MOISTURE EXCLUDING EFFECTIVENESS AND WEIGHT OF AIRCRAFT FINISHES ON PAPREG AND ON PLYWOOD

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MOISTURE-EXCLUDING EFFECTIVENESS AND WEIGHT OF AIRCRAFT FINISHES ON PAPREG AND ON PLYWOOD[1]

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Introduction

This study was part of a broader investigation of the finishing characteristics of papreg, the laminated paper plastic developed at the Forest Products Laboratory, and of aircraft finishes for plywood. The work was started under authorization of the Army-Navy Aeronautical Directional Committee, but the authorization was withdrawn before all the test panels originally programmed could be prepared. After the curtailment, those tests that were already under way were continued, but no further test panels were prepared. The results presented in this report, therefore, represent a preliminary survey rather than an adequate study of the subject.

Papreg presents a glazed, nonporous surface in contrast to the vascular surface of wood. Finishing materials do not penetrate into papreg, which therefore has no need of the sealers or primers required to hold out coatings on wood. Likewise papreg, being immune to the corrosion to which metals are subject, needs no inhibitive primers. The presumption is that finishing systems for papreg may be simpler and lighter in weight than those for wood or metal.

Finishes must cling to papreg entirely by specific adhesion without the aid of the mechanical adhesion available on wood. Under such circumstances, the fact that the surface of papreg consists largely of hardened phenolic resin makes it necessary to consider carefully whether requirements of compatibility with the resin may not restrict the nature of the vehicle in finishes suitable for papreg.

Papreg resembles wood more closely than it does metal in that papreg absorbs moisture and swells, though the amount of absorption under comparable conditions is less than that of wood. At edges of sheets where papreg has been cut, moisture is absorbed more rapidly than it is through surfaces that were in contact with the platens of the press in which the papreg was formed. It is assumed for the present that finishes, suitable for papreg to be exposed to the weather, should be protective finishes in the sense of retarding the movement of moisture. Even if the papreg itself requires no protection against weathering, it seems likely that a nonprotective coating probably would not maintain its own integrity very long. The Forest Products Laboratory

[1]This mimeograph is one of a series of progress reports prepared by the Forest Products Laboratory to further the Nation's war effort. Results here reported are preliminary and may be revised as additional data become available.

method of measuring moisture-excluding effectiveness of wood finishes is adaptable to similar evaluation of finishes on papreg.

Testing Procedure

Test specimens of papreg were 1/16 by 4 by 8 inches in size. The papreg was from batch number P1823-11-250; it was made of paper impregnated with Bakelite resin BV-16526 by Consolidated Water Power and Paper Co. and laminated at the Forest Products Laboratory, using the same resin and a pressure of 250 pounds per square inch. Plywood specimens were 3/32 by 4 by 8 inches in size, of several species of wood, made of three plies glued with phenolic resin, hot-pressed glue. All specimens were kept in 65 percent relative humidity at 80° F. until they came to constant weight.

Finish was applied to all surfaces of test specimens including the edges, and was allowed to dry in 65 percent relative humidity at 80°F. The specimens were then reweighed and the increase in weight recorded as the weight of finish, reported in pounds per 100 square feet of total surface. The total surface of the plywood specimens was 0.460 square foot, of papreg specimens 0.455 square foot.

After coming to equilibrium at 65 percent relative humidity, the finished specimens, together with two specimens of papreg and two of each kind of plywood left unfinished to serve as control specimens, were moved to 97 percent relative humidity at 80° F. After one week in the high humidity, all specimens were again weighed. The increase in weight in 97 percent humidity was considered moisture absorbed by the specimen, and the difference in absorption between a finished specimen and the average for the two unfinished control specimens of the same material was considered the moisture excluded by the finish. The moisture exluded by the finish, expressed in percentage of the average absorption by the unfinished control specimens, is the moisture-exluding effectiveness of the finish.

The extent to which the uncoated papreg and plywood specimens absorbed moisture during one week in 97 percent relative humidity, after previous equilibrium with 65 percent relative humidity, is shown in table 1.

