3M Solutions for Plastics

Design Guide for plastics application success

Bonding, attaching, mounting, laminating, fastening, sealing, labeling, protecting

3M

3M Product Portfolio for applications success

LSE (Low Surface Energy) → **HSE (High Surface Energy)**

	PTFE	Polypropylene	Polystyrene	Acrylic	PVC	ABS	Polyester
STRUCTURAL* ADHESIVES		Two-part Acrylic					
			Two-part Epoxy Two-part Urethane				
		Instant Adhesive (CA)					
		Instant Adhesive (CA) Primer					
			Polyurethane Reactive (PUR)				
NON-STRUCTURAL ADHESIVES**		Aerosol Cylinders Hot Melt Extrudable Hot Melt Sprayable Solvent-based*** Water-based Sealants					
			Bonding Films				
BONDING TAPES		Adhesive Transfer Tapes Double Coated Tapes General Purpose Foam Tapes 3M™ VHB™ Tapes					
OTHER SOLUTIONS		Reclosable Fasteners					
				Protective Tapes (Short Term) - except PVCs			
		High Performance Polyester Label Materials					

NOTE: The optimal curing guideline for plastics solutions ranges from 72 hours to 7 days.
* Structural strength adhesives reach a minimum of 1,000 psi overlap shear strength.

** Non-structural strength adhesives typically reach less than 1,000 psi overlap shear strength.
*** Solvent-based adhesives may craze (attack) some surfaces.

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With no surface preparation, 3M™ Scotch-Weld™ Structural Plastic Adhesive DP8005 bonds end caps on Low Surface Energy plastic fence posts. Handling strength in 2-3 hours.

5

3M™ Scotch-Weld™ Plastic & Rubber Instant Adhesive PR600 permanently bonds difficult-to-bond plastics and rubbers together, or in combination with metals and/or composites.

6

In bonding plastic feathers and nocks onto arrow shafts, 3M™ Scotch-Weld™ Industrial Plastic Adhesive 4475 dries quickly to a firm bond that resists plasticizers and water.

For thin bondlines in automotive interior trim attachment, 3M™ Quick Bonding Adhesive 360 bonds with strength greater than many thicker tapes.

3M™ Scotch-Weld™ Epoxy Adhesive 8405 readily bonds many difficult-to-bond plastics in applications ranging from computers to signage.

7

For ease of assembly and precise fit, die-cut 3M™ VHB™ Tape bonds and seals plastic components throughout a GPS unit.

Keeping pace with the growth in plastics products – 3M solutions for improved design, performance, and productivity

Applications success…
for wherever people live, work, or play

In 1976 plastics had become the most commonly used material in the world. By 2001 plastics was the fourth largest manufacturing segment in the United States. Today, wherever you live, work, or play, the use of plastics is growing, and with it the use of 3M adhesive and tape technologies to assemble, protect, and label products made of plastics or plastics combined with metal, wood, or other materials.

3M adhesive and tape benefits

- Bond strength matched to the job, for example, replacing screws and other mechanical fasteners; bonding LSE plastics with little or no surface preparation
- Virtually invisible fastening for an aesthetically-pleasing product
- Increased material options – bond more plastics than ever, including inexpensive hard-to-bond plastics
- Increased manufacturing efficiency with faster assembly speed and fewer assembly steps in many applications
- Bond and seal simultaneously

This guide is an overview to help you match 3M technologies to specific thermoplastics for applications success.

Types of plastics

Thermoplastics are polymers that can be repeatedly softened with heat for molding, becoming solid when cooled.

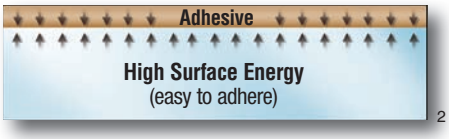
Thermosetting plastics soften with heat once, then cool to an insoluble solid.

Thermoset parts are easily bonded, while thermoplastics have a wide range of surface energy characteristics which must be considered for successful bonding or labeling.

At the same time, however, thermoplastics are more commonly used because of a wide variety of production and end use properties. For example, polypropylene is inexpensive with high chemical resistance, but is hard to bond due to its low surface energy. Nylon is more expensive, resists wear and heat, and is easier to bond given its high surface energy.

Low to high surface energy

An unwaxed car hood exhibits high surface energy (HSE) and water spreads across the surface. Similar to water, adhesive on a high energy surface flows and "wets out" the surface. "Wetting" is necessary for effective bonding.



