



Welding of Rear Seat Metal 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 describes the general requirements, designs and tests concerning laser-welded joints where 2- and 3- pieces of sheet metal are joined and contains general information to the design of a laser-welded joint in case where detailed information is not stated on the drawings.

Metallurgical aspects, e.g. grain size and hard-ness, are not considered.

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

1.2 Applicability. This standard is applicable to laser stainless steels and high strength low alloy (HSLA) steels with a carbon content of < 0.25 % (steels according to GMW2, GMW3032, GMW3399 and GMW14400).

Note: Exceptions to this standard such as e.g. sheet metal combinations which are not covered by this specification shall be agreed by the Product Engineering and Manufacturing Engineering departments and shall be indicated accordingly on the drawing.

In general uncoated sheet metals are used for rear seat structure. In exceptional cases Zinc (ZZ), hot-dip galvanized (HDG), zinc-nickel (ZN) and their alloys are permissible as coatings on one or both sides. A total coating thickness of 30 µm maximum is permissible between the sheets to be welded.

Welds on components with organic or non-metallic coatings are not covered by this standard.

1.3 Remarks.

1.31 Usage. Welded structures are considered satisfactory when they carry the intended service loads for a required period. Service loads on weldings 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.

1.5 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 applicable Welding Process Control Procedures.

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

Proposed changes to this standard shall be presented to the GMNA Weld Council. To suggest a change to this standard, reference the "Procedure for Weld Standard Changes" on the Weld Council's webpage.

2 References

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

2.1 External Standards/Specifications.

ISO 10447

ISO 13919-1

2.2 GM Standards/Specifications.

GMW2	GMW3032	GMW3059	GMW3399
GMW14400	GMW15563		

2.3 Additional References.

Quality Procedure Control on Critical Operations (D-01).

3 Test Preparation and Evaluation

3.1 Resources.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.1.3 Facilities. According to the tests referred to in this specification.

3.1.4 Equipment. According to the tests referred to in this specification.

3.1.5 Test Vehicle/Test Piece. Not applicable.

3.1.6 Test Time. Not applicable.

3.1.7 Test Required Information. Not applicable.

3.1.8 Personnel/Skills. Not applicable.

3.2 Preparation. According to the tests referred to in this specification.

3.3 Conditions. According to the tests referred to in this specification.

3.3.1 Environmental Conditions. According to the tests referred to in this specification.

3.3.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

3.4 Instructions. Not applicable.

3.5 Data. Not applicable.

3.6 Safety. This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

3.7 Documentation. Samples of components or material released to this standard shall be tested for conformity with the requirements of this standard and approved by the responsible GM Department prior to the start of delivery of production level components or materials.

Any change to the component or material, e.g., design, function, properties, manufacturing process and/or location of manufacture requires a new release of the product. It is the sole responsibility of the supplier to provide the customer, unsolicited, with documentation of any change or modification to the product/process, and to apply for a new release.

If not otherwise agreed to, the entire verification test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product. In some cases, a shorter test can be agreed to between the responsible GM department and the supplier.

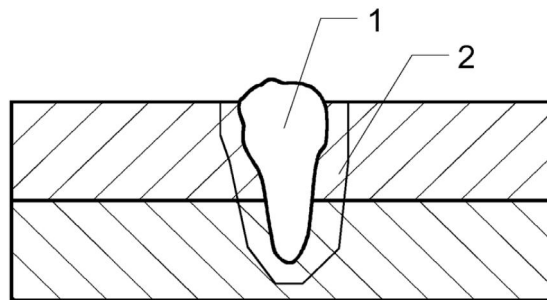
3.7.1 Test Results. Tests shall be documented and recorded in reports.

The results shall be represented in a test report with reference to this specification.

4 Requirements and Procedure

4.1 Technical Welding Aspects.

Figure 1: Schematic Diagram of a Welded Joint



- 1 Fusion zone
2 Heat-affected zone

The comments below apply to laser-welded lap joints.

4.2.1 Structural Laser Welds. Structural laser welds are necessary for the strength characteristics of the product. All laser welds are structural welds unless otherwise specified as processing welds on the drawing.

4.2.2 Processing Laser Welds. Processing laser welds are used to fix the assembly (tack welding). Processing laser welds shall be approved by the development department responsible and shall be indicated on the drawing.

4.2.3 Marking of Safety-Relevant Weld Seams. Welding seams, which are exposed to high requirements/loads and are accordingly safety-relevant, receive a KPC (KEY PRODUCT CHARACTERISTIC) into the welding drawing (see Figure 2).

