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Punch Card Index

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No 14'51

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Marshall Laboratory
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MEMORANDUM REPORT NO. M-399

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DRIER STUDY
CLASS "B" PROBLEM (WS-69-1)

Introduction:

This report covers the results of the drier study undertaken as a protective measure against a possible cobalt drier restriction for civilian use and the unreliable naphthenate type drier supply.

Summary and Conclusions:

1. Naphthenate Vs. Tallate

(a) The shortage of naphthenic acid forced the acceptance of tallate (or lino-resinate) type driers as emergency substitutes in most products. Release Letter #1310 covered this change, on the basis of alternate tallate for naphthenate driers, and this proposal worked satisfactorily in all cases except 301 Line house paint products. In this latter case, the tallate driers produce an excessive amount of false body that changes the brushing properties and the solids/viscosity relationship. Accordingly, the formulas were revised to use naphthenates only, until sufficient stability data could be obtained on a linoleate type formula.

(b) The performance of the tallate type driers in this study (other than the house paints) was quite comparable to the naphthenate controls.

2. Cobalt Drier Conservation

(a) Laboratory results of the program outlined in Table I

N35443

attached, show that excess amounts of cobalt drier are not currently being used in our products. However, the cobalt content in most products can be reduced by approximately 50% provided this reduction is compensated by manganese, a combination of manganese and calcium, or a combination of manganese and lead as follows:

1. Reduce cobalt 50% and replace with manganese.
2. " " " " " " and add .1% calcium metal.
3. Reduce cobalt 50% and replace with manganese, add lead drier to obtain a ratio of 30/1/1 lead/manganese/cobalt. The latter combination appears to be the best all round replacement suitable for most products.

It is suggested, however, if we are forced to cut the use of cobalt drier, that each type or line of products be individually tested for initial drying and general physical properties, because it has been established that slight modifications from the above recommendations may be necessary in some types of products or lines of products. Refer to the details portion and tables attached to this report for additional information on the details of other tests.

(b) We made no attempts to completely replace cobalt drier in this study.

(c) The introduction of manganese drier does not affect the initial color of such products as "Dulux" Super White beyond shading range, and six mos. YL and YD exposures have also indicated that such a replacement shows a definite improvement in color retention. (Exposure Series #12160).

3. Action to be taken

(a) Review retained samples from this study at end of one year storage to check on long time drying stability.

(b) Additional work should be undertaken to evaluate additional or complete cobalt drier replacement so as to be prepared for any possible complete cobalt drier allocation for civilian use.

(c) Follow-up on lead regarding improved color retention of manganese containing experiments discussed above.

4. Details

The following will discuss in more detail the results obtained with each product included in this study.

- (a) Brush "Duco" (80 Line)

1. Drier mixture #3 (Mn and lead) appears to be the best cobalt replacement in this line of products.

2. It was impossible to check drying and package stability on the one month oven sample because most of the samples showed considerable bodying and/or gelling.

(b) "Dulux" Super White (58 Line)

1. Drier mixtures #2 and #3 (Mn/calcium and Mn/Pb) are best suited for this product and the final selection should depend on whichever possesses better color retention.

2. The oven samples in this case also showed excessive bodying, except in case of the calcium containing experiments which showed considerable less tendency to body or gel.

3. The calcium and the high lead containing experiments also resulted in products possessing a lower (initial) and more stable sag reading.

(c) Interior Semi-Gloss (670 Line)

1. The tallate type driers did not perform as well in this type formulation as they did in other lines.

2. In this case, replacing the cobalt with manganese alone appears to give satisfactory results in all respects.

3. The tests were conducted with the 100% TiO_2 /alkyl type formulation, and no bodying or gelling encountered at elevated temperatures.

(d) Ovalite Undercoater (479-767)

1. Any of the cobalt drier replacements recommended above may be used in connection with this product. (Table 5)

2. No excessive bodying or gelling was encountered with this type formulation at elevated temperatures.

(e) Automotive "Dulux" (93 Line Red and Black)

1. Black (93-005): Drier mixture #3 (Mn and lead) appears to be the best cobalt replacement in these products from the standpoint of initial and long time drying stability. No wrinkling tests were run on this particular replacement; however, a wrinkling test was conducted on the #2 (Mn and Ca) type replacement which proved satisfactory but very slightly inferior to #3 in drying.

