Herein are the minimum requirements that shall be incorporated into the production process. This Production Process CG is in addition to and not intended to replace any requirements as outlined in the CG4338 GM 1927 03 GM Supplier Quality SOR. It is understood that advances in technology may require modifications to the following requirements to ensure state of the art processing and testing. It is the responsibility of the supplier to ensure that the process is state of the art and that the GM SQE is both informed and in agreement to any modifications of the requirements below.

The required tasks indicated below are based on experience, best practices and lessons learned to improve part quality using APQP Continuous Improvement activity in GM projects and are applicable to all impacted suppliers and parts in the supply chain. All deviations requested for “shall” items are to be detailed in *CG3404 M7 Technical Issues List* found in eSOR Appendix M7 and reviewed and approved by General Motors Supplier Quality prior to sourcing*.*

*Note(s):* “Shall” in this document is mandatory. “Should” is highly recommended.

Any deviations to this requirement shall be approved by the GM SQE

Index

[1. Introduction 1](#_Toc1849751577)

**2.** Release andRevisions………………………………………………………………………………………………………2

[Table 1 – Gas Metal Arc/Braze Welding Launch Per Shift Or Batch Schedule Requirements: 6](#_Toc1711613029)

[Table 2 – Laser Welding Launch Per Shift Or Batch Schedule Requirements: 6](#_Toc202007573)

[Table 3 – Resistance Spot Welding Launch Per Shift Or Batch Schedule Requirements: 7](#_Toc1638532781)

[Chart 1 – Resistance Spot Weld (RSW) Percent Conformance Level 8](#_Toc350520891)

[Chart 2 – Continuous Welds Percent Conformance Level 9](#_Toc1054224657)

[Table 4 – All Process Launch Per Shift or Batch Schedule Requirements: 11](#_Toc61397261)

**Note: If a supplier is unable or unwilling to meet all the requirements of this specification it is the responsibility of the supplier to inform the GM SQE immediately so escalation to GM SQ leadership can commence.**