In applying finishing materials, wood filler was brushed on and then wiped off according to the usual practice. Aircraft dope was applied by brushing. All other finishing materials were applied by dipping.

All but one of the finishing materials were commercial products sold for aircraft finishing. Comparison of one manufacturer's products with those of another, however, was not a primary objective of the work. The aim was to include finishes from a sufficient number of commercial sources to afford a reasonable representation. The major purpose was to study the combination of finishing materials into finishing systems, particularly systems of minimum weight and minimum number of operations consistent with the degree of moisture-excluding effectiveness presumably required for adequate protection. It was considered important to learn how much is contributed to the moisture-excluding effectiveness of a finishing system by sealers, fillers, surfacers, gloss enamels, and camouflage enamels and to compare oleoresinous finishes with lacquer finishes and direct finishes with fabric finishes. The curtailment of the original program has impaired the scale on which these comparisons can be made.

Accordingly, the finishing systems studied are not necessarily those recommended by the manufacturers of the products used. In general, emphasis was placed on systems consisting of fewer materials and fewer coats than are commonly advised. It was further assumed that a finishing system suitable for papreg may be somewhat simpler than the corresponding system for plywood, inasmuch as papreg may be considered sealed or primed to begin with.

The one finishing material not obtained from a commercial source was an aluminum primer, which was made at the Forest Products Laboratory. A spar varnish was made from paraphenylphenol-formaldehyde resin, tung oil, and linseed oil, in conformity with Army-Navy Aeronautical Specification AN-TT-V-118. To one gallon of the varnish, 1-3/4 pounds of standard aluminum paste was added. When freshly mixed, this paint dried promptly, but after standing for several days it became slow in drying. For these experiments it had stood some days before application. There is, therefore, reason to doubt that it is representative of good aluminum primers.

The various classes of finishing materials used, such as sealer, surfacer, gloss enamel, and camouflage lacquer, are listed in table 2 together with identifying symbols and the Army-Navy Aeronautical or Army Air Forces specifications to which they presumably conformed. Materials were not tested for conformity to specifications. The identifying symbols as used in the tables were also used in marking test specimens. The symbols are combined to indicate finishing systems. Thus the symbol AXR means a system consisting of one coat of clear sealer, one coat of sanding surfacer, and one coat of camouflage enamel, applied in the order named. If more than one coat of a material is applied, the symbol is repeated for each additional coat; thus TT/TTTVV means a system consisting of two coats of clear dope, a covering of fabric, three coats of clear dope, and two coats of gloss pigmented dope, applied in the order named.

Each manufacturer of finishing materials was assigned an identifying number, which appears in tables 3 and 4. The key to the numbers is part of the original records of the work but is omitted in this report. For marking test specimens the manufacturer's number was written as a prefix and the identification number of the papreg or plywood from table 1 was written as a suffix. Thus the complete symbol 3-AXR-5 means finishing system AXR, using materials supplied by manufacturer 3, tested on yellow-poplar plywood.

Results

Table 3 presents the weight of finish and the moisture-excluding effectiveness for the direct-on-plywood or direct-on-papreg finishes tested. Table 4 presents the results for fabric finishes.

Papreg Compared with Plywood

The moisture-excluding effectiveness of finishes on papreg varied through nearly the same range as finishes on wood. In table 3, the finishes on papreg varied from 9 percent to 74 percent in effectiveness. Finishes on plywood varied from -4 percent[2] to 89 percent in effectiveness. In general, the finishes on papreg stood in the same order of effectiveness as they did on plywood, that is, the higher of two finishes on papreg was likewise the higher of the same two on plywood.

The effectiveness of a finish on papreg increased with the thickness of the coating, just as has long been known of finishes on wood. Compare, for example, finish 8-M with 8-MM, finish 12-P with 12-PP, and finish 4-L with 4-LL in table 3. In each comparison, the one-coat finish is lower in effectiveness, lighter in weight, and thinner than the corresponding two-coat finish. The one-coat finishes averaged 0.85 pound per 100 square feet and 29 percent effectiveness, whereas the two-coat finishes averaged 2.70 pounds per 100 square feet and 41 percent effectiveness.

