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A COMPILATION OF LOW OUTGASSING POLYMERIC MATERIALS NORMALLY RECOMMENDED FOR GSFC COGNIZANT SPACECRAFT

Aaron Fisher Benjamin Mermelstein

Special Materials and Projects Office Materials Engineering Research Branch

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GODDARD SPACE FLIGHT CENTER Greenbelt, Maryland

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ABSTRACT

More than five hundred similarly tested polymer materials compiled from SRI, JPL and GSFC sources, successfully screened to meet acceptable outgassing criteria^{*1}, are presented in both application and alphabetical categories.

Some polymers with somewhat higher outgassing are included where they must perform a highly selective function and are the only materials available to meet special requirements.

A number of acceptable polymer materials suitable for system combinations are proposed. This material system concept can effectively increase the application scope of individual polymers listed, while still meeting outgassing criteria as a system.

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^{*}Materials are heated at 125° C for 24 hours at from 1×10^{-6} to 1×10^{-7} torr. Outgassed products are condensed on a 25° C surface and weighed. Criteria for accr₂ table materials must be both, less than 1 percent total outgassing and less than 0 1 percent condensables.

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MATERIAL APPLICATION TABLES OUTGASSING DATA (Continued)

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A COMPILATION OF LOW OUTGASSING POLYMERIC MATERIALS NORMALLY RECOMMENDED FOR GSFC COGNIZANT SPACECRAFT

INTRODUCTION

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The new sophisticated series of Goddard cognizant earth observing satellites together with the anticipated long lived communication, meteorological and explorer types have spawned new concepts in electro-optics instrumentation, radiant coolers and millimeter wave black boxes. These require absolute minimums of spacecraft contamination. ERTS oscillating optic elastomeric silicone dampers must be minimally outgassing. Spacecraft coolers cannot operate at design temperatures of -120°C if coated with a thickness of outgassed condensables measured in angstroms. Observations of environment sampling instrument signals, which might indicate the presence of amire, ammonia, gases, moisture, etc., require insurance that these molecular species do not emanate from the parent spacecraft. These are some of the problems which have led to an increasing need by designers, component manufacturers, contractors and spacecraft engineers for an initial acceptable first cut list of polymeric engineering materials based on low outgassing characteristics. The successfully screened materials presented in this document have been collected since JPL's early beginnings in 1964 through SRI^2 and include those resulting from recent on-going work at JPL³ and GSFC. GSFC's strong interest in outgassing condensables arises from the observed sensitivity of spacecraft electronics, optics, instrumentation and passive thermal control surfaces, to condensable contaminants.

The compilation and application discussion will benefit designers and engineers associated with the various spacecraft technologies by accelerating both the materials review, and design acceptance process, cutting lead times and costs. In addition, the testing of questionable vendor submitted materials with their attendant agonizing delays will be minimized.

Hopefully, tomerrow's design engineer and vendor can attack their complex problems with acceptable low outgassing polymer material systems. In addition, they may be stimulated to utilize in unusual ways, the new range of physical properties inherent in the latest generation of polymer compositions. Although the low outgassing compilation will assist individual engineers in making acceptable initial polymer selections, it is still highly desirable that they continue to seek specialist guidance on hardware compatibility from a total material system environment viewpoint. This is important since there are basic properties other than outgassing which may determine the selection of a polymer system to provide optimized service.

DISCUSSION: Material Application Tables

Tables will be discussed where applicable.

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Molding Compounds and Laminates for Structural Hardware (Table 1)

The group on molding materials and structural hardware includes readily available polymers and glass filled systems with individual inherent properties to fulfill a multitude of spacecraft strength and insulation requirements. In fact, epoxy boron and epoxy graphite laminate composites similar to those indicated herein, have, as demonstrated by an Air Force evaluation program.⁴ exceeded both the tensile strength and modulus values of aluminum on a density basis. Graphite fiber, resin system structural components have been proposed with essentially "0" coefficient of thermal explanison, ie., the antenna dish support on ATS F.&G. Convair is proposing a graphite resin, tube-structure, optical bench for the HEAO-C, X-Ray telescope⁵, that will allow a temperature tolerance of $\pm 100^{\circ}$ F as against aluminum's tolerance of $\pm 1^{\circ}$ F max. before defocusing occurs. The further versatility of various polymer systems is indicated by Vespel. Delrin, Teflon and FEP which individually or in combination with molybdenum disulphide can provide exceptionally frictionless surfaces for special situations. Vespel, Teflon and FEP are both ultraviolet and temperature resistant. The Delrin and Teflon are relatively poor in regard to particulate energy resistance; however, the Delrin has excellent dimensional stability with minimal moisture absorption. Add some glass fiber to all the above and most properties improve. These materials can provide rods, tubes, gears, housing walls, support, damping members and machined items of multidimensions and shapes. Although the polyimide Vespel has a submarginal total outgassing of 1.24%, this is primarily moisture. It may be considered for use where its excellent combination of properties, low condensables, low friction coefficient, excellent ultra violet, particulate radiation and high temperature resistance are essential to spacecraft function.

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				Comments and	Persent	Pentant	Lefe C
Material	Mfg. Code	ပိ	Composition	Previous Cure History	Weight Loss	Condensables	Source
P. a ctal/M 58 000 mol. wt. hi. visc.	Delrin-100NC10	DQ	AR	AR	0.58	90.06	SRI
P. acetal/M 58.000 mol. wt. hi. visc	Delrin-150NC10	DQ	AR	AR	0.56	0.06	SRI
P. acetal/M 38.000 mol. wt. med. visc.	Delrin-500NC10	DQ	AR	AR	0.48	0.07	SRI
P. acetal/M 32,000 mol. wt. low visc.	Delrin-900NC10	na	AR	AR	0.56	0.08	SRI
P. acetal/gl./M	Formafil-G80/20	۲. ۲.	80 r./20 gl.	AR	0.44	0.01	GSFC
P. acetal/gl./M	KF-1006	Z	70 r./30 gl.	AR	0.28	0.02	GSFC
P. acetal/teflon/M	Delrin-AF	DO	80 Delrin/20 Teflon	AR	0.47	0.05	JPL
P. acetal/teilon/M	Fulton 404	Ľ	80 Delrin/20 Teflon	AR	0.52	0.01	GSFC
P. arylether/M	Arylon-T	S	AR	AR	0.36	0.03	GSFC
P. arylether/gl./M	XF 1006	Ľ	70 r./30 gl.	AR	0.29	0.01	GSFC
P. arylsulphone/M	Astrel 360	MM	AR	AR	0.94	0.02	GSFC
P. boron-silica/M	Dexsil-201	8	AR	AR	0.07	0.01	GSFC
P. buta./acrylonitrile/gl./M	AF-1006	Ľ	70 r./30 gl.	AR	0.20	0.01	GSFC
P. carbonate/M intermed. mol. wt.	Lexan-100 - 111	GE	no additives	AR	0.06	0.02	SRI
P. carbonate/M intermed. mol. wt.	Lexan-100 - 112	GE	no additives	AR	0.09	0.04	SRI
P. carbonate/M intermed. mol. wt.	Lexan-101 - 111	GE	therm. stabilized	AR	0.08	0.01	SRI
P. carbonate/M intermed. mol. wt.	Lexan-103 - 112	B	therm. + UV stabilized	AR	0.17	0.01	SRI
P. carbonate/M high mol. wt.	Lexan-130 - 111	Э	no additives	AR	0.17	0.01	SRI
P. carbunate/M high mol. wt.	Lexan-131 - 111	GE	therm. stabilized	AP	0.18	0.01	SRI
P. carbonate/M high mol. wt.	Lexan-13! - 112	GE	therm. stabilized	AR	0.17	0.01	SRi
P. carbonate/M high raol. wt.	Lexan-133 - 112	GE	therm. + UV stabilized	AR	0.20	0.01	SRI
P. carbonate/M low mol. wt.	Lexan 140 - 111	B	no additives	AR	0.17	0.03	SRI
P. carbonate/M low mol. wt.	Lexan-141 - 111	GE	therm. stabilized	AR	0.17	0.04	SRI
P. carbonate/M low mol. wt.	Lexan-141 - 112	GE	therm. stabilized	AR	0.17	0.02	SRI
P. carbonate/M low mol. wt.	Lexan-243 - 112	GE	therm. + UV stabilized	AR	0.16	0.01	SRI
P. carbonate/S low mol. wt.	Lexan-9434-112	GE	AR	AR	0.19	0.01	GSFC
P. carbonate/gi./M	DF-1006	Ľ	70 r./30 gl.	AR	0.14	0.01	GSFC
P. carbonate/gL/M	Carbafil-G50/20	33	80 r./ 20 gl.	AR	0.12	0.01	CSFC
P. chlorofluorocarbon/M	Kel-F 81	MM	AR	AR	0.03	0.01	SRI
M/T3/4 D	Dial-FS-4	٩C	AR	24h. 150°C	0.58	0.02	SRI
UAP/gL/M	Dial-FS-10	AC	AR	24h. 150°C	0.70	0.03	SRI
DAP/gl./M	Dial-FS-40	AC	AR	24h. 150°C	1.00	0.02	SRI
DAP/gl./M	Dial-FS-80	AC	AR	AR	0.44	10.0	GSFC

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Malerial	Mfg. Code	రి	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
DAP/e1./M	Diat-52-40-40	¥د ا	AR	AR	0.70	0.06	SRI
DAF/gL/M	Dial-52-40-40	AC	AR	24h. 150°C	0.30	0.01	SRI
DAP/el./M	C2580-118	FM	AR	AR	0.30	0.01	GSFC
F.pcvy/M	Epocast 403-S-3	FU	AR	AR	0.32	0.01	GSFC
Epoxy/M	Fiberite E3938	FB	AR	AR	0.44	0.01	GSFC
Epoxy/M	Rogers RX -611	RG	AK	AR	0.53	0.02	GSFC
Epoxy/M	Furane 403	10	AR	AR	0.43	0.01	SRI
Epoxy/gl/min./M	Epiall 1906L	۲¥	.AR	AR	0.39	0.06	SRI
Epoxy/el/min./M	Epiall 1906L	λk	AR	2 th. 150°C	0 16	0.03	SRI
Eboxy/el/M	Epiall 1914	AΥ	AR	24n. 150°C	0.55	0.03	P13
Epoxy/el./M	EMC-115-B-1	PA	AR	١R	0.29	0.01	CSFC
Epoxy/iron/M	Eccosorb MF-124	EC	AR	ÅR	0.09	0.01	GSFC
Eboxy/metal/M	Eccosorb MI -1 24	Б	AR	7 8	0.20	0.02	JPL
Eboxy/metal/M	Eccosorb MI COSF 116	С Ш	AR	a: *	0.30	0.04	JPL
P. ester/el./M	WF-100h	LN	70 r./30 gl.	2	0.19	0.01	GSFC
P. ethylene/gl/M	FF 1006	Z	70 r./30 gl.	AR	0.13	0.03	GSFC
Fluorocarbon/M	Gylon Gasket	8	PTFE	AK	0.04	0.04	JPL
Filuorocarbon/cer./fiber/M	R1 Duroid Seck)	RG	PTFE	AR	0.22	0.03	JPL
Fluorocarbon/cer./fiber/M	RT Duroid 56.50	RG	PTFE	AR	0.28	0.01	JPL
Fluorocarbon/gL/M	REDUM. STI	ß	PTFE	AR	0.22	0.02	JPL
Fluorocarbon/gl./M	R'C Duroit Co	RG	PTFE	AR	0.12	0.02	JPL
Fluorocarbon/gl./M	CT-505	9	PTFE	AR	0.01	0.01	JPL
Fluorocarbon/mica/M	Fluorosint	ļ,	PT'FE/mix a	AR	0.09	0.03	IP.
Fluorocarbon/mica/M	Pluorosint LE 267	2	PEP-2/mi .	AR	0.20	0.04	JPL
P. imide/M	Gemon 3010	3	A.5.	AR	0.34	0.02	GSFC
P. imide/M	Vespel SP-1	DO	AR	AR	1.24	0.01	SRI
P. imide/gL/M	LNP XF 1004	LN	80 r./20 gl.	AR	1.06	0.01	GSFC
P. methacrylate-mod./M	Bavick II	Å	AR	AR	0.59	0.01	GSFC
P. methacrylate-mod./M	Lucerne 011-V	¥Χ	AR	AR	0.51	0.05	CSF/C
P. methacrytate/M	Plexiglas II	Ы	AR	AR	0.57	0.01	GSFC
P. methacrylate/M	Plexiglas VS-100	DC	AR	AR	1.60	0.01	GSFC
Nylon-12/M	Plaskon 1980	Z	AR	AR	0.65	0.03	JPL
Nylon 6/6/gL/M	RF 1006	Ľ	70 r./30 gl.	AR	0.81	0.04	GSFC
Nvion 6/10/sL/M	OF-1006	LN	70 r./30 gl.	AK	0.65	0.04	GSFC

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Molding Compounds and Lamina' es for Structural Hardware (continued)

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				Comments and	Bercent		
Materia	Mfg. Code	రి	Composition	Previous Cure History	Weight Loss	Condensables	Source
Nylon 11/gL/M	LNP-HF-1006	Ľ	70 t./30 gl.	AR	0.37	0.02	GSFC
Nyion 12/gL/M	LNP SF-1006	Ľ	70 r./30 gl.	AR	0.65	0.02	CSFC
P. phenylene-oxide/M	Noiyl	E	AR	AR	0.10	0.01	GSFC
P. phenylene-oxide/gl./M	Noryi-ZF-1006	GE	70 r./30 gl.	AR	0.04	0.01	GSFC
P. phenylene-oxide/gl./M	NF-1006	LN	70 r./30 gì.	AR	0.11	0.01	GSFC
P. propylene/M	Impalene	Э	AR	AR	0.30	0.05	GSFC
P. propyler-s/gl./M	MF-1006	Ľ	70 r., 30 gl.	AR	0.13	0.04	GSFC
P. styrene/M			AR	AR	0.26	0.01	JPL
P. Styrene/x/M	Q 200.5	d .	AR	AR	0.09	0.01	GSFC
P. styrene/gL/M	CF-1006	2	70 r./30 gl.	AR	0.10	0.01	GSFC
P. styrene/gl/Cro ² /M	Styraful/G33/20/CR02	ż	75 r./20 gl./5-ox	AR	0.53	0.01	GSFC
P. styrene-acry lonitrile/gl/M	Acrylagias S/40/35	5	65 r./35 gl.	AR	0.22	0.03	GSFC
P. styrene-acrylonitrile/gl/M	BF-1006	Ľ	70 r./30 gl.	A.	0.24	0.01	GSFC
P. styrene-acrylonitrilc/gL/M	Acrylafil G47/20	3	80 r./20 gl.	AR	0.23	0.01	GSFC
P. suphone/gl./M	GF-1006	Ľ	70 r./30 gl.	AR	0.24	0.01	GSFC
P. sulphone/gl./M	Sulfit.G-1500/20	99	80 r./20 gl.	AR	0.20	0.ÜI	GSFC
P. urethane/gl./M	TF-1008	Ľ	60 r./40 gl.	AR	0.37	0.0	GSFC
P. vinyl-chlor./gl./M	VI:-1007	Ľ	65 r./35 gl.	AR	0.30	C.D.	GSFC
Epoxy/boron fil./L	Rigidite 5505	N R	AR	.Sh. 93° C+	0.46	,0 U	JPL
				.sh. 177°C			
Epoxy/toron fit./L	Epon 828/1031	HS	25p. Epoxy+cat./	1h. 66°C	0.25	0.02	JPL
			75p. boron filament	1h. 82°C			
			Fpoxy+cat = 50p.82b	4h. 177° C			
			50p. { MNA-90p.				
			(BUMA-IUP.				
E-poxy/carbon hil./L		ς	AR	AR	0.55	0.04	GSFC
F.poxy/gl/L	Micaply G-284	MP	AR	AR	0.49	0.06	SRI
F.poxy/gl./L	Micarta 65M28 (FR-4)	¥C	AR	AR	0.26	0.01	JPL
Epoxy/gL/L	Micarta H-2497	WC	AR	AR	0.18	0.01	SRI
F:poxy/gL/1.	Micarta H-8457	WC	AR	AR	0.80	0.12	SRI
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Molding compounds and Laminates for Structural Hardware (continued)

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Material	Mfg. Code	ප	Composition	Comments and Previous Cure History	Percent Weight Low	Percent Condensables	Data Source
Epoxy/gl./L	Micarta H-17511	ļ	AR	₫₹		200	
Epoxy/el./L	Micarta H-17690	S	đ				Z
Furvial	Scotchalt VD 761 6				0.48	10.0	NY.
	C-ICZ IV Andminione		Innurectional	Jun. 149 C+4n. 17	C 0.58	0.01	JPL
The boxy/gr/L	Scotchiply 279	WW	35r./65 gd.	AR	0,96	0,06	JPL
E.oxy/gl./L	GE 101(FR-4)	EL	AR	AR	0.48	0.05	JPL
Epoxy/gL/L	K-6098	MM	AR	AR	0.0	0.01	GSFC
Epoxy/gl./L	MIT-1281627	TM	AR	AR	0.37	0.00	Cast Cast
Epoxy/gl./L	MIT-600	TM	AR	AR	0.64	0.03	
Epoxy/gl./pre/l.	Hexcel F153	ХН	AR	7h. 171°C/14 pst	0.19	6	GSFC
1			_				
Epoxy/gr/pre/L	BP-907	¥Χ	AR	1h. 177°C	0.84	0.02	JPL
t:poxy/graph/pre/L	HY-E 1001	8 H	42p. Epoxy 10836	1h. 132°C	0.53	0.04	JPL
			58p. graphite	1h. 171 ⁷			
			3p. BF complex				
Epoxy/graph/pre/L	HY-E 1002	EB B	(WS-1028 or	1h. 82°C	0,32	0.04	JPL
			38p. < 50p.Epon 1031	4h. 177° C	-		
		-	50p.Epon 1028				
			62p. graphite				
			90p. NMA				
i			.45p. BDMA				
r. ester/1	P-49	RD	AR	10min. 104°C	1.04	0.05	GSFC
P. ester/T	V-700075	B	AR	10min. 93°C	0.47	0.01	GSFC
P. imide/gl./L	Pyralin 12	DQ	AR	AR	0.52	0.01	GSFC
P. imide/gl./L	1	AM	AR	AR	0.77	0.01	CSEC.
Phenolic/gl./L	Micarta H-5834	ŴC	AR	AR	0.70	0.03	SRI C
Phenolic/gl./L	91 LD	SG	AR	AR	0.37	10.0	CSFC
Dipheny Hox/gt./L	Doryl H-17511	NC N	AR	AR	0.44	10.0	SRI
Diptheny Hox/gl./L	Doryl H-17511	Ň	AR	24h. 150°C	0.68	0.03	INS
Silicone/gl./L	Micarta 20201-2	Ň	AR	AR	0.16	0.04	SRI

Pottings (Table 2)

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The availability of low outgassing, across the board, potting types provides ready media for the solution of the many problems encountered in space hardware development. Cured potting hardnesses vary from the hard epoxies to the semi-rigid; include the "Solithane", urethane durometer A through D range and also the flexible silicones. Pottings are meant to protect and they will if the application is properly conceived and practiced. Many pottings involve non critical operations with selection depending on simple criteria of flexibility, electricals, exotherm, pot life, etc. However, each potting is a problem unto itself and the misinterpretation of a single condition can lead to the loss of a valuable complex piece of equipment. Pottings are easily formulated to lighter structures by utilizing glass, silica or ceramic microballoons. Adhesion of balloons to resin may be increased by surface treatment of balloons with reactive silanes.

The silicones are quality pottings and are recommended for their excellent electricals, temperature and high voltage resistance. Photo multiplier tubes should be their main target. Tube assemblies should be designed as a "total potted package." This implies that the designer must initially consider all potting operation requirements necessary to produce void free material in a vacuum environment. Potting specialists should be consulted. Design configurations aimed at potting protection with optimal, not marginal resistance to corona breakdown, should be given primary consideration. Many problems would be eliminated if these considerations were made originally. Tubes with excellent electronic characteristics can be ruined by poorly conceived and executed potting proceedures. Depotting in most cases is impossible.

Potting resins may in many instances be utilized as vehicles to make silver conductive paints for R.F. shielding or for preparing touch up black and white paints internal to the spacecraft wherever thermal control considerations are minimal, or as emergency, room temperature setting adhestives. High dielectric constant materials with K of 25 and higher or configured magnetic structures are easily formulated and designed. Energy attenuating forms can be made and these many material types readily formulated in various hardnesses.

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Matorial	Mfg. Code	ಲಿ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Conden::ables	Data Source
Epoxy	AV-100/HV 100	5	AR	14 B T	010		
Epoxy	Bacon Ind.	BN	AR	4h 71 C+	01.0	0.10	CSI C
ſ				16h. 100°C	71.0	10.0	
Epoxy	BSL 208	ប៊	AR	1h. 164°C	(1) 8.7		0.100
Epoxy	BSL 308	Ū	AR	1h. 175°C	0.02		Car.C
Ероху	EC 1751 A/B	WZ	S0p./1751 A	24h. R.T.	0.75	0.10	
			100p./1751 B			00.0	2.100
			15p./plicnyl				-
-			glycidyl ether				
Epoxy	Eccomold L-28	ß	AR	64h. 127° C	0.18	100	CSEC
Epoxy	Eccoseal 1207/20	ដ្ឋ	100p. 1207/1.5p. 20	4h. 71° C+	0.27	10.0	USPC -
				Ih. 177° C			-
EpoXy/iron	Eccosorb MF 112	EC	AR	AR	0.26	0.01	USEC
Epoxy/iron	Eccosorb MF 114	EC	AR	AR	0.22	10:0	100
Epoxy	Epocast N4E-053	FU	AR	24h. R.T.+	200	1000	
				2h. 93°C		0.02	GSFC
Epoxy	Epon 828/A	HS	100p. 828/8p.A	3h. 95° C	0.70	0.06	SRI
Epoxy	Epon 826/Z	S S	100p. 826/20p.Z	2h. 77° C+	0.91	0.02	Idi
				2h. 135°C			3
Epoxy	Fpon 828/Z	SH	100p. 828/20p.Z	2h. 75° C+	0.42	0.03	SRI
				2h. 135° C			
Epuxy/versum.	Epon 828/140	GS	50p. 828/50p.140	24h. R.J.	0.20	0.02	GSFC
	Epon 828/871/AEP	SS	35p./828	i 2h. R.T.	0.86	0.05	
			65p./871				, ;
Frov <i>u /</i> semi-cinid			15.5p./AEP				
District and the second s	Epon 828/871/AEP	S	40p./828	18h. 65° C	0.46	0.02	GSFC
<u></u>			60p./871				
Fastu			15.5p./AEP				
Enory	Epon X-24	R	AR	10h.100°C	0.42	0.05	GSFC
	Epotek-3UI A/B	ET	20p.A/5p.B	24h. R.T.	1.08	0.01	CSI:C
Enoxy			spectrally transparent				
	26-91-4H	HA	100p. DER 332 LC/18p.	5h. R.T. +12h. 90°C	0.33	0.02	GSFC
			HV	+24h, 90°C P C			

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Material	Mfg. Code	రి	Composition	Comments and Previous Cure l ⁴ istory	Percent Weight Loss	Percent Condensables	Data Source
Ероху	Hysol C9-4188/3469	ΗΥ	10p. 4188/.75p.3469	1h. R.T. 1h. 49°C 1h. 171°C	1.01	0.08	JPL
Ероху	Hysol C-9-4188/3469 Ferro V-780	ΗΥ	10p. 4188/.75p.3469	1h. R.T. 1h. 49°C 1h. 171°C	0.96	0.03	Tar
Epoxy	Hysol C9-5340/3426	Ϋ́Η Ϋ́	100p.5340/8.3p.3426	8h. R.T. 34h P.T	0.60	0.05	GSFC
E-MAY	H2-3475		¥,	2411° 1/1		10.0	2.00
Epoxy	Hysol XC9-G710/ H2-3561	λн	AR	AR	0:00	0.02	GSFC
Epoxy	Hysol 0151	ΥH	AR	24h. R.T.	0.78	0.02	GSFC
Epox /	Maraset 655/553	MR	100p.655/20p.553	16h. 82°C	0.59	0.01	SRI
Ероху	Maraset 655/553	MR	100p.655/20p.533	16h. 82°C+	0.32	0.01	SRI
	Manada CEREE	2	100- 28619- 664	24h. 150 [°] C		100	en t
	Malasci 000/000		100-1001/10.000	1011.02 C	14.0	10.0	
EPOXY	CCC/CCO 1958IBW	L L	ccc.d//cco.dnn1	101. 32 CF 24h. 150°C	C7 10	10.01	2KI
Epoxy	MPC 52	GE	AR	4h. R.T. +2h. 65°	C 0.17	0.01	GSFC
Epoxy	MY 750/HY974	ប	AR	30h. 60° C	0.19	0.01	GSFC
Ероху	MY 750/HY 974	D	AR	.75h. 100°C	0.27	0.03	GSFC
Epoxy	R-179	ß	aliphatic epoxy	.sh. 160° C	0.81	0.03	GSFC
Epoxy	R-6005	RD	aliphatic epoxy	10 min. 160° C	0.82	0.03	GSFC
lipoxy	Scotchcast 260	MM	AR	.sh. 150°C	0.52	0.03	SRI
Epoxy	Scotchcast 281 A/B	MM	100p.A/150p.B	20h. 75° C	0.36	0.05	SRI
Epoxy	Scotchcast 282 A/B	MM	2p.A/3p.B	20h. 75° C	0.74	0.10	JPL
Ероху	SMRD 49	GE	AR	AR	0.98	0.05	GSFC
Epoxy	Stycast 1263/31	ä	100p.1263/3p.31	16h. 107°C	0.12	0.01	SRI
Epoxy	Stycast 1269 A/B	S	100p.A/100p.B	16h. 100° C+	0.18	0.05	SRI
Epoxy	Stycast 2651/9	ΡW	AR	24h. 150 [°] C AR	0.23	0.01	GSFC

