MARSHALL SALES DEVELOPMENT LABORATORY
STANDARD FORMULATING PRACTICE NO. FP-874
DATE OF ISSUE: 3/9/60 - SUPERSEDING: New

I. DESCRIPTION OF LINE:

(A) General Description:

The 874-Line of "Lucite"* baking enamels includes a fairly complete range of colors formulated for rollercoat application to properly treated aluminum. Additional colors are currently under development and eventually a full range will be available. Film thickness is normally 0.8 to 1.1 mils. The major use of these enamels is for exterior use on aluminum for awnings and mobile homes. There are also other miscellaneous small volume end uses which require the balance of durability, formability and resistance properties shown by these enamels.

These enamels are usually applied as one coat systems. We anticipate that two coat systems will be feasible when a satisfactory primer is developed. Over some substrates, principally treated steel, resistance properties are borderline. In these cases use of a primer is preferred.

A comparison of 874-Line with established rollercoating lines, such as 751-Line and 703-Line will illustrate what can be expected propertywise from these enamels.

(1) Durability - 874-Line is expected to be more durable than 751 and 703-Lines. This is based on accelerated weatherometer data and related exterior durability data.

(2) Formability - 874-Line is definitely superior to 751-Line in all applications. It is slightly better than 703-Line in roll forming and slightly poorer than 703-Line in impact forming.

(3) Resistance Properties - 874-Line is approximately equal to 751 and 703-Lines over properly treated aluminum. Over treated steel, 874-Line is inferior to 751 and 703-Lines in salt spray and humidity cabinet performance.

(4) Overbake Discoloration - 874-Line is definitely superior to 751 and 703-Lines in this property.

(5) Gloss and Appearance - 874-Line is approximately equal to 751 and 703-Lines.

(6) Pressure Mottling - 874-Line is approximately equal to 703-Line and not quite as good as 751-Line in this property.

The binder used in 874-Line is a combination of G-393 (Rohm and Haas Acryloid B-82), G-395 (Rohm and Haas Acryloid AT-50), VG-5924 (Epon Solution) and HF-186 (Di-2-ethylhexylphthalate).

The following ratio is maintained for all colors and pigment levels:
Solids Basis: G-393/G-395/VG-5924/HF-186 = 82.2/6.6/1.2/10.0

The function of the various binder components is as follows:

G-393, which is the largest part of the binder, is an acrylic polymer and provides excellent durability along with the greatest contribution to the other properties of the enamel. G-395 and VG-5924 are used to provide resistance to pressure mottling and sticking in the coil. HF-186 is present to improve formability. As a general formulating guide it appears feasible to vary the formula amounts of these ingredients by ± 5% to achieve the desired film properties. If such variations are made initial production should be followed closely to be certain of the effect on the total balance of properties and particularly on formability and pressure mottling.

Slow evaporating thinners are used in 874-Line to give the proper balance of stable application viscosity, flow-out, resistance to popping and evaporation rate at the comparatively short high temperature baking schedules employed in the strip coating industry.

II. APPLICATION AND TESTING:

A hand roller and automatic drawdown apparatus are used for the laboratory testing of 874-Line enamels. Color is controlled by automatic drawdown on solvent cleaned Alclad Aluminum (TM-338-B). Gloss is measured on a hand rolled film on solvent cleaned Alclad Aluminum (TM-359-A). All other properties, including pitting are controlled by hand rolling a film on Alodized Aluminum (TM-359-A). If the enamel is too high in viscosity, T-8619 can be used to reduce to application viscosity in order to obtain the 1.0 to 1.1 mil film thickness for testing. In some cases it may be desirable or even necessary to test at much lower film thickness for some customers. These will have to be handled on an individual basis keeping in mind that these enamels are at far less than complete hiding in the white and pastel colors. Other tests include Pencil Hardness TM-231; Impact TM-386-A; Gloss TM-204-F; and where applicable Bleed Test TM-72-B.

If poor flow appears evident from a rollout, a check of the flocculation index of the enamel should be carried out. If this figure is greater than 1.5 reformulation of the enamel will be necessary. A flocculation index of 1.0 is considered best for good performance of the product.

