Structural Adhesives for High Speed Assembly

By Robert Sevigny, Application Engineer
Loctite Corporation

Structural adhesives are becoming increasingly popular as methods to reduce production costs of traditional mechanical assembly. User-friendly and cost-efficient, structural adhesives can permanently assemble similar and dissimilar materials, replacing mechanical fastening, welding, and brazing processes. Adhesives add only minimal weight to a finished assembly and allow for adjustment of parts when the proper cure system is used.

Compared to mechanical fasteners and spot welding, structural adhesives provide appliance manufacturers with many benefits. Adhesive assembly is typically less costly than mechanical fastening methods. Assemblies bonded with adhesives benefit from an even distribution of load stresses which reduces fatigue failures experienced with bolted, riveted, or welded assemblies. On dissimilar metallic assemblies, adhesives can act as galvanic insulating materials, protecting the assembly against corrosion. Structural adhesives can also improve the appearance of dryer, air conditioner, and other appliance cabinets, offering a cosmetically perfect look while eliminating the need to retouch dimpled or pitted areas around steel weld points.

Selecting an adhesive that will reduce costs and ensure product integrity can be a challenging assignment. To be effective in the selection process, engineers must consider all factors that will influence the performance of the bonded assembly. Such factors include joint design and stresses, substrate selection, and surface preparation methods.

Joint Design

Joint designs for other fastening methods may not be suitable for adhesive bonding. Adhesive joints must be specifically designed to generate the maximum strength and durability, and minimize stress concentration. Engineers should take into consideration manufacturing capabilities, production costs, and the desired final appearance of the assembly.

The strength of a bonded assembly depends upon 1) the mechanical properties of the substrates and adhesives, 2) residual stresses in the substrate and on the bonded assembly, 3) the degree of contact between mating parts, and 4) the bonded surface geometry. Through careful joint design, the engineer can eliminate stresses that will reduce the adhesive's strength and the assembly's useful life.

The most common joint used to assemble parts is the lap joint (figure 1). A standard lap joint will bend at the bond edges as force is applied. Modifications to a lap joint that will improve its performance include tapering the end of the laps to allow for some bending of the joint edges during loading; and bending one surface of the joint to provide a better distribution of stresses (figure 2).

Other Considerations

When selecting substrates, choose materials that process economically, meet the requirements of the finished product, and are available in many grades with a variety of surface treatments and finishes.

Proper surface preparation has a significant impact on the adhesive's initial performance and the long-term environmental resistance of the bonded assembly. Surface preparation can remove contaminants, control surface oxidation, alter the surface layer, plate or coat the base material, change surface roughness, remove aged surfaces, or build up new, active surfaces on the substrate. Surface preparation methods can be as simple as abrading or solvent wiping the

substrate. The treatment method selected depends on the level of surface contamination, the types of substrates, the initial and long-term bond performance required, and the financial practicality of the cleaning process.

Engineers should contact their adhesive manufacturer to discuss available adhesive technologies that are appropriate for their applications, and the cure requirements associated with these technologies.

# # #