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Material	Mfg. Code	ပိ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Epoxy	Stycast 2651/11	EC	AR	AR	0.14	0.01	GSFC
Epoxy	Stycast 2850 FT/9	с Э	100p.2850FT/3p.9	AR	0.25	0.01	GSFC
Eboxy	Stycast 2850 FT/9	ටු	100p.2850FT/3.5p.9	16ii. 25°C	0.34	0.04	SRI
Epuxy	Stycast 2850GT/11	S	100p.2850GT/4-5p.11	40h. 54°C	0.85	0.03	JPL
Epoxy	Stycast 2850GT/11	.a	AR	AR	0.33	0.02	JPL
Epoxý	Stycast 2862 A/B	පු	100p.A/100p.B	16h. 12C°C	0.01	0.01	SRI
				24h. 150°C	-		
Epoxy	Stycast 2862 A/B	ដ្ឋ	100p.A/100p.B	16h. 120°C	0.32	0.04	SRI
Epoxy	Stycast 3050/11	ដ្ឋ	100p.3050/9.5p.11	16ù. 77° C	0.68	0.06	SRI,
Epoxy	Trucast 111/	FW	100p.111/34p.901	24h. R.T.	0.36	0.01	GSFC
	Trucure 901						
Epoxy	2850/24LV	ß	AR	24h. 49° C +24h. 6	0°C 0.73	0.10	GSFC
Epoxy/syntactic	MPC49	GE	AR	4h. R.T. +	0.52	0.01	GSFC
				2h. 66° C			<u>,</u>
Epoxy/syntactic	MPC 49	5 E	AR	18h. R.T. +	0.39	0.01	GSFC
				2h. 66° C			
Epoxy/versam	Type II Circs 2.	HA	35p.DER332LC/30p.140	3h. 71°C	0.92	0.05	GSFC
P. ethylene	Stycast TPM-4	ß	AR	16h. 107°C	0.23	0.08	1d(
				4h. 121°C			
				40. 133 C			
Silicone	17-002	ğ	10p.77-002/1p.cat.	7d. R.T.	0.31	0.02	JPL
Silicone	77-002	Я	10p.77-002/1p.cat.	4h. 65°C	0.39	0.06	JPL
Silicone	93-500/cat.	Я	10p.93-500/1p.cat.	24h. R.T.	0.29	0.01	GSFC
Silicone	93-500/cat.	۲	10p.93-500/1p.cat.	7d. R.T.	0.22	0.02	JPL
Silicone	93-500/cat.	à	10p.93-500/lp.cat.	7d. R.T.	0.16	0.01	CSFC
Silicone	E691-22E	Я	Sylgard 184 Arripped of	AR	0.19	0.04	SRI
			low molecular weight frac-				
			tion by Dow Corning Corp.				
Silicone	RTV 11/T-12	GE	100p.11/2p.T-12	24h. R.T.	0.33	0.10	JPL
				24h. 130°C			
Silicone	RTV 566 A/B	GE	100p.A/.1p.B	24h. R.T.	0.14	0.02	GSFC
Silicone	RTV 566 A/B	ы В	100p.A/.2p.B	24h. R.T.	0.25	0.03	GSFC

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Material	Mfg. Code	ပိ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Silicone	RTV 566 A/B	GE	100p.A/.1p.B	7d. R.T.	0.07	0.04	JPL
Silicone/clear	SC-GSFC-19C	GS	12p. RTV 602 devol.+ 031n_SRC-05 cat.	G.E. prepolymer 602 heated 24h.			ι L
				150° C, 10 ⁻⁶ torr.			ידר זי
				at GSFC to visc.			
				of 2000-2200			
				ceutipoise and			
				cooled prior to			
				R.T. cure			
P. urethane	I	FM	100p. Sol. 113	16h. 57° C	0.53	0.01	GSFC
			51p. Sol. C-113-300				
		-	4.5p. Sol. C-113-328				
			10p. Eccosphere-SI				
P. urethane	I	GS	150p. Adiprene L-100	3h. 100°C	1.06	0.06	GSFC
			16.5p. MOCA	1			
P. urethane	I	SS	100p. Sol. 113	7d. R.T.	0.37	0.01	GSFC
			73p. Sol. C113-300				
			4 drops T-12				
P. urethane	I	S	100p. Sol. 113	7d. R.T.	0.+2	0.01	GSFC
			73p. Sol. C-113-300				
			6p. Cab. MS-5 4 drons T-12				
P. urethane	1	GS	100p. Sol. 113	7d. R.T.	0.40	0.01	GSFC
			73p. Sol. C-113-300				
			10.4p.Cab. MS-5				
		1	4 drops T-12	-			
P. urethane	1	S	100p. Sol. 113	7d. K.T.	9.37	0.01	
			7.8n.Cab MS-5				
			Bén Vvac				
			4 drone T-12				

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				Comments and	Percent	Percent	[]ata
Material	Mfg. Code	ပိ	Composition	Cure History	Weight Loss	Condensables	Source
P. urethane		GS	100p. Sol. 113 73p. Sol. C-113-300	16h. 70° C	0.42	0.01	GSFC
			7.8p.Cab. MS-5				
			.040p. Vyac				
P. urethanc	1	S	100p. Sol. 113	7d. R.T.	0.38	0.02	GSFC
			73p. Sol. C-113-300				
			10.4p.Cub. MS-5				
			.02p. Vyac				
			4 drops T-12				
P. urethanc	1	GS	100p. Sol. 113	7d. R.T.	0.31	0.01	GSFC
			73p. Sol. C-113-300				
			6.9p.Cab. MS-5				
			.04p. Rhodamine base				
			4 drcps T-12				
P. urethanc	1	cs	100n. Sol. 113	18h. 70° C	0.34	0.01	GSEC
			51p. Sol. C-113-300				
		_	4.2p. 301. C-1 1-3-340				
P. urethane	1	GS	100p. Sot. C-113	7d. R.T.	0.31	0.02	GSFC
			36.5p. Sol. C-113-300				
			7.5p. Sol. C-113-328				
P. urethane	1	ß	100p. Sol. C-113	20h. 70° C	0.30	0.02	GSFC
			36.5p. Sol. C-113-300				
			7.5p. Sol. C-113-328				
P. urethanc	1	GS	100p. Sol. 113	5h. 54°C	0.51	0.09	JPL
			73p. Sol. CI 13-300				
P. urethane	1	GS	100p. Sol. 113	7d. R.T.	u.69	0.09	GSFC
			73p. Sol. C-113-300				
			87p. Al powder, MD5100				
P. urethane	Conath.RN1510	RD	AR	20 min.149° C	1.09	0.10	GSFC
P. urethane	Hysol 13-105/MOCA	HΥ	100p.13-105/13p.MOCA	3h. 100° +	1.09	0.08	GSFC
				30d. R.T.			
P. urethane	PC-22	λH	AR	8h. 56 ⁷ C	0.72	0.01	CSFC

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Pottings (continued)

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	Me Code	3	Commentition	Comments and Previous	Percent	Percent	Data
Material	MIG. COUE	3	Composition	Cure History	Weight Loss	Condensables	Source
P. urethane	PR 1527 A/B	Q	26p.A/100p.B	5d. R.T. ۲۰۰۰ در ۲	0.92	0.10	CSI:C
				1x10-6			
P. urethane	PR-1538	PR	AR	20h. 70°C	0.97	0.02	GSFC
P. urethane	RB-8-133B	V	AR	7d. R.T.	0.75	0.01	GSFC
P. urethane	Stycast CPC-41A/B	3	100p.A/120p.B	48h. 65° C+	0.58	0.10	SRI
P unethane	240-2	AB	AR	24h. 150 C	0.44	0.07	GSFC
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Cellular Structures (Table 3)

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In reviewing the selection of available foam systems it is apparent, since they can be easily formulated in house, that syntactic fcams present no problem from the viewpoint of outgassing acceptability. Basically an inert microballoon phase embedded in an acceptable potting resin matrix with Cabosil thickener, the precured material lends itself to troweling. On cure, the balloons provide a rigid unicellular structure with overall density, depending on microballoon volume, ranging from about 22 pounds/cu. ft. to possibly 40-50 lbs./cu. ft. Many acceptable epoxy, urethane or silicone resin systems listed under pottings can be used in syntactic foam production. The 3M Co. and Emerson & Cumings supply inert bubbles or microballons.

The low density pourable foams appear to present a problem since there aren't many vendors with acceptable types. Because of this situation, marginal and submarginal systems are listed. The Nopco G-302 is the recommended material; however, if some of the marginal materials are especially uniquely suited to the specific processing involved, while the G-302 presents a difficultly soluble problem, the marginal material could be used. It is important however that post cure include a moderate temperature vacuum bake out.

Table 3

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Cullular Structures

Material	Mfg. Code	ĉ	Composition	Cruments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Epoxy Epoxy	Stycast 1090/9 Stycast 1090/11	22	100p. 1090/9p. 9 100p. 1090/12p. 11	16h. 50° C 12h. 60° C,+ 3h 82° C	0.31 0.63	0.0.0	SRI SRI
Epoxy Epoxy/syntactic	Stycast 1090/11 Stycast 1095/11 MPC 49	EC GE	100p. 1090/12p. i1 100p. 1095/12p. 1i AR	24h. 125°C 24h. 125°C 4h. R.T., 2h. 66°C	0.04 0.50 0.52	0.04 0.11 0.01	SRI SRI GSFC
Epoxy/syntactic	MPC 49	GE	AR	18h. R.T., 2h. 66	°C 0.39	0.01	GSFC
Epoxy/syntactic Epoxy/syntactic	Eccobond 3F-40 ERL-2795/HN 95-1	ECHA	AR 100p. ERL-2795 2-4p. B-35A microballood	48h. R.T. 24h. R.T. ns	0.24 0.50	0.04 0.03	GSFC GSFC
Fluorocarbon P. urethane P. urethane 2. urethane	Fluorel 1062 Eccofoam SH Nopco J-106 Nopco G-302 CPR-23-2A/2R	UP NP CC	5p. Cab. MS5 8p. cat. HN 95-1 elastomer 7.25 lbs/ft AR AR 23.4p.2A/9.9p.2B	AR AR AR AR AR AR ISh. R.T. + 5h. 93	0.38 1.03 1.12 0.30 0.30	0.03 0.01 0.07 0.07	GSFC SRI GSFC GSFC GSFC GSFC
P. urethane	Pt-:3	ŴC	AR	AR	0.95	0.05	GSFC

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Elastomers, Synthetic Rubber-Damping, Resilience, Sealing (Table 4)

A previous document⁶ noted that a number of silicone elastomers were found acceptable after a 24-48 hour post cure at 400-480°F. This group has been further extended to where twenty-six company formulations have been found suitable. The Viton and fluorocarbon clastomer group have also provided excellent low outgassing materials and there are many formulations to select from, depending on company listed properties. Although acceptable Vitons have good high temperature properties, with improved compression set, they are limited to about -30°C for useful operation. The many other rubbers available are traditionally plasticized, 5-40% by weight, to make them either more easily inoldable or to impart special properties. However, these low molecular weight loosely bound plasticizer molecules are readily released to the vacuum environment with resultant change in rubber properties and high condensable values. Three types of specialty rubbers have been noted. They should be used only when the mission requires the special unique property of the elastomer; i.e. butyl rubber for gas impermeability situations, butadiene-acrylonitrile formulations for oil resistance and the ethylene-propylene type elastomer in anhydrous ammonia propulsion systems. The latter was found to be the only type resistant to chemical breakdown in this severe environment. It will be noted that some rec mmendations in this latter group are submarginal. This should alert the engineer to design for minimal seal exposure or to design around the problem. In any event it calls for an increased effort to establish more acceptable elastomer formulations in this critical group.

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Elastomers. Synthetic Rubbers-Damping. Resilience. Sealing

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Material	MIG. LODE	3	Computation	Cure History	Weight Loss	Condensables	Source
Buta/Acrytonitrile-clast.	Hycar 520-67-108-5	Bŀ	AR	AR	0.95	0.03	SRI
Buta/Acrylonitrile-clast.	Hycar 520-67-108-6	BF:	AR	AR	1.03	0.03	SRI
Butyl clast.	GSFC 218	EN	AR	AR	0.28	0.03	CSFC
Buty's clast.	Sr-634-70	ST	AR	AR	0.93	0.10	CSFC
Butyl clast.	Ex-1092	EN	AR	4h. 150°C	0.86	0.10	SRI
tithy lenc/propylene elast.	E-515-8	EN	AR	AR	1.21	0.18	CSFC
Fluorocarbon elast.	JPL-10	DO	AR	AR	0.32	0.01	JPL
Fivorocarbon clast.	77-545	£	Viton A	AR	0.24	0.03	CISEC
l'fuorocarbon clast.	PLV-101	L	AR	AR	0.82	0.02	JPL,
i luorocarbon elast.	V377-9	S	Viton A	AR	0.33	0.01	SRI
Fissorocarbon stast.	ECD 487-90	DQ	AR	AR	0.51	0.01	CSFC
Pluorocarbon elast.	L605-6	£	Viton A	AK	0.55	0.03	Tif
- Juorocarbon elast.	PLV-1006-A	Е	AR	AR	0.52	0.02	JPL
Filuorocarbon clast.	PLV-3016-B	Ч	AR	AR	0.51	0.02	JPL
Fluorocarbon elast.	4411A-776	Da	Viton A	AR	0.29	0.05	SRI
Fluorocarbon clast.	4411A-776	DO	Viton A	24h. 200° C	0.03	0.01	SRI
Fluorocarbon clast.	4411A-777	DO	Viton A	AR	0.27	0.03	SRI
l'iucrocarbon clast.	4411A-777	na	Viton A	24h. 2v0 C	0.01	0.01	SRI
l'Iuorocarbon elast.	4411A-778	םו.	Viton A	AR	0.35	10.0	SRI
Fluorocarism slast.	4411A-778	na	Viton A	24h. 200° C	0.03	0.01	SRI
Fluorocarbon clast.	4411A-990	DA	Viton A	AR	0.54	0.03	IdS
l'Ivoroc arbon clast.	PLV-5010-B	Ч	AR	AR	0.38	0.02	Idr
l'fuorocarbon clast.	PI.V-8704	٦L	AR	AR	0.44	0.02	JPL
Fluorocarbon clast.	PLV-30001	Ъ	AR	AR	0.33	0.01	JPL
l'Iuorocarbon elast.	Viton B	SR	AR	AR	0.46	0.01	JPL
Fluor.carbon clast.	Viton B	DC	AR	AR	0.86	0.04	CISP.C
Fluorocarbon clast.	Viton C	M	AR	AR	0.30	0.03	GSFC
Fhuorosilicone clast.	L-443-6	£	AR	AR	0.53	0.07	SRI
Fluorosilicone elast.	105(1-70	X	AR	AR	0.56	0.03	SRI
Silicone clast/Al	Lond-HD-222-22-2	PO	BTR, silicone sendwich	AR	0.28	0.02	CSI (
-		<u></u>	between 0.020" aluminut	5	:		
Siliktone clart.	MS 20L08	MO	AK	2min. 163° C+	0.04	0.01	CSFC
				247 C			

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Materia	Mfg. Code	Co	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Silicone elast.	MS 30CO2	QW	AR	2mir. 163° C+ 2h. 249° C	0.07	0.05	CISUC
Silicone elast.	Silastic 35	В	AR	5min. 116°C+ 24h. 249°C	0.14	0.06	CSF/C
Silicone clast.	Silastic 75	X	AR	10min. 17. °C+ 3h. 204°C	0.31	0.10	GSFC
Silicone elast.	RR 423	RR	AR	24h. 232° C	0.11	0.02	GSFC
Silicone elast.	SE-556	GE	AR	24h. 2.i0° C	0.10	0.01	SRJ
Silicone elast.	Silastic 675	ß	AR	5 min. 116° C+	0.41	0.05	CSFC
Sulicome elast.	Silastic 916	8	AR	Smin. 116° C+24-1 249	ູເ 0.40	0.01	CSP.C
Silicone elast.	HR 2501	S	AR	AR	0.30	0.08	GSFC
Silicone elast.	SE-3604/Varox	GE	AR	24h. 204° C	0.09	0.04	JPL
Silicone elast,	SE-3604	GE	AR	24h. 250° C	0.03	0.03	SRI
Silicone elast.	SE-3613	GE	AR	24h. 249°C	0.09	0.06	SRI
Silicone elast,	SE-3713	ЗE	AR	24h. 249° C	0.20	0.09	SRI
Silicone elast.	SE-3813	GE	AR	24h. 249° C	0.27	0.04	SRI
Silicone elast.	SF-4401	GE	AR	10min. 110° C+	0.06	0.01	CSI:C
				24h. 249 C			
Silicone elast.	SE-4404	GE	AR	10min 10°C+24h. 24	9°C 0.10	0.01	GSFC
Silicone elast.	SE-4503	Β	AR	24h. 249° C	0.07	0.03	SRI
Silicone elast.	SE-4511	GE	AR	24h. 249° C	0.19	0.10	SRI
Silicone elast.	SE-5211	GE	AR	10min. 110° C	0.08	0.02	CSPC
				4h. 249°C			
Silicone elast.	SE-5403U	Э	AR	3h. 204 C	0.10	0.02	CSI:C
Silicone elast.	Cohr-9255	ป	AR	24h. 204 C	0.18	0.06	JPL
Silicone elast.	Silastic S-9711	Я	AR	24h. 125° C	0.19	0.05	SRI
Silicone elast.	Silastic S-9711	DC	AR	AR	0.27	0.10	SRI
Sulfone elast.	P-1700	DQ	AR	.25h. 343° C	0.39	0.01	Jar
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Adhesives, Liquid and Film (Table 5)

The adhesives area provides many excellent low outgassing systems, some even with room temperature cures. These range from the more rigid epoxies to the low temperature flexible epoxy 828-140 versamide. Even more cold temperature resistant is the DC-C6-1104 silicone type, flexible to -65°C and nonspalling from aluminum after one minute in liquid nitrogen. The silicone however is most suitable for comparatively light loads. This light load application is also exemplified by low outgasser Dow Corning 93-500 which has been thoroughly tested and recommended for the glass cover slip adhesive on solar arrays. ⁷,8

Outgassing observations on commercial tapes and their pressure sensitive adhesives indicated, that in general, acrylic adhesives were the best performers. Resultant testing of bulk acrylic adhesives with pressure sensitive capability showed that Monsanto's Gelva MP 263, which cross links after application had excellent outgassing characteristics even at room temperature cure. This adhesive might now be applied, in house, to thin annealed specialty foils of copper, lead, silver or any other small quantity film required for special characteristics at nominal temperatures, thus eliminating some of the dependence on tape manufacturers. Adhesion to FEP or Teflon would have to be examined. The availability of these various easily appliable adhesives can provide added scope or dimensions to the designers capability in creating or specifying low outgassing systems. For example, a thermal blanket might be specified, vaporized aluminum on Kapton or Mylar with separating layer of Dacron net. "hold or tie downs" would be requested in the acceptable Velcro polyester "hook and loop" system using low outgassing DC-C6-1104 silicone adhesive to adhere the loop and hook tape elements to the blanket film.

Selection of film adhesives which find application in honeycomb structures is a problem. Many are submarginal from an outgassing point of view, although having good strength characteristics. Film adhesive FM-1000 is one of our prime undesirables in this regard and should be forewarned against because it is so popular. It has excellent adhesion characteristics but is among the worst outgassers. Other marginal adhesives have been recommended not out of choice, but because there are so few acceptable types.

Table 5

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Adhesives, Liquid and Film

				Common to and			
Material	Mfg. Code	Co	Composition	Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Acrylic/I	Gelva MP263RA	MC	AR	7d. R.T.	0.79	0.08	Udse
Acrylic/I	Geiva MP263RA	MC	AR	24h. R.T. +	0.62	0.03	CSI:C
Acrylic/I	Gelva MP784RA	MC	AR	24h. 66 C 24h. R.T. +	1 00	200	Ullay
				24h. 66° C		6.0	
	PS-18	НУ	acrylic cement	72h. R.T.	0.74	0.01	GSFC
	Resyn 30-1215	SN	AR	16h. 66° C	0.82	0.08	IPI
	Armstrong A2/A	AP	100p.A2/4p.A	.75h. 74° C+	0.44	0.01	JPL
Epoxy/I	Armstrone A2/F	đ	100m A 2/6m E	.75h. 93° C			
Epoxy/l					0.26	0.03	SRI
Epoxv/l	Armstrong A12/A	Å,	AK	2h. 85 C	0.85	0.03	SRI
	Armstrong A12/A	Å	AR	2h. 85 [°] C+	0.62	0.02	SP.I
				48h. 125 C+			
Facev/I				1 x 10 ⁻³ torr			
Faxel	Armstrong A31A/B	AP	60p.A/40p.B	2h. 60° C	0.56	0.03	GSFC
Epocy/1	Eccobond 51/9	S	100p.51/7p.9	24h. R.T.	0.44	0.02	CSIC
	Eccobond 51/9	ы БС	100p.51/7p.9	48h. 95° C+	0.18	0.02	Carc
Factural				1 x 10 ⁻¹ torr			
	Eccobond 55/9	Б С	100p.55/12p.9	16h. 65° C	0.17	0.07	SRI
	Eccobond 55/9	ы С	100p.55/12p.9	24h. 25° C	0.40	0.06	SRI
E-poxy/	Eccobond 104A/B	С Ц	100p.A/64B	8h. 150°C	0.35	500	Ias
E	Epibond 123/952	D:I	100p.123/15p.952	24h. R.T.	0.63	0.03	
Epoxy/1	Epibond 8510A/B	FU	100p.A/30p./B	5d. R.T.	0.05	0.0	
	Epiphen ER 825A	ğ	100p. 825A	48h. 75° C	0.84	0.01	SRI
			12p Mod-7				
		_	7. fb.825 A rat				
Epoxy/l	Epiphen ER 825A	BC	100p. 825A	48h. 25° C	1 0.7	100	IDS
			12p. Mod-7	,		10.00	Ne
			40p. filler				
Epoxv/I	Enon 816/TETA		16p. 825A cat.	0			
Enory/	Epon 010/TETA	EN EN	LUP.815/1p. TETA	16h. 63 C	0.76	0.01	CSFC
Epoxy/	Epui 020/1E1A	ž	10p.820/1p. TETA	16h. 63 ⁻ C	0.36	0.04	GSFC
		HO	10P.820/1p. 1ETA	3d. R.T.	0.43	0.06	CSIC

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Adhesives, Liquid and Film (continued)

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Material	Mfg. Code	ථ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Enoxv/l	Epon 828/A	R	100p.828/8p.A	3h. 95° C	0.70	0.06	SRI
Forw/	Epon 828/TETA	SH	10p.828/1p. TETA	10h.60-66°C	0.38	0.61	GSFC
EDAY	Epon 828/TETA	HS	10p.828/1p. TETA	3d. R.T.	0.51	0.01	CSFC
Eboxv/l	Epon 828/Z	HS	100p.828/20p.Z	2h. 75° C+	0.42	0.03	SRI
			_	2h. 135 C	_		
Eboxv/l	Epon 901 A/B	HS	100p.901A/11p B	.5h. 116° C	0.73	0.06	Jaľ
Eboxy/l	Epon 901/B3	HS	100p.901/23p.B3	1.5h. 115° C+	0.19	0.01	SRI
				1.5h. 175° C			
Enerv/l	Epon 917	HS	AR	.25h. 175° C	0.17	0.03	SRI
Entry	Epon 929	SH	AR	1h. 149°C	0.68	0.06	GSFC
Envrv/l	Epon 931A/B	HS	100p.A/1p.B	1h. 125°C	0.13	0.01	SRI
Eboxv/l	Epon 934A/B-MoS,	HS	100p.A/33p.B	.25h. 66° C	0.54	0.01	USI SC
			5p.MoS,	1h. 93°C +			
			20ml, MEK	24h. 125° C			
				1 x 10 ⁻² torr			
Eboxv/l	Epon 934A/B	SH	100p.A/33p.B	16h. 52°C	0.42	0.02	Jdf
Eboxy/	Epon 934A/B	HS	100p.A/33p.B	7d. R.T.	0.28	0.01	GSEC
Epoxy/	Epon 956A/B	Ч	100p.A/58p.B	7d. R.T.	0.19	0.01	GSFC
Eboxv/	Epon 956A/B	SH	100p.A/58p.B	2.5h. 80° C	0.38	0.01	JPL
Epoxy/l	Epotex-301A/B	ET	20p.A/5p.3	24h. R.T.	1.08	10.0	CSFC
			spectrally transp.				
Epoxy/l	Hysol EA 956	ΥY	AR	R.T.	0.69	0.03	GSFC
Epoxy/versam/]	PS-269	BX	50p.828/50p.125	24h. R.T.	0.79	01.0	CSFC
Epoxy/l	Scotchweid 1838 A/B	MM	1p.A/1p.B	24h. R.T.	0.65	0.03	CSI:C
Epoxy/1	Torr Seal	٨N	equal lengths A, B	24h R.T.	0.84	0.01	GSFC
Epoxy/1	2850/24LV	ž	AR	24h. 49° C+	0.73	0.10	GSIC
				24h. 60° C			
Epoxy/versam/]	Epon 828/140	SS	60p.828/40p.140	24h. R.T.	0.74	0.05	GSFC
Epoxy/versam/l	Epon 828/140	ß	50p.828/50p.140	24h. R.T.	0.20	0.02	GSFC
Silicone/	C6-1104	S	AR	7d. R.T.	0.19	0.01	CSEC
Silicone	93-500	8	10p. 93-500/1p. cat	7d. R.T.	0.16	0.01	CSFC
Silicone	566A/B	B	100p. A/.1pB	7d R.T.	0.07	0.04	CSIC
Epoxy/gl/F	Ablefilm 517	AT	AR	3h. 71°C	0.07	0.01	GSFC

(continued)
Film
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Liquid
Adhesives,

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Epoxy/mod/F Epoxy/mod/F Epoxy/mod/F		ပိ	Composition	Previous Cure History	rercent Weight Loss	rercent Condensables	Data Source
Epoxy/mod/F Epoxy/mod/F	FM-96U	AY	AR	1h. 175°C	0.15	10'0	SRI
Epoxy/mod/F	Hysol A9-601	λH	AR	1h. 121 C+12psi	0.37	0.03	GSFC
	Metibond 328	XX.	AR	1.Sh. 165°C	0.12	0.10	SRI
Epoxy/mod/F	Methond 329	AN	AR	1.5h. 165°C	0.26	0.08	SRI
Epoxy/mod/l [?]	Narmco 328	R	AR	1.5h. 165° C	1.00	0.11	CSI:C
Epoxy/mod/F	Narmco 329	ZR	AR	1.5h. 165° C	1.21	0.05	CSI:C
Epoxy/nitrile/F	FM123-5	Aγ	AR	1h. 121° C+12psi	0.98	0.02	C:ISD
Enoxy/nitrile/E	EM.133 LVCM	V	đ¥	1 55 1160		90 Q	-
			22	- 011, IIC.1		0,.0	Jr
Epoxy/nyion/r	FM-1000*	ΑY	AR	2h. 200 C	5.55	4.71	SRI
Epoxy/nyion/F	Metalbond 227	NR	AR	2-3 C/min.to	0.99	0.08	GSFC
				127 C, held 1h.			
Epoxy/phenolic/F	HT-424	AΥ	AR	.5h 65°C	0.83	0.17	SRI
Epoxy/phenolic/F	HT-424	ΑY	AR	2h. 165°C	0.65	0.16	SRI
Epoxy/ <u>phenolic/F</u>	HT-424	Υ	alum/fiberglas/sandwich	30h. 166° C	0.18	0.09	JPL

*Discussion example, not desirable

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Insulation, Dielectrics, Circuit Boards, Tubing, Sleeving (Table 6)

There appear to be few problems associated with the selection of adequate insulation and dielectric materials. However, it should be noted that Teflon PTFE is subject to cold flow and has comparatively low particulate radiation resistance in non-radiation protected areas. This is not the case with FEP which has both good UV and particulate radiation resistance. FEP should be surface treated to provide improved adhesion to potting compounds. Silicone, either as potting or elastomer, should be one of the insulations considered for high voltage operations.

