3M

Automotive Structural Adhesives

Two-Part Induction-Cure Epoxy Adhesive 5045

Data Sheet **January 2002**

Supersedes data sheet dated January 1995

General

3M™ Automotive Two-Part Induction-Cure Adhesive is formulated specifically for aluminum hem flange bonding applications. It features low activation temperatures to minimize panel distortion, broad off-ratio and over-bake tolerance, spot cure capability, and structural bond strength, even on as received, draw-lubricated aluminum.

Product Features	Performance Advantages	Customer Benefits
Epoxy chemistry	High bond strength (2200+ psi OLS) on untreated aluminum Excellent environmental durability (to heat, humidity, salt water, solvents) Compatibility with a wide variety of draw lubricants	Robust, structural bonding performance even on untreated aluminum
Two-part	Extended Shelf Life Controlled reactivity; balance of longer open time before induction with fast lock-up after induction Room temperature strength build; permits spot induction cure Can be dispensed with commercially available dispensing systems; broad off-ratio tolerance Wash-out resistance	Broad handling and dispensing windows
Glass beads (optional)	Squeeze-out control; consistent bond line thickness	
Induction Cure	Low temperature activation at or below 135°C (275°F), depending on cycle time; reduced potential for panel distortion	Broad curing windows; faster cycle times
Final heat cure	Broad over-bake tolerance	
99+% solids	Low VOC content; no appreciable odor	Reduced VOC emissions/exposure

Shelf Life

Part A - Six months from date of receipt by customer when stored at 10° - 43°C (50° - 110°F)

Physical Properties

	Part A	Part B	Mixed Adhesive
Color	Tan	Black	Black
% Solids	100%	100%	100%
Density (at room temp)	1198 kg/m^3 (10.0 lbs/gal)	958 kg/m^3 (8.0 lbs/gal)	—
Viscosity (at room temp)	31,500 cps	26,900 cps	

[1] ASTM D816
[2] Rheometrics Dynamic analyzer at 100 sec^{-1}

Handling/Process Properties

Storage	**Part A**	**Part B**
Container sizes (standard)		
-drums	113.6 liters (30 gal)	208.2 liters (55 gal)
-dual-pack cartridges	150 ml	300 ml
Adhesive volume		
-drums	98.4 liters (26 gal)	196.8 liters (52 gal)
-dual-pack cartridge	150 ml	300 ml

Dispensing	**Mixed Adhesive**
Mix Ratio (B:A)	
-by weight	1.72 B : 1.0 A
-by volume	2.0 B : 1.0 A
Off-ratio tolerance	
-by weight	1.38 - 2.06 B: 1.0 A (± 20%)
-by volume	3.2 - 4.8 B: 1.0 A (±20%)
Open Time	30 - 60 minutes The actual open time will depend on the lubricant and other factors.

Induction Cure	
Typical induction cycles	4-8 seconds at 79° - 121°C (175° - 250°F)
Typical induction cycles	4-15 minutes

Final Cure	
Cure conditions	Cures at paint bake oven conditions

[1] Maintaining 80% of performance properties at the target ratio.
[2] Adhesive bond line temperature.

Dispensing Equipment

Drums can be dispensed through bulk equipment specifically designed for use with 2-part epoxy adhesives. For more information on recommended equipment, contact your 3M Automotive sales representative or call 1-800-521-8180.

Dual-pack cartridges can be dispensed manually; follow instructions included.

Clean-up

Uncured adhesive can be removed by scraping with a putty knife or similar tool. For cured material, remove by cutting or sanding. Do not use heat or flame to remove adhesive.

Safety Procedures

Read all Health Hazard, Precautionary, and First Aid statements found in the Material Safety Data Sheet and/or product label prior to handling or use. MSDSs are available on request. The website address for 3M MSDSs is www.3M.com/msds. If necessary, the 3M 24-hour emergency response telephone number is 1-800-364-3577 or 651-737-6501.

Performance Properties

Over-Lap Shear (OLS)[1] on draw lubricated 6111 aluminum	**Value**
Room temperature plus oven cure[2]	1200 psi (9600 kPa)
Induction plus 30 minutes RT cure[3]	300 psi (2070 kPa)
Induction plus 1 hour RT cure	400 psi (2760 kPa)
Induction plus 24 hours RT cure	800 psi (5520 kPa)
Induction plus oven cure[4]	2400 psi (16,550 kPa)
2000 hours salt spray[5]	80%$^{+}$ retention

The draw lubricant tested was a different petroleum-based product which has been selected by one automotive OEM for its draw lubricating properties, not its compatibility with the adhesive. The test results that are shown above are from the worst-case scenario. Adhesive performance on other draw lubricants would likely be better than this test data.

