

Tailor Welded Blanks: **Tailor Welded Blank Acceptance Guidelines**  
(July 1995)

## Acceptance Guidelines (July 1995)

# TAILOR WELDED BLANK ACCEPTANCE GUIDELINES

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## 1.0 SCOPE

The purpose of this document is to provide quality guidelines for the acceptance of tailor welded blanks using sheet steel materials for automotive applications. These include general provisions for dimensional accuracy, welding issues, packaging and handling and production validation.

These guidelines apply to the joining of sheet steels of the same or different thicknesses, compositions and/or coatings made by the fusion welding processes (e.g., laser or electron beam) and non-fusion welding processes (e.g., mash seam), prior to forming.

## 2.0 GENERAL PROVISIONS

The Tailor Welded Blanks Acceptance Guidelines are applicable to tailor welded blanks used in vehicle structures and components when specified on an applicable part drawing or purchase order.

The application of these guidelines is restricted to weldable grades of coated and uncoated sheet steels.

Any special requirements designated on the part drawing or purchase order are dominant to and take precedence over the requirements specified within these guidelines.

The surfaces and edges of the steel sheet at the time of welding should be free from scale, rust, paint and any other contaminants that would adversely affect the quality of the weld.

### 2.1 Definitions

Base Metal: The metal or alloy being welded.

Control Plan: A control plan is written description of the systems for controlling parts and processes. It is written by suppliers to address the important characteristics and engineering requirements of the product. Customer approval of a control plan may be required prior to submission of a production part.

Cpk: A measure of ongoing process capability. Ongoing process capability is a long-term measure of statistical process control or process performance. It differs from preliminary process capability by utilizing data from a longer time period to include all common causes of variation, in particular those common causes that may result in process shifts affecting a number of sample intervals. Systematic or repetitive patterns of special causes are understood. The time required for ongoing capability evaluation depends on the time required for the sources of variation to vary throughout their full ranges, but will typically be three to six months.

Cracks: A fracture-type discontinuity characterized by a sharp tip and high ratio of length and width to opening displacement.

Defect: A discontinuity or discontinuities that, by nature or accumulated effect (e.g., total crack length), render a part or product unable to meet the minimum applicable acceptance quality level. The term designates rejectability. (ANSI/AWS A3.0-94.)

Discontinuity: An interruption of the typical structure of a material such as a lack of homogeneity in the mechanical, metallurgical or physical characteristics. A discontinuity is not necessarily a defect. (ANSI/AWS A3.0-94.)

Electron Beam Welding (EBW): A welding process that produces a coalescence of metals with heat obtained from a concentrated beam composed primarily of high-velocity electrons impinging upon the joint.

Excessive Melt-Through: Excessive weld reinforcement, visible on the root side, that may be accompanied by an adjacent hole melted through the bead.

Fusion Zone: The area of the base metal melted as determined on the cross section of a weld.

Gas Tungsten Arc Welding Process: An arc welding process that produces a coalescence of metals by heating them with an arc between a tungsten electrode (non-consumable) and the work pieces. Shielding is obtained from a gas. Pressure and/or filler metal may or may not be used.

Heat-Affected Zone (HAZ): The portion of the base metal that has not been melted, but where the mechanical properties or microstructure have been altered by the heat of welding.

Inclusion: Entrapped foreign solid material, such as slag or oxide.

Laser Beam Welding (LBW): A welding process that produces a coalescence of materials with the heat obtained from the application of a concentrated coherent light beam impinging upon the joint.

Mash Seam Welding: A resistance seam welding process variant that makes a lap joint primarily by high-temperature plastic working and by diffusion as opposed to melting and solidification. The seam thickness is less than the original lap thickness.

Ppk: A measure of preliminary process capability. Preliminary process capability studies are short-term studies conducted to obtain early information on the performance of new or revised processes relative to internal or customer requirements. In many cases, preliminary studies should be conducted at several points in the evolution of new processes (e.g., at the equipment or tooling subcontractor's plant or after installation at the supplier's plant).

Pinhole: A small pinhole-sized pore that extends through the thickness of the weldment.

Planish: To reduce the thickness of a mash seam joint after mash seam welding using a mechanical rolling process.