High temperature resistant silicone coated glass sleeving is often obtained with undercured outgassing formulations. Such items may be cleaned up by baking at elevated temperatures for extended periods of time. Howe er, the designer can circumvent this problem by specifying an uncoated glass sleeving cleansed of lubricating oils and coated with DC-C6-1104. As previously indicated under "pottings", materials with varying dielectric constants can be easily fabricated.

Vinyl insulations with their high percentages of outgassing plasticizers are undesirable.

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Insulation-Sleeving Dielectrics, Circuit Boards, Tubing, Sleeving Table 6

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Material	Mfg. Code	ಲಿ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. acctal/I	Formex	GE	AR	AR	0.06	0.03	SRI
Fluorocarbon/I	FEP	HT	AR	AR	0.02	0.01	GSFC
Fluorocarbon/1	D-100 series	RA	Kynar solder sleeves	AR	0.38	0.08	GSFC
			w. polyethylene rings				
Fluorocarbon/I	D-100 series	RA	Kynar sleeves without	AR	0.44	0.08	GSFC
			polycthylenc				
Fluorocarbon/olefin/I	V-44	RA	p. vinylidene fluoride	AR	0.34	0.07	GSFC
			irradiated, over p. alkene,				
			irradiated				
Fluororarbon/I	33181019	BR	PTIFE	AR	0.01	0.01	CSI:C
Fluorocarbon/I	Permatube-1	MT	PTFE	AR	0.01	0.01	GSFC
P. ester/x/I	Poly thermaleze		x-linked p. ester +	AR	0.28	0.01	CSFC
			p. amide-imide jacket				
P. imide/I	XPI-MC-154	AΥ	AR	AR	1.14	Ú.01	GSFC
P. imide/I	Kapton T-400, 1/20	BR	AR	AR	0.51	0.10	GSFC
P. imide/I	Pyre ML	D	AR	AR	0.07	0.02	JPL
P. imide/FEP/I	T473-1/24	BR	AR	AR	0.52	0.01	GSFC
P. olefin./I	44/0611-9	RA	AR	AR	0.21	0.07	CSIC
P. olefin/mod/I	Suriyn A	RM	AR	AR	0.28	0.03	GSFC
Silicone/elast./I	B1WP/N	BW	high voltage silicone	24h. 232 [°] C	0.03	0.01	GSFC
	I: 5639-L-G22		cable	¢			
Silicone/clast./I	STW 0474	SU	AR	96h. 204 C	0.11	0.01	GSFC
P untition/1	Grineze	ΡH	AR	AR	0.16	0.02	JPL
D unstheme I	Suderozo	Ηd	AR	AR	0.09	0.03	GSEC
P ester/S.T.	Mvlar .004" wall	SP	AR	10min. 110° C	0.62	0.03	SRI
P. cster/S.T.	Mylar .012" wall	SP	AR	10min. 110° C	0.68	0.05	SRI
Fluorocarbon/S.T.	FEP-black	ξ	AR	AR	0.03	0.01	JPL
Fluorocarbon/S.T.	FEP-clear	БĊ	AR	AR	0.03	0.01	JPL
Fluorocarbon/S.T.	FEP-yellow	Бč	AR	AR	0.03	0.01	JPL
Fluorocarbon/S.T.	Thermofit 7-31-22	RA	p. vinylidene fluoride	1h. 150° C	0.27	0.09	SRI
Fluorocarbon/S.T.	Thermofit 7-32-16	RA	PTFE	1h. 150° C	0.01	0.01	SRI
Filuorocarbon/S.T.	Thermofit-R	RA	PTFE	Ih. 150°C	0.01	0.01	SRI
Filuorocarbon/S.T.	Thermofit 7-30-09	RA	PTI/E	1h. 150°C	0.01	0.01	SRI
Fluorocarbon/S.T.	Penntube II-SMT	PF	PTFE	1h. 150° C	0.01	0.01	SRI

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Material	Mfg. Code	රී	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. olefin/S.T.	Thermofit-876	RY	AR	.25h. 125° C	0.43	010	C.P.C
Acrylic/gL/SL	Lecton-B	BH	AR	24h. 150° C	0.09	0.09	
Acrylic/gl./SL	Acrylic C-2	BH	AR	AR	0.33	0.01	SRI
Acrylic/gL/SL	Acrylic A FA1	BH	AR	24h. 150° C	0.22	0.05	SRI
Acrylic/gl/SL	Acrylic A FAI	8:1	АК	AR	0.49	0.05	SRI
Suicore/gl/SL	1062-HA1	BH	AR	24h. 150°C	0.29	0.13	SRI
Fluorocarbon/D	Kynar	T	p. vinylidene fluoride	AR	0,19	0.08	JPL
Sulicone/D	K-707 (K~12)	Ð	AR	AR	0.41	0.01	SRI
Suicone/D	K-707 (K~!S)	GE	AR	AR	u.70	0.08	SRI
r. styrene/x/D	Q200.5	dd	AR	AR	0.09	0.01	GSFC
r. styrene/x/D	Rexolite 1422	BR	AR	AR	0.18	0.01	JPL
r. styrenc/x/D	Rexolite 1422	BR	no copper	AR	0.16	0.02	GSFC
Epoxy/gL/CB	FLGF 250C 2/2AIIB	AN	CB has 2 sides copper	AR	0.12	0.01	CSFC
F.poxy/gL/CB	FLGF EG-2028FR	FL	no copper	AR	0.44	0.01	SRI
Epoxy/gL/CB	FLGF EG-2028	H.	no copper	AR	0.33	0.01	INS
Epoxy/gl./CB	Marglass	MG	100p.Ciba MY 740	AR	0.93	100	CRF
			1.5p. accel. DY219				
			50p.cat HY219				
			glass cloth-1275				
			finish-P705				
Epoxy/gL/CB	Micaply EG-758T	IW	no copper	AR	0.48	0.05	103
Epoxy/gi./CB	Micaply EG-824T	IW	no copper	AR	0.40	3440	INC
Epoxy/gL/CB	Micaply EG-899T	IW	no copper	AR	0.0	0.00	INC
l:poxy/gl./CB	Micarta 65M25	WC	no copper	AR	0.43	10.0	
Epoxy/gL/CB	Micarta 65M28 (FR4)	ŴĊ	copper clad	AR	240	100	
					07*0	10.0	.Irl
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Insulation-Sleeving Diclectrics, Circuit Boards, Tubing, Sleeving (continued)

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Conduction (Table 7)

It is often desirable that some mode of electrical conduction other than through wires be used in special spacecraft applications. R.F. shielding and conductive adhesives demonstrate this important requirement. Shielding can be accomplished by covering insulated wires with metallic tapes. One can also protect the contents of metal boxes by using silver filled conductive compounds or gaskets at the cover/ box interface. Such materials also have good thermal conductivity if this is required. In this regard they make excellent thermocouple contacts to various substrates. One technique for making conductive coatings is to first select a low viscosity potting material with good adhesion characteristics from the acceptable list. This is then blended and catalyzed with about 71-74%, by weight, flake silver, similar in properties and shape to Handy & Harmon Silflake 135. The cured material should have excellent conductivity.

Table 7

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Material	Mfg. Code	ಲ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Acryluc/silver powder	Dupont 4922	DO	lp. r/lp. butyl acet.	.25h. 66°C + 48h. 99° C	0.61	0.01	GSFC
Acrylic/silver	E-Kote 3030	ER	conductive coating	24h. R.T., 1h. 66°C	0.76	0.06	GSFC
Alum,/acryhc/silver	Eccoshield PST-C-A	БĊ	aluminum foil	AR	0.26	0.09	GSFC
			tape with silver ball filled acrylic adhesive				
()u/actylic	X-1245	MM	copper foil with acrytic adhesive	AR	0.19	0.11	GSFC
Cu/acts lic	X-1181	MM	ccpper foil with	24h. 125° C	0.15	0.03	GSFC
Cu/acrylic	Mystic 7420	ΥM	acrylk: adhesive copper foil with acrylic adhesive	AR	0.22	0 01	CSFC
P.poxy/metal	Eccobond 56C/9	ЭЭ	100p.56c/2.5p.9	16h. 50° C	0.30	0.03	SRI
Epoxy/metal	Eccobond 57C-A/B	S	100p.A/100p.B	16h. 52° C	0.67	0.06	SRI
Epoxy/metal	Hysol K8-4238/H2-3475	λHS	100p4238/8p.3475	24h. R.T.	0.32	0.01	CSI:C
Silicone/metal	Cho Seal 1215	Ð	AR	AR	0.39	0.08	GSFC
Suicone/silver powder		GE	100p.RTV11/70p.silver/ 2p.T-12	24h. R.T.+ 24h. 130° C	0.08	0.01	JPL
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Tapes (Table 8)

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Tapes. glass, metal, polymer or composites the reof, can be useful on spacecraft as thermal control coatings, R.F. shielding, current carriers, low friction surfaces, radiation shielding, electrical and thermal insulation. Suitable application of the above concepts have been shown to be dependent on the adhesive component of the tape. Several specialty tapes, vapor deposited gold, lead and polyimide show high outgassing. The availability and use of low outgassing adhesives applied on site to representative films would allow the designer great r freedom in the selection of processes, and in the important aspect of programming the particular time, at which the material should be applied. Such adhesives, i.e., epoxy, epoxy-versamid, acrylic, and silicone, are available to help develop such an inhouse application system capability. (See adhesives list.) Note that most of the tapes have acrylic adhesives.

Material	Mfg. Code	ဗီ	Composition	Comments and Previous Cu:e History	Percent Weight Loss	Percent Condensal les	Data Source
P. estet/acrytic	S	WW	AR	AR	0.40	10'0	GSFC
P. ester/acrytic	850	MM	AR	AR	0.65	60.0	GSFC
P. ester/acrylic	X-1179	WW	AR	24h. 65° C	0.46	0.01	CSFC
P. ester/gl.	Fibre-mat 1-2539	WW	84.	AR	0.19	0.02	SRI
	Wetic-4043	λW	AR	AR	0.68	0.02	JPL
P. ester/scrylic	Mystic 7341	Ϋ́Μ	AR	AR	0.57	0.03	JPL
Fiberelass/actylic	Mystic 4052	ž	AR	AR	0.5'J	0.02	JPL
Fibenglass/silicone	Permacel 5208	M	AR	8ħ. 204° C	P.31	0.07	JPL
Finorocarbon/acrylic	63	MM	AR	AR	0.33	0.03	GSFC
Fluorocarbon/acry h.c	65	MM	AK	AR	0.29	0.08	CSFC
F huorocarbon/silicone	CHR C-400	C	PTFE carrier	AR	0.27	0.09	GSFC
P. imide/acrytic	Y1205	MM	AR	AR	0.73	0.10	GSFC
P. imide/acrylic	1255	MW	double coat of acrylic	.sh. 120°C	0.93	0.07	GSFC
			adhesive on p. imide				
P. imide/acrytic	7367	λW	AR	AR	0.64	0.05	GSFC
Stiicone/elast.	70	MM	AR	24h. 121°C	0.40	0.07	CSFC
				1x10 ⁻³ torr			
Al/p.estet/acrylic	850	WW	vaporized aluminum on Mvlar	AR	0.69	0.10	GSFC
Al./p.ester/acrylic	852	MM	vaporized aluminum	AR	0.59	0.03	GSFC
			on Mylar				
AL/p.ester/AL/acrylic	Y9360	Ň	vaporized aluminum	AR	0.54	0.01	GSFC
			top and bottom side				
			of Mylar				
	CI 1760643	2	e unimite beritanov	a	0.65	100	JEL
vr/bream/actions	C+CDC71-70	AT TAT	on Mylar	4	CO-0	10%	
Gold/p.imide/acrytic	Y-0184A	MiM	vaporized gold on	AR	1.42	0.01	GSFC
			Kapton				
AL/actyli	425	WW	aluminum friil	AR	0.24	0.03	GSFC

Tapes (continued)

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Material	Mfg. Code	S	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
AL/acrytic AL/acrytic	Mystic 7452 Mystic 7453	γM MY	aluminum foil aluminum foil	AR AR	0.25 0.64	0.03 0.04	GSFC JPL
AL/acryitc	Y9339	MM	type 2, aluminum foil	AR	0.80	0.02	GSFC
AL/acrylic	Y9339	MM	type 3, aluminum foil	AR	0.20	0.01	GSFC
Cu/acrylic		MM	copper foil w. acrylic	24h. 125 [°] C	0.15	0.03	GSFC
Cu/acrylic	X-1245	WW	copper foil w. acrylic	AR	0.19	0.11	GSFC
Cu/acrylic	Mystic 7420	ΜΥ	copper foil w. acrylic	AR	0.22	0.01	GSFC
Lead/acrylic	Mystic 742 i *	λW	lead foil w. acrylic	AR	1.33	0.06	JPL
Where needed for radiation resistance	8]					

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Film, Lacing (Table 9)

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It would appear that a simple item like acceptable lacing could be produced by many fabricators and in various types, however suitable lacing types are quite limited in availability. FEP Teflon would be desirable in a geometry or filled composition that would minimize its inherent low coefficient of friction. Polyester type lacings are useful, however most often they contain some coatings which outgas. These could be scoured or dissolved off in some instances. Irradiated polyvinylidene fluoride, high molecular weight polyethylene, polypropylene, polyvinyl fluoride should make effective aerospace lacings. None have yet made the scere.

Table 9 Film, Lacing

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Materia:	Mfg. Code	ů	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. ester/F	Cronar	Я	AR	AR	0.37	0.01	GSFC
	Ortho-S-Litho-CoS7	_					
P. ester/F	Mylar A	DQ	AR	AR	0.40	0.10	JPL
P. ester/F	Mylar HS	DQ	AR	AR	0.50	0.06	JPL
P. ester/F	Mylar 500A	DU	AR	AR	0.24	0.06	SRI
P. ester/F	Scotch Pak 8	MM	AR	AR	0.19	0.07	JPL
Fluorocarbon/F	FEP-100A	DO	AR	AR	0.06	0.06	SRI
Fluorocarbon/F	FEP-SUOA	DO	AR	AR	0.05	0.05	SKI
Fluorocarbon/F	FEP-SOOC	D	AR	AR	0.02	0.01	SRI
Fluorocarbon/F	Ribbon Dope	M	PTHE	AR	0.07	0.02	SRI
	Thread Seal 8030-						
	733-0055						
Fluorocarbon/F	Tedlar 100BG 30TR	DQ	p. vinyl fluəride	AR	0.23	0.10	SRI
Fluorocarbon/F	Tedlar 100BG-30TL	DC	p. vinyl fluoride	AR	0.09	0.09	SRI
Fluorocarbon/F	Tedlar A130WH	DG	p. vinyl fluoride	AR	0.47	0.01	SRI
Fluorocarbon/F	Tedlar 150 BL 30cc	DQ	p. viaiel fluoride	AR	0.14	0.01	GSPC
	black						
P. imide/F	Kapton 200XH 667	DQ	AR	AR	0.14	0.09	SRI
P. imide/FEP/F	Kapton 200XHF 929A	AP	AR	AR	0.54	0.05	SRI
P. imide/nylon/F	1	WN	thermal blanket	AR	0.61	0.03	CSFC
			composite				
P. phenylene-ox/F	PPO-531-081 opaque	GE	AR	AR	0.09	0.02	SRI
P. phenylene-ox/F	PPO-681-111 clear	GE	AR	5h. 180°C	0.07	0.05	SRI
P. sulphone/F	P-2300	3	AR	sh. 125° C	0.03	0.01	SRI
P. sulphone/F	F-7395-121-2	Ы	AR	AR	0.09	0.02	SRI
Pp-xylylene/F	Parylene C	ы	2 mils thick	AR	0.07	0.02	JPL
Pp-xylylene/F	Parylene C	S	AR	AR	0.12	0.01	SRI
Pp-xylylene/F	Parylene N	3	AR	AR	0.30	0.01	SRI
AI/p. ester/Dac./adhes./F	l	DC	vaporized aluminum	AR	0.46	0.09	GSFC
			on Mylar, over				
			Dacron adhered to				
			surface with adhes.				
			46960				

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Film, Lacing (continued)

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Mfg. Code Co
00M42 SU fedlar 136-30WH/AI 6056 H 191
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Astro-Tex HW
Sturdelace 18DH GB
Temp-Lace 256 GB
femp-Lace 256H GB

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Paints (Table 10)

Some of the formulations noted in this area are early, desperate in-house attempts at exploring the use of acceptable potting vehicles or adhesives for paints, since low outgassing paints were simply unavailable. Many commercial paints require high temperature bakeouts to even approach submarginal "total outgassing" acceptance. The problem probably results from several factors connected with the conventional use of normally desirable high boiling, low volatility solvents which are difficult to remove after paint surface case hardening. The paint vehicles explored were usually 100 percent solids, not considered sprayable, but which could be brushed out yielding glossy and flat surfaces. Application capability was a function of the initial resin-curing agent viscosity and filler content. However very little is known about the optical characteristics of these materials and so they are relegated to emergency or touch up functions. The Hughson Chemical Co. has within the past two years made available both a polyurethane black Z-306 and a white TS-1603-16. Both are splayable systems and show acceptable outgassing after 3-4 weeks of room temperature drying without bakeout. Like many other epoxy black paints 3M's Velvet Black, 401 series is a submarginal outgasser, however it is still recommended subject to rigorous vacuum bakeout because of good radiation resistance and greatly improved spectral reflectance properties, over a wider frequency spectrum, 15-80 μ than the Z-306 ⁹. Already, one of our staff has updated the Z-306 to near optical comparability with the Black Velvet paint series.¹⁰ Comparative, combined ultraviolet and particulate radiation resistance have yet to be obtained. The Hughson paints are recommended in interior spacecraft situations, where spectral reflectance in the longer wavelengths is not as critical, as in the selective chopper Radiometer. The inorganic paints dependent on the silicate binders for cohesion and adherence, and designed for all around radiation stability appear destined to continue with high total outgassing, primarily water, and low condensables. They are listed primarily to indicate the present state of the art. A recent potassium titanium fluoride type shows improved total outgassing. In spite of the excessive moisture release however, some might still be most desirable for long term space exploration where resistance to radiation and elevated temperatures are important vrerequisities. Hopefully the moisture would be dissipated at temperature and vacuum along the way to the experiment rendezvous.

The need still exists for easily applied, room temperature cured black and white low outgassing paints requiring no primer, having excellent low temperature adhesion, good optical characteristics, combined with ultraviolet-particulate radiation resistant properties. Some novel flexible and rigid silicone white systems with acceptable outgassing are still being developed. See FC-GSFC-14W, P764-IA¹¹ and Owens 650/ZrO in the paint section. If these cannot be fully evaluated soon, the answer to white paint thermal control may well be the long lived second surface inconel backed silver mirror with very low $\alpha_{\rm S}$ /E ratio. These metals are vacuum deposited on radiation resistant Corning 7940 glass or other higrade cerium protected, UV resistant silica. An excellently adhering moderately outgassing second surface glass mirror system with tested application techniques has been worked out in this group, and passed OAO thermal vacuum and vibration testing as a panel system. This presently includes a second surface mirror of vacuum deposited silver/inconel on glass with Dow Corning 3145 adhesive. Tests are presently underway using low outgassing Dow Corning C6-1104 adhesive on latest state of the art second surface mirrors having a gold colored protective inorganic dielectric backup against the silver. Excellent results are anticipated. Studies will also continue on the inconel backed mirrors employing Dow Corning C6-1104. The intermediate longevity type represented by second surface mirrors on FEP film may suffice in low radiation environments for comparatively short, 1 - 1.5 year, flights. FEP change due to 25-50Kev proton bombardment may present a long term problem.¹²

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Table 10

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			Paints				
Material	Mfg. Code	ى ئ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Alkyd/BF	101-C10	WW	AR	74. 110° C 241, 120° C	0.33	0.17	SRI
Epoxy/BF Epoxy/B	CTL-15(17038)	E H	3p.15A/1p.15B	2 coats, each	0.96	0.02	GSFC
				air dried .25h. +.25h. 65°C + 1.75h. 121°C			
Epoxy/BI [:]	FC-GSFC - 5B	ß	100p. 956A 58p. 956B	7d. R.T.	0.81	0.01	GSFC
			3.15p. Carb. 1 1.6p. Cab-MS-5				
Epoxy/BF	FC-GCFC-6B	S	100p.956A 580 956B	2h. 66° ٽ	0.49	0.01	GSFC
			3.15p. Carb.1	_			
	_		1.6p. Cab-MS-5				
Epoxy/BF	FC-CSFC-/B	S	100p.956A	7d. R.T.	1.02	0.01	GSFC
			3.15p. Carb. 1				
			1.6p. Syloid 620				
Epoxy/BF	FC-GSFC-11B	S	100p.956A	2h.t	0.85	0.10	GSFC
			58p.956B				
			.4p. Cab.MS-5				
			6.32p. MoS ₂ 75n. Carb I				
F poxy/versam./Al	S-GSFU-20-A1	ß	60p.828	48h. 100° C	0.77	0.07	GSFC
			40p.140				
			33p.MD5100 A1 powder				
			133p. { toluene-50 acetone-50				
P. ester-epoxy/BF	401 Series	MM	6p.r./1.5p.cat.	1h. 43° C	4.49	0.23	GSFC
P. ester-epoxy/W	401-A10	MM	3p.401-A10/1p.cat.	7d. R.T.+	3.09	0.08	G3FC
				24h. 121°C			
Fluorocarbon/W	Fluoroclad/W	SW	p.vinylidene fluoride	4h. R.T +	0.67	0.05	GSEC
			in solvent	.sh. 93` C			
				+.25h. 260 [°] C			
Silicate/bi	MSA/5	S	A sbestos, Talc,	72h. R. f.	3.14	0.02	GSFC
			Al ₂ SiO ₃ , Mica				
			Carbon black, K25103				

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Paints (continued)

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Material	Mfg. Code	S	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Sili ::ate/BF	MSA/S	CS	asbestos, Al ₂ SiO ₃ talc, mica, carbon black	48h. 100° C	2.24	0.04	GSFC
Silicate/BF	MSA/5 vLT.	GS	K ₂ SiO ₃ , binder asbestos, CaSiO ₃ , talc, mica, carbon black	72h. R.T.	3.50	0.02	GSFC
Silicate/W	MS-74	GS	K ₂ SiO ₃ , bınder TiO ₂ , ZnO. Al ₂ O ₃ , K ₂ SiO binder	24h. R.T.	6.27	0.03	GSFC
Silicate/W	MS-74	GS	Ti0 ₂ , Zn0 A1 ₂ 0 ₃	48h. 100° C	4.54	0.01	GSFC
Silicate/W	Z-93	GA	N25103, Diffuer ZnG/K25103 binder	7d. R.T.	2.54	0.01	GSFC
Silicone/W	C-101 GSFC-16W	S	300p. ZnO-SP500 + lithium + potassium	3h. air dry + 2h. 150°C	0.41	0.12	GSFC
			silicate 150p. RTV-602 100ml tolume				
Silicone/W Silicone/W	FC-GSFC-14W FC-GSFC-14W	<u>ខ</u> ្ល ខ្ល		3.5d. R.T. 7d. R.T.+	0.17 0.14	0.09 0.01	GSFC GSFC
Silicone/W Silicone/W	HC-GSFC-15W UTRI-S-13G	S S	dimethyl silicone,	24h. 66 C 4d. R.T. 16h. 121°C	0.21 0.42	0.08 0.10	GSFC GSFC
Silicone Silicone/W	Owens 650 Owens 650/ZrO	S S	200/x2303 AR 60p. 650/40p. ZrO	18h. i00° C AR	0.51	0.02 0.01	GSFC GSFC
Silicone/W	P-764-1A	S	260p. treated ZnO 100p. devolat. 602 .25% SRC-05 based on 60 360p. toluene	7d. R.T 2	0.30	0.01	GSFC

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Paints (continued)

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Material	Mfg. Code	පී	Committion	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Silicone	SC-GSFC-19C	S	12p. RTV 602 devol. .031p. SRC-05	G.E. prepolymer 602-heated 24h. 150°C, 10° ⁶ torr at GSFC to a viscosity of 2000 t 2200 centipoise an cooled prior to catalyzing	0.35 2.35	0.02	GSFC
Silicone/B	Sicon Black 7X9055	DX	AR	7d. R.T. cure 24h R.T., .5h.	0.98	0.04	GSFC
P. urethane/BG		ន	100p. Sol. 113 73p. Sol. C-113-300	22h. 60° C	0.40	0.01	GSFC
P. unethane/BG		S	2.6p. Carb. 46 2 drops T-12 100p. Sol. 113 73p. Sol. 113-300 2 6n Conh 46	7d. R.T.	0.51	0.02	GSFC
P. ure thane/BC		ß	2 drops T-12 2 drops T-12 100p. Sol. 113 73p. Sol. C113-300 2.6p. Carb. 1	18h. 50° C	0.41	0.04	GSFC
P. urethane/B P. urethane/W	Chemglaze Z-306 FC-GSFC-20/W	C HC	2 drops-1-12 10ml. MEK AR 100p. Sol. 113 73p. C-113-300 .26n. TrO.	30d. R.T. 7d. R.T.	0.56 0.29	0.01 0.01	GSFC GSFC
F. urethane/W	TS-1603-16	HC	l drop T-12 AR-w/solvent	7d. R.T.	19.0	0.02	GSFC

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Paints (continued)

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Data Source	GSFC
Percent Condensables	0.04
Percent Weight Loss	0.83
Comments and Previous Cure History	15d. R.T.
Composition	9ml. Chemglaze Z-306 2ml. toluene 1gm. 3M-84015 microballoons thru 44 micron sieve onto 37 micron sieve
లి	S
Mfg. Code	
Material	P. urethane/BF

Conformal Coatings (Table 11)

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Many types of conformal coatings have been examined and it would appear that those, which are of low viscosity and 100% solids for: ulated, are most successful from the outgassing viewpoint. These are represented by the cpoxy-versamide type, epoxies and polyurethanes. It is entirely possible that the group of previously noted low volatility silicones, GE 566, Dow Corning 93-500 or C6-1104 could also be used in high voltage specialty situations. The solution type conformal coatings, especially the epoxies, appear to lose considerable solvent during VCM testing, possibly because of previous solvent entraprior and due to surface cure.

