#### Herein are the minimum requirements that shall be incorporated into the manufacturing process for the above commodity. This Part Specific SOR is in addition to and not intended to replace any requirements as outlined in the CG4338 GM 1927 03 SQ 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 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*.*

**Notes**: “Shall” in this document is mandatory, “Should” is highly recommended. Nothing in this document supersedes any government law or federal regulation. In the event of a conflict between English and a different language, English language shall take precedence.

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**1.0 Introduction**

**Note: The Part Supplier shall review this document to ensure understanding of these requirements set forth within this document, prior to Tech Review. If the Part Supplier does not demonstrate understanding of these requirements set forth within this document during Tech Review, then GM reserves the right to disqualify the Part Supplier and could potentially be removed from future Bidlist consideration.**

**1.1 Purpose**

This document describes the minimum requirements to be incorporated into the manufacturing and quality processes for this specific commodity. Organizations shall refer to the CG4338 GM 1927 03 Supplier Quality Statement of Requirements, for requirements for organizations supplying parts and materials to General Motors in addition to this Part Specific SOR. The expectation is for GM to receive parts that meet 100% of the requirements

**1.2 Applicability**

Body Structure Small & Moderate Sub-Assemblies and Stamping Components

**1.3 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 of the requirements below.

**2.0 References**

**Note.1:** Only the latest approved standards are applicable unless otherwise specified. The latest versions posted on GM SupplyPower and IHS Markit.

**2.1 GM Standards/Specifications**

* GM 1927 10 Fixture Standards
* GM10067 Dimensional Fit, Function and Appearance Part Submittal
* GMW14056 Weld Acceptance Criteria and Repair Procedures Drawn-Arc Welded Automotive Studs, Nuts and Brackets
* GMW14057 Weld Acceptance Criteria and Repair Procedures Resistance Spot Weld – Steel
* GMW14058 Weld Acceptance Criteria and Repair Procedures Arc Welds and Arc Brazes – Steel & Aluminum
* GMW14085 Weld Acceptance Criteria and Repair Procedure for Mechanical Clinch Joining
* GMW14669 Organic Coating Performance for Exterior and Interior Metallic Components
* GMW15745 GM Dimensional Engineering Supplier Minimum Requirements
* GMW16215 Welding Acceptance Criteria and Repair Procedures: Resistance Projection Welded Steel Nuts, Studs, Cages and Other Parts with Solid Coined Projections
* GMW16383 Self-Piercing Rivets Acceptance and Repair Methods
* GMW16435 Weld Acceptance Criteria and Repair Procedure for Resistance Projection Welding - Steel
* GMW16536 Pump-able Sealer between Flanges of Welded Structures – Steel Acceptance Criteria and Repair Procedures
* GMW16537 Metal Bonding Structural Adhesive Acceptance Criteria and Repair Procedures – Weld Bonded, Rivet Bonded and Bonded Structures
* GMW16579 Material and Process Testing Requirements for Press Hardened Steel and Stamping Suppliers (PHS)
* GMW16804 Joining Acceptance Criteria and Repair Method Self-Piercing and Extruding Screws
* GMW16939 Wire, Filler, Welding and Brazing
* GMW16967 Aluminum Resistance Spot Welding
* GMW17533 Process Requirements for Steel Stamping Suppliers
* GMW18076 Antiflutter Adhesive (Body in White) Material Requirements
* GMW18077 Body Structure Adhesive Material Requirements
* CG4931 Resistance Spot Welding
* CG4352 Gas MIG Braze Weld Quality Verification Procedure
* CG6506 GM 1927 03a Weld Nut/Stud, Cage Nut & Clinch Nut/Stud Process Requirements
* GM Global Formability Analysis Standard R10
* Global Vendor Assembly Tool Design and Construction Specifications (GVATDCS1)
* GM Vendor Tooling Standards for Stamping Dies (VTSSD)

**2.2 Additional References**

* AIAG FMEA VDA Handbook, AIAG PFMEA 4th Edition, CQI Assessments and Automotive Core Tools
* CG4338 GM 1927 03 Supplier Quality Statement of Requirements (SQ SOR)
* GM 1927 16a Structures Upper and Lower Commodity Audit
* GM 1927 29 Gauge Concept, Design and Build Approval Workbook
* GM 1927 16b Weld Nut Stud, Cage Nut & Clinch Nut Stud Process Audit

**3.0 Requirements – Design & Development**

GM standards must be used in the design and development of assembly and stamping processes. A robust design that incorporates GM’s safety features as well as incorporates appropriate accessibility for tool / process maintenance is essential to the robustness of the process. The design of each process must be in line with the product DFMEA and process PFMEA documents.