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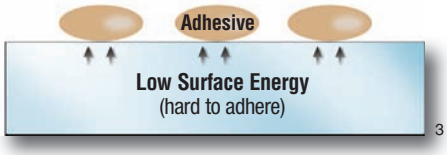
A waxed hood exhibits low surface energy (LSE). In effect, the "energy of the wax" repels the water, forcing it into beads. Adhesive also beads up and does not effectively wet an LSE



3

For bonding success with LSE thermoplastics, 3M offers several specially formulated adhesives and tapes.

Using the selection chart

This guide focuses on thermoplastics because of their complexity, versatility, and wide use. Thermoplastics are presented in the adjacent chart, moving left to right from low to high surface energy. At the intersections of 3M technology and plastic, 3M product numbers represent starting points for further evaluation.

For more information:
1-800-362-3550
www.3M.com/adhesives

	3M Solutions	Benefits
STRUCTURAL ADHESIVES	Two-part Acrylic	Versatile; eliminates or minimizes surface preparation even on LSE plastics
	Two-part Epoxy	Highest strength and elevated temperature resistance of all 3M™ Adhesives
	Two-part Urethane	Fast curing to a flexible, impact resistant bond; lower cost than epoxy or acrylic
	Instant Adhesive (CA)	One-part liquid reaches handling strength in 5-10 seconds at room temperature
	Instant Adhesive (CA) Primer**	Prepares LSE plastics for secure adhesive bonding
	Polyurethane Reactive (PUR)	Hot melt production speed with performance typical of structural adhesive
NON-STRUCTURAL ADHESIVES	Aerosol	Convenient fistful of bonding power and versatility
	Cylinders	Aerosol convenience, bulk productivity for large area coverage
	Hot Melt Extrudable	Fast bonding with a targeted bead of solventless adhesive; move assemblies immediately
	Hot Melt Sprayable	Fast wide area application; fast bonding for lightweight parts; solventless
	Solvent-based	Solvent speeds and strengthens the bond between a wide range of plastics and other surfaces
	Water-based	Easier environmental compliance; speed to handling exceeds most solvent-based systems
	Sealants	Flexible seals on many plastics to keep air, wind, dirt, and water in or out
	Bonding Films	Precision shape, size, and fit; bonds in seconds with heat; solventless
BONDING TAPES	Adhesive Transfer Tapes	Clean, precise application of dry pressure sensitive adhesive for bonding on contact
	Double Coated Tapes	Benefits of adhesive transfer tapes but with a carrier for handling stability and die-cutting
	General Purpose Foam Tapes	Benefits of double coated tapes but with foam carrier for gap filling
	3M™ VHB™ Tapes	Pressure sensitive adhesive on a roll to replace mechanical fasteners and solvent welding
OTHER SOLUTIONS	Reclosable Fasteners	Stick to a variety of plastic surfaces that need repeated attachments and removals
	Protective Tapes (Short Term)	Protect plastic surfaces from scratching, abrasion, and chipping; remove cleanly
	High Performance Polyester Label Materials	Abrasion and solvent resistant facestocks; permanent adhesion even to LSE plastics

NOTE: The technical information and data on these pages should be considered representat
A variety of other bonding, joining, and sealing products are available for these as well as va
and/or based on processing techniques. Since various grades of a particular resin can con
product selection should only be made by the users after evaluation of sample bonds and consid

Matching 3M technology to the thermoplastics of your choice...even LSE

LSE (Low Surface Energy)

