DuraTech Fundamentals of Adhesion

There are differences in adhesives. Selecting the proper adhesives for a nameplate, label or membrane switch application requires consideration of environmental, surface, appearance and performance requirements. Our purpose is to cover some of the principles of adhesion.

Surface contact is fundamental to adhesive performance. To maximize adhesive contact on a surface:

- It must be dry and free of contaminates.
- Firm pressure must be applied to increase the flow and contact of the adhesive with the substrate.
- Time and temperature will increase the surface contact and adhesion values.

Adhesion is the molecular force of attraction between unlike materials. The strength of attraction is determined by the surface energy of the material. The higher the surface energy, the greater the molecular attraction. The lower the surface energy, the weaker the attractive forces.

Greater molecular attraction results in increased contact between an adhesive and substrate. In other words, on a high surface energy material, the adhesive can flow ("or wet-out") to assure a stronger bond.

Consider an automobile that has not been waxed for a long time. When water contacts the surface it spreads in large puddles. The unwaxed car surface exhibits high surface energy—the molecular attraction allows the water to flow.

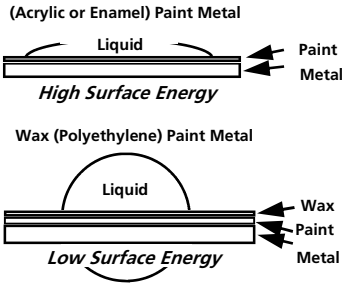
In comparison, water beads up into small spheres on a freshly waxed car. It is an example of low surface energy—the liquid (or adhesive) does not flow out.

Surface energy is measured by dynes per centimeter. The dyne level is the actual reading of the critical surface tension.

Modified acrylic and synthetic adhesives with better flow (or "wet-out") characteristics have been developed to adhere to low surface energy substrates. The Surface Energy Chart below compares the relative surface energy of commonly used substrates.

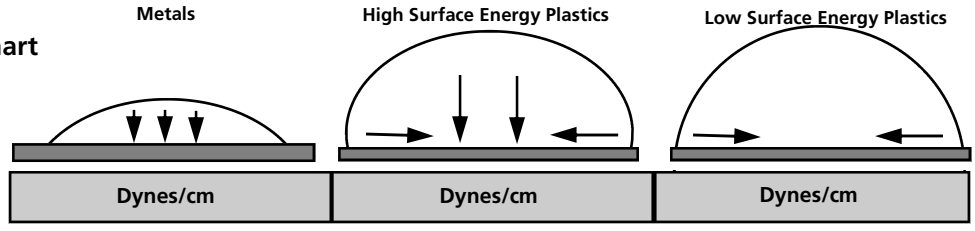
3M's firm acrylic adhesives such as #200, #200MP and #600 families will not readily adhere to substrates categorized as having "low surface energy." However, 3M's #300, #320, and #350 modified acrylics, or #700 synthetic rubber adhesives have been designed to adhere to low surface energy plastics, and should be considered for those applications.

Wet-ability Principle



This illustration demonstrates the effect of surface energy on adhesive interfacial contact. High surface energy materials draw the adhesive closer for high bond strength.

Surface Energy Chart



Metals	High Surface Energy Plastics		Low Surface Energy Plastics
1103 Copper	50 Kapton®	39 PVC	37 PVA
840 Aluminum	47 Phenolic	38 Noryl®	36 Polystyrene
753 Zinc	46 Nylon	38 Acrylic	36 Acetal
526 Tin	45 Alkyd enamel	38 Polane® Paint	33 EVA
458 Lead	43 Polyester		31 Polyethylene
700-1100 Stainless Steel	43 Epoxy Paint		29 Polypropylene
250-500 Glass	43 Polyurethane paint		28 Tedlar®
	42 ABS		18 Teflon®
	42 Polycarbonate		

*These values are provided as a guide. Modifications in formulations can substantially alter surface energies. Kapton®, Tedlar® and Teflon® are registered trademarks of Dupont. Noryl® is a registered trademark of General Electric. Polane® is a registered trademark of the Sherwin-Williams Company.