DATE: JULY 15, 1944 REPORT NO. 901

PARLIN LABORATORY REPORT

SUBJECT: COLD CRACKING OF MAROON METALLIC "DUCO"

PERIOD: FEBRUARY 1944 TO JUNE 1944

NOTEBOOK NO. 2086

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I. INTRODUCTION

In 1942, numerous complaints were received from the refinish field on account of the early failure by cracking experienced in Maroon Metallic "Duco". A study was made of this problem and the trouble was diagnosed as cold cracking. Although very few complaints were actually received on the original finish, it became apparent that the cracking was prevalent with this particular color before the cars were refinished. These cracks were hardly ever completely removed when the cars were refinished, and, therefore, served as a starting point for cracking of the refinish film. As a result of the study, the formula was slightly modified whereby the ratio of nitrocellulose to other film forming ingredients was reduced. This was done by eliminating the 9% of clear base called for in the original formula. (See formulas on page 3.) Even though this change was relatively small, it appeared, from tests carried out at the time to have accomplished the purpose desired. However, this was apparently due to the fact that the testing equipment, then available, was inadequate; for when the new formula was retested, using improved equipment, it was found to lack sufficient cold crack resistance, even though it represented a noticeable improvement (Table I).

Experimental Project No. J-330 was drawn up to cover further work on this problem of cold cracking with the object of obtaining a satisfactory answer.

II. SUMMARY

The present work embodied the testing of thirty-five compositions representing modifications in nitrocellulose, resin, pigment and plasticizer content, and has resulted in the formulation of a finish which combines satisfactory hardness and buffing properties with greatly improved cold crack resistance. This product has been given the experimental code J-213-X-6493. It is formulated from 3/8 sec. nitrocellulose and raw castor oil (H-22) substituted for 1/4 sec. nitrocellulose and pale blown castor oil (H-120). Otherwise, it is identical in composition to the material previously used in the field, equaling it in hardness and buffing properties. Therefore, it should be possible to use this new lacquer without any change in application technique.

III. CONCLUSIONS

It has been concluded that the most important single factor affecting cold crack resistance in maroon finishes is the viscosity of the nitrocellulose used. ... VIII, IV, and V) Within the practical

nitrocellulose viscosity range for this work, 1/8 sec. to 1/2 sec., the cold crack resistance improved as the nitrocellulose viscosity increased. It was found that in order to incorporate good cold crack resistance with the necessary degree of hardness, the nitrocellulose viscosity had to be increased from 19.9 seconds (5015) to a minimum of 28 seconds (5015). The latter figure represents about the middle of the range for 3/8 sec. nitrocellulose. If the viscosity of the nitrocellulose is permitted to drop below 28 seconds (5015), the formula cannot safely tolerate the additional clear base so necessary for hardness.

Formulations containing raw castor oil (H-22) proved to be superior in cold crack resistance to like formulas containing pale blown castor oil (H-120. This improvement was not attended by a sacrifice in hardness, an added recommendation for the raw oil.

Of the other plasticizers tested, the Baker oils, PD-16 and PD-16E, were the only ones that gave improved cold crack resistance without corresponding softening of the finish. They appeared to be about equal to raw castor oil (H-22) in this respect and could presumably be used to replace the latter if ever the need arose. Their use, of course, would be contingent on satisfactory durability results.

This work has demonstrated marked differences in cold crack resistance between the 213-33039-M Maroon Metallic and 253-2122 Black on one hand and 214-36259 Lancaster Gray on the other. The latter two were included in the experimental work as controls for the maroon. However, at equal film thicknesses*, the black proved to be little better in cold crack resistance than the maroon; whereas, the gray was shown to be definitely superior. These differences cannot be explained on the basis of solids ratios, plasticizer differences or nitrocellulose viscosity (Table II, 4 mil panels). The average viscosities for the nitrocelluloses used in these lacquers are 19.9 sec. (5015) for the maroon 20.4 sec. (5015) for the black and 22 sec. (5015) for the gray. These differences are too slight to explain their cold cracking behavior. The gray is not only much more cold crack resistant but it is also harder than either the maroon or the black. It is believed that the pigments themselves must be important factors in explaining these differences (Table II-B). The nature of the maroon pigment is probably accountable for much of the weakness experienced in the maroon finish. The