	PTFE	Polypropylene	TPO	Polyethylene	Polystyrene	Acrylic	PVC - Plasticized	PVC - Unplasticized	ABS
	–	DP8005, DP8010	DP8005, DP8010	DP8005, DP8010	DP807, DP810, DP812, DP825, DP8010	DP807, DP810, DP812, DP825, DP8010	DP807, DP810, DP812, DP825, DP8010	DP807, DP810, DP812, DP825, DP8010	DP807, DP81 DP812, DP82 DP8010
	–	–	–	–	2216 B/A, DP100 Plus, DP125, DP420, DP460, DP8405	2216 B/A, DP100 Plus, DP125, DP420, DP460, DP8405	2216 B/A, DP100 Plus, DP125, DP420, DP460, DP8405	2216 B/A, DP100 Plus, DP125, DP420, DP460, DP8405	2216 B/A, DP100 DP420, DP460,
	–	–	–	–	3532 B/A, DP604NS, DP605NS, DP640	3532 B/A, DP604NS, DP605NS, DP640	3532 B/A, DP604NS, DP605NS, DP640	3532 B/A, DP604NS, DP605NS, DP640	3532 B/A, DP DP605NS, DP
	Primer AC77* with SF100	Primer AC77* with PR600 or SF100	Primer AC77* with PR600 or SF100	Primer AC77* with PR600 or SF100	CA40H, CA100, PR600, SF100	CA40H, CA100, PR600, SF100	CA40H, CA100, PR600, SF100	CA40H, CA100, PR600, SF100	CA40H, CA10 SF100
	AC77*	AC77*	AC77*	AC77*	AC77*	None Needed	None Needed	None Needed	None Needed
	–	–	–	–	EZ250030, EZ250150, TE031, TS230	EZ250030, EZ250150, TE031, TS230	EZ250030, EZ250150, TE031, TS230	EZ250030, EZ250150, TE031, TS230	EZ250030, EZ TE031, TS23
	–	77, 90	77, 90	72, 77, 90	78	77, 90	80	77, 90	77, 90
	–	90, 94	78HT, 90	90, 94	70, 78HT	90, 94	4491	90, 94	90, 94
	–	3731, 3748, 3764, 3796	3731, 3764, 3792LM, 3796	3731, 3748, 3764, 3796	3764, 3796	3747, 3764, 3792LM, 3796	3789, 3796	3731, 3747, 3764, 3796	3748, 3764, 3792LM, 379
	–	6111HT, 6116	6111HT, 6116	6111HT, 6116	6111HT	6111HT	6111HT	6111HT	6111HT
	–	4693	4693	4693	1357, 4693	5, 1357, 2262, 4475, 4693	5, 1099, 2262, 4475	5, 2262, 4475, 4693	5, 1099, 4693
	–	2000NF	2000NF	2000NF	30NF, 49, 2000NF	30NF, 49, 100, 2000NF	30NF, 49, 2000NF, 4224-NF	30NF, 49, 100, 2000NF	30NF, 49, 100 2000NF
	–	5354	5354	5354	540, 606NF, 5354	540, 560, 5354	800	540, 606NF, 800, 5354	540, 800, 535
	–	–	–	–	615, 615S, 668, 690	615, 615S, 668, 690	–	615, 615S, 668, 690	615, 615S, 66
	–	926 (ATG), 9472LE, 9626, 9627	926 (ATG), F9465PC, 9472LE, 9626, 9627	9472LE, 9626, 9627	969 (ATG), 9442, 9472LE	468MP, 950, 969 (ATG), F9469PC, 9626, 9627	969 (ATG), F9473PC	468MP, 950, 969 (ATG), 9472LE, F9473PC, 9626, 9627	468MP, 950, 9472LE, F947 9626, 9627
	–	9086, 9087, 9088, 9088FL, 9495LE, 9500PC, 9629PC	9495LE, 9690, 9629PC	9495LE, 9629PC	9495LE, 9500PC	444, 9086, 9495MP, 9500PC, 9629PC	9087	9086, 9087, 9088, 9088FL, 9495LE, 9629PC	9086, 9087, 9 9088FL, 9495 9495MP, 962
	–	4462, 4466	4462, 4466	4462, 4466	4016, 4032, 4492, 4496	4016, 4032, 4492, 4496	4016, 4032, 4492, 4496	4016, 4032, 4492, 4496	4016, 4032, 4
	–	Primer 94* with 4941 or 5952	Primer 94* with 4941 or 5952	Primer 94* with 4941 or 5952	Primer 94* with 4941 or 5952	4910, 4941, 5952	4941	4941, 5952	4941, 5952
	–	SJ3530/SJ3531, SJ3540	SJ3530/SJ3531, SJ3540	SJ3530/SJ3531, SJ3540	SJ3550, SJ3571/SJ3572	SJ3550, SJ3571/SJ3572	SJ3522/SJ3523, SJ3560	SJ3550, SJ3560, SJ3571/SJ3572	SJ3550, SJ3571/SJ35
	–	–	–	–	–	Contact 3M for recommended products*** 1-800-241-2031.	–	–	Contact 3M fo recommende products*** 1-800-241-20
	–	7868, 7871	7868, 7871	7868, 7871	7868, 7871	7816, 7868, 7871	7816, 7868, 7871	7816, 7868, 7871	7816, 7868, 7

ive or typical only and should not be used for specification purposes.
arious other plastics. Many plastics can vary from supplier to supplier
tain different additives or plasticizers which can affect adhesion, final
eration of a variety of factors such as application and end-use conditions.