Less finish was applied on papreg than on plywood, even when the number of coats was the same on both kinds of material. The difference arose chiefly with the first coat of finish applied, which was usually much lighter in weight on papreg than on plywood. The relatively nonabsorptive nature of the surface presented by papreg, in contrast to the absorptive surface of wood, accounts readily for the observed difference in weight of finish applied. For the same reason, a single application of finish on papreg often formed a coating continuous enough to afford substantial moisture-excluding effectiveness, an achievement rarely possible on wood. Finish 12-P, for example, was 48 percent effective on papreg, with a weight of 1.20 pounds per 100 square feet, and coating 3-S was 58 percent effective with a weight of 0.63 pound per 100 square feet. No one-coat finishes were tested on plywood because much previous work has shown that a single coat is nearly always low in effectiveness (Forest Products Laboratory Technical Note No. 181 and Mimeograph No. R974).

Finishes 1-BR, 8-ZM, 12-PP, and 12-RP were tested on papreg, birch, and yellow-poplar. On papreg the four finishes averaged 40 percent effectiveness and 1.89 pounds per 100 square feet in weight. On birch the average effectiveness was 44 percent and the average weight 2.38 pounds. On yellow-poplar the average effectiveness was 34 percent and the average weight 2.69 pounds. The limited amount of data suggest that, on papreg, the weight of finish required to attain moisture excluding effectiveness between 44 percent and 34 percent may be fully 0.5 pound per 100 square feet less than is needed on plywood. This is a saving of one-sixth to one-fifth of the weight of the simpler types of direct finish.

Twelve of the finishes reported in table 3 were tested both on papreg and on yellow-poplar; their average weight and average effectiveness, respectively, were 1.80 pounds and 40 percent on papreg and 2.48 pounds and 24 percent

[2]Negative effectiveness means that the specimens with finish absorbed more moisture in 97 percent relative humidity than the control specimens without finish. Such results are usually considered experimental errors attributable to variability even among matched specimens of wood.

on yellow-poplar. Seven finishes were tested both on papreg and on birch; their average weight and average effectiveness, respectively, were 2.27 pounds and 40 percent on papreg and 2.69 pounds and 49 percent on birch. These results confirm the conclusion that a given degree of moisture exclusion can be attained on papreg with less weight of finish than is required on wood.

From the data presented in the two preceding paragraphs it may be that to attain equal effectiveness, slightly more finish is required on yellow-poplar than on birch. There were 12 finishes tested both on birch and on yellow-poplar. On birch the average weight of the 12 finishes was 3.34 pounds per 100 square feet and the average effectiveness was 42 percent, whereas on yellow-poplar the average weight was 3.85 pounds and the average effectiveness was 36 percent.

Among the fabric finishes from manufacturer 13, reported in table 4, wood sealer was applied for the first step on plywood but was not used on papreg. For each fabric finish on papreg, however, there was a corresponding finish on birch and on yellow-poplar plywood that differed only in the use of sealer on the plywood and its omission on the papreg. For the six sets of fabric finishes that may be so compared, the average weight of finish was 9.16, 8.81, and 9.47 pounds per 100 square feet on papreg, birch, and yellow-poplar respectively, and the average moisture-excluding effectiveness was 19 percent on papreg, 45 percent on birch, and 33 percent on yellow-poplar. The weight of fabric finish on papreg, therefore, was not significantly less than that on plywood, despite the omission of sealer on papreg, but the moisture-excluding effectiveness was much lower on papreg than on birch or yellow-poplar plywood. Apparently the oleoresinous sealer used on plywood must be credited with effecting the higher moisture-excluding effectiveness observed on plywood in comparison with papreg. If so, it is evident that the fabric and dope finishes offered much less resistance to movement of moisture than is obtainable with oleoresinous finishes.

Comparisons of Finishing Systems

Because of the limited number of tests, it is not possible to draw firm conclusions about the comparative effectiveness of the different finishing systems. The trends of the results, however, agreed well with expectations based on past experience with the kinds of finishing materials in question.