Plasma Arc Welding: An arc welding process that produces a coalescence of metals by heating them with a constricted arc between an electrode and the workpiece (transferred arc) or the electrode and the constricting nozzle (non-transferred arc). Shielding is obtained from the hot, ionized gas issuing from the torch which may be supplemented by an auxiliary source of shielding gas. Shielding gas may or may not be used, and filler metal may or may not be supplied.

Porosity: Cavity-type discontinuities formed by gas entrapment during solidification.

Process Change: Any change in the process that could alter its capability to meet the design intent or durability of the product. This includes new, different, relocated or rehabilitated production machinery/equipment; any change in subcontracted products or services, including the use of engineering approved alternate materials; or changes to rework methods. Process changes also include changes in the sequence of operations and changes in chemical compounds such as adhesives, sealers, lubricants, etc., which are part of the product.

Statistical Process Control (SPC): The use of statistical techniques, such as control charts, to analyze a process or its outputs so that appropriate actions can be implemented to achieve and maintain a state of statistical control and to improve the process capability.

**Slag:** A nonmetallic product resulting from the dissolution of nonmetallic impurities in the weld metal.

**Starts and Stops:** In a fusion weld, the likely concavity (or suck back) at the beginning or the end of the weld in the direction of weld. In a non-fusion weld, the likely formation of cold welds at the beginning and/or the end of the weld.

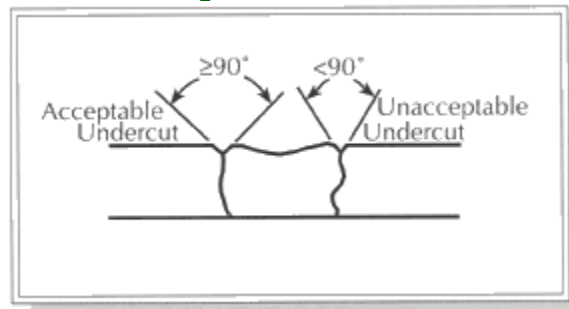
**Step Mismatch:** The difference in height of the two parent metal surfaces being welded (flushness). With a dissimilar gauge combination, one side is usually desired to be flush, and the step mismatch refers to the degree of mismatch on the flush side of the weld.

**Surface Voids:** Cavity-type discontinuities, typically large than porosity, formed by shrinkage during solidification.

**Tailor Welded Blanks (Tailored Blanks):** The product of the joining of two or more steel sheets into a single welded blank to enable product and manufacturing engineers to “tailor” the best properties of different steels so that they are located precisely within a part where needed.

**Undercut:** A groove melted into the base metal adjacent to the weld toe or root and left unfilled by weld metal. An undercut appears as a sharp (less than 90°) notch along the edges of the weld seam (Figure 1).

**Figure 1: Undercut.**



**Underfill:** A depression on the weld face or root surface extending below the adjacent surface of the base metal.

**Weld Concavity:** The underfill (or suck back) of metal in the weld causing the weld surface to be below flush with the parent metal surfaces. This condition may exist on either root or face surfaces.

**Weld Convexity:** The solidified, overfilled weld metal causing the weld surface to be above flush with the parent metal surfaces. This condition may exist on root or face surfaces and, when measured, both should be added for an accumulated effect.

**Weld Face:** The portion of the weld where the through thickness melting of the weld joint is initiated.

**Weld Root:** The portion of the weld where the through thickness melting of the weld joint is completed.

### 3.0 MATERIAL STANDARDS

Steel used in the manufacture of tailor welded blanks, regardless of type, shall meet the applicable material specification/standards of the buyer except as agreed to by the buyer, processor(s) and seller. This includes the use of hot or cold rolled, coated or uncoated, low carbon, HSLA (high strength low alloy), DQSK (drawing quality special killed), IF (interstitial free), DR (dent resistant) and BH (bake hardenable) steels for both fusion and non-fusion welding processes as defined Section 5.0.

In addition to meeting the required steel specifications, issues regarding unwelded blanks, such as flatness, formability, thickness, cleanliness and lubrication, can also be given consideration and should be agreed upon among the buyer, processor(s) and seller.

## 4.0 DIMENSIONAL ACCURACY OF TAILOR WELDED BLANKS

### 4.1 Customer Requirements

The blank size, shape, critical dimensions, weld location and flatness should meet specifications as agreed upon by buyer, processor(s) and seller.

