



Welded Blanks Fabricated from Aluminum Sheet

1 Scope

1.1 Material Description. This standard defines the requirements for Aluminum Welded Blanks (AWB) used by GM in the manufacture of stamped sheet aluminum parts. It applies only to the as-supplied condition of welded blanks.

1.2 Symbols. Not applicable.

1.3 Applicability. Typical applications for these blanks include, but are not limited to, door inner panels, motor compartment rails, body side inners.

1.4 Remarks. Blanks supplied under this standard shall be made by Friction Stir Welding (FSW) or Laser Butt Welding (LW) two or more aluminum sheet blanks used for subsequent cold forming into a pre-determined configuration. Same gauge to same gauge AWBs are not permitted. The minimum gauge differential is 30%.

1.5 Aluminum Alloys. The requirements for the aluminum sheet are found in GMW15192. The initial pre-weld coils or component blanks must be from a supplier approved to GMW15192 and GMW15420.

2 References

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

2.1 External Standards/Specifications.

ISO 2768-1	ISO 6892-1	ISO/TS 16949
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2.2 GM Standards/Specifications.

GMW3059	GMW15192	GMW16823
GMW14019	GMW15420	GMW16854

2.3 Additional References.

- Manufacturing Engineering (ME) Lastenheft
- NACB – GMNA Stamping Plant Requirements for Sheet Metal Coils and Blanks

3 Requirements

3.1 Requirements on Delivery.

3.1.1 Chemical Requirements. Chemical composition of the component blanks shall meet the requirements of GMW15192.

3.1.1.1 Filler Wire. If filler wire is used, the composition must be agreed upon between the purchaser and supplier.

3.1.2 Mechanical Requirements. The sheet aluminum of the component blanks shall meet the mechanical properties specified in GMW15192.

3.1.3 Physical Requirements.

3.1.3.1 Quality of Laser Weld Joint. Laser welds contained in the blanks shall conform to the requirements in Table A1 and in Figures A1 through A9. Weld porosity and geometry shall be controlled such that formability and function of the part are not affected.

3.1.3.2 Quality of Friction Stir Welded Joint. Friction stir welds contained in the blanks shall conform to the requirements in Table A1 and in Figures A1 through A9. Weld porosity and geometry shall be controlled such that formability and function of the part are not affected.



3.1.3.3 Blank Edge Preparation. The welder of the sub-blanks is responsible for determining and controlling the quality of the edges to be welded. Maximum allowable burr on any edge that is not welded shall be $\leq 10\%$ metal thickness.

3.1.3.4 Material Thickness. The thickness and tolerance for the component blanks shall be specified by the detailed engineering math data. For the tolerances of the single sheet thickness GMW15192 is applied.

3.1.3.5 Lubrication. The entire welded blank shall be free from corrosion products as specified in GMW16823. The raw material sheet stock shall have oil as specified in GMW14019 to provide corrosion protection in the coil and component blanks. However, $> 1.5 \text{ g/m}^2$ is not allowed due to process ability.

3.1.3.6 Surface Quality of Laser Welded Blanks. The surface quality and the roughness of the Laser welding blanks shall be agreed upon by purchaser and supplier.

3.1.3.7 Surface Quality of Friction Stir Welded Blanks. The surface quality and the roughness of the FSW blanks shall be agreed upon by purchaser and supplier.

3.1.3.8 Paint Adhesion on Weld Seams. The requirements for paint adhesion as described in GMW15192 and GMW15420 shall be fulfilled on the weld seam also.

3.1.3.9 Weld Seam Location. The location of the weld seam on the welded blank shall not deviate from the given definition by more than $\pm 1.0 \text{ mm}$ per weld seam intersected along the distance being measured. An example is given in Figure A10. Deviations of this criterion may be issued by the local business unit.

3.1.3.10 Blank Dimensional Tolerances. Tolerances for linear and angular dimensions without individual tolerance indications shall be determined according ISO 2768-1, class C. Method of measurement: On a master sample reference points shall be agreed with GM Supplier Quality (SQ). During production the influential dimensions have to be measured.

Note: Regulations may be different in the GM units and will be issued by the local business unit.

