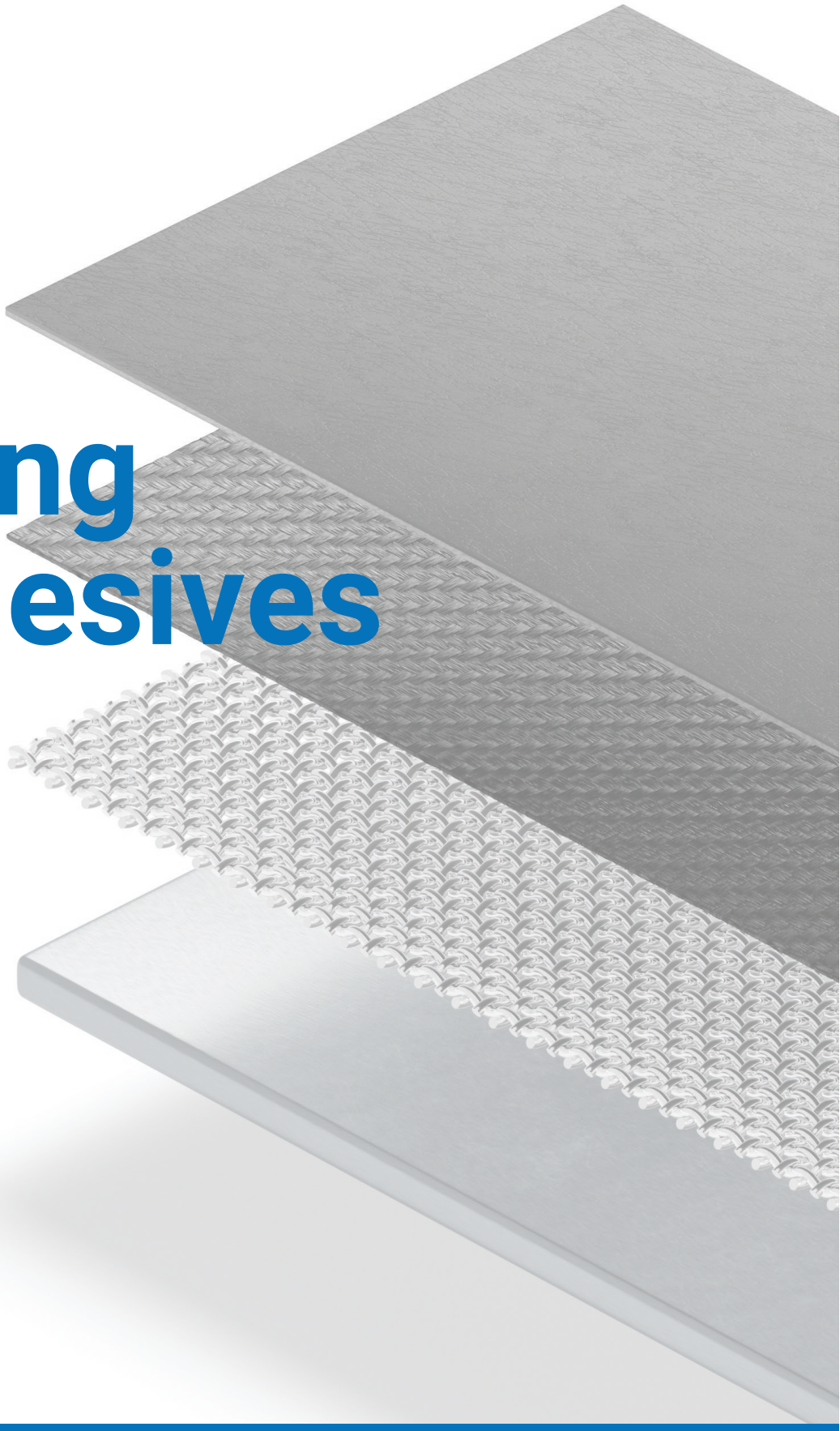
MELROSE

Bonding & Adhesives



Technical Solutions Through Expertise and Partnership

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The Fundamentals of Bonding & Adhesives

One of the most demanding challenges engineers and production teams face today is the bonding of materials.

This document helps to identify the different materials, adhesives, and factors to consider when tasked with bonding materials for your design/assembly.

We'll break this down into some starting point categories that should help you ask the right questions when engineering the ideal bonding solution.

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Bonding Surfaces

Q. What materials are being bonded together?

Here are some simple categories to help identify material properties and bonding requirements:

Metals (unpainted, uncoated)

These materials provide the best surfaces for bonding and adhesion. Metals such as copper, aluminum and stainless steel are high surface energy materials and promote excellent adhesion and bond.

