



Joint Design for Structural Adhesives

Technical Bulletin

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 or eliminated. 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.

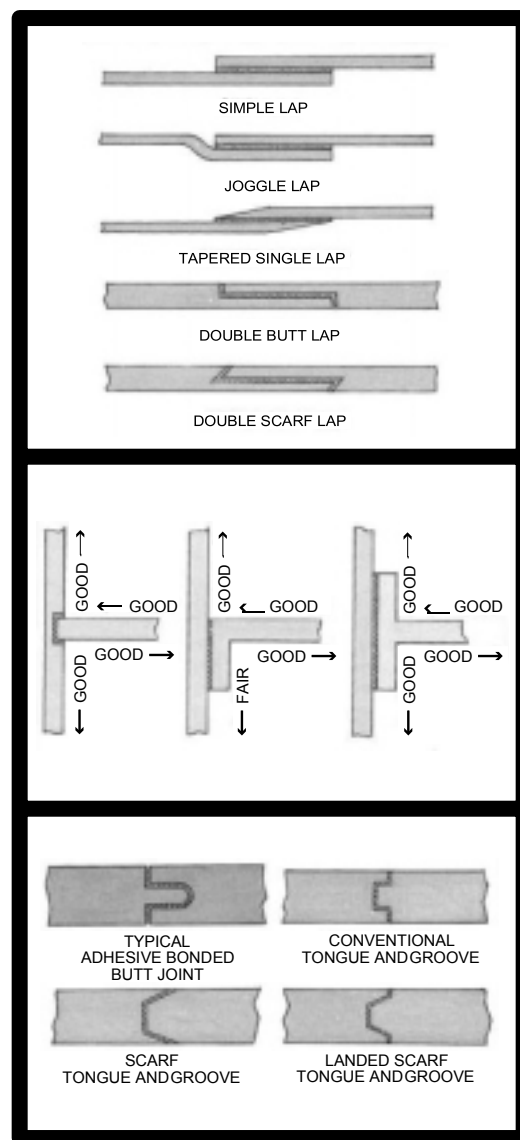
Double scarf lap joints have better resistance to bending forces than double butt joints. However, this type of joint also requires machining.

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.

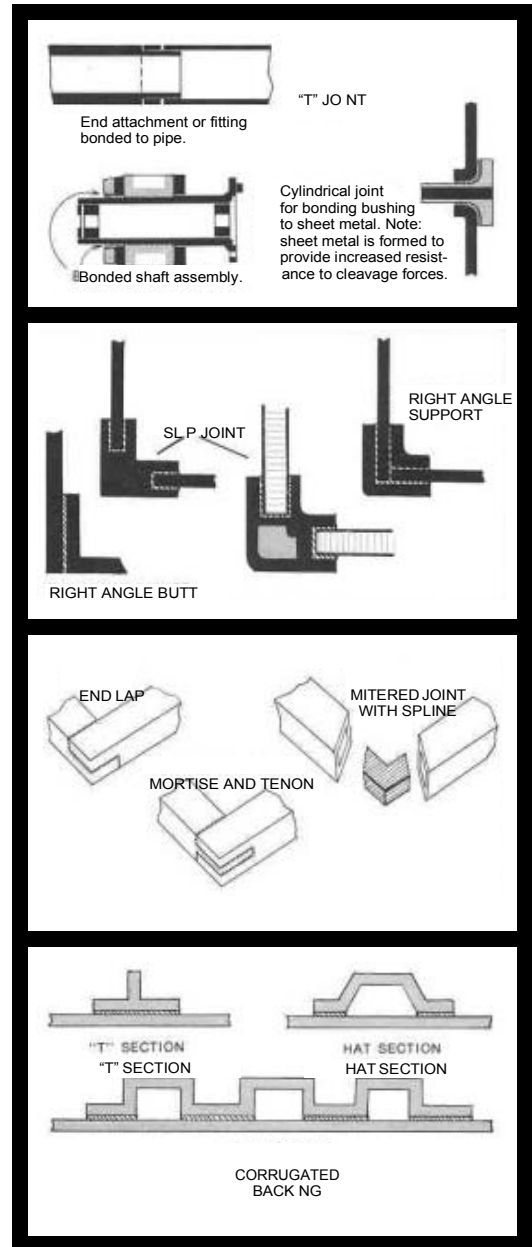
With this technique, thin gauge metals or sandwich panels can be easily formed into boxes, cases, housings, vehicle bodies, metal boat hulls, etc.