2. Red (93-1683): In this product, best results (including wrinkling) are obtained by reducing cobalt 50% and just adding .1% calcium metal on the oil. However, cobalt replacement #1 and #2 (Mn and Mn and Ca) may also be used with very slight sacrifice in hardness.

(f) Clears - "Dulux" and Orthodox

1. "Dulux" Clear - RK-265: Drier mixture #3 (Mn and Pb) is the best cobalt replacement in this type product. However, the lead content should be held to minimum amounts required to avoid excessive cloudiness.

2. Orthodox Clear - VK-913: In this product, replacing 50% cobalt with lead only (20/1 ratio Pb/Co) appears sufficient to give performance equal to std. Mixture #3 (Mn and lead) may also be used to obtain the same results.

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B. L. *TRANS* *farsi*

TABLE I

COBALT DRIER PROGRAM

1. Determine whether excess cobalt is now used by decreasing its amount 25%, 50%, 80% and 100%.
2. Reduce inhibitor content 50% with the 50% reduction in cobalt.
3. Reduce the cobalt 50% and add 0.1% calcium metal as the naphthenate (on the oil) to determine possible activation of cobalt by calcium.
4. Reduce cobalt 50%, replace with manganese, and add 0.1% calcium metal as the naphthenate.
5. Reduce cobalt 50% and replace with manganese.
6. Cut the cobalt 50% and put in lead to give a ratio of 20/1 of lead/cobalt.
7. Cut the cobalt 50% and replace with manganese, add lead drier to obtain a ratio of 30/1/1 of lead/manganese/cobalt.
8. Cut the cobalt 50% and add calcium naphthenate to obtain a ratio of 1/1/6 of cobalt manganese/calcium.

These tests will be made in the following types of products:

- a. Brush "Duco" White 80-26
- b. "Dulux" Super White 58-5223
- c. "Dulux" Clear RK-265
- d. Automotive "Dulux" 93-005 and 93-1863-R
- e. Ovalite Undercoater 479-767
- f. Interior Semi-Gloss 670-760
- g. Orthodox Clear RK-913

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Table - #2
Brush "Dug" White (80-26)

Code	Description	INITIAL DRYING			DRYING STABILITY			VISC. #10			T.M. - 311-B			G/L
		TACK FREE	CH. HARDNESS	1 MONTH TACK FREE	1 MONTH HARDNESS	6 MONTH TACK FREE	6 MONTH HARDNESS	INTL. WK	INTL. WK	INTL. WK	INTL. WK	INTL. WK	INTL. WK	
P80-R-87817-1	CONTROL	6 HRS.	GOOD STD	6 HRS.	GOOD STD	6 HRS.	54	59	77	47	45	30	91	8
" R-87817-1A	CONTROL	6 "	= TO STD	6 "	= TO STD	6 "	52	59	77	47	46	30	91	8
" R-87817-1B	Reducing Ca 25%	6 "	VS. INFERIOR	7 "	" " "	6 "	53	59	76	45	46	30	91	8
" R-87817-1C	" " 50%	6 "	VS. INFERIOR	7 "	" " "	6 "	51	62	78	45	45	31	91	8
" R-87817-1D	" " 30%	6 "	" "	6 "	VS. INFERIOR	6 "	54	62	78	45	44	31	90	8
" R-87817-1E	" " 80%	8 "	" "	8 "	" "	8 "	53	62	76	42	44	32	90	8
" R-87817-1F	" " 100%	6 HRS (WET)	18 HRS WET	6 HRS (WET)	18 HRS WET	6 HRS (WET)	53	61	72	46	45	34	-	9
" R-87817-2	" " 50% AND 50% Red. in Inhibitor.	6 HRS.	VS. INFERIOR	7 HRS	DEF. INFERIOR	6 HRS	56	67	79	45	45	31	91	8
" R-87817-3	" " 50%, Add .10% Ca. on O.B. *	6 "	VS. INFERIOR	6 "	" "	6 "	55	67	76	46	44	31	91	8
" R-87817-4	" " 50%, Replace with Mn. Add .1% Ca. *	6 "	= TO STD	6 "	" "	6 "	54	60	73	46	47	33	91	8
" R-87817-5	" " 50%, Replace with Mn.	6 "	" "	6 "	VS. INFERIOR	6 "	53	61	70	45	41	33	91	8
" R-87817-6	" " 50%, Add Pb. to 20% Pb./Co.	6 "	VS. INFERIOR	7 "	= TO STD	6 "	53	61	73	47	50	32	91	8
" R-87817-7	" " 50%, Replace with Mn. Add Pb. to 30% Pb./Co./Mn.	6 "	= TO STD	6 "	" "	6 "	52	53	63	46	50	34	91	8
" R-87817-8	" " 50%, Replace with Mn. Add Ca. to 1 1/2% Co./Mn./Ca. *	6 "	" "	6 "	" "	6 "	51	57	69	44	43	33	91	8

* Calcium Naphthenate, Tallate base used in all experiments, except R-87817-1 (CONTROL) and R-87817-1D, which control. For further details regarding these results refer to Book #5270 Page 17.