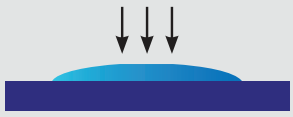
High Surface Energy Plastics

A large range of industrial and commercial plastics providing good adhesion for bonding.

Low Surface Energy Plastics

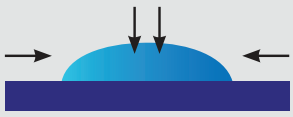
These materials can provide a challenging platform for adhesives to bond to. Specialty adhesives, primers, and other methodologies may be required given properties of these materials and their tendency to inhibit adhesion/bonding.

Metal Surfaces (High Surface Energy)



mJ/m²	Surfaces
1103	Copper
840	Aluminum
753	Zinc
526	Tin
458	Lead
700–1100	Stainless Steel
250–500	Glass Porcelain

High Surface Energy Plastics (HSE)



mJ/m²	Surfaces
50	Polyimide Industrial Film
47	Phenolic
46	Nylon
45	Alkyd Enamel
43	Polyester
43	Epoxy Paint

mJ/m²	Surfaces
43	Polyurethane Paint
42	ABS
42	Polycarbonate
39	PVC Rigid
38	Modified PPE Resin
38	Acrylic

Low Surface Energy Plastics (LSE)

mJ/m²	Surfaces
37	PVA
36	Polystyrene
36	Acetal
33	EVA
31	Polyethylene
29	Polypropylene
28	Polyvinyl Fluoride Film
18	PTFE
Broad Range	Powder Coated Paints

As a rule of thumb, the higher the surface energy, the greater the strength of adhesion.
Note: These values are provided as a guide. Formulation modifications can substantially alter surface energies.

Types of Adhesives

Q. Which adhesive is the best solution for my requirements?

Here are some commonly used adhesives and where they are utilized:

Acrylic Adhesives

Removable: Designed for temporary bond or for applications where resealing function is required.

Permanent:

- **General Purpose**: Most commonly used when bonding high surface energy materials not requiring extreme temperature performance. Options include economy-grade products to balance performance and cost.
- **Low Surface Energy**: Used in applications where bond surfaces include low surface energy plastics or coatings requiring a higher performance adhesive.
- **Low and/or High Temperature:** A range of products to meet extreme temperature environments. Operating as low as -60F to peak temps of 450F.

Silicon Adhesives

Typically used when bonding to silicone surfaces but also utilized in applications where extreme temperature exposure (-60F to 500F) exceeds performance of acrylic adhesives.

Foam Tapes/Adhesives

- **Acrylic Foam Tapes**: Products like 3M VHB closed cell foam tape are used to replace mechanical fasteners, reduce vibration, and withstand extreme conditions. Excellent sealing solution for ingress protection.
- **Urethane Foam Tapes**: Open cell general purpose mounting tape for applications such as acoustic panels, dispensing products, clips and electrical channels.
- **Polyethylene Foam Tapes**: Open cell general purpose mounting tape for displays, signs, and Point-Of-Purchase related items.

Optically Clear Adhesives

Used in display and electronic assemblies when adhering 2 different materials, but bonding cannot be visible or interfere with the image being displayed.

Applying Adhesives

Q. What conditions and processes should be considered when applying adhesive?

Here are some factors that may positively or negatively impact bonding:

Surface

Make sure the surface you are applying the adhesive to is clean and free of dust, debris, and oils. Dirt and oil will inhibit bond and adhesion.

Process

What methods are you employing to apply the adhesive? Manual application or automation? Ensure that whatever process you use for application provides even and consistent pressure for good contact.

Time to Use

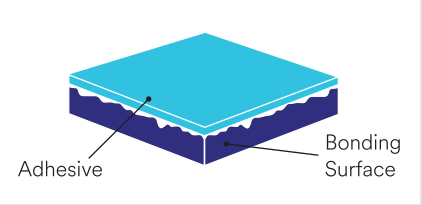
Adhesives take time to provide the highest levels of performance and bond. Carefully evaluate the adhesives initial tack and ultimate bond time to ensure it will meet your requirements.

Temperature

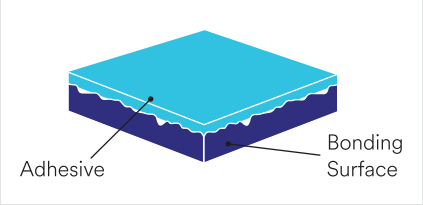
Are you bonding the materials in a controlled and consistent environment? Conditions such as extremes in low or high temps will influence how the adhesive behaves during and after application.

Applying firm pressure to the bond increases adhesive flow and contact for more secure bonding.
Time and temperature will typically further increase contact and adhesion values.

