REPORT NO. 926

E.I. DU PONT DE NEMOURS & CO. INC.
FABRICS AND FINISHES DEPARTMENT
CHEMICAL DIVISION
FARLIN LABORATORY

SUBJECT: STRIPPABLE PROTECTIVE SPRAY COATINGS
NAVY RESEARCH CONTRACT NOrd 5216

PERIOD: JANUARY 1, 1946 TO DECEMBER 31, 1946

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I - INTRODUCTION

This report covers the experimental work done under the subject research contract for the period January 1, 1946, through December 31, 1946. It supplements Parlin Laboratory Reports Numbers 900, 906 and 914 which covered the experimental work done on this problem from January 1, 1944, through December 31, 1945.

Reports number 900 and 906 covered the development phase of this project while report number 914 covered mainly surveillance tests of exposure series on the various formulations developed under the subject contract and of the NOLss. 193 Lacquer. This report covers a continuation of the surveillance tests of exposure tests recorded in report number 914.

II - RESULTS AND CONCLUSIONS

The conclusions drawn from the exposure series examined in the period covered by this report in general confirm and substantiate those recorded in report number 914.

However, at the request of the Naval Ordnance Laboratory, Silver Spring, Maryland, an additional exposure series was put out to evaluate "Protek-Coat", an asphaltic type material manufactured by Davison Chemical Company, as a topcoat for 52041 (Int.) stripping lacquer in the OP-1845 method of packaging.

The results of examining this exposure series after six months' exposure in Florida indicate that the use of "Protek-Coat" as a final topcoat over 52041 Lacquer definitely improves the durability of the lacquer film, but that an equal or possibly better means of improving the durability of the film can be accomplished by the use of a final topcoat of 52041 Lacquer pigmented with aluminum powder. This latter method also has the advantage of reflecting rather than absorbing light and heat rays so that the temperature change in the interior of a package would vary less in a 24 hour period than when "Protek-Coat" is used.

III - EXPERIMENTAL

The conclusions reached in the previous section of this report concerning the outdoor durability of stripping lacquers are based on the results of examining a large number of exposure series, the more important of which are as follows:

A - Exposure Series J-3034

This series was put out to determine means of improving the durability of the NOLSS-193 stripping lacquer when used in the OP-1845 method of packaging. Carbon black pigmented and aluminized vinyl (including the NOLSS-193 formulation), neoprene and ethyl cellulose types stripping lacquers were applied over the NOLSS-193 bridge on 15 x 15 inch wooden frames and also over airplane cloth on frames. Carbon black pigmented and aluminized "Duco" and a carbon black pigmented vinyl topcoat were also applied over the clear NOLSS-193 Lacquer. The films were sprayed to a thickness of 40 ± 5 mils and exposed in Florida facing south at 45°.

At the end of eighteen months' exposure the following observations were made:

(1) In general the pigmented vinyl type stripping lacquers have better initial film properties and show less deterioration than the neoprene or ethyl cellulose type. The one exception to this is a carbon black pigmented vinyl plasticized with tricresyl phosphate and modified with red lead which has become quite boardy and is definitely deficient in impact resistance.

(2) Pigmenting the clear vinyl with either carbon black or aluminum, or topcoating with a black vinyl topcoat definitely improves the durability. The use of a 5-6 mil thick black vinyl topcoat appears to be just as effective as completely pigmenting the film. The clear NOLSS-193 film at this stage has practically completely disintegrated with only small portions of the film having enough cohesive strength to remain on the frame.

(3) While black or aluminized "Duco" topcoats over the clear NOLSS-193 lacquer are not practical because of poor intercoat adhesion, the clear films underneath show practically no signs of deterioration, emphasizing the effect of pigmentation in protecting a clear vinyl film from the actinic rays of the sun.

Comparative data on the progressive weathering of the above films is contained in Chart No. I at the end of this report.

