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October 22, 1951.

MEMORANDUM REPORT NO. M-396

"INDEXED"
No 12

MARKING RESISTANCE AND RELATED PROPERTIES OF 751 LINE ENAMELS

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Introduction:

The experimental work covered by this report was designed to determine the relative significance of several factors that were suspected of influencing the property of 751 Line enamels known as marking resistance. This property manifests itself during fabrication and assembly of coated venetian blind stock: when one coated strip is drawn along another a black streak will result if the enamel is weak in marking resistance.

Work done independently of and prior to this investigation, in the development of a suitable enamel for use by the Hunter Douglas Corporation of New Hyde Park, New York, had resulted in fairly definite conclusions that (1) the gloss of the enamel influenced strongly the marking resistance and (2) variations in amount of surface slip agent (candellila wax) had a negligible effect on this property. Since the products finally approved at Hunter Douglas differed from conventional 751 Line formulations in the oil length of the alkyd employed and in the type of nitrogen resin used (and in the gloss and marking resistance levels thereby realized), our experiment was designed to investigate three factors:

1. Oil length of alkyd resin (and finished product).
2. Type of urea-formaldehyde resin.
3. Type of melamine-formaldehyde resin.

Summary and Conclusions:

1. A laboratory test for marking resistance has been devised which has sufficient reproducibility to enable differentiation between films of significantly different marking resistance.

2. A 751 Line enamel which exhibits improved gloss and marking resistance at a hardness equal to current enamels can be formulated. This is accomplished by using competitive nitrogen resins, which have increased mineral spirits tolerance as an obvious characteristic.

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TABLE I

ALKYD RESINS (PHTHALIC-GLYCERIDE TYPE)

	% Oil	% Solids	Acid No.	Oil	% X's Glyc.	Thinner
RC-444	55	58	6	CO-DCO	3.2	Pine Oil-Petroleum Naphtha
RC-478	50	56	6	CO-DCO	4.5	Solvesso #150
RC-476	43	50	12	DCO	5.3	Solvesso #150

UREA-FORMALDEHYDE RESINS

	Solids	Solvent	Mineral Spirits * Tolerance Index
RC-718	60	Butyl Alcohol	2.7
Uformite F-240	60	Butyl Alc./Xylol 3:2	29.4
Uformite F-240 N	60	HiFlash Naphtha	14.7

TRIAZINE-FORMALDEHYDE RESINS

	Solids	Solvent	Mineral Spirits * Tolerance Index
Uformite MM 55(G-78)	50	Butyl Alc./Xylol 4:1	4.0
Plaskon 3381	50	Butyl Alc./Xylol 1:1	24.0
Uformite MX-61	66	Butyl Alc./Xylol 1:1	6.0

(*) Comparative value obtained by titration of resin solution in common solvent, using mineral spirits (H-287) as titrating liquid. Appearance of cloud or precipitate marked endpoint.

3. Due to the higher cost of the purchased resins involved, widespread commercial utilization of these new enamels is not feasible. The quality improvement, although desired, does not justify the cost increase involved.

4. Information gained will be helpful when formulating 751 Line enamels for premium performance or specialty uses.

5. Use of Plaskon 3381 Melamine Formaldehyde (KG-3837) in place of Uformite MM-55 (G-78) in 751 Line enamels will return advantages in gloss (95% reliability) and marking resistance (97% reliability) at no increase in cost. The improvement is slight, and thus it may not justify the purchasing and stocking of the Plaskon material. For more significant improvements, the costly expedient of purchasing urea-formaldehyde resins is necessary.

6. No further work is contemplated until adaptable nitrogen resins of our own manufacture are available for evaluation and formulation.

7. An interesting hypothesis resulting from this work is that the use of properly designed urea formaldehyde and melamine formaldehyde resins might lead to considerable cost reduction as an outgrowth of the leaner solvent combinations possible; and quality advantages might accrue. This hypothesis is admittedly meagerly documented; work done by other groups has indicated that quality sacrifices are noted with certain specialty resins of the type under surveillance here. Balancing the unfavorable comment, however, are these pertinent instances: (1) cost reduction in furniture clears by use of a higher mineral spirits tolerance resin, (2) knowledge that a competitor (Ferbert-Schorndorfer) is successfully exploiting a low-butanol UF type high bake white formula, (3) the known compatability of such resins with other formulating vehicles, i. e. VAGH vinylite and styrenated alkyds, and (4) successful use of Plaskon 3381 for G-78 in 751 Line with a resulting leaner solvent balance.

Experimental:

1. General:

As this investigation was conducted under the aegis of a Sales Department request, and therefore on a very limited budget, we found it necessary to ignore, or assume the unimportance of, several variables. The majority of these were primarily identified with the liquid dispersion state of the system (such as solvents, percent solids, and viscosity) but others, primarily excess glycerine, molecular weight and acid number of the alkyd resins and possible structural differences in the nitrogenous resins, affect the static characteristics of the cured film. Accordingly, our conclusions must necessarily be of the "This resin is superior to that resin for these particular properties" type, rather than attempt to postulate the basic reasons for such behavior.

Our primary experimental design embraced three alkyd resins of varying oil length, three urea formaldehyde type resins of varying mineral spirits tolerance, and three triazine formaldehyde type resins of varying mineral spirits tolerance. (For description see Table I). Enamels were formulated to implement a 3 x 3 Latin square, using a 55:35:10 alkyd: UF: melamine solids ratio with pigment (W-93) to binder ratio constant at 90/100. Information derived from analysis of these results was then used to set up a factorial design, from which our final conclusions are drawn.

2. Preparation of Panels:

All panels used in these experiments were prepared by flowing enamels at equal viscosity on to 4" x 12" Bonderite #100 steel panels. After flashing, the coated panels were baked 12 minutes at 300° F. Measurements of gloss, hardness and marking resistance were carried out in areas of 1.0 ± 0.1 mil dry film thickness.

3. Experimental Measurements:

Gloss was determined using the DuPont Universal Glossmeter, with the angle of incidence at 20°.

Hardness was determined with the Tukon Hardness Tester.

Marking resistance was rated by drawing an aluminum edge, under constant weight, across a prepared panel. Four such draws are made, parallel and within a half inch band: the rating is obtained by comparison with a standard panel. Standard error of this test was found to be ± 4 units on a scale of 100. 20 Units is considered a significant difference.

4. Discussion:

The best individual enamel uncovered by this study is one containing RC-478, Uformite F-240 and Plaskon 3381. Although the main effect in increased gloss and marking resistance is due to a change in the melamine-formaldehyde resin, the amount of interaction between the melamine and urea formaldehyde variables is such that only by fixing both at the improved levels are significant advantages obtained. The effect of decreasing the oil length of the alkyd, while advantageous, is secondary: other formulation difficulties make this approach less attractive than that involving the nitrogen resins.

Uformite MX-61, while an attractive resin for reasons outside the scope of this report, has as its principal drawback extremely slow speed of conversion, when compared to the resins with which it is grouped by virtue of its structure and cost range. This same drawback was noted to a lesser degree with the Uformite F-240 N, and to a still lesser degree with Uformite F-240. In the latter case, the slightly slower speed of conversion (compared to RC-718) is subordinate to other formulating variables, and did not cause difficulty.

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10/19/51