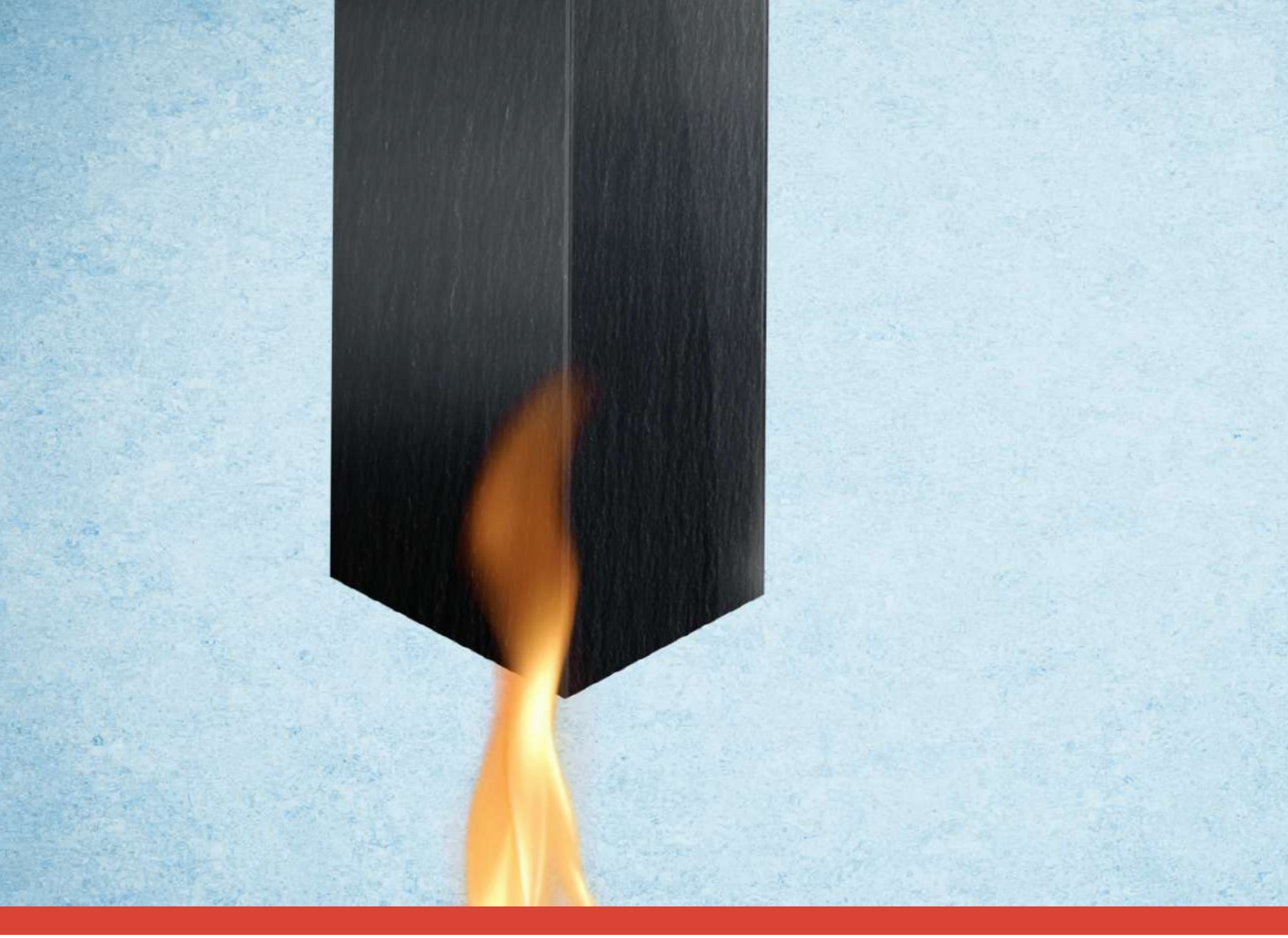

The Importance of Flame Retardant Epoxies

Flame, Smoke & Toxicity Reference Standards

MASTERBOND®
ADHESIVES | SEALANTS | COATINGS

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Table of Contents

The Importance of Flame Retardant Epoxies

Flame retardant epoxies play a critical role in applications and products where safety and reliability are paramount. From consumer electronics, appliances, electrical components, automobiles, and airplanes, flame retardant epoxies are critical for assuring the longevity and safety of the device or component in question.