Note: Flatness tolerance is dependent on part geometry, materials, stacking stamping presses and stamping process.

### 4.2 Measurements

Gauge, length, width and cut-out angles should be checked for accuracy by micrometer, tape measure or template in accordance with customer requirements.

Flatness may be checked by feeler or step gauges.

### 4.3 Inspection Procedure

Supplier is responsible for maintaining and documenting blank dimensional accuracy and flatness as required per Statistical Process Control plan, detailed in Appendix 2.

## 5.0 WELD ISSUES

### 5.1 Weld Quality, Fusion Butt Welds (Laser, Electron Beam, Plasma and Gas Tungsten Arc Welds)

- |       |  |
|-------|--|
| 5.1.1 | <p>Length and Location of Welds</p> <p>The length and location of the weld(s) should be as specified on the drawing.</p>   |
| 5.1.2 | <p>Continuity</p> <p>The full seam length should be joined in a single, continuous full-penetration pass for the length of the specified welds. The weld should show a complete metallurgical bond along the entire length of the weld seam. However, starts and stops of the weld bead in the offal areas are generally permissible. Due to inherent limitations in autogenous fusion welding, the beginning and the ending 3.0mm of a weld section shall be relieved from quality criteria such as concavity, convexity and other geometrical and metallurgical specifications. Therefore, discontinuities in these weld nugget and/or heat-affected zones are permissible and may need to be removed by trimming. No non-fused or non-metallurgically bonded areas, skips or porosity shall be present on either surface of the weld seam when viewed under low-power magnification (typically 10x). In cases of blanks processed using fusion welding processes, such as laser beam welding, electron beam welding, plasma arc welding or gas tungsten arc welding, the weld solidification pattern should be consistent and free of restarts or sudden changes.</p> |
| 5.1.3 | <p>Surface Voids</p> <p>Voids that are observable by visual inspection are unacceptable.</p>   |
| 5.1.4 | <p>Cracks</p>  |

The weld shall be crack-free when examined using standard production evaluation techniques as agreed upon by supplier and user.

5.1.5

**Porosity**

Surface porosity that is observable by visual inspection is unacceptable. Internal porosity limits in terms of the maximum allowable size and/or numbers of pores/area should be established based on service requirements and agreed upon by supplier and user.

5.1.6

**Pinholes**

The weld should not contain any holes or pinholes that extend through the thickness when examined using any non-destructive evaluation technique.

5.1.7

**Excessive Melt-Through**

A weld is not acceptable if excessive melt-through occurs in any part of the weld.

5.1.8

**Undercut**

Undercut that is observable by visual inspection is unacceptable.

5.1.9

**Slag**

Loose slag may peel off under forming operation and interfere with the forming dies. Hence, no slag should be allowed on the surface of the weld. The part's control plan should address this issue.

5.1.10

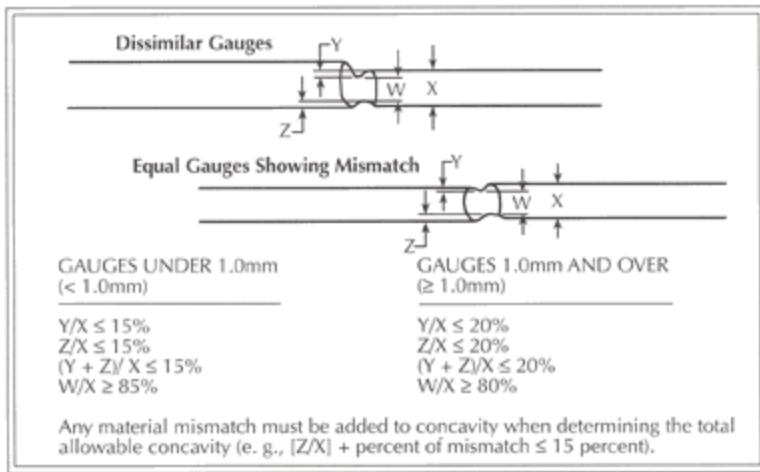
**Concavity**

Overall concavity should not exceed 15 percent of the governing metal thickness for thickness less than 1.0mm (Figure 2). The governing metal thickness is the thinner of the two sheet metals being joined. For metal thicknesses equal to or greater than 1.0mm, the overall concavity should not exceed 20 percent. Any material mismatch must be added to concavity when determining the total allowable concavity.