Table - # 3

Dulux Super White Gloss (58-5223)														
Code	Description	Initial Drying		Drying Stability		Vise. 70		SAP		Gloss		Color	Color Reproduced	
		Free	Hardness	1 month	3 months	1 month	3 months	1 month	3 months	1 month	3 months			
P58 R87816-1	Control	7 1/2 hrs	STD.	8 1/2 hrs	STD.	14 hrs.	76/118	123	37	33	32	93/93	87	Good STD
" R-87816-1A	Control	8 "	V.S. Superior	11 1/2 "	" Superior	11 "	77/117	118	37	20	18	93/91	88	= to STD
" R87816-1B	Reducing Co. 25%	9 "	Sh. Superior	9 1/2 "	"	14 "	77/113	116	37	21	19	93/93	87	V.S. Superior
" R-87816-1C	"	9 "	"	12 1/2 "	"	14 "	77/115	116	38	22	20	93/93	89	"
" R-87816-1D	"	9 "	"	11 1/2 "	"	14 "	80/123	127	37	37	35	94/92	89	"
" R-87816-1E	"	13 "	"	17 "	"	15 1/2 "	79/117	119	38	25	23	93/92	91	Def. Clearer
" R-87816-1F	"	24 hrs (wet)	—	wet	wet	24 hr	80/117	119	38	31	27	—	—	"
" R-87816-3	"	7 1/2 hrs	Superior	7 1/2 "	Def. Superior	13 1/2 "	77/107	116	19	18	18	93/92	86	Def. Clearer
" R-87816-4	"	7 1/2 "	"	6 "	"	11 "	77/106	116	18	17	17	93/92	87	Sh. Red-bleeder
" R-87816-5	"	7 1/2 "	"	11 1/2 "	Def. Superior	14 1/2 "	81/128	138	34	15	19	93/92	90	"
" R-87816-6	"	14 "	"	14 "	"	15 1/2 "	75/114	122	38	24	21	93/93	87	Sh. Clearer
" R-87816-7	"	7 1/2 "	STD.	7 3/4 "	"	11 "	79/117	118	17	18	17	93/93	89	= to STD.
" R-87816-8	"	7 1/2 "	Superior	6 "	Def. Superior	11 "	77/103	111	16	16	16	93/92	86	Sh. Drier
* Calcium Naphthenate Tallate Driers, used in all experiments except R-87816-1 (Control) and R-87816-1D which contain Naphthenate For further detail regarding these results Refer to Book 5223 Page 16.														

* Calcium Naphthenate
Tallents Diol used in all experiments except R-87816-1 (Control) and R-87816-10 which contain Naphthenate
For further details regarding these results Refer to Book 5270 Page 16.