Master Bond offers a wide range of epoxy adhesives, sealants, and encapsulants that meet a variety of industry-specific standards for flame retardancy. As epoxies themselves are a polymeric material, their testing is generally covered under the Underwriter's Laboratory **UL 94V0**, **UL 94HB**, and **UL 746A** standards for plastics and polymeric materials. In addition to these more general standards for evaluating the flame retardancy and material properties of plastics, select Master Bond products have been tested for compliance with several Aerospace standards including: **FAR**, **Boeing**, and **Airbus** standards. In addition to these standards and in service to the health and safety of consumers, Master Bond products are compliant with various regulations such as **RoHS** and are free from substances of very high concern (SVHCs) per **REACH**.

Relevant Standards

- UL 94V0, UL94HB, UL 746A
- FAR 25.853(a) Amdt. 25-116 and Part 25 Appendix F
- Boeing BSS 7238 Rev C, Boeing BSS 7239 Rev A
- Airbus AITM 2.0002B, Issue 2 for spec ABD0031, Issue F, Sec. 7.1.2
- Airbus AITM 2.0007B, Issue 3 for spec ABD0031, Issue F, Sec. 7.3.2
- RoHS Compliance
- REACH Compliance

Relevant Industries

• Aerospace & Aviation • Automotive • Consumer Electronics • Electrical Components

Flame Retardant Epoxy Applications

• Bonding • Sealing • Coating • Encapsulation

PARAMETERS ASSESSED DURING FLAME RETARDANCY TESTING

As with any material or safety testing, the nature of the test conditions and the requirements are specific to the application at hand. Some commonly assessed parameters include:

SMOKE - The primary cause of death in fires. Standardized test chambers—such as the National Bureau of Standards (NBS) Smoke Density Chamber—are used to determine the extent of smoke generation when the test material is exposed to a standardized radiant heat source or open flame. The specific optical density of the smoke is measured and provides a means to quantify the extent of smoke generation.

TOXICITY - Thermal degradation products emitted from a material when burning can be highly toxic. Analytical techniques such as draeger tubes or more advanced spectroscopy or mass spectrometry methods can be used to detect and quantify the amount of certain toxic substances released during burning.

BURN RATE - Under standard conditions, the rate at which the test material burns when exposed to an open flame. The burn rate is an effective quantitative measure of the material's resistance to fire.

TIME FOR SELF-EXTINGUISHING - After the heat source is removed, will the material continue to burn or will it self-extinguish? This is a critical measure of a material's fire resistance, as a self-extinguishing material will limit the risk of a fire spreading.

FLAME DRIPPING - After the heat source is removed, will the material continue to burn or will it self-extinguish? This is a critical measure of a material's fire resistance, as a self-extinguishing material will limit the risk of a fire spreading.

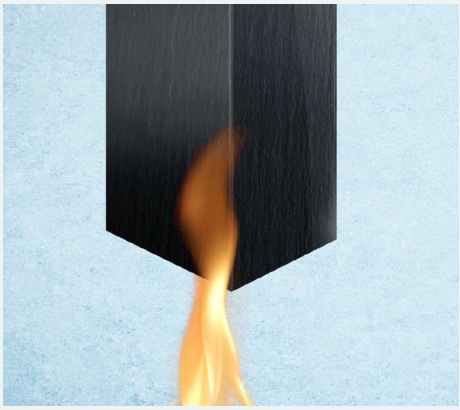
TEST CONDITIONS FOR ASSESSING FLAME RETARDANCY

Orientation of the Test Specimen

Horizontal, Vertical, or Angled. The thickness of the sample will generally be specified.