The location, frequency and method of measuring should be established based on service requirements. Under stringent forming conditions and/or high-performance parts, lower concavity limits may have to be established. The applicable design and manufacturing activities should be responsible for determining when lower concavity limits are necessary.

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**Figure 2: Concavity.**

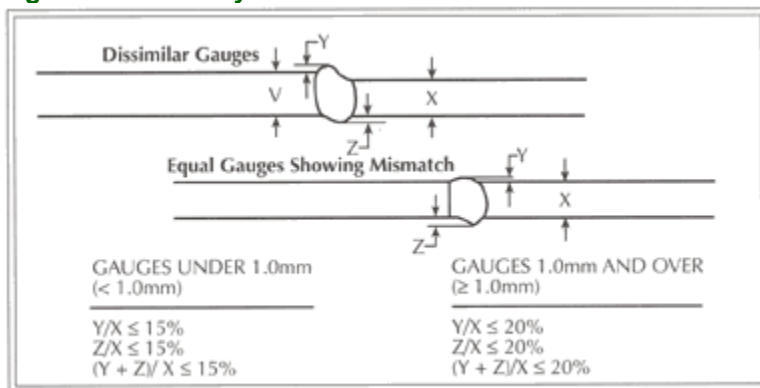


5.1.11

**Convexity**

Overall convexity should not exceed 15 percent of the governing metal thickness for thickness less than 1.0mm (Figure 3). The governing metal thickness is the thinner of the two sheet metals being joined. For metal thicknesses equal to or greater than 1.0mm, the overall convexity should not exceed 20 percent. Any material mismatch must be added to the convexity when determining the total allowable convexity.

The location, frequency and method of measuring should be established based on service requirements. Under stringent forming conditions and/or for high-performance parts, lower convexity limits may have to be established. The applicable design and manufacturing activities should be responsible for determining when lower convexity limits are necessary.

**Figure 3: Convexity.**

5.1.12

**Inclusions**

Subsurface inclusions could adversely affect formability. If subsurface inclusions are present, then size and/or frequency limitations should be established based on service requirements.

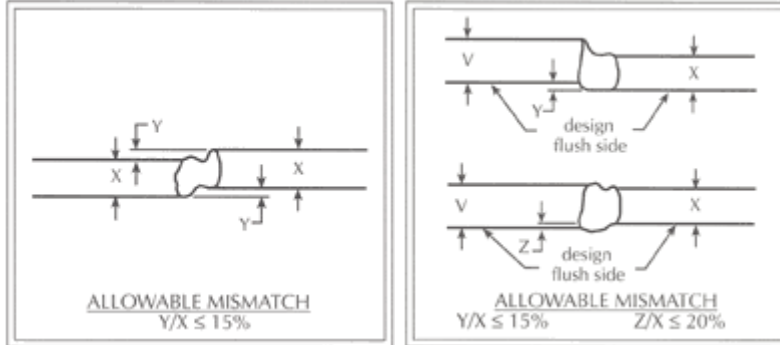
5.1.13

**Mismatch**

Mismatch requirements are driven by product requirements as well as process requirements, such as die settings and weld strength requirements in stamping operations. In order to obtain quality stamped panels, tailor welded blanks should be

sufficiently aligned so that no point along the weld seam is offset by greater than 15 percent below flush or 20 percent above flush of thickness of the thinner member over and above the steel tolerance (Figures 4 and 5) unless otherwise specified. The engineering drawings should indicate the maximum material offset allowable.

**Figure 4: Mismatch (Equal Thickness).** **Figure 5: Mismatch (Dissimilar Thickness).**



5.1.14

#### Microstructure

In the event that any of the weld requirements listed in Section 5.0 cannot be positively established by the procedures noted, or for arbitration of a disagreement, the final decision will be based on a micro-examination of a metallographic section.

## 5.2 Weld Quality, Non-Fusion Lap Welds

### 5.2.1 Continuity

The full seam length should be joined in a single, continuous pass for the length of the specified weld. The weld should show complete metallurgical bond along the entire length of the weld. However, starts and stops of the weld bead in the offal areas are generally permissible. Due to inherent limitations in non-fusion lap welding, the beginning and ending 3.0mm of a weld section shall be relieved from quality criteria, such as concavity, convexity and other geometrical and metallurgical specifications. Therefore, discontinuities in these weld nugget and/or heat-affected zones are permissible and may need to be removed by trimming.

