

3M™ Thermal Bonding Film AF42

Product Description

3M™ Thermal Bonding Film AF42 is an epoxy, thermoset film adhesive developed for structural bonding of metal, glass, and other engineering grade substances for electronics applications.

Key Features

- 177°C (350°F) cure
- Tough, high-peel strength
- No tack, low flow
- Cures clear
- 4°C (40°F) storage required

Product Construction

Non-Tacky Epoxy Adhesive: 3.0 mil
Brown Paper Liner: 6.5 mil

Material Description

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

3M™ Thermal Bonding Film AF42	
Property	Value
Base Resin	Epoxy
Adhesive Thickness	3.0 mil (0.08 mm)
Liner Thickness	6.5 mil (0.17 mm)
Tack	None
Color	Translucent

Typical Applications

- Bonding metals, glass, magnets, plastics, rubbers, and fabrics
- Bonding of dissimilar materials (e.g., metal-to-fabrics, rubber-to-metal, metal-to-plastic, etc.)
- Please work with your 3M Application Engineer to discuss other potential joining and bonding applications.

3M™ Thermal Bonding Film AF42

Typical Physical Properties and Performance Characteristics After Cure

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes. Final product specifications and testing methods will be outlined in the product's Certificate of Analysis (COA) that is shipped with the commercialized product.

3M™ Thermal Bonding Film AF42	
Property	Value
Tensile (psi)	4800
Elongation (%)	250
Modulus (psi)	65,000
Color After Cure	Clear

Suggested Use Procedure

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Room Temperature Work Life – 3M™ Thermal Bonding Film AF42 has a work life of 4 weeks. Work life is defined as the time at room temperature that the product will still yield the performance data summarized in this data sheet if bonds are made and tested per instructions.

Shelf Life – (usable life) of Bonding Film AF42 is:

- 4 weeks @ 21°C (70°F)
- 15 months @ 4°C (40°F)

Cure Conditions – The suggested curing condition for 3M film AF42 is 60 minutes at 177°C (350°F). The adhesive may be cured either under pressure or in a vacuum bag. Alternate suggested cure cycles are shown below.

3M™ Thermal Bonding Film AF42	
Bondline Temperature	Time (minutes)
177°C (350°F)	60
204°C (400°F)	15
232°C (450°F)	10

During cure, pressure is required to keep parts in alignment and in intimate contact. A minimum of 20 psi is suggested, but higher psi is acceptable if resultant flow during cure is not excessive.

Bondline Thickness – Unless otherwise specified, the bondline thickness used to generate the data in this data sheet was 3 mils. Since 3M film AF42 will flow when heated to its curing temperature (... and the higher the cure temperature, the more the flow...), it may be necessary to insert mechanical spacers (i.e., beads, wires, stops, etc.) in the bondline to maintain this thickness.

Cold Storage Removal – Important: During storage, 3M film AF42 should be wrapped/sealed in a polyethylene (or similar) wrap/bag. When removing the wrapped roll or sheets from cold storage, especially if stored below 0°C (32°F), ample time should be given before handling or overwrap removal to allow for the roll/sheets to acclimate to room temperature for two reasons:

1. To prevent moisture from condensing on the adhesive surface; and
2. To prevent cracking of the adhesive as it is brittle when cold.

Surface Preparation Prior to Bonding – A thoroughly cleaned, dry, grease-free surface is essential for maximum performance. Cleaning methods which will produce a break-free water film on metal surfaces are generally satisfactory.

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Suggested Use Procedure

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Application of Film to Substrate:

- 1) Cut a portion of film sufficient for the assembly from the stock roll with protective liner(s) in place. Note earlier comment to bring adhesive to room temperature before use.
- 2) Place the adhesive against the substrate using the liner as a protective cover.
- 3) Position film and remove liner.
- 4) Complete assembly and cure, be careful to avoid trapping air.