3.1.3.11 Lead Edge Offset. Regulations are handled differently in the GM units and will be issued by the local business unit.

3.1.3.12 Length/Width Tolerance. Unless otherwise specified, the maximum offset of the sheets (see Figure A11) is $\pm 1.5 \text{ mm}$. Deviations of this criterion may be issued by the local business unit.

3.1.3.13 Start/Finish of Weld. Unless otherwise specified, laser welds shall start and finish within 2 mm (GME) or 3 mm (GMNA) of the edge of the sheets (see Figure A12). For FSWs, the circumference of the circular part of the weld seam at the start (plunge) and finish (exit) shall be within 2 mm (GME) or 3 mm (GMNA) of the edge of the sheets (see Figure A12).

3.1.3.14 Flatness of Individual Blanks After Welding. Flatness of individual blanks after welding shall be agreed upon by purchaser and supplier.

3.1.4 Testing of Weld Seam.

3.1.4.1 Non-Destructive Testing. Each tailored blank shall be tested online (100% by online system) with appropriate and assured test procedures approved by SQ. Additional visual inspection is possible. It is recognized that up to 5 mm maximum at the beginning and end of the weld cannot be monitored by state of the art online Test Procedures.

3.1.4.2 Destructive Testing.

3.1.4.2.1 Erichsen Cupping Test. Destructive testing of laser welded joints with the Erichsen Cupping test shall be performed according to GMW16854. The evaluation of weld quality is done according to pictures in Table A2. Frequency of the cup test is minimum once a lot prior to shipment.

3.1.4.2.2 Limiting Dome Height Test. Destructive testing of FSW joints with the Limiting Dome Height (LDH) Test shall be performed. The evaluation of weld quality is done according to dome height and the pictures in Table A3. For 6000 grades, the LDH test should be performed a minimum of 4 days after welding to allow for natural aging. Frequency of the LDH test is minimum once a lot prior to shipment.

3.1.4.2.3 Cross Section. Samples shall be taken 5 mm minimum for laser welding and 25 mm minimum for FSW from both ends of welds. Samples should concentrate on "hot spots" of formed part. Measurement shall be performed according to Appendix A, Section A2. Frequency of the cross section is minimum once a lot prior to shipment.

3.1.4.2.4 Tensile Tests. Tensile tests with the laser or friction stir weld transverse to the load axis according to ISO 6892-1 shall be performed for initial submissions.

3.1.5 Blank Packaging.

3.1.5.1 Blank Packaging Specification. Blank packaging is specific to a part and the front of line requirements at the GM stamping plant. Therefore, each part number will have a blank packaging specification that is unique to that part and GM stamping plant. The GM stamping plant that will receive the blanks is responsible to create a blank packaging specification for each part. The blank stack should meet the requirements shown in Figures A10 thru A15 unless otherwise specified. If there is any discrepancy between this document and the blank packaging specification sheet, the blank packaging specification sheet shall be used. This blank packaging specification must coincide with Material Part Specification (MPS) Release 2 and be updated with the publication of MPS Release 3.

If dimpling is used, the blank packaging specification sheet shall show the type and location of the dimples. Recommended dimple dimensions are provided in Figure A16 and Figure A17. Note that small dimples (pimple dimples) may be present for de-stacking purposes. These small de-stacking dimples should not be present along the edge to be welded.

Blank packaging shall follow the requirements in the NACB specification for North America unless otherwise specified in this document. If there is any discrepancy between the NACB specification and this document, this document shall be used.

Blank packaging shall follow the requirements in the Lastenheft document for GME, unless otherwise specified in this document. If there is any discrepancy between the Lastenheft and this document, this document shall be used.

3.1.5.2 Dimensions and Tolerances of the Blank Stack. The blanks shall be stacked so that each stack is identical in shape with the edges flush. The dimensions and tolerances for the stacks are outlined in the NACB specification for North America, and the Manufacturing Engineering (ME) Lastenheft document for GME. If there is any discrepancy between the NACB and this document, this document shall be used. If there is any discrepancy between the Lastenheft and this document, this document shall be used.

3.1.5.3 Stack Shift, Blank Stagger and Stack Lean Tolerances. Permissible tolerances for these requirements are ± 3 mm or $h = 6$ mm maximum. (See Figure A13 and Figure A14).