The 874-Line enamels are formulated to give satisfactory performance at laboratory control bakes of 72 seconds @ 450°F in a Grieve-Hendry Oven.

The gloss on 874-Line White is 60 min. @ 20° angle. Enamels which contain large amounts of nonastral oxide or black pigments will be 50 min. @ 20° angle. If there is any question concerning gloss, approval should be obtained from the Sales Region involved.

III. FORMULATION:

Introduction:

874-Line is formulated with a new line of mill bases, 903-Line, in both the white and colors. Because of compatibility requirements, these are the only bases to be used in formulating the quality. Use of even trace amounts of other mill bases is apt to give incompatibility difficulties evidenced by seeding and/or low gloss. The 903-Line bases employ G-393 (Acryloid B-82) as the binder. Slow evaporating thinners H-601 (Solvesso 150) and H-79 (Cellosolve acetate) are used to give the

desired maximum flow under the relatively short flash time and high temperature bake conditions existent during application.

A. Pigmentation:

(1) White enamels in 874-Line are formulated with W-43 rutile TiO_2. Three levels of pigment to binder are shown in the table varying from low to high hiding. Performance characteristics and cost considerations will guide the formulator in picking the proper pigmentation level, keeping in mind the fact that increased pigmentation will lower flexibility performance.

The pigment levels given in the table for colors are maximum levels consistent with obtaining satisfactory durability, gloss and appearance. Pigmentation levels may vary from those suggested in the formulating tables based on performance requirements and cost considerations. Since most formulations will be complex blends of colors whose hiding characteristics cannot be estimated in advance, it will be the formulators responsibility to insure that enamel developments have proper hiding for the intended end use.

The pigmentations used in 874-Line should conform to the recommendations of FP-885 with the following exceptions:

(1) No bleeding pigments except W-612 should be used.

(2) Monastral pigments while yielding durable enamels may give too low a gloss in rollercoating enamels.

B. Mill Base Formulation:

Mill bases are formulated for "47 Process" dispersion. 90 Line mill base formulations are recommended as starting compositions with respect to ratio of pigment to binder. In most cases they will be satisfactory after minor adjustment. In the 903-Line bases VG-5686 (40% solid solution of G-393 in H-601/H-79 - 3/1) will be substituted for the lacquer vehicle used in 901-Line. H-601/H-79 - 3/1 should be used for viscosity reduction in 903-Line bases.

C. Vehicle and Thinners:

The binder in 874-Line consists of the following. VG-5686 (G-393 Acrylic - 40% solids in H-601/H-79 - 3/1), G-395 (Thermosetting Acrylic 50% solids), VG-5924 (Epon Solution 50% Solids) and HF-186 (di-2-ethylhexylphthalate plasticizer). These components are blended in the following ratio to give the proper balance of pressure mottling resistance and flexibility: Solids basis G-393/G-395/VG-5924/HF-186 - 82.2/6.6/1.2/10. As pointed out in an earlier section, variations up to 5% of the formula weight of these ingredients can be made to adjust film properties When this is done, initial production must be followed to determine the effect on film properties until we have adequate background information of the effect of these formulating variables on production lines. The recommended thinner for 874-Line is T-8619.

The flash point of 874-Line is +80L.

D. Modifying Agents:

32-5979, a Polymekon wax dispersion in H-12, is used in amounts of 0.25 to 0.87% based on vehicle solids to impart mar and block-

fabrication of the finished products.

E. Viscosity:

Package viscosity can be varied to suit the individual customer; however, most products are packaged at #15c 23 to 27". Settling properties should be checked on enamels packaged at significantly lower viscosities.

IV. FORMULATING TABLES:

Formulating tables for 874-Line enamels are set up as part of this practice. They are intended as a guide. P/B ratios, resin balances, and thinner content may be varied if so needed, but it is the formulator's responsibility to insure proper package stability, flow, film properties, etc.

V. MANUFACTURING PROBLEMS:

Care should be taken to insure that the constituents of each formulation are added in the order specified, and mixed as directed on the formula card. The exact amount of 32-5979 should be added as specified on the formula.

