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3M™ Thermal Bonding Film 615

Product Description

3M™ Thermal Bonding Film 615 is a flexible, light colored, thermoplastic adhesive bonding film which exhibits good adhesion to a variety of substrates. The bonding film is supplied on a release coated paper liner.

Key Features

- Can be die-cut
- Consistent, uniform adhesive thickness
- Quick fixturing/holding strength
- 100% solids
- Excellent adhesion to many substrates

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.

Product	3M™ Thermal Bonding Film 615
Base Resin	Polyester Thermoplastic (non-curing)
Adhesive Thickness	2.5 mil (0.06 mm) 4.0 mil (0.10 mm)
Liner Thickness	3.0 mil (0.08 mm) nominal
Color	Translucent / Tan
Specific Gravity	1.00
Solids	100%
Ball and Ring Softening Range	116 to 123°C (240 to 250°F)
Tensile Strength @ Break	450 psi
Elongation @ Break	~300%
Two Lb. Dead Load Heat Resistance	102°C (215°F)

Note 1: The data reported in this data sheet was determined using 4.0 mil film thickness 3M™ Thermal Bonding Film 615.

Note 2: Other thicknesses may be available upon request. Contact your local 3M sales representative for details.

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 equipment used to bond 3M™ Thermal Bonding Film (TBF) 615 will depend on the application 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 TBF 615, the adhesive, with the liner in place, can be first tacked (lightly bonded) to one of the substrates using low heat. The liner can then be removed, and placing the second substrate to the exposed adhesive surface, make the final bond using heat and pressure.

Alternatively, remove the liner and 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
60°C to 80°C bondline temperature
1-2 seconds dwell time
5-10 psi (35-70 kPa) 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 is to use a method which will result in an adhesive bondline temperature of 135°C (275°F) for 2-5 seconds using 10-20 psi pressure.

Suggested BEGINNING Bonding Conditions
130°C to 150°C bondline temperature
2-5 seconds dwell time
10-20 psi (70-140 kPa) pressure

Directions For Use (continued)

One approach to establishing the correct/optimum bonding conditions for a user's application is to evaluate a series of bonding temperatures, for example 121, 135, 149, 163 and 177°C (250, 275, 300, 325 and even 350°F). 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 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 93°C (200°F) is adequate to allow the bonded parts to be unfixtured/unclamped and handled.

For reference, the following tables show typical bond strengths for bonds made at various temperatures. **Such tables 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.

Overlap Shear Adhesive vs Bonding Temperature
CRS/CRS Overlap Shear

Bondline Temperature	3M™ Thermal Bonding Film 615 (4.0 mil)
110°C (230°F)	460 psi
121°C (250°F)	820 psi
132°C (270°F)	910 psi
143°C (290°F)	1070 psi
154°C (310°F)	1100 psi
166°C (330°F)	1090 psi

- Bond strength determined using Instron tester at 0.2 in/minute (0.5 cm/min).
- Oven bonding method 10 minutes, 4.5 psi (30 kPa) pressure.
- CRS is Cold Rolled Steel.

T-Peel Adhesion of PET/PET and PI/PI Bonded at Various Temperatures

Bondline Temperature	3M™ Thermal Bonding Film 615 (4.0 mil) PET/PET	3M™ Thermal Bonding Film 615 (4.0 mil) PI/PI
82°C (180°F)	0.3 piw	1.2 piw
91°C (196°F)	0.6 piw	2.9 piw
102°C (216°F)	1.3 piw	3.8 piw
113°C (235°F)	1.8 piw	6.1 piw
124°C (256°F)	3.6 piw	6.7 piw
136°C (277°F)	5.2 piw	9.7 piw
148°C (298°F)	6.4 piw	10.7 piw
157°C (315°F)	8.0 piw	11.2 piw

- PET is 2 mil polyester film.
- PI is 3 mil polyimide film.
- Bonds made using 5 second dwell, 5 lb gauge pressure.
- T-Peel adhesion is 90° peel pulled @ room temperature using Instron tester @ 2 in/minute.

3M™ Thermal Bonding Film 615
Peel Strengths of Bonds Made at Various Temperatures

