

3M™ Anisotropic Conductive Film 7371

Product Description

3M™ Anisotropic Conductive Film (ACF) 7371 is a heat-bondable, electrically conductive adhesive film. The unbonded film is slightly tacky at room temperature and consists of a thermoset-elastomer and thermoplastic adhesive matrix randomly loaded with conductive particles. These particles allow interconnection of circuit lines through the adhesive thickness, but are spaced far enough apart for the product to be electrically insulating in the plane of the adhesive. Application of heat and pressure causes the adhesive to flow and to bring the circuit pads into contact by trapping the conductive particles. The adhesive rapidly cross-links at modest bonding temperature and pressure. 3M ACF 7371 may be used to bond a flexible printed circuit to another flexible printed circuit or to a plastic touch screen or plastic flat panel display device.

Construction

General Properties

| Property | Value |
|---------------------------|--------------------------------------|
| Adhesive Type | Thermosetting Type |
| Particle Type | Gold-Coated Polymer |
| Particle Size | 10 micron |
| Liner Type | Polyester Film with Silicone Release |
| Adhesive Thickness | 25 micron |
| Liner Thickness | 50 micron |

Typical Physical Properties and Performance Characteristics

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

Design Requirements

| Property | Value | Units |
|---|---------------------|----------------------------|
| Minimum Space Between Conductors | 100 (4) | micron (mil) |
| Minimum Pitch | 200 (8) | micron (mil) |
| Minimum Pad Area | 0.1 (160) | sq. mm (sq. mil) |

Ambient Physical Properties

| Property ⁽¹⁾ | Test Substrates | Value | Test Method |
|--------------------------------|-----------------------------------|-------------|---------------------------|
| Interconnect Resistance | Flex-to-PC board ⁽²⁾ | < 20 mOhms | 3M TM-2314 ⁽³⁾ |
| Interconnect Resistance | Flex-to-Ag-Ink/PET ⁽⁴⁾ | < 20 mOhms | 3M TM-2314 ⁽³⁾ |
| Peel Strength | Flex-to-ITO/PET ⁽⁵⁾ | > 700 gf/cm | 3M TM-2313 ⁽⁶⁾ |
| Peel Strength | Flex-to-Ag-Ink/PET ⁽⁴⁾ | > 600 gf/cm | 3M TM-2313 ⁽⁶⁾ |
| Peel Strength | Flex-to-bare-PET ⁽⁷⁾ | > 900 gf/cm | 3M TM-2313 ⁽⁶⁾ |

(1) For a given application, values may differ depending on particular substrate material or type of circuitry.

(2) Measured for gold/nickel/copper polyimide flex circuits bonded to printed circuit board. Contact overlap area was 0.38 sq. mm. Pad pitch was 500 microns.

(3) 3M internal test method TM-2314 based on IPC 650 - Section 2.6.24. The flex has the shorting strap located near the bond-line to approximate a 4-wire test structure and eliminate most extraneous resistance in the measurement due to the circuit lines.

(4) Measured for gold/nickel/copper polyimide flex circuits bonded to silver-ink/indium-tin-oxide/polyester. Contact overlap area was 2.0 sq. mm. Pad pitch was 2 mm.

(5) Measured for gold/nickel/copper polyimide flex circuits bonded to indium-tin-oxide/polyester. Flex circuit pitch was 500 microns.

(6) 3M internal test method TM-2313 based on IPC 650 - Section 2.4.9.1.

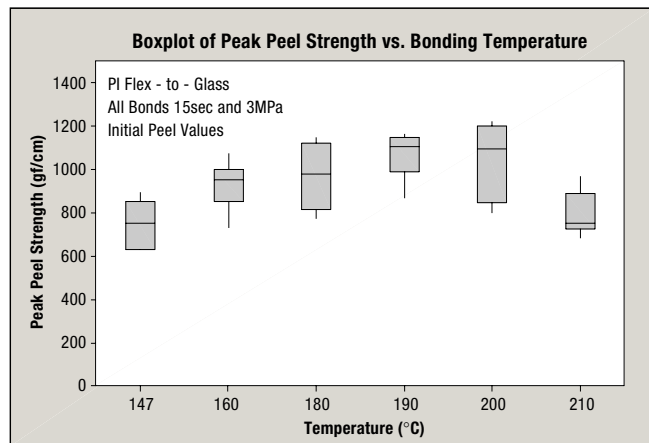
(7) Measured for gold/nickel/copper polyimide flex circuits bonded to bare polyester. Flex circuit pitch was 2 mm.



Typical Physical Properties and 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.

Ambient Physical Properties – Peel Strength⁽⁸⁾



Reliability Performance – Electrical Contact⁽⁹⁾

| Test Conditions | Interconnect Resistance (mOhms) 3M TM-2314 ⁽¹⁰⁾ |
|-----------------------------|---|
| 100°C x 1000 hrs | < 100 |
| -40° to 85°C x 1000 cycles | < 100 |
| 85°C / 85% r. h. x 1000 hrs | < 100 |

⁽⁸⁾ Measured for gold/nickel/copper polyimide flex circuits bonded to glass. Pad pitch was 100 microns.