B - Exposure Series J-3092

This series was put out to determine (1) the optimum thickness of carbon black pigmented NOLSS-193 needed to protect a clear NOLSS-193 film on outdoor exposure, (2) the effect of molecular weight and vinyl chloride content on the durability of a stripping lacquer of the NOLSS-193 type, (3) the effect

of using different types of carbon black in pigmenting NOLSS-193 and (4) the effect of dispersing the carbon black in a steel ball mill versus a W. & P. mixer. The lacquers were applied at both a 40 mil and a 20 mil thickness over clean bare steel and were adhered to the edges of the panels with "Pliobond" adhesive.

At the end of one year's exposure in Florida, facing south at 45°, the following observations were made:

(1) A two mil thick carbon black pigmented modification of the clear when applied over the clear definitely improves the durability and at this stage in the exposure is as effective as thicker films or totally pigmented films.

(2) The clears all have darkened considerably, show bad surface checking, decreased toughness and bad corrosive effect on the substrate with the lower molecular weight/lower vinyl chloride content resin formulations being slightly poorer (the difference in decreased toughness is not as noticeable in the pigmented formulations).

(3) There appears to be no appreciable difference in the grades of carbon black tested, but carbon black dispersed in a W. & P. tends to return slightly better durability than when dispersed by steel ball mill grinding.

Comparative data on the progressive weathering of the films with varying thicknesses of pigmented topcoat is contained in Chart No. II at the end of this report.

G - Exposure Series J-3193

This series was put out to determine the relative durability of 13005, Clear Stripping Lacquer meeting specification 52041, under the following topcoats: (1) J-200-X-7131, a carbon black pigmented modification of 13005, (2) aluminized modifications of 13005 and (3) "Protek-Coat", an asphaltic type material made by Davison Chemical.

At the end of six months' exposure in Florida, facing south at 45°, the following observations were made:

(1) All of the topcoated films under test show little or no deterioration, while the clear has darkened considerably and checked badly. It has also decreased considerably in toughness as measured by loss in tensile strength and elongation.

(2) While those films having "Protek-Coat" as a topcoat over the clear show little change in toughness, the "Protek-Coat" has chalked considerably, lost its surface tack,

and is tending toward embrittlement. Those films having aluminized or carbon black topcoat show little surface change and no appreciable tendency toward embrittlement.

(3) The moisture vapor transmission rate of the films topcoated with an aluminized or carbon black topcoat has remained practically constant except in the case of the clear film with the 20 mils thick aluminized topcoat which has increased slightly. However, those films topcoated with "Protek-Coat" are showing an increase in MVTR above that of the aluminized film referred to in the previous sentence. This could possibly be due to the "Protek-Coat" becoming brittle.

The sample of "Protek-Coat" evaluated was received from the Naval Ordnance Laboratory, Silver Spring, Maryland. An analysis of the sample indicates that it is an asphaltic paint packaged at 65.6% total solids. It is non-pigmented, but contains a small amount of fibrous asbestos. It contains no drying oils or resins. It has a paste consistency and at room temperature is barely mobile.

It cannot be sprayed with conventional lacquer type spraying equipment, but it can be sprayed without reduction at room temperature under the following conditions to give a fairly smooth film with a build of 5-10 mils per spray coat. An "Eclipse Gat" spray gun equipped with a #17 internally atomizing head and an 1/8 inch tip can be used. A fluid pressure of 45 psi and an air pressure at the gun of 60 psi are required.

It air dries quite readily to a tacky, somewhat glossy film, have good adhesion to 52041 stripping lacquer at room temperature. The film has little or no cohesive strength. Its resistance to cold crack, however, is fairly poor, becoming stiff and brittle at 0°F., and cracking off the undercoat in large pieces when bent through 180° at this temperature. A topcoat of highly aluminized 52041 lacquer (20% aluminum paste on the lacquer) will also crack under these conditions but retains its adhesion to the clear undercoat.