Table # 4

Interior Semi-Gloss White (670-760)																		
Code	Description	Initial Drivings					Drying Stability					Viscosity #15			Sag		Glass	Color
		Track Face	Driv. Hardness	1 Month Hardness	1 Month Hardness	1 Month Hardness	1 Month Hardness	1 Month Hardness	1 Month Hardness	1 Month Hardness	1 Week	1 Week	1 Week	1 Week	1 Week	1 Week		
670R-87818-1	Control	12 Hrs	Good STD	13 1/2 Hrs	23 Hrs	11 1/2 Hrs	22	45	46	13	21	18	19	24	28 1/2	57	Good STD	
" R-87818-1#	Control	13 1/2 "	= to STD	13 1/2 "	30 Hrs	15 "	28	40	42	15	20	17	18	20	28 1/2	62	= to STD	
" R87818-1B	Reducing Co. 20%	13 1/2 "	" " "	17 "	" " "	" " "	21	38	46	13	21	17	18	18	27 1/2	66	" " "	
" R-87818-1C	" " 50%	20 "	SL Inferior	20 1/4 "	SL Inferior	" " "	21	39	47	13	22	19	23	23	28 1/2	68	SL Inferior	
" R-87818-1D	" " 50%	20 1/4 "	DeF. Inferior	19 1/2 "	" " "	" " "	22	39	57	15	23	21	21	21	27 1/2	71	DeF. Inferior	
" R-87818-1E	" " 80%	26 1/4 "	V. Soft	25 "	V. Soft	" " "	20	38	45	13	25	21	21	21	25	27 1/2	70	DeF. Inferior
" R-87818-1F	" " 100%	26 1/4 (wet)	wet	wet	30 Hrs wet	wet	20	36	59	14	28	24	23	23	29	27 1/2	" " "	
" R-87818-2	" " 50% And 50% Red. in Inhibitor	17 1/4 Hrs	SL Inferior	20 "	SL Inferior	15 Hrs	22	40	50	12	23	20	19	22	27 1/2	66	" " "	
" R-87818-3	" " 50% Add 1% Co. oil.	* 15 "	" " "	17 1/2 "	" " "	14 "	23	37	41	13	20	18	19	21	28 1/2	63	SL Inferior	
" R-87818-4	" " 50% Replace with Mn. Add 1% Co. oil.	* 10 "	= to STD	12 1/2 "	23 Hrs	9 "	23	33	41	14	26	17	16	17	25 1/2	54	DeF. Inferior	
" R-87818-5	" " 50% Replace with Mn.	12 "	" " "	14 1/2 "	" " "	19 Hrs	22	36	43	12	21	19	16	19	26 1/2	62	" " "	
" R-87818-6	" " 50% Add Pb. to 29% Pb./ca.	17 1/2 "	SL Inferior	19 1/2 "	V. Soft	12 "	19	30	34	12	24	19	19	22	28 1/2	68	SL Inferior	
" R-87818-7	" " 50% Replace with Mn. Add Pb. to 50 1/1 Pb./ca.	9 "	= to STD	11 1/2 "	= to STD	8 1/2 "	17	25	26	12	23	17	16	20	28 1/2	59	DeF. Inferior	
" R-87818-8	" " 50% Replace with Mn. Add Ca. to 1 1/2 Co./ca.	12 "	SL Superior	12 "	" " "	23 "	25	30	29	13	20	17	20	23	28 1/2	41	SL Inferior	
* Calcium Naphthenate Talcum Drisk used in all Experiments except R-87818-1 (Control) and R-87818-10, which contain Naphthenate. For Further Details Regarding these Results Refer to book 52-70 page 18.																		

Table - # 5

Ovalite Undercoater (479-767)

Code	Description	INITIAL DRYING				DRYING STABILITY				Vise. - 15 cup		SAG	Color
		18 hours	18 hours	18 hours	18 hours	18 hours	18 hours	18 hours	18 hours	18 hours	18 hours		
		Good (STD)	Good (STD)	Good (STD)	Good (STD)	Good (STD)	Good (STD)	Good (STD)	Good (STD)	18	24	18	14 16 15
P479-R-87815-1	Control	= to STD	= to STD	= to STD	= to STD	= to STD	= to STD	= to STD	= to STD	16	19	15	15 16 16
" R-87815-1A	Control	"	"	"	"	"	"	"	"	16	19	15	14 17 16
" R-87815-1B	Reducing Co. 25%	"	"	"	"	"	"	"	"	16	20	16	14 17 15
" R-87815-1C	"	"	"	"	"	"	"	"	"	18	23	18	14 17 15
" R-87815-1D	"	"	"	"	"	"	"	"	"	17	20	16	14 17 16
" R-87815-1E	"	"	"	"	"	"	"	"	"	16	20	16	14 17 16
" R-87815-1F	"	"	"	"	"	"	"	"	"	19	23	19	14 16 16
" R-87815-3	"	"	"	"	"	"	"	"	"	18	22	19	14 17 17
" R-87815-4	"	"	"	"	"	"	"	"	"	16	20	18	14 19 16
" R-87815-5	"	"	"	"	"	"	"	"	"	16	19	17	15 16 17
" R-87815-6	"	"	"	"	"	"	"	"	"	22	27	27	14 15 15
" R-87815-8	"	"	"	"	"	"	"	"	"	"	"	"	"

* Calcium Naphthate etc.

Tailcoat driers used in all experiments except R-87815-1 (control) and R-87815-10 which contain Naphthate. For further details regarding these results refer to Book # 5270 Page 15.

