



Metal Bonding Structural Adhesive Acceptance Criteria and Repair Procedures - Welded Bonded, Rivet Bonded, and Bonded Structures

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This standard provides the acceptance criteria and repair procedures for structural adhesives in automotive products for which GM is responsible for establishing or approving product design. This standard does not apply to hem flange or anti-flutter (semi-structural) adhesives.

1.2 Applicability. This standard applies to any applications where a structural adhesive is used to bond metallic automotive substrates (this includes applications with self-piercing and extruding screws).

The criteria established in this standard become mandatory when referenced in product release information. Deviations from any adhesive criteria provided in this standard must be identified in product release information or an approved Product Quality Standard (PQS) document.

1.3 Remarks.

1.3.1 Usage. Structural bonds are considered satisfactory when they carry the intended service loads for a required period. Service loads on structures containing adhesive in a vehicle are varied in both type and magnitude and cannot be addressed by this standard. Therefore, while the manufacturing acceptance criteria of this standard are consistent with service loading requirements, they have been established specifically for use in process and product monitoring. Any attempted application of this document to other uses, such as post-crash quality assessment, may lead to an erroneous result or conclusion. Discrepant adhesive applications may still contribute to the integrity of the assembly by retaining a portion of their engineering properties.

1.3.2 Clarification. For clarification of this standard or editorial comments, email the GM Global Weld Council at: weld.council@gm.com.

Proposed changes to this standard must be presented to the Global Weld Council. To suggest a change to this standard, reference the "Procedure for Weld Standard Changes" on the Global Weld Council's web page.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15049

2.3 Additional References.

- GMS Operating Guidelines and Global Launch Manual, Section B4
- GM Global Quality Requirements
- PCPB003 GM Joining and Dispense Process Control Procedure
- Procedure for Weld Standard Changes
- Process Data Sheets (Product Specific)

3 Requirements

3.1 General Acceptance Criteria.

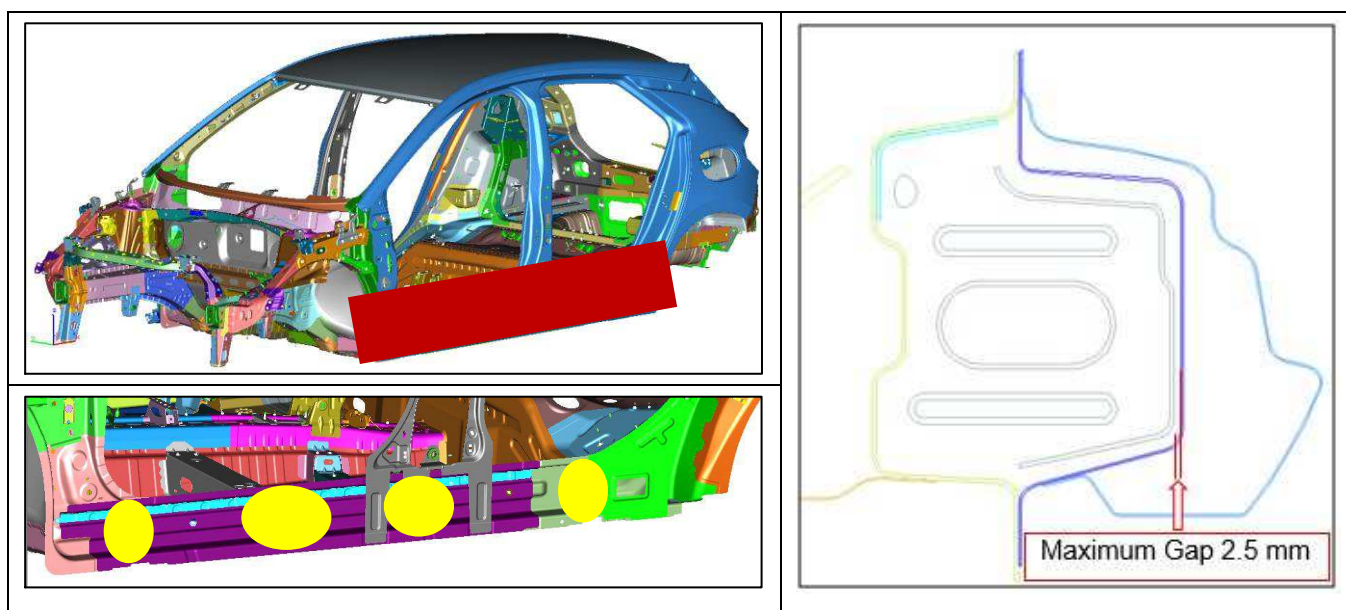
3.1.1 Correct Material. The structural adhesive applied shall be the material specified in the design release documentation. The product is non-conforming if incorrect material is being applied.