3.1.5.4 Flatness of a Stack. The parallelism and flatness tolerance for the stack must fall between two planes parallel to the plane of the pallet. A stack height deflection of ± 25 mm is permitted ($h = \pm 25$ mm), as seen in Figure A15, unless otherwise specified by the receiving GM Stamping Plant on the blank packaging specification sheet.

If necessary, dimples may be added to the stack to maintain the flatness of the stack. Recommended dimensions for the dimples are described in Figure A16 and Figure A17. Round dimples may be also used with agreement between purchaser and supplier. Dimples should either be staggered, or put on every other blank in a stack. The parallelism shall not be obtained by additional devices. Dimple type and location shall be agreed upon by purchaser and supplier.

3.1.6 Additional Requirements.

3.1.6.1 Process Control. The supplier shall develop quality process control procedures compliant with ISO/TS 16949 demonstrating that the product will conform to all specification requirements listed in this document. This shall include a statistically-based sampling plan based upon product quality performance. The data required to be submitted for this specification for each shipment will be determined by the manufacturing location. The process shall be assured by traceability from stack label back to the batch number of aluminum sheet or coil.

3.1.6.2 Other Specifications. If there is any discrepancy between the GMNA Stamping Plant Requirements for Sheet Metal Coils and Blanks (NACB) specification and this document, this document shall be used. If there is any discrepancy between the Lastenheft and this document, this document shall be used.

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

5.2 Language. In the event of conflict between the English and domestic language, the English language shall take precedence.

5.3 Inspection and Rejection. Samples of components or materials released to a GM material specification shall be tested for conformity with the requirements of this material specification and approved by the responsible Engineering department prior to commencement of delivery of bulk supplies.

A new approval must be received for any changes, e.g., properties, manufacturing process, location of manufacture, etc. If not otherwise agreed, all testing and documentation normally required for initial release must be completed.

It is the responsibility of the supplier to inform the customer in a timely manner, without solicitation, and to include documentation of all modifications of materials and/or processes and to apply for a new release.

5.4 Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS). For new product submissions, or when a change in chemical composition of an existing product has occurred, a complete copy of the Material Safety Data Sheet/Safety Data Sheet must be submitted in compliance with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) requirements or other country-specific MSDS/SDS requirements.

5.5 All materials supplied to this standard must comply with the requirements of the International Material Data System (IMDS) and GMW3059, **Restricted and Reportable Substances**.

6 Approved Sources

Materials supplied to this specification must be approved by General Motors.

A list of approved materials can be found in MATSPC. This GM Material File is provided to third parties to reduce redundant testing of materials. If approved material already listed is used, the part supplier can use GM Material File reference for Production Part Approval Process (PPAP) material approval. If the decision is made to use a not yet approved material, contact the appropriate Materials Engineering department for details on the approval process. The material approval process must be completed prior to PPAP start date of the part supplied to General Motors.

The supplier of the component blanks must be approved to GMW15192 and GMW15420.

7 Notes

7.1 Glossary.

MATSPC: Global repository of GM approved materials for corresponding GM Engineering Standards.

7.2 Acronyms, Abbreviations, and Symbols.

AWB	Aluminum Welded Blank
f	Porosity Projection Fraction
FSW	Friction Stir Welding
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
h	Deviation in mm
HAZ	Heat Affected Zone
IMDS	International Material Data System
LDH	Limiting Dome Height
LW	Laser Butt Welding
ME	Manufacturing Engineering
MPS	Material Part Specification
MSDS	Material Safety Data Sheet
PPAP	Production Part Approval Process
SDS	Safety Data Sheet
SEL	Stahl-Eisen-Lieferbedingungen
SQ	Supplier Quality
t₁	Thickness of Thicker Sheet
t₂	Thickness of Thinner Sheet

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February 2016

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Documents

Document Sharing Hub

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Material per GMW17518

9 Release and Revisions

This standard was originated in December 2015. It was first approved by Materials - Global Ferrous and Sheet Metals Team in February 2016. It was first published in February 2016.

Issue	Publication Date	Description (Organization)
1	FEB 2016	Initial publication.