

TRADE-MAINTENANCE PRODUCTS

Research Report No. TM-110-A Interim

LEAD REMOVAL - EXTERIOR HOUSE PAINTS

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INTRODUCTION

To comply with the Chicago regulation allowing a maximum of .06% lead on the total non-volatile a program was initiated to remove all lead from solvent house paints. For investigative purposes our paints were divided into three groups as follows:

- A. Alkyd house paint - Y-1901
- B. Linseed oil house paints - Y-1801
- C. Exterior wood primer - Y-1851

SUMMARY

1. Manganese in combination with zirconium actually retarded dry as the manganese content increased. This was observed in all 3 systems; Alkyd, Oil, Primer.
2. Manganese in combination with zirconium and cobalt retarded dry as the manganese content increased; all 3 systems.
3. Zirconium gives a tougher through-dry than lead yet the film remains flexible, as tested on the Conical Mandrell; all 3 systems.
4. High cobalt concentrations, up to 0.13% metal for alkyds and 0.125% metal for oil, on vehicle solids, can be used without causing wrinkling if in combination with zirconium.
5. For feeder friers Troykyd Perma-Dry gives a boost to initial dry while Mooney #30 has no effect. Shelf stability is still being investigated.
6. Calcium as a "block" drier, or added to be absorbed by the pigment to prevent drier loss, has no initial effect on dry.
7. In all 3 systems lead-free drier combinations are equal to or better than the standard drier combinations.

Specific recommended drier combinations are as follows:

A. Alkyd House Paints - Y-1901

Standard

<u>Drier</u>	<u>Lbs./100 Gallons</u>	<u>% Metal on Vehicle Solids</u>
E-303	0.50	0.0161 Co
E-325	1.34	0.0323 Mn
E-347	6.43	0.6206 Pb
E-396	4.30	0.5072 Pb feeder

Recommended Lead-Free

E-303	1.00	0.032 Co
E-390	5.00	0.16 Zr
TroyKyd		
Perma-Dry	1.50	- - - -

Cost increase 2.1¢ per gallon over standard.

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Velvet House Paint

<u>Drier</u>	<u>Lbs./100 Gallons</u>	<u>% Metal on Vehicle Solids</u>
E-303	1.00	0.0625 Co
E-347	3.40	0.6375 Pb

Recommended Lead-Free

E-303	1.00	0.0625 Co
E-390	5.00	0.3125 Zr

Cost increase 3.3¢ per gallon over standard.

B. Oil House Paint - Y-1801

Standard

<u>Drier</u>	<u>Lbs./100 Gallons</u>	<u>% Metal on Vehicle Solids</u>
E-325	0.66	0.0155 Mn
E-342	11.60	0.7269 Pb
E-396	5.00	0.5744 Pb feeder
E-382	2.70	0.0423 Ca

Recommended Lead-Free

E-303	3.00	0.0940 Co
E-390	5.00	0.1567 Zr
TroyKyd		
Perma-Dry	1.50	- - - -

Cost increase 3.4¢ per gallon over standard.

C. Exterior Wood Primer - Y-1851

Standard

<u>Drier</u>	<u>Lbs./100 Gallons</u>	<u>% Metal on Vehicle Solids</u>
E-325	1.60	0.0483 Mn
E-347	4.50	0.5436 Pb
E-390	1.50	0.0604 Zr

Recommended Lead-Free

E-303	1.00	0.0403 Co
E-390	5.00	0.2013 Zr
TroyKyd		
Perma-Dry	1.50	- - - -

Cost increase 2.5¢ per gallon over standard.

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At 50° F. and 70% R.H. the paints dried considerably slower than at more normal drying conditions; however, the relationships were the same. At 50° F. and 70% R.H. all of the oil house paints wrinkled including the standard, which has no cobalt drier so no special significance could be attributed to the fact that cobalt drier was present in the new recommendations.

These paints will be checked again at 3 to 6 months shelf time to check for loss of dry and/or any change because of the Mooney or TroyKyd feeder driers. Blister resistance tests for Y-1851 are to be completed.

DISCUSSION

Paints were prepared as "blanks", without driers, and then various drier additions were made to carefully weighed samples. These finished samples were then aged for 24 hours and checked for dry, on drawdowns (3 mils wet), on sealed Leneta charts. The drier combinations were tested under both normal exterior summer drying conditions and severe drying conditions in the environmental room.

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CODES used in the following detailed listings:

D = Dry Through

TF = Tack Free

S = Soft

M = Mushy

E-303 = Cobalt 12%

E-325 = Manganese 9%

E-347 = Lead 36%

E-396 = Mooney Lead Feeder

E-390 = Zirconium 12%

E-371 = Zinc 16%

E-382 = Calcium 6%

E-342 = Lead 24%

All dry time reported in hours.

