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MATERIAL - CORROSION PROTECTION COATINGS - FOR USE IN F-111 INTEGRAL FUEL TANKS - SCREENING TESTS OF

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Department 6
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TEST DATA MEMORANDUM

F-TDM NO. -3126
MODEL F-111
TEST NO. 30-2657(1), -2691(2), -2718(3), -2754(4)

TEST: MATERIAL - CORROSION PROTECTION COATINGS - FOR USE IN F-111 INTEGRAL FUEL TANKS - SCREENING TEST OF

OBJECT: To conduct screening tests on corrosion protection coatings for use in F-111 integral fuel tanks.

TEST SPECIMENS:

Coatings and Primers	Source
PR-1560 A/B Coating (1)(Polyurethane) P-97-345 A/B Coating(2)(Mod. Epoxy)	Products Research Company Burbank, California
Q-9-0089 Coating(1) (Silicone) RTV-1200 Primer(used with Q-9-0089 and Q-94-003) Q-9-4000 Coating(3) (Silicone) Q-94-003 Coating(4) (Silicone) A-4094 Primer(used with P-9-4000)	Dow Corning Corporation Midland, Michigan
EC-1981 Coating(2) (Kel-F) (XS-1344152)	Minnesota Mining & Mfg. Co. St. Paul, Minnesota
Thermoline 200 Coating(3)(Furane) Thermoline R.S.Primer (used with Thermoline 200)	Thermoline Company Dallas, Texas
FMS-1001 A/B Coating(4)(GD/FW formulation)(Modified silicone)	Desoto Chemical Company Garland, Texas

PROCEDURES: Procedures for specimen preparation and testing are listed in Table I.

RESULTS: Test results are listed in Table II.

DISCUSSION: The performance and reliability requirements of the F-111 airplane necessitate the use of corrosion prevention coatings in the integral fuel tanks. The coatings investigated for this purpose must first be screened by a few selected tests (Table I), simulating the F-111 fuel tanks environment, in order to eliminate the inadequate materials from the more extensive and costly evaluation tests. The eight coatings and the test data listed in this report represent four test requests and were grouped together to facilitate reporting.

The coatings tested, environmental conditions, and test results are listed in Table II. It should be pointed out that one of the desirable characteristics of the coating selected for this application is transparency before and after exposure to the environments. This would permit visual detection of corrosion if it were to occur beneath the coating at the metal-coating interface.

CONCLUSION: All coatings tested, with the exception of Thermoline 200 and Desoto FMS-1001, passed all the requirements of the screening tests conducted. However, of the room temperature curing coatings*, Minnesota Mining EC-1981 and Dow Corning Q94-003 were the only coatings that are transparent.

Test Dates: 3-18-63 through 5-28-63

*Q-9-4000 was transparent but required a 350°F cure.

DATE: 10 June 1963

BY [signature]
CHECKED [signature]
APPROVED [signature]

TABLE I

PROCEDURES FOR SPECIMEN PRAPARATION AND TESTING

I. Preparation of Test Specimens

Refer to Paragraphs 4.6.2 and 4.6.3 of Military Specification MIL-C-27725 (USAF) "Coating, Corrosion Preventative, for Integral Fuel Tanks", dated 4 April 1962, for test panel cleaning and coating application. Prior to coating, clean the panels with A3 cleaner per GD/FW specification FMS-0140(A), then treat with Alodine 1200 per GD/FW's FPS-0011.

II. Adhesion and Resistance to Salt Water and Fuel

When tested as described below, the cured coating shall show no blistering, softening, leaching, shrinkage, corrosion extending more than 1/8 inch in form the panel edges or loss of adhesion.