⁽⁹⁾ Measured for gold/nickel/copper polyimide flex circuits bonded to Ag-Ink/indium-tin-oxide/polyester. Contact overlap area was 2.0 sq. mm. Pad pitch was 2 mm. Also, measured for gold/nickel/copper polyimide flex circuits bonded to printed circuit board. Overlap area was 0.38 sq. mm. Pad pitch was 500 microns.

⁽¹⁰⁾ 3M internal test method TM-2314 based on IPC 650 - Section 2.6.24. The flex has the shorting strap located near the bond-line to approximate a 4-wire test structure and eliminate most extraneous resistance in the measurement due to the circuit lines.

Reliability Performance – Peel Strength⁽¹¹⁾

| Test Conditions | Peel Strength (gf/cm) 3M TM-2313 ⁽¹²⁾ |
|-----------------------------|---|
| 100°C x 1000 hrs | > 500 |
| -40°C to 85°C x 1000 cycles | > 500 |
| 85°C / 85% r. h. x 1000 hrs | > 500 |

Assembly Process Techniques

Assembly Process

A source of heat and pressure, such as a thermo-compression (hot bar) bonder is required for use of 3M™ Anisotropic Conductive Film 7371. Several commercially available models exist; a list of vendors can be obtained by calling the toll free number on the back of this Technical Data Sheet.

Bonding of 3M ACF 7371 requires a three-part procedure:

Tacking the film to one substrate (pre-tacking)

Removing the release liner

Bonding the first substrate to the second substrate.

A pre-tacking temperature of 90°C under a pressure of about 10 kg/cm² should be used (see Table below). **For automated ACF application:** Set the ACF pretacking equipment to deliver the conditions provided in the Tacking and Bonding Conditions Table below. Slight adjustment to these conditions may be necessary for each application or for different types of circuitry. **For manual ACF application:** Cut the adhesive to the size of the flex circuit. Place the adhesive on the flex and set flex on hot plate at setpoint up to 90°C. Use roller to press adhesive onto the flex. After allowing flex and adhesive to cool, remove liner.

⁽¹¹⁾ Measured for gold/nickel/copper polyimide flex circuits bonded to Ag-Ink/ITO/polyester. Contact overlap area was 2.0 sq. mm. Pad pitch was 2 mm.

⁽¹²⁾ 3M internal test method TM-2313 based on test method IPC 650 - Section 2.4.9.1.

Assembly Process Techniques (continued)

Tacking and Bonding Conditions

| Procedure | Conditions |
|-----------------------------|----------------------------|
| Tacking Conditions | |
| Temperature ⁽¹³⁾ | 60 - 90°C |
| Pressure | 1 - 15 kg/cm ² |
| Time | ~1 sec |
| Bonding Conditions | |
| Temperature ⁽¹³⁾ | 140 to 170°C |
| Pressure | 10 - 20 kg/cm ² |
| Time ⁽¹⁴⁾ | 10 - 20 sec |

Final bonding must be done under heat and pressure, with a typical desirable bond line temperature that reaches at least 140°C after 10 seconds at a pressure of at least 10kg/cm² (see Table above). This has been achieved using a total bond time of 10-20 seconds where over the first 3-5 seconds the adhesive ramps quickly to near the target temperature and over the last 5-17 seconds the temperature reaches between 140°C and 170°C.⁽¹⁵⁾ A plot of the temperature vs. time profile is shown in Figure 1. Electrical contact between the circuits is typically achieved shortly after the thermode is pressed against the parts. Additional time at temperature is necessary to cross-link the thermoset-elastomer material to generate peel strength and the ultimate reliability. Bond times may vary depending upon the substrates to be bonded. (Optionally, for maximum mechanical and electrical performance, the pressure may be maintained while cooling to below 100°C. This increases the total bond time. The time required to drop adhesive bond-line temperature below 100°C is highly dependent on the bonding equipment used.)

⁽¹³⁾ Temperature measured in the adhesive. Thermode set points will be higher and will depend upon the substrate materials and bonding equipment. A typical set-up for tacking is a setpoint temperature of 125°C. Typical set-up for a flex circuit to polyester touch screen bond is a thermode temperature of 250°C and bonding time of at least 10 seconds (see next note).

⁽¹⁴⁾ The required minimum bonding temperature is usually reached at the endpoint of bonding time. The optimum bonding temperature and time may be different depending on customer application and design. Also, it may be desirable to hold pressure while cooling to below 100°C for maximum performance.

⁽¹⁵⁾ Bonding temperature up to 190°C has been shown to be acceptable for 3M™ Anisotropic Conductive Film 7371.