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DRYER COMBINATION LBS./100 GALLONS

A.

Y-1901	E-303	E-325	E-347	E-396	E-290	E-371	E-382	Troykyd Perma-Dry	Mooney No. 30	Normal	Dry Time Hours
Std.	0.50	1.34	6.43	4.3	-	-	-	-	-	Dry 7	-
Advance	1.88	-	-	-	2.52	-	-	-	-	" 7-3/4	-
Nuodex	0.64	-	-	-	9.52	-	-	-	-	" 14	-
Y-1850	-	1.20	-	-	-	2.20	14.50	-	-	" 11-3/4	-
#1	0.52	1.36	1.60	4.3	3.00	-	-	-	-	" 11-1/4	-
#2	0.52	1.36	-	4.3	3.52	-	-	-	-	" 13	-
#3	0.80	1.36	-	4.3	3.52	-	-	-	-	" 17	-
#4	1.24	-	-	-	2.52	-	-	-	-	" 6-1/2	-
#5	-	3.20	-	-	2.52	-	-	-	-	" 12	-
#6	-	1.60	-	-	2.52	-	-	-	-	" 15-1/2	-
#7	-	1.36	-	-	2.52	2.20	-	-	-	" 17	-
#8	1.88	0.56	-	-	2.52	-	-	-	-	" 9	-
#9	1.88	1.00	-	-	2.52	-	-	-	-	" 10-1/2	-
#10	1.88	1.50	-	-	2.52	-	-	-	-	" 11	-
#11	1.88	1.36	-	4.3	3.52	-	-	-	-	" 14-1/2	-
0-281 Std.	0.50	1.34	6.43	4.3	-	-	-	-	-	" 11-1/2	-
V2393 Std.	0.50	1.34	6.43	4.3	-	-	-	-	-	" 8	-
0-281	1.88	1.50	-	4.3	2.52	-	-	-	-	" 11-3/4	-
V-2393	1.88	1.50	-	4.3	2.52	-	-	-	-	" 11	-
0-281	1.88	-	-	4.3	2.50	-	-	-	-	" 9	-
0-281	1.88	-	-	4.3	1.75	-	-	-	-	" 8-1/4	-
#12	1.88	-	-	-	5.00	-	-	-	-	" 8	-
#13	1.88	-	-	-	2.50	-	-	-	-	" 7	-
#14	1.88	-	-	-	5.00	-	-	-	-	" 7-3/4	-
#15	1.88	-	-	-	5.00	2.20	-	-	-	" 5-3/4	-
#16	1.88	-	-	-	5.00	-	-	1.50	-	" 4-1/4	-
#17	1.88	-	-	-	2.50	-	-	-	-	" 6-3/4	-
#18	1.00	-	-	-	5.00	-	-	1.50	-	" 6-1/2	-
#19	0.50	-	-	-	5.00	-	-	1.50	-	" 10	-
#20	1.88	-	-	-	5.00	-	-	-	4.30	" 7-1/4	-

b.

DRYER COMBINATION LBS./100 GALLONS

B.