Impact Resistance	**Value**
Induction plus oven cure	6.8^{+} N-m (60^{+} inch-lbs)

Note: These properties are representative of the product's performance even on a difficult draw lubricant and are supported by laboratory test data. However, the values reported are not intended to be used for specification purposes.

1 Measured on 25.4 mm (1 inch) wide coupons using 12.7 mm (0.5 inch) over-lap bonds. Thickness of the bond line was 0.25 mm (0.010 inch). Cross head speed was 12.7 mm/minute (0.5 inches/minute). Metal thickness was approximately 0.76 mm (30 mils). Coating weight was approximately 400 mg/sq. ft.

2 After 24 hours at room temperature followed by 20 minutes at 185°C (365°F)

3 After 2 induction-cure cycles of 4 seconds each at 107°C (225°F) followed by the time indicated at room temperature.

4 After 2 induction-cure cycles of 4 seconds each at 107°C (225°F) followed by 24 hours at room temperature and a multi stage heat cure of 30 minutes at 205°C (400°F), 1 hour at room temperature, 10 minutes at 163°C (325°F), 1 hour at room temperature, and 10 minutes at 130°C (266°F). Other single or multi stage cures will produce similar results, depending on the draw lubricant and induction cure conditions.

5 After induction plus oven cure as in subscript 4 followed by 2000 hours 5% NaCl salt spray at 35°C (95°F) (ASTM B117).

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Minimum 30% Post-Consumer Fiber

Printed in U.S.A.

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Automotive Structural Adhesives

Two-Part Epoxy Adhesive 7036

Data Sheet **January 2002**

General Description

3M™ Automotive Two-Part Epoxy Adhesive 7036 is formulated specifically for steel hem flange bonding applications involving *very high draw lubricant coating weights with good induction reactivity to achieve quick lockup.* It features low activation temperatures to minimize panel distortion, broad off-ratio and over-bake tolerance, spot cure capability and structural bond strength, even on as-received, draw lubricated steel.

Product Features	Performance Advantages	Customer Benefits
Epoxy Chemistry	High bond strength (2330 psi OLS) with cohesive failure mode on hot dipped galvanized (HDG) steel	Robust, structural bonding performance even on uncleaned steel
	Compatible with significant coating weights of draw lubricants of several varieties	*Very high draw lubricant coating weights* can be tolerated
	Excellent long-term durability (to heat, humidity, salt water, solvents)	
Two-Part	Extended shelf life	Broad handling and dispensing windows
	Controlled reactivity; balance of longer open time before induction with fast lock-up after induction	
	Room temperature strength build; permits spot induction cure	
	Can be dispensed with commercially available dispensing systems; broad off-ratio tolerance	
	Wash out resistance	
Induction Activation and Cure	Low temperature activation at or below 200°F (93°C), depending on cycle time; reduced potential for panel distortion	Broad curing windows; faster cycle times
Final Heat Cure	Broad over-bake tolerance	
99+% Solids	Reduced emissions/vapors/odor	Low regulatory concern

Shelf Life

Six months from date of receipt by customer when stored at room temperature.

Physical Properties

	Part A	Part B	Mixed Adhesive
Color	Amber	Black	Black
% Solids	100%	100%	100%
Density	1167 kg/m^3 (9.81 lbs/gal)	1037 kg/m^3 (8.72 lbs/gal)	—

Handling/Process Properties

Storage	**Part A**	**Part B**
Container sizes (standard)		
-drums	113.6 liters (30 gal)	208.2 liters (55 gal)
-dual-pack cartridges	80 ml	320 ml
Adhesive volume		
-drums	98.4 liters (26 gal)	196.8 liters (52 gal)
-dual-pack cartridge	80 ml	320 ml

Dispensing	**Mixed Adhesive**
Mix Ratio (B:A)	
-by weight	3.49 B : 1.0 A
-by volume	4.0 B : 1.0 A
Off-ratio tolerance	
-by weight	2.8 - 4.2 B : 1.0 A (± 20%)
-by volume	3.2 - 4.8 B : 1.0 A (±20%)
Open Time	120 minutes

Induction Cure	
Activation temperature	93°C (200°F)
Over-bake temperature	218°C (425°F)
Typical induction cycles	4-6 seconds at 121°C (250°F)

Final Cure	
Cure temperature	Cures at paint bake oven conditions

Dispensing Equipment

Drums can be dispensed through bulk equipment specifically designed for use with 2-part epoxy adhesives. For more information on recommended equipment, contact your 3M Automotive sales representative.

