EXHIBIT 58

CSL-140A
(Supersedes CSL-140)

Report from the
COATINGS SERVICE LABORATORY

ADHESION OF LACQUERS TO ALUMINUM FOIL

Requirements of good coatings for aluminum foil – adhesion, fast-dry, flexibility, printability, and light stability – can be obtained from lacquers based on nitrocellulose or ethyl cellulose.

Adhesion is particularly difficult to achieve on aluminum because of the smooth, dense, impervious surface of the metal; and aluminum foil usually presents an even more difficult problem because the oil residues which have been baked into the surface during processing are not usually removed. Thus, coatings that have good adhesion to untreated foil are relatively uncommon.

Good adhesion to untreated aluminum foil has been obtained in our laboratory with lacquers and inks based on Hercules® Ethyl Cellulose and Nitrocelliulose. This report presents results obtained from two programs; the first section covers studies made with nitrocellulose lacquers and the second reports studies with ethyl cellulose lacquers.

A. ADHESION OF NITROCELLULOSE LACQUERS

The Hercules Coatings Service Laboratory investigated the adhesion of four nitrocellulose-based formulations to two types of untreated foil – "Reynolds Wrap" foil sold for household use, and a heavy-duty foil used as an overwrap on cigarette cartons. The coatings were applied with a No. 150 hand gravure roller, flash-dried a few seconds, then force-dried 2 minutes at 180°F.

Nitrocellulose lacquers modified with a poly(vinyl acetate) resin were found to have strong adhesion to Reynolds Wrap. This untreated foil is particularly difficult to coat because a special oil, which causes poor adhesion of coating materials, is applied after processing to protect its surface (formulations #1 and #2 in Table I). These same lacquers, surprisingly, had only fair adhesion to the foil used to overwrap cigarette cartons; here the processing oils were baked on the foil surface. Two other lacquers, one modified with a polyamide and the other with Neolyn® 23 resin (formulations #3 and #4 in Table I), adhered to the overwrap foil surface more strongly than the commercial coating presently used.

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Table I

ADHESION OF LACQUERS TO ALUMINUM FOIL

Vehicle Solids	1(a)	2(a)	3(a)	4(a)	5 Commercial foil coating
RS* Nitrocellulose, 1/2 sec.	-	-	-	50	
SS* Nitrocellulose, 1/2 sec.	25	20	50	-	
Poly(vinyl acetate) (Gelva V-25)	60	40	-	-	
Polyamide (Versamid 940)	-	-	-	36	
Neolyn® 23 resin	-	-	36	-	
Acetyl tributyl citrate	15	40	-	-	
Dicyclohexyl phthalate	-	-	-	14	
Santicizer 141	-	-	14	-	
Total	100	100	100	100	
Physical Properties					
Scotch Tape adhesion(b) to:					
Reynolds Wrap (untreated foil)	G	G	-	P	-
Untreated foil used for cigarette carton overwrap	F	F	G	G	F
Shellac-treated foil	P	F	-	G	-
Blocking, 130°F. 2 p.s.i. at 40 hr.					
Face-to-face	B	B	NB	NB	-
Face-to-back	NB	NB	NB	NB	-

*Hercules Trademark

Legend: B = block; NB = no blocking; G = good; F = fair; P = poor.

(a) Solvent Systems:

	For Formulations 1 & 2	For Formulation 3
Toluene	43	50
Ethyl alcohol	17	20
Ethyl acetate	13	15
Butyl acetate	27	15
	100	100

For Formulation 4 – Dissolve Versamid 940 in a 50:50 mixture of toluene and ethyl alcohol. Add this solution to a nitrocellulose-plasticizer solution dissolved in solvent(b).

(b) Adhesion test method – Adhesion was tested by firmly pressing Scotch Brand Acetate Film Tape No. 800 on the coating. The tape was removed by pulling it back at an angle of 180°. Adhesion was noted as:

Good – no failure occurred when tape was removed abruptly.
Fair – failure occurred when tape was abruptly removed. No failure occurred when tape was pulled back slowly.
Poor – failure occurred when tape was removed slowly.
Very poor – no force was required to remove coating.

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B. ADHESION OF ETHYL CELLULOSE LACQUERS

Hercules® Ethyl Cellulose N-10, modified with Aroclors 1254 and 5460 (lacquer #1, Table II), produced a coating having excellent adhesion and flexibility on both lightweight and heavy aluminum foil. Aging of the lightweight coated foils for two months did not impair film adhesion properties. This formulation was at least as good as the better of two commercial foil lacquers on lightweight foil (Table IV), and superior to both on heavy-gauge foil (Table V).

Two other experimental lacquers (#4 and #6, Table II) had good to excellent initial adhesion on lightweight foil, about equivalent to the better of the two commercial coatings. On two months' aging, however, some loss of adhesion resulted (Table IV). On heavy-gauge foil, #6 lacquer was unsatisfactory, but #4 was somewhat better than the commercial products (Table V).

Special tests involved additions of 0.25% phosphoric acid to determine if adhesion could be improved by the etching action of the acid on the foil. Little if any effect was observed (Tables IV and V).

A report from the trade had previously stated that adhesion was adversely affected by addition of certain dyes such as Calco Fast Spirit Red B. This report was not substantiated by these tests.

