3M™ Bonding Film 406

Product Description

3M™ Bonding Film 406 is a flexible, light colored, thermoplastic adhesive bonding film which exhibits good adhesion to a variety of substrates, especially metals.

Key Features

- Consistent, uniform adhesive thickness
- Excellent metal adhesion
- Good solvent resistance
- Quick fixturing/holding strength
- 100% solids
- Reworkable

Typical Physical Properties

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

Base Resin	Ethylene Acrylic Acid Copolymer
Adhesive Thickness	3.0 mil (.003 in.) / 0.08 mm
Liner	None
Color	Translucent
Solids	100%
Ball and Ring Softening Range	300 to 320°F (149 to 160°C)
Tensile Strength @ Break	2600 psi (3.0 mil film)
Elongation @ Break	750% (3.0 mil film)
Two Lb. Dead Load Heat Resistance	200°F (93°C)

Application Equipment Suggestions

Note: Appropriate application equipment can enhance bonding film performance. We suggest the following equipment for the user's evaluation in light of the user's particular purpose and method of application.

The type of application equipment used to bond 3M™ Bonding Film 406 will depend on the application involved and on the type of equipment available for the user. Thin films and flexible substrates can be bonded using a heated roll laminator where heat and pressure can be varied to suit the application. Larger, thicker substrates can be bonded using a heated static press or, in some cases, an autoclave. For applications where a shaped adhesive is to be transferred to a flat or three-dimensional part, a hot shoe or thermode method may be appropriate.

It is recommended that whatever method of bonding the user chooses, the user should determine the optimum bonding conditions using the specific substrates involved.

Directions For Use

To make a bond using 3M™ Bonding Film 406, the adhesive can be first tacked (lightly bonded) to one of the substrates using low heat, and placing the second substrate to the exposed adhesive surface, making the bond using heat and pressure.

Alternatively, place the adhesive film between the two substrates and make the bond through heat and pressure using a heated press, a hot roll laminator, a hot shoe thermode method or similar equipment.

Suggested TACKING Conditions

240°F to 250°F (116°C to 121°C) bondline temperature

1-2 seconds dwell time

5-10 psi pressure

For optimum bonding, heat, pressure and dwell time will depend upon the type and thicknesses of the substrates being bonded together.

A suggested starting point, however, is to use bonding conditions described below.

Suggested BEGINNING Bonding Conditions

300°F to 320°F (149°C to 160°C) bondline temperature

2-5 seconds dwell time

10-20 psi pressure

Directions For Use (continued)

One approach to establishing the optimum bonding conditions for a user's application is to evaluate a series of bonding temperatures, for example 250, 270, 290 and 310°F (121, 132, 143 and 154°C). Time and pressure will be dictated by the thickness of the substrate and the type of substrate being bonded. Thicker substrates and more difficult to bond surfaces will require longer times, higher pressures and/or higher temperatures.

Once the bond is made, the bondline should be allowed to cool somewhat before stress is applied to the bond. Generally, cooling the bondline below 200°F (93°C) is adequate to allow the bonded parts to be unfixtured/unclamped and handled.

For reference, the following table shows typical bond strengths for bonds made at various temperatures. **Such a table can be used to evaluate optimum bondline temperatures.** It is very important to note that this table is valid only for the specific substrates shown. Varying temperature, pressure, or substrates can affect bond strengths. **User should develop a similar table using the specific substrates involved.**

Note: Temperatures shown are bondline temperatures and not heat block or roll settings!