Dual-pack cartridges can be dispensed manually; follow instructions included.

Clean-up

Uncured adhesive can be removed by scraping with a putty knife or similar tool. For cured material, remove by cutting or sanding.

Safety Procedures

Observe proper handling precautions as outlined in the Material Safety Data Sheet (MSDS), which is available on request. The website address for 3M MSDSs is www.3M.com/msds. If necessary, the 3M 24-hour emergency response telephone number is 1-800-364-3577 or 651-737-6501.

Performance Properties

Over-Lap Shear (OLS)[1] on draw lubricated Electro EG60 steel	**Value**	**Failure Mode**
Room temperature plus oven cure[2]	2520 psi (17400 kPa)	Cohesive
Induction plus oven cure[3]	2550 psi (17600 kPa)	Cohesive
500 hours salt spray[4]	2320 psi (16000 kPa)	Cohesive
180°F (82°C) hot shear	1580 psi (10900 kPa)	Cohesive
30 APGE	1740 psi (12000 kPa)	Cohesive

Over-Lap Shear (OLS) on draw lubricated G60 HDG steel	**Value**	**Failure Mode**
Room temperature plus oven cure	2330 psi (16100 kPa)	Cohesive
Induction plus oven cure	2340 psi (16200 kPa)	Cohesive
500 hours salt spray	2175 psi (15000 kPa)	Cohesive
180°F (82°C) hot shear	1300 psi (9200 kPa)	Cohesive
300 APGE	1590 psi (11000 kPa)	Cohesive

T-peel	**Value**
On G60 HDG steel	31 piw (5.7 kg/cm width)
On EG60 electro steel	33 piw (6.1 kg/cm width)

Note: This data is not intended to be used for specification purposes.

[1] Measured on 25.4 mm (1 inch) wide coupons using 12.7 mm (0.5 inch) over-lap bonds. Thickness of the bond line was 0.25 mm (0.010 inch). Cross head speed was 12.7 mm/minute (0.5 inches/minute). Metal thickness was approximately 0.76 mm (30 mils). Coating weight was approximately 400 mg/sq. ft.

[2] After 24 hours at room temperature followed by 20 minutes at 171°C (340°F)

[3] After induction-cure cycle of 5 seconds each at 121°C (250°F) followed by 24 hours at room temperature and 20 minutes at 171°C (340°F)

[4] After room temperature plus oven cure as in subscript 2 followed by 500 hours 5% NaCl salt spray at 35°C (95°F)

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Minimum 30% Post-Consumer Fiber

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5026 Two part Epoxy Adhesive Structural Adhesives

Technical Data Sheet

Product Description

3M™ Automotive Two-Part Epoxy Adhesive 5026 is formulated specifically for steel hem flange bonding applications involving *very high draw lubrican coating weights with good induction reactivity to achieve quick lockup*. It features low activation temperatures to minimize panel distortion, broad off-ratio and over-bake tolerance, spot cure capability, structural bond strength, even on as-received, draw lubricated steel.

Product Features	Performance Advantages	Customer Benefits
Epoxy Chemistry	High bond strength (15 MPa psi OLS) with cohesive failure mode on hot dipped galvanized (HDG) steel Compatible with significant coating weights of draw lubricants of several varieties Excellent environmental durability (to heat, humidity, salt water, solvents)	Robust, structural bonding performance even on uncleaned steel *Very high draw lubricant coating weights* can be tolerated
2-part	Extended shelf life Controlled reactivity; balance of longer open time before induction with fast lock-up after induction Room temperature strength build; permits spot induction cure Can be dispensed with commercially available dispensing systems; broad off-ratio tolerance Wash out resistance	Broad handling and dispensing windows
Induction activation and cure	Low temperature activation at or below 95°C depending on cycle time; reduced potential for panel distortion	Broad curing windows; faster cycle times
Final heat cure	Broad over-bake tolerance	
99+% solids	Reduced emissions/vapours/odour	Low regulatory concern

Physical Properties

	Part A	Part B	Mixed Adhesive
Colour	Amber	Black	Black
% solids	100%	100%	100%
Density	1.043 g/l	0.88 g/l	

Handling/Process Properties

Storage	Part A	Part B
Container sizes (standard) - drums - dual pack cartridges	 208.2 l 80 ml	 208.2 l 320 ml
Adhesive volume - drums - dual pack cartridges	 196,8 l 80 ml	 196,8 l 320 ml
Shelf life - at room temperature	 6 months	 6 months