**3.1 Product Design**

**3.1.1** The Part Supplier shall confirm and ensure all assemblies, components and tiered supplied components follow and adhere to requirements as stated in the engineering BOM, design record and/or math file.

**3.1.2** The Part Supplier shall use approved materials as stated in the design record and/or math file.

**3.1.3** The Part Supplier shall and must use the specific component if called out by part number within BOM, design record and/or math file, even in the case of the part number being a purchased tiered supplied component.

**3.1.4** If there are changes to the Design of the product, the supplier shall follow GM engineering change procedures documented by the GM DRE through an approved GM TWO and/or EWO.

**3.2 Tooling Design**

**3.2.1** The Part Supplier must understand all customer engineering design record and specification requirements and ensure the process has the ability to produce product meeting these requirements during an actual production run at the quoted production rate.

**3.2.2** The Part Supplier must consider error proofing techniques are preferred to error detection techniques.

**3.2.3** The Part Supplier must consider the critical importance of material utilization, scrap shedding in stamping operations as well as weld robot access in assembly tool operations.

**3.2.4** The Part Supplier must consider incorporating automatic monitors with alarms for critical utilities such as electricity, air and water pressure as well as oil levels.

**3.3 Tooling Planning & Development**

**Note:** An engineering tolerance stack-up study is mandatory for all critical components and final system to ensure tooling can meet manufacturing feasibility requirements.

**3.3.1** The Part Supplier shall have a common, general understanding (i.e.: gage concept, datum concept) of dimensional methodology for tooling datum strategy and checking gage fixture robustness in accordance with GM1927 10 Fixture Standards.

**3.3.2** Prior to TKO, The Part Supplier shall complete a tolerance stack-up evaluation on individual components within each assembly.

**3.3.3** The Part Supplier must submit design change recommendations to the appropriate Design Release Engineer prior to beginning tool construction.  All individual components within each assembly must be capable of assembling components to meet all Engineering Tolerances.

**3.3.4** The Part Supplier must develop blanking/stamping dies/laser to incorporate the direction of blanking and pierce/punch/trim as shown for specific parts identified in the eSOR.

**3.4 Formability**

**Note:** The Part Supplier shall submit a formability report using the guidelines listed below. Suppliers must conform to requirements set forth in GM Global Formability Analysis Standard R10 and submit required deliverables according to Table 3.4.5 below.

**3.4.1** Suppliers shall use formability analysis tools such as AutoForm, Dyna, FTI or PAM-STAMP to confirm that the P2 Math as released is manufacturable.

**3.4.2** The formability report shall include the following: (1) Complete forming process, (2) Forming Limit

Diagram (FLD), (3) Thinning Maps at each stage, (4) Blank Size, (5) Panel break downs (at least binder wrap, 6mm-off bottom and 3 mm-off bottom) and (6) Z-Displacement Springback for specified material.

**3.4.3** At Tech Review, the Part Supplier shall demonstrate if any Splits, Wrinkles, Thinning, Thickening, Edge Splits, Folds or Springback issues are present in the product.

**3.4.4:** The Part Supplier shall notify GM DRE and GM SQE of all issues found in the formability analysis. The Part Supplier shall propose product design or tolerance changes to make the part manufacturable. All final product design or tolerance changes must be approved by GM Product Engineering DRE. See the Buyoff Criteria in GM Global Formability Analysis Standard – GM 010.30.00.

**Table 3.4.5**

**Note:** GM reserves the right to amend the exceptions below in the event of requirements changes, technology innovation, etc.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Supplier Deliverable | Milestone Event:  Tech Review | Milestone Event:  2 Wks after TKO | Milestone Event:  6 Wks after TPO |
| 3.4.5.1 | Formability Numerical Analysis and Design for Manufacturability | 1-Step and Discuss method in detail. | Full-incremental | Full-incremental with Springback analysis |
| Highlight all issues and hot spots; specifically High Thinning & Thickening areas. | Show plan to resolve all issues | Confirm all issues are resolved |
| 3.4.5.2 | Die Operation Lineup (DOL) | Provide “rough” DOL then discuss product details and provide alternative solutions for manufacturing (if necessary). | Show adjusted and/or modified DOL, present/review issues and plan to resolve all issues | Provide final DOL |
| 3.4.5.3 | Compensation Plan to meet GD&T requirements | Detailed analysis and discuss compensation details utilizing M7 document. | Determine springback and compensation tooling execution strategy | Tooling Compensation plan must be provided from die tooling shop to Tier-1 |

**3.5 Part Buyoff**

The Part Supplier shall confirm (in the event of) any surface quality issues for any parts discovered during formability analysis are documented in CG3404 M7 Technical Issues List and provided to GM SQE for Part Supplier to inspect high-risk zones for Life of Program.