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*In practice, the black is applied at considerably lower film thicknesses than the maroon because of the wide difference in hiding power. This, no doubt, explains the fact that no cold cracking difficulty has been experienced in the field with black except in a few special instances where excessive film thicknesses were employed, e.g. on hearses and ambulances

higher viscosity nitrocellulose is believed to compensate for the presumably inherent weakness of the pigment, thereby producing finishes of sufficient toughness and flexibility to resist cold cracking.

IV. EXPERIMENTAL

The cold crack data for this report were obtained by spraying thinned enamels on 4 x 12 inch panels which had been prepared with standard automotive undercoats. The lacquers were sprayed at approximately 2 and 4 mils thicknesses, baked at 180°F. for 20 minutes and then buffed.

The lacquers used in this work were 213-33039-M (issued October 21, 1941), 213-33039-M (issued July 7, 1942) and modifications of the latter. The solids composition of the two Maroon Metallics coded 213-33039-M are:

	213-33039-M (Issued 10/21/41)		213-33039-M (Issued 7/7/42)	
	Solids	Ratio	Solids	Ratio
PX (19.9" 5015)	13.4%	10.0	11.9%	10.0
RL-233	5.4	4.0	5.8	4.9
H-120	2.7)	4.5	3.0)	5.5
H-111	3.3)		3.6)	
W-821	5.0	3.7	5.5	4
W-284	0.1	.07	.1	.08
W-173	0.05	.04	.05	.04
	29.95%		29.95%	

The testing equipment used throughout this work consisted of an oven kept at 100°F. and a dry ice cabinet capable of maintaining the reduced temperatures required. The time lapse between changing the panels from the oven to the ice-box or from the ice-box to the oven was as short as possible.

Preliminary work was carried out to make certain that the conditions chosen for the cold crack cycle were strenuous enough to demonstrate differences in the finishes yet not strenuous enough to eliminate those of proven flexibility. The cycle selected consisted of 20 minutes at 100°F one hour at -20°F and finally 20 minutes at 100°F. again. The panels were examined for cracks after each cycle.

In the tables that follow, formula 213-33039-M (issued 7/7/42) is taken as the standard maroon to which the others are compared. All the lacquers are modifications of this formula unless otherwise stated.

In each table the results of the first and last cycle are recorded along with the cycles in which changes occurred.

Results of the first set of cold crack tests are recorded in Table I along with panel hardness measurements which were run on the two mil panels after they had been subjected to 20 cold crack cycles*.

In the attached Tables I-A and I-B, the first three results show the effects of increasing the nitrocellulose content of the formula. Hardness increased but cold crack resistance decreased.

The next results (4-10) show the effects of various plasticizers. Raw castor oil (H-22) caused a marked improvement in cold crack resistance. Practically no improvement was gained by substituting blown cottonseed oil (H-103) for pale blown castor oil (H-120) or by replacing dibutyl phthalate (H-111) with 2-ethyl butyl phthalate. The latter, used as the total plasticizer, produced some improvement in cold crack resistance; however, difficulties were incurred in preparing the Maroon Toner Stock. The Baker oils, PD-16 and PD-16E, seemed to possess good cold crack resistance when substituted for the pale blown castor oil (H-120). A formulation using Baker's PD-16 as the total plasticizer was attempted but the Maroon Toner Stock could not be prepared from it. Dibutyl sebacate greatly improved cold crack resistance but caused too much softening of the finish.