* Not for sale or use in California.

** Recommended for a wide variety of LSE plastics and hard-to-bond elastomers:
- AC77 (with SF100) for HIPS (High Impact Polystyrene), PBT (Polybutylene Terephthalate), PMP (Polymethylpentene), POM (Polyoxymethylene) acetal resin, STYRON™, VALOX®, TPX™, and ISOPLAST™
- AC78 (with PR1500, SF20, SF100, or SF600) for Silicone, Santoprene™, fluoroelastomer, and EPDM.

plastics

HSE (High Surface Energy)

	Polycarbonate	Polyester (PET)	Polyurethane (RIM)	Nylon
0, 5,	DP807, DP810, DP812, DP825, DP8010	DP807, DP810, DP812, DP825, DP8010	DP807, DP810, DP812, DP825, DP8010	DP807, DP810, DP812, DP825,
0 Plus, DP125, DP8405	2216 B/A, DP100 Plus, DP125, DP420, DP460, DP8405	2216 B/A, DP100 Plus, DP125, DP420, DP460, DP8405	2216 B/A, DP100 Plus, DP125, DP420, DP460, DP8405	2216 B/A, DP100 Plus, DP125, DP420, DP460, DP8405
604NS, 640	3532 B/A, DP604NS, DP605NS, DP640	3532 B/A, DP604NS, DP605NS, DP640	3532 B/A, DP604NS, DP605NS, DP640	3532 B/A, DP604NS, DP605NS, DP640
0, PR600,	CA40H, CA100, PR600, SB20, SF100	CA40H, CA100, PR600, SB20, SF100	CA40H, CA100, PR600, SF100	CA40H, CA100, PR600, SF100
	None Needed	None Needed	None Needed	None Needed
Z250150, 0	EZ250030, EZ250150, TE031, TS230	EZ17010, EZ250030	EZ17010, TE031, TE040	EZ250150, TE031
	77, 90	77, 90	74, 77, 90	77, 90
	90, 94	90, 94	74, 92	90, 94
6	3731, 3747, 3748, 3764, 3796	3731, 3764, 3796	3731, 3748, 3764, 3796	3731, 3796
	6111HT	6111HT	6111HT	6111HT
3	5, 1099, 4475, 4693	1099, 1357, 4693	847, 1099	1099, 1357, 4693
0,	30NF, 49, 100, 2000NF	30NF, 49, 100, 2000NF	30NF, 49, 100, 2000NF	30NF, 49, 100, 2000NF
54	540, 800, 5354	540, 800, 5354	540	560, 800, 5354
68, 690	615, 615S, 668, 690	615, 615S, 668, 690	615, 615S, 668, 690	615, 615S, 668, 690
969 (ATG), 3PC,	468MP, 926 (ATG), 950, 969 (ATG), 9472LE, F9473PC, 9626, 9627	468MP, 926 (ATG), 950, 969 (ATG), 9472LE, F9473PC, 9626, 9627	468MP, 950, 969 (ATG), 9472LE, F9473PC, 9626, 9627	468MP, 926 (ATG), 950, 969 (ATG), 9472LE, F9473PC, 9627
9088, LE, 9PC	9086, 9087, 9088, 9088FL, 9495LE, 9495MP, 9629PC	9086, 9087, 9088, 9088FL, 9495LE, 9495MP, 9629PC	9086, 9087, 9088, 9088FL, 9495LE, 9495MP, 9629PC	9086, 9087, 9088, 9088FL, 9495LE, 9495MP, 9629PC
4492, 4496	4016, 4032, 4492, 4496	4016, 4032, 4492, 4496	4016, 4032, 4492, 4496	4016, 4032, 4492, 4496
	4910, 4941, 5952	4941, 5952	4941, 5952	4941, 5952
72	SJ3550, SJ3571/SJ3572	SJ3550, SJ3571/SJ3572	SJ3550, SJ3571/SJ3572	SJ3550, SJ3571/SJ3572
r d 031.	Contact 3M for recommended products*** 1-800-241-2031.	Contact 3M for recommended products*** 1-800-241-2031.	Contact 3M for recommended products*** 1-800-241-2031.	–
7871	7816, 7868, 7871	7816, 7868, 7871	7816, 7868, 7871	7816, 7868, 7871

*** Short term surface protection tape solutions vary depending on substrate and conditions of application/usage. For product selection guidance, please use the online product selector tool at www.3M.com/ProtectiveTapes.