Heat Source and Angle

Typically, an open flame or a standardized radiant heat source. For a flame, the angle at which the flame contacts the test material may also be specified. For electronic applications, an electrical arc may be used as the ignition source such as for High Amp Arc Ignition (HAI) in UL 746A series testing.



PRODUCTS MEETING SELECT FLAME RETARDANCY STANDARDS

Explore Our Top Flame Retardant Epoxy Adhesives

At Master Bond, we understand the crucial role of flame retardant epoxies in assuring project success, safety, and reliability. Our products meet a variety of Flame Retardancy standards including Underwriters Laboratory (UL) standards for general consumer goods and electronics. We are also proud to offer specialized standards for the aviation and avionics industry including FAR, Airbus, and Boeing standards.

PRODUCT	UL STANDARDS			FAR STANDARDS		AIRBUS STANDARDS			BOEING STANDARDS	
	UL 94-0	UL 94-HB	UL 746A HAI	VERTICAL BURN	HORIZONTAL BURN	VERTICAL BURN	SMOKE	TOXICITY	SMOKE	SMOKE TOXICITY
EP21FRNS-2	x									
EP21AC		x	x							
EP90FR-H					x					
EP90FR-HFL					x					
EP93AOFR				x						
EP90FR-V				x					x	x
EP93FRHT						x	x	x		
EP36FR						x		x		

Packaging Options for Products Listed*

Cans

Pails

Premixed & Frozen Syringes

*Please note that **epoxy system EP36FR** offers different packaging options as stated on the specific product page

Specification Details for FAR, Airbus, and Boeing

FAR Standards: 14 CFR 25.853(a) Amdt. 25-116 and Part 25 Appendix F

Vertical Burn: Part I (a)(1)(i) Amdt. 25-111 Vertical

Horizontal Burn: Part I (a)(1)(iv) Amdt. 25-111 Horizontal

Airbus Standards: Airbus Document ABD0031, Issue F

12 s Vertical Burn: AITM 2.0002B, Issue 2 per Section 7.1.2

Smoke Generation: AITM 2.0007B, Issue 3 per Section 7.3.2, Table 1

Smoke Toxicity: AITM 3.0005, Issue 2 per Section 7.4

Boeing Standards: Boeing Document D6-51377, Rev. F

Smoke Generation: BSS 7238, Rev. C per Table 2

Smoke Toxicity: BSS 7239, Rev. A per Table 1

PRODUCTS MEETING UNDERWRITERS LABORATORIES STANDARDS

UL 94

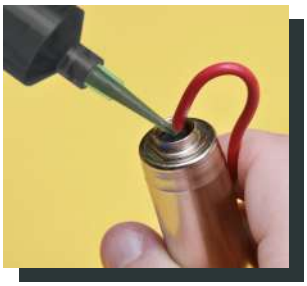
Flame retardancy standard for plastics and polymeric materials used in consumer goods and electronics. A flame is applied to the test material for a period of time in order to promote ignition. Parameters such as burning time, burn rate, afterglow following ignition, flaming drips, and combustion up to the holding clamp are measured depending on the specifics of the test and the sample thickness. The test may be done in horizontal or in vertical orientation—the vertical orientation test and rating, UL 94V-0, is more stringent whereas the horizontal test, UL 94HB, is the lowest fire rating in the UL 94 standard. UL 94V-0 is the highest level of flame retardancy, decreasing in flame retardancy as the numerical value increases to UL 94V-1 and UL 94V-2.

UL 746A HAI

Test specific to applications where the material may be exposed to electrical arcing. Electrical arcs can degrade a polymeric material and result in a fire. The High Amp Arc Ignition (HAI) specification evaluates the test material for resistance to ignition after exposure to 150 high current arc discharges. A Performance Level Category (PLC) is assigned where a PLC of 0 is the best rating and a PLC rating of 4 is the lowest rating expressing resistance to ignition when exposed to repeated high amp arc discharges.