Six test panels of 2024-T81 clad aluminum, measuring 0.040 x 2-7/8 x 6 inches, shall be coated with the test coating material and cured in accordance with manufacturer's instructions. After curing, two panels shall be conditioned for seven days at 375° ±5°F in air and two panels shall be conditioned by being immersed vertically in a covered glass vessel containing a two layer liquid consisting of a three percent aqueous solution of sodium chloride and jet reference fluid in such a manner that two inches of the panels are exposed to the salt solution, two inches to the jet reference fluid and two inches to the air-vapor mixture above the liquid. The test panels shall be subjected to this exposure at 180° ±2°F for seven days. The panels shall then be removed from the liquid, wiped dry and thoroughly examined. Test panels shall be cooled for a minimum of one hour at standard conditions before being tested for adhesion as follows:

Scribe two parallel marks one inch apart through the coating to the metal. The parallel scribe marks shall be along the six inch dimension.. Apply a strip of one inch masking tape perpendicularly across the scribe marks. Apply one strip of tape across each of the test panels which received only a standard cure and across each of the heat conditioned panels. On the immersion conditioned panels, apply a piece of tape in each section of the panels exposed to the different fluid phases including the air-vapor mixture phase. Press the tape firmly onto the coating with a rubber covered roller, using a pressure of approximately 4 psi. The tape shall be removed in one abrupt motion perpendicular to the panel surface. The panel shall be examined for coating adhesion failure.

TABLE I
(continued)

III. Low Temperature Flexibility

When tested as described below, the cured coating shall withstand the low temperature test without cracking, checking or loss of adhesion.

Eight test panels of 2024 T-81 clad aluminum, measuring 0.040 x 2-7/8 x 6 inches, shall be coated with the test coating material in accordance with manufacturer's instructions. After standard cure, two panels shall be conditioned for seven days at 375° ±5°F in air; two panels shall be conditioned by immersion in jet reference fluid for seven days at 180°±2°F; and two test panels shall be conditioned, first, by immersion in jet reference fluid for seven days at 180°±2°F and, then in air, for seven days at 375°±50°F. Immediately upon completion of the conditioning period, the conditioned panels and the two panels which received only a standard cure shall be placed in a low temperature flexibility jig. The temperature of the test panels shall be reduced to -65°±2°F and stabilized at that temperature for a period not to exceed two hours. After stabilization the panels shall be flexed through 130 consecutive cycles or until the coating fails.

Note: All coatings were allowed to cure 14 days at room temperature except Q-9-4000 which received 24 hours at room temperature plus 8 minutes at 350°F.

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TABLE II

RESULTS OF SCREENING TESTS ON CORROSION PROTECTION COATI

Test Number	Coating	Primer if Required	Color as Cured	Color After 7 days at 375°F	7 days at 375°F		7 Days in JRF (Salt Water at 18 Adhesion		
					Flex.	Adhesion	Vapor	JRF	Salt
30-2657	PR-1560	-	light green	dark brown	pass	pass	pass	pass	p
30-2657	Q-9-0089	RTV-1200	white	white	pass	pass	pass	pass	p
30-2691	EC-1981	-	clear	clear	pass	pass	pass	pass	p
30-2691	P-97-345	-	yellow	dark brown	pass	pass	pass	pass	p
30-2718	Q-9-4000	A-4094	clear	clear	pass	pass	pass	pass	p
30-2718	Thermo-line-200	Thermo-line-R.S.	trans-parent amber	black	pass	pass	pass	fail	p
30-2754	FMS-1001	-	yellow	tan	pass	pass	fail	fail	f
30-2754	Q94-003	RTV-1200	clear	clear	pass	pass	pass	pass	p

(1) Jet Reference Test Fluid

TABLE II

CORROSION PROTECTION COATINGS FOR USE IN F-111 INTEGRAL FUEL TANKS

at 375°F	7 Days in JRF[1] Salt Water at 180°F Adhesion			7 Days in JRF @ 180°F	7 Days in JRF at 180°F plus 7 days at 375°F	Spray-abil-ity	Remarks
Adhesion	Vapor	JRF	Salt Water	Flex	Flex		
pass	pass	pass	pass	pass	pass	good	Coating good but possible health hazard when applying; two component
pass	pass	pass	pass	pass	pass	good	Very easily marred; one component
pass	pass	pass	pass	pass	pass	good	Tough after cure; one component
pass	pass	pass	pass	pass	pass	fair	Does not wet substrate well; two component
pass	pass	pass	pass	pass	pass	poor	Requires 350°F cure; one component
pass	pass	fail	pass	pass	pass	good	Lost adhesion in JRF; one component
pass	fail	fail	fail	pass	fail	good	Blistered and lost adhesion; two component
pass	pass	pass	pass	pass	pass	good	Somewhat tough after cure; one component