Y-1801	E-303 E-325 E-342 E-396 E-390 E-371 E-382				Troykyd Mooney		Dry Time Hours	
	E-303 E-325 E-342 E-396 E-390 E-371 E-382				Perma-Dry No. 30	Normal	50° F.-70° R	
Std.	-	0.66	11.60	5.00	-	-	TF9/Dry O/N	TF18/Dry 24
2	2.00	-	-	2.00	-	1.50	TF10-1/2 Dry O/N	TF32/Dry -
3	2.00	-	-	5.00	-	1.50	TF10/Dry O/N	TF32/Dry -
4	2.00	-	-	10.00	-	1.50	TF10/Dry O/N	TF18/Dry 24
5	3.00	-	-	2.00	-	1.50	TF9-1/2/Dry O/N	TF17-1/2/Dry 24
6	3.00	-	-	5.00	-	1.50	TF9/Dry O/N	TF17-1/2/Dry 24
7	3.00	-	-	10.00	-	1.50	TF14-1/2/Dry O/N	TF24/Dry 48
8	4.00	-	-	2.00	-	1.50	TF14-1/2/Dry O/N	TF18/Dry 24
9	4.00	-	-	5.00	-	1.50	TF14/Dry O/N	TF18/Dry 24
10	4.00	-	-	10.00	-	1.50	TF13-1/2/Dry O/N	TF18/Dry 24
11	2.00	-	-	2.00	-	-	TF -	TF24/Dry -
12	2.00	-	-	5.00	-	-	TF -	TF24/Dry -
13	2.00	-	-	10.00	-	-	TF22/Dry 24	TF18/Dry 24
14	3.00	-	-	2.00	-	-	TF20/Dry 24	TF22/Dry 26
15	3.00	-	-	5.00	-	-	TF20/Dry -	TF20/Dry 30
16	3.00	-	-	10.00	-	-	TF15/Dry O/N	TF21/Dry 30
17	4.00	-	-	2.00	-	-	TF15/Dry O/N	TF21/Dry 30
18	4.00	-	-	5.00	-	-	TF14-1/2/Dry O/N	TF20/Dry 30
19	4.00	-	-	10.00	-	-	TF14-1/2/Dry O/N	TF20/Dry 24
Tenneco 20	0.65	2.10	-	3.25	-	-	TF15/Dry O/N	-
21	0.65	-	-	3.25	-	-	TF15/Dry O/N	-
Std.	-	0.65	11.60	5.00	-	-	TF9/Dry 15	-
Std.	-	0.66	11.60	5.00	-	-	-	-
7	-	1.20	-	5.00	-	-	-	-
8	-	1.40	-	5.00	-	-	-	-
9	-	1.60	-	5.00	-	-	-	-
10	-	1.40	-	5.00	-	-	-	-
Y-2240-F	-	-	-	-	-	1.50	-	-
Std.	-	0.55	7.00	-	-	-	TF18/Dry 29	TF30/Dry 48
2	-	0.55	-	7.00	-	-	TF26/Dry 33	TF30/Dry 48
3	-	0.55	-	14.00	-	-	TF27/Dry 30	TF30/Dry 48
4	-	1.10	-	14.00	-	-	TF22/Dry 30	TF30/Dry 48

DRIER COMBINATION LBS./100 GALLONS

Y-5003	E-303	E-325	E-342	E-396	E-390	E-371	E-382	Troykyd	Mooney	Dry Time Hours
								Perma-Dry No. 30	Normal	50° F.- 70 RH
Std.	-	0.66	11.60	5.00	-	-	-	-	-	/Dry 14-1/2
7	-	1.20	-	-	5.00	-	-	-	-	/Dry 20
8	-	1.40	-	-	5.00	-	-	-	-	/Dry 22
9	-	1.60	-	-	5.00	-	-	-	-	/Dry 22
10	-	1.40	-	-	5.00	-	-	1.50	-	/Dry 19
A. velvet										
Std.	1.00	-	E-347	-	-	-	-	-	-	TF3/Dry 7
2	1.00	-	3.40	-	-	-	-	-	-	TF3/Dry 6
3	-	2.00	-	-	5.00	-	-	-	-	TF4/Dry 8
4	-	2.00	-	-	10.00	-	-	-	-	TF5/Dry 12
C. Primer Y-1851 - No Calcium										
Std.	-	1.60	4.50	-	-	-	-	-	-	TF2/Soft 4
24	0.50	-	-	-	1.50	-	-	-	-	TF2/dry 7
25	0.50	-	-	-	2.00	-	-	1.50	-	TF2/dry 7
26	0.50	-	-	-	5.00	-	-	1.50	-	TF2/S-7
27	1.00	-	-	-	10.00	-	-	1.50	-	TF2/S-7
28	1.00	-	-	-	2.00	-	-	1.50	-	TF2/D-7
29	1.00	-	-	-	5.00	-	-	1.50	-	TF2/S-9
30	1.00	-	-	-	10.00	-	-	1.50	-	TF2/D-6
31	1.50	-	-	-	2.00	-	-	1.50	-	TF2/S-7
32	1.50	-	-	-	5.00	-	-	1.50	-	TF2/S-7
33	1.50	-	-	-	10.00	-	-	1.00	-	TF2/S-7
34	0.50	-	-	-	2.00	-	-	-	4.30	TF2/S-4
35	0.50	-	-	-	5.00	-	-	-	4.30	TF2/D-7
36	0.50	-	-	-	10.00	-	-	-	4.30	TF2/S-7
37	1.00	-	-	-	2.00	-	-	-	4.30	TF2/S-7
38	1.00	-	-	-	5.00	-	-	-	4.30	TF2/S-7
39	1.50	-	-	-	10.00	-	-	-	4.30	TF2/S-7
40	1.50	-	-	-	2.00	-	-	-	4.30	TF2/S-7
41	1.50	-	-	-	5.00	-	-	-	4.30	TF2/S-4
42	1.50	-	-	-	10.00	-	-	-	4.30	TF2/S-7
43	0.50	-	-	-	2.00	-	-	-	-	TF2/S-4
44	0.50	-	-	-	5.00	-	-	-	-	TF2/S-7
45	0.50	-	-	-	10.00	-	-	-	-	TF2/S-7
46	1.00	-	-	-	2.00	-	-	-	-	TF2/D-7
47	1.00	-	-	-	5.00	-	-	-	-	TF2/D-7
	1.00	-	-	-	10.00	-	-	-	-	TF2/M-7
										TF2/S-7
										TF11-1/2/S-18
										TF11-1/2/D-18
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										TF11-1/2/D-18