1. **Introduction**
   1. The Part Supplier shall review this document to ensure understanding of these requirements set forth within this document, prior to Tech Review.
   2. **Purpose:** This document describes the minimum batch and hold requirements to be incorporated into the manufacturing and quality processes for this specific commodity. The expectation is for GM to receive parts that meet 100% of these requirements
   3. **Applicability:** Body Structure Small/Moderate/Critical Sub-Assemblies
   4. **Remarks:** It is understood that advances in technology may require modifications to the following requirements to ensure state of the art processing and testing. It is the responsibility of the supplier to ensure that the process is state of the art and that the GM SQE is informed and in agreement to any modifications to the requirements below.
2. **Before Weld Verification Run Begins:**
   1. Confirm weld study for proper size, location and quantity of welds, weld map shall include direction of weld bead for cut & etch verification sectioning
   2. Confirm the material processed meets the design specification of material composition, thickness, and coating weight
   3. Confirm all components are dimensionally correct with a PAST score of 90% or greater.
   4. Scribe or drill panel completed for variation control <.5mm Resistance Spot Weld (RSW) Gage R studies completed with confirmation report
   5. Gap study - weld joint gaps for Gas Metal Arc Welds (GMAW) need to be repeatable and consistent, supplier must demonstrate capability to meet all weld acceptance criteria in GMW14058. Suggested gap size is a maximum 1x weld wire diameter.
   6. Gauge R studies completed with confirmation report available for review/upload during APPV.
   7. As weld verification commences during the Production Part Approval Process, the Supplier shall begin to record weld quality results into a run health chart format with stability & repeatability trends per the shipments.
3. **Rework & Repair Requirements**
   1. The Supplier is responsible for establishing documented processes and test methods to assure that the criteria of GMW weld standards are met and consistent with applicable GMW. When repair is required, weld repairs shall follow the repair method authorized per appropriate weld process GMW. Supplier shall follow applicable GMW for acceptance and repair disposition. The information below outlines the definition of repair versus rework, along with repair requirements. The Supplier shall meet all the requirements below to be qualified to perform and ship any parts or batches.
   2. Rework: An action on a nonconforming product to make it conform to the requirements. This is bringing a non-conforming part back into conformance by simply reprocessing a prior sequence.
   3. Repair: An action on a nonconforming product to make it acceptable for the intended use. This is bringing a non-conforming part back into conformance using methods outside the original process.
   4. Weld Cut and Etch or Peel Tests Report Bookends showing less than the allowable percent non-discrepant welds, automatically requires Post-Weld Repair Cut and Etch or Peel Test verification. This verification shall be performed on the repaired welds from one sample in the batch containing the largest quantity of repaired welds based on weld destruct reports and/or post Early Production Containment (EPC) Inspection data.
   5. Supplier shall retain repair weld cut and etch reports and shall have the reports available upon request. Repair results shall meet the minimum percent non-discrepant per applicable Material Requirement Dates (MRD) timing to release the batch (Following applicable GMW for qualified repairs).
      1. If Post-Repair Weld Cut and Etch Report shows results less than the minimum percent non-discrepant passing, that batch must be scrapped, welds cannot be repaired more than **once**.
   6. All repair procedures shall include the following:
      1. Weld Map displaying the part, along with weld locations with out of specification welds identified.
      2. Repair Welding Procedure Specification (WPS) with all essential variables listed per stackups.
      3. Procedure Qualification Record (PQR) showing verification of Welder Procedure Specification (WPS) variables producing a quality weld per material stackups and weld position through cut and etch evaluation.
      4. Welder Qualification Record (WQR) that provides evidence that repair welders have been qualified and can produce a quality weld per material stackup and weld position per Welder Procedure Specification (WPS).
      5. Completed “I Chart” which includes weld failure modes, confirmed weld ID numbers repaired, Pareto Chart of weld failure modes and weld destructs event dates.
         1. Every repair welder must be qualified for each combination of weld material stackups, weld position and Welding Procedure Specification (WPS) that they are to produce. This information shall be documented and available upon request.
         2. If any repair welder has not performed repairs for specified material stackups and weld position including weld parameters within 6 months, those welders will need to be re-qualified.
         3. If any repair welder has produced repairs not meeting GM GMW’s weld quality requirements, or their skill is in question for any reason, those welders shall be re-qualified.
4. **Weld Verification During Production Part Approval Process**
   1. Weld Verification Build Process for all welding processes within GM SQ Body Structures and Chassis.
      1. Manufacture first build size of 12 complete parts to net 10 shippable parts. Conduct a visual evaluation of all welds, along with weld destructive evaluation from applicable GMW of the first and last parts of the build.
      2. Measure and document each weld per applicable GMW specification and requirements.
      3. Parts tested must conform to Weld Quality milestone requirements if requirements are not met supplier will perform necessary changes to bring weld quality into conformance. Repeat 12 part run again
      4. Repeat this process until 10 consecutive builds of 12 parts provide product conformance.
      5. Manufacture the next 209 parts to net 200 consecutive assemblies.
      6. Visually evaluate and then destruct first off and every 25th sample.
      7. Measure and record the weld size, confirm location and presence for each weld destructively tested.
      8. Parts tested must conform to Weld Quality milestone requirements specification if requirements are not met supplier will perform necessary changes to bring weld quality into conformance and repeat the run.
      9. At this point, the remaining parts (providing product conformance has been met) can be used for PPAP statistical capability studies as required for approval and follow the batch and hold process.
      10. Manufacture the next scheduled consecutive production run in accordance with the approved process control plan.
5. **Batch & Hold Weld Verification Frequencies All Commodity’s:**
