Joint Design for Structural Adhesives

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Joint design – Specific stress resistance is a major consideration.

Joints should be specifically designed for use with structural adhesives. This is largely a matter of common sense and experience. Two basic factors should be the design guidelines. First, structural joints should be designed so that all of the bonded area equally shares the load. Second, the joint configuration should be designed so that basic stress is primarily in shear of tensile, with cleavage and peel minimized oreliminated. Finally, appropriate joint thickness should be accounted for in the design (typically, 0.1-0.5mm depending on joint design and stresses, temperature fluctuations during use, etc).

The following structural joints and their advantages/disadvantages illustrate some typical design alternatives. They are not, of course, the limit of possible adhesive bonded joints.

Lap joints …
… are most common. They are most practical and applicable in bonding thin materials.

The *simple lap joint* is off-set. This can result in cleavage and peel stress under load when using thin materials.

The *joggle lap joint* gives more uniform stress distribution than either the simple or tapered lap joint. The joint can be formed by simple metal forming operations. The curing pressure is easily applied.

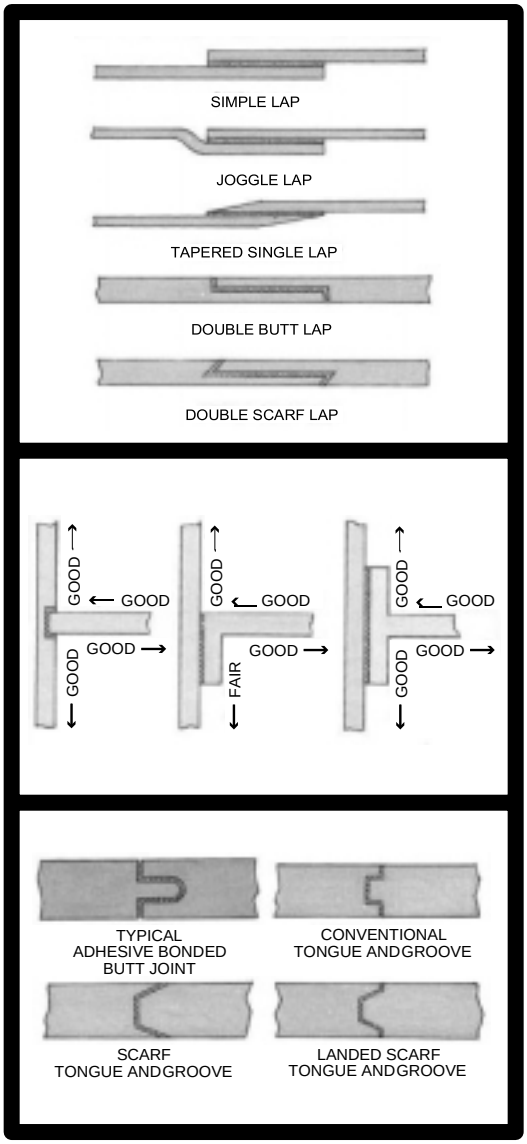
A *tapered single lap joint* is more efficient than a simple lap joint. The tapered edge allows bending of the joint edge under stress.

The *double butt lap joint* gives more uniform stress distribution in the load-bearing area than the above joints. However, this type of joint requires machining which is not always feasible with thinner gauge metals.

Double scarf lap joints have better resistance to bending forces than double butt joints. However, this type of joint also requires machining.

Angle joints …
… give rise to either peel or cleavage stress depending on the gauge metal. Typical approaches to the reduction of cleavage are illustrated.

Butt joints …
A straight butt joint has poor resistance to cleavage. The following recessed butt joints are recommended: landed scarf tongue and groove, conventional tongue and groove, and scarf tongue and groove. Landed scarf tongue and groove joints act as stops which can control adhesive line thickness. Tongue and groove are self- aligning during assembly and act as a reservoir for void filling type adhesives.



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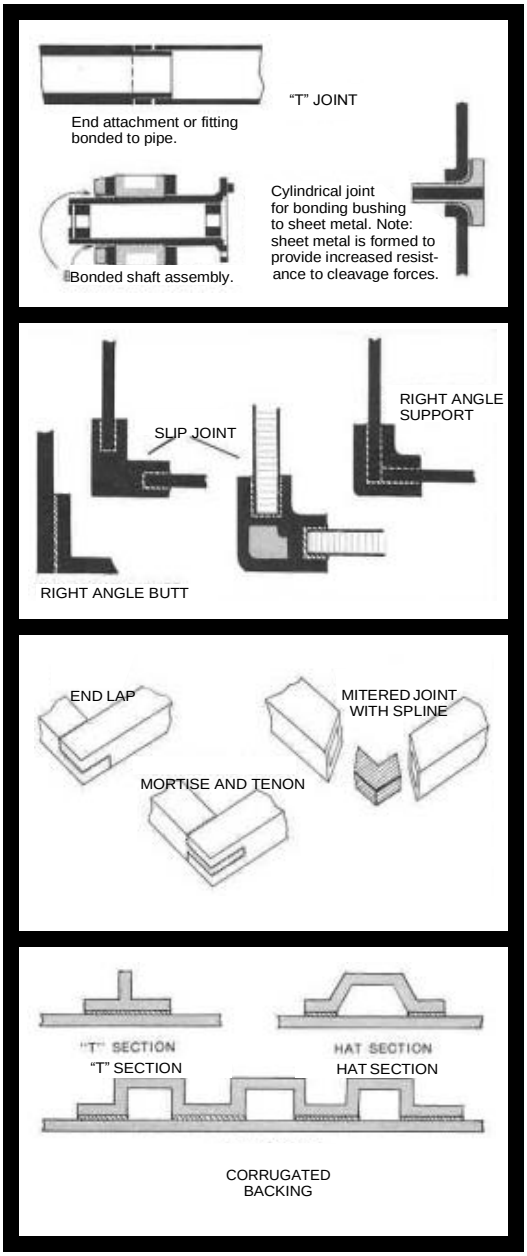
Cylindrical Joints
The T-joint and overlap slip joint are typical for bonding cylindrical parts such as tubing, bushings, and shafts. With adhesive bonding, all available contact area contributes to carrying the load. Adhesives also provide a joint with better appearance and eliminate distortion caused by high welding temperatures.

Corner joints – sheet metal
Corner joints can be assembled with adhesives by using simple supplementary attachments. This permits joining and sealing in a single operation. Typical designs are right angle butt joints, slip joints and right angle support joints. These joints increase the structure's rigidity. Void filling adhesives are most frequently used. Use of a heat curing adhesive depends on the heat resistance of the materials being bonded.

With this technique, thin gauge metals or sandwich panels can be easily formed into boxes, cases, housings, vehicle bodies, metal boat hulls, etc.

Corner joints – Rigid members
Corner joints, as in storm doors or decorative frames, can be adhesive bonded. End lap joints are the simplest design type although they require machining. Adhesives requiring pressure during cure may be utilized in such designs. Mortise and tenon joints are excellent from a design standpoint but also require machining. Mitered joint with spline is best if members are hollow extrusions. In this case, a void filling adhesive is recommended.

Stiffener Joints
Deflection and flutter of thin metal sheets can be minimized with adhesive bonded stiffeners. When such assemblies are flexed, peel stresses are exerted on the adhesive. If the flanges on the stiffening section can bend with the sheet, minimum peel stress on the bond will result. Increasing sheet gauge or decreasing the gauge of the stiffener flange will give equivalent results. Stiffening members such as T-sections, hat sections and corrugated backing can be used depending on desired rigidity.



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