



TECHNICAL BULLETIN

PROS AND CONS OF URETHANE, EPOXY, OR SILICONE ADHESIVES



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With so many adhesive technologies available, choosing the right material for your application can be a daunting task. Epoxies, silicones, and urethanes are three primary chemistries widely used in industrial applications. Each has its own benefits and drawbacks to consider.

Epoxy Adhesives

Epoxy adhesives are available in one or two-part formulations with room temperature and heat cure options. Known for strong bonds, they are a common structural-grade adhesive choice and are best at bonding similar substrates like glass, metal, and wood.

Pros of Using an Epoxy Adhesive

- Good chemical resistance
- Excellent environmental resistance
- Tough, high-strength bonds
- Wide variety of cure speeds
- Good void-filling capabilities
- Can be electrically and thermally conductive
- Resistance to creep under sustained loads

Cons of Using an Epoxy Adhesive

- Room temperature curing epoxies do not operate well over 120 °C, a heat cured epoxy is required
- Without modification, cured epoxies can be brittle
- Proper curing of two-part epoxies requires exact mix ratios
- Slow cure times

Silicone Adhesives

Silicone adhesives are available in one or two-part formulations and are widely known for being incredibly elastic and thermally stable. Their environmental resistance properties make them a great sealant choice against water and air penetration. Dispensed with a honey-like consistency, they eventually cure to a tough, rubbery solid.



Pros of Using an Silicone Adhesive

- Very flexible
- Excellent environmental resistance
- Room temperature curing silicones can easily operate over 150 °C
- Extremely low glass transition temperature (-100 °C or colder)
- Lower durometers and higher elongation
- Antimicrobial

Cons of Using an Silicone Adhesive

- Poor adhesion to a large variety of substrates
- Poor chemical resistance
- Less resistance to aggressive fluids
- Low surface tension (cannot be painted)
- Cannot handle heavy loads
- Slow cure times

Urethane Adhesives

Urethane adhesives, known for being durable and elastic, are available in moisture and heat cure systems, and work well in structural applications. They can bond both similar and dissimilar substrates including plastics, and typically don't require surface preparation.



Pros of Using an Urethane Adhesive

- Lower durometers and higher elongation
- The “go to” choice for submersion in water
- Better adhesion to a wide variety of plastics
- Excellent impact and vibration resistance
- Polybutadiene urethanes are used in underwater acoustic applications due to similar acoustic transmission to sea water
- Polybutadiene urethanes have low glass transition (T_g) temperatures, making them good for extreme cold electronic applications
- Low odor

Cons of Using an Urethane Adhesive

- Does not operate well over 120 °C
- Less resistance to aggressive fluids
- Slow cure times
- Moisture sensitive prior to curing
- Difficult to integrate into an assembly process

Creating a Custom Epoxy, Silicone, or Urethane Adhesive

In some instances, existing adhesives on the market don't have the right mix of chemical characteristics to meet unique application needs. For example, a company might be interested in the structural qualities of a particular epoxy adhesive, but their assembly process requires a faster cure time. Epoxy, silicone, and urethane adhesives can be modified or custom formulated to address these challenges. Other common reasons for developing a custom-formulated adhesive include:

- A material is slated for discontinuation, and your application requires a suitable replacement
- A material is no longer in regulatory compliance with REACH, RoHS, or Prop 65
- A material is a candidate for future non-compliance with REACH, RoHS, or Prop 65

ResinLab, a sister company of Ellsworth Adhesives, has a full-service laboratory and team of chemists who use a variety of equipment and testing methods to create a custom epoxy, silicone, or urethane. Common services performed during new product development include:

- **Rheological analysis:** viscosity, cure response, and yield stress.
- **Thermal analysis:** coefficient of thermal expansion (CTE), glass transition temperature (Tg), softening (HDT), melting temperature, compression modulus, specific heat (Cp), thermal diffusivity, etc.
- **Electrical analysis:** electrical conductivity, dielectric strength, bulk/volume resistivity, and surface resistivity.
- **Chemical analysis:** chemical composition, impurity analysis, and chemical comparison.
- **Mechanical analysis:** adhesive strength, tensile strength, yield stress, tear strength, flexural strength, elongation, and modulus.

For many manufacturers, investing in a custom material provides long-term benefits for both the application and the bottom line.



Ask the Glue Doctor®

Making the right material choice is crucial to ensuring your application is successful, with variables like cost, substrates, and assembly environment coming into play. Ellsworth Adhesives Glue Doctors® are uniquely equipped with decades of application and product selection experience to help make the process simple. Connect with the team to find the right adhesive option for your unique application:

Ask the Glue Doctor®

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