Among one-coat finishes on papreg, an aluminum enamel was 58 percent effective, three gloss oleoresinous enamels averaged 43 percent effective, a gloss lacquer was 23 percent effective, six camouflage oleoresinous enamels average 20 percent effective, and two camouflage lacquers averaged 15 percent effective. For systems consisting of two coats of a single material, aluminum enamel was 72 percent, gloss oleoresinous enamel 63 percent, gloss lacquer 31 percent, and camouflage lacquer 29 percent effective. Three coats of gloss pigmented dope were 17 percent effective.

Camouflage oleoresinous enamels generally were lower in effectiveness than gloss enamels although the poorest gloss enamel was less effective than the best camouflage enamel. Similarly, camouflage lacquer was less effective than gloss lacquer. The relatively permeable nature of the camouflage coatings results, of course, from the excessive proportion of pigment necessary to produce a lusterless surface. One camouflage enamel, however, was much more effective than the others. The most effective one, that made by manufacturer 7, was not entirely lusterless and might not have passed specifications with respect to lack of gloss. The relatively effective camouflage enamel undoubtedly contained less pigment than the others. The results indicate a need for thorough study of the pigmentation of lusterless finishes for exterior surfaces.

It is noteworthy that camouflage enamels, except for the unusual one of manufacturer 7, tended to have lower effectiveness on plywood than on papreg, whereas gloss enamel when applied in two coats was fully as effective on plywood as it was on papreg. Often two coats of camouflage enamel on plywood were less effective than one coat on papreg. Wood, of course, absorbs part of the vehicle from at least the first coat of a pigmented material, thereby materially increasing the proportion of pigment in the coating left on the surface. With camouflage enamel, which is already unduly high in pigment, apparently the second coat may be similarly altered by absorption of vehicle. Gloss enamel, however, has enough vehicle to prime the wood with the first coat, if it is a reasonably generous one, so that the second coat remains undisturbed in composition. The nonabsorptive nature of papreg, on the other hand, leaves even camouflage coatings essentially unaltered in composition.

In line with the foregoing considerations, use of sealer under camouflage finishing coats sometimes improved the moisture-excluding effectiveness but it did not improve the effectiveness of gloss finishing coats. When a sanding surfacer was used under finishing coats, the weight of coating was increased greatly; the effectiveness usually increased observably but not to an extent comparable with the increase in weight.

Among the fabric finishes, those with camouflage dope were significantly lower in moisture-excluding effectiveness than those with gloss pigmented dope. Use of aqueous-emulsion lacquer in place of aqueous-emulsion dope for cementing and sealing the fabric slightly improved the effectiveness at the cost of slight increase in weight. The improvement in effectiveness may have been no more than the increased weight accounts for. In view of their relatively great weight, all of the fabric finishes must be considered very low in effectiveness per unit weight.

Minimum Finishes for 50-percent Effectiveness

The minimum degree of moisture-excluding effectiveness that should be demanded of protective finishes for wood exposed to the weather has not been established, but for aircraft a minimum of 50 percent certainly should not be unreasonable. Good house paints materially exceed that minimum.

Table 5 summarizes the finishes that attained at least 50 percent moisture-excluding effectiveness on papreg and on yellow-poplar plywood. The finishes are listed separately for papreg and for plywood, in each starting with the finishes of fewest coats and lightest weight and proceeding to the more complicated and heavier finishes. The last column of table 5 records the ratio of moisture-excluding effectiveness to weight of coating. The ratio is useful as a crude indication of a relation between effectiveness and weight, but a more satisfactory scale of values would be furnished by the ratio between moisture impedance and the product of thickness of coating by average specific gravity of coating.

On papreg the arbitrary minimum of 50-percent moisture-excluding effectiveness was achieved with a single coat of aluminum enamel or of gloss enamel, but no one-coat finish tested on plywood reached that standard. On plywood, the minimum was attained in two-coat systems having either aluminum enamel or gloss enamel for the second coat. For finishes with lusterless surface, the fewest coats to attain 50-percent effectiveness were two on papreg and three on plywood.