**Note.1:** GM will not accept defects such as wrinkles, folds, cracks, edge splits or surface “lows” on any areas of the part.

**Note.2:** The Part Supplier shall confirm with GM Product Engineering DRE if any due care or extra care surface quality requirements for Non-Class A parts will be required to control through manufacturing best practices for Life of Program.

**Note.3:** The Part Supplier shall conduct a GM Cross-Functional Team (DRE, SQE and Plant Launch Team) review to provide visibility on high-risk zones of part and understand potential impact to overall vehicle build for life of program.

**Note.4:** Any deviation request(s) from Part Supplier shall be approved by GM SQE during PPAP.

**Note.5:** The Part Supplier shall maintain approved Draw Panel and process parameters, once all requirements below are approved by GM SQE, for life of program.

**Note.6:** See Surface Quality Requirements - Appendix A, at the end of this document.

**3.5.1 Circle Grids**

**Note:** See Section 8.0 Diagram 1.

**3.5.1.1** Supplier shall identify areas of required physical measurement via ultrasound or white light scan of areas that are high risk for thinning per the formability analysis at Mini-Match MRD Event with GM DRE and SQE input and/or approval.

**3.5.1.2** Supplier shall provide documentation of passing circle grid and formability analysis from: (1) final Tool Supplier Design & Build Shop AND (2) prior to PPAP Approval from Homeline Run.

**3.5.2 Part Verification Requirements during Launch and Production**

**Note.1:** The Part Supplier shall use Data Sheet A3: Inspection Process Form per GMW17533.

**Note.2:** The Part Supplier shall seek PPAP approval of GM SQE for Method and Measurement Locations along with Data Sheet A3: Inspection Process Form per GMW17533 which shall be uploaded into SQMS under PPAP Element – Process Documentation.

**Note.3:** The Part Supplier shall use only approved red markers (DYKEM RINZ OFF 44 or EXPO DRY ERASE 80002) during inspection process.

**3.5.2.1** The Part Supplier is responsible to collect physical micrometer measurements of High-Risk Thinning areas to ensure thinning issues are mitigated and addressed at stamping component level before splits occur and incorporate into control plan/inspection process.

**3.5.2.2** The part shall be compared to a known Formability and Circle Grid standard as defined in the development of the stamping process during Tooling Design & Development Stages.

**3.5.2.3** The Part Supplier shall inspect 1st off, last off and have an in-process frequency inspection using the Inspection Process Form after the individual stamping has been produced.

**3.5.2.4** The Part Supplier shall institute a batch and hold strategy and verify parts meet released specifications prior to submitting the batch for approval and release for shipment.

**3.5.2.5** When weld teardown requirements are applicable, The Part Supplier shall ensure, verify and include surface verification part conformance into all applicable in-process documentation.

**3.5.2.6** The Part Supplier shall have a calibrated/certified checking fixture and/or instrument(s) onsite.

**3.5.3 Additional Measures to ensure Part Thinning Verification Requirements are met during Launch & Production**

**3.5.3.1 Part Bearing:**

**Note.1:** Any changes to the stamping process or tooling shall require revalidation through the entire stamping process, and/or specific operation if deemed applicable by the Part Supplier and GM SQE.

**Note.2:** After all tooling development is finished and final, a PPAP validation sample shall be collected as a GM approved master part sample and shall be recorded (part retention) for baseline of future product.

**3.5.3.1.1** The Part Supplier is responsible for Blue Panel Bearing verification to ensure 100% Bearing Requirement within Die Tooling to ensure Part or Panel sits down on all trim edges, pierce, and flange edges and critical areas per GD&T (net surfaces, attach points, etc.) and die operation has proper part contact, location and retention prior to trimming and flanging.

**3.5.3.1.2** The Part Supplier is responsible and shall implement bottoming mark feature in the draw/restrike die tool to ensure part is being drawn fully in its home position and all part features are fully present during inspection. The bottoming mark feature should not damage or impact surface quality of part. This bottoming mark feature should be verified at First-Piece buyoff inspection process.

**3.5.3.1.3** The Part Supplier is responsible and shall develop plans for the maintenance of proper stamping dies to meet the quality needs of the material and part being processed during any manufacturing location changes and/or between production runs.

