Custom Color System | Light Tone Gloss White |
| 639-776 | " " " | Deep Tone Gloss White |
| 639-779 | " " " | Light Tone Semi-Gloss White |
| 639-780 | " " " | Deep Tone Semi-Gloss White |
| 639-777 | " " " | Light Tone Flat White |
| 639-778 | " " " | Deep Tone Flat White |

The modified "Flow Kote" whites have been placed in "389-Line" and are coded as follows:

| | | |
|---|---|---|
| 389-006 | Custom Color System | Light Tone "Flow Kote" White |
| 389-007 | " " " | Deep Tone "Flow Kote" White |

639-775 - Custom Color System Light Tone Gloss White:

This product, except for a slight change in drier and inhibitor content plus a small decrease in hiding power, is the same as an untinted 80-95 Brush "Duco" Gloss White, the properties of which are fully covered in Release Letter 916-U. The only significant difference between 80-95 and 639-775 is the increase in tack-free time in the latter to 9 hours ± 2 instead of 8 hours ± 2.

639-776 - Custom Color System Deep Tone Gloss White:

This product is essentially a low $TiO_2$ analogue of 639-775 with the same general properties, formulated to reduce cost and conserve $TiO_2$ while maintaining a reasonable level of hiding in deep gloss tints.

639-779 - Custom Color System Light Tone Semi-Gloss White:

Except for a change in drier and inhibitor content, this product is the same as 69-900 (9/15/53) Color Conditioning Semi-Gloss White Enamel, the properties of which are described in Release Letter 962-I. The only significant difference between 69-900 and 639-779 is the increase in tack-free time in the latter to 10 hours ± 2 instead of 8 hours ± 2.

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639-780 - Custom Color System Deep Tone Semi-Gloss White:

This product is essentially a low $TiO_2$ analogue of 639-779 with the same general properties, formulated to reduce cost and conserve $TiO_2$ while maintaining a reasonable level of hiding in deep semi-gloss tints.

639-777 - Custom Color System Light Tone Flat White Enamel:

This product represents a new quality, low odor flat enamel similar to 399-789, Americana Blending White. Ease of spreading is slightly better than 399-789, but ease of lapping is markedly improved. The improved spreading will possibly encourage users to cover a larger area per volume of paint than they would normally cover with a flat enamel and this may result in complaints on poor hiding, particularly when let down into a very light tint. However, the titanium level of the product is fixed by colormatching requirements to the gloss and semi-gloss light tone tints and should give adequate hiding. Calculated square foot coverage of the white at a contrast ratio of 0.95 is 560 and the fact that the material is self sealing simplifies re-coating should it be necessary for a particular job.

The product is designed for brush application at package viscosity after tinting, but may be reduced with H-632, Odorless Mineral Spirits, up to one pint per gallon for roller-coat application with a mohair roller. Use of a lamb's wool roller is not recommended. Settling difficulty at package viscosity has not been encountered in plant production of 639-777 after 10 months, nor after 11 months in laboratory production. Severe, hard settling is not anticipated.

Compared to 399-789, Americana Blending White, the new product exhibits improved holdout, faster dry, considerably improved washability and lapping characteristics, excellent self-sealing properties and smoother texture. ASTM 85° gloss is the same, but the finer grind and improved dispersion of 639-777 result in a higher side sheen than 621-900 when viewed from a very low angle.

639-778 - Custom Color System Deep Tone Flat White Enamel:

This product is essentially a low $TiO_2$ analogue of 639-777 with the same general properties, formulated to reduce cost and conserve $TiO_2$ while maintaining a reasonable level of hiding in deep flat tints.

389-006 - Custom Color System Light Tone "Flow Kote" White:

This product represents a modificiation of our existing 391-012 "Flow Kote" White, being similar in application characteristics, except that when tinted to deeper colors it may require additional thinning for ease of application. The hiding power of 389-006 is approximately equal to that of 391-012. To date,

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no complaints on hiding has been received as the result of application tests. Color uniformity is somewhat better than that of our regular "Flow Kote" in the deeper tints and approximately equal to that of our regular "Flow Kote" in the lighter tints. This difference, at present, is believed to be due to the improved dispersion of the color pigments themselves rather than any difference in the base whites.