None of the lacquer, dope, or fabric-and-dope finishes tested attained 50-percent moisture-excluding effectiveness on papreg or on yellow-poplar plywood.

On papreg the minimum of 50-percent effectiveness was attained with an aluminum finish at a weight of 0.63 pound per 100 square feet, but yellow-poplar plywood took 1.49 pounds of aluminum finish to pass the required minimum in effectiveness. Similarly with gloss finish, a weight of 1.39 pounds sufficed on papreg whereas 3.50 pounds were necessary on yellow-poplar plywood to attain 50 percent effectiveness. Among lusterless finishes, the lightest to pass the requirement on papreg weighed 4.03 pounds and on yellow-poplar plywood weighed 7.30 pounds per 100 square feet.

Greatest moisture-excluding effectiveness for least weight (highest ratio of E/W) was achieved with aluminum finishes, both on papreg and on plywood. Next in order were the gloss finishes in which the sanding surfacer was omitted. A surfacer always increased the weight of finish without achieving a proportionate increase in moisture-excluding effectiveness. All of the lusterless finishes that met the required minimum of 50 percent moisture-excluding effectiveness were relatively heavy finishes.

Table 1.--Moisture absorbed by uncoated papreg and plywood test specimens after 7 days in 97 percent relative humidity.[1]

Material	Material reference number	Weight in 65 percent relative humidity	Gain in moisture content after 7 days in 97 percent relative humidity
		Grams	Grams
Papreg	0	44.41	2.31
Mahogany	1	31.03	3.71
Walnut	2	37.53	3.98
Birch	3	37.52	5.27
Maple	4	38.97	4.63
Yellow-poplar	5	23.33	3.41
Sweetgum (sliced)	6	31.88	4.17
Sweetgum (rotary)	7	30.87	4.03
Douglas-fir(sliced)	8	27.78	3.26
Sitka spruce(sliced)	9	36.34	4.11

[1]Specimens initially were in equilibrium with 65 percent relative humidity at 80° F. Each value is the average of two similar test specimens.

Table 2.--Classes of finishing materials used, identification symbols, and specifications to which they presumably conformed.

Identification symbol	Material	Army Air Forces or Army-Navy Aeronautical specification
A	Clear sealer for wood, oleoresinous type	AN-S-17
A'	Wood filler, oleoresinous type	-------
B	Pigmented sealer, oleoresinous type	AN-S-17
C	Aluminum primer, oleoresinous type	AN-TT-V-118
X	Sanding surfacer, oleoresinous type	AAF-14115
Z	Sanding surfacer, lacquer type	-------
L	Gloss lacquer	AN-TT-L-51
M	Camouflage (lusterless) lacquer	AAF-14105
P	Gloss enamel, oleoresinous type	AN-E-3
R	Camouflage (lusterless) enamel, oleoresinous type	AN-E-7; AAF-14109
S	Aluminum enamel, oleoresinous type	AN-TT-V-118
T	Clear dope	AN-TT-D-514
T'	Aqueous emulsion dope	-------
U	Aqueous emulsion lacquer	-------
V	Gloss pigmented dope	AN-TT-D-554
W	Camouflage (lusterless) dope	AN-D-8
Y	Aluminized dope	AN-TT-D-551
/	Fabric	AN-C-83