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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3M EPX™ Applicators and Nozzles

Technical Bulletin

April, 2015

Cartridge Size	37 mL (2:1) and 43 mL (2:3)	45 mL (10:1)	50 mL (1:1)	200 mL (1:1 and 2:1)	400 mL (1:1 and 2:1)	490 mL (10:1)
3M™ EPX™ Applicators – manual	EPX Metal Applicator (62-9740-9935-0) 21789 2:1 Plunger ^{2,3} (62-9744-9930-3) 82314		EPX Metal Applicator (62-9740-9935-0) 21789 2:1 Plunger ^{2,3} (62-9744-9930-3) 82314	EPX 200/250/400 mL Manual Applicator (62-9148-9930-7) 98073	EPX 200/250/400 mL Manual Applicator (62-9148-9930-7) 98073	
	EPX Plus II Applicator (62-9170-9930-1) 50004 2:1 Plunger ² (62-9170-9921-0) 50006	EPX Plus II Applicator (62-9170-9930-1) 50004 10:1 Plunger (62-9160-9910-4) 69044	EPX Plus II Applicator (62-9170-9930-1) 50004 1:1 Plunger ² (62-9170-9911-1) 50005	EPX 200 mL Manual Applicator (62-9136-9930-2) 87977 Plunger ^{2,3} (62-9136-9938-5) 87981		EPX 490 mL Manual Applicator (62-9182-9930-6) 71115
– pneumatic	EPX 50 mL Pneumatic Applicator (62-9781-9930-5) 83528	None	EPX 50 mL Pneumatic Applicator (62-9781-9930-5) 83528	EPX 200 mL Pneumatic Applicator (62-9140-9930-4) 87978	EPX 400 mL Pneumatic Applicator (62-9145-9930-3) 87979	EPX 490 mL Pneumatic Applicator (62-9152-9930-9) 69041
3M™ EPX™ Nozzles	EPX Mixing Nozzle for 50 mL Applicator (62-9178-9150-9) 81449	EPX Mixing Nozzle Square Orange for 50 mL Applicator (62-9154-9136-9) 69043	EPX Mixing Nozzle for 50 mL Applicator (62-9178-9150-9) 81449	EPX 6mm Nozzle for 200 mL / 400 mL Applicators (62-9142-9930-0) 87982	EPX 6mm Nozzle for 200 mL / 400 mL Applicators (62-9142-9930-0) 87982	EPX Mixing Nozzle Helical Orange for 490 mL Applicator (62-9158-9136-0) 69042
	EPX Mixing Nozzle - Square Gold (62-9171-9153-8) 50008		EPX Mixing Nozzle - Square Gold (62-9171-9153-8) 50008	EPX Mixing Nozzle - Square Gold (62-9176-9127-1) 97331	EPX Mixing Nozzle - Square Gold (62-9176-9127-1) 97331	EPX Mixing Nozzle Green (lower volume) (62-9184-9490-7) 81619

¹ Must be ordered separately - not included with EPX Plus II applicator.

² Included with the applicator.

³ There is no 1:1 plunger for this applicator, use 2:1 plunger with 1:1 products.

