I. INTRODUCTION

There can be no doubt that performance is the most important factor in the selection of a structural adhesive. However, even the strongest adhesives may not provide adequate bond strengths unless they are properly applied. Also, in the practical world, the total cost of producing a bonded structure is strongly influenced by the choice of the application methods.

Ideally, the design of the assembled product will include consideration of the bond area, the performance requirement of the adhesive, the method of application, and the manner in which the adhesive will be cured. Ignoring any of these factors early in the design of the assembly line can lead to difficult problems later on, when the product is being manufactured. Early concern for these elements should result in optimum use of the selected adhesive.

Structural adhesives run the gamut of almost all possible physical forms. They appear as liquids, pastes, solid shapes, pellets, films, and even powders. Occasionally the same basic product may be presented in more than one form, but often there will be performance differences, of varying degree, associated with the different physical forms.
II. FACTORS AFFECTING THE CHOICE OF A METHOD OF APPLICATION

A. Adhesive Properties

1. Physical Form

   a. Liquid. Liquid adhesives have the advantage of usually being easy to pump, and often may be sprayed, roll coated, curtain coated, or dipped. They have the disadvantage of sometimes being messy, requiring a clean-up step and leading to significant waste. They also require some means of controlling the applied thickness, the detailed application to complex shapes may be difficult. Manual methods of application are usually easy to design and include syringes, gravity or pressure-fed flow apparatus, and even plastic squeeze bottles.

   b. Paste. As the viscosity of liquid products increases and they become pastes, they soon become more difficult to handle by the above methods. Pastes are applied by extrusion of beads or ribbons, injected into bond areas, coated on complex flat shapes by means of silk screen processes, and sometimes applied by roll coaters. Sometimes the viscosity is great enough, through the curing process, to allow the parts to be self-fixturing until the adhesive hardens. Manual applications can be quite simple utilizing syringes, caulking guns, and even tongue depressors or spatulas. Clean-up of pastes can be a problem, although, since they are rarely sprayed, there is usually little waste.

   c. Pellets and Preforms. Some adhesive products, especially the epoxies, are available in the form of solids such as pellets or preformed shapes. These materials change to a liquid during heat curing. With the proper substrate design, the fluid adhesive will then flow into the bond area. The proper quantity of adhesive is assured by the volume of the preform. Since these products are solid at room temperature, they are clean, easily measured, and can be handled by equipment normally used for mechanical fasteners such as vibratory feeders, etc. They can also be easily applied manually. Although such products tend to be expensive, there is essentially no waste. Figure 1 illustrates an application of a pelletized adhesive to bond the base to the barrel of a butane reservoir.

   d. Powders. Powdered adhesives are not common, although powdered epoxies are often seen as protective coatings. These adhesives, like pellets, are clean to use. Spills can be swept up and overspray can be handled by