EP21FRNS-2

Two part epoxy rated for UL94V-0



Key Features

- Good flow properties ideal for electronic potting and encapsulation
- Convenient processing, 1:1 mix ratio by weight
- Meets UL 94V-0 flame retardant specifications
- Cures at room temperature in 48-72 hours or 2-3 hours at 200°F

UL 94V-0

REQUEST A TDS for EP21FRNS-2

Flammability	Value	Test Method
Flame Rating (3.22 mm, BK)	V-0	UL 94 IEC 60695-11-10, -20

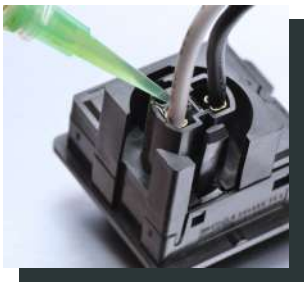
Thermal	Value	Test Method
RTI Elec (3.0 mm)	90°C	UL 746
RTI Imp (3.0 mm)	90°C	UL 746
RTI Str (3.0 mm)	90°C	UL 746

Performance Properties of EP21FRNS-2

Hardness, 75°F	>75 Shore D
Tensile Lap Shear Strength, Al-Al, 75°F	>1,200 psi
Coefficient of Thermal Expansion	50-55 x 10^{-6} in/in°C
Dielectric Constant, 75°F, 60 Hz	4.5
Service temperature range	-51°C to +90°C [-59.8°F to +194°F]

EP21AC

Two part epoxy, filled with a non-halogenated flame retardant



Key Features

- Convenient processing, 1:1 mix ratio by weight
- Low shrinkage upon cure and excellent dimensional stability
- Cures in 2-3 hours at 150-175°F
- For bonding, sealing, coating and potting applications

UL 94HB

UL 746A HAI

Flammability	Value	Test Method
Flame Rating		
1.5 mm, YL	HB	UL 94
3.0 mm, YL	HB	UL 94
3.0 mm, YL	HB 40	IEC 60695-11-10, -20
1.5 mm, YL	HB 75	IEC 60695-11-10, -20

Performance Properties of EP21AC

Hardness, 75°F
75-85 Shore D

Tensile Lap Shear Strength, Al-Al, 75°F
2,600-2,800 psi

Coefficient of Thermal Expansion
35-40 x 10^{-6} in/in°C

Dielectric Constant, 75°F, 60 Hz
4.7

Service temperature range
-60°C to +90°C [-75°F to +194°F]

REQUEST A TDS for EP21AC

Electrical	Value	Test Method
High Amp Arc Ignition (HAI) (3.0 mm)	PLC 0	UL 746A

Thermal	Value	Test Method
RTI Elec		UL 746B
1.5 mm	90°C	
3.0 mm	90°C	
RTI Imp		UL 746B
1.5 mm	90°C	
3.0 mm	90°C	
RTI Str		UL 746B
1.5 mm	90°C	
3.0 mm	90°C	

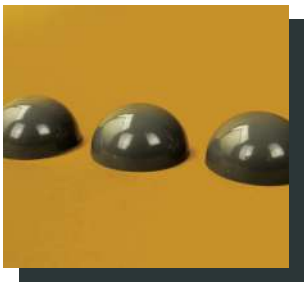
PRODUCTS MEETING FAR STANDARDS

FAR Standard 14 CFR 25.853(a)
Horizontal Burn for Flame Retardant Epoxy

This test is specified in Amendment 25-116 and Part 25 Appendix F. The sample is assessed for **Burn Rate**, **Burn Length**, and **Elapsed Time** of burn. These assessed parameters must conform to the specifications laid out under Part I (a)(1)(iv) Amdt. 25-111 for **Horizontal**.