The first production-size batches were made at Philadelphia in August of 1953 and are now approximately seven months old. Laboratory samples are now 8 months old. No adverse stability characteristics with any of these materials has been noted. With some of the earlier material, an oven pH drop was noted, but this drop stabilized at a pH of 7.5. This pH is below the solubility point for the dowicide used as an anti-putrefaction agent but is above the pH considered critical for stability. Oven stability data on production samples from Fort Madison show that the pH is now stabilizing itself at about 8.5, which is satisfactory to insure solubilization of the dowicide. This higher pH was obtained by adding an additional amount of ammonia solution to the let-down formula.

The principal ingredient difference between Custom Color System "Flow Kote" white and 391-012 is in the wetting agent content. The Custom Color System "Flow Kote" has additional wetting agents added to permit dispersion of the alkyd tinting colors. This increase in wetting agent produces a sacrifice in scrub-resistance in the untinted white. This decrease may be expressed as the difference between a failure of 1,000 strokes after one week aging for the Custom Color "Flow Kote" vs. 2,000 strokes to failure for the 391-012. However, when alkyd tinting color is added to the Custom Color "Flow Kote" White, its scrub resistance in the early stages is essentially equal to that of 391-012. For this reason, and also because an untinted white is somewhat dirtier than 391-012, the use of Custom Color "Flow Kote" as an untinted white should not be recommended.

All of the technical difficulties associated with color development in Custom Color "Flow Kote" have not been investigated. However, all colors that have been recommended have been made in the laboratory, using plant produced Custom Color "Flow Kote" White.

389-007 - Custom Color System Deep Tone "Flow Kote" White:

This product is essentially a low $TiO_2$ analogue of 389-006 with the same general properties, formulated to reduce cost and conserve $TiO_2$, while maintaining a reasonable level of hiding in deep latex tints.

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Comparison of Compositions - Gloss:

| Code | Ingredient Name | 639-776 | 639-775 | Current 80-95 |
|---|---|---|---|---|
| RC-537 | 59.7% SBO/PE Resin -55% Solids | 5.35 | 4.64 | 4.07 (1) |
| RC-538 | 63.7% SBO/Gly.resin -83%Solids | - | 0.69 | 1.17 (2) |
| H-555 | Neofat | 0.02 | 0.02 | 0.03 (3) |
| H-632 | Odorless Mineral Spirits | 1.16 | 1.17 | 1.25 |
| VD-1428 | Lead Naphthenate - 16% soln. | 0.10 | 0.10 | 0.10 |
| H-172 | Cobalt Naphthenate -6% soln. | 0.03 | 0.03 | 0.03 |
| H-580 | ASA | 0.02 | 0.02 | 0.01 (4) |
| W-154 | Zinc Oxide | 0.12 | 0.15 | 0.16 (5) |
| W- 43 | "Ti-Pure" R-510 | 1.36 | 2.67 | 3.08 (6) |
| W- 73 | Surfex | 0.88 | 0.22 | -- (7) |
| | Pounds per gallon | 9.04 | 9.71 | 9.90 |
| | Solids by volume | 41.4% | 44.3% | 46.0% |
| | Solids by weight | 54.4% | 64.2% | 66.1% |
| | Pigment Volume | 19.6% | 20.1% | 20.0% |
| | $TiO_2$/gallon | 1.36# | 2.67# | 3.08# |

Explanation of Differences:

(1) Resin solids increased to increase total solids at lowered $TiO_2$ level.

(2) RC-538 is eliminated from 639-776 to keep flow level constant at lower solids.

(3) Neofat content reduced to keep flocculation constant at lower solids.

(4) Inhibitor content raised in 639-775 and 639-776 to prevent skinning in partially filled containers.

(5) Zinc oxide adjusted to 5% on the total pigment.

(6) $TiO_2$ adjusted to give satisfactory color matches to semi-gloss tints consistent with latent management visual comparisons.

(7) Surfex added to 639-776 to keep pigment volume essentially constant at lower $TiO_2$ level.