Typical Overlap Shear (OLS) Adhesion to Various Substrates

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

3M™ Thermal Bonding Film AF42	
Substrate	Overlap Shear Adhesion (psi)
Al (etched)	4600
Al (sanded, solvent wiped)	3700
Al (scour pad abraded, solvent wiped)	3750
Al (solvent wiped)	500
CRS (scour pad abraded, solvent wiped)	1350
Stainless Steel (solvent wiped)	600
FR-4 (solvent wiped)	2500
LCP (solvent wiped)	400
Polyimide Film	650
Polyester Film	350
Black E-Coat	350
Phenolic Board	1000
Ultem™ Resin 1000	1500
PEN Plastic	250

- OLS values given in psi (pounds per square inch). ASTM D1002.
- Al (aluminum), CRS (cold rolled steel), FR-4 (printed circuit board substrate), LCP (liquid crystal polymer), and PEN (polyethylene naphthalate).
- Solvent wiped (Methyl ethyl ketone [MEK], alcohol)*; 3M™ Scotch-Brite™ Scour Pad (green) abraded; sanded (600 grit sandpaper).
- OLS bonds were 1" x 0.5" and tested at 0.2"/minute.
- Bonds were cured 60 minutes (+ 7 minutes ramp time) at 121°C (250°F).
- The polyimide and polyester films were overbonded to CRS using 3M™ Scotch-Weld™ Epoxy Adhesive DP-190.

***Note:** When using solvents, extinguish all ignition sources and follow the manufacturer's precautions and directions for use.

3M™ Thermal Bonding Film AF42

Typical Peel Adhesion to Various Substrates

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

3M™ Thermal Bonding Film AF42	
Substrate	Peel Adhesion (lbf/inch width)
Al (etched)	55
Al (sanded, solvent wiped)	48
Al (scour pad abraded, solvent wiped)	45
Al (solvent wiped)	52
CRS (scour pad abraded, solvent wiped)	58
Stainless Steel (solvent wiped)	11
FR-4 (solvent wiped)	58
LCP (solvent wiped)	1
Polyimide Film	8
Polyester Film	2.5
Black E-Coat	49
Phenolic Board	36
Ultem™ Resin 1000	50
PEN Plastic	14
Borosilicate Glass	60

- 90° peel test of 1/2" wide, 4 mil thick etched aluminum foil bonded to each test substrate.
- Peel rate 2"/minute.
- Peel values given in piw (pounds per inch width). ASTM D1876.
- Al (aluminum), CRS (cold rolled steel), FR-4 (printed circuit board substrate), LCP (liquid crystal polymer), and PEN (polyethylene naphthalate).
- Solvent wiped (Methyl ethyl ketone [MEK], alcohol)*; 3M™ Scotch-Brite™ Scour Pad (green) abraded; sanded (600 grit sandpaper).
- Bonds were cured for 60 minutes (+ 7 minutes ramp time) at 250°F (121°C).
- The polyimide and polyester films were overbonded to CRS using 3M™ Scotch-Weld™ Epoxy Adhesive DP-190.

***Note:** When using solvents, extinguish all ignition sources and follow the manufacturer's precautions and directions for use.

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Adhesion Retention Values After Environmental Aging

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

3M™ Thermal Bonding Film AF42	
Aging Parameters	Peel Adhesion (lbf/inch width)
30 days at room temperature (control)	63
30 days at 71°C (160°F) oven	68
30 days at 49°C (120°F) and 100% RH	58
30 days immersion in distilled water	55
Hot/cold cycling	63

- Peel bonds consisted of 10 mil etched aluminum strips bonded to 0.047" FR-4. Panels were cured 60 minutes + 7 minutes (ramp time) at 121°C (250°F) and peeled at 2"/minute speed.
- Hot/cold cycle was 17 hours at 49°C (120°F) and 5 hours at -21°C (-5°F) with one hour at room temperature between temperature changes.

3M™ Thermal Bonding Film AF42	
Aging Parameters	Overlap Shear Adhesion (psi)
30 days at room temperature (control)	1200
30 days at 71°C (160°F) oven	1450
30 days at 49°C (120°F) and 100% RH	200
30 days immersion in distilled water	300
Hot/cold cycling	900

- OLS (overlap shear) bonds consisted of 3M™ Scotch-Brite™ Scour Pad (green) abraded CRS to CRS, cured 60 minutes + 7 minutes (ramp time) at 121°C (250°F) and tested at 0.2"/minute speed.
- Hot/cold cycle was 17 hours at 49°C (120°F) and 5 hours at -21°C (-5°F) with one hour at room temperature between temperature changes.

