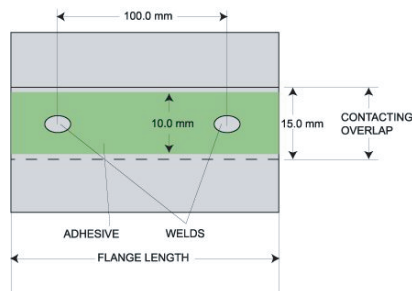


The Auto/Steel Partnership (A/SP) Weld Bond Adhesive Guidelines are intended to provide design information for A/SP projects. The Guidelines provide information for body structure design engineers and for modeling engineers working on body-in-white designs utilizing adhesives. This information pertains to pumpable adhesives and is applicable for NVH, durability or crash analyses. For more information regarding OEM requirements, please see individual OEM engineering specifications.

Flange Width: Minimum flange width recommended for structural adhesive applications is 15 mm (or the minimum outlined for welding if greater than 15 mm). This flange width is recommended to allow for Manufacturing to apply an adhesive bead and avoid/minimize squeeze-out. Avoid deviations (i.e., < 15mm) on exterior joints, where squeeze-out would be exposed to the body washers and cleaning sprays found in the Paint Shop (to avoid wash off).

Compressed Bead “Wet-Out”:

- After the flange is compressed and welded, the desired wet-out width is 10 mm minimum.
- Allowable deviations: This 10 mm minimum wet-out is required for 70 % of the overall flange length (10% of allowable flange length may be 5-9 mm in width and no more than 20% of flange length may be missing).
- More than 10% of the bond length at 5-9 mm in width, once compressed, is considered a skip.



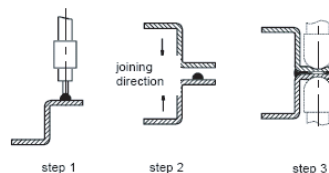
Distance from Arc Welding Operations: The minimum distance for any adhesive or sealer application from arc-weld or fusion welding operations shall not be less than 100 mm. Thermal decomposition from the sealer or adhesive may cause porosity in the weld and weaken the joint.

Joint Gaps: Avoid using structural adhesives in areas where gaps exceed 1.4 mm. Ideal joint strength is realized at gaps between 0.2 mm and 0.5 mm (typically found between spot welds). Strength is greatly diminished at gaps exceeding 1.4 mm or less than 0.1 mm.

Use Temperature Range: Avoid adhesive applications near high heat sources (i.e., exhaust manifolds, catalytic converters, etc.) where service temperatures may exceed 80 °C (175 °F). Since bulk material properties of adhesives change up to three orders of magnitude when exposed to temperatures near or exceeding their glass transition temperatures (T_g), it is useful to keep the service temperature from crossing over the T_g. It is recommended that full vehicle CAE models use properties of the adhesive generated at -40 °C and at 80 °C. This covers the spectrum of adhesive properties of both cold brittle behavior and ductile behavior found over the temperature range experienced in service. This will also ensure that the joint requirements are met over the use range.

Loading Conditions: Minimize peel loading where possible. Adhesives offer maximum joint strength when loaded in shear. If peel loading is anticipated, utilize resistance welds or mechanical fasteners to act as “peel-stoppers”.

Sub-assembly Considerations: After the adhesive is applied, parts should be sub-assembled in such a manner to avoid “skiving” or sliding the parts together in the fixture. Parts should come together normal to each other to avoid scraping the adhesive out of position.



Distance between Spot Welds or Mechanical Fasteners with

Adhesive Bonding: It is recommended that spot welds or mechanical fasteners be spaced a maximum of 100 mm apart when weld-bonding is utilized. Alternatively, some means to keep the mating parts in compression until the adhesive is cured is needed. This recommendation is particularly important when the adhesive is cured in the paint system ovens as the steel may expand in the oven away from the adhesive resulting in no bond occurring between the steel and adhesive.

Bead Length: Avoid multiple start-stop points along the length of the flange unless needed to avoid relief notches or access holes. Applied bead lengths of less than 50 mm are difficult to dispense without variation. Flanges with long straight runs are ideal for good bead control and maximize use of available cycle time.

Substrate: Adhesives are compatible with most substrates; however, pretreatments, e.g. Zn, on steel are required to prevent undercutting of adhesive in corrosive environments. Galvanneal is not recommended for structural bonding applications where joint integrity is required in dynamic loading conditions. Galvanneal may be considered for stiffness or fatigue / durability applications.

Lubricants and Blank Washers: Compatibility with a given adhesive must be confirmed by specification testing prior to use.