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Comparison of Compositions - Semi-Gloss:

| Code | Ingredient Name | 639-780 | 639-779 | Current 69-900 |
|---|---|---|---|---|
| RC-539 | 66.2% SBO/PE resin - 45%Solids | 3.58 | 3.31 | 3.46 (1) |
| RC-537 | 59.7% SBO/PE resin - 55%Solids | 0.30 | 0.32 | - (2) |
| H-555 | Neofat | 0.03 | 0.04 | 0.04 |
| H- 59 | Soya Varnish Oil | - | - | 0.20 |
| VO-969 | Bodied Soya Oil | 0.19 | 0.19 | - |
| H-632 | Odorless Mineral Spirits | 1.48 | 1.67 | 1.74 |
| VD-1428 | Lead Naphthenate - 16%soln. | 0.12 | 0.12 | 0.12 |
| H-172 | Cobalt Naphthenate - 6%soln. | 0.02 | 0.02 | - (3) |
| VD-7750 | " " - 2%soln. | - | - | 0.10 (3) |
| VH-1833 | Thymol | 0.06 | 0.06 | 0.05 (4) |
| W- 41 | Zinc Oxide | 0.21 | 0.24 | 0.25 (5) |
| W- 73 | Surfex | 2.90 | 2.05 | 2.14 (6) |
| W-28 | "Ti-Pure" R-110 | 1.43 | 2.87 | 3.00 (7) |
| | Pounds per gallon | 10.32 | 10.89 | 11.10 |
| | Solids by volume | 44.2% | 43.5% | 39.4% |
| | Solids by weight | 63.8% | 65.4% | 65.6% |
| | Pigment volume | 39.8% | 41.4% | 47.9% |
| | $TiO_2$ per gallon | 1.43# | 2.87# | 3.00# |

Explanation of Differences:

(1) Resin content adjusted in 639-780 to keep gloss constant at higher Surfex content.

(2) RC-537 added for gloss adjustment consistent with latest management visual comparisons.

(3) Concentrated cobalt naphthenate solution replaces 2% solution to reduce contamination with normal mineral spirits.

(4) Inhibitor content raised in 639-780 and 639-779 to prevent skinning in partially filled containers.

(5) Zinc oxide adjusted to 5% on the total pigment.

(6) Surfex content increased in 639-780 to increase pigment volume at lower $TiO_2$ content.

(7) $TiO_2$ content decreased in 639-780 to obtain deeper tints at lower cost.

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Comparison of Compositions - Flat:

| Code | Ingredient Name | 639-778 | 639-777 | 399-789 | |
|---|---|---|---|---|---|
| RC-539 | 66.2% SBO/PE resin - 45% solids | 4.28 | 3.98 | - | (1) |
| H-599 | Linogel | - | - | 3.37 | (1) |
| H-555 | Neofat | 0.04 | 0.04 | - | (2) |
| VM-7790 | Soya Lecithin - 50% soln. | - | - | 0.09 | (3) |
| VM-1592 | Aluminum Stearate -8.9% soln. | - | - | 0.30 | (2) |
| H-632 | Odorless Mineral Spirits | 1.665 | 1.805 | - | (4) |
| H-262 | Heavy Mineral Spirits | - | - | 1.74 | (4) |
| VD-5087 | Lead Naphthenate - 16%soln(spec) | 0.07 | 0.06 | - | |
| VD-1428 | Lead Naphthenate - 16% soln. | 0.02 | 0.04 | 0.23 | (5) |
| VD-7750 | Cobalt Naphthenate -2% soln. | - | - | 0.23 | (6) |
| H-172 | " " -6% soln. | 0.03 | 0.03 | - | (6) |
| VH-1833 | Thymol | 0.06 | 0.06 | 0.06 | |
| H-580 | ASA | 0.005 | 0.005 | - | |
| W-154 | Zinc Oxide | 0.13 | 0.17 | 0.20 | (7) |
| W-165 | Celite #266 | 1.21 | 1.00 | 1.77 | (9) |
| W-43 | "Ti-Pure" R-510 | - | - | 2.74 | (8) |
| W- 28 | "Ti-Pure" R-110 | 1.12 | 2.02 | - | (8) |
| | Pounds per gallon | 8.630 | 9.210 | 10.73 | |
| | Solids by volume | 33.2% | 33.0% | 49.2% | |
| | Solids by weight | 51.8% | 55.0% | 68.0% | |
| | Pigment volume | 32.5% | 37.0% | 38.5% | |
| | $TiO_2$ per gallon | 1.12# | 2.02# | 2.74# | |

Explanation of Differences:

(1) RC-539 replaces H-599 to make full alkyd, low odor products.