The most effective modifiers for improved foil lacquers based on ethyl cellulose were:

1. Aroclors 1254 and 5460.
2. Triphenyl phosphate and Resimene 881.

Five experimental ethyl cellulose lacquers (#1 through #5, Table II) were tested at 1-mil film thickness for initial adhesion and flexibility on lightweight aluminum foil. The results, compared with four commercially coated foils, were used to select most promising compositions for further testing. Results are in Table III.

The two best lacquers (#1 and #4, Tables II and III) were coated along with a third composition (#6, Table I) in nominal film thickness of 0.2 mil on both lightweight and heavy-gauge aluminum foil. Results on lightweight foil are in Table IV, and on heavy-gauge foil in Table V. See page 6 for description of test methods used as reported in these tables.

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Method Of Film Casting

On lightweight foil, the coatings were cast with a Hercules casting knife, air-dried 5 minutes, force-dried 5 minutes at 190°F., and air-dried overnight.

The heavy-gauge foil was dip-coated, air-dried 5-10 minutes, force-dried 5 minutes at 190°F., and air-dried overnight.

Table II

ETHYL CELLULOSE LACQUER
COMPOSITIONS FOR ALUMINUM-FOIL COATING

Solids	1	2	3	4	5	6
Hercules® Ethyl Cellulose N-10	60	60	60	50	50	-
Hercules Ethyl Cellulose N-14	-	-	-	-	-	50
Aroclor 1254	20	-	-	-	-	-
Aroclor 5460	20	-	-	-	-	-
Super Beckacite No. 1001	-	28	-	-	-	-
Tricresyl phosphate	-	6	-	-	-	-
Triphenyl phosphate	-	6	10	25	-	-
Staybelite Ester® No. 10	-	-	30	-	-	40
Santicizer B-16	-	-	-	-	-	10
Resimene 881	-	-	-	25	25	-
Paraplex RG-2	-	-	-	-	25	-
	100	100	100	100	100	100
Solvent						
Xylene	80	80	-	80	80	80
Toluene	-	-	80	-	-	-
Isopropanol	20	20	-	20	20	20
Ethyl acetate	-	-	20	-	-	-

Table III

ETHYL CELLULOSE FILM PROPERTIES

	Lacquer No.					Commercially Coated Foils			
Adhesion - Initial	1	2	3	4	5	1	2	3	4
Tape test (method A)	E	G	G	E	F	G	G	G	G
Fingernail test	E	E	G	E	F	G	G	G	G
Flexibility (180° crease at 75°F.)									
Initial	E	E	E	E	E	E	E	E	E
Nominal film thickness	1 mil								
Aluminum foil gauge	0.35-0.40 mil								
Lacquer solids, %	33								

Legend: E = excellent, no effect; G = good, very slight effect; F = fair, moderate effect; P = poor, noticeable effect.

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Table IV

ETHYL CELLULOSE FILM
PROPERTIES ON LIGHTWEIGHT FOIL

	Lacquer Number			Commercial Lacquer	
Adhesion – Initial	1	4	6	X	Y
Tape test (method C)					
Lacquer additive - none	E	E	G	F	G
acid[a]	E	E	E	F	E
dye[b]	E	E	E	P	E
acid[a] + dye[b]	E	E	G	P	E
Adhesion – 2 Months Aging					
Tape test (method C)					
Lacquer additive - none	E	E	P	F	E
acid[a]	E	P	P	F	E
dye[b]	E	P	G	P	E
acid[a] + dye[b]	E	P	P	P	E
Flexibility (180° crease at 75°F.)					
Initial	E	E	E	E	E
Aged 2 month	E	E	E	E	E
Nominal film thickness	0.2 mil				
Aluminum foil gauge	0.35-0.40 mil				
Lacquer solids, %	14-15.5				

Legend: Same as in Table III on page 4.

(a) 0.25% phosphoric acid based on lacquer solids.
(b) 2.6% Calco Fast Spirit Red B dye based on lacquer solids.

Table V

ETHYL CELLULOSE FILM
PROPERTIES ON HEAVY-WEIGHT FOIL

	Lacquer Number			Commercial Lacquer	
Adhesion – Initial	1	4	6	X	Y
Tape test (method B except as noted)					
Lacquer additive - none	E	E	P[a]	G	P[a]
acid[b]	E	E	P	G	-
dye[c]	E	E	P	P	P
acid[b] + dye[c]	E	P	P	E	-
Flexibility (180° crease at 75°F.)					
Initial	E	E	E	E	E
Nominal film thickness	0.2 mil				
Aluminum foil gauge	3.5-4.5 mils				
Lacquer solids, %	14-15.5				

Legend: E = excellent, no effect; G = good, very slight effect; F = fair, moderate effect; P - poor, noticeable effect.

(a) Tape test method C.
(b) 0.25% phosphoric acid based on lacquer solids.
(c) 2.6% Calco Fast Spirit Red B dye based on lacquer solids.

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ADHESION TEST METHODS

Tape Test Method A

Three inches of 1-inch wide Scotch Tape was applied and smoothed over the coated foil. After 30 to 60 seconds, it was rapidly pulled away from the surface. Adhesion was estimated by noting the amount of lacquer removed by the Scotch Tape.

Tape Test Method B

Same as Test A, except that a 1,000-gram weight was rolled over the Tape after application.

Tape Test Method C

Same as Test A, except masking tape was used in place of Scotch Tape and a 200-gram weight was used. This method is not as severe a test as Method B.

Fingernail Test

An area of the coated foil was crosshatched in approximately 1/8 to 3/16 inch squares with a razor blade. Adhesion was estimated by ease of removal when scratched with the fingernail.

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