874-Line is not compatible with "Dulux" or other "Lucite" lines. Formulas should carry the following notation: "CAUTION: Keep free from mutual contamination with "Dulux" and other "Lucite" products."

Tinting bases which appear in the quantities of:

0 - 4% may vary 50%
4.1 - 15% may vary 20%
15.1 - 50% may vary 10%
50/- 100% may vary 5%

A trace of tinting may be omitted without Laboratory approval

VI. REASON FOR ISSUE:

New

SALES DEVELOPMENT LABORATORY

H. HALPIN

HH:jp
3/9/60

874-LINE FORMULATING TABLE BASIS 100 LBS. OF MILLBASE AND LBS. OF INTERMEDIATES TO GIVE DESIRED P/B RATIO

PIGMENT	BASE CODE	GAL. WT.	GALLONS	VG-5686	G-395	VG-5924	HF-186	32-5979	T-8619*	TOTAL	# SOLIDS	P/B	GAL. WT.	REMARKS
W-43	903-043	14.73	27.07	144.4	10.6	1.9	8.0	2.0	1.0	267.9	140.0	75/100	9.90	Low Hiding **
W-43	903-043	14.73	23.32	117.0	8.8	1.6	6.7	1.7	1.0	236.8	126.7	90/100	10.16	Normal Hiding**
W-43	903-043	14.73	19.24	87.3	6.9	1.3	5.2	1.3	1.0	203.0	112.2	115/100	10.55	High hiding**
W-243	903-243	8.18	47.08	237.7	18.5	3.4	14.0	12.2	1.0	386.8	147.0	5/100	8.22	General purpose
W-355	903-355	13.16	59.36	359.2	25.4	4.6	19.3	16.8	1.0	526.3	241.0	25/100	8.87	Light fast
W-362	903-362	11.72	51.05	294.3	21.1	3.8	16.0	13.9	1.0	450.1	200.0	25/100	8.82	Light fast
W-381	903-381	13.08	32.99	173.3	13.2	2.4	10.0	8.7	1.0	308.6	150.0	50/100	9.35	Fugitive, dark spotting
W-382	903-382	13.13	32.97	173.3	13.2	2.4	10.0	8.7	1.0	308.6	150.0	50/100	9.36	Fugitive, dark spotting
W-383	903-383	13.13	32.97	173.3	13.2	2.4	10.0	8.7	1.0	308.6	150.0	50/100	9.36	Fugitive, dark spotting
W-384	903-384	13.04	33.02	173.3	13.2	2.4	10.0	8.7	1.0	308.6	150.0	50/100	9.35	Fugitive, dark spotting
W-551	903-551	8.38	25.95	88.5	9.8	1.8	7.4	6.4	1.0	214.9	85.1	15/100	8.28	Lightfast, expensive
W-582	903-582	8.56	22.87	70.2	7.9	1.4	6.0	5.2	1.0	191.7	75.0	25/100	8.38	Fugitive
W-612	903-612	8.50	32.20	135.0	12.3	2.2	9.3	8.1	1.0	267.9	108.3	15/100	8.32	Lightfast, expensive, bleeds
W-622	903-622	12.59	20.83	83.6	8.1	1.5	6.2	5.4	1.0	205.8	104.9	70/100	9.88	Lightfast, alkali sensitive
W-630	903-630	10.35	36.50	178.9	15.0	2.7	11.4	9.9	1.0	320.4	142.5	25/100	8.83	Lightfast
W-679	903-679	11.96	20.30	77.4	7.5	1.4	5.7	5.0	1.0	198.0	97.1	70/100	9.75	Lightfast, alkali sensitive,
W-686	903-686	14.87	26.24	132.5	10.4	1.9	7.9	6.8	1.0	260.5	133.6	70/100	9.93	" " " "
W-750	903-750	8.45	36.62	164.5	14.7	2.7	11.1	9.7	1.0	303.7	122.1	10/100	8.29	Lightfast, expensive

*Use T-8619 to reduce to viscosity 23-27 sec. #15 Parlin Cup.

**Formulator will have to determine degree of hiding necessary and formulate accordingly
Higher amounts of W-43 will lower flexibility performance.

Whites have 0.25% wax and colors 0.87% wax, based on binder.

jp