   1. Suppliers must demonstrate weld process capability, stability, and repeatability within the proper weld equipment potential by certifying that all components or sub-assemblies are dimensionally correct and meet the required specifications with **“DRIVE TO NOMINAL”** strategies in place before staging for usage. Requirements include all Tier 2 or 3 sub-assembly weld verification if applicable.
6. **Batch and Hold Definition:** 
   1. Batch production is a method of manufacturing where the products are made as specified groups or scheduled amounts, by specified fixtures / production lines within a time frame. The start of a batch will always be the next part produced after any “special cause” variation and end of a batch will be the last part prior to any “special cause” variation. Supplier of record is responsible for weld quality and all applicable documentation regardless of manufacturing location (Integrator, Low Volume Supplier, Prototype, Homeline etc.).
   2. Suppliers shall **Hold all Batches** of parts produced prior to **shipment** from the manufacturing location (Integrator, Low Volume Supplier, Prototype, and Homeline etc.) until the following criteria are met:
      1. **Severity 9 and 10** All welds must be verified through destructive testing per the applicable welding GMW **daily** per value stream through cut & etch evaluation.
         1. Data shall follow the weld map and shall be recorded on the weld process health chart prior to each shipment. Weld Destruct Data must be documented and available on request.
         2. Batches shall be analyzed through weld destruct data cut and etch and released by validating weld conformance for each MRD milestone per the minimum percent non-discrepant welds as stated in GMW 14058.
         3. This is required throughout the life of the program.
      2. **Severity 8 and below** All welds must be verified through weld destructive testing per the applicable Weld GMW, no to exceed more than 5 times Supplier Daily Capacity (SDC), per value stream through applicable weld destruct method.
         1. Prior to Steady State: Batch size equals one shift, or no more than 12 hours, to provide adequate time for weld destruct quality feedback.
            1. Data shall follow the GM weld map and shall be recorded on the weld process health chart prior to each shipment. Weld destruct data must be documented and available on request.
            2. Batches shall be analyzed and released by validating weld conformance for each MRD milestone per minimum percent non-discrepant welds as stated in applicable GMW.
         2. After Steady State: Batch size equals one destruct per part per week per value stream 5 times SDC.
            1. This only applies if no special cause variation occurs.
            2. If low volume or program is not meeting SDC targets, supplier must consult with GM SQE representative for adequate batch size approval.
   3. Suppliers shall implement across all production lines / all weld fixtures and shall accurately record in the weld process health chart header column.
   4. Ultrasonic testing, at this time, can only be used to supplement in process weld checks and cannot replace weld destruct events.
      1. Suppliers can implement ultrasonic testing of resistance spot welds throughout Production Part Approval Process (PPAP) to collect correlation studiesand gain experience with the technology.
7. **Documentation Required (DR) Weld Chassis Only:** 
   1. When a potential weld issue is identified and may lead to a formal investigation (field, yard hold, etc.) it is imperative the ***effected welds*** are properly identified, and weld quality be reported out daily. Product Engineering in conjunction with GM Weld GPL and Supplier Quality is responsible for identifying the effected welds as DR. The supplier shall implement daily cut & etch confirmation. Reporting periodicity maximum 30 days or extended by the Field Investigation Team.
8. **Gas Metal Arc Welding (GMAW) Prior to Steady State**
   1. **Beginning of Batch** – First off confirmation by Visual Inspection, **Optional:** Chisel Check, Bend Pry Test or Cut & Etch per GMW1556.
      1. If acceptable to requirements, begin production runs.
   2. **During Batch Build** – Confirmation by Visual Inspection, **Optional:** Chisel Check, Bend Pry Test or Cut & Etch per GMW15563.
      1. If acceptable to requirements, continue the production run and update production run charts.
   3. **End of Batch** – Last off confirmation by Visual Inspection and Cut & Etch sectioning to verify conformance according to the Weld Verification Plan submitted and approved to specified map requirements.
      1. If acceptable, move **“BATCHED”** product forward through the value stream.
9. **Laser Prior to Steady State**
   1. **Beginning of Batch** – First off Visual Inspection, **Optional:** Chisel Check, Bend Pry Test or Cut & Etch per GMW15563.
      1. If acceptable to requirements, begin production runs.
   2. **During Batch Build** – Visual Inspection, **Optional:** Chisel Check, Bend Pry Test or Cut & Etch per GMW15563.
      1. If acceptable to requirements, continue the production run and update production run charts.
   3. **End of Batch** – Last off confirmation by Visual Inspection and Cut & Etch sectioning to verify conformance according to the Weld Verification Plan submitted and approved to specified weld map requirements.
      1. If acceptable, move **“BATCHED”** product forward through the value stream.
10. **Resistance Spot Welding (RSW) Prior to Steady State**
    1. **Beginning of Batch** – First off Visual Inspection and Peel Testing Method.
       1. If acceptable to requirements, begin production runs.
    2. **During Batch Build** – Visual Inspection and Deformation Test (chisel) Check, or Peel Test.
       1. If acceptable to requirements, continue production run.
       2. If acceptable, move “BATCHED” product forward through the value stream.
11. **Drawn Arc Stud Welding (DAW) Prior to Steady State**
    1. **Beginning of Batch** – First off confirmation by Visual Inspection and Peel Testing Method.
       1. If acceptable to requirements, begin production runs.
    2. **During Batch Build** – Confirmation by Visual Inspection and Non-Destructive bend test with Click Wrench or Peel Test per GMW 15563.
       1. If acceptable to requirements, continue production run.
    3. **End of Batch –** Last off confirmation by Visual Inspection and Peel Test to verify conformance to specified requirements.
       1. If acceptable, move “BATCHED” product forward through the value stream.
12. **Fastener Welding Prior to Steady State**
    1. **Beginning of Batch** – First off confirmation by Visual Inspection, Thread Check, Set-down and Push Out or Peel Testing Method
       1. If acceptable to requirements, begin production runs
    2. **During Batch Build** – Confirmation by Visual Inspection, Thread Check and Set-down Test or Peel Test per GMW 15563
       1. If acceptable to requirements, continue production run
    3. **End of Batch –** Last off confirmation by Visual Inspection, Thread Check, Set-down and Peel Test or Push Out Test to verify conformance to specified requirements