Thermoplastics properties and typical applications

PTFE (Polytetrafluoroethylene)

- Very low friction; excellent dielectric
- Slippery, non-stick surfaces; insulator

Polypropylene

- Toughness; chemical resistance
- Furniture, luggage, containers, fishing tackle

TPO (Thermoplastic polyolefin)

- UV and impact resistance for outdoors
- Automotive bumper fascia, roofing membrane

Polyethylene

- Water, oil, and solvent resistance
- Housewares; many injection molded parts

Polystyrene

- Lightweight, rigid, water resistance
- Toys, decorative panels, refrigerator trays

Acrylic

- Stiff, durable, weather resistance; unlimited color
- Signs, dials, appliance trim, shower tray, light cover

PVC (Polyvinyl chloride)

- Lightweight, stiff, hard, durable
- Window extrusions; gutters

ABS (Acrylonitrile-Butadiene-Styrene)

- Tough, rigid, heat/weathering/chemical resistance
- Refrigerator liner, housings, dashboard, handles

Polycarbonate

- High impact resistance, toughness, transparency
- Medical equipment, electrical/electronics, toys

Polyester (PET – Polyethylene terephthalate)

- Electrical properties, chemical/abrasion resistance
- Motor housing, small appliances, cable connectors

Polyurethane (RIM – Reaction Injection Molding)

- Hold fine detail, tough, wear resistance
- Carved wood simulations, housings

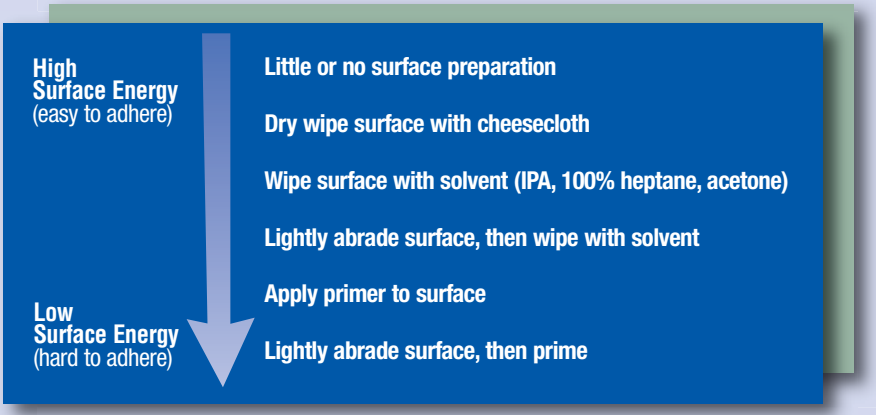
Nylon

- Impact/fatigue/abrasion resistance, low coefficient of friction, good electrical properties
- Bearings, gears, hinges, casters, valves, bike wheels

3M Solutions for Plastics - Surface Preparation

Surface preparation will typically enhance adhesion and contribute to greater consistency of bond strength. This is especially important when moving from High Surface Energy plastics (which are easier to bond) to Low Surface Energy plastics (which are more difficult to bond).

For any type of plastics, it's important to consider the different options for surface preparation. While 3M has products that minimize or eliminate surface preparation for LSE plastics, the general rule of thumb is the lower the surface energy, the greater the need for additional surface preparation steps. All adhesives are recommended to have good surface preparations before applying the adhesive.



Graphic shows surface preparation methods which may be required to maximize bond strength.

Solutions through science and service

Solutions in this brochure are only a few of the many available from 3M now. 3M R&D is also ongoing with more than a billion dollars a year invested to develop innovative new solutions for the future. But since science and innovation are practical only to the extent that end users can put them to work, 3M also emphasizes service:

- 3M representatives for sales assistance in more than 50 countries
- Highly trained technical service teams to help customers evaluate 3M products for specific applications
- Authorized distributor networks for local assistance and product availability
- Authorized converters to adapt 3M technologies to meet special requirements for form, fit, and function

More information

- **3M™ Adhesives, Tapes, Reclosable Fasteners, and Protective Products:** 1-800-362-3550 or www.3M.com/adhesives
- **3M™ Performance Label Materials:** 1-800-422-8116 or www.3M.com/converter
- **3M products converted to precise size and shape:** 1-800-223-7427 or www.3M.com/converter

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