While a topcoat of "Protek-Coat" does lower the MVTR of the film somewhat it is no better in this respect than a topcoat of highly aluminized 52041 lacquer at equal film thickness. It also reduces the total strength of the film somewhat more than a highly aluminized 52041 topcoat as indicated below:

System	Film Build	T.S.	Elong.	MVTR*
52041 Clear	35 mils	1595 psi	392%	39 grams (calculated to 50 mils
52041 Clear (30 mils) plus (52041 + 20% Al. paste) (20 mils)	50 mils	945 psi	368%	23 grams
52041 Clear (30 mils) plus "Protek-Coat" (20 mils)	50 mils	785 psi	356%	21 grams

*MVTR = grams/100 square meters/hour @ 39.5°C. at a vapor pressure differential corresponding to 100% relative humidity on one side of the film and less than 3% on the other side.

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CHART NO. I (J-3034)

SYSTEM	ORIGINAL* T.S.	Elong.	MVTR	6 MONTHS** T.S.	Elong.	MVTR	12 MONTHS** T.S.	Elong.	MVTR	18 MONTHS** T.S.	Elong.	MVTR	REMARKS
NOLSS-193 System	1420	300.0	35	985	415	62	-	-	-	-	-	-	failed completely
NOLSS-193 bridge plus J-200-X-6463 Black E/C type	495	40.0	136	1200	31.0	207	1290	8.0	191	-	-	-	too brittle to cut test pieces
NOLSS-193 bridge plus aluminized E/C type	486	29.0	113	1105	13.0	137	1175	-	127	-	-	-	too brittle to cut test pieces
NOLSS-193 bridge plus J-200-X-6453 neoprene type	450	400	55	680	85.0	154	773	40.0	38	594	56.0	77	
NOLSS-193 bridge plus aluminized neoprene type	340	110	29	437	40.0	292	542	26.0	121	288	24.0	119	
NOLSS-193 bridge plus J-200-X-6624 black vinyl type	1480	340	60	1570	215	45	-	-	-	-	-	-	too brittle to cut test pieces
NOLSS-193 bridge plus aluminized J-200-X-6624	970	260	16	880	175	86	-	-	-	-	-	-	too brittle to cut test pieces
NOLSS-193 system plus one double coat N/C black lacquer	1420	300	35	1630	440	51	1775	375	57	1688	376	38	
NOLSS-193 system plus one double coat N/C alumn.lacquer	1420	300	35	1510	440	49	1520	270	52	1607	368	43	
NOLSS-193 system plus 5 mils J-200-X-6624	1300	365	45	1400	435	66	1480	357	54	1435	336	32	
J-200-X-6463 over airplane cloth	-	-	206	-	-	181	-	-	227	-	-	-	too brittle to cut test pieces
J-200-X-6453 over airplane cloth	-	-	43	-	-	94	-	-	62	-	-	118	
J-200-X-6624 over airplane cloth	-	-	57	-	-	111	-	-	85	-	-	-	too brittle to cut test pieces
NOLSS-193 system pigmented with carbon black	1070	300	55	1510	405	45	1352	293	69	1370	286	77	
NOLSS-193 system aluminized	800	260	32	860	232	41	946	192	40	832	162	24	

* original tests run on Suter Tester
**Run on Scott Tester

T.S. = pounds/square inch
Elong.= percent
MVTR = grams/100 square meters/hr.@ 39.5°C. under a vapor pressure differential corresponding to 100% relative humidity on one side of the film and less than 3 percent on the other side.