Dispensing	Mixed Adhesive
Mix Ratio (B:A) - by weight - by volume	 3.4 B : 1.0 A 4.0 B : 1.0 A
Off-ratio tolerance - by weight - by volume	 2.7 - 5.1 B : 1.0A (20%) 3.2 - 4.8 B : 1.0A (+20%)
Open time	120 minutes
Induction cure	
Activation temperature	95°C
Over-bake temperature	220°C
Typical induction cycles	4-6 sec. at 120°C
Final cure	
Cure temperature	Cures at paint bake oven conditions

Dispensing equipment	Drums can be dispensed through bulk equipment specifically designed for use with 2-part epoxy adhesives. Dual pack cartridges can be dispensed manually; follow instructions included.
Clean-up	Uncured adhesive can be removed by scraping with a putty knife or similar tool. For cured material, remove by cutting or sanding.

Health and Safety Information

Read all Health Hazard, Precautionary, and First Aid statements found in the Material Safety Data Sheets and/or product label prior to handling or use.

Performance Properties

Over-Lap Shear (OLS)[1] on draw lubricated Electro EG60 steel	**Value**	**Failure Mode**
Room Temperature plus oven cure[2]	19.5 MPa	Cohesive
Induction plus 24 hours RT cure[3]	10.7 MPa	Mixed
Induction plus oven cure[4]	17.6 MPa	Cohesive
1000 hours salt spray[5]	18.6 MPa	Cohesive
107°C Hot shear	10.9 MPa	Cohesive
30 APGE	16.9 MPa	Cohesive

Over-Lap Shear (OLS) on draw lubricated G60 HDG steel	**Value**	**Failure Mode**
Room Temperature plus oven cure	18.0 MPa	Cohesive
Induction plus 24 hours RT cure	10.7 MPa	Mixed
Induction plus oven cure	16.4 MPa	Cohesive
1000 hours salt spray	15.5 MPa	Cohesive
107°C Hot shear	9.2 MPa	Cohesive
30 APGE	13.1 MPa	Cohesive

T-Peel		
On G60 HDG steel	5.3 kg/cm width	
On EG 60 Electro steel	5.5 kg/cm width	

Note: These properties are representative of the product's performance on a specific draw lubricant, and are not intended to be used for specification purposes.

From previous page:

[1] Measured on 25.4 mm wide coupons using 12.7 mm over-lap bonds. Thickness of the bond line was 0.25 mm. Crosshead speed was 12.7 mm/min. Metal thickness was approximately 0.76 mm. Coating weight was approximately 400 mg/sq. ft.

[2] After 24 hours at room temperature followed by 20 minutes at 163°C

[3] After induction-cure cycle of 5 seconds at 107°C followed by room temperature cure

[4] After induction-cure cycle of 5 seconds each at 107°C followed by 24 hours at room temperature and 20 minutes at 163°C

[5] After room temperature plus oven cure as in subscript 2 followed by 1000 hours of 5% NaCl salt spray at 35°C

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5027 Two part Epoxy Adhesive Structural Adhesives

Technical Data Sheet

Product Description

3M™ Automotive Two-Part Epoxy Adhesive 5027 is formulated for hem flange bonding applications on aluminium, steel or SMC.
It features broad off-ratio and over-bake tolerance, and structural bond strength on untreated surfaces with high draw lubricant coating weights. It can be induction cured at low temperatures, thereby minimizing panel distortion and is adaptable to spot cure.

Product Features	Performance Advantages	Customer Benefits
Epoxy Chemistry	High bond strength (15 MPa psi OLS) with cohesive failure mode on hot untreated surfaces	Robust, structural bonding performance even on untreated substrates
	Very good compatibility with a wide variety of draw lubricants	Surfaces with high draw lubricant coating weights can be tolerated
	Very good environmental durability (to heat, humidity, salt water, solvents)	
2-part	Long shelf life (6 months)	Broad handling and dispensing windows
	Controlled reactivity; balance of longer open time before induction with fast lock-up after induction	Extended open time allows for greater processing latitude
	Room temperature strength build; permits spot induction cure with cohesive failure mode	
	Can be dispensed with commercially available dispensing systems; broad off-ratio tolerance	
	Good wash out resistance	
Induction activation and cure	Low temperature activation at or below 107°C depending on cycle time; reduced potential for panel distortion	Broad curing windows; faster cycle times and low induction temperatures minimize risk of panel distortion
Final heat cure	Broad over-bake tolerance	
99+% solids	Low VOC content	

Physical Properties

	Part A	Part B	Mixed Adhesive
Colour	Amber	Black	Black
% solids	100%	100%	100%
Density[1] at room temp	1.105 g/l	0.88 g/l	-
Viscosity[2] at room temp	45,000 cps	180,000 cps	-