When the plasticizer content of the formula was raised, cold crack resistance increased, but hardness decreased (11-12) and reduction in plasticizer content produced the opposite effect which was expected (13)

Cold crack resistance improved when the pigment content was reduced (14) and when the pigment content was increased, the opposite result was expected; the discrepant result (15) is probably an experimental error.

The following results (16-18) show the effect of nitrocellulose viscosity; 1/8 sec. PX is inferior to 1/4 sec. PX (1), and 3/8 sec. and 1/2 sec. PX are superior. Relatively no improvement was gained by using 1/4 sec. PXC nitrocellulose (19) and it was found to be rather unsuitable for use in the pulp process.

Replacement of cocoanut oil resin (RL-233) with hydrogenated castor oil resin (RL-272) produced no improvement.

The refinish panel (21) was included to compare a typical refinish system involving Maroon Metallic to the original factory finish.

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*This accounts for the differences in hardness measurements between Tables I and IV. In the latter table the pencil hardness measurements were made on glass panels prepared for that purpose.

The last two results show that the black control (22) is hardly any better than the maroon (1) and that the gray control (23) is markedly superior.

The finishes that showed promising results in the first series of cold cracking experiments were rechecked along with some new formulations, which the previous work seemed to suggest. The results obtained in this series, Tables II-A and II-B, check the first.

The first four results in Table II are arranged to show the effect of increasing the nitrocellulose viscosity, and the second four show the effect of increasing the nitrocellulose viscosity plus the effect of substituting raw castor oil (H-22) for blown castor oil (H-120)

The last two compositions were formulated to prove that the difference in cold crack resistance between the gray and the maroon has something to do with the pigments themselves. These results substantiate that opinion for the maroon composition based on the gray solids (13) was relatively no better than 213-33039-M (2); whereas, the gray (12) was definitely superior. This maroon was formulated merely to obtain data for the pigment content of the gray formula is too low to give good hiding power in the maroon. Therefore, a composition was formulated containing plasticizer, resin, and nitrocellulose in the same solids ratio as the gray but with the pigment content of the maroon (14). The results show this finish to be definitely inferior.

The panels in Tables II-A and II-B that withstood 20 cold crack cycles at -20°F. without cracking, were subjected to 11 cycles of progressively lower ice-box temperatures. The results are found in Tables III-A and III-B. The changes in ice-box temperature are recorded above the cycles. The oven temperature was maintained at 100°F.

The results in Tables III-A and III-B demonstrate the importance of nitrocellulose viscosity on cold cracking and also show that formulas containing raw castor oil (H-22) are better than like ones containing blown castor oil (H-120). The results obtained from 3/8 sec. PX with H-120 and 3/8 sec. PX with H-22 appear to be discrepant, for past experiments have shown the latter plasticizer to be superior. However, this difference is believed to be due to a variation in the nitrocellulose viscosities. (See the note at the end of Table III-B).

Thus far, this work has mainly stressed the importance of cold crack resistance, for that seemed to be the first problem. However, the importance of hardness has not been overlooked. Since 213-33039-M (10/21/41) was used in the field and found satisfactory in hardness and buffing properties, it was considered desirable to at least equal

it in hardness. Therefore, the formulations, that seemed cold crack resistant enough to tolerate an increase in nitrocellulose content, were selected for the following cold crack tests. The modifications containing 1/2 sec. nitrocellulose were omitted in order not to raise the viscosity of the finished product any higher than necessary.

The results of the third series of cold crack tests along with pencil hardness measurements are found in Table IV. The cold crack cycle used in this series consisted of 20 minutes at 100°F., one hour at -40°F. and 20 minutes at 100°F.

Only the formulations containing 3/8 sec. nitrocellulose with no increase in plasticizer (5 and 7) equaled 213-33039-M (10/21/41) in hardness.

To recheck the results obtained these two lacquers were prepared from new material using the same lots of nitrocellulose. The results are found in Table V. It was necessary to run these at -40°F. in order to demonstrate differences in the last two compositions. The temperature change from 100°F. to -20°F. was not sufficient to make them crack.

