



Weld Acceptance Criteria and Repair Procedures Laser Fillet Welds in Lap Joints - Steel

1 Scope

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 continuous roof joint laser fillet welds for which GM is responsible for establishing or approving product design.

1.2 Applicability. This standard is applicable to autogenous laser welding process (LBW).

The criteria established in this standard become mandatory when referenced on a weld design document. Deviations from any weld criteria provided in this standard must be identified on a weld design document.

1.3 Usage. Welded structures are considered satisfactory when they carry the intended service loads for a required period. Service loads on weldments in a vehicle are varied in both type and magnitude and cannot be addressed by this standard. Therefore, while weld quality 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 weld quality assessment, may lead to an erroneous result or conclusion. Discrepant welds by retaining a portion of their engineering properties may still contribute to the integrity of the assembly.

1.4 Clarification. For clarification of this standard or editorial comments, email the GM 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 webpage.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15563

3 Requirements

3.1 General Acceptance Criteria.

3.1.1 Categories of Welds.

3.1.1.1 Structural Welds. Structural welds are required for performance of the welded product. All welds are structural unless specifically noted as process welds on the weld design document.

3.1.1.2 Process Welds. Process welds are installed to facilitate in-process assembly, but are not required for structural performance of the product. Process welds must be approved by Product Engineering and shown on the weld design document.

3.1.2 Evaluation of Welds.

3.1.2.1 Structural Welds. Structural welds shall be evaluated to the requirements of 3.2 and 3.3. See Appendix B.

3.1.2.2 Process Welds. Process welds shall be evaluated to the requirements of 3.2.1, 3.2.2 and 3.2.3.

3.2 Visual Acceptance Criteria.

3.2.1 Weld Location. Welds are properly located when installed within 3 mm from the start and end locations indicated on the weld design document or weld template.

Weld beads not correctly located require that the welding process be adjusted to the original qualified setup.

3.2.2 Surface Cracks. Weld beads with any surface cracks that are visible without the aid of magnification are discrepant. See Glossary.

3.2.3 Burn-Through. Burn-Through (hole) is a discontinuity and the length of Burn-Through cannot be counted in the effective weld length. See Glossary.

3.2.4 Meltback. Meltback is a discontinuity and the length of meltback cannot be counted in the effective weld length. Welds with meltback over the length specified on the design document are discrepant. See Glossary.

3.2.5 Melt-Through. When a weld bead with melt-through extending more than $0.2 \times t_2$ (the bottom piece being welded) beyond the bottom surface occurs, the welding process is to be adjusted to the original qualified setup. Weld beads with melt-through are not discrepant welds. See Glossary.

3.2.6 Direction of Weld. Weld beads that deviate from a specified weld direction (if indicated on the weld design document) are discrepant.

3.2.7 Spatter. When weld spatter occurs on a surface visible to the customer the weld spatter must be removed. Spatter does not make the weld bead discrepant. The cause of spatter shall be determined and eliminated.

3.2.8 Skip. A skip is a discontinuity and the length of skip cannot be counted in the effective weld length. Welds with skips over the length specified on the design document are discrepant. See Glossary.

3.2.9 Surface Porosity. When surface porosity is present and determined to be unacceptable, the process shall be adjusted to its original qualified setup to eliminate the porosity.

3.3 Measurable Acceptance Criteria.

3.3.1 Effective Weld Length (L_e). Weld beads that have an effective length greater than or equal to the required weld bead length (as described in Table 1) are acceptable provided that the maximum allowable discontinuity value listed in Table 1 is not exceeded. Weld beads that do not have an effective weld length greater than or equal to the required weld bead length (as described in Table 1) are discrepant. Weld beads exceeding the maximum allowed weld length ($L_w + 2L_t$) shall have the welding process adjusted to the initial qualified setup. See Figure D1 in Appendix D.

Table 1: Weld Length Requirements ^{Note 1}

Specified Weld Length (mm) L_w	Maximum Allowable Length (mm) for Any Single Discontinuity listed in of Appendix B	Weld Length Tolerance (mm) L_t
41 to 100	5	6
> 100	8 +2 for every additional 25 mm	10% of L_w

Note 1: A single discontinuity may not exceed 16 mm for any weld bead.

$$\text{Effective Weld Length} = L_e = L_a - L_d$$

$$\text{Minimum Required Weld Length} = L_r = L_w - L_t$$

Where:

- L_e = Effective Weld Length
- L_a = Actual Weld Length
- L_d = combined discontinuity lengths
- L_r = Minimum Required Weld Length

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- L_w = Specified Weld Length

3.3.2 Weld Cross-Section(s). The required number and location of the representative cross-section samples are specified GMW15563. Figure A1 in Appendix A illustrates a typical laser weld bead cross-section.