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CHART NO. II - (J-3092)

SYSTEM	ORIGINAL T.S.	ORIGINAL Elong.	ORIGINAL MVTR	3 MONTHS T.S.	3 MONTHS Elong.	3 MONTHS MVTR	6 MONTHS T.S.	6 MONTHS Elong.	6 MONTHS MVTR	12 MONTHS T.S.	12 MONTHS Elong.	12 MONTHS MVTR	Remarks
NOLSS-193 40 mils	1750	470	49	1152	309	46	1262	296	71	1022	277	38	Darkened and badly checked
NOLSS-193 -38 mils +2 mils NOLSS-193 pigmented black	1670	435	37	1715	354	52	1787	405	41	1720	390	40	Substrate badly corroded
NOLSS-193 -35 mils +5 mils NOLSS-193 pigmented black	1750	455	39	1798	344	36	1880	405	36	1712	384	53	
NOLSS-193 -30 mils +10 mils NOLSS-193 pigmented black	1710	432	45	1667	352	40	1635	357	37	1665	368	37	
NOLSS-193 -25 mils +15 mils NOLSS-193 pigmented black	1670	455	68	1758	362	48	1919	408	43	1757	384	39	
NOLSS-193 pigmented black -40 mils	1450	410	49	1532	296	45	1703	320	45	1632	324	43	
NOLSS-193 -20 mils	1715	455	68	693	72	86	667	69	117	-	-	-	failed completely
NOLSS-193 -18 mils +2 mils NOLSS-193 pigmented black	1720	440	66	1750	349	65	1610	354	67	1645	357	61	
NOLSS-193 -15 mils +5 mils NOLSS-193 pigmented black	1790	450	66	1710	291	72	1585	338	72	1752	362	59	
NOLSS-193 10 mils +10 mils NOLSS-193 pigmented black	1590	430	65	1608	293	83	1439	312	90	1492	282	65	
NOLSS-193 pigmented black 20 mils	1890	410	63	1888	314	72	1710	333	70	1642	317	66	

T.S. = pounds per square inch
Elong. = percent
MVTR = gram/100 square meters/hr. @ 39.5°C. under a vapor pressure differential corresponding to 100% relative humidity on one side of the film and less than 3 percent on the other side.

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CHART NO. III (J-3193)

Panel No.	System	ORIGINAL T.S.	ORIGINAL Elong.	ORIGINAL MVTR	3 MONTHS T.S.	3 MONTHS Elong.	3 MONTHS MVTR	6 MONTHS T.S.	6 MONTHS Elong.	6 MONTHS MVTR	Remarks
1	#13005 lacquer -35 mils	1595 psi.	392%	56g.	1035 psi.	278%	38 g.	1296 psi.	286%	34 g.	darkened and badly checked
2	#13005 -45 mils +J-200-X-7131 (5 mils)	1645	417	35	1813	406	26	1952	422	32	no appreciable visual change in appearance
3	#13005 -45 mils + #13005 alum. with 5% Al.paste (5 mils)	1490	384	30	1550	391	42	1860	390	32	no appreciable visual change in appearance
4	#13005 -45 mils + #13005 alum. with 10% Al. paste (5 mils)	1430	384	31	1485	387	30	1620	405	27	no appreciable visual change in appearance
5	#13005 -45 mils + #13005 alum. with 20% Al. paste (5 mils)	1480	400	30	1393	414	22	1585	416	30	no appreciable visual change in appearance
6	#13005 -30 mils + #13005 alum. with 20% Al.paste (20 mils)	945	368	23	946	361	23	977	360	36	no appreciable visual change in appearance
7	#13005 -45 mil + "Protek-Coat" -5 mil	1395	389	27	1413	371	29	1597	368	46	considerable chalking and loss of surface tack
8	#13005 -40 mils + "Protek-Coat" -10 mil	1310	392	25	1308	361	28	1503	342	49	considerable chalking and loss of surface tack
9	#13005 -30 mils + "Protek-Coat" -20 mil	785	356	21	854	354	41	1097	345	44	considerable chalking and loss of surface tack

13005 = clear lacquer meeting 52041

J-200-X-7131 = 13005 pigmented with carbon black

Aluminum paste = #205 Alcon Albron Paste

MVTR = grams/100 square meters/hour @ 39.5°C. at a vapor pressure differential corresponding to 100% relative humidity on one side of the film and less than 3% on the other side.

T.S. = tensile strength (lbs./square inch)

Elong.= percent

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