

## Tech Table: Aerospace structural adhesives

By Jeff Sloan / Editor-in-Chief

► The bonding of aerostructures is becoming increasingly important as airframers seek solutions for next-generation aircraft that enable increased lightweighting. The ability to assemble and unitize structures and minimize use of mechanical fasteners is critical to efficient, high-rate commercial aircraft manufacturing. That said, bond application control and bond quality assurance are still maturing, and thus have not yet supplanted mechanical fasteners in aircraft assembly.

Still, manufacturers have brought to market a wide array of adhesives designed to mate structures of all types of materials, including metal and composite laminates and honeycomb cores. This is the first of a series of Tech Tables that CW will publish in 2020, each designed to provide as comprehensive a list as possible of suppliers, their products and selected product specifications.

This table of aerospace structural adhesives, which includes film and paste adhesives, was built with data provided by suppliers. It should be noted that not all of the same data were provided for each adhesive by each supplier. Further, each supplier conducts different tests to characterize the adhesive; one test, however, was conducted more than others, and that is the single lap shear test, also known as ASTM D 1002. Based on data CW received, most of the single lap shear strength data were derived from tests with metallic adherends, or the adherend was not specified at all. A minority of single lap shear strength data were derived from tests with composite adherends.

Look for two more Tech Tables in 2020: Mold release agents (July) and compression molding machines (December). **cw**

TECH TABLE: ADHESIVES

Supplier	Product	Format	Type	Areal weight(s), gsm (film only)	Cure temperature, °C	Cure time	Glass transition temperature (T <sub>g</sub> ), °C	Service temperature, dry, °C	Single lap shear strength, RT, Mpa*
3M	AF 126	film	epoxy	147 - 391	120	1-1.5 hours	80	120	33
	AF 126-2	film	epoxy	147 - 391	120	1-1.5 hours	80	120	39
	AF 163-2	film	epoxy	73 - 415	120	1-1.5 hours	108-125	120	40
	AF 3109-2	film	epoxy	73 - 415	120	1-1.5 hours	125-135	120	40
	AF 555	film	epoxy	73 - 244	175	1-1.5 hours	160	175	39
	AF 191	film	epoxy	73 - 391	175	1-1.5 hours	175	175	35
	AF 131-2	film	epoxy	366	175	1-1.5 hours	175	175	16
Barrday	FA EP255SP	Film	Epoxy	293	113, 135	1-2 hours			
	FA EP259	Film	Epoxy		113, 135	1-1.5 hours			
Click Bond	CB200	Paste	Acrylic		RT	24 hours		-55 to 121	30.3
	CB359	Paste	Epoxy		RT-82	1 hour-7 days		-55 to 93	31.0
	CB394	Paste	Epoxy		RT-65	1 hour-5 days		-55 to 177	30.0
	CB420	Paste	Acrylic		RT	24 hours		-54 to 121	21.0
Henkel	Loctite EA 7000 AERO	Film	Epoxy	146-391	121, 177	1-2 hours	145	150	28.0*
	Loctite EA 9309.3NA AERO	Paste	Epoxy		RT, 82	1 hour-5 days	61, 81		32.8, 34.5
	Loctite EA 9377 AERO	Paste	Epoxy		RT, 82	1 hour-7 days	67		36.9
	Loctite EA 9380.05 AERO	Paste	Epoxy		82-104	2 hours	106	121	35.0
	Loctite EA 9394 AERO	Paste	Epoxy		25, 66, 93	1 hour-5 days	78	177	28.9
	Loctite EA 9394.2 AERO	Paste	Epoxy		25	24 hours	70	121	33.9
	Loctite EA 9396.6MD AERO	Paste	Epoxy		25, 82, 93	1 hour-7 days	64-112	149	18.6