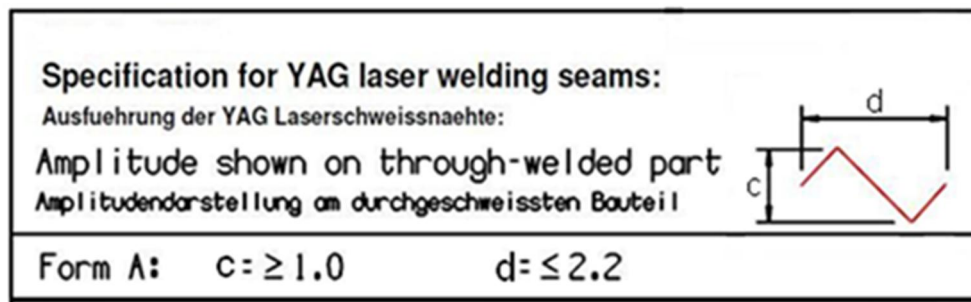
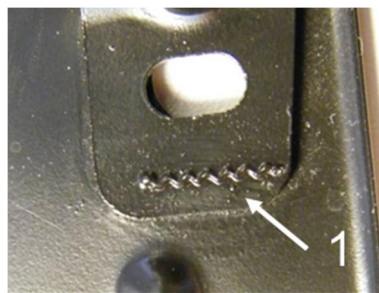
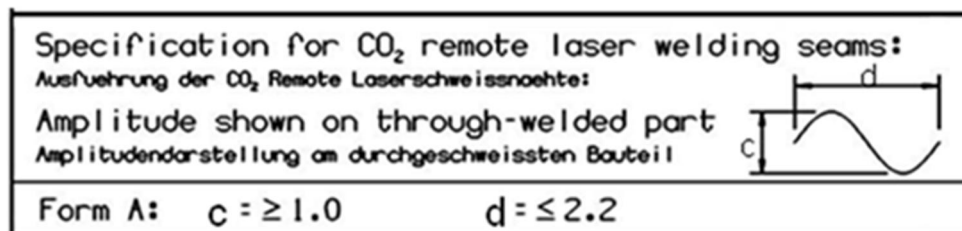
Figure 2: Marking of Safety-Relevant Weld Seams

GM KCDS SHALL BE ADMINISTERED IN ACCORDANCE WITH THE LATEST VERSIONS OF GMW15049 AND KCDS TEMPLATES.								
17				LAST NUMBER USED	KPC (KEY PRODUCT CHARACTERISTIC) PQC (PRODUCT QUALITY CHARACTERISTIC) AQC (ATTRIBUTE QUALITY CHARACTERISTIC) DR (DOCUMENTATION REQUIRED)			
17				TOTAL BY COLUMN				
KPC #	PQC #	AQC #	DR #	CHARACTERISTIC	RATIONALE	ZONE	SH	PLCS
KPC NO.	PQC NO.	AQC NO.	DR NO.					
1				WELDING SEAM	SAFETY CRITICAL SYMBOL	H28		
2				WELDING SEAM	SAFETY CRITICAL SYMBOL	H28		
3				WELDING SEAM	SAFETY CRITICAL SYMBOL	H28		

4.2.4 Specification for Laser Welding Process. For high load cases an oscillated weld seam shall be preferred to elongate the weld seam length.

- For YAG (Yttrium-Aluminium-Granat-Laser):
The weld seam amplitude is shown on through – welded part (see Figure 3).
- For CO₂ remote laser welding process:
The weld seam amplitude is shown on through – welded part (see Figure 4).

Figure 3: Specification only for YAG Laser Welding

Figure 4: Specification for CO₂ Laser Welding (example of Amplitude)

1 Example: Amplitude shown on through welded part

4.3 Assessment of the External Appearance of Laser-Welded Seams. There are limits to the possibility of testing laser-welded seams because of their narrowness and the characteristics of the test method. It should be noted with reference to all welded seams that welding defects such as weld surface concavity, root sagging, edge notches and fusion defects impair the strength of welded seams in the long term, especially in components which are subject to vibration.

The assessment of the series of tests is based on ISO 13919-1. This is valid for the quality monitoring of components made of steel in the manufacturing and contains the assessment criteria for laser-welded joints on the basis of specific characteristics.

Irregularities according to ISO 13919-1, such as pores, shrink holes and clusters of pores in the surface of the weld seam are assessed separately.

4.4 Evaluation of Quality. Laser welds shall be evaluated on the basis of the criteria below, using the terms below.

4.4.1 Structural Laser Welds in Manufacturing. Structural laser welds shall be evaluated with regard to the requirements of paragraphs 4.4.3, 4.4.4, 4.4.5, 4.4.6 and 7 in accordance with conditions according to paragraphs 4.5 and 4.6 and 4.7.

4.4.2 Processing Laser Welds. Processing laser welds shall be evaluated according to the requirements in paragraphs 4.4.3.2, 4.4.3.3 and 4.4.6.3.

4.4.3 Welded Seam Dimensions. A welded seam which meets the requirements in the paragraphs below with regard to width and length is deemed acceptable.