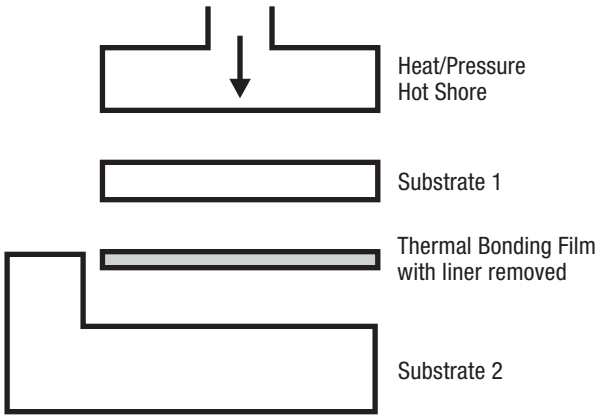
Bondline Temperature	CRS AL	FR-4 AL	PC AL
57°C (135°F)	0.4 piw	0.4 piw	0.2 piw
66°C (150°F)	0.4 piw	0.7 piw	0.2 piw
74°C (165°F)	0.9 piw	3.0 piw	0.5 piw
82°C (180°F)	1.7 piw	3.7 piw	1.0 piw
91°C (195°F)	3.3 piw	7.0 piw	2.9 piw
99°C (210°F)	2.1 piw	8.2 piw	4.0 piw
107°C (225°F)	8.4 piw	8.8 piw	3.6 piw
116°C (240°F)	9.2 piw	9.0 piw	8.8 piw
124°C (255°F)	8.6 piw	8.3 piw	9.3 piw
132°C (270°F)	8.7 piw	9.4 piw	8.6 piw
141°C (285°F)	7.9 piw	10.0 piw	9.4 piw
149°C (300°F)	7.8 piw	9.9 piw	9.6 piw
157°C (315°F)	8.5 piw	9.7 piw	9.9 piw
166°C (330°F)	9.7 piw	10.8 piw	9.9 piw
174°C (345°F)	10.6 piw	9.9 piw	10.7 piw
182°C (360°F)	10.5 piw	9.8 piw	9.3 piw

- Substrates used: Cold Rolled Steel (CRS), FR-4 PCB (FR-4), Polycarbonate (PC), Aluminum (AL).
- Bonds made using 2 second dwell, 10 psi.
- Peels tested at 90° angle, 2 in/minute.

Typical Methods For Bonding 3M™ Thermal Bonding Film Adhesives

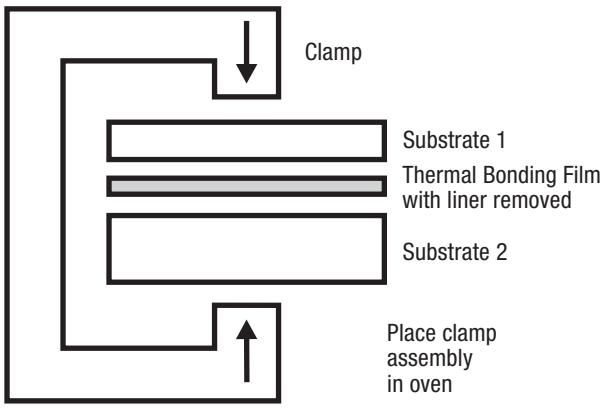
The following illustrations show several of the many methods that can be used to make bonds using 3M™ Thermal Bonding Film (TBF) adhesives. Equipment is generally available commercially or can be built or modified by the user to fit a particular application.

Hot Shoe or Thermode Bonding



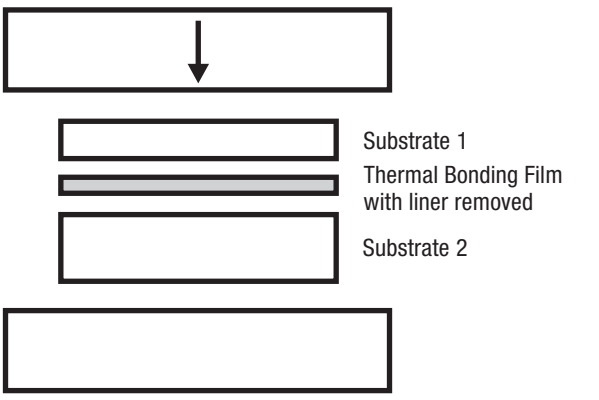
Generally used for small area bonding.

Oven (Static or Conveyorized) Bonding



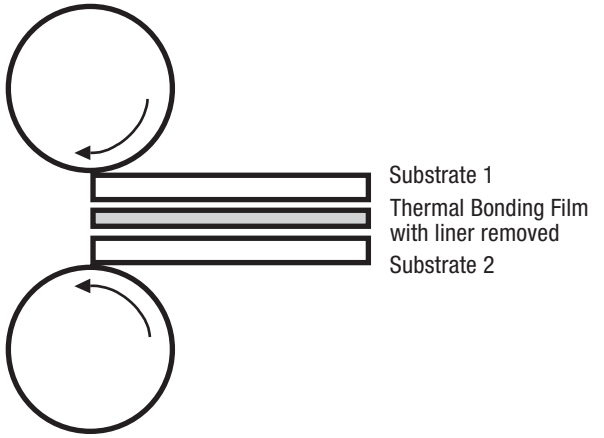
Good for small volume or startup bonding.

Hydraulic or Mechanical Press Bonding



Useful in larger area applications.

Lamination Bonding of Thin Substrates



Suitable for thin, large area parts.

Debonding – Since 3M™ Thermal Bonding Film (TBF) 615 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 135-149°C / 275-300°F) to soften the adhesive and then pry or peel the substrates apart.