### 5.2.2 Cracks

The weld and HAZ should be free of cracks when using standard production evaluation techniques as agreed upon by supplier and user. Cracks should not be confused with the area not bonded near the edge of the interfacing sheets. See Figure 6.

**Figure 6.**



### 5.2.3 Voids

Mash seam welds, due to the non-fusion nature of the process, do not exhibit solidification-related pores. It is conceivable that due to entrapment of mill oil or another contaminant between the faying surfaces, porosity may result. Internal porosity limits, in terms of the maximum allowable size and/or numbers of pores per unit area, should be established based on service requirements and agreed upon by supplier and user.

### 5.2.4 Excessive Melt-Through

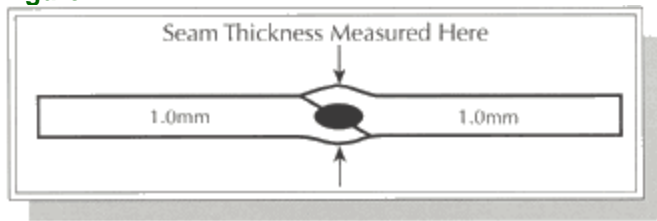
A weld is not acceptable if excessive melt-through occurs in any part of the weld.



### 5.2.5 Seam Thickening

Seam thickening is an increase in thickness caused by over-lapping of the sheets to be welded (Figure 7). Maximum seam thickening shall be specified by the product and processing requirements.

**Figure 7.**



### 5.2.6 Slag

Loose slag may peel off during the forming operation and interfere with the forming dies. No slag should be allowed on the surface of the weld. The part control plan should address this issue. When planished, mash seam welds do not generally have any loose slag.

### 5.2.7 Microstructure

Details about the microstructure of mash seam welds are given in Appendix 1. The joint line clearly visible at low magnifications may be the result of etching caused by differing grain sizes through the thickness of the sheet material; alloys between the sheet material and the coating material; or the inclusion of impurities in the sheet surface.

Metallographic examination of the heat-affected zones and welds, with clearly visible joint lines at magnification between 30x and 100x, should be examined at a higher magnification (>300x) in order to evaluate the quality of the weld. Magnification of 300x is necessary to judge whether a connection has been made by recrystallization across the welded surface.

## 5.3 Weld Testing

### 5.3.1

#### Integrity/Strength of the Weld and Heat-Affected Zone

Tailor welded blanks normally have greater strength in the weld than in the base metal. The dome test and peel/pliers test (for mash seam welds) should be used to evaluate the integrity/strength of the weld. Failure within and parallel to the weld is not acceptable.

#### 5.3.1.1 Ball Punch Deformation Test (Draw Cup Test)

Perform Ball Punch Deformation Test on samples cut from the welded blank (reference ASTM E643.78 or other approved test method). The acceptance criteria for the weld seam subjected to the cup test are as follows:

Perform Ball Punch Deformation Test on samples cut from the welded blank (reference ASTM E643.78 or other approved test method). The acceptance criteria for the weld seam subjected to the cup test are as follows:

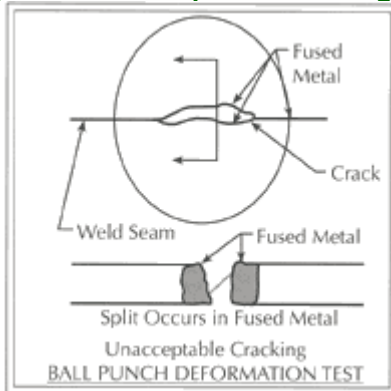
#### A) Weld Failure Mode

- 1) If a weld break occurs in the weld parallel to the

weld seam, the weld is unacceptable. Refer to Figure 8a.

2) If a weld break occurs in the weld perpendicular to the weld bead, the weld is acceptable. Refer to Figure 8b.