TABLE - # 6
Automotive "Dulux" (93-005) BLACK

Code	Description	DRIER				TACK				FREE				DEV				Hardness				Visc. # 3 ZAHN			
		INITIAL	1 WEEK	1 MONTH	6 MONTHS	INITIAL	1 WEEK	1 MONTH	6 MONTHS	INITIAL	1 WEEK	1 MONTH	6 MONTHS	INITIAL	1 WEEK	1 MONTH	6 MONTHS	INITIAL	1 WEEK	1 MONTH	6 MONTHS	INITIAL	1 WEEK	1 MONTH	6 MONTHS
93-005	Control	Naphth	4 Hrs	5 Hrs	6 Hrs	6 Hrs	6 Hrs	6 Hrs	6 Hrs	STD	STD	STD	STD	18	23	22									
P93R-87072	Reducing Co. 85%	Tallate	4 "	5 "	7 1/2 "	7 "	7 "	7 "	7 "	= To STD	= To STD	= To STD	= To STD	18	21	18									
" R-87073	" 50%	"	5 "	6 "	9 "	8 "	8 "	8 "	8 "	5 1/2" Inferior	5 1/2" Inferior	5 1/2" Inferior	5 1/2" Inferior	18	21	18									
" R-87074	" 80%	"	7 "	9 "	9 "	9 "	9 "	9 "	9 "	5 1/2" Inferior	5 1/2" Inferior	5 1/2" Inferior	5 1/2" Inferior	19	21	19									
" R-87075	" 100%	"	7 "	9 "	9 "	9 "	9 "	9 "	9 "	" "	" "	" "	" "	19	21	19									
" R-87077	" 50% and 50% Red. of Inhibitor	"	5 "	6 "	9 "	7 "	7 "	7 "	7 "	DEF. Inferior	DEF. Inferior	DEF. Inferior	DEF. Inferior	19	23	19									
" R-87079	" 50% Add .10 Pb. Ca. on the oil *	"	5 "	6 "	9 "	8 "	8 "	8 "	8 "	DEF. Inferior	DEF. Inferior	DEF. Inferior	DEF. Inferior	18	23	20									
" R-87081	" 50% Replace with Mn. Add .10 Pb. Ca. *	"	5 "	5 "	7 1/2 "	7 "	7 "	7 "	7 "	= To STD	= To STD	= To STD	= To STD	18	22	19									
" R-87083	" 50% " " " "	"	5 "	6 "	7 "	8 "	8 "	8 "	8 "	5 1/2" Inferior	5 1/2" Inferior	5 1/2" Inferior	5 1/2" Inferior	18	23	18									
" R-87085	" 50% Add Pb. to 10% Pb. Ca.	"	4 "	5 "	7 "	7 "	7 "	7 "	7 "	= To STD	= To STD	= To STD	= To STD	18	24	26									
" R-87087	" 50% Replace with Mn. Add Pb. Ca. *	"	4 "	5 "	6 "	7 "	7 "	7 "	7 "	= To STD	= To STD	= To STD	= To STD	18	22	25									
" R-87089	" 50% Replace with Mn. Add Pb. Ca. *	"	5 "	5 "	6 "	7 "	7 "	7 "	7 "	5 1/2" Inferior	5 1/2" Inferior	5 1/2" Inferior	5 1/2" Inferior	18	27	Gelled									
For Further Details Regarding These Results Refer To Book # 5368 AND BUREAU OF STANDARDS' METHOD OF 3/2/51																									
* CALCIUM NAPHTHENATE																									