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Table 11 Conformal Coatings

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Material	Mfg. Code	Co	Composition	Comments and Previous Cure History	Percent Neight Loss	Percent Condensables	Datr Source
Ероху	PCA/16	ЭЭ	10/p.A/2p.16	1h. 25° C+ 7h. 06° C+	0.18	0.02	SRI
				2h. 150°C			
Eboxy	SMRD 100A/B	GE	57p.A/44p.B	16h. 130°C	0.46	0.04	GSFC
Epoxy	Stycast 1467/9	EC	100p.1467/7p.9	18h. R.T. +	0.14	0.01	GSFC
•				Ih. 77° C			
Epoxy/versam.	Epon 846/140	RO	7.0p. 828	1h. R.T. +	0.27	0.02	GSFC
			30p. 140	2h. 60°C		-	
			lp. SR-82				
P. ester/imide	l'somid	S	AR	Air dry + 2 min.	0.44	0.03	GSFC
Pluorocarhon	Fluoroclad V78-VP21	WS	AR	Air drv +	0.05	0.01	GSFC
		:		.5h. 93°C +			
				25h. 260° C			
Fluorosilicone	94-003-dispersion	g	AR	75d. R.T.	0.18	0.01	GSFC
P. urethane	FC-GSFC-20/w	S	100p. Sol. 113	74. R.T.	0.29	0.01	GSFC
			73p. Sol. C113-300				
			.25p. TiO,				
			l drop T-12				
P. urethane	JPL 1002	AB	AR	4h. 75° C	0.19	0.02	SRI
P. urethane	1001 Jrt	AB	AR	4h. 75° C	0.20	0.10	SRI
P. urethane		Ŧ	100p. Sol. :13	sh. 54°C	0.51	0.09	JPL
			73p. Sol. C113-300				
P. urethane	1	SS	100p. Sol. 113	22h. 70°C	0.31	0.01	GSFC
			73p. Sol. C113-300				
P. urethane	ł	S	100 ₁ . Sol. 113	?d. R. I.	0.37	0 .0	CSI CS
			150p. Sol. C113-300				
P. urethane	I	S	100p. Sol. 113	18h. 50° C	0.31	U.04	GSFC
			150p. Sol. C113-300				
P. urethane	1	SB	100p. Sol. 113	16h. 28° C	0.21	0.01	GSFC
			51p. Sol. C113-300				
			4.5p. Sol. C11J-328				
			20.5p.B-35A gl.				

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Conformal Coatings (continued)

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Mfg. Code	ප	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
RCA-A-4675	RCA	100p. 11 55A/70p. 1 155B +30p. cellosolve ac. tate	10min. R. T.+ .25h. 49° C for each of two coats + 3h. 60° C final	6.81	0.05	GSFC

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Lubricants and Interfaces - Liquid Lubricants, Solid Films, Optical and Thermal Grease (Table 12)

There are few design considerations which have received the analysis and attention by aerospace technologists, as the lubricant interface between moving parts. These lubricants may be liquid or solid film. The former are generally represented by silicone oils such as F-50, purified hydrocarbon Apiezon C and refined azelate, sebacate and/or adipate esters. Apiezon L is a grease with a hydrocarbon liquid phase. A good deal of the concern with lubricating silicones even in low speed low load applications has been the high outgassing of the thin film lubricant vehicle, and in some cases non-standard quality control resulting in inconsistent properties. Each of the asterisk indicated lubricants¹³ are normally considered unacceptable outgassers. However, they do have unique lubricating properties and have often been used on spacecraft in specially designed sealed systems.

New low outgassing lubricants F6-1101 a fluorosilicone and F6-1107 a chlorophenyl siloxane, both servicable from -40 to 400°F have become available from Dow Corning. Their counter parts are FS-1265 and DC-560.

The F6-1101 however, a fluorinated silicone oil shows excellent lubricity in the four ball wear test, ASTM-D-2266, when compared to either F6-1107, F-50, chlorophenyl siloxanes, or Apiezon-C hydrocarbon. Wear scar values were 0.42, 1.89, 1.23 and 0.78 millimeters respectively for the four lubricants.¹⁴ Some GSFC evaluation of F6-1101 potential as either an improved lubricant oil or base for new greases using possibly tricresyl phosphate additive could be fruitful. Here again it becomes possible for those versed in the art to develop new specialty lubricants based on these low outgassing oils. Silicone oil creep would have to be reasessed.

Solid film lubricants are also utilized in spacecraft. These may be polymer based, epoxy or phenolic molybdenum disulphide types or the inorganic silicate molybdenum disulphide type. The latter material specified in MIL-L-81329(WP) Oct '65 was developed by personnel of the Aeronautical Materials Department.¹⁵ Details on processing and the latest material technology can be obtained there. This is an excellent solid lubricant surface when correctly applied. It has flown on ATS satellites and is recommended in critical areas. It remains to be evaluated in outgassing tests. Teflon composites have seen satisfactory service in low load applications and usually have acceptable outgassing values. Low outgassing thermal grease used at interfaces to preserve thermal continuity is a normal development consideration for low volatility silicone oils. There are many thermally conducting filler/concentration combinations of greases or silicone pottings that can be explored and developed for maximum thermal conducitivity at interfaces. A small investment in time with such fillers as zinc, aluminum, or possibly beryllium oxides could provide materials helpful to thermal control designers.

Application of more effective low outgassing thermal greases or potting systems could lead to more exact anticipated temperatures and faster thermal equilibration of spacecraft, factors necessary to good thermal control.

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Table 12

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Lubricants and Interfaces-Liquid Lubricants, Solid Films, Optical and Thermal Grease

Material	Mfg. Code	ပိ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Ester/LL*	DOA		dioctyl adipate	AR	100.00	I	GSFC
Fluorocarbon old/LL	Krytox 143-AX	Ŋ	fluoroalkyl polyether oil	AR	28.54	5.71	GSFC
Hy drocarbon/LL*	Apiezon-C	BU	AR	AR	31.50	I	GSFC
Hydrocarbon/LL	Apiezon-L, gres e	BD	AR	AR	0.06	0.01	JPL
Silicone/TG	C6-1102	X	AR	AR	0.05	0.02	GSFC
Silicone/G/LL	C6-1103-vac. grease	8	AR	AR	0.17	0.01	GSFC
Silicone Oil/I L	F6-1100	В	dimethyl siloxane	AR	0.07	0.Q	GSFC
Silicone Oil/LL	F6-1101	ß	fluorosilicone	AR	0,05	0.03	GSFC
Silicone Oil/LL	F6-1105	X	phenyl methyl siloxane	AR	0.07	0.06	GSFC
Silicone Oil/LL	F6-1107	g	chlorophenyl siloxane	AR	0.11	0.07	GSFC
Silicone Oil/LL*	F-50, Versilube	GE	AR	AR	4.50	I	GSFC
Silicone Oil/LL*	SF-96[500 cp.]	B	AR	AR	4.00	1	GSFC
Silicone Oil, LL*	SF-96 [50cp.]	B	AR	AR	8.00	1	GSFC
Silicone Oil/LL	1147	GE	AR	AR	4.28	2.41	GSFC
P. acetal/teflon/M/SF	Delrin AF	Da	80 Delrin/20 Teflon	AR	0.47	0.05	JAC
P. acetal/teflon/M/SF	Fulton 404	Ľ	80 Delrin/20 Teflon	AR	0.52	0.01	GSFC
P. acetul/gl./SF	Formafil G80/20	FF	80 r./20 gl.	AR	0.44	0.01	GSFC
Epoxy/MoS./SF	Epon 934A/B-MoS,	SS	100p. 934A/33p.B	.25h. 66° C,	0.54	0.01	GSFC
a	•		5p.MoS ₂ 20ml. MEK	1h. 9 .3° C + 24h. 125° C, 10° ² torr			
Epoxy/MoS,/SF	FC-GSFC-11-B	S	100p. 956A	2h. 66° C	0.85	0.10	GSFC
•			58p. 956B 6.3p. MoS ₂ 8 Cath 1				
			.4p. CabMS-5				
Fluorocarbon/SF	3318i019	BR	PTFE	AR	0.01	0.01	GSFC
Flucrocarbon/Dax/SF	Fairprene 80-080	DU	AR	AR	0.30	0.01	SRI
Fluntocarbon/Dac/SF	Fairprene 80-070	DQ	AR	AR	0.30	0.01	SRI
Fluorocarbon/Dac/SF	Fairprene 80-060	DG	AR	AR	0.34	0.01	SRI
Fluorocarbon/gl./St?	TBS-PTNE	B	AR	AR	0.05	0.05	Taí

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Fluorexarbon/[4]/SF RT Duronearbon/[4]/SF RT Duronearbon/[4]/SF RT Duronearbon/[4]/SF RT Duronearbon/[4]/SF Processition Rt 0.12 0.02 0.03 H Duronearbon/[4]/SF Duronearbon/[4]/SF Processition Rt 0.12 Duronearbon/[4]/SF Duronearbon/[4]/SF Processition Duronearbon/[4]/SF Rt 0.01 Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF A R 0.01 Duronearbon/[4]/SF Duronearbon/[4]/SF A R 0.01 Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF A R 0.01 Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF A R 0.03 Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF A R 0.03 Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF Duronearbon/[4]/SF <thd< th=""><th>Material</th><th>Mig. Code</th><th>පී</th><th>Composition</th><th>Comments and Previous Cure History</th><th>Percent Weight Loss</th><th>Percent Condensables</th><th>Data Source</th></thd<>	Material	Mig. Code	පී	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Fluorocarbon/inicid/SF Pluorocarbon/inicid/SF Pluorocarbon/inicid/SF<	Fluorncarbon/gl/SF	RT Duroid 5870	RG	PTFE	AR	0.12	0.02	JPL
Fluoresthon/Intex(SF Fluoresthon/Intex(SF Fluoresthon/Intex(SF CO00 0.00 0.03 1 P. muck/SF Amalion/SF Amalion/SF Amalion/SF Amalion/SF 0.00 0.03 1 P. muck/SF Amalion/SF Amalion/SF Amalion/SF 0.00 0.03 1 Rise/SF Verspillskip DU AR AR 0.05 0.02 5 Movy/disatph/de/SF Wolykon, microsize DU AR AR 0.05 0.01 1 Movy/disatph/de/SF Wolykon, microsize DU AR AR 0.05 0.01 1 Mov/disatph/de/SF Wolykon, microsize DC AR AR 0.05 0.02 5 Mov/disatph/de/SF 2066 EF thin film 2h, 80° Cr 0.05 0.01 5 Silicom/DG DC-20057 DC AR AR 0.05 0.01 5 Silicom/DG EC AR AR 0.01 5 0.01	Fluorocarbon/mica/SF	Fluorosint LE 207	ñ	PTFE/mica	AR	0.20	0.04	JPL
Functionerboninyton(SF Ammalien 96-101 DU AR AR 0.48 0.002 5 Movycient/SF Woysient/SF Vergel SF-1 DU AR AR 0.48 0.002 5 Movycient/SFF Movycient increases DU AR AR AR 0.03 5 Neuroic/Moss/SFF Movycient increases DU AR AR 0.35 0.01 3 Neuroic/Moss/SFF 2306 EF thin film 1.5h.190°C 0.05 0.01 5 Subcons/DG DC20067 DC AR AR 0.31 0.07 Subcons/DG Ecconterm TC4 C AR AR 0.33 0.01 5 Subcons/DG Ecconterm TC4 C AR 0.31 0.07 5 Subcons/DG Ecconterm TC4 AR AR 0.33 0.07 5 Subcons/DG Ecconterm TC4 AR AR 0.33 0.07 5 Subcons/TG	Fluorocurbon/mica/SF	Fluorosint	2	PTFE/mica	AR	0.09	0.03	JPL
P. imide/SF Vergel SP-1 DU AR AR 1.24 0.01 5 Menolski/SF Molytok, microsise DV AR AR 1.24 0.01 5 Menolski/MoS_JSF QF 1006 Tr 70-r/30 gi. AR AR 0.65 0.01 5 Remote/MoS_JSF QF 1006 Tr 70-r/30 gi. AR AR 0.65 0.01 5 Stateset/MoS_JSF 2396 EF thin film 2.1, 90° C 2.05 0.01 5 0.01 5 Stateset/MoS_JSF DC AR AR 0.35 0.01 5 0.01 5 Stateset/MoS_JSF DC AR AR 0.35 0.01 5 0.01 5 0.01 5 0.01 5 5 0.01 5 0.01 5 5 0.01 5 5 0.01 5 5 0.01 5 5 5 0.01 5 5 5 5	Fluorocarbon/nylon/SF	Armalon 98-101	DQ	AR	AR	0.48	0.02	SRI
Molytistrephtide/SF Molyticute, microsize DC AR 0.55 0.01 H Yhoan 6/10/g4/SF QF 1006 LIN 70 r/30 g4. AR 0.55 0.01 H Yhoan 6/10/g4/SF QF 1006 EF thth film 1.3699 0.05 0.01 H Statematic/MoS/SF 2366 EF thth film 2.1690° 0.05 0.01 S Stateore/DC DC-20-057 DC AR AR 0.31 0.07 S Stateore/DC Ecconterm TC4 AR AR AR 0.05 0.01 S Stateore/DC Ecconterm TC4 AR AR 0.31 0.07 S S 0.07 S	P. imide/SF	Vespel SP-1	DU	AR	AR	1.24	0.01	SRI
Wytar 6/10/gt/SF GF 1006 LN 70.4/30 gt AR 0.65 0.04 G Persols/Mods/sF 2396 EF thin film 1.5h. 190°C 0.05 0.04 G Suitent/Mods/sF EF thin film 2h.80°C 0.05 0.01 S Suitent/Mods/sF EF thin film 2h.80°C 0.03 0.01 S S Suitent/Mods/sF EC AR 2h.80°C 0.03 0.01 S S Suitent/Mods/sF EC AR AR 0.31 0.03 0.01 S S C MR AR 0.03 0.01 S S C MR AR A.63 A.73 A.73 A.74 A.74 A.74 A.74 A.75 A.74 A.74 A.75 A.74 A.74 A.75 A.74 A.74 A.74 <t< th=""><th>Molydisulphide/SF</th><th>Molykote, microsize</th><th>8</th><th>AR</th><th>AR</th><th>0.55</th><th>0.01</th><th>JPL</th></t<>	Molydisulphide/SF	Molykote, microsize	8	AR	AR	0.55	0.01	JPL
Prenote/Nets_/SF 4306 EF thin film 1.5h. 190° C 305 2396 27h. 13h. 190° C 305 900 I 5 Silucone/ICC DC 20057 DC AR 2h. 50° C+ 0.01 5 Silucone/ICC EC all AR AR 2h. 50° C+ 0.05 0.01 5 Silucone/ICC Econterm TC4 EC AR AR 0.31 0.01 5 Silucone/ICC Econterm TC4 EC AR AR 0.03 0.01 5 Silucone/ICC Econterm TC4 EC AR AR 0.03 0.01 5 Silucone/ICC Econterm TC4 EC AR AR 0.05 0.07 5 </th <th>Nylon 6/10/gt./SF</th> <th>QF 1006</th> <th>Ľ</th> <th>70 r./30 gl.</th> <th>AR</th> <th>0.65</th> <th>0.04</th> <th>GSFC</th>	Nylon 6/10/gt./SF	QF 1006	Ľ	70 r./30 gl.	AR	0.65	0.04	GSFC
Silicate/hio52/57 2396 Fr thin film 2h. 80° C+ 0.05 0.01 S Silicone/OG DC-20057 DC DC A 0.01 S Silicone/OG Ecconterm TC4 EC A A 0.01 S Silicone/TG Ecconterm TC4 EC A A 0.01 S Silicone/TG Ecconterm TC4 EC A A 0.03 0.01 S Silicone/TG Ecconterm TC4 EC A A 0.03 S S 0.07 S S S 0.07 S<	Phenotic/MoS_/SF	4306	EF	thin film	1.5h. 190°C	3.05	0.01	SRI
Stlicene/OC BC-20-057 BC AR 21, 205 Stlicene/TC Eccotterm TC-4 EC AR AR 0.34 AR AR 0.35 AR AR 0.05 AR AR 0.05 AR AR 0.05 AR AR 0.05 AR AR A	Suicate/MoS ₂ /SF	2396	Ъ	thin film	2h. 80° C+	0.05	0.01	SRĮ
Statione/TG Eccotherm TC4 EC A.R. A.R. 0.05 GE A.R. A.R. 0.05 GE A.R. A.R. 0.05 C-683 A.R. A.R. 0.05 C-683 A.R. A.R. 0.05 C-683 A.R. A.R. 0.05 C-683 A.R. A.R. 0.05 A.R. 0.		DC-20-057	ž	AR	2h. 205 AR	0.31	0.07	JPL
Sittoone/TG GE AR C63 C6633 C6 S C007 S <th>Silicone/TG</th> <th>Eccotherm TC-4</th> <th>ß</th> <th>Ϋ́́</th> <th>AR</th> <th>0.54</th> <th>0.05</th> <th>GSFC</th>	Silicone/TG	Eccotherm TC-4	ß	Ϋ́́	AR	0.54	0.05	GSFC
	Silicone/TG	G-683	GE	AR	AR	62	0.07	SRI
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Lubricants and Interfaces-Liquid Lubricants, Solid Films, Optical and Thermal Grease (continued)

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Table 13 Textiles

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Material	Mfg. Code	රී	Composition	Comments ? -4 Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Cu/silicone/Dac		ΗŢ	AR	AR	0.64	0.08	GSFC
P. ester	I	RB	P. ester latex 404m 2-3	AR	0.05	0.04	GSFC
			on Dacron cloth				
P. ester	ł	RB	p. cster latex 404m 2-3	AR	0.19	0.06	GSFC
			on Dacron net		_		
P. ester	I	RB	P. ester latex 404m 2-3	AR	0.45	0.09	GSFC
			V-46-AX on Dacron threa	- P			
P. ester/HL	Velcro 100	Æ	nook and loop	AR	0.54	0.03	GSFC
			fastener, total system			_	
Fluorocarbon/Dac	Fairprene 80-060	DQ	AR	AR	0.34	0.01	SRI
Fluorocarbon/Dac	Fairprene 80-070	DQ	AR	AR	0.30	0.01	SRI
Fiuorocarbon/Dac	Fairprene 80-080	DU	AR	AR	0.30	0.01	SRI
Fluorocarbcn/el.	Emfab 20-60 PTFE	AF	AR	AR	10.0	10.0	GSFC
Fluorocarbon/el.	TB5-PTFE	MM	AR	AR	0.05	0.05	SRI
Fluorocarbon/nvlon	Armalon 98-101	DQ	AR	AR	0.48	0.02	SRI
Fluorocarbon/Dac	1	BX	Viton/Dacron	AR	0.86	0.09	GSFC
P. imide/st.	Pyre M.L. Type 1	DQ	AR	AR	0.50	0.01	SRI
Stainless steel	Velcro 150-46-306-	ΥĒ	AISI 300 series	AR	0.03	0.02	GSFC
	1754		stainless-hook and loop				
			fastener, total system				
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CONCLUSION

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One advantage of developing this compilation is that it spotlights areas of critical material application which lack necessary and effective low outgassing systems. Conversely, it also points up the many new materials and potential material systems with the inherent possibility of doing things a better way, cutting costs, simplifying and speeding fabrication. Above all a mutual understanding by all involved, relative to the type materials desired, simplifies selection and dissipates the doubts and misunderstandings of operating without any initial material guidance.

Many spacecraft contain lightweight honeycomb sandwich structures with maximum strength characteristics provided by excessively outgassing a lhesive systems. (see film adhesive section.) Where possible, one should analyze structural requirements to ascertain whether lower outgassers might be suitable. Gross adhesive outgassing as occurs with FM-1000, table 5, raises the specter of possible jeopardy to some crucial onboard experiment. The use of improved low outgassing adhesives in core structures is additionally recommended. Improved, acceptable low outgassing silicone paints are being evaluated. At the present time, however, second surface silver mirrors on radiation resistant glass or quartz probably represents the optimum thermal control system, , one considers both minimal weight penalization and minimal thermal change for moderately long term flights. Heat pipes have been shown to be very effective but costly, since configuration standardization is difficult.

There is a need for low outgassing pourable foams in various densities from 2-10 lbs./cu.ft. There are very few representative types that can be recommended. There is a need for multifunctional lubricants together with prescribed systems within which they can operate and cleanliness procedures for operational effectiveness. This entire area needs to be opened to the light of day so that there is a common ground of GSFC concepts, functional systems, and procedures within the scope of material acceptability. Perhaps the new low volatile silicone oils and lubricants will provide this impetus.

Little mention has as yet been made in this report of a previously noted important concept, pre-vacuum bakeout. All component systems incorporating "acceptable material" design should be prebaked at least 24 hours in a 10^{-6} torr vacuum at the maximum allowable temperature, i.e. $15-25^{\circ}$ C above the highest thermal-vacuum test level exposure for the particular spacecraft. This should be done prior to thermal-vacuum acceptance testing. Marginal systems should be vacuum baked longer, 48-72 hours. Heat sensitivity of the electronic components and coefficients of thermal expansion should be primary considerations in determining bakeout temperatures. Temperatures should not exceed prescribed electronic-component limits. The above procedure should eliminate the possibility of even the very slightest condensable deposits seen occasionally with very low outgassing materials, in our 125°C vacuum test system.

Thanks to Dr. Benjamin Seidenberg and spacecraft liaison specialists A. Babecki, J. Grimsley, C. Johnson, T. Sciacca, Dr. G. Eubanks, L. Kobren, E. Nelson, E. Miekle, J. Tarply, C. Clatterback, Dr. T. Presend C. Haehner who have all been involved with obtaining critical samples through Goddard spacecraft project engineers.

Special commendation is due to Mr. Bill Campbell, Aerospace Technician, who has performed excellently as manager of the GSFC outgassing facility during the past year.

ALPHABETICAL INDEX OF ACCEPTABLE POLYMERIC MATERIALS

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Material	Mfg. Code	Co	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
p. acetal/M 58,000 mol. wt. hi. visc.	Delrin-100NC13	na	AR	AR	0.58	0.06	SRI
P. acetal/M 58,000 mol. wt. hi. visc.	Delrin 150NC10	DQ	AR	AR	0.56	0.06	SRI
P. acctal/M 38,000 mol. wt. med. visc.	Delrin-500NC10	na	AR	AR	0.48	0.07	SRI
P. acetal/M 32,000 mol. wt. low visc.	Delrin 900NC10	LN	AR	AR	0.56	0.08	SRI
P. acetal/I	Formex	GE	AR	AR	0.06	0.03	SRI
P. scetal/gl/M	Formafil G80/20	FF	80 r./20 gl.	AR	0.44	0.01	GSFC
P. acctal/gl./M	KF 1006	Ľ	70 r./30 gl.	AR	0.28	0.02	GSFC
P. acetal/tefton/M/SF	Delrin AF	P.	80 Delrin/20 Teflon	AR	0.47	0.05	JPL
P. acetal/teflon/M/SF	Fuiton 404	LN	80 Delrin/20 Teflon	AR	0.52	0.01	GSFC
Acrylic/A	Gelva MP263RA	MC	AR	7d. R.T.	0.79	0.08	GSFC
Acrylic/A	Gelva MP263RA	UMC MC	AR	24h. R.T. +	0.62	0.03	GSFC
		-		24h. 66° C			
Acrylic/A	Gelva MP784RA	MC	AR	24h. R.T. +	1.00	0.05	GSFC
				24h. 66° C			
Acrylic/A	PS-18	RH	acrylic cement	72h. R.T.	0.74	0.01	GSFC
Acrylic/A	Resyn 30-1215	NS	AR	16h. 66° C	0.82	0.08	JPL
Acrylic/gl./SL	Acrylic C-2	BH	AR	AR	0.33	0.01	SRI
Acrylic/gl./SL	Acrylic A FA 1	BH	AR	24h. 150°C	0.22	0.05	SRI
Acrylic/gl./SL	Acrylic A FA l	BH	AR	AR	0.49	0.05	SRI
Acrylic/gL/SL	LectonB	BH	AR	24h. 150°C	0.09	0.09	SRI
Acrylic/silver powder/CT/c	Dupont 4922	DQ	lp. r / lp. butyl acetate	.25h. 66°C +	0.61	0.01	GSFC
A coulic/eiture f(TT/c	E.K.ata 3030	1	đv	48h. 99°C 24 b b T 1b 66°C	72.0	20	UED (
	E-NOIC 2020	23	AR	24 n. K. I. 10. 00 C	e/ .0	90. 0	Corc
Alkyd/BF/PN	101-C10	MM	AK	71, 110°C	0.33	0.17	SRJ
AL/acrylic/t	425	MM	aluminum foil	AR	0.24	0.03	GSFC
AL/acrylic/t	Mystic-7452	ΥM	aluminum foil	AR	0.25	0.03	GSFC
AL/acrylic/t	Mystic 7453	МΥ	aluminum foil	AR	0.64	0.04	Taſ
Al./acryliv./t	Y9339	MM	type 2, aluminum foil	AR	0.80	0.02	GSFC
Al./acry lic/t	Y9339	MM	type 3, aluminum foil	AR	0.20	0.01	GSFC
Al./acrylic/silver/c	Eccoshield PST-C-A	ы С	alum. foil tape with	AR	0.26	0.09	GSFC
		_	silver ball filled				
			acry lic adhesive				
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Ex.

