

# 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.

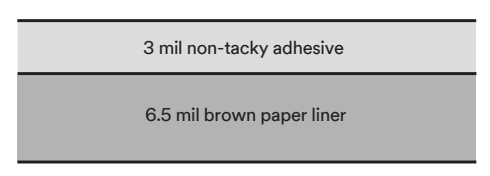
**3M film AF42 must be stored at or below 4°C (40°F) before use.**

## Key Features

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

## Physical Properties Before Cure

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

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

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## Physical Properties After Cure

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

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

## Suggested Use Procedure

**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.

Bondline Temperature	Time (in 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 (continued)

### Application of Film to Substrate:

- A. 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.
- B. Place the adhesive against the substrate using the liner as a protective cover.
- C. Position film and remove liner.
- D. Complete assembly and cure, be careful to avoid trapping air.

## Typical Overlap Shear (OLS) Adhesions 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.

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

- 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.

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## 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.

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

- 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 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.

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

\* 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.

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

\* 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

Aging Parameters	3M™ Thermal Bonding Film AF42
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.

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

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

- 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.

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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.

Test	Method <sup>1</sup>	3M™ Thermal Bonding Film AF42
Dielectric Constant	ASTM D-150	4.6 @ 1 kilohertz 4.2 @ 10 kilohertz 3.8 @ 100 kilohertz
Dissipation Factor	ASTM D-150	.004 @ 1 kilohertz .006 @ 10 kilohertz .008 @ 100 kilohertz
Dielectric Breakdown Strength	ASTM D-149	900 volts/mil (7 mil)
Volume Resistivity	ASTM D-257	$1.2 \times 10^{15}$ ohm-cm (3 mil)

<sup>1</sup>Tested in accordance with ASTM test method.

## Thermal Properties

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

Test	3M™ Thermal Bonding Film AF42
Weight Loss by TGA (Thermal gravimetric analysis) @ 10°C/min.	1% wt loss @ 68°C 5% wt loss @ 320°C 10% wt loss @ 357°C
Coefficient of Thermal Expansion by TMA (units/unit/°C @ 10°C/min.)	$63 \times 10^{-6}$ (-60 to 40°C)* $13 \times 10^{-6}$ (-60 to 40°C)** $266 \times 10^{-6}$ (+65 to 125°C)**
Tg (glass transition temperature) by TMA @ 10°C/min.	onset @ 55°C**
Tg by DSC @ 5°C/min.	midpoint @ 50°C* midpoint @ 45°C**
Thermal Conductivity (Tested in accordance with ASTM C177)	0.124 BTU-FT/FT <sup>2</sup> - hr °F (0.21 Watt/M - °K)

\* 1<sup>st</sup> heat values

\*\* 2<sup>nd</sup> heat values

## Storage Requirements

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

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**Safety Data Sheet:** Consult Safety Data Sheet before use.

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

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