**Figure 8a: Unacceptable Cracking.** **Figure 8b: Acceptable Cracking.**



5.3.1.2

Peel/Pliers Test

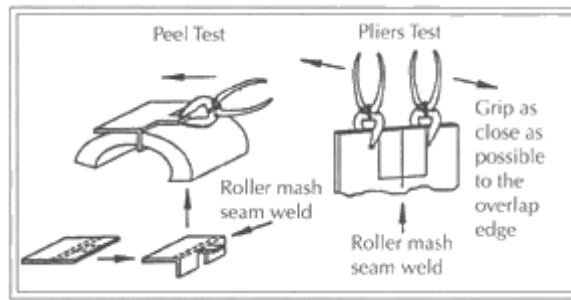
A) Peel Test

If the seam of the mash seam weld can be peeled away, the weld is unsatisfactory. The seam thickening should not be removed. If the thinner/lower strength sheet is only partly peeled off and at least half of the width of the seam remains attached to the thicker/higher strength sheet, experience dictates that the weld can be subjected to further processing by deep drawing without difficulty. This type of fracture occurs with coated or poorly weldable uncoated sheets or when sheets of unequal thicknesses are welded. Fracture in the base material or in the interface area is representative of a satisfactory weld.

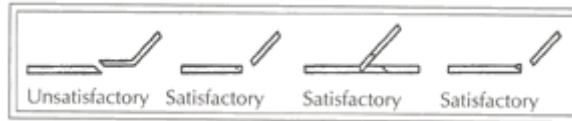
B) Pliers Test

At the end or the beginning of the weld, grip the ends of the weld seam as close as possible to the weld and pull away one sheet from the other. This test is carried out to examine the quality of the weld bond at the start and the end of the weld joint. The failure assessment criteria is same as for the peel test. See Figures 9 and 10 for peel/pliers test and failure analysis.

**Figure 9: Pliers/Peel Test.**



**Figure 10: Failure Analysis.**



## 6.0 WELDED BLANK PACKAGING AND HANDLING ISSUES

Special considerations should be given to the packaging and handling of tailor welded blanks. Tailor welded blanks should be identified with traceability information as outlined in Section 6.1. The blanks should be packaged and shipped according to Section 6.2 so that the blanks are appropriately secured and are not damaged in transit, storage or during in-plant handling.

### 6.1 Material Traceability

Tailor welded blank lots should be identified with a traceability code agreed upon by the buyer, processor and seller. The blank lots should be identified so that the individual blanks in the tailor welded blank can be identified with respect to processor and mill coil identity.

### 6.2 Packaging and Handling

Tailor welded blank lots should be shipped and handled to prevent uneven stacks of blanks from shifting. Lot quantities should be based in part on the height differential created by multi-gauge tailor welded welded blanks. Dimpling the thinner gauge blank can minimize the height differential. Stacking, banding and wrapping procedures should conform to the receiving plant requirements. Alternate methods of blank handling may be defined by the receiving plant due to specific requirements.

## 7.0 PRODUCTION VALIDATION AND CAPABILITY

### 7.1 Process Control

The supplier should identify and plan the production, installation and servicing processes that directly affect tailor welded blank quality and should ensure that these processes are carried out under controlled conditions.

### 7.2 Inspection and Testing

The supplier should establish and maintain documented procedures for inspection and testing activities in order to verify that the specified requirements for the tailor welded blanks are met. The required inspection, testing and the records to be established should be detailed in the Control Plan or documented procedures.

The supplier should carry out all final inspections and testing in accordance with the Control Plan and/or documented procedures to complete the evidence of conformance of the finished product to the specified requirements. If no such requirements have been established, a  $Cpk > 1.33$  will be used as the default value for

inspection measurement data that occurs with normal distribution.

The Control Plan and/or documented procedures for final inspection and testing should require that all specified inspection and tests, including those specified either on receipt of product or in-process, have been carried out and that the results meet specified requirements. No product is to be dispatched until all the activities specified in the Control Plan and/or documented procedures have been satisfactorily completed and the associated data and documentation are available and authorized.

### 7.3 Control of Inspection, Measuring and Test Equipment

The supplier should establish and maintain documented procedures to control, calibrate and maintain inspection, measuring and test equipment used by the supplier to demonstrate the conformance of tailor welded blanks to the guidelines contained herein. Inspection, measuring and test equipment shall be used in a manner that ensures that the measurement uncertainty is known and is consistent with the required measurement capability.