**Proposed deviations to these sections or Table 1 and 2 must be reviewed by GM SQ Welding GPL, Product Engineering and approved in writing by GM SQE, and GM SQ Manager (*load in SQMS “Customer Specific Requirements”*).**

## Table 1 – Gas Metal Arc/Braze Welding Launch Per Shift Or Batch Schedule Requirements:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SMT COMMODITY**  **All welded assemblies being shipped to GM Assembly Centers** | **FIRST OFF OF BATCH**  *Note 1*  **Production Run Plan to Start**  **All Welds per GMW15563** | **MID SHIFT**  *Note 1* **Production Run Plan to Continue**  **All Welds per GMW15563** | **LAST OFF OF BATCH**  *Note 1, 2*  **Weld Assembly Confirmation to Release Product**  **All Welds per GMW15563** | **CUT & ETCH PLAN**  *Note 1, 2*  **Per GM Weld Map.**  ALL WELDS ON PART SHALL BE INCLUDED IN DESTRUCTIVE EVENT |
| **Suppliers own first off approval as part of the startup.**  **PFMEA severities shall determine which 1st off method shall be used** | **Suppliers own ongoing visual inspection by an approved Vision System or Weld Cell Operator, Chisel, Bend or Pry test may be considered** | **Complete Visual conformance review and Cut & Etch sectioning required and recorded into the sustainability health chart** | **WELD PASSES**  **START / STOP**  **Refer to GMW14058**  **-----------------------------------------**  **\*Chassis Only\***  **6-****10mm from each end**  **Refer to CG4352**  **ALL WELDS ARE CONSIDERED EFFECTIVE WELD LENGTHS AS SHOWN IN THE GM WELD FILE** |