The composition containing 3/8 sec. nitrocellulose and raw castor oil (H-22) was finally selected and given the experimental code number J-213-X-6493 This combination produced relatively little increase in the thinning viscosity of the finished product compared with the standard using 1/4 sec. nitrocellulose, and equaled 213-33039-M (10/21/41) in hardness and buffing properties.

The first two compositions in Table V represent the past standard and the present standard, resulting from previous laboratory work The last two represent what was accomplished in the work described in this report.

V. MISCELLANEOUS DATA

Included in this work were 4 x 12 inch durability panels for Parlin and Florida exposure. These were sprayed with the lacquers described in Table I and exposed at two and four mils thicknesses. No. J-2973, 1-46 covers this series. These panels will furnish durability information on the various plasticizers used in this work.

Large 12 x 22 inch panels were prepared for Parlin exposure. These were also sprayed at approximately two and four mils with the lacquersin Table I. They are being subjected to weathering conditions such as those experienced by cars when moved from heated garages to below freezing temperature. It is hoped that this type of exposure will bring out differences not manifested by continuous exposure

TABLE I-A

Panels 2.1-2.4 mils	Hardness	Cycles 1	2	3	7	11	17	20
1. 213-33039-M (7/7/42)	F	-	-	-	-	-	-	-
2. 213-33039-M (10/21/41)	H	-	-	Tr.	Tr.	Tr.	Sl.-	Sl.-
Modifications of 213-33039-M (7/7/42)								
3. 24% added clear base	2H	Sl.+	Def.	Def.	Def.+	Bad-	Bad	Bad
4. H-120 replaced by H-103	F	-	-	-	-	-	-	-
5. H-120 replaced by H-22	F	-	-	-	-	-	-	-
6. H-111 replaced by 2-ethyl butyl phthalate	F	-	-	-	-	-	-	-
7. 2-ethyl butyl phthalate as total plasticizer	F-	-	-	-	-	-	-	-
8. Dibutyl sebacate as total plasticizer	H-B	-	-	-	-	-	-	-
9. H-120 replaced by Baker's PD-16	F	-	-	-	-	-	-	-
10. H-120 replaced by Baker's PD-16E	F	-	-	-	-	-	-	-
11. 2% H-120 added	H-B	-	-	-	-	-	-	-
12. Plasticizer increased 25%*	F-	-	-	-	-	-	-	-
13. Plasticizer decreased 25%*	H	-	-	-	-	-	-	-
14. 25% less pigment	F	-	-	-	-	-	-	-
15. 25% more pigment	F	-	-	-	-	-	-	-
16. 1/4" PX replaced by 1/8" PX	F	-	-	-	-	-	-	-
17. 1/4" PX replaced by 3/8" PX	F	-	-	-	-	-	-	-
18. 1/4" PX replaced by 1/2" PX	F	-	-	-	-	-	-	-
19. 1/4" PX replaced by 1/4" PXC	F	-	-	-	-	-	-	-
20. RL-233 replaced by RL-272	F	-	-	-	-	-	-	-
21. Refinish panel sprayed with 213-33039-M (7/7/42)	F	-	-	-	-	-	-	-
22. 253-2122 Black	H	-	-	-	-	-	-	-
23. 214-36259 Gray	2H	-	-	-	-	-	-	-

Legend: Sl. = Slight; Def. = Definite; Tr. = Trace

*The resin content was raised or lowered as required to keep the solids at 29.9%.