Peel Adhesion Vs Bonding Temperature

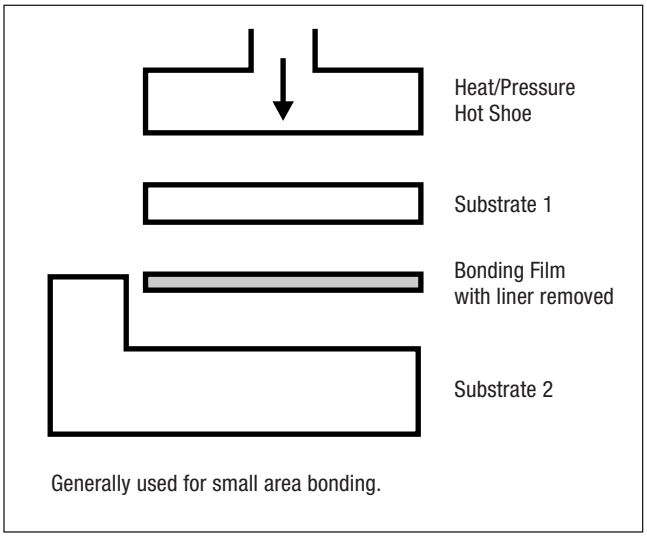
Bondline Temperature	T-Peel Strength AL/AL	AL/CRS	AL/FR-4
120°F (49°C)	0.2 piw	—	—
130°F (54°C)	0.2 piw	—	—
140°F (60°C)	0.3 piw	—	—
150°F (66°C)	0.5 piw	—	—
160°F (71°C)	1.2 piw	—	—
170°F (77°C)	1.8 piw	—	—
180°F (82°C)	5.0 piw	—	—
190°F (88°C)	5.8 piw	—	—
200°F (93°C)	6.3 piw	—	—
210°F (99°C)	6.8 piw	—	—
220°F (104°C)	7.5 piw	—	—
230°F (110°C)	7.8 piw	—	—
240°F (116°C)	8.1 piw	6.0 piw	1.2 piw
250°F (121°C)	8.2 piw	—	—
255°F (124°C)	—	9.1 piw	1.5 piw
260°F (127°C)	8.4 piw	—	—
270°F (132°C)	8.7 piw	11.1 piw	1.7 piw
280°F (138°C)	9.0 piw	—	—
285°F (141°C)	—	14.3 piw	1.7 piw
290°F (143°C)	9.5 piw	—	—
300°F (149°C)	10.5 piw	13.3 piw	2.3 piw
310°F (154°C)	10.8 piw	—	—
315°F (157°C)	—	17.4 piw	3.4 piw
320°F (160°C)	10.2 piw	—	—
330°F (166°C)	9.8 piw	12.9 piw	4.8 piw
340°F (171°C)	9.7 piw	—	—
345°F (174°C)	—	12.5 piw	5.2 piw

- Bonds made using 3 second dwell, 5 lbs gauge pressure.
- Peels done at 90° angle, 2 in/minute, Instron tester.
- AL is 4.5 mil etched aluminum foil.

Typical Methods For Bonding 3M™ Bonding Film Adhesives

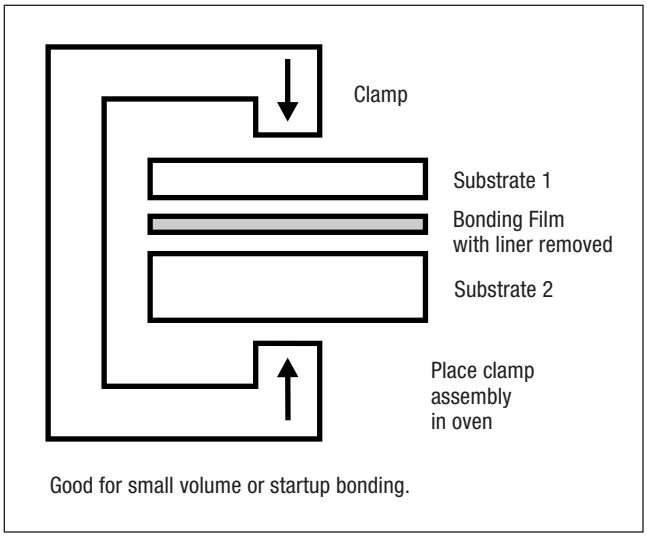
The following illustrations show several of the many methods that can be used to make bonds using 3M™ Bonding Film Adhesives. Such equipment is generally available commercially or can be built or modified by the user to fit a particular application.

Hot Shoe or Thermode Bonding



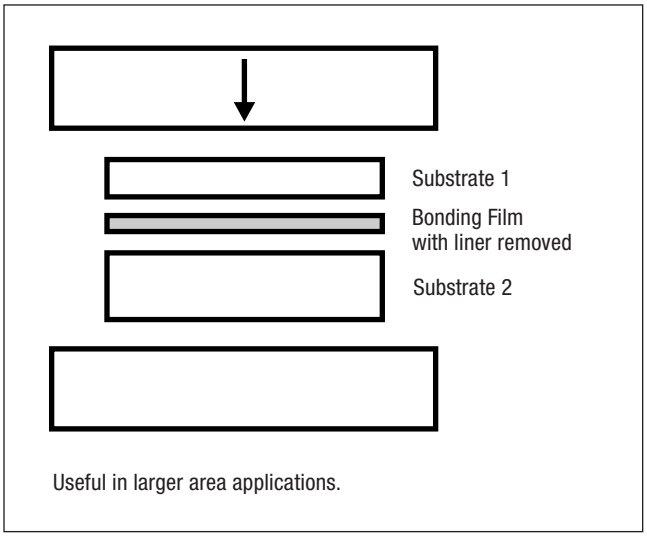
Generally used for small area bonding.