EP90FR-H

Two part epoxy rated for FAR25.853(a), Horizontal Burn



FAR 25.853(a)

Key Features

- Exceptionally low shrinkage and high dimensional stability
- Superb electrical insulator
- Passes horizontal burn test per FAR Standard 14 CFR 25.853(a) Amdt. 25-116 and Part 25 Appendix F, Part I (a)(1)(iv) Amdt. 25-111 Horizontal
- Cure schedule: overnight at room temperature followed by 2-3 hours at 150-200°F

FAR Standard 14 CFR 25.853(a): Horizontal Burn			
Flame Size:	1 1/2 inch	Ignition Exposure:	15s
Burner Fuel:	Methane	Flame Temp:	1633 °F min.
Master Bond EP90FR-H			
Specimen No.	Distance Traveled, inch	Elapsed Time, s	Burn Rate, in/min
1	0	0	0.0
2	0	0	0.0
3	0	0	0.0
Average:	—-	—-	0.0
Limit:	Not Specified	Not Specified	2.5 Max
Master Bond EP90FR-H: CONFORMS			

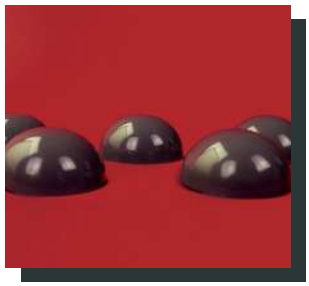
REQUEST A TDS for EP90FR-H

Performance Properties of EP90FR-H

Hardness, 75°F	>80 Shore D
Tensile Lap Shear Strength, Al-Al, 75°F	>1,500 psi
Coefficient of Thermal Expansion	35-40 x 10^{-6} in/in°C
Dielectric Constant, 75°F, 60 Hz	4.4
Service temperature range	-51°C to +121°C [-60°F to +250°F]

EP90FR-HFL

Two part epoxy rated for FAR25.853(a), Horizontal Burn



FAR 25.853(a)

Key Features

- Easy to use 1:1 mix ratio by weight and low shrinkage
- Toughened epoxy that withstands thermal cycling, mechanical shock and vibration
- Passes horizontal burn test per FAR Standard 14 CFR 25.853(a) Amdt. 25-116 and Part 25 Appendix F, Part I (a)(1)(iv) Amdt. 25-111 Horizontal
- Cure schedule: overnight at room temperature followed by 3-4 hours at 150-200°F

FAR Standard 14 CFR 25.853(a): Horizontal Burn			
Flame Size:	1 1/2 inch	Ignition Exposure:	15s
Burner Fuel:	Methane	Flame Temp:	1633 °F min.
Master Bond EP90FR-HFL			
Specimen No.	Distance Traveled, inch	Elapsed Time, s	Burn Rate, in/min
1	0	0	0.0
2	0	0	0.0
3	0	0	0.0
Average:	—-	—-	0.0
Limit:	Not Specified	Not Specified	2.5 Max
Master Bond EP90FR-HFL: CONFORMS			

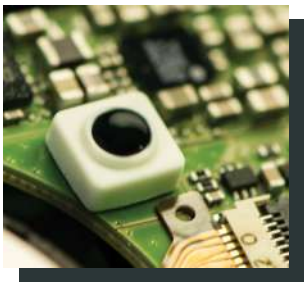
REQUEST A TDS for EP90FR-HFL

Performance Properties of EP90FR-HFL

Hardness, 75°F	25-45 Shore D
Hardness after 1,000 hrs @ 85°C/85%RH	35 Shore D
Tensile Lap Shear Strength, Al-Al, 75°F	1,200-1,400 psi
Coefficient of Thermal Expansion	70-75 x 10^{-6} in/in°C
Tensile Lap Shear Strength, Al-Al, 75°F	4.3

EP93AOFR

Two part epoxy rated for FAR25.853(a), Vertical Burn



FAR 25.853(a)

Key Features

- Easy to use 1:1 mix ratio by weight and low shrinkage
- Favorable thermal conductor and electrical insulator
- Passes verticle burn test per FAR Standard 14 CFR 25.853(a) Amdt. 25-116 and Part 25 Appendix F, Part I (a)(1)(i) Amdt. 25-111 Vertical
- Cure schedule: overnight at room temperature followed by 3-4 hours at 150-200°F