Solvent Resistance of Cured Films After 60 Days Immersion at RT

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

3M™ Thermal Bonding Film AF42	
Aging Parameters	Result
Isopropyl Alcohol	No Attack
Methyl Ethyl Ketone	No Attack
Heptane	No Attack
3M™ Citrus Base Cleaner	No Attack

- Samples were cured according to data sheet instructions [60 minutes at 121°C (250°F)] and immersed in test solvents.
- After 60 days, samples were removed, dried, and examined for swelling and surface attack.

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Overlap Shear and Peel Adhesion Tested at Various Temperatures

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

3M™ Thermal Bonding Film AF42	
Test Temperature	Overlap Shear Adhesion (psi)
-55°C (-67°F)	1500
24°C (75°F)	1300
82°C (180°F)	350
121°C (250°F)	175

3M™ Thermal Bonding Film AF42	
Test Temperature	Peel Adhesion (lbf/inch width)
-55°C (-67°F)	66
24°C (75°F)	56
82°C (180°F)	54
121°C (250°F)	36

- OLS bonds were 0.5" x 1" (CRS, 3M™ Scotch-Brite™ Scour Pad [green] abraded, solvent wiped).
- Peel bonds were 0.5" wide, 10 mil etched aluminum strips bonded to 0.047" FR-4 board.
- Both OLS and peel bonds were made and tested in similar fashion described in previous sections.

Thermal Properties

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

3M™ Thermal Bonding Film AF42	
Test	Value
Weight Loss by TGA @ 10°C/min. (Thermal Gravimetric Analysis)	1% wt. loss @ 68°C 5% wt. loss @ 320°C 10% wt. loss @ 357°C
Coefficient of Thermal Expansion (CTE) by TMA (units/unit/°C @ 10°C/min.)	63×10^{-6} (-60 to 40°C)* 13×10^{-6} (-60 to 40°C)** 166×10^{-6} (+65 to 125°C)**
Tg (Glass Transition Temperature) by TMA @ 10°C/min.	Onset @ 55°C**
Tg (Glass Transition Temperature) by DSC @ 5°C/min.	Midpoint @ 50°C* Midpoint @ 45°C**
Thermal Conductivity (Tested in accordance with ASTM C177)	0.21 W/m-K

*1st heat values

**2nd heat values

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Electrical Properties

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

3M™ Thermal Bonding Film AF42		
Test	Method	Value
Dielectric Constant	D150	4.6 @ 1 kHz 4.2 @ 10 kHz 3.8 @ 100 kHz
Dissipation Factor	D150	.004 @ 1 kHz .006 @ 10 kHz .008 @ 100 kHz
Dielectric Breakdown Strength	D149	900 volts/mil (7 mil)
Volume Resistivity	D257	1.2×10^{15} ohm-cm (3 mil)

*Tested in accordance with ASTM test method.

Storage and Shelf Life

The shelf life of 3M™ Thermal Bonding Film AF42 is 15 months from the date of manufacture when stored in original packaging materials and stored at 4°C (44°F) and 40-50% relative humidity.

Cleanup

Uncured 3M™ Thermal Bonding Film AF42 can be removed using acetone, MEK or 3M™ Citrus Base Cleaner.*

***Note:** When using solvents, extinguish all ignition sources and follow the manufacturer's precautions and directions for use

Certificate of Analysis (COA)

The 3M Certificate of Analysis (COA) for this product is established when the product is manufactured and deemed commercially available from 3M. The COA contains the 3M specifications, test methods, and test results for the product's performance attributes that the product will be supplied against. Contact your local 3M representative for this product's COA.

3M™ Thermal Bonding Film AF42

Regulatory: For regulatory information about this product, contact your 3M representative.

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