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DRIER COMBINATIONS LBS./100 GALLONS

Y-1851		Troykyd. Mooney										50° F. - 70 .--	
No Calcium		E-303	E-325	E-347	E-396	E-390	E-371	E-382	Perna-Dry	No. 30	Normal		
48		1.50	-	-	-	2.00	-	-	-	-	TF2/D-6	TF11-1/2/S-20	
49		1.50	-	-	-	5.00	-	-	-	-	TF2/S-7	TF11-1/2/S-20	
50		1.50	-	-	-	10.00	-	-	-	-	TF2-1/2/S-7	TF11-1/2/S-18	
<u>Y-1851 with Calcium</u>													
Std.		1.00	-	-	-	2.00	-	-	-	-	TF2/D-6	TF6/S-24	
19		-	-	-	-	2.00	-	-	-	-	TF2/D-5-1/2	TF6/D-O/N	
20		0.30	-	-	-	2.00	-	-	-	-	TF2/D-6	TF6/D-O/N	
21		0.50	-	-	-	2.00	-	-	-	-	TF2/D-6	TF6/S-O/N	
22		0.70	-	-	-	2.00	-	-	-	-	TF2/D-6	TF6/S-O/N	
10		1.00	-	-	-	1.00	-	-	-	-	TF2-3/4/D-5	TF9/D-16	
11		1.00	-	-	-	2.00	-	-	-	-	TF4/D-6	TF6/D-10	
12		1.00	-	-	-	5.00	-	-	-	-	TF-2-1/2/D-4	TF6-1/2/D-9	
13		1.00	-	-	-	10.00	-	-	-	-	TF2-1/2/D-4	TF6/D-10	
14		1.50	-	-	-	1.00	-	-	-	-	TF2-1/2/D-4	TF6/D-10	
15		1.50	-	-	-	2.00	-	-	-	-	TF2-1/2/D3-1/2	TF6/D-10	
16		1.50	-	-	-	5.00	-	-	-	-	TF2-1/2/D-4	TF6/D-8	
17		1.50	-	-	-	10.00	-	-	-	-	TF2-1/2/D-3	TF6/D-10	
Std.		-	1.60	4.50	-	1.50	-	-	-	-	TF4-1/2/D-6-1/2	TF9/D-16	
A2		-	1.60	-	-	6.00	-	-	-	-	D-6-1/2	Wet 24	
A3		-	1.60	-	-	10.00	-	-	-	-	D-6	Wet	
A4		-	1.60	-	-	15.00	-	-	-	-	D-5-1/2	Wet	
A5		0.51	-	Act-8	-	-	-	-	-	-	D-4	TF8/D-O/N	
A6		0.51	-	-0.62	-	1.02	-	-	-	-	D-4-1/2	TF9/D-O/N	
A7		0.51	-	-	-	2.00	-	-	-	-	TF4/D-6-1/2	TF9/D-O/N	
A8		0.50	-	-	-	5.00	-	-	-	-	TF4/D-6	TF9/D-O/N	
A9		0.50	-	-	-	10.00	-	-	-	-	TF4-1/2/D-71	TF9/D-O/N	

COMMENT

Most of the drier recommendations made in this report are in line with the supplier's recommendations with exception of the linseed oil house paint, Y-1801. The .09% cobalt is excessively high in relation to the recommended amounts of .02 to .04%. The reason for this high amount was to achieve equal dry to the standard lead combination under cold damp drying conditions in the environmental chamber. We have been told that cobalt drier in excess of .04% will cause premature cracking and checking. Our own exposure reports of 1952 to 1956 show bad cracking when cobalt drier was used in Y-1850. (House paint - fume resistant.) We do not recommend issuing Y-1801 with .09% cobalt without adequate exposure history. If we had to issue a lead-free formula today we would go with a drier combination that would be 2 hours slower than standard under normal drying conditions and 6 hours slower under cold damp drying conditions.

These drier studies for Y-1801 were done on the 100% oil formula. Future work will be done with the C-pigment replacement formula vehicle system which replaces O-131 bodied linseed oil with alkyd resin V-2385. It is hoped that the dry improvement will be sufficient so the cobalt metal levels can be reduced to a safer level and prevent possible cracking.