(2) H-555 replaces VM-1592 to control flocculation and brushability.

(3) Soya Lecithin is replaced by Lead naphthenate as a wetting agent and grinding aid.

(4) Odorless Mineral Spirits replaces Heavy Mineral Spirits to improve odor in 639-777 and 639-778.

(5) Lead Naphthenate content is reduced in 639-777 and 639-778 to eliminate skinning in partially filled containers.

(6) A 6% cobalt naphthenate solution is used in 639-777 and 639-778 to reduce contamination with normal mineral spirits.

(7) Zinc Oxide content increased to 5.3% on the total pigment to reduce flow.

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(8) $TiO_2$ is adjusted to give satisfactory color matches to Semi-gloss tints.

(9) Celite content adjusted to maintain 85° gloss of 4 ± 2.

(10) W-43 replaced by W-28 to improve color matches to semi-gloss standards and reduce flow.

Comparison of Compositions - "Flow Kote":

| Code | Ingredient Name | 389-007 | 389-006 | Current 391-012 |
|---|---|---|---|---|
| H-506 | Water | 3.10 | 3.09 | 3.06 |
| G-128 | Domestic Casein | 0.11 | 0.11 | 0.13 |
| H-502 | Pine Oil | 0.01 | 0.01 | 0.01 |
| G-731 | Potassium Fluoride - 85% | 0.02 | 0.02 | 0.03 |
| G-1207 | Hydrogenated Vegetable Oil-61% Solids | 0.03 | 0.03 | 0.02 |
| H-284 | Ammonia - 28% soln. | 0.03 | 0.03 | 0.01 (1) |
| G-730 | Potassium Hydroxide - 85% | 0.01 | 0.01 | 0.01 |
| G-263 | Pentachlorophenol (anti-putrefaction agent) | 0.03 | 0.03 | 0.04 |
| W-165 | Celite #281 | - | - | 0.95 |
| W-1002 | ASP-400 Clay | 2.39 | 1.51 | 0.03 (2) |
| W-43 | "Ti-Pure" R-510 | 1.13 | 2.54 | 2.18 (3) |
| G-728 | Dow Latex 762-W - 48% solids | 2.84 | 2.84 | 3.51 (4) |
| G-729 | Soya Lecithin Based Dispersing Agent | 0.16 | 0.16 | 0.21 (5) |
| H-224 | Butyl Cellosolve | 0.08 | 0.08 | 0.20 (6) |
| G-733 | Anti-Foaming Agent - 50% solids | - | - | 0.06 (7) |
| KG-5188 | Lustrex 820 (alkali soluble styrene copolymer) | 0.04 | 0.04 | - (8) |
| KH-5187 | Glycerol Mono Ricinoleate | 0.04 | 0.04 | - (9) |
| KH-5185 | Triton 770 (Cationic wetting agent) | 0.26 | 0.26 | - (10) |
| KH-5186 | Water Dispersible Linseed Oil - 80% solids | 0.42 | 0.42 | - (11) |
| H-172 | Cobalt Naphthenate - 6% soln. | 0.01 | 0.01 | - (12) |
| VD-1846 | Manganese Naphthenate - 3% soln. | 0.06 | 0.06 | - (12) |
| G-732 | Aqueous Solution of Polyacrylic Acid | 0.03 | 0.03 | 0.01 |
| | Pounds per gallon | 10.80 | 11.32 | 10.73 |
| | Solids by volume | 41.2% | 42.9% | 40.7% |
| | Solids by weight | 54.6% | 56.8% | 54.0% |
| | Pigment Volume | 34.8% | 34.0% | 32.6% |
| | $TiO_2$ per gallon | 1.13# | 2.54# | 2.18# |

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Explanation of Differences:

(1) Additional H-284 in 389-006 and 389-007 to insure pH stability.

(2) ASP-400 clay is preferred over Celite 281 for use in tints to improve color uniformity.

(3) R-510 $TiO_2$ content in 389-006 and 389-007 to produce color matches to semi-gloss standard.