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Henkel	Loctite EA 9658 AERO	Film	Epoxy	290-490	177	1 hour	200	177	35.9, 36.5
	Loctite EA 9686 AERO	Film	Epoxy	146-415	121, 177	1-1.5 hours	121-124	-55 to 149	40.7, 43.0
	Loctite EA 9695 AERO	Film	Epoxy	171-244	121, 177	1-1.5 hours	122, 150	149	31.7, 34.5
	Loctite EA 9696 AERO	Film	Epoxy		107, 129	1-1.5 hours	123	121	34.8-42.0
	Loctite EA 9814 AERO	Paste	Epoxy		127, 177	1-1.5 hours		177	
	Loctite EA 9820 AERO	Paste	Epoxy		121, 177	1-1.5 hours		177	
	Loctite EA 9824 AERO	Paste	Epoxy		127, 177				
	Loctite EF 562 AERO	Sheet	Epoxy		121, 177	1 hour	149	-55 to 177	
Hexcel	HexBond 200 Series	Sheet	Epoxy		121, 177	1 hour		-55 to 220	
	HexBond 308	Film	Epoxy	293	171	1 hour		121	46.9
	HexBond 319	Film	Epoxy	176-391	177	1-4 hours		-55 to 149	31-45
	HexBond 322	Film	Epoxy	244-381	177	1 hour		199	21, 22
	HexBond 340U(SP)	Film	Epoxy	50-150	175	1 hour		180	31, 32
	HexBond ST1150	Film	Epoxy	750-1500	120-180	1 hour			
	HexBond ST1480	Film	Epoxy	75-292	180	1.5-4 hours	180-193	-55 to 150	32.6, 33.8*
L&L Products	L-0010	Sheet			RT, 50		133		27.8-30.7
	L-9000	Sheet			121-177				
	L-9001	Sheet/ Beads			140	1 hour			
	L-9003	Sheet/ Beads			140	1 hour			
	L-9100 Series	Paste	Epoxy		15-30				
	L-9107	Paste	Epoxy		23, 65	15 min-5 days		-55 to 135	
	L-9115	Paste	Epoxy		15-30				
	L-9150	Paste	Epoxy		15-30				
Lord	LORD 403/406/410	Paste	Acrylic		RT, 66	24 hours		-40 to 149	13.3-20.7
Magnolia	Magnobond 6162 A/B	Paste	Epoxy		RT, 52, 82	1 hour-7 days			34.5
	Magnobond 6166 A/B	Paste	Epoxy		RT, 52, 82	1 hour-7 days	100		27.6
	Magnobond 6168 A/B	Paste	Epoxy		RT, 82, 121	1 hour-7 days			27.6
	Magnobond 6380 A/B	Paste	Epoxy		RT, 77, 104	1 hour-3 days			31
	Magnobond 6388-3 A/B	Paste	Epoxy		RT, 127	1 hour-7 days		-55 to 149	22
	Magnobond 6389 A/B	Paste	Epoxy		RT, 60	4 hours-5 days		-55 to 149	20.7
	Magnobond 6392-2 A/B	Paste	Epoxy		RT, 66, 121	1 hour-7 days			31
	Magnobond 6398 A/B	Paste	Epoxy		RT, 66, 122	1 hour-7 days			32.4
	Magnobond 6448 A/B	Paste	Epoxy		RT	8 hours			27.8
	Magnobond 7500 A/B	Paste	Epoxy		RT plus 93	20 hours			27.6

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Renegade	RM 1005	Film	Polyimide	293-488	177	2 hours	327		17.2*
	RM 1010	Film	Polyimide	293-488	357	2 hours	371		19.3*
	RM 1014	Film	Polyimide	293-488	293	2 hours	316		20.0*
	RM 3006	Paste	Bismaleimide		227	12 hours		-54 to 204	13.8
	RM 3007	Paste	Bismaleimide		227	12 hours		-54 to 204	
	RM 3011	Film	Bismaleimide	293	232	13 hours	310	204	
Solvay	FM 209-1	Film	Epoxy	150-490	121, 177	1.5 hours	132	121	31.4, 34.7
	FM 300	Film	Epoxy	146-391	177	30 min	109	-55 to 149	29.8-40.3
	FM 300-2	Film	Epoxy	146-489	121, 149	1.5 hours		-55 to 149	14.8-30.0*
	FM 309-1	Film	Epoxy	146-391	177	1.5-2 hours	182	177	30.5-41.2
	FM 450-1	Film	Bismaleimide	147-488	191	4 hours		232	23.0
	FM 57	Film	Polyimide	293, 488	177	1.5 hours		-55 to 288	24.3*
	FM 73	Film	Epoxy	100-420	121	1 hour	76	-55 to 82	39.8-47.2
	METLBOND 1515-4M	Film	Epoxy	158-390	121, 177	2 hours	170	148	14.8-32.8
Toray	EF8020	Film	Epoxy	100, 300	70-120	.5-8 hours	116	121	27.0, 38.0
	EX-1516	Film	Cyanate ester		121		126		29.7
	EX-1543	Film	Cyanate ester	146	177-218		191, 236		16.8, 17.9
	MicroPly EF72	Film	Epoxy	100-300	120	1 hour	112		25, 32
	RS-15H	Film	Epoxy		80-93	6.5 hours	99		21.0
	RS-4A	Film	Cyanate ester		177		195, 238		28.3
	TC263	Film	Epoxy	70-293	121	2 hours	110-115	93	19.6-33.8
	TC310	Film	Epoxy	171, 293	121, 177	2-3 hours	157		31.1-37.1
	TC4015	Film	Cyanate ester	171-288	177, 232	2 hours	321	538	15.2, 17.9*

\*Composite material specified by supplier as adherend in single lap shear test