AL/p. ester/F 100M 42 SU vsporized aluminum AR AL/p. ester/bac/adhes./F DU vsporized aluminum AR AL/p. ester/bac/adhes./F DU vsporized aluminum AR AL/p. ester/bacyluc/t B50 3M, vsporized aluminum on AR AL/p. ester/bacyluc/t B50 3M, vsporized aluminum on AR AL/p. ester/bacyluc/t B52 MM vsporized aluminum on AR AL/p. ester/bacyluc/t S1-1250543 MM vsporized aluminum on AR AL/p. ester/bacyluc/t S2 MM vsporized aluminum on AR AL/p. ester/acyluc/t S1-1250543 MM vsporized aluminum on AR AL/p. ester/AL/scrylic/t Y9360 MM vsporized aluminum on AR AL/p. ester/AL/scrylic/t Y936	Material Mfg. Code	ථ	Composition	Previous Cure History	Percent Weight Loss	Percent Condensaioles	Data Source
Al./p. ester/bac/adhec./F DU vaporized aluminum AR Al./p. ester/acryluc/t 850 3M, vaporized aluminum on AR Al./p. ester/acryluc/t 852 MM vaporized aluminum on AR Al./p. ester/acryluc/t 822 MM vaporized aluminum on AR Al./p. ester/acryluc/t 810 MM vaporized aluminum on AR Al./p. ester/acryluc/t 812 MM vaporized aluminum on AR Al./p. ester/Al/acryluc/t 8460 </th <th>ster/F 100M 42</th> <th>SU</th> <th>vaporized aluminum on Wutar</th> <th>AR</th> <th>0.14</th> <th>0.02</th> <th>GSFC</th>	ster/F 100M 42	SU	vaporized aluminum on Wutar	AR	0.14	0.02	GSFC
Al. p. ester/acrylic/t B50 Mylar, over Dacron Al. p. ester/acrylic/t B50 3M, vaporized aluminum on AR Al. p. ester/acrylic/t B50 3M, vaporized aluminum on AR Al. p. ester/acrylic/t B50 3M, vaporized aluminum on AR Al. p. ester/acrylic/t B50 3M, vaporized aluminum on AR Al. p. ester/acrylic/t S1-1250543 MM vaporized aluminum on AR Al. p. ester/acrylic/t S1-1250543 MM vaporized aluminum on AR Al. p. ester/al/acrylic/t S1-1250543 MM vaporized aluminum on AR Al. p. ester/al/acrylic/t S1-1250543 MM vaporized aluminum on AR Al. p. ester/al/acrylic/t V9360 MM vaporized aluminum on AR Al. p. ester/al/acrylic/t V9360 MM vaporized aluminum on AR Al. f cster/Al/acrylic/t V9360 MM vaporized aluminum on AR Al. f cster/Al/acrylic/t V9360 MM vaporized aluminum on AR Al. f cster/Al/acrylic/t V9360 MM vaporized aluminum AR Al. f cster/Al/acrylic/t V9460 MM vaporized aluminum AR Al. f cster/Al/acr	ster/Dac/adhes./F	DU	vaporized aluminum	AR	0.46	0.09	GSFC
AL/p. ester/acrylic/l BS0 3M, vaporized aluminum on Mylar AR AL/p. ester/acrylic/l BS0 3M, vaporized aluminum on Mylar AR AL/p. ester/acrylic/l BS2 MM vaporized aluminum on Mylar AR AL/p. ester/acrylic/l BS2 MM vaporized aluminum on Mylar AR AL/p. ester/acrylic/l SL-1250543 MM vaporized aluminum on Mylar AR AL/p. ester/AL/acrylic/l V9360 MM vaporized aluminum on Mylar AR AL/p. ester/AL/acrylic/l 9460A MM vaporized aluminum AR P. arylether/fd/M AF-1006 IN Vith acrylic act Kylar AR P. arylether/fd/M Artria Vith acrylic act Kylar AR P. arylether/fd/M Artria Vith acrylic aluminum AR P. arylether/fd/M Artria Vith acrylic aluminum AR P. arylether/fd/M Artria Vith acrylic for Kylar AR P. aryleth			on Mylar, over Dacron				_
AL/p. esten/acrylic/t 850 3M, adhes. 46960 AR AL/p. esten/acrylic/t 852 MM waporized aluminum on AR AL/p. esten/acrylic/t 81-1250543 MM waporized aluminum on AR AL/p. esten/Al/scrylic/t 81-1250543 MM waporized aluminum on AR AL/p. esten/Al/scrylic/t 9360 MM waporized aluminum on AR AL/p. esten/Al/scrylic/t 9460A MM waporized aluminum on AR AL/p. esten/Al/scrylic/t 9460A MM waporized aluminum on AR AL/p. esten/Al/scrylic/t 9460A MM with acrylic adhesive. AR AL/p. esten/Al/scrylic/t 9460A MM waporized aluminum on AR AL/p. esten/Al/scrylic/t 9460A MM waporized aluminum on AR AL/p. esten/Al/scrylonitribe/slat. 9460A MM waporized aluminum on AR P. solven-alitic/t 9460A MM Vor./30 gll AR			adhered to surface with				
AL/p. ester/acrylic/t 850 3M. vaporized aluminum on AR AL/p. ester/acrylic/t 852 MM vaporized aluminum on AR AL/p. ester/acrylic/t 852 MM vaporized aluminum on AR AL/p. ester/acrylic/t 81-1250543 MM vaporized aluminum on AR AL/p. ester/acrylic/t 81-1250543 MM vaporized aluminum on AR AL/p. ester/acrylic/t 81-1250543 MM vaporized aluminum on AR AL/p. ester/Al/acrylic/t 81-1250543 MM vaporized aluminum on AR AL/p. ester/Al/acrylic/t 81-1250543 MM vaporized aluminum on AR AL/p. ester/Al/acrylic/t 9460A MM vaporized aluminum AR AL/p. cster/Al/acrylic/t 9460A MM vaporized aluminum AR P. uvalascrylonitide/gl/M Aritol 300 MM vaporized aluminum </th <th></th> <th></th> <th>adhes. 46960</th> <th></th> <th></th> <th></th> <th><u> </u></th>			adhes. 46960				<u> </u>
Al./p. ester/scrytic/t 852 MM "monitorm on hyperimentation on hyperimen	ster/acrytic/t 850	3M.	vaporized aluminum on Mular	AR	0.69	0,10	GSFC
AL/p. ester/acrylic/t X-9460 MM Waylar AL/p. ester/acrylic/t SL-1250543 MM Vaporized aluminum on AR AL/p. ester/AL/acrylic/t Y9360 MM Vaporized aluminum on AR AL/p. ester/AL/acrylic/t Y9360 MM Vaporized aluminum on AR AL/p. ester/AL/acrylic/t Y9360 MM Vaporized aluminum on AR AL, for ester/AL/acrylic/t Y9460A MM Vaporized aluminum on AR AL, for ester/AL/acrylic/t Y660A MM Vaporized aluminum on AR AL, for ester/AL/acrylic/t Y660A MM Vaporized aluminum on AR AL, for ester/AL/acrylic/t Y660A MM Vaporized aluminum on AR AL, for ester/AL/acrylic/t Y60.0 MM Vaporized aluminum on AR AL, for ester/AL/acrylic/t Y60.0 MM Vaporized aluminum on AR AL, ester/AL/acrylic/t Y60.0 MM Vaporized aluminum on <th>ster/actylic/t 852</th> <th>MM</th> <th>vaporized aluminum on</th> <th>ЛR</th> <th>0.59</th> <th>0,03</th> <th>GSFC</th>	ster/actylic/t 852	MM	vaporized aluminum on	ЛR	0.59	0,03	GSFC
AL/p. ester/acrytic/t X-9460 MM vaporized aluminum on AR AL/p. ester/acrytic/t SL-1250543 MM vaporized aluminum on AR AL/p. ester/acrytic/t SL-1250543 MM vaporized aluminum on AR AL/p. ester/AL/acrytic/t SL-1250543 MM vaporized aluminum on AR AL/p. ester/AL/acrytic/t Y9360 MM vaporized aluminum on AR AL/p. ester/AL/acrytic/t Y9360 MM vaporized aluminum on AR AL/p. ester/AL/acrytic/t 9460A MM vaporized aluminum AR P. ester/AL/acrytic/t 06 NM vaporized aluminum AR P. avial auphrow/M P. avial auphrow/M Ar AR AR			Mylar				
AL/p. ester/acrylic/t SL-1250543 MM vaporized aluminum on AR AL/p. ester/Al/acrylic/t Y9360 MM vaporized aluminum on AR AL/p. ester/Al/acrylic/t Y9360 MM vaporized aluminum on AR AL/p. ester/Al/acrylic/t Y9360 MM vaporized aluminum AR AL/p. ester/AL/acrylic/t 9460A MM vaporized aluminum AR P. est. better/M Arylon T UN Vaporized aluminum AR P. est. better/M Arylon T UN AR AR P. est. better/M Artel 360 MM AR AR P. uut/acrylonitribeclast. Hycar 520-67-108-5 BF AR P. buta/acrylonitribeclast.	ster/acrylic/t X-9460	MM	vaporized aluminum on Mylar	AR	0.83	0.04	GSFC
AL/p. ester/Al/acrylic/t Y9360 MM waporized aluminum AR AL/p. ester/AL/acrylic/t Y9360 MM vaporized aluminum AR AL/p. ester/AL/acrylic/t 9460A MM vaporized aluminum AR AL/p. ester/AL/acrylic/t 9460A MM vaporized aluminum AR AL/p. ester/AL/acrylic/t 9460A MM vaporized aluminum AR P. arylether/M Arylon T UN Vaporized aluminum AR P. arylether/M Arylon T UN AR AR P. arylether/M Artel 360 MM AR AR P. uta/acrylonitribeelast. Hycar 520e57-108-5 BF AR AR Butyl elast. F. 1006 LN 70 r/30 gi. AR Butyl elast. Sre534-70 ST AR AR Art AR AR AR AR	ster/acrylic/t SL-1250543	MM	vaporized aluminum on	AR	0.65	0.01	GSFC
AL/p. ester/Al/acrylic/t Y9360 MM vaporized aluminum AR AL/p. ester/AL/acrylic/t 9460A MM vaporized aluminum AR AL/p. ester/AL/acrylic/t 9460A MM vaporized aluminum AR AL/p. ester/AL/acrylic/t 9460A MM vaporized aluminum AR P. arylethur/gL/M Arylon T UN vaporized aluminum AR P. arylethur/gL/M Arylon T UN AR AR P. buta/acrylonitribeelast. HYcar 520-67-108-5 BF AR AR Butyl elast. Sr634-70 ST AR AR Butyl elast. Sr634-70 ST AR AR			Mylar				
AL, ^f ₁ . ester/AL/acrylic/i 00 both sides of Mylar, with acrylic adhesive, superimposed on one side of aluminum AL, ^f ₁ . ester/AL/acrylic/i 9460A R. aryiether/M with acrylic adhesive, superimposed on one side of aluminum P. aryi sulph::acrylonitribelist. MM P. aryi sulph::acrylonitribelist. UN P. utua/acrylonitribelist. UN P. buta/acrylonitribelist. UN P. buta/acrylonitribelist. NM P. buta/acrylonitribelist. NM P. buta/acrylonitribelist. NM P. buta/acrylonitribelist. NM P. buta/acrylonitribelist. NT P. P. Butyl elist. NT P. AR AR	ster/Al/actylic/t Y9360	MM	vaporized aluminum	AR	Ū.54	10'0	GSFC
AL, [*] ₁ , - ester/AL/acrylic/i 9460A with acrylic adhesive, superimposed on one side AL, [*] ₁ , - ester/AL/acrylic/i 9460A MM vaporized aluminum P. aryl sulph-mer/M MM vaporized aluminum AR P. aryl sulph-mer/M Arylon T UN Vaporized aluminum AR P. aryl sulph-mer/M Arylon T UN AR AR P. aryl sulph-mer/M Arrel 360 MM AR AR P. boron-siliva/M Hycar 520-67-108-5 BF AR AR P. buta/scrytonitribe-last. HYcar 520-67-108-5 BF AR AR Butyl elast. F. buta/scrytonitribe/gL/M GSFC 218 ST AR AR Butyl elast. F. oto F. AR AR AR AR			on both sides of Mylar,				
AL/P. cster/AL/acrylic/i 9460A MM superimposed on one side AL/P. cster/AL/acrylic/i 9460A MM vaporized aluminum P. aryi sulph-ne/M Aryion T UN vaporized aluminum P. aryi sulph-ne/M Aryion T UN AR P. aryi sulph-ne/M Aryion T UN AR P. aryi sulph-ne/M Arrel 360 MM AR P. bottom-siliva/M MM Arrel 360 MM P. bottaristic/gL/M Dexsil-201 OC AR P. bottaristic/gL/M AF 1006 LN 70 r./30 gL AR P. buta/acrytonitribe-last. HYcar 520-67-108-5 BF AR AR Butyl clast. F. buta/acrytonitribe/gL/M GSFC 218 ST AR AR Butyl clast. F. outa/acrytonitribe/gL/M GSFC 218 ST AR AR			with acrylic adhesive,				
AL, ^P c. ester/AL/acrylic/i 9460A MM vaporized aluminum AR P. ester/AL/acrylic/i 9460A MM vaporized aluminum AR P. estrether/M Arylon T UN vaporized aluminum AR P. aryl sulph-rac, ^M Arylon T UN AR AR P. aryl sulph-rac, ^M Astrel 360 MM AR AR P. boron-silva/M Hycar 520-67-108-5 BF AR AR P. butal/scrytonitribe-last. HYcar 520-67-108-5 BF AR AR Butyl elast. Sref 300 NM 70 r./30 gl. AR Butyl elast. Sref 34-70 Sr AR AR Butyl elast. EN AR AR AR			superimposed on one side				
AL, ^e , -ster/AL/acrytic/i 9460A MM vaporized aluminum AR P. exylether/M Arylon T UN AR AR P. aryl sulph-rac, ^M Arylon T UN AR AR P. aryl sulph-rac, ^M Arylon T UN AR AR P. aryl sulph-rac, ^M Arrel 360 MM AR AR P. toronn-tik/s/M Arrel 360 MM AR AR P. toronn-tik/s/M Dexsil/201 OC AR AR P. toronn-tik/s/M Britter 360 MM AR AR P. toronn-tik/s/M Dexsil/201 OC AR AR P. totta/acrytonitribeelast. HYcar 520-67-108-5 BF AR AR Butta/acrytonitribe/gL/M AF 1006 LN 70 r./30 gl. AR Butta/acrytonitribe/gL/M Sre530-67-108-5 EN 70 r./30 gl. AR Butta/acrytonitribe/gL/M Sre530-67-108-5 EN 70 r./30 gl. AR Butta/acrytonitribe/gL/M Sre530-67-108-5 EN 70 r./30 gl. AR			of aluminum	-			
R. ary lether/M Arylon T UN Arg R. ary lether/M Arylon T UN AR R. ary lether/M Arylon T UN AR R. ary subhranc/M Arrel 360 MM AR P. vuts/acrylonitribe-elast. Hycar 520-67-108-5 BF AR P. buta/acrylonitribe/gL/M AF 1006 LN 70 r./30 gL AR Buryl elast. HYcar 520-67-108-5 BF AR AR R. buta/acrylonitribe/gL/M AF 1006 LN 70 r./30 gL AR Buryl elast. F. Nuta/acrylonitribe/gL/M AF 1006 LN 70 r./30 gL AR Buryl elast. F. Nuta/acrylonitribe/gL/M AR AR AR	ster/AL/actylic/i	MM	vaporized aluminum	AR	0.79	0.03	GSFC
P. ary lether/M Arylon T UN aide of Kylar AR P. aryl sulph-ac/M XF-1006 I.N 70 r./30 gl. AR P. aryl sulph-ac/M Astrel 360 MM AR AR P. boron-tifk/M Dexsil-201 OC AR AR P. bottal/acrylonitrile-elast. Hycar 520-67-108-5 BF AR AR P. buta/acrylonitrile/gl./M AF 1006 LN 70 r./30 gl. AR Butyl elast. AF 1006 LN 70 r./30 gl. AR Butyl elast. Sre63+70 ST AR AR Butyl elast. Sre63+70 ST AR AR			top and bottom			-	
P. arylether/M Arylon T UN AR AR P. arylether/gl/M XF-1006 I.N 70 r./30 gl. AR P. aryl sulphcne/M Astrel 360 MM AR AR P. botta/acrylonitrile-elast. Hycar 520-67-108-5 BF AR AR D. buta/acrylonitrile/gl./M AF 1006 LN 70 r./30 gl. AR Butyl elast. HYcar 520-67-108-5 BF AR AR Butyl elast. AF 1006 LN 70 r./30 gl. AR Butyl elast. Sre63+70 ST AR AR Butyl elast. EN AR AR			side of Kylar			_	
P. arylether/g//M XF-1006 I.N 70 r./30 gl. AR P. aryl sulphene/M Astrel 360 MM AR AR P. honon-tilka/M Dexsil-201 00C AR AR P. botta/acrylonitribe/gl./M Mycar 520-67-108-5 BF AR AR D. buta/acrylonitribe/gl./M AF 1006 LN 70 r./30 gl. AR Butyl clast. AF 1006 LN 70 r./30 gl. AR Butyl clast. Sre63+70 ST AR AR Buryl clast. Fx./193 BN AR AR	ther/M Arylon T	N	AR	AR	0.36	0.03	GSFC
P. aryl sulph::ne/M Astrel 360 MM AR AR P. boron-ulika/M Dexsil-201 OC AR AR P. bouta/acrylonitrile-elast. Hycar 520-67-108-5 BF AR AR P. buta/acrylonitrile/gl_M AF 1006 LN 70 r./30 gl. AR Butyl elast. Sre63+70 ST AR AR Butyl elast. F. total AR AR	thur/gi./M TF-1006	I.N	70 r./30 gl.	AR	0,29	0.01	GSFC
P. boron-tik/s/M Dexsil-201 OC AR AR P 'uts/acrylonitrile-elast. Hycar 520-67-108-5 BF AR AR AR 1. buts/acrylonitrile-elast. HYcar 520-67-108-6 BF AR AR AR P. buts/acrylonitrile/gl_/M AF 1006 LN 70 r/30 gl. AR AR Butyl elast. Sre53-70 ST AR AR AR Butyl elast. Fx-1092 EN AR AR	sulphane,'M Astrel 360	MM	AR	AR	0.94	0.02	GSFC
P . uta/acrylonitrile-elast. Hycar 520-67-108-5 BF AR AR 1. buta/acrylonitrile/elast. HYcar 520-67-108-6 BF AR AR P. buta/acrylonitrile/gl_/M AF 1006 LN 70 r./30 gl. AR Butyl elast. Sre53-70 ST AR AR Butyl elast. Sre53-70 ST AR AR	n-silikra/M Dexsil-201	8	AR	AR	0 0	0.01	GSFC
1. buta/acrylonitrile/gl_M HY car 520-67-108-6 BF AR AR P. buta/acrylonitrile/gl_M AF 1006 LN 70 r./30 gi. AR Buryl clast. Sre534-70 ST AR AR Buryl clast. Ex. Sre534-70 ST AR Buryl clast. Ex. AR AR Buryl clast. Ex. Sre534-70 ST AR	/acrylonitrile-clast. Hycar 520-67-108-5	BF	AR	AR	0.95	0.03	SRI
P. buta./acrytonitrile/gl./M AF 1006 LN 70 r./30 gl. AR Buryl clast. GSFC 218 EN AR AR Buryl clast. Sr634-70 ST AR AR Buryl clast. Ex.(1992 EN AR AR	/acrytonitrilo-clast. HY car 520-67-108-	BF	AR	AR	1.03	0.03	SRI
Butyl clast. GSFC 218 EN AR AR AR Butyl clast. Sr-634-70 ST AR AR AR AR Butyl clast. Ex. (1902 EN AR AR An ISO [®] C	/acrylonitrile/gl./M AF 1006	LN	70 r./30 gi.	AR	0.20	0.01	GSFC
Butyletast. Sr-634-70 ST AR AR AR AR Butyletast. Ex. (1902 EN AR At 150°C	last. GSFC 218	EN	AR	AR	0.28	0.03	GSFC
i Busta had AR [Fx-1192] EN AR [4h. 150°C	last. Sr-634-70	ST	AR	ÅR	£6,0	0.10	GSFC
	last. Ex-1092	EN	AR	4h. 150 C	0.86	0.10	SRI
P. carbonate/M intermed, mol. wt. Lexan 100-111 GE no additives AR	onate/M intermed, mol. wt. Lexan 100-111	GE	no additives	AR	0.06	0.02	SRI

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Material	Mfg. Code	රී	Composition	Comments and Previous Curr History	Percent Weight Locs	Percent Condensables	Data Source
P.carbonate/M intermed, mc' wt.	Lexan 100-112	B	no additives	AR	60.0	0.04	SRI
P.carbonate/M intermed. mcl. wt.	Lexan 101-111	GE	therm. stabilized	AR	0.08	0.01	SRI
P.carbonate/M intermed. riol. wt.	Lexan 103-112	GE	therm. + UV stabilized	AR	0.17	0.01	SRI
P.carbonate/M high mol. wt.	Lexan 130-111	GE	no additives	AR	0.17	0.01	SRI
P.carbonate/M high mol. wt.	Lexan 131-111	GE	therm. stabilized	AR	0.18	0.01	SRI
P.carbonate/M high mol. wt.	Lexan 131-112	GE	therm. stabilized	AR	0.17	0.01	SRI
P.carbonate/M high mol. wt.	Lexan 133-112	GE	therm. + UV stabilized	AR	0.20	0.01	SRI
P.carbonate/M low mol. wt.	Lexan 140-111	GE	no additives	AR	0.17	0.03	SRI
P.carbonats/M low mol. wt.	Lexan 141-115	GE	therm. stabilized	AR	0.17	0.2	SRI
P.carbonate/M low mol. wt.	Lexan 141-112	GE	therm. stabilized	AR	C.17	0.02	SKI
P.carbonate/M low mol. wt.	Lexan 243-112	5	therm. + UV stabilized	AR	0.16	0.01	SRI
P.carbonate/S low moi. wt.	Lexan 9434-112	GE	AR	AR	0.19	0.01	GSFC
P. carbonate/st./M	DF-1006	Ľ	70 t./30 st.	AR	0.14	0.01	GSFC
P. carbonate/rd./M	Carbafil-G50/20	FF	80 r./20 gl.	AR	0.12	0.01	GSFC
P. chlorofhuorocarbon/M	Kel-F 81	MM	AK	AR	0.03	0.01	SRI
Cu/actylic/t/c	X-1181	MM	copper foil	24h. 125° C	0.15	0.03	GSFC
			with acrylic adhetive				
Cu/crybic/t/c	X-1245	MM	copper foil	AR	0.19	0.11	GSFC
			with acrylic adhesive				
Cu/acrylic/t/c	Mystic 7420	ΥM	copper foil	AR	0.22	0.01	GSFC
			with acrylic achesive				
Cu/silicone/Dac/TX		LH	AR	AR	0.64	0.08	GSFC
DAP/dL/M	Dial-FS-4	AC	AR	24h. 150°C	0.58	0.02	Shi
DAP/dL/M	Dial-FS-10	AC	A.R.	24h. 150°C	0.70	0.03	SRI
DAP/d/M	Dial FS-40	AC	AR	24h. 150°C	00.1	0.02	SRI
DAP/dL/M	Dial FS-80	AC	AR	AR	0.44	0.01	GSFC
DAP/dL/N	Dial 52-40-40	AC	AR	AR	0.70	0.06	SRJ
DAP/52.(M	Dial 52-40-40	V C	AR	24h. 150° C	0.30	0.01	SU
DAP/et./M	C2580-118	N.I	AR	AR	0.30	0.01	GSFC
Dig.:::ny Lox/gl./L	Doryl H-17511	ŴĊ	AR	AR	0.44	0.04	SRI
Dipheny Hox/gL/L	Doryl H-17511	WC	AR	24h. 150°C	0.68	0.03	SRI

Material	Mfg. Code	ಲೆ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Epoxy/A	Armstrong A2/A	Ą	100p.A2/4p.A	.75h. 74° C +	0.44	0.01	Ia
				.75h. 93° C			2
Escurit.	Armstrong/E	AP	100p.A2/6p.E	.75h. 93° C	0.26	0.03	SRI
	Armstrong A12/A	AP	AR	2h. 85° C	0.85	0.02	100
Epoxy/A	Armstrong A12/A	A P	AR	2h. 65°C +	0.62		SRI
				48h. 125°C, +			
Epóxv/A	A	-		IXI0 torr			
Epoxv/P	Alinstrong A31 A/B	रे ह	60p.A/40p.B	2h. 60 C	0.56	0.03	GSFC
Epoxv/P	Bacca Ind	3 2	AR	7d. R.T.	0.78	0.10	GSFC
	Dacon Ind.	Z	AR	4h. 71°C+	0.12	0.61	GSFC *
Epoxy/P	BSL 208	5	đ	160. 100 C			
Epoxy/P	BSI 308	55	AR	11h. 164 C	0.82	0.11	GSFC
Epoxv/BF/PN*	CAT.A.1 AC 463 2 0	58	AK	[]h. 175 C	0.49	0.10	GSFC
Enoxv/A	Ecchartat 403-3-6	1 I 1 I	AR	24h. 120 [°] C	1.33	0.01	GSFC
Enorv/A		U U U	100p.51/7p.9	24h. R.T.	0.44	0.02	GSFC
	Eccopond 21/9	C H	100p.51/7p.9	48h 95° C	0.18	0.02	GSF.C
Eboxv/A				1x10 ⁻¹ torr			
Fineworks	Eccobond 55/9	с Э	100p.55/12p.9	24h. 25° C	0.40	0.06	SRI
Eboxv/A	Eccobond 55/9	2	100p.55/12p.9	16h. 65° C	0.17	0.07	SRI
Eonxv/P	Eccobond 104A/B	с Ш	100p.A/64B	8h. 150°C	0.35	0.03	SRI
		MW	50p. 1751 A	24h. R.T.	0.75	0.06	Lass -
			100p. 1751 B			2	50
Enorv/P			15p. phenyl glycidyl ethe				
Enovy/P	Eccomold L-28	Ы Ц	AR	64h. 127° C	0.18	10 /	Jaso
	Eccoseal 1207/20	EC	100p. 1207/1.5p.20	4h. 71°C +	0.27	0.01	CSFC 1
Epoxy/A	Faihand 113 laca			lh. 177° C			2
Eboxv/A		2	100p.123/15p.952	24h. R.T.	0.63	0.03	(;SFC
Enorv/A	appoond 55 IU A/B	FU	100p.A/30p.B	5d. R.T.	0.05	0.01	CEC
	Actor CK623A	Da Da	100p. 825A	48h. 25° C	1.07	0.01	SRI
			12p. Mod-7				
			4 up. tuter 16p. 825A cat.				
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*Acceptable where none else will perform a required function

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Material	Mfg. Code	ပိ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
V/xod:	Epiphen-ER 825 A	BO	100p. 825A	48h. 75° C	0.84	0.01	SRI
			12p. Mod-7 40p. filler				
Epoxv/M	Enocast 403-S-3	ΡU	AR AR	AR	0.32	0.01	GSFC
Enoxy/P	Ebocast N4E-053	FU	AR	24h. R.T. +	0.07	0.02	CSFC
)		2h. 93° C			, ; ;
Epoxy/P	Epon X-24	ΗS	AR	10h. 100° C	0.42	0.05	GSFC
Epoxy/A	Epon 815-TETA	SH	10p. 815/1n.TETA	16h. 63° C	9.76	0.01	GSFC
Epoxy/A	Epon 820/TETA	HS	10p. 820/1p.TETA	3d. R.T.	0.43	0.06	GSFC
Epoxy/A	Epon 820/TETA	SH	10p. 820/1p.TETA	16h. 63° C	0.36	0.04	GSFC
Epoxy/P	Epon 826/7	RO	100p. 826/20p.Z	2h. 77° C+ 2h. 135° C	16.0	0.02	jPL
Epoxy/P	Epun 828/A	HS	100p. 828/8p.A	3h, 95° C	0.70	0.06	SRI
Epoxy/A	Epon 828/TETA	HS	10p. 828/1p.TETA	3d. R.T.	0.51	0.01	CSFC
Epoxy/A	Epon 828/TETA	HS	10p. 828/1p.TETA	10h. 60-66° C	0.38	0.01	GSFC
Epoxy/P	Epon 828/Z	HS	100p. 828/20p.Z	21. 75°C,	0,42	0.03	SRI
				2h. 135 ⁷ C			_
Epoxy/semi-rigid/P	Epon 828/871/AFP	S	35p./828	12h. R.T.	0.86	0.05	GSFC
			65p./871 15 55 /AED				
Epoxy/semi-rigid/P	Epon 828/871/AEP	S	10:00./828	18h. 65° C	0.46	0.02	GSFC
			60p./871		-		
			15.5p./AEP	c			
Epoxy/A	Epon 901 A/B	HS	100p. 901/11p.B	.sh. 116 C	0.73	0.06	JPL
E boxy/A	Epon 901/B3	HS	100p. 901/23p.B3	1.5h. 115°C+	0.19	0.01	SRI
				1.5h. 175° C			
Epoxy/A	Epon 917	HS	AR	.25h. 175° C	0.17	0.03	SRi
Epoxy/A	Epon 929	HS	AR	lh. 149° C	0.68	0.06	GSFC
Epoxy/A	Epon 931A/B	HS	100p. A/1p.B	1h. 125° C	0.13	0.01	SRI
Epoxy/A	Epon 934A/B	HS	100p. A/33p.B	7d. R.T.	0.28	10.0	CISEC
Epoxy/A	Fpon 934A/B	HS	100p. A/33p.B	16h. 52 [°] C	0.42	0.02	JPL
Epoxy/A	Epon 956A/E	HS	100p. A/58p.B	7d. R.T.	0.19	0.01	GSFC