Solvents, such as acetone, MEK, toluene and 3M™ Citrus Base Cleaner will soften 3M TBF 615 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.

Adhesion to Various Substrates

Test Substrate	Overlap Shear 3M™ Thermal Bonding Film 615 (4.0 mil)	90° Peel 3M™ Thermal Bonding Film 615 (4.0 mil)
Cold Rolled Steel	840 psi	13.5 piw
Stainless Steel	825 psi	16.0 piw
Aluminum	810 psi	15.5 piw
Polycarbonate	890 psi	11.5 piw
Acrylic	905 psi	13.0 piw
FR-4 PCB	930 psi	10.5 piw
ABS	805 psi	10.5 piw
HDPE	210 psi	3.5 piw
Polypropylene	410 psi	0.7 piw
PVC	915 psi	12.0 piw
Fir Wood	360 psi	NT
LCP (Vectra A-130)	NT	14.0 piw
LCP (Vectra B-130)	NT	11.0 piw
LCP (Zenite 6130L)	NT	13.0 piw
Nylon 6,6	NT	9.5 piw
PPS (Polyphenylene Sulfide)	NT	7.5 piw

- Overlap shear made bonding 20 mil aluminum to test substrates using 138°C (280°F) bondline temperature, 5 seconds dwell, 5 lbs gauge pressure.
- Peel bonds made bonding 4.5 mil aluminum foil to test substrates using 138°C (280°F) bondline temperature, 5 seconds dwell, 5 lbs gauge pressure.
- Adhesion tests done using Instron @ 2 in/minute for peel, .2 in/minute for OLS.
- NT – Not Tested.

Bond Strength Retention After Humidity Aging

Copper to Polycarbonate Bonds	3M™ Thermal Bonding Film 615 (4.0 mil)
Initial (Before Aging)	11.0 piw
6 days @ 95% RH / 66°C (150°F) 21 days @ 95% RH / 66°C (150°F)	10.2 piw 5.4 piw
6 days @ 95% RH / 85°C (185°F) 21 days @ 95% RH / 85°C (185°F)	10.2 piw 4.2 piw

- Bonds made bonding 1.5 mil copper foil bonded to 0.125 in polycarbonate @ 127°C (260°F), 5 second dwell, 5 lbs gauge pressure.
- Bonds tested by Instron peel @ 2 in/minute @ 90° peel angle.

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	3M™ Thermal Bonding Film 615 (4.0 mil) Peel Strength Cu to PC	3M™ Thermal Bonding Film 615 (4.0 mil) Overlap Shear Strength CRS to CRS
24°C (75°F)	11.0 piw	1130 psi
45°C (113°F)	8.5 piw	220 psi
66°C (150°F)	1.8 piw	35 psi
85°C (185°F)	0.4 piw	20 psi
95°C (203°F)	0.2 piw	7 psi

- Cu is 1.5 mil copper foil, PC is 0.125 in polycarbonate, CRS is Cold Rolled Steel.
- Peel bonds made @ 127°C (260°F), 5 seconds dwell, 5 lbs pressure.
- OLS bonds made @ 138°C (280°F), 10 minutes oven, 5 lbs pressure.
- Adhesion determined using Instron tester @ 2 in/minute for peels, .2 in/minute for OLS.

Electrical Data

Test	3M™ Thermal Bonding Film 615 (4.0 mil) Method	Value
Dielectric Constant	ASTM D-150	4.4 @ 1 kilohertz 4.4 @ 3 kilohertz
Dissipation Factor	ASTM D-150	0.018 @ 10 kilohertz 0.018 @ 100 kilohertz 0.017 @ 1000 kilohertz
Dielectric Breakdown Strength	ASTM D-149	520 volts/mil
Surface Resistivity	ASTM D-257	2×10^{13} ohms/sq.
Volume Resistivity	ASTM D-257	6×10^{14} ohm-cm

Thermal Data

Test	3M™ Thermal Bonding Film 615 (4.0 mil) Method	Value
Weight Loss By TGA (Thermal gravametric analysis)	Perkin-Elmer Series 7 RT to 800°C, 5°C/min, in air	1% wt loss @ 202°C 5% wt loss @ 268°C 10% wt loss @ 307°C
Coefficient of Thermal Expansion By TMA (Thermal mechanical analysis)	Perkin-Elmer Series 7 -60°C to 125°C @ 10°C/min	102×10^{-6} unit/unit/°C (-60°C to 20°C)

Storage and Shelf Life

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

Shelf Life: Shelf life is 2 years from the date of shipment under storage conditions mentioned above.

Safety Data Sheet

Please consult Safety Data Sheet prior to use.

Important Note

Please consult Federal, State, and Local Regulations. State Volatile Organic Compound (VOC) regulations may prohibit the use of certain alcohol solutions or solvents. You should check with your state environmental authorities to determine whether use of a solution or solvent is restricted or prohibited.

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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