TABLE I-B

Panels 4.0-4.4 mils	Cycles 1	2	3	4	5	6	7	9	10	11	14	17	20
1. 213-33039-M (7/7/42)	-	Sl.-	Sl.-	Sl.-	Sl.	Sl.+	Def.-	Def.-	Def.-	Def.	Def.	Def.	Def.
2. 213-33039-M (10/21/41)	Sl.-	Def.-	Def.	Def.	Def.	Def.	Def.+	Def.+	Def.+	Def.+	Def.+	Def.+	Def.+
Modification of 213-33039-M (7/7/42)													
3. 24% added clear base	Def.	Def.+	Def.+	Def.+	Def.+	Def.+	Bad-	Bad-	Bad-	Bad	Bad	Bad	Bad
4. H-120 replaced by H-103	-	Sl.-	Sl.-	Sl.-	Sl.-	Sl.-	Sl.	Sl.	Sl.+	Def.-	Def.-	Def.-	Def.-
5. H-120 replaced by H-22	-	-	-	-	-	-	-	-	-	-	-	-	-
6. H-111 replaced by 2-ethyl butyl phthalate	Sl.-	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.+	Def.+	Def.+	Def.+
7. 2-ethyl butyl phthalate as total plasticizer	-	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.+	Sl.-	Sl.	Sl.
8. Dibutyl sebacate as total plasticizer	-	-	-	-	-	-	-	-	-	-	-	-	-
9. H-120 replaced by Baker's PD-16	-	-	-	-	-	-	-	-	-	-	-	-	-
10. H-120 replaced by Baker's PD-16E	-	-	-	-	-	-	-	-	-	-	-	-	-
11. 2% H-120 added	-	-	-	-	-	-	-	-	-	-	-	-	-
12. Plasticizer increased 25%*	-	-	-	-	-	-	-	-	-	-	-	-	-
13. Plasticizer decreased 25%*	-	Sl.	Sl.	Sl.	Sl.	Sl.	Sl.+	Sl.+	Sl.+	Def.-	Def.-	Def.-	Def.-
14. 25% less pigment	-	-	-	-	-	-	-	-	-	-	-	Tr.	Tr.
15. 25% more pigment	-	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Sl.-	Sl.	Sl.+	Sl.+
16. 1/4" PX replaced by 1/8" PX	Sl.-	Sl.	Sl.+	Def.-	Def.	Def.	Def.	Def.	Def.+	Def.+	Def.+	Def.+	Def.+
17. 1/4" PX replaced by 3/8" PX	-	-	-	-	-	-	-	-	-	-	-	-	-
18. 1/4" PX replaced by 1/2" PX	-	-	-	-	-	-	-	-	-	-	-	-	-
19. 1/4" PX replaced by 1/4" PXC	-	-	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Sl.-	Sl.	Sl.+	Sl.+
20. RL-233 replaced by RL-272	-	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Sl.-	Sl.	Sl.+	Sl.+	Def.-	Def.
21. Refinish panel sprayed with 213-33039-M (7/7/42)	-	-	-	Tr.	Tr.	Tr.	Sl.-	Sl.-	Sl.	Sl.	Sl.	Sl.+	Sl.+
22. 253-2122	-	-	-	Sl.-	Sl.-	Sl.-	Sl.	Sl.	Sl.	Sl.+	Sl.+	Def.-	Def.
23. 214-36259	-	-	-	-	-	-	-	-	-	-	-	-	-

*Resin content was raised or lowered as required to keep the solids at 29.9%.

TABLE II A

Panels 2.1-2.3 mils	Cycles 1	7	20
1. 1/4" PX replaced by 1/8" PX	-	-	-
2. 213-33039-M (7/7/42)	-	-	-
3. 1/4" PX replaced by 3/8" PX	-	-	-
4. 1/4" PX replaced by 1/2" PX	-	-	-
5. 1/8" PX with H-22	-	-	-
6. 1/4" PX with H-22	-	-	-
7. 3/8" PX with H-22	-	-	-
8. 1/2" PX with H-22	-	-	-
9. 213-33039-M (10/21/41)	-	-	-
10. Plasticizer increased 25%	-	-	-
11. 253-2122 Black	-	-	-
12. 214-36259 Grey	-	-	-
13. Formula using solids* ratio of gray	-	-	-
14. Formula using solids** ratio of gray but with pigment content of maroon	-	Tr.	Tr.