Matorial	Mfg. Code	co	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Epoxy/A	Epon 956A/B	HS	1C0p. A/58p.B	2.5h. 80° C	0.38	0.01	Jar
Epoxy/A	Epotek-301A/B	ET	20p.A/5p.B	24h. R.T.	1.08	0.01	GSFC
		_	spectrally transp.				
Epoxy/M	Fiberite E3938	FB	AR	AR	0.44	10.0	GSFC
Epoxy/M	Furane 403	FU	AR	AR	0.43	0.01	3RI
Epoxy/P	HP-16-92	HA	100p. DER 332LC/18p. HV	Sh. R.T. +	0.33	0.02	GSFC
				12h. 90° C +			
Enoxy/P	Hved 0151	μ	AR	24h. 90 C.P.C.	0 C		
				240. K.I.	0./8	0.62	GSFC
EpoXy/mod./F/A	Hysol A9-601	λH	AR	Ih. 121 ^C - 12 _F ei	0.37	0.03	GSFC
Epoxy/P	Hysol C9-4188/3469	ΥН	10p. 4188/.75p. 3469	1h. R.T.+1h. 49° (1.01	0.08	14
				1h. 171°C			
Epoxy/P	Hysol C9-4188/3469	HΥ	10p. 4188/.75p. 3469	1h. R.T. +	0.96	0.03	JPL
	Ferro V-7 80		_	1h. 49°C 1h. 171°C	<u></u>		_
Epoxy/P	Hysol C9-5340/3426	λн	100p. 5340/8.3p. 3426	8h. R.T.	0.60	0.05	GSFC
Epoxy/P	Hysol XC9-G71D/	λH	AR	AR	0.90	0.02	GSFC
	H2-3561				_		
Epoxy/A	Hysol EA 956	HΥ	AR	R.T.	0.69	0.03	GSFC
Epoxy/P	Hysol R8-2038/	λн	AR	24h. R.T.	0.53	0.01	GSFC
	H2-3475						
Epoxy/P	Maraset 655/553	MR	100p. 655/20p. 553	16h. 82° C	0.59	0.01	SRI
a/kxova	Maraset 655/553	MR	100p. 655/20p. 553	16h. 82°C +	0.32	0.01	SRI
				24h. 150°C			
Epoxy/P	Maraset 655/555	MR	100p. 655/7p. 555	16h. 82° C	0.41	0.01	SRI
Epoxy/P	Maraset 655/555	MR	100p. 655/7p. 555	16h. 82°C +	0.25	0.C1	SRI
				24h. 150°C			
Epoxy/P	MPC 52	GE	AR	4h. R.T. 2h 66° C	0.17	0.01	GSFC
Epoxy/P	MY 750/HY974	ច៖	AR	30h. 60° C	0.19	0.01	GSFC
±puxy/F	MI //UC/ 14/4	5	AK	/sn. 100 C	0.27	0.03	GSFC

Material	Mfg. Code	ပိ	Composition	Comments and Previous Cvre History	Percent Weight Loss	Percent Condensables	Data Source
Epoxy/CF	PCA/16	ង	100p. A/2p. 16	1h 25° C +	0.18	0.02	SRI
				2h. 95°C + 2h. 150°C		-	
Epoxy/wersam/A	PS-269	BX	50p. 828/50p. 125	24h. R.T.	0.79	0.10	GSFC
Epoxy/P	R-179	ß	aliphatic-epoxy	.sh. 160°C	0.81	0.03	GSFC
Époxy/P	R-6005	Ð	aliphatic epoxy	10min. 160°C	0.82	0.03	GSFC
Epoxy/M	Rogers RX-611	RG	AR	AR	0.53	0.02	GSFC
Epoxy/P	Scotchcast 260	MM	AR	.5h. 150°C	0.52	0.03	SRI
Epoxy/P	Scotchcast 281 A/B	MM	100p. A/150p.B	20h. 75° C	0.36	0.05	SRI
Epoxy/P	Scotchcast 282 A/B	MM	2p. A/3p.B	20h. 75° C	0.74	0.10	JPL
Epoxy/A	Scotchweld 1838 A/B	MM	1p. A/1p.B	24h R.T.	0.65	0.03	GSFC
Epoxy/P	SMRD 49	B	AR	AR	0.98	0.05	GSFC
Epoxy/CF	SMRD 100A/B	B	57p. A/44p.B	16h. 100° C	0.46	0.04	GSFC
Epoxy/CL	Stycast 1090/9	ပ္ထ	100p. 1090/9p.9	16h. 50° C	0.31	0.07	SRI
Epoxy/CL	Stycast 1090/11	ដ្ឋ	100p. 1090/12p. 11	12h. 60°C +	0.63	0.13	SRI
		_		3h. 82° C			
Epoxy/CL	Stycast 1090/11	ы С	100p. 1090/12p. 11	24h. 125°C	0.04	0.04	SRI
Epoxy/CL	Stycast 1095/11	ß	100p. 1095/12p. 11	24h. 125°C	0.50	0.11	SRI
Epoxy/P	Stycast 1263/31	С Д	100p. 1263/3p. 31	16h 107°C	0.12	0.01	SRI
				24h. 150°C			
Epoxy/CF	Stycast 1467/9	ລ	100p. 1467/7p. 9	18h R.T. +	0.14	0.01	GSFC
Enory/P	Sturget 7651 10		đ	ur. 77 C			0100
Enouv (2)			A -001/ -001	AN	0.40	10.0	Carc
	aly cut 1200 Alp	3	1 uup. A/ 1 uup. B	16h. 100 C +	81'0	sr.0	SKI
Epoxy/P	Stycast 2651/11	ß	AR	AR	0.14	0.01	GSFC
Epoxy/P	Stycast 2850 FT/9	S	100p. 2850FT/3p. 9	AR	0.25	0.01	GSFC
Epoxy/P	Stycast 2850 FT/9	БĊ	100p. 2850FT/3.5p. 9	16h. 25° C	0.34	0.04	SRI
Epoxy/P	Stycast 2850 GT/11	S	AR	AR	0.33	0.02	JPL
Epoxy/P	Stycast 2850 GT/11	ß	100p. 2850GT/4-5p.11	40h 54°C	0.85	0.03	JPL
Epoxy/P	Stycast 2862 A/B	EC	100p. A/100p. B	16h. 120°C,	0.32	0.04	SRI
Epoxy/P	Stycast 2862 A/B	23	100p. A/100.p. B	16h. 120°C, 24h. 150	c 0.01	0.01	SRI
Epoxy/P	Stycast 3050/11	Б С	100p. 3050/9.5p. 11	16h. 77° C	0.68	0.06	SRI
Epoxy/A	Torr Seal	٨٨	equal lengths A,B	24h. R.T.	0.84	0.01	GSFC
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Material	Mfg. Code	රි	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Epoxy/P	Trucest 111/	FW	100p. 111/34p. 901	24h. R.T.	0.36	0.01	GSFC
Epoxy/P	1 rucure you 2850/24LV	Da	AR	24h. 49° C +	0.73	0,10	GSFC
Epoxy/B/PN	CTL-15(17038)	НА	3p. 15A/1p. 15B	24h. bu C 2 coats, each	0.96	0.02	GSFC
				air dried .25h. +.25h. 65°C +1.75h. 121°C			
Epoxy/BF/PN	FC-GSFC-SB	ß	100p. 956A	7d. R.T.	0.81	0.01	GSFC
			58p. 956B 3.15p. Carb. 1 1 for Coh Mc.f				
Epoxy/BF/PN	FC-GSFC-6B	ß	1.0p. 956A	2h. 66° C	0.49	0.01	GSFC
			58p. 956R 3 16- Coch 1				
			1.6p. Cab. MS-5				
Epoxy/BF/PN	FC-GSFC-7B	S	100p. 956A	7d. R.T.	1.02	0.01	GSFC
			3.15p. Carb. 1				
Eboxv/RF/PN/SF	FC-GSFC-11B	S	1.6p. Syloid 620 100n, 956A	2h. 66° C	0.85	010	GSFC
		;	58p. 956B				
			.4p. Cab. MS-5 6.3p. MoS.				
			.8p. Carb. 1				
Epoxy/boron fil./L	Epon 828/1031	HS	25p. Epoxy+cat/	ih. 66° C	0.25	0.02	JPL
		_	75p. boron filament	1h. 82°C			
			Epoxy+cat. 50p. 828 50b. (MNA-90	4h. 177 C			
			BDMA-10	c			
Epoxy/boroa fil./L	Rigidite 5505	NR	AR	.sh. 93ັ C .sh 177ໍ ເ	0.46	0.01	JAL

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Matorial	Mfg. Code	ප	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Epoxy/Carbon fil./L	Ę	5	AR	AR	0.55	0.04	GSFC
Epoxy/st./F/A	Ablefilm 517	AT	AR	3h. 71° C	0.07	0.01	GSFC
Enoxv/st./bre/L	BP-907	AΥ	AR	1h. 177° C	0.84	0.02	JPL
Epoxy/st/M	EMC-115-B-1	PA	AR	AR	0.29	0.01	GSFC
Epoxy/el/min./M	Epiall 1906L	AΥ	AR	AR	0.39	0.16	SRI
Epoxy/el/min./M	Epiall 1906L	AΥ	AR	24h. 150°C	0.16	0.03	SRI
Epoxy/st/M	Epiall 1914	AΥ	AR	24h. 150° C	0.55	0.03	SRI
Epoxy/gl./CB	FL G::/EG-2028	FL	no copper	AR	0.33	0.01	SRI
Epoxy/gl./CB	FL GF/EG 2028FR	FL	no copper	AR	0.44	0.01	SRI
Epoxy/gl./CB	FLGF 250C2/2AHB	AN	CB has 2 sides copper	AR	0.12	0.01	GSFC
Enoxv/el./L	GE 101(FR-4)	EL	AR	AR	0.48	0.05	JPL
Funxv/al./me/L	Hexcel F 153	HX	AR	7h. 171° C 14 psi	0.19	0.01	GSFC
			İ				
Epoxy/gt./t.	K-6098	MM	AR	AR	0.01	0.01	GSFC
Epoxy/gL/CB	Marglass	MG	100p. Ciba MY 740	AR	0.93	0.01	GSFC
)		1.5p. accel. DY 219				
			50p. cat. HY 219				
			glass cloth 1275	_			
			COVA ASIAN	Ę	0 4 0	0.05	103
Epoxy/gr/CB	Micaply EC-7361	TW	no copper	AK	0.40	50.0	INC.
Epoxy/g1/CB	Micaply EG-824T	ĪW	no copper	AR	0.40	0.05	SRI
Epoxy/gl./CB	Micaply EG-899T	IW	no copper	AR	0.29	0.03	SRI
Epoxy/gL/L	Micaply G-284	MP	AR	AR	0.49	0.06	SRI
Epoxy/gl./CB	Micarta 65M25	Ň	AR	AR	0.43	0.01	SRI
Epoxy/et/CB	Micarta 65M28 (FR4)	WC	copper clad	AR	0.26	0.01	JPL
Epoxy/gl./L	Micarta H-2497	ŴC	AR	AR	0.18	0.01	SRI
Epoxy/g1/L	Micarta H-8457	Ŵ	AR	AR	0.80	0.12	SRI
Epoxy/gl./L	Micarta H-17511	WC	AR	AR	0.44	0.04	SRI
Epoxy/gl./L	Micarta H-17690	WC	AR	AR	0.48	0.07	SRI
Epoxy/gL/L	MIT-600	MT	AR	AR	0.64	0.03	GSFC

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Material	Mfg. Code	ට	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Cor densables	Data Source
Epoxy/gr/L	MT-1281627	TM	AR	AR	0.32	0.02	GSFC
Epoxy/gt/L	Scotchply XP 251-S	MM	unidirectional	.sh. 149°C+ 4h. 177°C	0.58	0.01	1ar
Epoxy/gl./L	Scotchply 279	MM	35 г./65 gl.	AR	0.96	0.06	JPL
Epoxy/graph./pre./L	HY-E 1001	FB	42p. epoxy 10836	Ih. 132°C	0.53	0.04	JAL
		l	38p. graphite 3p. BF3 complex				
Epoxy/graph./pre/L	HY-E 1002		WS-1028 or	1h. 82 C	0.32	0.04	Tar
			50p. Epon 1028				
			62p. graphite				
			90P. NMA 45þ. BDMA				
Epoxy/iron/M	Eccosorb MF 112	EC	AR	AR	0.26	0.01	GSFC
Epoxy/iron/M	Eccosorb MF114	ß	AR.	AR	0.22	0.01	CSFC
Epoxy/iron/M	Eccosorb MF-124	2	AR	AR	0.09	0.01	GSFC
Epoxy/metal/c	Eccobond 56C/9	ည္ထ	100p. 56C/2.5p. 9	16h. 50°C	0.30	0.03	SRI
Epoxy/nietal/c	Eccobond 57C-A/B	ß	100p. A/100p. B	16h. 52°C	0.67	0.06	SRI
Epoxy/metal/M	Eccosorb MF-116	с Ш	AR	AR	0.20	0.02	JPL
Epoxy/metal/%	Eccosorb MF500F116	С Ц	AR	AR	0.30	0.04	Jar
Epoxy/metal,'c	Hysol K8-4238/H2-347;	S HY	100p.4238/8p. 3475	24h. R.T.	0.32	0.01	GSFC
Epoxy/MoS ₂ /SF	Epon 934 A/B-MoS,	ß	100p. A/33p.B	.25h. 66° C,	0.54	0.01	GSFC
1	3		Sp. MoS ₂ 20 ml MFK	1h. 93° C + 24h. 125° C.			
				1×10^{-2} torr			
Epoxy/mod./F/A	FM-96U	AΥ	AR	Ih. 175°C	0.15	0.01	SRI
Epoxy/mod/F/A	Metibond-328	R	AR	1.5h. 165°C	0.12	0::0	SRI
Epoxy/mod./F/A	Metibond 329	an N	AR	1.5h. 165°C	0.26	0.08	SRI
Epoxy/mod/F/A	Narmco 328	¥	AR	1.5n. 165 C	1.00	0.11	CSI:C
Epoxy/mod/F/A	Narmco 329	XZ	AR	1.5h. 165 [°] C	1.21	0,05	CSFC

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Material	Mfg. Code	రి	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Deta Source
Epoxy/nitrila/F/A	FM-123 LVCM	۸	AR	1.5h. 116° C	1.10	0.08	Táf
Epoxy/nitrile/F/A	FM123-5	Ϋ́	AR	1h. 121° C 12 psi	0.98	0.02	GSFC
Epoxy/nylon/F/A*	FM-1000	ΑY	AR	2h. 200°C	5.55	4.71	SRI
Epoxy/nylon/F/A	Metalbona 227	R	AR	2-3°C/min. to	0.99	0.08	GSFC
			ļ	127°C, held ih.			
Epoxy/phenolic/F/A	HT-424	Ā	AR	.5h. 65°C	0.83	0.17	SRI
Epoxy/phenolic/F/A	HT-424	λ	AR	2h. 165 C	0.65	0.16	SRI
Epoxy/phenolic/F/A	HT-424	Ϋ́Υ	alum./fiberglass sandwich	30h. 166 C	0.18	0.09	JPL
Epoxy/syntactic/CL	Eccobond SF-40	S	AR	48h. R.T.	0.24	0.04	GSFC
Epoxy/syntactic/CL	MPC 49	GE	AR	18h. R.T. + 2h. 66° C	0.39	0.01	GSFC
Bpoxy/syntactic/CL	MPC 49	GE	AR	4h. R.T.+ 2h.66° C	0.52	0.01	GSFC
Froxy/syntectic/CL	ERL-2795/HN 95-1	HA	100p. ERL-2795	24h. R.T.	0.50	0.03	GSFC
			2-4p. B-35A micro-				
			balloons				
			5p. Cab. MS				-
			8p. cat. HN 95-1				
Epoxy/wersem./P	Epon 828/140	ខ	50p. 828/50p. 140	24h. R.T.	0.20	0.02	GSFC
Epoxy/versum./A	Epon 828/140	S	60p. 828/40p. 140	24h. R.T.	0.74	0.05	GSFC
Epoxy/www.ACF	Epon 828/140	RO	70p. 828	1h. R.T. +	0.27	0.02	GSFC
			30p. 140	2h. 60° C			
			1p. SR-82				
Epuxy/verman/P	Type II class 2	YF.	35p. DER 332LC	3h. 71 C	0.92	0.05	GSFC
			30p. 140	(
Epoxy/wersam./Al/PN	S-GSFC-20-AI	S	60p. 828	48h. 100°C	0.77	0.07	GSFC
			40p. 140	·			
444 e r			33p. MD 5100 Al				
			powuer f toluene SOn				
			133p. (acetone 50p.				
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*Discussion example, not desirable

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M atorial	Mfg. Code	ප	Composition	Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. ester/Lc	Astro-Tex	ΜH	AR	AR	0.58	0.07	JPL
P. ester/F	Cronar	DQ	AR	AR	0.37	0.01	GSFC
	Ortho-S-Litho CoS 7		;				
Ester/LL*	DOA	5	diocty hadipate	AR	100.00	1	GSFC
P. rater/F	Mylar A	DQ	AR	AR	0.40	0.10	JPL
P. estar/F	Mylar 500A	DO	AR	AR	0.24	0.06	SRI
P. ester/F	Mylar HS	В	AR	AR	0.50	0.06	JPL
P.ester/S.T.	Mylar .004" wall	5	AR	10min. 110°C	0.62	0.03	SRI
P. exter/S.T.	Mylar .012" wall	đ,	AR	10min. 110°C	0.68	0.05	SRI
P. ester/T	P-49	8	AR	10min. 104°C	1.04	0.05	GSFC
P.estter/x/l	Polythermaleze	BE	x-linked p.ester +	AR	0.28	0.01	GSFC
			p. amide-imide jacket				
P. exter/F	Scotch Pak 8	WW	AR	AR	0.15	0.0C	JPL
P. ester/T	V-700075	ß	AR	10min. 93° C	0.47	0.01	GSFC
P. exter/HL/TX	Velcro 100	VE	hook and loop	AR	0.54	0.03	GSFC
			fastener, tota!				
			system				
P. enter/TX	!	RB	p. ester latex	AR	0.19	0.06	GSFC
			404m 2-3 on				
			Dacron ret				
P. ester/TX	1	RB	p. ester latex	AR	0.05	0.04	GSFC
			404m 2-3 on				
	1	9	Dacron cloth	Q		0000	UTSU
		2	404m 2-3 V-46-AX on		2		
			Dacron thread				
P. ester/acrylic/t	S	MM	AR	AR	0.40	10.0	GSFC
o ester/acrylic/t	850	MM	AK	AR	0.65	0.09	GSFC
P. ester/acrybic/t	X-1179	MM	AR	24h. 65° C	0.46	0.01	GSFC
P. ester/acrylic/t	Mystic 4043	λW	AR	AR	0.68	0.02	JPL
P. ester/activitic/t	Mystic 7341	ΥW	AR	AR	0.57	0.03	JPL
P. ester/elast./Lc	Sturdelace 18DH	GB	Dacron/rubber	24h. 150 C	0.34	0.06	SRI
P. ester/elast./Lc	Gude-Spec.18D96	8	Dacron/rubber	24h. 150°C	0.42	0.10	SRI
•Actual lubricant weight loces when heate	d at 121°C and 1 × 10 ⁻⁴ t] <u>-</u>	34 hours outside the VCM	net facility These	In heicants may ha	when used under]

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special conditions, where outgassing effects are minimized.

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Material	Mfg. Code	ပိ	Composition	Comments and Previous Cure History	Percent Weight Loss	Purcent Condensables	Data Source
P. ester-epoxy/BF/PN P. ester-epoxy/W/PN	401 Series 401-A10	MM	6p. r./1.5p. cat. 3p. 401-A10/1p. cat.	1h. 93° C 7d. R.T. +	4.49 3.09	0.13 0.08	GSFC GSFC
r. ester/gl./1	Fibre-mat 1-2539	MM	AR	24h. 121 [°] C AR	0.19	0.02	SRI
P. ester/gl./M P. ester/imide/CF	WF-1006 Isomid	S E	70 1./30 gl. AR	AR Airdry + 2min.	0.19 0.44	0.01 0.03	GSFC GSFC
P. ethylene/P	Stycast TPM-4	<u>بر</u>	Ak	204 C 16h. 107°C	0.23	0.08	JPL
				4h. 121 C 4u. 135°C 8 1. R.T.			
P. ethylene/gl./M	FF 1006	Ľ	70r./30 gl.	AR	0.13	0.03	GSFC
Ethylene/propylene clast.	E 515-8	EN	AR	AR I	1.21	0.18	GSFC
Fibergiass/acrymc/t Fiberg'ass/silicone/t	Mystic 4057 Permacel 5208	A M	AR AR	АР. 204°С	0.50	0.02	JPL
Fluorocarbon/I	D-100 series	RA	Kynar solder sleeves	ar ≺	0.38	0.08	GSFC
			w. polyethylene rings				
Fluorocarbon/1	D-100 crites	RA	Kynar sold¢r sleeves without nolvethvlene	8	0.44	0 08	GSFC
Fluorocarbon/l		HT	AR	AR	0.02	0.01	GSFC
Fluorocarbon/F	TECTON.	DC:	AR	AR	0.06	0.06	SRI
Fluorocarbon/F	FEP-500.	Ľ.	AR	AR	0.05	0.05	SRI
Fluorocarbon/F	FEP SONC	2	AR	AR	0.02	0.01	SRI
Fluorocarbon/S.T.	FEP clear		***	AR	0.03	10 0	JPL
Fluorocarbon/S.T.	FEP-yellow	• •	مربع	AR	0.03	0.01	JPL
Fluorocarbon/S.T.	FEP-black	2		AR	0.03	0.01	JPL
Fluorocarbon/W/PN	Fluoroclad/W	W S	p. vinylidene fluoride	4h. R.T. +	0.67	0.05	GSFC
			In solvent	.25h. 260°C			
Fluorocarbon/CF	Fluoroclad V78-VP21	ws	AR	Airdry + .5h 93° d +.25h. 260° C	0.05	0.01	GSFC
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Material	Mfg. Code	ප	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Fluorocarbon/M	Gylon Gasket	ե	PTFE	AR	0.04	0.04	Id
Fluorocarbon oil/LL	Krytox 143-AX	DQ	fluoroalkyl polyether oil	AR	28.54	5.71	GSFC
Fluorocarb::n/D	Kynar	L.	p. vinvlidene fluoride	d₽		80.0	-
i*!orocarbon/S.T.	Penntube II-SMT	Ъ.	PTFE		000	0.06	J.L
Fluorocarbon/1	Permatube-1	MT	PTFE		10.0	10.0	SKI
Fluorocarbon/F	Ribbon Dope Thread	M	PTER		10.0	10.0	SFC.
	Seal 8030-733-0055			42		70.0	2KI
Fluorocarbon/F	Tedlar A130WH	D	p. vinylfluoride	AR	0.47	0.01	SPI
Fluorocarbon/F	Tedlar 100BG 30 TL	DQ	p. vinylfuoride	AR	0.00	0.00	Ido
Fluorocarbon/F	Tedlar 100 BG 30 TR	3	p. vinylfluoride	AR	0.23	010	
Fluorocarbon/F	Tediar 150 BL 30cc	N	p. vinylfluoride	AR	C.14	0.01	GSFC
	i black						,
Fluorocarbon/Lc	Temp-Lace 256	B	PTFE	er	0.12	0.03	- Idi
Fluorocarbon/Lc	Temp-Lace 256H	80 10	PTFE	AR	0.64	010	Idi
Fluorocarbon/Lc	Temp-Lace H256H	B	AR	AR	0.60	0.05	SRI SRI
Fluorocarbon/S.T.	Thermofit-7-3()-09	RA	PTFE	Ih. 150°C	0.01	0.01	SRI
Fluorocarbon/S.T.	Thermofit-7-31-22	RA	p. vinylidene fluoride	Ih. 150°C	0.27	60.0	SRI
iluorocarbon/S.T.	Thermofit 7-32-16	RA	PTFE	Ih. 150°C	0.01		SRI
Fluorocarbon/S.T.	Thermofit R	R	PTFE	1h 150°C	0.01	÷	SRI
r luorocarbon/I	33181019	BR	PTFE	AR	0.01	(, .1 (, .1	C.ISD
Fluorccarbon/Al/F	Tedlar 1 36-30WH/AI-	2	.002" p. vinyl fluoride	5min. 120° C	0.15	0.05	GSEC
	5056 H 191		.0047" aluminum 153				,
		_	composite		_		
Fluorocarbon/acrylic/t	63	MM	AR	AR	0.33	C.03	GSFC
Photocarbon/acrylic/t	65	MM	AR	AR	0.29	0.08	GSFC
riuorocarbon/Dac/TX	t	BX	Viton/Dacron	A 8	0.86	0.09	CSFC
riuorocarbon/Dac/TX	Fairprene 80-060	D	AR	AR	0.34	0.01	SRI
	Fairprene 80-070	DQ	AP	AP.	0.30	0.01	SRI
	Fairprene 80-080	B	AR	AR	0.30	0.01	SRI
	ECD 487-90	D	AR	AR	0.51	0.01	CSFC
	Fluorel 1062	SW	elastomer	AR	J.38	0.03	GSFC
	JP-10	Da	AR	AR	0.32	0.0	JPL