TABLE 3 — Weight and Moisture-Excluding Effectiveness of Direct Finishes

RESULTS: W = WEIGHT OF FINISH IN POUNDS PER 100 SQUARE FEET; E = MOISTURE-EXCLUDING EFFECTIVENESS IN PERCENT — ON —

Classification of Finishing System	Manufacturer Nº	System: Clear Sealer	Pigmented Sealer	Wood Filler	Aluminum Primer	Sanding Surfacer	Camouflage Enamel	Gloss Enamel	Aluminum Enamel	Papreg -0 W	Papreg -0 E	Mahogany -1 W	Mahogany -1 E	Walnut -2 W	Walnut -2 E	Birch -3 W	Birch -3 E	Maple -4 W	Maple -4 E	Yellow-Poplar -5 W	Yellow-Poplar -5 E	Sweetgum (Sliced) -6 W	Sweetgum (Sliced) -6 E	Sweetgum (Rotary) -7 W	Sweetgum (Rotary) -7 E	Douglas-Fir -8 W	Douglas-Fir -8 E	Spruce -9 W	Spruce -9 E
ONE- OR TWO-COAT SYSTEMS:																													
Camouflage (Lusterless) Oleoresinous	1						RΦ			0.77	15									1.68	3								
	3						R			2.88	21																		
	5						RΦ			.29	9					1.39	13			1.92	13								
	8						RΦ			.82	15									3.19	37								
	7						RΦ			1.48	44					2.45	42												
	12						RΦ			.36	13					2.11	6			2.30	1								
	1	A					R			1.01	18									1.68	2								
	3	A					R													4.36	19					3.70	23		
	12	A					R			1.20	47									1.87	18								
	12			A'			R									.86	9												
	1		B				R			.42	11					1.20	4			1.63	-4								
	3					X	R			8.80	41																		
	7					X	R			1.63	47					1.15	51												
	12					X	R			5.26	68																		
	3				C●		R			4.03	36									5.00	37					4.08	32		
Camouflage (Lusterless) Lacquer	5						M			.29	13																		
	8						M			.46	17																		
	8						MM			1.44	29									2.26	4								
	5	A					M			1.01	19																		
	5		B				M			1.16	31																		
	5					X	M			2.93	21																		
	8					Z	M			2.11	38					2.21	34			2.50	26								
	3						RM									1.11	14			1.58	15								
	8						RM													2.50	8								
Gloss (Lustrous) Oleoresinous	3							P		.96	21																		
	9							PΦ		1.89	59					3.17	72												
	12							P		1.20	48																		
	12							PP		3.02	63					3.36	76			3.50	64								
	3	A						P												1.87	13								
	12	A						P		2.07	64																		
	3					X		P		6.00	36																		
	9					X		P		3.65	70																		
	12					X		P		6.10	74																		
	12						R	P		1.83	49					2.74	63			3.12	48								
Gloss (Lustrous) Lacquer	4							L		.86	23																		
	4							LL		1.63	31									2.54	-1								
	4	T						L		1.44	33																		
Gloss (Lustrous) Aluminum	3								S	.63	58																		
	3	A							S											1.49	60					1.34	61		
	3					X			S	5.95	65																		
	3				C●				S	1.73	72									2.11	67					1.34	65		
THREE- OR FOUR-COAT SYSTEMS:																													
Camouflage (Lusterless) Oleoresinous	3	A				X	R													8.50	63					7.92	61		
	12	A				X	R													7.30	76								
	3			A'		X	R									10.90	66												
	12			A'		X	R									7.35	83												
Camouflage (Lusterless) Lacquer	8	A					MM													2.93	12								
	5	A					MM									1.83	25			2.40	21								
	5		B				MM									2.50	38			3.60	33								
	6	T					MM			1.11	18																		
	6						WMM			1.11	17																		
	5	A				X	M			3.36	34					3.98	38												
	5					X	MM									8.20	28												
	8	A				Z	M									3.46	55			4.08	45								
Camouflage (Lusterless) Dope	6						WWW			.96	7																		
	4						WWW			1.92	25																		
	4	T					WW			1.44	23									1.54	11								
	4				Y		WW			1.56	43									1.97	10								
Gloss (Lustrous) Oleoresinous	12	A						PP												4.90	67								
	12			A'				PP								3.34	77												
	12	A					R	P												3.50	53								
	12			A'			R	P								2.55	65												
	3	A				X		P												6.24	62								
	9	A				X		P		3.31	68					4.22	80												
	12	A				X		P												8.21	82								
	3			A'		X		P								8.80	60												
	12			A'		X		P								7.16	87												
	12					X		PP		6.00	74																		
	12	A				X		PP				9.20	86	9.50	88	9.40	89	9.40	88	10.10	85	9.83	87	9.75	86	9.40	84	9.75	87
	12			A'		X		PP				9.00	86	8.90	87	8.73	89	8.80	88	9.50	85	8.60	87	9.30	87	9.03	84	8.93	87
Gloss (Lustrous) Dope	6							YYY		1.73	17																		
Gloss (Lustrous) Aluminum	3	A				X			S											7.15	81								
	3			A'		X			S							8.60	83												