(4) Dow Latex 762-W is partially replaced by KH-5186 to maintain constant pigment volume.

(5) Soya lecithin is partially replaced by KH-5185 to improve alkyd color base dispersion.

(6) Higher butyl cellosolve content in 391-012 to reduce spackle peeling.

(7) G-733 replaced by KH-5187 as specific defoamer for Lustrex 820.

(8) Present in 389-006 and 389-007 to assist in dispersion of alkyd tinting colors.

(9) Foam reducer recommended for use with Lustrex 820.

(10) Present to assist in dispersion of alkyd tinting colors.

(11) Present to assist in dispersion of alkyd tinting colors replacing a portion of Latex 762-W.

(12) Driers present to accelerate cure of KH-5185.

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Properties of the White "Blending Bases" are as Follows:

| PROPERTY | TM | 639-775 | 639-776 | 639-779 | 639-780 | 639-777 | 639-778 | 389-006 | 389-007 |
|---|---|---|---|---|---|---|---|---|---|
| *Film Properties | 340-A | = std. | = std. | = std. | = std. | = std. | = std. | = std. | = std. |
| *Viscosity | 9-A;9-I | #10/70±5 | #10/70±5 | #10/75±5 | #10/75±5 | ST/75±2 | ST/78±2 | ST/80±3 | ST/80±3 |
| *Weight/Gal. | | 9.71# | 9.04# | 10.89# | 10.32# | 9.21# | 8.63# | 11.51# | 10.89# |
| *Gloss | 204-C | 87min | 87min | 45±10 | 45±10 | 4 ± 2 | 4 ± 2 | 4 ± 2 | 4 ± 2 |
| | 204-D | | | | | | | | |
| *Color | 350-A | = std | = std | = std | = std | = std | = std | = std | = std |
| *Sag | 311-B | 25-35 | 25-35 | 15-25 | 15-25 | 15-20 | 15-20 | - | - |
| *Tinting Strength | 71-D | 100±5 | 100±5 | 100±5 | 100±5 | 100±5 | 100±5 | 100±7.5 | 100±7.5 |
| *Drying Time | 219-A | | | | | | | | |
| Dust-free | | 1hr±½ | 1hr±1/2 | 1hr±1/2 | 1hr±1/2 | 1hr±1/2 | 1hr±1/2 | - | - |
| *Tack-free | | 9hrs±1 | 9hrs±1 | 10hrs±2 | 10hrs±2 | 3hrs±1 | 3hrs±1 | < 1hr | < 1hr |
| Hard dry | | 16hrs±2 | 16hrs±2 | 17hrs±2 | 17hrs±2 | 16hrs±2 | 16hrs±2 | = std | = std |
| Solids | 221 | 64.2% | 54.4% | 65.4% | 63.8% | 55.0% | 51.8% | 56.8% | 54.6% |
| Odor | | = std | = std | = std | = std | = std | = std | = std | = std |
| Flash Point | 205-B | min80°F | min80°F | min80°F | min80°F | min80°F | min80°F | min130°F | min130°F |
| Package Stability | | = std | = std | = std | = std | = std | = std | = std | = std |
| Tone on Reduction | | = std | = std | = std | = std | = std | = std | = std | = std |
| pH | | - | - | - | - | - | - | 9.3±0.3 | 9.3±0.3 |

Starred (*) items are suggested for routine control.

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The titanium level of all whites has been carefully adjusted so that equal volumes of "632-Line" color bases, when added to the gloss, semi-gloss, flat and modified "Flow Kote", where recommended, will yield satisfactory color matches in all four qualities. In order to maintain these matches in practice, close control is required. For example, gloss and viscosity adjustments must be accompanied by a compensating prime pigment adjustment so that the tinting strength of the finished product remains constant.

Manufacture:

Three 100 gallon alighment batches of the eight products have been made in the Philadelphia Plant. These batches have been manufactured under slightly varied formulae to resolve skinning difficulties, but have otherwise shown uniform quality and good reproducibility.

Presently, all white-"blending bases" are being made at Fort Madison. Because of the necessity of strict color control, all alkyd bases will be manufactured conventionally by a single process, "47 Process", with the modified "Flow Kote" bases being manufactured "48 Process".