3.1.2 Material Shelf-Life. The “shelf-life” of the material shall not exceed the requirements in the material specifications. Material in containers with “shelf life” exceeding the specifications shall be replaced. The material shall not be exposed to temperatures during storage which exceed the requirements in the material specifications.

3.1.3 Bond Gap. Bond gap refers to the amount of separation between the faying surfaces of a joint. The maximum recommended (PT) gap is 0.5 mm except as follows:

- 1.4 mm for full spectrum impact resistant (IR) adhesive; or
- 2.5 mm for bulkheads constrained between two parts inside the rocker assembly – Figure 1.

Joints that exceed the desired gap should have the product and/or process adjusted to reduce the gap to the desired range.



Note: This requirement applies only to Rocker Bulkheads that are designed to either be part of the Rocker Inner Assembly and/or Rocker Outer assembly.

Figure 1: Bulkheads inside Rocker Assembly

3.1.4 Substrate Condition. Cleaning of the faying surfaces is not required unless visibly contaminated by dirt, dust, corrosion, or other foreign matter. Preparation of the faying surfaces is not required unless specified in the material specifications.

3.1.5 Adhesive Pattern. A pattern is a collection of adhesive beads defined by Product Engineering to which a tolerance is applied to meet structural requirements and for determining manufacturing acceptance of the product. A pattern shall be designed in a manner that all beads within the pattern are associated to the same joint. A pattern cannot contain beads that are in different functional areas of the body structure. Patterns are required when a BA1 Key Characteristic Designation System (KCDS) classification is assigned. (Refer to Appendix C, Figure C2 for an example of KCDS special bead designations in the Process Data Sheet.)

3.2 Visual Acceptance Criteria. Visual appearance of the dispensed bead on a panel prior to wet out/marriage of the second panel to construct a joint.

3.2.1 Bead Location. Bead application position across the flange may be adjusted to achieve wet out and to minimize or eliminate excess material squeezed out of the joint (see Figure A3 and Figure A4 in Appendix A). Squeeze-out of adhesive is not allowed in locating holes, fixing holes and tooling holes. For other types of holes,

e.g., clearance holes, drain holes, etc., small amounts of squeeze-out can be accepted as long as functionality is not degraded and work environment and wash-off problems do not occur. Squeeze-out is not permitted on unsupported surfaces. Squeeze-out > 1 mm on metal backed seams should have the process adjusted to minimize squeeze-out.

3.2.2 Voids, Skips or Interruptions. Visual appearance of adhesive voids, skips or interruptions in the applied bead are acceptable provided wet out requirements are achieved.

3.3 Measurable Acceptance Criteria.

3.3.1 Wet Out. Wet out is defined as the “footprint” of adhesive surface area on each of the flanges in a joint that the adhesive covers. It is required that both flange surfaces exhibit evidence of adhesive contact (flattening of the dispensed bead) after separation. The portion of the joint not achieving wet out or only exhibiting adhesive on one surface, without the flattening of the applied bead, is a discontinuity and the length of the joint not wet out cannot be counted in the effective length. If the length of this discontinuity exceeds the maximum allowable length for a discontinuity (see Table 1) then the product is nonconforming.

3.3.1.1 Wet Out Width. The wet out width (see Figure A4 and Figure A5) is to be measured on the flange surface opposing the bead application flange or the bead application flange if it demonstrates evidence of adhesive contact (flattening). If the wet out width at the narrowest place, is less than the minimum width dimension shown in the design release documentation and on the Process Data Sheet (example in Appendix A, Figure A1 and Figure A2), then the portion/length of adhesive less than the minimum width is a discontinuity and cannot be counted in the effective length. If the length of this discontinuity exceeds the maximum allowable length for a discontinuity (see Table 1) refer to Table B1 in Appendix B.

If a wet out width dimension is not defined on the design release documentation, the default wet out width requirement is a minimum 7 mm width.