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Material	Mfg. Code	ů	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
		ŀ			266	0.05	TDT
Fluorocarbon elast.	1.608-6	2		AR	CC.V	\$0.0	116
Fhurrocarbon elast.	PLV-101	2	AR	AR	0.82	0.02	JPL
Fluorccarbon elast.	PLV-1006-A	Ľ	AR	AR	0.52	0.02	JPL
Fluorocarbon elast.	PLV 3016-B	PL	AR	AR	0.51	0.02	.PL
Fluorocarbon elast.	PLV 5010-B	7	AR	AR	0.38	0.02	JPL
Fluorocarbon elast.	PLV 8704	Ы	AR	AR	0.44	0.02	JPL
Fluorocarbon elast.	PLV-30001	PL	AR	AR	0.33	0.01	JPL
Fluorocarbon elast.	6-17EV	S	Viton A	AR	0.33	0.01	SRI
Fluorocarbon elast,	Viton B	SR	AR	AR	0.46	0.01	JPL
Fluorocarbon elast	Viton B	DQ	AR	AR	0.86	0.04	GSFC
Fluorocarbon elast.	Viton C	ME	AR	AR	0.30	0.03	GSFC
Fluorocarbon elast.	77-545	2	Viton A	AR	0.24	0.03	GSFC
Fluorocarbon elast.	4411A-776	DU	Viton A	AR	0.20	0.05	SRI
Fluorocarbon eia.t.	4411A-776	DQ	Viton A	24'n. 200° C	0.03	0.01	SRI
Fluorocarbon elast.	4411A-777	DQ	Viton A	.AR	0.27	0.03	Ski
Fluorocarbon elast.	4411A-777	DQ	Viton A	24h. 200 C	0.01	ن 10	SRI
Fluorocarbon elast.	4411A-778	DO	Viton A	AR	0.35	0.01	SRI
Fluorocarbon elast.	4411A-778	DQ	Viton A	24h. 200° C	0.03	0.01	SRI
Fluorocarbon elast.	4411A-990	DQ	Viton A	AR	0.54	0.03	SRI
Fluorocarbon/gl/M	CT-505	ĉ	PTF2	AR	0.01	0.01	JPL
Pluotocarbon/gl.	Emíab 20-60 PTFE	AF	AR	AR	0.01	0.01	GSFC
Fluorocarbon/mica/M	Fluorosint	ž	PTFE/mica	AR	0.09	0.03	JPL
Fluorocarbon/mica/M	Fluorosint LE207	ß	PTFE/mica	AR	0.20	0.04	JPL
Fluorocarbon/cet./fiber/M	RT Duroid 5600	RG	PTFE	AR	0.22	0.03	JPL
Fluorocarbon/cer./fiber/M	RT Duroid 5650	RG	PTFE	AR	0.28	0.01	JAL
Fluorocarbon/gl./M	RT Duroid 5813	RG	PTFE	AR	0.22	0.02	JPL
Fluorocarbon/gl./M	RT Duroid 5870	RG	PTFE	AR	0.12	0.02	I.I.
Fluorocarbon/gl./TX	TLS-PTFE	MM	AR	AR	0.05	0.05	SRI
Fluorocarbon/nylon/TX	Armalon 98-101	DQ	AR	AR	0.48	0.02	SRI
Fluorocarbon/olefin	V-44	RA	p. vinylidene fluoride	AR	0.34	0.07	GSFC
			irradiated, over				
			p. alkene, irradiated				
Fluorocarbon/silicone/?	CHR C-430	5	PTFE carrier	AR	0.27	0.09	GSFC
Fluorositicone elast.	L-449-6	PS	AR	AR	0.53	0.07	SRI

Material	Mfg. Code	ပိ	Cumposition	Comments and Previous Cure History	Percent Weight Loss	Percent (")ondensables	Data Source
Fluorositicone/CF	94-003-dispersion	ß	AR	75d. R.T.	0.18	0.01	GSFC
Fluorosilicone elast.	1050-70	PR	AR	AR	0.50	0.03	SRI
Gold/p. imide/acrylic/t	Y-9184A	MM	vaporized gold	AR	1.42	0.01	GSFC
			on Kaptor				
Hydrocarbon/LL*	Apiezon-C	BD	AR	AR	31.50	I	GSFC
Hydrocarbon/LL	Apiezon-L, Grease	BD	AR	AR	0,06	10.0	JPL
P. imide/M	Gemon 3010	GE	AR	AR	0.34	0.02	GSFC
P. finide/F	Kapton 200XH667	D	AR	AR	0.14	0.09	SRI
P. imide/I	Kapton T-400, 1/20	BR	AR	AR	0.51	0.10	GSFC
P. imide/I	Pyre. ML	na	AR	AR	0.07	0.02	JPL
P. imide/M	Vespel SP-1	DQ	AR	AR	1.24	0.0 i	SRI
P. imude/I	XPI-MC-154	AY	AR	AR	1.14	0.01	GSFC
P. imide/acrylic/t	Y1205	MM	AR	AR	0.73	0.10	GSFC
P. imide/acrylic/t	1255	MM	double coat of	.sh. 130°C	0.93	0.07	GSFC
			acrylic adhesive				
			on p. imide				
P. imide/acrylic/t	7367	λW		AR	0.64	0.05	GSFC
P. imide/FEP/F	Kapton 200XHF 929A	DQ	AR	AR	0.54	0.05	SRI
P. imide/PEP/I	T473-1/24	BR	AR	AR	0.52	0.61	GSFC
P. imide/gt/L		MM	AR	AR	0.77	0.01	GSFC
P. imide/gl/M	LNP XF1004	Ľ	80 r./20 gl.	AR	1.06	0.01	GSFC
P. imide/gt./L	Pyralin 12	DQ	AR	AR	0.52	0.01	GSFC
P. imide/gl./TX	Pyre-M.L. Type 1	DQ	AR	AR	0.50	0.01	SRI
P. imide/nylon/F	1	MN	thermal blanket	AR	0.61	0.03	GSFC
			composite				
Lead/acrylic/t	Mystic 7431	λW	kad foil	AR	1.33	0.06	JPL
P. methacrylate/M	Plexiglas II	DQ	AR	AR	0.57	0.01	GSFC
P. methacrylate/M	Plexiglas VS-100	D	AR	AR	1.00	0.01	GSFC
P. methacrylate-mod/M	Bavick II	ğ	AR	AR	0 59	0.01	GSFC
P. methacrylate-mod/M	Lucerne 011-V	AΥ	AR	AR	0.51	0.05	GSFC
Moly disulphide/SF	Molykote microsize	X	AR	AR	0.55	0.01	JPL
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*Actual lubricant weight iosses when heated at 121°C and 1 x 10⁻⁴ torr for 24 hours outsids the VCM test facility. These lubricants may have been used under special conditions, where outgassing effects are minimized.

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Material	Mfg. Code	පී	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Mc1	Dischan 1020	Z	AR	AR	0.65	0.03	JPL
Nutran 6 /6 /al M	RF 1006	N	70 r./30 el.	AR	0.81	0.04	GSFC
Nvlon 6/10/st/M	OF-1006	Ľ	70r./30gl.	AR	0.65	0.04	GSFC
Nvion 11/st./M	LNP-HF-1006	LN	70 r./30 gt.	AR	0.37	0.02	GSFC
Nylon 12/eL/M	LNP-SF 1006	Ľ	70 r./30 gl.	AR	0.65	0.02	GSFC
P. olefin/I	44/0611-9	RA	AR	AR	0.21	0.07	GSFC
P. olefin/S.T.	Thennofit-876	RY	AR	.25h. 125° C	0.43	0.10	GSFC
P. olefin/mod/I	Surlyn A	RM	AR	AR	0.28	0.03	GSFC
Phenolic/gl./L	Micarta H-5834	WC	AR.	AR	0.70	0.03	SRI
Phenolic/gl./L	91 LD	SG	AR	AR	0.37	0.04	GSFC
Phenolic/MuS_/SF	4306	EF	thin film	1.5h 190°C	0.05	0.01	SRI
P. phenylene-ox/M	Noryl	B	AR	AR	0.10	0.01	GSFC
P. phenylene-ox/F	PPO-531-081 opaque	B	AR	AR	0.09	0.02	SRI
P. phenylene-ox/F	PPO-681-111 clear	B	AR	.sh. 180° C	0.07	0.05	SRI
P. phenylene-ox/gl./M	NF-1006	Ľ	70 r./30 gl.	AR	0.11	0.01	GSFC
P. phenylene-ox/gl./M	Noryl-ZF-1006	GE	70 r./30 gl.	AR	0.04	0.01	GSFC
P. propylene/M	Impalene	E	AR	AR	0.30	0.05	GSFC
P. propylene/gl./M	MF 1006	Z	70 r./30 gl.	AR	0.13	0.04	GSFC
Silicate/W/PN	C-PS7-150 GSFC/17W	S	K2TiF ₆ +	181. 122°C	0.84	0.01	GSFC
			K ₂ SiO ₂ binder				
Silicate/BF/PN	MSA/S	SS	asbestos, A1, SiO3	73.h. R.T.	3.14	0.02	GSFC
			talc, mica				
			carbon black				
			K_2 SiO ₃ binder				-
Suitcate/BF/PN	MSA/S	S	asbestos, Al ₂ SiO ₃	48h. 100° C	2.24	0.04	GSFC
			taic, mica carbon black				
			K ₂ SiO ₂ binder				
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Material	Mfg. Code	ပိ	romposition	Comments 2nd Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Silicate/BF/PN	MSA/5 ALT.	GS	asbestos, CaSiO ₃ talc, mica carbon black K ₂ SiO ₃ binder	72h. R.T.	3.40	0.02	GSFC
Silicate/"/PN	M'74	ß	. TiO ₂ , ZnO, Al ₂ O ₃ K ₂ SiO ₃ biແປລ	24h. R.T.	6.27	0.03	CSFC
Silicate/W/PN	MS-74	GS	TiO ₂ ,ZnO, Al ₂ O ₃ K ₂ SiO ₃ binder	48h. 100° C	4.54	0.01	GSFC
Silicate/W/PN	Z-93	GA	ZnO/K ₂ SiO ₃ binder	7d. R.T.	2.54	0.01	GSFC
Silicate/MoS ₂ /Si ⁻	2396	EF	thin film	2h. 80°C+ 2h. 205°C	0.05	0.01	SRI
Silicone/TG Silicone/A Silicone/W/PN	C6-1102 C6-1104 C-101 GSFC-16W	888	AR AR 300p. ZnO-SP500 ithium +	AR 7d. R.T. 2h. 150 [°] C +	0.05 0.19 0.41	0.02 0.01 0.12	GSFC GSFC GSFC GSFC
Silicone/OG Silicone/P	DC-20-057 E691-22E	22	potassaun silicate 150p RTV 602 100ml, toluene AR Sylgard 184 stripped of low mol. wt. fraction by Dow Corning Corp.	AR AR	0.31 0.19	0.04	JPL SRI
Silicone/TG Silicone/W/PN	Eccotherm TC-4 FC-GSFC-14W	EC GS	AR -	AR 3.5d. R.T.	0.54 0.17	0.05 0.09	GSFC GSFC

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Material	Mfg. Code	ප	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Silicone/W/PN	FC-GSFC-14W	GS	I	7d. R.T. +	0.14	0.01	CSFC
Sili-sne/W/PN	FC-GSFC-15W	ŝ	I	24h. 66 C		000	0400
Silicone/TG	G-683	88	AR	AR AR	0.62	0.08	
Silicone/W/PN	UTRE-S-13G	S	dimethyl silicone	16h. 121°C	0.42	0.10	CSFC
			ZnO/K,SiO3	1x10 ⁻⁶ torr	5	01.0	5
Silicone	Owens 650	S	ÂR Č	18h. 100°C	0.51	0.02	GSEC
Silicone/W/PN	Owens 650 ZrO	S	60p. 650/40p. ZrO	AR	0.77	0.01	GSFC C
Siticone/W/PN	P-764-1A	S	260p. treated ZnO	7d. R.T.	0.30	0.01	GSFC
			100p. devolat. 602			-	2
			.25% SRC-05 based on 60	2			
			360p. toluene				
Sütcone/P	RTV 11/T-12	B	100p. 11/2p. T-12	24h. R.T.	0.33	0.10	JPL
Silicone/P/A	RTV SC6 A/B	đ	100m A/ 1m B		50 0		Ĩ
		3	Top. A. T. D. D	/m. N.I.	0.0/	500	JYL
Subcone/P/A	RTV 566 A/B	B	100p. A/.1p. B	24h. R.T.	0.14	0.02	GSFC
Silicone/P/A	RTV 566 A/B	GE	100p. A/.2p. B	24h. R.T.	0.25	0.03	GSFC
Silicone/P/A	SC-GSFC-19C	ß	12p. RTV 602-devol.	G.E. prepolymer	0.35	0.02	GSFC
			.031p. SRC-05	602-hcated 24h.			
			•	150°C			
		-		10 ⁻⁶ torr at			
				GSFC to a viscos-			
		_		ity of 2000 to			
				2200 centipoise			
				and cooled prior			<u>.</u>
		_		to catalyzing			
	-			7d. R.T. cure			
Silicone/B/PN	Sicon Black 7x9055	DX	AR	24h. R.T.	0.98	0.04	GSFC
				sh. 177° C			
Silicone/P	77-002	X	10p. 7 /-002/1p. cat.	7d. R.T.	0.31	0.02	JPL
Silicone/P	77-002	ğ	10p. 77-002/1p. cat.	th. 65°C	0.39	0.06	JPL
Silicone/A/P	93-500/cat.	В	10p. 93-500/1p. cat.	24h. R.T.	0.29	0.01	GSFC
Silicone/A/P	93-500/cat.	8	10p. 93-500/1p. cat,	7d. R.T.	0.22	0.02	JPL.
Silicone/A/P	93-500/cat.	ä	10p. 93-500/1p. cat.	7d. R.T.	0.16	0.01	GSFC

Material	Mfg. Code	රී	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
Silicone elast./]	B1WP/N	BW	high voltage	24h. 232° C	0.03	0.01	GSFC
	F 5639-L-G22		silicone cable				
Silicone elast.	Cohr-9255	ರ ರ	AR	24h. 204°C	0.18	0.06	JPL
Silicone elast.	HR. 2501	PS	AR	AR	0.30	0.08	GSFC
Silicone elast.	MS 20L08	MO	AR	2 min 163°C +	0.04	0.01	GSFC
				2h. 249° C			
Silicone elast.	MS 30C02	MO	AR	2 min. 163 °C + 2h. 249 °C	0.07	0.05	`.sFC
Silicone elast.	RR 423	RR	AR	24h. 232°C	0.11	0.02	GSFC
Silicone elast	SE-556	GE	AR	24h. 250°C	0.10	0.01	SRI
Silicone elast.	SE-3604	GE	AR	24h. 250°C	0.03	0.03	SRI
Silwone elast.	SE-3604/Varox	B	AR	24h. 204°C	0.09	0.04	JPÌL
Silicone elast.	SE-3613	GE	AR	24h. 249°C	0.09	0.06	SRI
Silicone clast.	SE-3713	B	AR	24h. 249°C	0.20	0.09	SRI
Silicone elast.	SE-3813	Щ С	AR	24h. 249°C	0.27	0.04	SRI
Silicone elast.	SE-4401		AR	10 min. 110°C +	0.06	0.01	GSFC
				24h. 249°C			
Silicone elast.	SE-4404	B	AR	10 min. 110°C +	0.10	0.01	GSFC
				24h. 249°C			-
Silicone elast.	SE-4503	GE	AR	24h. 249°C	0.07	0.03	SRI
Silicone elast.	SE-4511	GE	AR	24h. 249°C	0.19	0.10	SRI
Silicone elast.	SE-5211	B	AR	10 min. 110°C+	0.08	0.02	GSFC
				4h. 249°C			
Silucote elast.	SE-5403U	B	AR	3h. 204°C	0.10	0.02	GSFC
Silicone elast.	Silastic 35	R	AR	5 min. 116°C+	0.14	0.06	GSFC
				24h., 249 [°] C			
Silicone elast.	Silastic 75	8	AR	10 min. 171 C +	0.31	0.10	GSFC
				3h. 204°C			
Silicone elast.	Silastic 675	ä	AR	5 min. 116 C +	0.41	0.05	GSFC
		_		24h., 250°C		-	
Silicory elast.	Silastic 916	X	AR	5 min. 115 C + 24h. 249 C	0.40	0.01	GSFC
Silicone elast.	Silastic S-9711	Å	AR	AR	0.27	0.10	SRI
Silicone elast.	Silastic S-9711	8	AR	24h. 125°C	0.19	0.05	SRI

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Material	Mfg. Code	ප	Computition	Comments and Previous	Percent Weight Loss	Percent Condensables	Data Source
				Cure rustory	,		T
Silicone elast	STW 0474	SU	AR	96h. 204°C	0.11	0.01	GSI
Silicone elast/t	70	MM	AR	24h. 121°C	0.40	0.07	GSFC
		(96.0		500
Silicone elast./Al	Lord-HD-222-22-2	2	BIR, suicone	АК	0.20	70.0	
			sandwich between				
			0.020'' aluminum				
Silicone/G/LL	C6-1103 vac. grease	8	AR	AR	0.17	0.01	GSFC
Silicone oil/LL*	F-50	GE	AR	AR	4.50	1	GSFC
Silicone oil/LL	F6-1100	8	dimethyl siloxane	AR	0.07	0.04	GSFC
Silicone oil/LL	F6-1101	8	fluorosilicone	AR	0.05	0.03	GSFC
Silicone oil/LL	F6-1105	Я	phenyl methyl siloxane	AR	0.07	0.06	GSFC
	E¢ 1103	Ż	ablacation of a star	QA	110	0.07	CSEC
		3 8			1.0		0.100
Silicone oil/LL*	SF-96 (50 cp)	3	AK	AR	8.00	1	1350
Silicone oil/LL*	SF-96 (500 cp.)	39	AR	AK	4.00	1	
Silicone oil/LL	1147	GE	AR	AR	4.28	2.41	GSFC
Silicone/D	K-707 (K~12)	GE	AR	AR	0.41	0.01	SRI
Silicone/D	K-707 (K~15)	GE	AR	AR	0.70	0.08	SRI
Silicone/gl/L	Micarta 20201-2	WC	AR	AR	0.16	0.04	SRI
Silicone/gL/SL	1062-HAI	BH	AR	24h. 150° C	0.29	0.13	SRI
Silicone/metal/c	Cho Seal 1215	R	AR	AR	0.39	0.08	GSFC
Silicone/silver powder/c	I	GE	100p. RTV 11/70p. silver/ 2p. T-12	24h. R.T. + 24h. 130° C	0.08	0.01	JJL
Silver/FEP/edhes./F	ł	S	vaporized silver on FEP with	AR	0.34	0.13	GSFC
	Values 160 46	A	Garlock 201 adhesive	QV	0.02	600	CSEC
Diamness sicci/ nL/ I A	306-1754	2 >	stainless-hook	~~~	0.00	70.0	,
			and loop fastener				
			total system				
P. styrene/x/D	Q200.5	2	AR	AR	0.09	0.01	GSFC
P. styrene/x/D	Rexolite 1422	BR	no copper	AR	0.16	0.02	GSFC
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*Actual lubricant weight losses when heated at 121°C and 1 x 10⁻⁴ torr for 24 hours outside the VCM test facility. These lubricants may have been used under special conditions, where outgassing effects are minimized.

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Material	Mfg. Code	ප	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. styrene(x/D	Rexolite 1422	BR	AR	AR	0.18	0.01	JPL
P. styrene/M	ł		AR	AR	0.26	0.01	JPL
P. styrene/TiO ₂ /M	Hi-K-707-L-9	ß	p. styrene, TiO,	AR	0.08	0.01	GSFC
P. styrene/gl/M	CF-1006	LN	70 r./30 gl.	AR	0.10	0.01	GJFC
P. styrene/gl./CrO ₂ /M	Styrafil/G33/20/CrO2	FF	75 r./20 gl./5 ox.	AR	0.53	0.01	GSFC
P. styrene-acrylonitrile/gl./M	Acrylafil G47/20	ЕF	80 r./20 gl.	AR	0.23	0.01	GSFC
P. styrene-acrylonitrile/gl./M	Acrylaglas S40/35	FF	65 r./35 gl.	AR	0.22	0.03	GSFC
P. styrene-acrylonitrile/gL/M	BF-1006	Ľ	70 r./30 gl.	AR	0.24	0.01	GSFC
P. sulphone/F	P-2300	g	AR	.Sh. 125°C	0.03	0.01	SRI
P. sulphone/F	P-7395-121-2	S	AR	AR	0.09	0.02	SRI
P. sulphone/gl./M	GF-1006	Ľ	70 r./30 gl.	AR	0.24	0.01	GSFC
P. sulphone/gl./M	Sulfil G-1500/20	FF	80 r./20 gl.	AR	0.20	0.01	GSFC
Sulfone elast.	P-1700	DQ	AR	.25h. 343° C	0.39	0.01	JPL
P. urethane/P	1	S	150p. Adiprene L-100	3h. 100°C	1.06	0.06	GSFC
			16.5p. MOCA				
P. urethane/P	ļ	ვ	100p. Sol. 113	sh. 54°C	0.51	0.09	JPL
			73p. Sol C113-300				
P. urethane/CF	1	S	100p. Sol. 113	22h. 70° C	0.31	0.01	GSFC
			73p. Sol. C113-300				
P. urethane/P		ខ	100p. Sol. 113	7u. R.T.	0.37	0.01	GSFC
			73p. Sol. C113-300				
			4 drops T-12				
P. urethane/P	1	3	100p. Sol. 113	7d. K.T.	0.69	60.0	CSFC
			73p. Sol. C113-300	-			
			87p. Al powder				
	EC CEEC 10 L		MD 5100				
P. unethane/CF	FC-GSFC-ZU/W	GS	100p. Sol. 113	7d. R.T.	0.29	0.01	GSFC
			73p. Sol. C113-300	_			
			.25p. TiO ₂				
			l arop f.12				
P. urethane/P	1	S	100p. Sol.C113	7d. R.T.	0.31	0.02	GSFC
			7.5p. Sol C113-328				

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Matorial	Mfg. Code	පී	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. urethane/P	1	GS	100p. Sol. C113 36.5p. Sol. C113-300	20h. 70° C	0.30	0.02	GSFC
P. weinano/P	I	CS	7.5p. Sol. C1 i3-328 100p. Sol. C1 13-300 51p. Sol. C1 13-300 4.5p. Sol. C1 13-328	18h. 70° C	0.34	0.01	GSFC
P. urethane/P	1	EM	100p. Sol. C113 51p. Sol C113-300 4 \$n Sol C113-328	16h. 57° C	0.53	0.01	GSFC
P. wrethane/CF	1	SB	100. Eccosphere-SI 100. Sol. 113 51p. Sol. C113-300 4.5p. Sol. C113-328	16h. 38° C	0.21	10.0	GSFC
P. urethane/P	i	ß	20.5p. B-35A gl. bubbles 100p. Sol. 113 73p. Sol. C113-300 6a. Cah.MS.5	7d. RT	0.42	0.01	GSFC
P. wrethane /P	I	GS	4 drops T-12 100p. Sol. 113 73p. Sol. C113-300 6.9p. Cab. MS-5	7d. R.T.	0.31	0.01	GSFC
P. wrethane/P	ł	ß	.04p. Khodamine pase 4 drops T-12 100p. Sol. C113-300 73p. Sol. C113-300 7 8a Cah Mc.4	16h. 70° C	0.42	0.01	GSFC
P. wrethune/P	1	GS	.040p. Vyac .040p. Vyac 100p. Sol. C113-300 73p. Cab. MS-5 .086p. Vyac	7d. R.T.	0.37	0.01	GSFC

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Manats	Mig. Code	පී	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. wrethane/P	1	ខ	1009. Sol. 113 73p. Sol. C113-300 10.4p. Cab. MS-5	7d. R.T.	0.40	0.01	GSFC
P. wrethane/P	1	3	4 drops T-12 100p. So C113 73p. Sol. C113-300 10.4p. Cab. MS-5 .02b. Vvac	7d. R.T.	0.38	0.02	GSFC
P. urethane/BG/PN	1	S	4 drops T-12 100p. Sol. 113 73p. Sol. C113-300 2.6p. Cath. 1 2.4cccc T-12	18h. 50° C	0.41	0.0	GSFC
P. urethene/BG/PN	I	S	10 mL-ME K 100p. Sol. 113 73p. Sol. 113-300 2.6p. Carb. 46	7d. R.T.	0.51	0.02	GSFC
P. wrethane/BG/PN	ł	S	2 ar.ps 1-12 1.0ml-MEK 100p. Sol. 113 73p. Sol. C113-300 2.6p. Carb. 46	22h. 60° C	0.40	0.01	GSFC
P. wrethano/CF P. wrethano/CF	1 1	<u> 8</u> 8	2 drops T-12 100p. Sol. 113 150p. Sol. C113-300 100p. Sol. 113	7d. R.T. 18h. 50° C	0.37	0.04	GSFC GSFC
P. wrethane/BF/PN	I	GS	150p. Sol. C113-300 9ml. Chemglaze Z-306 2ml. toluene 1gm. 3M-840.0 microballoons thru 44 micron sieve, onto 37 micron sieve	lsd. R.T.	0.83	0.0	GSFC