***Note 1:*** *T*he supplier cannot substitute mechanical testing for standard cut & etch evaluation.

***Note 2:*** Follow Applicable GMW for all welding requirements**.**

## Table 2 – Laser Welding Launch Per Shift Or Batch Schedule Requirements:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SMT COMMODITY**  **All welded assemblies being shipped to GM Assembly Centers** | **FIRST OFF OF BATCH**  *Note 1*  **Production Run Plan to Start**  **All Welds per GMW15563** | **MID SHIFT**  *Note 1* **Production Run Plan to Continue**  **All Welds per GMW15563** | **LAST OFF OF BATCH**  *Note 1, 2*  **Weld Assembly Confirmation to Release Product**  **All Welds per GMW15563** | **CUT & ETCH PLAN**  *Note 1, 2*  **Per approved GM Weld Map.**  ALL WELDS ON PART SHALL BE INCLUDED IN DESTRUCTIVE EVENT |
| **Suppliers own first off approval as part of the startup.**  **PFMEA severities shall determine which 1st off method shall be used** | **Suppliers own ongoing visual inspection by an approved Vision System or Weld Cell Operator, Chisel, Bend or Pry test may be considered** | **Complete Visual conformance review and Cut & Etch sectioning required and recorded into the sustainability health chart** | **See appropriate laser process GMW for cut and etch requirements** |

***Note 1:*** The supplier cannot substitute mechanical testing for standard cut & etch evaluation.

***Note 2:*** Follow Applicable GMW for all welding requirements**.**

## Table 3 – Resistance Spot Welding Launch Per Shift Or Batch Schedule Requirements:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SMT COMMODITY**  **Chassis and Structures -**  **Complex Assemblies** | ***BEGINNING OF BATCH***  **FIRST OFF (1) Production Run Plan to Start**  **100% All Welds** | ***DURING BATCH BUILD***    **A Minimum of 2 In Process Checks are required per batch. Refer to GMW15563**  ***\*In Process Inspection*** | ***END OF BATCH***  **LAST OFF**  **Weld Assembly Confirmation to Release Product** | **PEEL TEST PLAN**  *Note 1, 2*  **Per approved GM Weld Map.** |
| STRUCTURES – ALL  INCLUDING IP/CCB’s | Peel Test | Chisel Check | Peel Test | ALL WELDS ON PART SHALL BE INCLUDED IN DESTRUCTIVE EVENT |

***Note 1:*** The supplier may substitute standard Peel Testing evaluation as a substitute for supplemental In Process Inspection (Chisel Check). Proposed alternatives must be agreed to in advance by GM Supplier Quality and GM Product Engineering.

***Note 2:*** Frequencies and methods are subject to be modified based on the introduction of new technologies, 100% In-Line performance features, Feedback Weld controls, etc., are required to not only detect process failure, but shall be capable of shutting down the weld system cycle for proper analysis of the weld failure mode. Weld Verification process confirmation must include but not limited to Stability & Capability results, Weld Health charts over time, zero PRR’s or GM Plant disruption.

1. **Batch Definition of Special Cause Variation:** 
   1. The start of a batch will always be the next part produced after any “special cause” variation and end of a batch will be the last part prior to any “special cause” variation. These “special cause” variation shall include the following:
      1. Any essential variable weld parameter change. (Examples: current/wire feed speed, voltage, travel speed, torch angles, gas mixture ratio, filler metal specification).
         1. Note: Shielding Gas and filler metal changes would require approval, re-PPAP.
      2. Any Temporary Authorization (TA) on a detail affecting weld joint fit up.
         1. Temporary Authorization (TA) for out of tolerance condition.
      3. Any major maintenance of key equipment in an assembly production line.
      4. Any extended down time (summer/holiday shutdowns).
      5. Any change in manufacturing method/process, tool/machine, cross pollination (shared tooling, parts, and/or process, etc.) of sub-assembly parts or streams.
      6. Any system changeover in shared tooling.
2. **Minimum % of Non-Discrepant Welds per PPAP Weld Destruct Event:** 
   1. Suppliers must demonstrate capability within the verified weld equipment by validating weld conformance throughout PPAP milestones. Health charts are to be created at the beginning of a program and fully integrated by Start of Regular Production (SORP).

