Adhesive Preform Options:

Ensuring Seals in Design Match Seals in Production

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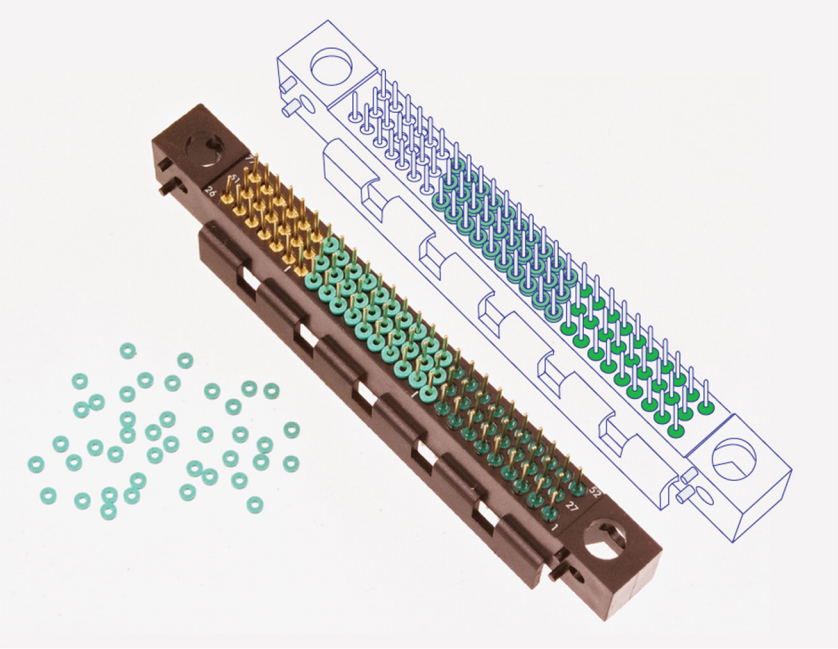
Adhesives are critical to appliance performance as they must bond disparate materials in diverse environments and protect electronics from a variety of contaminants. However, the seals on a designer's print do not often match the seals in production. Too often, seal quality depends on operator technique and training, which is unpredictable when manufacturing personnel and locations are frequently changed. To ensure consistency, many manufacturers have adopted preformed adhesives as an alternative to liquid dispensing for sealing or bonding their components. Adhesive preforms are pre-shaped polymers that are solid at room temperature. When heated, they melt and form a seal. If the adhesive is a thermoset, it will not re-liquefy after subsequent heat exposure. Pre-shaped adhesives prevent the drips, inconsistencies, and waste typical of liquid dispensing, and they can be loaded at rapid rates, either manually or with automated equipment, with minimal operator training. This helps to ensure that seals in design match the seals on the final product. Yet designing preformed seals is not merely a matter of determining shape and size. Choosing the right adhesive is also essential to seal quality.



Adhesive preforms ensure that seals on a designer's print match the seals in production.

Viscosity

The results of preformed adhesives are highly repeatable not only because they are pre-shaped. The adhesives are also pre-mixed. Unlike two-part liquid adhesives, which must be mixed in correct ratios by production personnel to ensure consistent viscosity and setting, the components in adhesive preforms are already combined and b-staged. This pre-mix eliminates a manufacturing step and potential variation.

Moreover, most two-component adhesives have a pot life and gradually polymerize as the material is dispensed. As the liquid polymerizes, it becomes more viscous, influencing the spread and shape of a seal. Preformed adhesives have no pot life, which ensures that seal spread is the same from the beginning to the end of a production run.

The flow of a preformed adhesive is determined by its formulation. No-flow and low-flow adhesives have minimal spread. This is a useful property for applications such as lens assemblies in which the adhesive must not obscure an aperture. Low flow is also useful for sealing connectors with low standoffs that can be violated if the sealant meniscus migrates too far up terminals. Other components may need a higher flowing adhesive, such as an IP67-rated connector that requires the adhesive to wick into gaps between terminals and housings and flow around complex features to protect connections for appliances used in outdoor environments. Deep-fill potting applications, such as feedthrough connections, also require a higher flow for a settled seal. The preform manufacturer can offer guidance on adhesive flow selection.

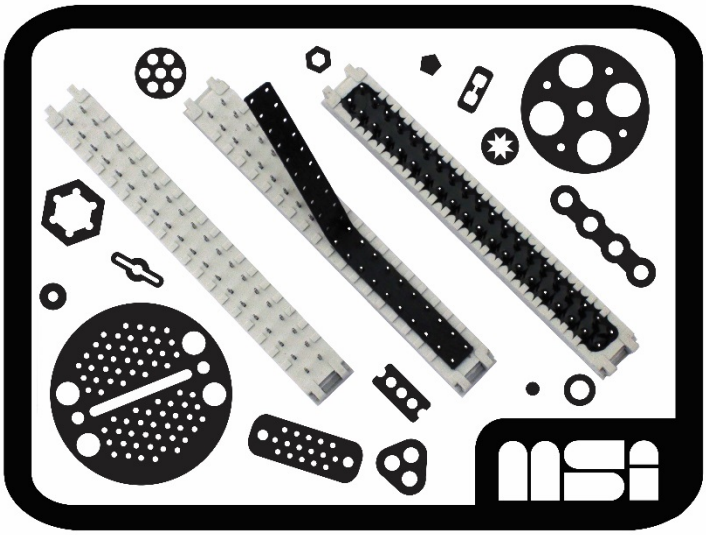
Chemical and Heat Resistance

Highly cross-linked epoxies offer robust resistance to solvents and other aggressive chemicals.

Epoxy preforms are generally preferred when seals are exposed to strong solvents or other aggressive chemicals. A highly cross-linked epoxy will withstand submersion in MEK, Xylene, Acetone, Toulene, and other strong solvents for weeks without softening or absorbing solvent. Highly cross-linked epoxies also have higher glass transition temperatures. Although most thermosets will not re-melt once they have cured, they will transition from a hard state to a softer, rubbery state when they are exposed to high temperatures. An epoxy with a high glass transition temperature will remain in its harder state at higher temperatures, which helps the seal withstand subsequent hot processes such as overmolding. Most epoxy preforms also have low outgassing properties, a common requirement for aerospace environments.

Flexibility

While some epoxies may be ideal for chemical resistance and high glass transition temperatures, highly cross-linked systems tend to be less flexible after cure. If components are exposed to aggressive thermal cycling, a rigid adhesive may have difficultly adhering to surrounding materials with different coefficients of thermal expansion. For these applications, a linear epoxy may be used. Linear epoxies remain comparatively flexible after cure, allowing the adhesive to maintain adhesion on different metals and plastics that expand and contract at dissimilar rates as the assembly heats and cools. Although the linear epoxy remains relatively flexible, it is sufficiently robust to protect components from many chemicals and contaminants, such as the conditions of an under-the-hood automotive environment.



Copolymer adhesives provide flexibility before and after cure.

More flexible polymers, often combined with epoxy resins, allow even greater flexibility than linear epoxies. Flexible copolymer adhesives allow for larger and more complex configurations. Flexible adhesives may be produced in long strips with multiple holes or geometries with an array of inside diameters to seal devices with multiple terminals. The may also be produced as frames with complex seal paths to join housings and cases. Many copolymers can also be rapidly prototyped, allowing engineers to qualify and modify seal configurations early in a component's design.

Other considerations that may influence adhesive preform selection include the maximum processing temperature that a component can tolerate, short cure schedules for high-volume production, adhesion to specific substrates, and operating environment conditions. Discussing seal requirements with an adhesive preform supplier early in the component design will ensure trouble-free adhesion in production and operation.