Specimen	Nominal Width	Nominal Length	Nominal Thickness	Time to Extinguish	Burned Length	Drip Time to Extinguish
	in.	in.	in.	seconds	in.	seconds
1	3.0	12.0	0.122	3.5	1.3	0 (ND)
2	3.0	12.0	0.123	5.3	1.2	0 (ND)
3	3.0	12.0	0.116	3.4	1.1	0 (ND)
4	3.0	12.0	0.118	*4th Specimen not required*		
			Average:	**4.1**	**1.2**	**0 (no drips)**
			Maximum Allowed:	**15**	**6**	**3**

REQUEST A TDS for EP93AOFR

Performance Properties of EP93AOFR

Hardness, 75°F	80-85 Shore D
Thermal Conductivity, °F	3.5-4.2 BTU•in/(ft²•hr•°F) [0.5-0.6 W/(m•K)]
Tensile Lap Shear Strength, Al-Al, 75°F	800-1,000 psi
Coefficient of Thermal Expansion	25-30 x 10^{-6} in/in°C
Dielectric Constant, 75°F, 60 Hz	4.7
Service Temperature Range	-62°C to +149°C [-80°F to +300°F]

PRODUCTS MEETING FAR & BOEING STANDARDS

FAR Standard 14 CFR 25.853(a)
Vertical Burn for Flame Retardant Epoxy

This test is specified in Amendment 25-116 and Part 25 Appendix F. The sample is assessed for **Burn Rate**, **Burn Length**, and **Elapsed Time** of burn. These assessed parameters must conform to the specifications laid out under Part I (a)(1)(i) Amdt. 25-111 for **Vertical**.

Boeing BSS Testing
Smoke Emission & Toxic Gas Generation

This series of testing includes Smoke Emission and Toxic Gas Generation during burning per BSS 7238, Rev. C and BSS 7239, Rev. A, respectively, for criteria specified by Boeing Document D6-51377, Rev. F, Paragraphs 5.1b(a) and 4.1b(3), Table 2 for smoke density and Table 1 for toxicity.

FAR 25.853(a)

BOEING BSS 7238

BOEING BSS 7239

EP90FR-V *Two part epoxy rated for FAR25.853(a), Vertical Burn, BSS7238 Smoke, & BSS7239 Toxicity*

FAR 25.853(a)

BOEING BSS 7238

BOEING BSS 7239

Key Features

- Easy to use 1:1 mix ratio by weight and low shrinkage
- Toughened epoxy that withstands thermal cycling, mechanical shock and vibration
- Passes verticle burn test per FAR Standard 14 CFR 25.853(a) Amdt. 25-116 and Part 25 Appendix F, Part I (a)(1)(i) Amdt. 25-111 Vertical
- Passes Boeing specifications BSS 7238, Rev. C for smoke density and BSS 7239, Rev. A for toxicity

BSS 7238, Rev. C: Smoke Generation		
Ignition Exposure:		4 min.
Thermal Source:		Flame
Pre-Test Conditioning: Min. 24 hr @ 70 °F / 50 %RH		
Master Bond EP90 FR-V		
	Specific Optical Density, D_s	
Time from Initiation, min	Average (n=4)	St. Dev.
0	0	0
0.5	0	0
1.0	8	2
1.5	38	10
2.0	63	12
2.5	88	16
3.0	121	25
3.5	147	22
4.0	178	30
D_{max}	**200**	**30**
Max Allowable:	200	—
Master Bond EP90 FR-V: CONFORMS		

Performance Properties of EP90FR-V

Hardness, 75°F	>75 Shore D
Tensile Lap Shear Strength, Al-Al, 75°F	>1,400 psi
Coefficient of Thermal Expansion	40-45 x 10^{-6} in/in°C
Dielectric Constant, 75°F, 60 Hz	4.57
Service temperature range	-51°C to +121°C [-60°F to +250°F]