If no different requirement is specified on the drawing, the sum of all the irregularities (surface concavity, pore areas, underfilling, etc.) may not be more than 25 % maximum of the total welded seam length if no effects on ability to function shall be expected. Deviations in the chisel test and/or in the fatigue life test will lead to the component being rejected.

$$\sum l_d + \sum l_p \leq 25 \% L_s$$

$$L_k = L_s - L_a - L_e - (0.25 \times L_s)$$

with

L_k = welded seam length stiffness calculation

L_a = welded seam beginning (tbd mm)

L_e = welded seam end (tbd mm)

l_d = external fault

l_p = internal fault

L_s = welded seam length

(see Figures 5, 6 and 7)

The 3 mm at the beginning and end of the welded seam shall not be included in the strength calculation (see Figure 5).

Figure 5: OK Weld; Total of the Objections ≤ 25 % of the Welded Seam Length L_s

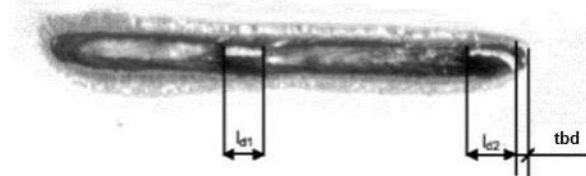


Figure 6: NOK Weld; Total of the Objections > 25 % of the Welded Seam Length L_s

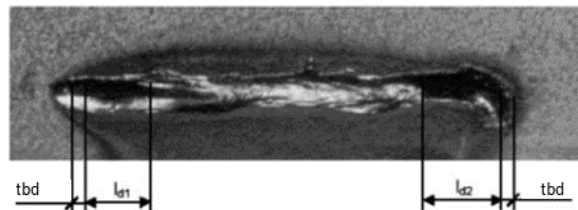


Figure 7: Stiffness Calculation

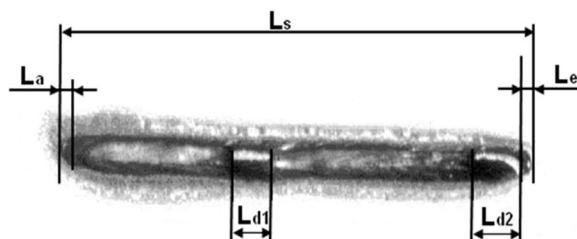
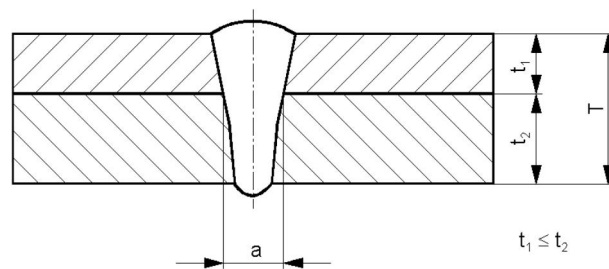
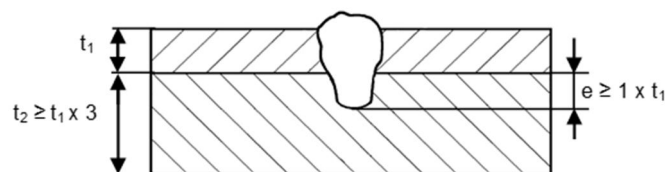


Figure 8: Measurement of Seam Width

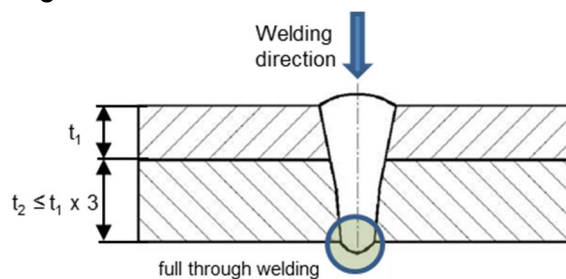


a Seam width

4.4.3.1.1 With Material Thicknesses at the Ratio of $\geq 1:3$. In welded joints the minimum penetration depth is $e \geq 1 \times t_1$. “ t_1 ” represents the thickness of the thinner piece of sheet metal (see Figure 9).

Figure 9: Ratio of Material Thicknesses $\geq 1:3$ 

4.4.3.1.2 With Material Thicknesses at the Ratio of $\leq 1:3$. It is advisable that the welding seam go through the welding components completely (Weld through). With a following visual check the complete penetration of the welding seam shall be optically checked on the opposite side of the welding direction (see Figure 10).

Figure 10: Ratio of Material Thicknesses $\leq 1:3$ 

4.4.3.2 Seam Length.

4.4.3.2.1 Length of the Weld Surface L_s . The length of the weld which is measured on the surface of the sheet metal is designated the seam length L_s . The measure L_s shall be within the dimension specified on the drawing (see Figure 11).