Oven (Static or Conveyorized) Bonding



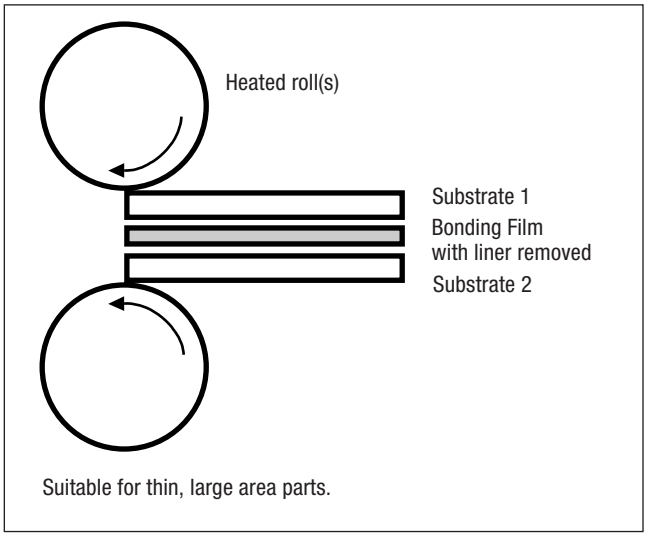
Good for small volume or startup bonding.

Hydraulic or Mechanical Press Bonding



Useful in larger area applications.

Lamination Bonding of Thin Substrates



Suitable for thin, large area parts.

Debonding – Since 3M™ Bonding Film 460 is a thermoplastic material, no curing during heating or aging occurs. To debond or open bonded parts, simply heat the bonded part to an adequate temperature (typically 210-230°F / 99-100°C) to soften the adhesive and then pry or peel the substrates apart.

Solvents, such as acetone, methyl ethyl ketone (MEK), toluene and 3M™ Citrus Based Cleaner will soften this bonding film adhesive and can be used to remove excess adhesive in unwanted areas.* Soaking bonds in these solvents can also aid in debonding operations where appropriate.

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

Typical Performance Characteristics

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

Overlap Shear Strength to Various Substrates

Test Substrate	Overlap Shear psi	90° Peel piw
Cold Rolled Steel	1160	17.0
Stainless Steel	740	4.4
Aluminum, Etched	1090	16.6
Polycarbonate	70	2.2
Acrylic	260	—
FR-4 PCB	1120	10.0
ABS	—	—
HDPE	—	—
Polypropylene	80	1.3
PVC	—	—
Nylon 6,6	140	3.5
Glass	—	1.9
SBR Rubber	—	12.1
Nitrile Rubber	—	11.7
Polyimide	—	9.2
Polyester	—	—

- Overlap shear made bonding 20 mil aluminum to test substrates using 320°F (160°C) bondline temperature, 2 seconds dwell, 14 lbs gauge pressure.
- Peel bonds made bonding 4.5 mil aluminum foil to test substrates using 320°F (160°C) bondline temperature, 2 seconds dwell, 14 lbs gauge pressure.
- Adhesion tests done @ 2 in/minute for peel, .2 in/minute for OLS.

Humidity Aging

Aging Conditions	Time	90° Peel piw
	0 (Control)	15.4
150°F / 95% rh	6 days	16.9
150°F / 95% rh	21 days	17.7
185°F / 95% rh	6 days	16.6
185°F / 95% rh	21 days	16.2

- Peel bonds made bonding 4 mil etched aluminum to 63 mil etched aluminum using 320°F (160°C) bondline temperature, 2 seconds dwell, 10 lbs gauge pressure.
- Peel tests @ 2 in/minute.

Typical Performance Characteristics (continued)

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

Adhesion Strength TESTED at Various Temperatures

Test Temperature	Overlap Shear psi	90° Peel piw
75°F (24°C)	1160	16.5
100°F (38°C)	1090	17.5
125°F (52°C)	990	19.2
150°F (66°C)	910	18.0
175°F (79°C)	590	15.0

- Overlap shear made bonding 20 mil etched aluminum to 63 mil etched aluminum using 320°F (160°C) bondline temperature, 2 seconds dwell, 14 lbs gauge pressure.
- Peel bonds made bonding 4.5 mil aluminum foil to test substrates using 320°F (160°C) bondline temperature, 2 seconds dwell, 14 lbs gauge pressure.
- Adhesion tests done @ 2 in/minute for peel, .2 in/minute for OLS.

Electrical Data

Test	Method	3M™ Bonding Film 406 Value
Dielectric Constant	ASTM D-257	2.4 @ 1 kilohertz 2.4 @ 10 kilohertz 2.4 @ 100 kilohertz 2.4 @ 1 megahertz
Dissipation Factor	ASTM D-257	.005 @ 1 kilohertz .001 @ 10 kilohertz .001 @ 100 kilohertz .006 @ 1 megahertz
Dielectric Breakdown Strength	ASTM D-149	2300 volts/mil
Volume Resistivity	ASTM D-257	5.9×10^{17} ohm-cm

Storage and Shelf Life

Storage: Store in a dry (preferably <50% RH) location at 35°F (2°C) to 80°F (27°C).

Shelf Life: Shelf life is 1 year from the date of shipment under storage conditions mentioned above.

Safety Data Sheet: Consult Safety Data Sheet before use.

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

Technical Information: The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

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