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EPX™ Applicators and Nozzles

Technical Information

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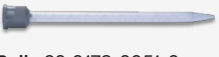






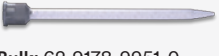


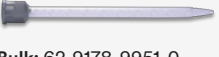



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3M™ EPX™ Applicators and Nozzles

		Replacement Plunger Orders							Static Mixing Nozzle Options	
		43 mL (2:3)	45 mL (10:1)	48.5 mL (1:1)	50 mL (2:1)	200 mL (2:1 & 1:1)	400 mL (2:1 & 1:1)	490 mL (10:1)		
3M™ Scotch-Weld™ EPX™ Plus II Applicator*  Stock #: 62-9170-9932-7 UPC: 00-063806-01001-7 *Includes 1:1, 2:1 and 10:1 plunger.	1:1/2:1 Shared Plunger Stock #: 62-9170-9913-7 UPC: 00-063806-01000-0		✓	✓					3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Green, 48.5mL/50mL Stock #: 62-9154-9148-4 UPC: 0-00-76308-86434-7	 Bulk: 62-9171-9954-9 Bulk: 0-00-63806-01003-1
			✓	✓					3M™ EPX™ Mixing Nozzle Helical White, 48.5mL/50mL Stock #: 62-9178-9151-7 UPC: 00-063806-01004-8	 Bulk: 62-9178-9951-0 Bulk: 00-063806-01005-5
	2:1 Plunger Used only for 2216 epoxy Stock #: 62-9170-9922-8 UPC: 0-00-76308-86390-6	✓							3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Gold, 43mL Stock #: 62-9171-9153-8 UPC: 0-00-21200-50008-4	 Bulk: 62-9171-9953-1 Bulk: 0-00-21200-50009-1
	10:1 Plunger Stock #: 62-9160-9911-2 UPC: 0-00-76308-86391-3		✓						3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Orange, 45mL Stock #: 62-9154-9136-9 UPC: 0-00-51115-81449-0	 Bulk: 62-9178-9950-2 Bulk: 0-00-51115-81467-9
3M™ EPX™ Metal Applicator  Stock #: 62-9740-9935-0 UPC: 0-00-21200-21789-0		✓							3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Gold, 43mL Stock #: 62-9171-9153-8 UPC: 0-00-21200-50008-4	 Bulk: 62-9171-9953-1 Bulk: 0-00-21200-50009-1
	2:1 Plunger Stock #: 62-9744-9930-3 UPC: 0-00-21200-82314-5								3M™ Scotch-Weld™ EPX™ Mixing Nozzle Helical White, 43mL Stock #: 62-9178-9150-9 UPC: 0-00-51115-81449-5	 Bulk: 62-9178-9950-2 Bulk: 0-00-51115-81467-9
				✓					3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Green, 43mL/48.5mL Stock #: 62-9154-9148-4 UPC: 0-00-76308-86434-7	 Bulk: 62-9171-9954-9 Bulk: 0-00-63806-01003-1
				✓					3M™ EPX™ Mixing Nozzle Helical White, 48.5mL/50mL Stock #: 62-9178-9151-7 UPC: 00-063806-01004-8	 Bulk: 62-9178-9951-0 Bulk: 00-063806-01005-5
3M™ EPX™ Pneumatic Applicator 48.5/50 mL  Stock #: 62-9781-9931-3 UPC: 00-063806-01006-2	N/A		✓	✓					3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Green, 43mL/48.5mL Stock #: 62-9154-9148-4 UPC: 0-00-76308-86434-7	 Bulk: 62-9171-9954-9 Bulk: 0-00-63806-01003-1
			✓	✓					3M™ EPX™ Mixing Nozzle Helical White, 48.5mL/50mL Stock #: 62-9178-9151-7 UPC: 00-063806-01004-8	 Bulk: 62-9178-9951-0 Bulk: 00-063806-01005-5
3M™ Scotch-Weld™ EPX™ Manual Applicator 200 mL  Stock #: 62-9136-9930-2 UPC: 0-00-21200-87977-7	1:1/2:1 Shared Plunger Stock #: 62-9136-9938-5 UPC: 0-00-21200-87981-4				✓	✓			3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Gold, 200mL and 400mL Stock #: 62-9176-9127-1 UPC: 0-00-21200-97331-4	 Bulk: 62-9176-9127-1 Bulk: 0-00-21200-97331-4
									3M™ Scotch-Weld™ EPX™ Mixing Nozzle Helical White, 200mL and 400mL Stock #: 62-9142-9930-0 UPC: 0-00-21200-87982-1	 Bulk: 62-9142-9930-0 Bulk: 0-00-21200-87982-1