From a color standpoint, variations in white tinting strength have been demonstrated to our satisfaction to be considerably less than anticipated and satisfactory color reproducibility will bemaintained by blending three lots of white pigment for each batch prepared. In addition, each batch of white will be tested and adjusted for tinting strength under TM-71-D with limits being set at ± 5% of standards (Custom Color "Flow-Kote" limits are ± 7% of standards).

Release of the white alkyd bases for a six-month trial marketing period to obtain customer reaction and field experience has been written and approved under Marshall Laboratory Release Letter #1513. The release letter for the modified "Flow-Kote" whites is now in the process of being written, along with supplementary release letters for the alkyd whites to record latest formula revisions, changes in test procedures, etc.

Filling and Packaging of White "Blending Bases":

The mechanics of the Custom Color System require that the base whites be packaged 28 fluid ounces per quart and 112 fluid ounces per gallonras appropriate with a maximum weight variation of ± 3% by weight, since a greater deviation will result in poor color matches to standards by dealers. Since only limited stability information is available on the exact formulas in 7/8 full containers, temporarily at least, it will be necessary to package all alkyd qualities with an inert gas cover of $CO_2$ as insurance against skinning. This practice will continue until

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the laboratory can demonstrate satisfactory skinning resistance at a reasonable drying level without use of $CO_2$.

White "Blending Bases" have been coded under the system set up by D. V. Bauder of the Sales Department as follows for dealer identification:

| | |
|---|---|
| 191 | Flat Light |
| 192 | Flat Deep |
| 291 | Semi-Gloss Light |
| 292 | Semi-Gloss Deep |
| 391 | Gloss Light |
| 392 | Gloss Deep |
| 491 | Latex Light |
| 492 | Latex Deep |

Stability of White "Blending Bases":

The Marshall Laboratory will be responsible for the stability follow-up of all base whites. The major stability problem of the gloss and semi-gloss Custom Color Enamels is limited to dry/skinning characteristics in 7/8 full containers since these products are modifications of standard materials. The flat and modified "Flow-Kote" whites, however, represent new qualities and although satisfactory to date, complete stability background will not be available for approximately nine months.

Performance Comments of White "Blending Bases":

Field performance background is limited to tests by laboratory employees plus a few tests arranged by the Sales Department. No unsatisfactory reports have resulted from these tests.

1. The proposed gloss products may dry to a low, non-uniform gloss when applied at a spreading rate of less than 600 square feet per gallon and dried at low temperatures. This deficiency is characteristic of all low odor gloss products and may be the cause of complaints.

2. The drying time of all products is dependent on the color depth to which they are subsequently tinted, and the quality of the color base used, which will not necessarily be our own "632-Line".

3. Non-reproducibility of color may occur as the result of inadequate mixing or excessive cleavage loss.

4. Non-uniformity of color may develop if sufficient mixing time is not allowed for.

5. Hiding is most critical at the lightest tint of both light and deep tone bases mainly in the yellow range.

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COLOR STANDARDS

A series of approximately 1200 color chips, which represented, mathematically, all the possible colors available in the system, were prepared and forwarded to Faber Birren, a color consultant, for his approval. Of this total, he selected 70 scales having a total of 572 colors, which he felt represented a well-balanced, comprehensive, yet simple, system. These included all bright scales and their adjacent intermixes, all earth scales and their adjacent intermixes, selected bright/earth intermixes, an earth gray scale and a black scale. The 70 scales chosen were organized in two ways:

(a) Wall Chart, having 5 series of spectrum ranges towards gray.

(b) Album Pages, 10 in number, in which colors are grouped by hue families.

In addition, 108 colors were grouped as being currently most popular.

The Album Page arrangement is the basis for setting up individual color chip identifications called Custom Color Numbers. Each of the 572 colors are numbered in the 1000 series according to the sequence found in the album page arrangement, with the lightest color in the 11 series being 1001, the next deeper 1002, etc. These Custom Color Numbers will appear on the reverse side of the color chip, along with the appropriate mixing directions.