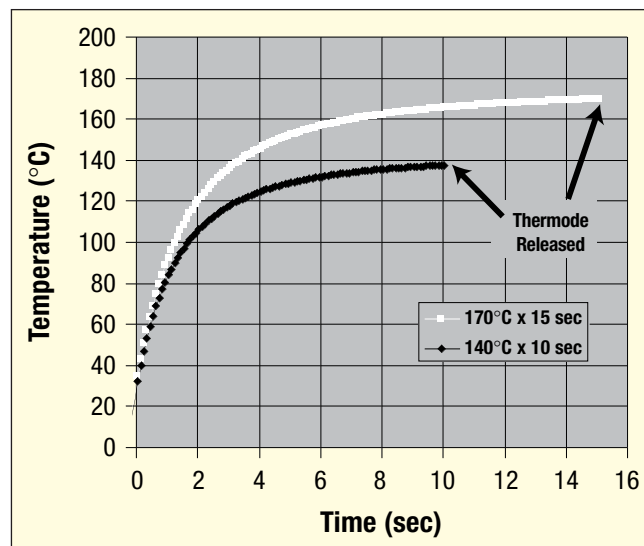


Figure 1. Graph of ACF temperature vs. time profile showing typical examples of bonding cycle.

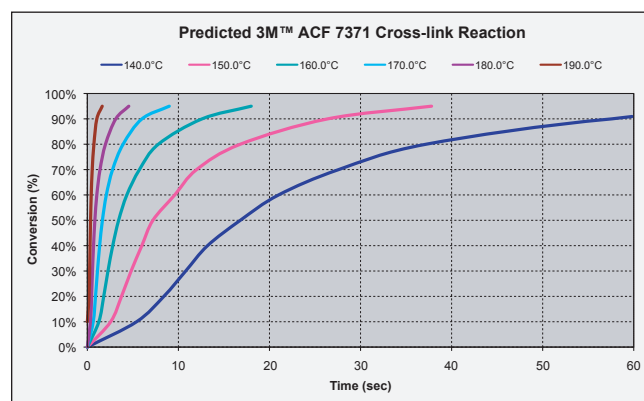


Figure 2. Graph of predicted cross-link reaction compared with bonding temperature and time.

A comparison of the predicted level of cross-link reaction across a range of bonding temperature and bonding time is shown in Figure 2.

Repair

Bonds made with 3M™ Anisotropic Conductive Film 7371 may be repairable. The method for successful rework can show considerable variation for different design applications, process parameters, and equipment capabilities. Contact your local Tech Service Representative for further information.

Assembly Process Techniques (continued)

Storage

The 3M™ Anisotropic Conductive Film 7371 should be kept frozen in the original airtight shipping bag and stored at temperatures $\leq 2^{\circ}\text{C}$. The product should be allowed to warm to room temperature for approximately 30 minutes prior to use to prevent moisture condensation on the film. Whenever possible, 3M ACF 7371 should be kept away from high humidity environments as absorbed water can lead to moisture volatilization producing bubbles during heat bonding or gradual degradation of the product. The 3M ACF 7371 can be held at room temperature for product utilization provided the cumulative room temperature shelf life of 4 weeks is not exceeded.

Shelf Life Data

| Storage Environment | Value |
|-----------------------------------|-----------|
| Freezer ($< 2^{\circ}\text{C}$) | 12 months |
| Room Temperature | 4 weeks |

Product Selection Guide

| | Flex Type | | | Connection Type | | | | Pitch and Space Requirements | |
|-------------|-------------------------|--------------------------|--------------------------|-----------------|------------------------|-------------|--------------|----------------------------------|------------------|
| | Silver Ink on Polyester | Gold/Copper on Polyester | Gold/Copper on Polyimide | Flex to Glass | Flex to Plastic Device | Flex to PCB | Flex to Flex | Minimum Space Between Conductors | Minimum Pad Area |
| ACF 5363 | | | X | | | X | X | 100 micron | 0.15 sq. mm |
| ACF 7303 | X | X | X | X ¹ | X ² | X | X | 250 micron | 0.75 sq. mm |
| ACF 7371 | X | X | X | X | X | | X | 100 micron | 0.10 sq. mm |
| ACF 7371-20 | X | X | X | X | X | | X | 100 micron | 0.50 sq. mm |
| ACF 7376-10 | X | X | X | X | X | X | X | 70 micron | 0.10 sq. mm |
| ACF 7376-30 | X | X | X | X | X | X | X | 100 micron | 0.50 sq. mm |
| ACF 7379 | X | X | X | X | | | | 50 micron | 0.05 sq. mm |

¹Tested only for silver frit; not suitable for ITO traces.

²Suitable for silver ink traces only; not suitable for ITO traces.

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.

Product Use

Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. Given the variety of factors that can affect the use and performance of a 3M product, user is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application.

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