REQUEST A TDS for EP90FR-V

FAR Standard 14 CFR 25.853(a): Vertical Burn			
Flame Size:	1 1/2 inch	Ignition Exposure:	60s
Burner Fuel:	Methane	Flame Temp:	1633 °F min.
Pre-Test Conditioning: Min. 24 hr @ 70 °F / 55 %RH			
Master Bond EP90FR-V			
Specimen No.	Distance Traveled, inch	Elapsed Time, s	Burn Rate, in/min
1	0	0	0.0
2	0	0	0.0
3	0	0	0.0
Average:	—-	—-	0.0
Limit:	15 Max.	3 Max.	6.0 Max
Master Bond EP90FR-V: CONFORMS			

BSS 7239, Rev. A: Toxic Gas Analysis						
Sampling Initiated 4 mins after start of BSS 7238, Rev. C						
Master Bond EP90 FR-V						
	CO	HCl	NO_x	HCN	SO_x	HF
Average (n=2):	200	0 (NI)	90	45	0 (NI)	0 (NI)
Max Allowed:	—	500	100	150	100	200
Master Bond EP90 FR-V: CONFORMS						

PRODUCTS MEETING AIRBUS STANDARDS

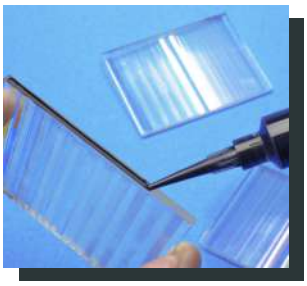
Vertical Burn, Smoke, & Toxicity

This series of testing includes a Vertical Burn Test—the sample is exposed to a 38 mm flame for 12 seconds—per AITM 2.0002B, Issue 2 for specification ABD0031, Issue F, Section 7.1.2. Time to extinguish (max 15 s), Burned Length (max 203 mm), and Drip Time to Extinguish (max 5 s) are measured and assessed.

Further testing assesses the extent of Smoke Generated—per AITM 2.0007B, Issue 3 for specification ABD0031, Issue F, Section 7.1.2—and Toxic Gas Analysis of the resulting smoke per AITM 3.0005, Issue 2 for specification ABD0031, Issue F, Section 7.4. Here, an epoxy casting is exposed to flame for 4 minutes, the specific optical density (Ds) of the smoke generated is measured, and the maximum specific optical density of the smoke (Dmax) during the test cannot exceed 200. After the 4 minutes, the toxicity of the resulting smoke is measured via Draeger tube for CO, HCl, $NO+NO_2$, HCN, SO_2, and HF emissions; the measured concentration in ppm must not exceed the allowable maximum for each toxic gas. The analysis is performed in replicate.

AIRBUS
ABD0031

EP93FRHT *Two part epoxy rated for Airbus ABD0031 Vertical Burn, Smoke, and Toxicity*



AIRBUS
ABD0031

Key Features

- Easy to use 1:1 mix ratio by weight and low shrinkage
- Moderate viscosity with a very long open time
- Top notch adhesion to a wide variety of substrates
- Passed demanding Airbus flame retardancy standards, ABD0031, Issue F
- Cures at room temperature overnight followed by 3-5 hours at 150-200°F

AITM 2.0002B, Issue 2: 12 Second Vertical Ignition			
Flame Size:	38 mm	Ignition Exposure:	12s
Burner Fuel:	Methane	Flame Temp:	1625 °F min.
Pre-Test Conditioning: Min. 24 hr @ 23 °C / 50 %RH			
Master Bond EP93FRHT			
	Time to Extinguish (s)	Burned Length, mm	Drip Time to Extinguish, s
Average (n=3)	<1	7.3	0 (no drips)
Max Allowed:	15	203	5
Master Bond EP93FRHT: CONFORMS			

AITM 3.0005, Issue 2: Toxic Gas Analysis						
Sampling Initiated 4 mins after start of AITM 2.0007B						
Master Bond EP93FRHT						
	CO (n=4)	HCl (n=2)	NO+NO_2 (n=4)	HCN (n=2)	SO_2 (n=4)	HF (n=2)
Average:	166	0 (NI)	49.3	15	5	0 (NI)
St. Dev.:	21	—	10.5	—	1	—
Max Allowed:	1000	150	100	150	100	100
Master Bond EP93FRHT: CONFORMS						