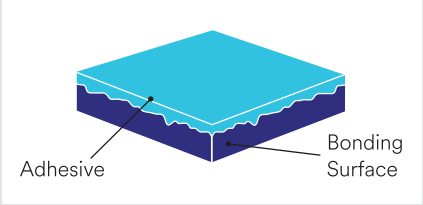
1 Initial Contact (Minimal Contact)



2 After Rubdown (More Contact)



3 After Dwell Time (Excellent Contact)



Environmental Factors

Q. What conditions is the adhesive being subjected to and how do I need it to perform?

Here are some environmental factors that should be assessed for suitability in the end application:

Temperature

Confirm any extreme high or low temperatures to ensure the appropriate adhesive is selected.

Chemical Exposure

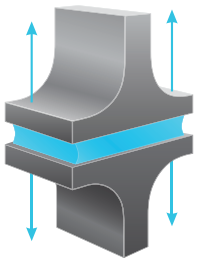
Determine if adhesive and bond areas will be subjected to chemical contact. Confirming the exact chemicals and duration of exposure will help with adhesive selection to prevent failure.

Sealing and Ingress Requirements

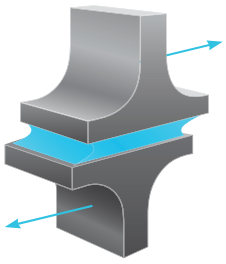
Confirm if adhesive requirement includes sealing against water, dirt/dust, and other contaminants that may adversely affect your product function.

Exerting Forces

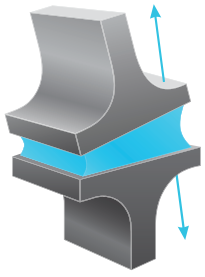
When bonding 2 materials together confirm if there are peel, shear, or other stresses being imparted onto your assembly after bonding.
See examples below.



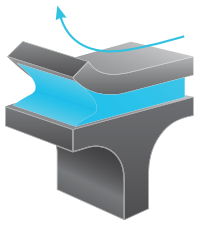
Tensile is pull exerted equally over the entire joint. Pull direction is straight and away from the adhesive bond.



Shear is pull directed across the adhesive, forcing the substrates to slide over each other.



Cleavage is pull concentrated at one edge of the joint, exerting a prying force on the bond. The other edge of the joint is theoretically under zero stress.



Peel is concentrated along a thin line at the edge of the bond where one substrate is flexible. Once peeling has begun, the stress line stays out in front of the advancing bond separation.

Markets & Applications

Q. What are the typical adhesive performance requirements and use cases?

Aerospace & Defense

Foam adhesives for structural bonding and dampening, silicon and acrylic adhesives for high temp environment, low outgassing adhesives for sensitive electronic environments.

Automotive & Transportation

High performance adhesives for assembling vehicle bodies, bonding to prevent vandalism, adhesives for sound & vibration dampening.

Electronics

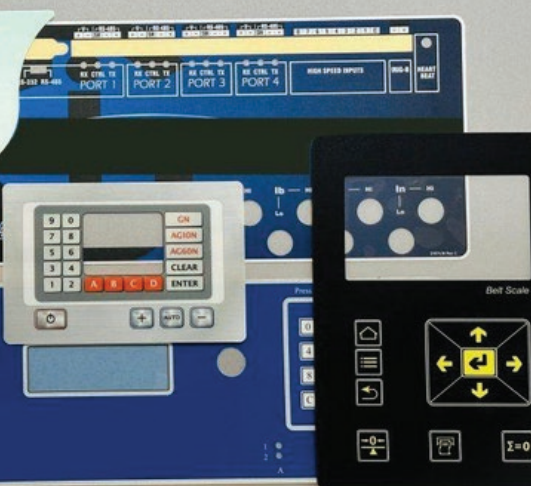
Adhesives for circuit board assembly, thermal or electrical conductivity, sealing against ingress.

Medical Devices

Assembling and sealing medical instruments, skin safe adhesives for wearables, and bonding solutions suitable for sterilization processing.

Industrial

Bonding and sealing critical components, adhesives for extreme temperatures and chemical exposure, adhesives for dampening and impact.



Melrose Nameplate & Label Co. delivers engineered solutions for industrial manufacturing, specializing in custom-printed and die-cut components. With decades of expertise, we ensure seamless ordering, technical precision, and 100% quality. We are committed to innovation, efficiency, and problem-solving for every customer's unique needs.

How Can We Help?

As engineers tackle some of today's most exciting, innovative, and challenging product design requirements, having access to information is key to ensuring reliable solutions. This document is just a starting point to the ongoing conversation about bonding, adhesives, and aligning performance to the end-use requirements. At Melrose, we remain focused on building product and materials expertise to help engineers solve the most difficult problems across the range of applications and markets.

Contact us to get started.

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