The supplier should establish and maintain documented procedures to control, calibrate and maintain inspection, measuring and test equipment used by the supplier to demonstrate the conformance of tailor welded blanks to the guidelines contained herein. Inspection, measuring and test equipment shall be used in a manner that ensures that the measurement uncertainty is known and is consistent with the required measurement capability.

### 7.4 Summary of Validation and In-Process Tests – See Table 1 Below

**Table 1: Example of Validation and In-Process Test Sheet**

Test Name	Section	Min. Samples per lot	Acceptance Criteria	Acceptance Criteria and Min. Sample Size
Dimensional Accuracy	4.0	3	Size, shape, flatness and weld location should be as specified on process sheet or documentation used for purchasing agreement.	As specified on process sheet or documentation used for purchasing agreement. Frequency and check location must be specified in control plan.
Ball Punch Def. Test	5.3.1.1	A. 3 B. 30 samples required for each source for correlation.	A. Break must be perpendicular to weld joint or outside the fused zone. B. Cup heights established from 30 sample study acceptable finished part formability. Ppk $\geq 1.67$ .	A. Break must be perpendicular to weld joint or outside the fused zone. B. Frequency and check locations must be specified in control plan per QS-9000. Cup height within tolerance. Cpk $\geq 1.33$ .
Peel Test (mash seam welds only)	5.3.1.2	3	Break must be outside the fused zone.	Break must be outside the fused zone. Frequency and check must be specified in control plan per QS 9000.
Weld Quality	5.0	3	Refer to Section 5 for details.	Refer to Section 5 for details.
Continuity	5.1.2, 5.2.1	3		
Cracks	5.1.4, 5.2	3		
Porosity	5.1.5	3		
Pinholes	5.1.6	3		
Excessive Melt-Through	5.1.7, 5.2.4	3		
Undercut	5.1.8	3		
Slag	5.1.9, 5.2.6	3		
Concavity	5.1.10	Suff. qty. to determine Ppk per QS-9000.	Refer to Section 5.1.10 and Figure 2. Ppk $\geq 1.67$ . Face analyzed separately from root.	Acceptance criteria same as for product validation. The supplier must submit a quality control plan per QS-9000, which must specify check locations and frequency. Ppk $\geq 1.33$ .
Mismatch	5.1.13	Suff. qty. to determine Ppk per QS-9000.	Refer to Section 5.1.13 and Figures 4 and 5. Ppk $\geq 1.67$ . Face analyzed separately from root.	
Materials	3.0	3	Refer to Section 3 for details.	

## 8.0 DISPOSITION OF NON-CONFORMING TAILOR WELDED BLANKS

Tailor welded blanks that do not conform to the specified acceptance criteria should be repaired or scrapped according to approved engineering repair or scrappage practices as agreed upon among buyer, processor(s) and seller.

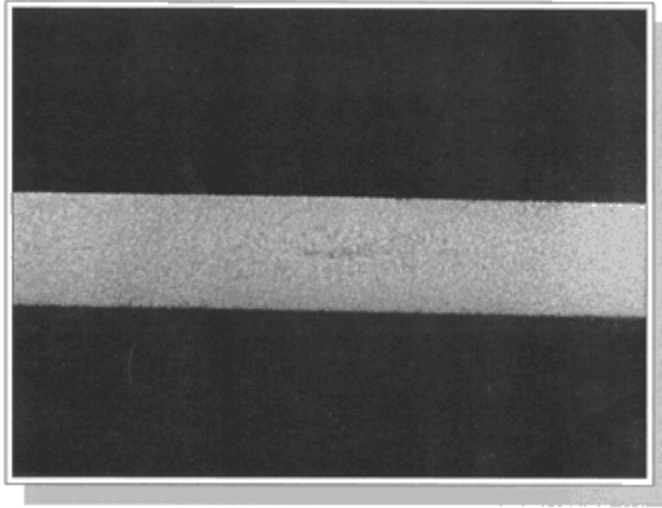
## APPENDIX 1

### Microstructure of Mash Seam Welds.

1. Generally there are three types of microstructures common to the roller mash seam welding process. The microstructures are seen when etched metallurgical samples are viewed under a microscope. The microstructures are described in numbers 2 to 4 which follow.
2. Homogenous structure: Examine for homogenous structure (Figure A-1) throughout with no clearly visible weld nugget or joint line. Joints of this type are often obtained with sheets of the same quality.