3.3.2.1 Leg Length (b). The leg length is the distance from the weld root to the weld toe of the weld where there is evidence of fusion. The leg length is acceptable when the leg length is greater than or equal to $0.7 \times t_{\min}$ (the thinner metal being welded). See Figure A1 in Appendix A.

3.3.2.2 Throat Thickness (a). The throat thickness is the minimum distance minus any convexity between any weld root and the weld face. The throat thickness is acceptable when the throat thickness is greater than or equal to $0.5 \times t_{\min}$ (the thinner metal being welded). See Figure A1 in Appendix A.

3.3.2.3 Depth of Fusion. Depth of fusion in either piece less than $10\% t_{\min}$ (the thinner metal being welded) requires the process to be adjusted to the original qualified setup. See Glossary.

3.3.2.4 Internal Porosity. Porosity is acceptable provided that the pores meet all of the following criteria:

- Pores are in a random non-linear pattern
- Oval pores have a pore length that is not more than three times the pore's width
- Diameter of any one pore must be ≤ 0.5 mm
- Total area of all pores is $< 25\%$ of the weld cross-sectional area

The process shall be adjusted to the initial qualified setup when any of these requirements are not met. See Glossary.

3.3.2.5 Internal Cracks. The weld cross-section must not contain any cracks that are visible at 15x magnification or less. Weld beads containing cracks are discrepant. See Glossary.

3.3.2.6 Convexity. Convexity is acceptable provided it does not interfere with any subsequent assembly operations.

3.4 Disposition/Repair Procedure.

3.4.1 Structural Welds. All known discrepant welds shall be repaired.

3.4.2 Process Welds. Process welds that do not meet the criteria of 3.2.3 must be repaired. Process welds that do not meet the remaining requirements of 3.2 should have the process adjusted to the initial qualified setup.

3.4.3 Weld Repair Procedures.

3.4.3.1 Weld repair procedures are shown in Appendix C. In the event a Weld Repair Data Sheet indicates a different method of repair, the Weld Repair Data Sheet must be followed. Exceptions are permitted based on documented review and approval by the appropriate Product Engineer (e.g., Temporary Work Order (TWO) or equivalent).

3.4.3.2 All discrepant welds shall be reworked to comply with the requirements of this standard. Weld repair equipment and process parameters must be validated prior to rework. Manual weld repair personnel are also required to demonstrate their ability to perform weld repairs that meet the requirements of this standard. The welding source responsible for the manufacture of the welded components shall retain documentation confirming qualification of weld repair personnel.

4 Manufacturing Process

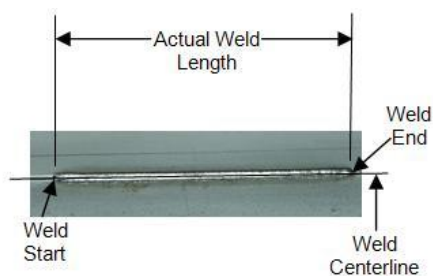
4.1 Process Control. The welding source is responsible for establishing practices and test methods to assure that the criteria of this standard are met, and are consistent with GMW15563 "Joining and Dispense Process Control Procedure".

5 Notes

5.1 Glossary.

Acceptance Criteria: The defined limits for discontinuities that are permissible and the limit where the discontinuities cause the weld to become discrepant.

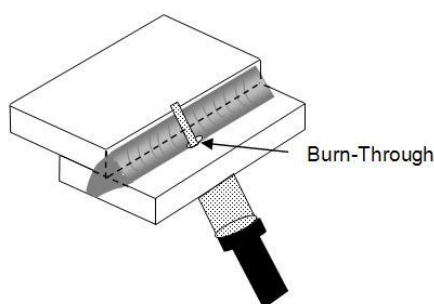
Actual Weld Length (L_a): The distance measured along the weld centerline from the weld start to weld end.



Attributes: Attributes are specific identifiable characteristics in either the surface appearance or geometric structure of a weld bead. Examples are undercut, porosity and cracks.

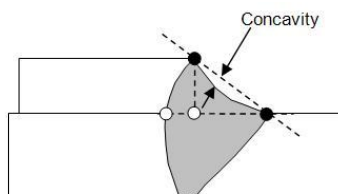
Base Metal: Used to refer to the parts, sheets, components, materials, or structures being welded.

Burn-Through: Excessive melt-through producing a hole in the weld bead.



Coalescence: The growing together or growth into one body of the metals being welded.

Concavity: The maximum distance from the face of a concave fillet weld perpendicular to a line joining the weld toes.



Continuous Weld: A weld that extends continuously from one end of a joint to the other. Where the joint is essentially circular, it extends completely around the joint.

Convexity: The maximum distance from the face of a convex fillet weld perpendicular to a line joining the weld toes.