Wet standards of the final 572 colors selected were prepared using standardized plant materials with color additions being 95% of the calculated amounts, allowing for a 5% cleavage loss in tubes. These wet standards were turned over to Color Card for production of color chips and instruction manuals. Instrumental tristimulus values of each of the 572 standard tints have been recorded and will be used as reference standards for all future work.

SALES DEVELOPMENT

C. W. Secker

C. W. SECKER

CWS:mlf
4/7/54-R
4/13/54-R

DUP030003679

BASIC CHART ARRANGEMENT:

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 11-12 | 12 | 12-13 * (1:4) | 13 | 13-14 * (1:4) | 14 | 14-15 | 15 | 15-16 | 16 | 16-17 | 17 | 17-18 | 18 | 18-11 |
| 11-21 | 11-22 | 12-22 | 12-22 * (1:4) | 13-22 | 14-22 | 15-22 | 14-23 | 15-23 | 15-24 | 16-22 | 16-23 | 16-24 | 16-25 | 17-25 | 18-26 |
| 11-26 | 21 | 12-21 | 13-21 | 22 | 13-23 | 23 | 23-24 | 24 | 17-24 | 24-25 | 25 | 11-25 | 26 | | |
| 11-23 | 26-22 | 21-22 | 14-21 | 15-21 | 22-23 | 22-24 | 17-22 | 14-25 | 17-23 | 23-25 | 18-25 | 18-21 | 11-24 | | |
| 21-27 | 21-23 | 22-27 | 23-27 | 24-27 | 18-24 | 25-27 | 25-26 | 26-27 | 27 | | | | | | |

* These intermixes are in a 1:4 ratio.

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ALBUM PAGE ARRANGEMENT:

| PAGE | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 11 | 11-21 | 11-23 | 26 | 21-27 | 11-12 | 11-22 |
| 2 | 12-21 | 21 | 26-22 | 12 | 12-22 | 21-22 | 21-23 |
| 3 | * 12-13 (1:4) | * 12-22 (1:4) | 13-21 | 14-21 | 15-21 | 13 | 13-22 |
| 4 | 22 | * 13-14 (1:4) | 14-22 | 14 | 15-22 | 13-23 | 22-23 |
| 5 | 14-15 | 14-23 | 22-27 | 15 | 15-23 | 22-24 | 23 |
| 6 | 15-24 | 23-24 | 23-27 | 15-16 | 16-22 | 14-25 | 24 |
| 7 | 17-22 | 16-23 | 17-23 | 24-27 | 16 | 16-24 | 17-24 |
| 8 | 16-17 | 16-25 | 23-25 | 24-25 | 18-24 | 17 | 17-25 |
| 9 | 17-18 | 25 | 18-25 | 25-27 | 18 | 25-26 | 27 |
| 10 | 18-11 | 18-26 | 11-25 | 18-21 | 11-26 | 11-24 | 26-27 |

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108 COLOR SELECTION (Identified by Custom Color Numbers):

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 1003 | 1321 | 1182 | 1458 | 1118 | 1311 | 1517 | 1255 | 1045 |
| 1005 | 1380 | 1184 | 1460 | 1121 | 1298 | 1519 | 1257 | 1063 |
| 1007 | 1382 | 1186 | 1462 | 1135 | 1299 | 1521 | 1259 | 1065 |
| 1009 | 1384 | 1187 | 1464 | 1107 | 1301 | 1523 | 1261 | 1075 |
| 1442 | 1087 | 1535 | 1148 | 1339 | 1059 | 1427 | 1551 | 1403 |
| 1443 | 1090 | 1537 | 1151 | 1342 | 1061 | 1429 | 1553 | 1447 |
| 1445 | 1092 | 1539 | 1153 | 1343 | 1071 | 1431 | 1555 | 1449 |
| 1200 | 1109 | 1117 | 1266 | 1043 | 1396 | 1291 | 1510 | 1225 |
| 1233 | 1319 | 1137 | 1268 | 1044 | 1398 | 1317 | 1468 | 1227 |
| 1378 | 1161 | 1313 | 1513 | 1047 | 1282 | 1198 | 1470 | 1078 |
| 1405 | 1080 | 1323 | 1514 | 1049 | 1284 | 1201 | 1472 | 1073 |
| 1407 | 1082 | 1325 | 1516 | 1050 | 1286 | 1204 | 1474 | 1017 |

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