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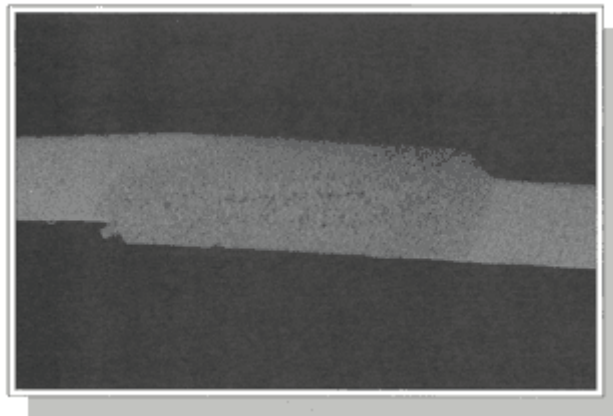
**Figure A-1: Example of homogeneous weld structure.**



3. Visible Weld Nugget (Figure A-2 on page 32): A visible weld nugget appears in the center of the joint and has clearly defined joint lines at the boundary of the weld nugget. Joints of this type are typical of uncoated and coated sheets with relatively low electrical material resistance and high surface resistance. The position of the nugget may vary considerably. The formation of a nugget in the weld is mainly dependent on the ratio of the material resistance to the transition resistance between the sheets. The size of the overlap and the welding speed are further influencing factors.

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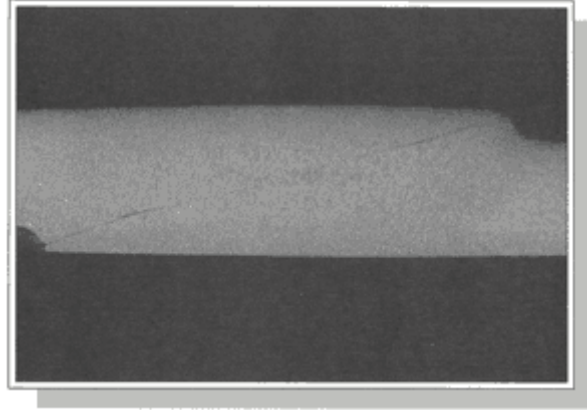
**Figure A-2: Example of visible nugget.**



4. Visible joint (Figure A-3): The final type of weld is one with no weld nugget and clearly visible joint lines across the entire weld. Joints of this type are typical of coated sheets with relatively high electrical material resistance and low surface resistance.

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**Figure A-3: Example of a visible joint.**



## **APPENDIX 2**

**Dimensional Control – See Chart Below.**

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**Dimensional Control**

**S.P.C.**

STATISTICAL PROCESS CONTROL DATA  
PART #

Date: \_\_\_\_\_

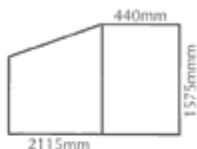
Shift: \_\_\_\_\_

Operator: \_\_\_\_\_

Supervisor: \_\_\_\_\_

C/O Press: \_\_\_\_\_

Coil Width: \_\_\_\_\_ 1575mm



440mm

2115mm

1575mm

Critical Measure: \_\_\_\_\_ 440mm

Coil Width: \_\_\_\_\_ 1575mm

Length: \_\_\_\_\_ 2115mm

Critical Measure: \_\_\_\_\_ 440mm

Bow Tolerance: 5/16 IN. MAX.

HOME PRESS FOR THIS PART:

LENGTH – MEASURE TOP BLANK EACH LIFT

2115mm																				
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BOW TOLERANCE: 5/16 IN. MAX BOW

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CRITICAL MEASURE – MEASURE TOP BLANK EACH LIFT (TOLERANCE ← +3mm -0)

438mm																				
439mm																				
440mm																				
441mm																				
442mm																				

COIL WIDTH – MEASURE TOP BLANK EACH LIFT (or) MEASURE THE COIL AT ITS ENTRY INTO THE CUT-OFF PRESS – ONCE PER LIFT

1573mm																				
1574mm																				
1575mm																				
1576mm																				
1577mm																				

VENDOR																				
TALLY #																				
LIFT #																				