*Solids		Ratio
PX	14.2%	10.0
RL-233	7.2	5.0
H-120	2.3	
H-111	2.7	3.5
W-821	3.6	2.5
	29.9%	

**Solids		Ratio
PX	12.9	10.0
RL-233	6.4	5.0
H-120	1.8	
H-111	2.7	3.5
W-821	6.1	8.5
	29.9%	

TABLE II-B

Panels 4.1-4.3 mils	Cycles 1	2	3	4	6	8	11	12	14	16	18	20
1. 1/4" PX replaced by 1/8" PX	Sl.	Sl.+	Sl.+	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.	Def.
2. 213-33039-M (7/7/42)	-	Tr.	Tr.	Tr.	Tr.	Tr.	Sl.-	Sl.-	Sl.	Sl.	Sl.+	Sl.+
3. 1/4" PX replaced by 3/8" PX	-	-	-	-	-	-	-	-	-	-	-	-
4. 1/4" PX replaced by 1/2" PX	-	-	-	-	-	-	-	-	-	-	-	-
5. 1/8" PX with H-22	-	-	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Sl.-	Sl.-	Sl.-
6. 1/4" PX with H-22	-	-	-	-	-	-	-	-	-	-	-	-
7. 3/8" PX with H-22	-	-	-	-	-	-	-	-	-	-	-	-
8. 1/2" PX with H-22	-	-	-	-	-	-	-	-	-	-	-	-
9. 213-33039-M (10/21/41)	Sl.	Sl.+	Sl.+	Sl.+	Def.	Def.	Def.	Def.	Def.	Def.	Def.+	Def.+
10. Plasticizer increased 25%	-	-	-	-	-	-	-	-	-	-	-	-
11. 253-2122 Black	Sl.	Sl.	Sl.	Sl.	Sl.+	Sl.+	Sl.+	Def.	Def.	Def.	Def.	Def.
12. 214-36259 Gray	-	-	-	-	-	-	-	-	-	-	-	-
13. Formula using * solids ratio of gray	-	-	-	-	-	Tr.	Sl.	Sl.	Sl.	Sl.	Sl.	Sl.
14. Formula using solids** ratio of gray but with pigment content of maroon	Sl.+	Def.	Def.+	Def.+	Def.+	Def.+	Def.+	Def.+	Def.+	Def.+	Bad-	Bad

*Refer to end of Table II-A.
**Refer to end of Table II-A.

TABLE III-A

Panels 2.1-2.3 mils	Cycles -30°F. 1	-30°F. 3	-40°F. 6	-40°F. 8	-50°F. 9	-50°F. 11
1. 1/4" PX replaced by 1/8" PX	-	-	-	-	-	Tr.
2. 213-33039-M (7/7/42)	-	-	-	-	-	-
3. 1/4" PX replaced by 3/8" PX	-	-	-	-	-	-
4. 1/4" PX replaced by 1/2" PX	-	-	-	-	-	-
5. 1/8" PX with H-22	-	-	-	-	-	-
6. 1/4" PX with H-22	-	-	-	-	-	-
7. 3/8" PX with H-22	-	-	-	-	-	-
8. 1/2" PX with H-22	-	-	-	-	-	-
9. 213-33039-M (10/21/41)	-	-	-	-	Tr.	Sl.
10. Plasticizer increased 25%	-	-	-	-	-	-
11. 253-2122 Black	-	-	-	-	-	Tr.
12. 214-36259 Gray	-	-	-	-	-	-
13. Formula using solids ratio of gray	-	-	-	-	-	-