[1]ASTM D 816; typical values
[2]Rheometrics Dynamic Analyzer at 100sec.$^{-1}$

Handling/Process Properties

Storage	Part A	Part B
Container sizes (standard) - drums - dual pack cartridges	 113.5 l 150 ml	 208.2 l 300 ml
Adhesive volume - drums - dual pack cartridges	 98.4 l 150 ml	 208.2 l 300 ml
Shelf life - at room temperature	 6 months	 6 months

Dispensing	Mixed Adhesive
Mix Ratio (B:A) - by weight - by volume	 1.65 B : 1.0 A 2.0 B : 1.0 A
Off-ratio tolerance[1] - by weight - by volume	 1.32 - 1.98 B : 1.0A (± 20%) 1.6 - 2.4 B : 1.0A (± 20%)
Open time (dispense to induction)	Minimum of 2 hours

[1]Maintaining 80% of performance properties at the target ratio

Induction cure	
Typical induction cycles	4-8 sec. at 79°-120°C[2]
Typical lock-up time	30 mins

[2]Adhesive bondline temperature

Final cure	
Cure temperature	Cures at paint bake oven conditions

Dispensing equipment	Drums can be dispensed through bulk equipment specifically designed for use with 2-part epoxy adhesives. Dual pack cartridges can be dispensed manually; follow instructions included.
Clean-up	Uncured adhesive can be removed by scraping with a putty knife or similar tool. For cured material, remove by cutting or sanding.

Health and Safety Information	Read all Health Hazard, Precautionary, and First Aid statements found in the Material Safety Data Sheets and/or product label prior to handling or use.

Performance Properties

Over-Lap Shear (OLS)[1] on dra r lubricated 6111 Aluminium	**Value**	**Failure M ode**
Room temperature (RT) cure[2]	4.97 MPa	Cohesive
Room temperature plus oven cure[3]	16.5 MPa	Cohesive
Induction plus 30 mins RT cure[4] Induction plus 60 mins RT cure[4] Induction plus 24 hours RT cure[3]	0.69 MPa 1.55 MPa 9.66 MPa	N/A N/A N/A
Induction plus oven cure[5]	16.5 MPa	Cohesive
1000 hours salt spray[6]	> 80% retention	Cohesive

Note: The draw lubricant tested was a difficult petroleum-based product which had been selected by on automotive OEM for its draw-lubricating properties, not its compatibility with the adhesive.

Creep resistance[7] on draw lubricated 6111 Aluminium	**Value**
RT cure - 24 hours	4.54 kg
RT cure - 72 hours	6.80 kg
Induction plus 24 hours RT cure	11.34 kg
Induction plus 72 hours RT cure	20.41 kg

T-Peel on draw lubricated 6111 Aluminium	**Value**
Room temperature plus oven cure	4.5 kg/cm width
Induction plus oven cure	5.4 kg/cm width

Note: These properties are representative of the product's performance on a specific aluminium draw lubricant, and re not intended to be used for specification purposes.

Over-Lap Shear (OLS) on dr w lubricated G60 HDG steel	**Value**	**Failure M ode**
Room temperature plus oven cure[8]	15.2 MPa	Cohesive

Note: These results were obtained using two different draw lubricants.

From previous page:

[1] Measured on 25.4 mm wide coupons using 12.7 mm over-lap bonds. Thickness of the bond line was 0.25 mm. Crosshead speed was 12.7 mm/min. Metal thickness was approximately 0.76 mm.

[2] After 24 hours at room temperature

[3] After 24 hours at room temperature followed by a multi-stage oven cure. See note 5.

[4] After 2 induction-cure cycles of 4 seconds each at 107°C bondline temperature followed by the time indicated at room temperature

[5] After 2 induction-cure cycles of 4 seconds each at 107°C bondline temperature followed by 24 hours at room temperature and a multi-stage heat cure of 30 minutes at 205°C, 1 hour at room temperature, 10 minutes at 163°C, 1 hour at room temperature, and 10 minutes at 130°C. Other single or multi-stage cures will produce similar results, depending on the draw lubricant and induction cure conditions.

[6] After induction plus oven cure as in note 5 followed by 1000 hours 5% NaCl salt spray at 35°C.

[7] Maximum static load held by overlap shear bond for 40 minutes at 205°C.

[8] After 24 hours at room temperature followed by 30 minutes at 180°C. Crosshead speed was 12.7 mm/min. for aluminium testing; 50.8 mm/min for steel.

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