Φ ONE COAT ON PAPREG BUT TWO COATS ON BIRCH OR YELLOWPOPLAR

● ALUMINUM PRIMER MADE AT FOREST PRODUCTS LABORATORY

Z M 52272 F

TABLE 4 —Weight and Moisture-Excluding Effectiveness of Fabric and Dope Finishes

Classification of finishing system	Manufacturer Nº	System: (materials applied in order given, left to right)											Results: (W = weight of finish, lbs./sq.ft.; E = effectiveness, percent)					
		Clear sealer	Clear dope	Emulsion dope	Emulsion lacquer	Fabric	Emulsion dope	Clear dope	Emulsion lacquer	Camouflage dope	Gloss dope	Camouflage lacquer	On Papreg -0		On Birch -3		On Yellow-Poplar -5	
													W	E	W	E	W	E
FOUR- OR FIVE-COAT SYSTEMS:																		
Camouflage	13			T'		/	T'			WW			7.72	1				
	13				U	/			U	WW			9.70	11				
	13	A		T'		/	T'			WW					8.25	29	9.60	23
	13	A			U	/			U	WW					8.98	32	10.19	28
Gloss	13			T'		/	T'				VV		8.11	23				
	13				U	/			U		VV		9.55	31				
	13	A		T'		/	T'				VV				8.52	47	8.72	36
	13	A			U	/			U		VV				9.40	57	10.27	47
SIX- OR SEVEN-COAT SYSTEMS:																		
Camouflage	13			T'		/	T'	TT		WW			9.70	13				
	13	A		T'		/	T'	TT		WW					8.95	55	9.00	21
	6		TT			/		TTT		WW					5.12	17		
	6		TT			/		TTT				M			5.16	16		
Gloss	13			T'		/	T'	TT			VV		10.19	36				
	13	A		T'		/	T'	TT			VV				8.78	53	9.05	43
	6		TT			/		TTT			VV				5.75	17		

Z M 52273 F

Table 5.--Summary of finishes affording at least 50 percent moisture-exluding effectiveness on papreg and on yellow-poplar plywood.

Number of coats	Type of surface	Description of finishing system	Moisture-excluding effectiveness E	Weight of coating W	Ratio E/W
			Percent	Pounds per 100 square feet	
On papreg					
1	Aluminum	Aluminum enamel	58	0.63	92
1	Glossy	Gloss enamel	59	1.39	42
2	Aluminum	Aluminum primer, aluminum enamel	72	1.73	42
2	Aluminum	Surfacer, aluminum enamel	65	5.95	11
2	Glossy	Sealer, gloss enamel	64	2.07	31
2	Glossy	2 coats of gloss enamel	63	3.02	21
2	Glossy	Surfacer, gloss enamel	74	6.10	12
2	Lusterless	Aluminum primer, camouflage enamel	56	4.03	14
2	Lusterless	Surfacer, camouflage enamel	68	5.28	13
3	Glossy	Sealer, surfacer, gloss enamel	68	3.31	21
3	Glossy	Surfacer, 2 coats of gloss enamel	74	6.00	12
On yellow-poplar plywood					
2	Aluminum	Sealer, aluminum enamel	60	1.49	40
2	Aluminum	Aluminum primer, aluminum enamel	67	2.11	32
2	Glossy	2 coats of gloss enamel	64	3.50	18
3	Aluminum	Sealer, surfacer, aluminum enamel	81	7.15	11
3	Glossy	Sealer, camouflage enamel, gloss enamel	53	3.50	15
3	Glossy	Sealer, 2 coats of gloss enamel	67	4.90	14
3	Glossy	Sealer, surfacer, gloss enamel	82	8.21	10
3	Lusterless	Sealer, surfacer, camouflage enamel	76	7.30	10
4	Glossy	Sealer, surfacer, 2 coats of gloss enamel	85	10.10	8