TABLE III-B

Panels 4.1 4.3 mils	Cycles -30°F. 1	-30°F. 3	-40°F. 6	-40°F. 8	50°F. 9	-50°F. 11
3. 1/4" PX replaced by 3/8" PX*	-	-	-	-	Tr.	Tr.
4. 1/4" PX replaced by 1/2" PX	-	-	-	-	-	Tr
6. 1/4" PX with H-22	-	Tr.	Sl.-	Sl.-	Sl.	Sl.
7. 3/8" PX with H-22**	-	-	Tr.	Tr.	Tr.	Tr.
8. 1/2" PX with H-22	-	-	-	-	-	-
10. Plasticizer increased 25%	-	-	-	-	-	Tr.
12. 214-36259 Gray	-	-	-	-	-	-

*Viscosity of nitrocellulose used is 31" (5015)
**Viscosity of nitrocellulose used is 27.2" (5015)

TABLE IV

Panels 4.1-4.2 mils	*Hardness	Cycles 1	2	3	4	5	6	7	8	9	10	12
1. 213-33039-M (7/7/42)	H-B	Sl.	Sl.+	Def.	Def.+	Def.+	Def.+	Bad	Bad	Bad	Bad	Bad
2. 213-33039-M (10/21/41)	F	For pencil hardness test										
3. H-120 replaced by H-22	H-B	-	-	Tr.	Tr.	Tr.	Tr.	Sl.	Sl.	Sl.	Sl.	Sl.
4. 1/4" PX replaced by 3/8" PX	H-B	-	-	-	-	-	-	-	-	-	-	-
5. 9% base added to (4)	F	-	-	-	-	Tr.	Tr.	Sl.-	Sl.-	Sl.-	Sl.-	Sl.-
6. 3/8" PX with H-22	H-B	-	-	Tr.-	Tr.	Tr.	Tr.+	Sl.-	Sl.-	Sl.	Sl.	Sl.
7. 9% base added to (6)	F	-	-	-	-	-	Tr.	Sl.	Sl.+	Sl.+	Sl.+	Sl.+
8. Plasticizer increased 25%	B	-	-	Tr.-	Tr.	Tr.	Tr.	Sl.-	Sl.-	Sl.-	Sl.-	Sl.-
9. 9% base added to (8)	H-B	Tr.+	Sl.-	Sl.-	Sl.	Sl.	Sl.	Sl.+	Sl.+	Sl.+	Sl.+	Sl.+
10. Plasticizer increased 25% + 1/4" PX with H-22	2B	-	-	-	-	-	-	-	-	-	-	-
11. 9% base added to (10)	H-B	Tr.-	Tr.-	T_r.-	T_r.-	Tr.-	Tr.-	Tr.+	Tr.+	Sl.	Sl.+	Sl.+
12. Plasticizer increased 25% + 3/8" PX substituted for 1/4" PX	B	-	-	-	-	-	-	-	-	-	-	-
13. 9% base added to (12)	H-B	-	-	-	-	-	-	Tr.+	Tr.+	Sl.	Sl.	Sl.
14. 3/8" PX with H-22	B	-	-	-	-	-	-	-	-	-	-	-
15. 9% base added to (14)	H-B	-	-	Tr.-	Tr.-	Tr.-	Tr.-	Tr.+	Tr.+	Sl.	Sl.	Sl.
16. 253-2122 Black	H	Sl.+	Sl.+	Sl.+	Def.	Def.	Def.	Def.+	Def.+	Def.+	Def.+	Def.+
17. 214-36259 Gray	2H	-	-	-	-	-	-	-	-	-	-	-

*For these measurements, the lacquers were sprayed on glass panels at approximately three mils thickness and then baked 1/2 hour at 65°C. Dixon's Eldorado Typhonite pencils were used.

TABLE V

Panel 4.1-4.2 mils	Cycles 1	2	3	4	5	6	7
213-33039-M (10/21/41)	Sl.+	Def.	Def.+	Def.+	Bad	Bad	Bad
213-33039-M (7/7/42)	Sl.	Sl.	Sl.+	Sl.+	Def.	Def.	Def.
3/8" PX and H-22	-	-	Tr.-	Tr.-	Tr.-	Tr.-	Tr.-
3/8" PX and H-120	-	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.