AITM 2.0007B, Issue 3: Smoke Generation		
Ignition Exposure:		4 min.
Thermal Source:		Flame
Heat Flux Density:		2.50 W/cm^2
Pre-Test Conditioning: Min. 24 hr @ 23 °C / 50 %RH		
Master Bond EP93FRHT		
	Specific Optical Density, D_s	
Time from Initiation, s	Average (n=4)	St. Dev.
0	0	0
30	0	0
60	<1	1
90	11	5
120	36	13
150	66	12
180	96	13
210	114	20
240	138	24
D_{max}	**138**	**24**
Max Allowable:	200	—-
Master Bond EP93FRHT: CONFORMS		

Performance Properties of EP93FRHT

Hardness, 75°F	80-90 Shore D
Tensile Lap Shear Strength, Al-Al, 75°F	1,200-1,400 psi
Coefficient of Thermal Expansion	40-45 x 10^{-6} in/in°C
Dielectric Constant, 75°F, 60 Hz	4.5
Service temperature range	-62°C to +204°C [-80°F to +400°F]

REQUEST A TDS for EP93FRHT

EP36FR *One part B-staged epoxy rated for Airbus ABD0031 Vertical, and Toxicity*

AIRBUS
ABD0031

Key Features

- One part system, filled with a non-halogenated flame retardant
- Unique B-staged epoxy packaged as a partially cured system
- Transforms into a liquid after exposure to 200°F for 30 minutes
- Withstands thermal and mechanical shocks
- Wide service temperature range; retains toughness and heat resistance up to 500°F
- Superior durability

VERTICAL BURN TEST RESULTS

Specimen	Nominal Width	Nominal Length	Nominal Thickness	Time to Extinguish	Burned Length	Drip Time to Extinguish
	mm	mm	mm	seconds	mm	seconds
1	76.8	304.8	2.91	<1	10.2	0 (no drips)
2	78.6	304.8	2.52	<1	9.9	0 (no drips)
3	77.1	304.8	2.75	<1	10.1	0 (no drips)
			Average:	**<1**	**10.1**	**0 (no drips)**
			Maximum Allowed:	**15**	**203**	**5**

TOXIC GAS EMISSIONS RESULTS

		Test Mode:		Flaming Exposure			
		Gas Sampling Initiation:		4 minutes after start of AITM 2.0007B			
SPECIMEN ID	DETERMINATION	CO	HCl	$NO+NO_2$	HCN	SO_2	HF
		ppm	ppm	ppm	ppm	ppm	ppm
1F	1	211	0 (NI)	30.4	20	8	0 (NI)
2F	2	179	0 (NI)	21.9	18	8	0 (NI)
3F	3	260		31.0		11	
4F	4	239		30.6		7	
	Average:	**222**	**0 (NI)**	**28.5**	**19**	**9**	**0 (NI)**
	Standard Deviation:	**35**	**n/a**	**4.4**	**n/a**	**2**	**n/a**
	Maximum Allowed:	**1000**	**150**	**100**	**150**	**100**	**100**

Performance Properties of EP36FR

Hardness, 75°F	80 Shore D
Tensile strength, 75°F	1,400-1,600 psi
Coefficient of Thermal Expansion	75-85 x 10^{-6} in/in°C
Dielectric Constant, 75°F, 60 Hz	4.7
Service temperature range	-100°F to +500°F [-73.3°C to 260°C]

REQUEST A TDS for EP36FR

Packaging Options for EP36FR

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Materials—including epoxies that serve as adhesives, coatings, and encapsulants—that meet stringent flame retardancy requirements are necessary to ensure the safety and reliability of the products and service we use every day. The team of chemists at Master Bond is constantly pursuing the development of new formulations to meet the increasing flame retardancy, health, and safety demands of the consumer goods, electronics, automotive, aerospace, and aviation industries.

Our technical staff has decades of expertise in solving application problems. Every incoming inquiry is assigned to an experienced technical representative who will work with you throughout the design, prototyping, and manufacturing process. We take special pride in the personal “one on one” support we provide.

DISCUSS YOUR APPLICATION

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