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P. urethane/B/PN Chemplace 7.306 HC AR 304. R.1. P. urethane/CL C. could:	Material	Mfg. Code	ĉ	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. verthane/B/PN Cheruglaze Z.:306 HC AR 304. R.T. P. urethane/CL Counthit'11510 RD 23.4P. 24/9.9P. 2B 181. R.T. + P. urethane/CL Counthit'1510 RD 23.4P. 24/9.9P. 2B 181. R.T. + P. urethane/CL Eccofoam SH EC 7.2515/f13 AR 304. R.T. P. urethane/CL Eccofoam SH EC 7.2515/f13 AR 304. R.T. P. urethane/C HY and 13-105/MOCA HY 1000-13-105/H3 AR 4n.75° C P. urethane/C P. urethane/C P. urethane/C P. Nopco G-302 NP AR 4n.75° C P. urethane/C P. urethane/C P. urethane/C P. Nopco J-106 NP AR AR AR P. urethane/C P. urethane/C P. UREthane/C P. AR AR AR AR P. urethane/C P. urethane/C P. UREthane/C P. AR AR AR P. urethane/C P. UREthane/C P. UREthane/C P. UREthane/C P. UREthane/C P. urethane/F P. urethane/F P. UREthane/C P. ODP. 11558 S.G. C P. urethane/F P. UREthane/C P. UREthane/F P. ODP. 11558 S.G. C P. urethane/F P. UREthane/F P. O								
P. weethanol B/FN Chemiquace 7:306 HC AR 3304, R.1. P. weethane/CL Coundth.:/*1510 RD AR 331, 19° C P. weethane/CL Coundth.:/*1510 RD 23.4p. 2A/9.9p. 28 18h. R.T. + P. weethane/CL Coundth.:/*1510 RD AR 33h. 19° C P. weethane/CL Eccorant SH EC 7.25 ts/s/tr3 AR 33h. 19° C P. weethane/C Eccorant SH EC 7.23 ts/s/tr3 AR 33h. 19° C P. weethane/C Eccorant SH Ecc 7.23 ts/s/tr3 AR 304. R.T. P. weethane/C PL 1001 AB AR Ah 75° C Ah 75° C P. weethane/C PL 1002 AB AR Ah 75° C Ah 75° C P. weethane/C PL 1002 AB AR Ah 75° C Ah 75° C P. weethane/C PL 1002 AB AR Ah 75° C Ah 75° C P. weethane/C PL 1002 AB AR Ah 75° C AR P. weethane/C P. weethane/C P. 256.A/100p.B Sd. R.T. AR P. weethane/C P. 256.A/100p.B Sd. R.T. AR AR P. weethane/C P. 256.A/100p.B Sd. R.T. P.								
P. urethane/CL Counth. : (*11510 RD AR 33h. 149° C P. urethane/CL Curethane/CL CPR-23-2A/23 UP 23.4p. 2A/9.9p. 2B 1Bh. R.T. + P. urethane/CL Eccofoam SH EC 7.25 ibs/f1 ³ AR AR P. urethane/CL Eccofoam SH EC 7.25 ibs/f1 ³ AR AR P. urethane/C Hysol 13-105/MOCA HY 100p. 13-105/13p. MOCA 3h. 100° C + 30d. R.T. P. urethane/C PPL 1001 AB AR AR AR P. urethane/C PPL 1002 AB AR AR AR P. urethane/C PD 1002 AB AR AR AR P. urethane/C Nopco G-302 NP AR AR AR P. urethane/C PPL 1002 AB AR AR AR P. urethane/C PPL 1002 NP AR AR AR P. urethane/C PPL 1002 NP AR AR AR AR P. urethane/C <t< th=""><th>P. wrethane/B/PN</th><th>Cherughaze 7-306</th><th>E</th><th>AR</th><th>30d. R.T.</th><th>0.56</th><th>0.01</th><th>GSFC</th></t<>	P. wrethane/B/PN	Cherughaze 7-306	E	AR	30d. R.T.	0.56	0.01	GSFC
P. urethane/CL CPR-23-2A/23 UP 23.4p. 2A/9.9p. 2B 18h. R.T. + P. urethane/CL Eccofoam SH EC 7.25/bs/fr ³ AR AR P. urethane/CL Eccofoam SH EC 7.25/bs/fr ³ AR AR P. urethane/CF Inuethane/CF Inuethane/CF Inuethane/CF Inuethane/CF AR AR AR P. urethane/CF IPL 1001 AB AR AR AR AR AR P. urethane/CF IPL 1001 AB AR AR AR AR AR P. urethane/CL IPL 1002 NP AR	P. urethane/F	Countr. :('!1510	RD	AR	.33h. 149° C	1.09	0.10	GSFC
P. urethane/CL Eccofoam SH EC 7.25!bs/ft ³ 5h. 93° C P. urethane/CL Develtane/C Hysol 113-105/MOCA HY 100p. 13-105/13p. MOCA 3h. 100° C+ P. urethane/CF JPL 1001 AB AR Ah. 75° C P. urethane/CF JPL 1001 AB AR Ah. 75° C P. urethane/CF JPL 1001 AB AR Ah. 75° C P. urethane/CF JPL 1002 AB AR Ah. 75° C P. urethane/CF Nopco J-106 NP AR Ah. 75° C P. urethane/C NP AR AR AR P. urethane/C Nopco J-106 NP AR AR P. urethane/C PD 26p.A/100p.B 5d. R.T. P. urethane/P PR. 1533 AO AR AR P. urethane/P PR. 1531 A/B PD 26p.A/100p.B 5d. R.T. P. urethane/P PR. 1533 AO AR AR 20. 70° C P. urethane/P PR-133B AO AR 20. 70° C P. urethane/P PR-133B AO AR 20. 70° C P. urethane/P P. urethane/P PA AR 20. 70° C P. urethane/CT P. urethane/P P. 155B	P. urethane/CL	CPR-23-2A/23	5	23.4p. 2A/9.9p. 2B	18h. R.T. +	1.04	U.0	GSFC
P. urethane/CL Eccofoam SH EC 7.25tbs/ft ³ AR P. urethane/C Hysol 13-105/13p. MOCA 3h. 100° C+ AR AR AR P. urethane/C P. urethane/C P. urethane/C P. urethane/C AR AR AR P. urethane/C P. urethane/C P. urethane/C P. urethane/C AR AR AR AR AR P. urethane/C P. urethane/C P. urethane/C P. urethane/C AR AR AR AR AR P. urethane/C P. urethane/C P. urethane/C P. are AR AR AR AR AR P. urethane/C P. urethane/C P. are AR AR AR AR AR P. urethane/C P. urethane/C P. arethane/C P. aretha				•	5h. 93°C			
P. urethane/I Gripeze 2 PH AR AR P. urethane/CF Hy sol 13-105/MOCA Hy 100p. 13-105/13p. MOCA 3h. 100° C + 30d. R.T. P. urethane/CF JPL 1001 AB AR Ah. 75° C P. urethane/CF JPL 1001 AB AR Ah. 75° C P. urethane/CL Nopco G-302 NP AR AR AR P. urethane/CL Nopco G-302 NP AR AR AR P. urethane/CL Nopco J-106 HY AR AR AR P. urethane/CL Nopco J-106 HY AR AR AR P. urethane/CL Nopco J-106 HY AR AR AR P. urethane/CL PR-1327 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR-1538 AO AR AR P. urethane/P PR-1538 AO AR 72h. 52° C P. urethane/P P. urethane/P R.G.A.4875 RC 100p. 1155A P. urethane/F P. urethane/F AR 71h. 70° C P. urethane/F R.urthane/F AR 10h. 70° C P. urethane/F R.urthane/F RCA.44875 RC 70h. 1155B P. urethane/F P.UP. 1155	P. urethane/CL	Eccofoam SH	යු	7.25!bs/ft ³	AR	1.03	0.01	SRI
P. urethane/P Hysol 13-105/MOCA HY 100p. 13-105/13p. MOCA[3h. 100° C + 30d. R.T. P. urethane/CF JPL 1001 AB AR 4h. 75° C P. urethane/CF JPL 1002 AB AR 4h. 75° C P. urethane/CF JPL 1002 AB AR 4h. 75° C P. urethane/CL Nopco G-302 NP AR 4h. 75° C P. urethane/CL Nopco J-106 NP AR 8h. 66° C P. urethane/CL Nopco J-106 NP AR 8h. 66° C P. urethane/P PF-3 WC AR 8h. 66° C P. urethane/P PR-1538 PD 26p.A/100p.B 3d. R.T. P. urethane/P P. urethane/P PR-1538 AO AR AR P. urethane/P P. urethane/P PR-1538 AO AR AR AR P. urethane/P P. urethane/P P. Urethane/P P. 26p.A/100p.B 3d. R.T. 72h.S2° C P. urethane/P P. Urethane/P P. AR AR AR 20h.70° C	P. urethane/l	Gripeze 2	H	AR	AR	0.16	0.02	JPL
P. urethane/CF JPL 1001 AB AR 30d. R.T. P. urethane/CF JPL 1002 AB AR 4h. 75° C P. urethane/CL Nopco G-302 NP AR 4h. 75° C P. urethane/CL Nopco G-302 NP AR 4h. 75° C P. urethane/CL Nopco G-302 NP AR 4h. 75° C P. urethane/CL Nopco G-302 NP AR AR P. urethane/CL P. urethane/CL P. urethane/CL P. urethane/CL P. urethane/P P. urethane/CL P. 26p.A/100p.B 5d. R.T. P. urethane/P P. urethane/CL P. 26p.A/100p.B 5d. R.T. P. urethane/P P. R.1538 P.D 26p.A/100p.B 72h.52° C P. urethane/P P. urethane/P AR 7d. R.T. P. urethane/P P. urethane/P P. 11558 1000.1155A P. urethane/CT R.B.4133B AO AR 7d. R.T. P. urethane/P P. urethane/P P. 1155A 125A 1000.1155A P. urethane/I Sodereze P.H AR AR P. urethane/I Sodereze P.H AR AR	P. urethane/P	Hysol 13-105/MOCA	λн	100p. 13-105/13p. MOCA	3h. 100°C +	1.09	0.08	GSFC
P. urethane/CF JPL 1001 AB AR 4h. 75° C P. urethane/CF JPL 1002 AB AR 4h. 75° C P. urethane/CL Nopco J-106 NP AR AR P. urethane/CL Nopco J-106 NP AR AR P. urethane/CL Nopco J-106 NP AR AR P. urethane/P FC-22 HY AR Bh. 66° C P. urethane/P FF-3 WC AR Bh. 66° C P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 15338 PD 26p.A/100p.B 54. R.T. P. urethane/P PR-1538 PD 26p.A/100p.B 54. R.T. P. urethane/P PR-1558 100p.1155A 120m.10° C P. urethane/P R. 48 AR 70. 1155B 250.40° C P. urethane/P PH AR 70. 1155B 100p.1155A P. urethane/I Sodereze PH AR 70. 100p.B					30d. R.T.			
P. urethane/CF JPL 1002 AB AR 4h. 75° C P. urethane/CL Nopco G-302 NP AR AR AR P. urethane/CL Nopco J-106 NP AR AR AR P. urethane/CL Nopco J-106 NP AR AR AR P. urethane/CL PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 15338 PD 26p.A/100p.B 54. R.T. P. urethane/P PR 15338 PR AR 20h. 70° C P. urethane/P R.15538 AO AR 74. R.T. P. urethane/P R.1558 100p.1155A 120m.10° C P. urethane/P R.4.4875 RC 70p.1155B 120m.16° C P. urethane/P PH AR 74. R.T. 74. R.T.	P. urethane/CF	JPL 1001	AB	AR	4h. 75°C	0.20	0.10	SRI
P. urethane/CL Nopco G-302 NP AR AR P. urethane/CL Nopco J-106 NP AR AR AR P. urethane/CL Royco J-106 NP AR AR AR P. urethane/CL PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 15338 PR AR 26p.A/100p.B P. urethane/P PR 15338 PR AR 20h. 70° C P. urethane/P R.L.538 PR AR 74. R.T. P. urethane/P PR-1538 AO AR 74. R.T. P. urethane/P R.G.A-4875 RC 100p. 1155A 126m. 70° C P. urethane/P R.D.48913B AO AR 74. R.T. P. urethane/P R.D.1155B 100p. 1155A 126mu. 8.T P. urethane/I Sodereze PH AR 70. 1155B P. urethane/I Sodereze PH AR 70. 1155B	P. ure thane/CF	JPL 1002	AB	AR	4h. 75° C	0.19	0.02	SRì
P. urethane/CL Nopco J-106 NP AR AR AR P. urethane/CL FC-22 HY AR Bh. 66° C AR P. urethane/CL FF-3 WC AR Bh. 66° C AR P. urethane/C Fr.3 WC AR Bh. 66° C AR P. urethane/P Fr.1538 PD 26p.A/100p.B 54. R.T. P. urethane/P PR.1538 PD 26p.A/100p.B 54. R.T. P. urethane/P PR.1538 PD 26p.A/100p.B 54. R.T. P. urethane/P PR.1538 AO AR 72h.52° C P. urethane/P PR.1553 AO AR 74. R.T. P. urethane/P R.G.A.4875 RC 100p.1155A 125h.49° C P. urethane/I Sodereze PH AR 70p. 2155B 250 coatt P. urethane/I P. urethane/I P. AR 70p. 1155B 72h.50° C 73h.60° C final P. urethane/I P. urethane/I P. AR 70p. 250 coatt 74. R.T. 75. AP 75. AP P. urethane/I P. UR P. AR <th>P. urethane/CL</th> <th>Nopco G-302</th> <th>ď</th> <th>AR</th> <th>AR</th> <th>0.30</th> <th>0.07</th> <th>GSFC</th>	P. urethane/CL	Nopco G-302	ď	AR	AR	0.30	0.07	GSFC
P. urethane/P FC-22 HY AR 8h. 66° C P. urethane/CL PF-3 WC AR AR AR P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR 1538 PR AR 72h. 52° C P. urethane/P PR-1538 PR AR 70h. 70° C P. urethane/P RCA-4875 RC 100p. 1155A 10min. R.T P. urethane/I Soderece PH AR 71. S5A 10min. R.T P. urethane/I Soderece PH AR 70p. 1155B 125h. 49° C P. urethane/I Soderece PH AR 70p. 20001000000000000000000000000000000000	P. urethane/CL	Nopco J-106	ŝ	AR	AR	1.12	0.01	GSFC
P. urethane/CL PF-3 WC AR AR P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR-1538 PR AR AR AR P. urethane/P PR-1538 PR AR 20h. 70° C 1 x 10^6 P. urethane/P P. urethane/P RC-338 PR AR 74. R.T. P. urethane/CT RC-4875 RC 100p. 1155A 10min. R.T + P. urethane/CT RC-4875 RC 100p. 1155A 10min. R.T + P. urethane/CT RC-4875 RC 100p. 1155A 10min. R.T + P. urethane/CT RC-4875 RC 100p. 1155B 125h. 49° C - P. urethane/I Sodereze PH AR - <	P. urethane/P	FC-22	λH	AR	8h. 66° C	0.72	0.01	GSFC
P. urethane/P PR 1527 A/B PD 26p.A/100p.B 54. R.T. P. urethane/P PR-1538 PR 72h. 52° C 72h. 52° C P. urethane/P PR-1538 PR AR 72h. 52° C P. urethane/P PR-1538 PR AR 74. R.T. P. urethane/P RB-8-133B AO AR 74. R.T. P. urethane/CT RD-1155A 10mui. R.T 74. R.T. P. urethane/CT RC-A-4875 RC 100p. 1155A 10mui. R.T P. urethane/CT Sodereze PH AR 70. 1155B 125h. 49° C P. urethane/I Sodereze PH AR 30p. cellosolve for each of 2 coatt	P. urethane/CL	PF-3	NC	AR	AR	0.95	0.05	GSFC
P. urethane/P P. urethane/P P. urethane/P P. urethane/P P. urethane/P P. urethane/P P. urethane/C I.x 10 ⁻⁶ P. urethane/C RB-B-133B AO AR 74. R.T. P. urethane/C RB-B-133B AO AR 74. R.T. P. urethane/C RB-B-133B AO AR 74. R.T. P. urethane/C RCA-A-4875 RC 100p. 1155A 10mui. R.T + 70p. 1155B .25h.49° C 30p. cellosolve for each of 2 coath P. urethane/I Sodereze PH AR AR	P. urethane/P	PR 1527 A/B	2	26p.A/100p.B	5d. R.T.	0.92	0.10	GSFC
P. urethane/P PR-1538 PR AR 11 × 10° P. urethane/P RB-8-133B AO AR 7d. R.T. P. urethane/P RB-8-133B AO AR 7d. R.T. P. urethane/CT RCA-4875 RC 100p. 1155A 10mui. R.T + P. urethane/CT RCA-4875 RC 100p. 1155A 10mui. R.T + P. urethane/CT RCA-4875 RC 100p. 1155A 10mui. R.T + P. urethane/CT RCA-4875 RC 100p. 1155B 125h. 49° C P. urethane/I Sodereze PH AR AR AR					72h. 52°C			
P. urethane/P PR-1538 PR AR 20h. 70° C P. urethane/P RB-8-133B AO AR 7d. R.T. P. urethane/CT RB-8-133B AO AR 7d. R.T. P. urethane/CT RCA-4875 RC 100p. 1155A 10nui. R.T + P. urethane/CT RCA-4875 RC 100p. 1155A 10nui. R.T + P. urethane/CT RCA-4875 RC 100p. 1155A 10nui. R.T + P. urethane/CT RCA-4875 RC 100p. 1155B .25h. 49° C P. urethane/I Sodereze PH AR AR					1 × 10 ⁻⁶			
P. urethane/P RB-8-133B AO AR 74. R.T. P. urethane/CT RCA-A4875 RC 100p. 1155A 10mun. R.T + P. urethane/CT RCA-A4875 RC 100p. 1155B .25h. 49° C P. urethane/I Solp. cellosolve for each of 2 coats acetate + 3h. 60° C final P. urethane/I Sodereze PH AR AR AR	P. urethane/P	PR-1538	PR	AR	20h. 70°C	0.97	0.02	GSFC
P. urethane/CT RCA-A-4875 RC 100p. 1155A 10mun. R. f 70p. 1155B .25h. 49° C .25h. 49° C .25h. 49° C 30p. cellosolve for each of 2 coats acetate + 3h. 60° C final P. urethane/I Sodereze PH AR	P. urethane/P	RB-8-133B	AO	AR	7d. R.T.	0.75	0.01	GSFC
P. urethane/I Sodereze PH AR AR AR AR	P. urethane/CT	RCA-A-4875	RC	100p. 1155A	10mm. R.T +	0.81	0.05	GSFC
P. urethane/I Sodereze PH AR AR AR				70p. 1155B	.25h. 49° C			
P. urethane/I Sodereze PH AR AR AR AR				30p. cellosolve	for each of 2 coat			
P. urethane/I Sodereze PH AR AR AR				acetate	+ 3h. 60° C final			
	P. urethane/I	Sodereze	Hd	AR	AR	0.09	0.03	GSFC
r. ure unane/r $[20, 100, 100, 100, 100, 100, 100, 100, 1$	P. urethane/P	Stycast CPC-41A/B	ß	100p. A/120p.B	48h. 65° C +	0.58	0.10	SRI
24h. 150°C					24h. 150°C			
P. unethane/W/PN TS-1603-16 HC AR w/solvent 7d R.T.	P. urethane/W/PN	TS-1603-16	HC	AR w/solvent	7d R.T.	0.61	0.02	GSFC
P. weethane/gl./M TF-1008 LN 60 r./40 gl. AR	P. urethane/gl./M	TF-1008	Ľ	60 r./40 gl.	AR	0.37	0.08	CSFC
P. urethane/P AR 7d. R.T.	P. urethane/P	240-2	AB	AR	7d. R.T.	0.44	0.07	GSFC

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Jetto	Mfg. Code	ප	Composition	Comments and Previous Cure History	Percent Weight Loss	Percent Condensables	Data Source
P. vinyl-chlor./gl./M	VF-1007	Ľ	65 r./35 gl.	AR	0.30	0.05	CSPC
P. p-xylylene/F	Parylene C	с С	2 mils thick	AR	0.07	0.02	JPL
Pp-xytylene/F	Parylene N	3	AR	AR	0.30	0.0	SRI
P. p-xylykae/F	rarykne c	3	Y	ž	2		
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Material	Mfg. Code	ပိ	Composition	C⇔mmenta and Previo∴s Cure History	Percent Weight Loss	Percent Condensables	Data Source
P.ester/Tx	Style 15320	SS	AR, rabric	AR	0.13	0.02	GSFC
Epoxy/A	Hysol 11-C	λн	equal lengths A&B	AR	0.64	0.01	GSFC
Epoxy/P	Dynaloy 325A/B	λα	1p.A/1p.B	24h. R.T.	0.69	0.03	GSFC
Epoxy/P	C7/activator W	ŭ	S0p.C7/50p.W	18h. R.T.	0.36	0.02	GSFC
Epuxy/P	Epibond 1210/9615A	5	100p. 1210/65p. 9615A	3h. 65°C	0.66	0.02	GSFC
Epoxy/alumina, FN	Bond 517	AR	insulating paint	AR	0.88	0.04	GSPC
Epoxy/gl/CB	G11-FR-4	IW	AR	AR	0.32	0.02	GSFC
Epoxy/gL/CB	FLG-65M,28-11	MM	fire retardant type-AR	AR	0.20	0.01	GSFC
			low therm. expansion,				
Epoxy/graph./L	HMS/4617	8	high modulus,	AR	0.63	0.03	GSFC
			no coating				
Epoxy/graph./L	HMS/4617	8	As above with	AR	0.55	0.02	GSFC
		_	aluminized coating microwave absorber				
Epoxy/iron/P	Eccosorb MF-110	Sa		AR	0.51	0.01	GSFC
Epoxy/sitver/A	Eccobond 2015A/B	Ą	10p.A/1p.B	2h. 66°C	0.44	0.02	GSFC
Fluorocarbon/F	XR	B	AR	AR	0.04	0.03	GSFC
Fluorocarbon/acrylic/t	Y-9224	WW	teflon	ÅR	0.19	0.03	GSFC
Fluorocarbon/silicone/t	61	MM	teflon/silicone	3h.260°C	0.15	0.08	GSFC
Fluorocarbon/gl./CB	CPT G/1-62	S	AR without copper	AR	0.03	0.02	GSFC
P.imide/CL	Skybond RI-7271-06	WC	rigid feam 61b/ft3	AR	0.32	0.05	GSFC
P.imide/CL	Skybond-RI-7271-12	WC	rigid foam 12lbs/ft3	AR	0.42	0.02	GSFC
P.imide/graph./M	Vespe! SP-22-D-1	DQ	60p. imide/40p. graph.	AR	0.58	0.01	GSFC
Silicone/W/PN	S13G-C120	L	GSFC P764 devol.	R.T.	0.36	0.11	GSFC
			or out and II IKI pigment system				

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	LETTER	CODE	
Α	adhesive	\mathbf{SL}	sleeving
AR	as received	ST	shrink tubing
В	black	\mathbf{SF}	solid film
BF	black flat	Т	tube
BDMA	benzyl dimethyl amine	t	tape
BF3	borontrifluoride	TG	thermal grease
buta	butadiene	TX	textile
с	conductive	w	white
Carb.	carbolac	x	cross linked
Cab.	Cabosil		
СВ	circuit board		
cer	ceramic powder		
CF	conformal coat		
CL	cellul ar		
СТ	coating		
D	dielectric		
Dac	dacron		
DAP	Diallyl phthalate polymer		
DP	damping		
fil	filament		
F	film type		
gl	glass fiber		
graph.	graphite		
G	grease		
HL	hook, loop		
I	insulation		
\mathbf{L}	laminate		
Lc	lacing		
1	liquid		
$\mathbf{L}\mathbf{L}$	liquid lubricant		
Μ	molding compound		
	or structural hardware		
min	mineral filled		
MEK	methyl ethyl ketone		
MoS ₂	molybdenum, disulphide		
NMA	nadic methyl anhydride		
OG	optical grease		
р.	parts by weight		
pre	prepreg		
PN	paint		
Р	potting		
r	resin		
8	sheet		

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SOURCES

AB	Ablestik Adhesive Co.
AC	Allied Chemical Corp.
AD	Adhesive Engineering Co.
AF	Amflex Products Co.
AL	Alpha Electronic Wire Co.
АМ	Amoco
AN	Atlantic Laminate Co.
AO	Allaco
AP	Armstrong Products Co.
AR	Aremco
AT	Abletech Co.
AY	American Cyanamid Corp.
BA	BASF Colors & Chemicals Inc.
BC	Baker Chemical Co.
BD	Biddle Co.
BE	Belden Co.
BF	B. F. Goodrich Chemical Co.
BH	Bently Harris Co.
BI	Boston Insulated Wire Co.
BN	Bacon Industries
BO	Borden Chemical Co.
BR	Brand Rex Div. American Enka Co.
BW	Boston Wire & Cable Co.
BX	Bendix Corp.
Сн	Chomerics Inc.
CI	Ciba Corp.
CL	Connecticut Hard Rubber Co.
CO	Convair
СР	Coast Pro Seal Co.
CU	Custom Materials Inc.
DC	Dow Corning Corp.
DU	E. 1. Dupont de Nemours Inc.
DX	Dexter Corp Midland Div.
DY	Dynaloy Inc.
EC	Emerson & Cuming Inc.
EF	Electrofilm Inc.
EL	Electrophy Co.
ЕМ	EMR Co.
EN	Enjay Chemical Co.
EP	Elco Pacific Co.
ЕТ	Epoxy Technology Inc.

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FB	Fiberite Co.
FC	Fluorocarbon Co.
FF	Fiberfill Corp.
FH	Fairchild Hiller
FI	Franklin Institute
FL	Fortin Laminating Co.
FM	Food Machinery Corp.
FP	Finch Paint & Chemical Co.
FU	Furare Plastics Inc.
FW	Fenwall Co.
GA	Grumman Aircraft Co.
GB	Gudebrod Brothers Silk Co.
GC	Guylon Gasket Co.
GE	General Electric Co.
GK	Garlock Inc.
GR	Green Rubber Co.
GS	Goddard Space Flight Center
GY	Goodyear Corp.
HA	Hughes Aircraft Corp.
нс	Hughson Chemical Co.
нт	Hi-Temp. Wire Co.
HW	Hope Webbing Co.
HX	Hexcel Aerospace
НҮ	Hysol Corp.
IE	Imperial Eastman Ltd.
IM	Irving B. Moore Co.
IT	IITRI
LH	Lockheed Corp.
LN	Liquid Nitrogen Process Corp.
LO	Lord Mfg. Co.
MC	Monsanto Chemical Co.
MD	Microdot Corp.
MG	Marglas
М	Mica Corp.
MM	Minn. Mining & Mfg. Co.
MO	Moxness Co.
MP	Micaply Co.
MR	Marblette Corp.
MS	Mosites Co.
MT	Mass. Inst. Tech.
MY	Mystic Tape Co.
NM	National Metallizing Co.
NP	Nonco Chemical Co

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NR	Whittaker Corp. Narmco Div.
NS	National Starch and Chemical Corp.
OC	Olin Corp.
PA	Pacific Resin & Chemical Co.
PC	Polymer Corp.
PD	Products Research Inc.
PF	Pennsylvania Fluorocarbon Co.
PH	Phelps Dodge Corp.
PL	Pelmor Labs.
РМ	Permacell Corp.
PN	Plaskon Corp.
PP	Polypenco Corp.
PR	Products Research & Chemical Jorn
PS	Parker Seal Co.
RA	Ravelad Tubes Inc.
RB	Rubber Corp. of America
RC	Ram Chemicals Co.
RD	Resdell Co.
RG	Rogers Corp.
RH	Rhom & Haas Co.
RM	Rome Cable Corn.
RO	Radio Corp. of America
RP	Riegle Paper
RR	Ranthor Reiss Corn.
RY	Raychem Corp.
SB	Santa Barbara Research Center
ŝC	Schenectady Chemical Co.
SD	Schieldahl Co.
5G	Space General Corp.
SH	Shell Chemical Co.
SP	Stone Paper Tube Co.
SR	Schultz Rubber Products
SS	Stem & Stern Textiles
ST	Sargent Industries, Stillman Rubber
SU	Super-Temp. Div. of Haveg Industries
SW	Sherwin Williams Paint Co.
ТВ	T & B Ty-Rap Co.
TH	Thiokol Chemical Co.
UC	Union Carbide Corp.
UN	Uniroval Chemical Co.
UP	Upjohn Co.
VA	Varian Associates
VE	Velcro Co.
WC	Westinghouse Electric Corn.
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