3.3.1.2 Voids, Skips or Interruptions. Voids, skips or interruptions in the adhesive wet out are discontinuities and cannot be counted in the effective length.

3.3.1.2.1 Skips. A skip is defined as a missing portion of the applied bead that results in zero wet out on both the applied surface and the opposing surface. See Figure A6.

3.3.1.2.2 Voids. A void is defined as a missing portion of the bead on the opposing surface. See Figure A6.

3.3.1.2.3 Interruptions. An interruption is a bead wet out to the opposing surface but did not meet the 7 mm minimum width. Interruptions cannot exceed 30% of the specified length of a Single Bead or a Pattern. If an interruption exceeds 30% of the specified length the joint is considered nonconforming. See Figure A6.

3.3.1.3 Effective Length (Le) for Single Bead Applications. Adhesive applications that have an effective length greater than or equal to the minimum required length are acceptable provided that the maximum allowable discontinuity value listed in Table 1 is not exceeded. Adhesive applications that do not have an effective length greater than or equal to the minimum required length could be nonconforming (refer to Table B1 in Appendix B to determine if product is nonconforming and reaction plan). Refer to Appendix C, Figure C1 for adhesive Length Acceptability Flow Chart used with Table 1.

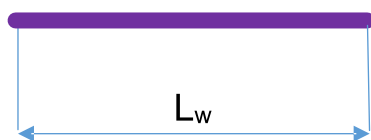
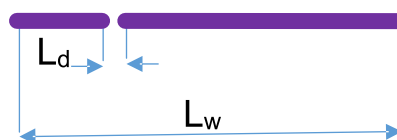
Table 1: Single Bead Length Requirements ^{Note 1}

Specified Length (mm) L_w	Maximum Allowable Length (mm) for any Single Discontinuity (post wet out)	Length Tolerance (mm) L_t	Minimum Required Length (mm) L_r
< 30	0	presence	N/A
30 to 150	20% of L_w up to a Maximum of 15	20% of L_w	$L_w - L_t$
> 150	30		

Note 1: Effective Length is defined as $L_e = L_a - L_d$.

Where:

L_e = Effective Length, L_a = Actual Length, L_d = Combined discontinuity lengths

3.3.1.3.1 Examples. See Figure 2 and Figure 3. L_w Specified Bond Length L_t Length Tolerance L_r Minimum Required Length L_a Actual Bond Length L_d Combined Discontinuity Length L_e Effective Bond Length**Math Data** $L_w = 100$ (as measured in math) $L_t = 20$ (calculated from Table 1) $L_r = 80$ ($L_w - L_t$)**Actual Physical Product** $L_a = 90$ (as measured on product) $L_d = 5$ (as measured on product) $L_e = 85$ ($L_a - L_d$) $L_e \geq L_r$ **Figure 2: Simple “Footprint”****Math Data** $L_w = 310$ (as measured in math) $L_t = 62$ (calculated from Table 1) $L_r = 248$ ($L_w - L_t$)**Actual Physical Product** $L_a = 295$ (as measured on product) $L_d = 20$ (as measured on product) $L_e = 275$ ($L_a - L_d$) $L_e \geq L_r$ **Note:** All lengths (L_x) are determined by the sums of the individual parts in the pattern.**Figure 3: Complex “Footprint”**

3.3.1.4 Effective Length (L_e) for Pattern Applications. The effective length for a pattern is the total length for all beads assigned to that pattern. Adhesive patterns that have an effective length greater than or equal to the minimum required length are acceptable provided that the maximum allowable discontinuity value listed in Table 2 is not exceeded. Adhesive patterns that do not have an effective length greater than or equal to the minimum required length could be nonconforming (refer to Table B1 in Appendix B to determine if product is nonconforming and reaction plan). Refer to Appendix C, Figure C1 for adhesive Length Acceptability Flow Chart used with Table 1.

Table 2: Pattern Length Requirements ^{Note 1}

Specified Pattern Length (mm) L_w	Maximum Allowable Length (mm) for any Single Discontinuity (post wet out)	Length Tolerance (mm) L_t	Minimum Required Length (mm) L_r
< 30	0	presence	not applicable
30 to 150	20% of L_w up to a Maximum of 15	20% of L_w	$L_w - L_t$
> 150	30		

Note 1: Effective Length is defined as $L_e = L_a - L_d$.**Where:** L_e = Effective Length, L_a = Actual Length, L_d = Combined discontinuity lengths