TABLE #7
Automotive Durex (93-1863) Red

No.	Description	Type	Drier			Free Stack			Dry			Hardness			Visc. #3 ZAHN		
			INITIAL	4 Hrs	5 Hrs	5 Hrs	5 Hrs	5 Hrs	INITIAL	4 Hrs	5 Hrs	5 Hrs	5 Hrs	5 Hrs	INITIAL	4 Hrs	5 Hrs
93-1863	Control		Naphth.	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	22	27	25
P93R87068	Reducing Co.	25%	Tallate	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	21	24	24
" R87069	"	50%	"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	21	27	22
" R87070	"	80%	"	5"	7"	7"	7"	7"	7"	7"	7"	7"	7"	7"	21	24	24
" R87071	"	100%	"	6"	8"	8"	8"	8"	8"	8"	8"	8"	8"	8"	20	24	20
" R87076	"	50% Add 50% Red. of inhibitor	"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	21	29	23
" R87078	"	50% Add 10% Ch. on the oil. *	"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	21	28	22
" R87080	"	50% Replace with Mn. Add 1% Ch. *	"	4"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	21	29	22
" R87082	"	50% " " " "	"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	20	28	22
" R87084	"	50% Add Pb. to 20% Pb. Co.	"	7"	7"	7"	7"	7"	7"	7"	7"	7"	7"	7"	21	25	22
" R87086	"	50% Replace with Mn. Add Pb. to 30% Pb. Co.	"	7"	7"	7"	7"	7"	7"	7"	7"	7"	7"	7"	21	27	23
" R87088	"	50% Replace with Mn. Add Ch. I. 1/16"	"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	22	27	29
		50% 29/104/104	"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	5"	22	27	29

For Further Details Regarding These Results. Refer to Book #228 and B.M. Tamm's memo of 3/27/51.

* Calcium Naphthenate

Table # 8
"Duhux" Clear (RK-265)

Code	Description	Initial Dry Tack Free (Hours)	17 days 1 month 1 year	Viscosity Initial	Viscosity Final
PRKR-83122-1A	(Control)	TF 8	STD	F + 1/4	F
" R-83122-1B	Reducing Co. 25%	SLT 8	TF 7.5 = 6 STD	F	F
" R-83122-1C	" " 50%	T 8	SLT 8.25	F	F
" R-83122-1D	" " 80%	VT 8	T 8.25 SL. Supra	G	G
" R-83122-1E	" " 100%	VT 8	VT 8.25 Supra (same)	F	F
" R-83122-2	50% and 50% Red. inhibitor	SLT 8	SLT 8.25 = 6 STD	K	J
" R-83122-3	50% Add 10% Ca. on O.V *	VT 8	TF 7.5 SL. Supra	F	U-1/4
" R-83122-4	50% Replaced with Mn. Add 1% Ca. on oil *	T 8	TF 7.5	G - 1/4	U + 1/3
" R-83122-5	50% Replace with Mn.	SLT 8	TF 7.5	F	F
" R-83122-6	50% increase Pb. to 20% Pb/Co	SLT 8	TF 7.5	F	F-M
" R-83122-7	50% Replace with Mn. Add Pb. to 30% Pb/Co	TF 6	TF 6.75	E + 1/3	F-M
" R-83122-8	50% Replaced with Mn. Add Ca. to 1 1/2 % Ca/Co *	SLT 8	TF 8.25	F	T + 1/4
* Calcium Naphthenate					

For further details regarding these results Refer to Buks 5172 and 5177 and P. E. Hansen's memo of February 14, and 27, 1951.

TABLE # 9
Orthodox Varnish Clear (VK-913)

Code	Description	Initial Dry Tack		Sticking Power		Film Hardness		Viscosity	
		(Hours)	(Hours)	(Hours)	(Hours)	(Days)	(Days)	Initial	Final
PVK R-83123-1A	(Control)	3.0	STD	3.25	3.25	17 days	17 days	E+1/2	E
" R-83123-1B	Reducing Co. 25%	3.25	= to STD	3.25	3.25	"	"	E+1/2	E-1/4
" R-83123-1C	"	3.50	"	4.0	4.0	"	"	E+1/4	E-1/4
" R-83123-1D	"	4.0	"	5.75	5.75	"	"	E+1/2	E-1/3
" R-83123-1E	"	7.5	"	8+	8+	"	"	E+1/2	E-1/4
" R-83123-3	"	4.0	"	4.0	4.0	"	"	E+1/4	E+1/4
" R-83123-4	"	4.0	"	5.5	5.5	"	"	G-1/4	F-1/4
" R-83123-5	"	4.0	"	4.0	4.0	"	"	E+1/2	F-1/4
" R-83123-6	"	3.25	"	3.25	3.25	"	"	E+1/2	F-1/3
" R-83123-7	"	3.25	"	3.25	3.25	"	"	E+1/2	F-1/3
" R-83123-8	"	5.0	"	5.5	5.5	"	"	G+1/2	F+1/8
* Calcium Naphthenate									

FOR FURTHER DETAILS REGARDING THESE RESULTS REFER TO BOOKS 52-53 AND RS. LARSEN'S MEMO OF FEBRUARY 14, AND 28, 1951.