## Chart 1 – Resistance Spot Weld (RSW) Percent Conformance Level

Acceleration

***Note 1:*** Weld destruct events per MRD dates shall follow PPAP gate dates***.***

***Note 2:*** Weld quality conformance percentage is related to first time weld quality prior to any weld repair or welding rework.

***Note 3:*** Follow Applicable GMW for all welding requirements.

## Chart 2 – Continuous Welds Percent Conformance Level

Acceleration

***Note 1:*** Weld destruct events per MRD dates shall follow PPAP gate dates***.***

***Note 2.*** Weld quality conformance percentage is related to first time weld quality prior to any weld repair or welding rework.

***Note 3:*** Follow Applicable GMW for all welding requirements**.**

1. **Testing Strategy at SORP Milestone:**
   1. Once Supplier has proven capability and steady state, the batch definition will be migrated to “special cause variation” control with a maximum of 5 times SDC. Severity 9 and 10 welds shall require daily weld destructs. The Table below only applies to Suppliers that are in Steady State and for welds with severity 8 and less.
   2. **Steady State Requirements Begin When suppliers can demonstrate:**
      1. Approved (Full) PPAP Including but not limited to the following:
         1. Scribe or drill panel study completed and approved by GM SQE
         2. Gage R studies completed with confirmation report approved by GM SQE
         3. Weld Gap Study completed and approved by GM SQE
         4. Weld Maps completed and approved by GM Product Engineering
         5. Weld Health Charts completed and approved by GM SQE
         6. Weld quality 95% or greater, Weld Pattern compliance achieved
      2. Passing Run at Rate Status
      3. Qualified weld repair personnel and procedures per every material weld stackup and weld position

## Table 4 – All Process Launch Per Shift or Batch Schedule Requirements:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Steady State / SORP Testing Plan for Severity 8 and Less Welds** | | | | | |
| **Weld Process** | **Arc** | **Resistance Spot** | **Welded Fasteners** | **Drawn Arc** | **Laser** |
| **First Off of Day/Batch** | Visual and  Length Measurement | Visual and  UTS (If applicable) and  Peel Test | Visual and  Set down and  Thread Check  Push Out or Peel Test | Visual and  Peel Test | Visual and  Length Measurement |
| **Mid Shifts** | Visual and  Length Measurement | Visual  Pry Check and  UTS (If applicable) | Visual and  Thread Check | Visual  Nondestructive bend Test w/Click Wrench | Visual and  Length Measurement |
| **Last Off Day/Shift** | Visual and  Length Measurement | Visual and  Pry Check and  UTS (If applicable) | Visual and  Set down and  Thread Check | Visual  Nondestructive bend Test w/Click Wrench | Visual and  Length Measurement |
| **Last Off**  **5 x SDC** | Visual and  Length Measurement  Cut and Etch Evaluation | Visual  UTS (If applicable)  Peel Test | Visual and  Set down and  Thread Check  Push Out or Peel Test | Visual and  Peel Test | Visual and  Length Measurement and  Cut and Etch |

**2. Release and Revisions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Change History** | | | | |
| **Date** | **Version** | **Change Summary** | **Approver** | **Approving Organization** |
| 8/9/2023 | 1 | Initial upload of document to GDocs | Shelly Hlifka | Supplier Quality and Development |
|  |  |  |  | Supplier Quality and Development |