3M™ EPX™ Applicators and Nozzles

		Replacement Plunger Orders						Static Mixing Nozzle Options	
		37 mL (2:1) & 43 mL (2:3)	45 mL (10:1)	50 mL (1:1)	200 mL (2:1 & 1:1)	400 mL (2:1 & 1:1)	490 mL (10:1)		
3M™ EPX™ 200, 400 mL Manual Applicator  Stock #: 62-9148-9930-7 UPC: 0-00-51111-98073-6	N/A				✓	✓	✓	3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Gold, 200mL and 400mL Stock #: 62-9176-9127-1 UPC: 0-00-21200-97331-4 	
		3M™ Scotch-Weld™ EPX™ Mixing Nozzle Helical White, 200mL and 400mL Stock #: 62-9142-9930-0 UPC: 0-00-21200-87982-1 							
3M™ EPX™ 490 mL Manual Applicator  Stock #: 62-9182-9930-6 UPC: 0-00-51115-71115-2	N/A						✓	3M™ Scotch-Weld™ EPX™ Mixing Nozzle Helical Orange, 490mL Stock #: 62-9158-9136-0 UPC: 0-00-51115-69042-6 	
		3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Green, 490mL Stock #: 62-9184-9490-7 UPC: 0-00-51115-81619-2 							
3M™ Scotch-Weld™ EPX™ Pneumatic Applicator 200 mL  Stock #: 62-9140-9930-4 UPC: 0-00-21200-87978-4	N/A				✓			3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Gold, 200mL and 400mL Stock #: 62-9176-9127-1 UPC: 0-00-21200-97331-4 	
		3M™ Scotch-Weld™ EPX™ Mixing Nozzle Helical White, 200mL and 400mL Stock #: 62-9142-9930-0 UPC: 0-00-21200-87982-1 							
3M™ EPX™ 400 mL Pneumatic Applicator  Stock #: 62-9145-9930-3 UPC: 0-00-21200-87979-1	N/A					✓		3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Gold, 200mL and 400mL Stock #: 62-9176-9127-1 UPC: 0-00-21200-97331-4 	
		3M™ Scotch-Weld™ EPX™ Mixing Nozzle Helical White, 200mL and 400mL Stock #: 62-9142-9930-0 UPC: 0-00-21200-87982-1 							
3M™ EPX™ 490 mL Pneumatic Applicator  Stock #: 62-9152-9930-9 UPC: 0-00-51115-69041-9	N/A						✓	3M™ Scotch-Weld™ EPX™ Mixing Nozzle Helical Orange, 490 mL Stock #: 62-9158-9136-0 UPC: 0-00-51115-69042-6 	
		3M™ Scotch-Weld™ EPX™ Mixing Nozzle Square Green, 490 mL Stock #: 62-9184-9490-7 UPC: 0-00-51115-81619-2 							
Standard Caulk Gun	N/A						3M™ Concrete Repair Urethane 8.4 oz cartridges	3M™ Concrete Repair 8.4 oz Cartridge Nozzles Stock #: 62-9637-9935-8 UPC: 0-00-48011-53382-7 	

For low volume applications and take-it-to-the-job convenience, the 3M™ EPX™ Plus II and EPX™ metal manual applicators comfortably dispense any of the 3M™ Scotch-Weld™ Duo-Pak Structural Adhesives. For higher volume applications, select the 200mL manual dispenser, or the 200mL or 400mL pneumatic dispenser. For concrete repair, there are both manual or pneumatic options.

3M™ Scotch-Weld™ One-Part Heat Cured Epoxies require a unique manual or pneumatic dispenser, such as Semco® 250, 350, 850, 950, or equivalent.