**3.5.3.1.4** The Part Supplier should perform Blue Panel Bearing verification prior to (1) final Tool Supplier Die Buyoff AND (2) prior to PPAP Approval from Homeline Run.

**3.5.3.2 Visual End of Line Inspections:**

**Note.1:** The Part Supplier shall use only approved red markers (DYKEM RINZ OFF 44 or EXPO DRY ERASE 80002) during inspection process.

**Note.2:** The Part Supplier shall check parts determined by part volume and part criticality, with agreement from GM SQE. GM 1927 28 Early Production Containment Procedure inspection frequency shall be approved by GM SQE and protect production steady-state until release from Early Production Containment Procedure by GM Assembly Plant.

**3.5.3.2.1** The Part Supplier should have an End of Line Visual Inspection in an established area with adequate lighting to perform surface verification prior to subsequent assembly operations to inspect for splits or surface “lows” on any known high-risk areas of the part.

**3.5.3.2.2** The Part Supplier should trace or use cross hatch method using red approved marker on all high-risk thinning characteristics identified per the Formality and Circle Grid Analysis on the panel to ensure visual inspection has been completed on known problematic areas.

**3.5.3.2.3** All part or surface quality areas of non-compliance and corrective actions need to be documented and approved by the Part Supplier Plant Leadership Team and reviewed with GM SQE.

**4.0 Requirements – PFMEA & Control Plan**

For sub-assemblies and stamping components, the supplier shall use PFMEA to identify and address failure modes in products and processes while maintaining an adequate Control Plan describing required measurements, inspections, quality checks or monitoring of process parameters. These documents should use published industry standards and applicable GM engineering standards to support its development.

**Note:** Suppliers must conform to requirements set forth in Structure Potential Failure Modes according to Table 4.7 below.

**4.1 Baseline**

**4.1.1** The PFMEA shall be prepared and reviewed with the responsible GM Supplier Quality Engineer.

**4.1.2** As a baseline, all Lessons Learned from previous GM project(s) or program(s) shall be used.

**4.1.3** Error proofing shall be the preferred choice to error detection.

**4.1.4** The PFMEA shall be treated as a “Living Document”, with updates posted as quality issues arise and during Risk Reduction Initiatives. It is to be reviewed with the GM SQE yearly as a minimum frequency.

**4.1.5** The DFMEA to PFMEA Risk Mitigation Gap Analysis must be formalized and submitted to GM SQE at CRV 4 with all gaps reconciled by CRV 6.

**4.2 Rankings**

**Note.1:** The Part Supplier shall ensure that tiered supplier PFMEAs adhere and comply to AIAG FMEA VDA Handbook or AIAG PFMEA 4th Edition and CG4338 GM 1927 03 SQ SOR.

**4.2.1**. For welded fasteners, the Part Supplier shall follow guidelines outlined in CG6506 GM 1927 03a Weld Nut/Stud, Cage Nut & Clinch Nut/Stud Process Requirements.

**4.3 Process Control Plans**

**4.3.1** For Process: Stamping / Material Properties: Steel, specific Minimum PCP required for all Body Structure Parts and Assemblies.

**4.3.2** Proper Material Specification, verification source documentation is based on Steel Certification from approved GM Steel Mill.

**4.3.3** PCP includes verification that proper material has been ordered, received, and placed to the production line for each production run. Production and Quality records can trace coil certification to production run.

**4.3.4** For Process: Welding / Application: MIG and Resistance Welding, specific Minimum PCP required for all Body Structure Parts and Assemblies.

**4.3.5** Weld validation and welding process verification is in place and compliant with all applicable GMW specifications, including GMW14056, GMW14057, GMW14058, GMW16215, GMW16536 and GMW16537.

**4.3.6** PCP includes both destruct and non-destruct testing with batch and hold process compliant with GMW15563, CG4931 and CG4352.

**4.4 Structural Adhesive/Sealer Application**

**Note:** Suppliers must use 100% automated application for all adhesives and sealers.

**4.4.1** Manually applied adhesives and sealers will be permissible in repair operations and during MRD events prior to Homeline installation specifically identified in writing and approved by GM Product Engineering and Supplier Quality.

**4.4.2** The Part Supplier must confirm severity ratings of structural adhesive and body sealer applications with GM design engineer prior to initiating PFMEA and process control plans. Severity ratings of 6 and below are considered due care and shall be controlled and monitored within the manufacturing process.

**4.5 Visual Management of Safety Value Stream**

**4.5.1** For failure modes with a severity ranking of 9 or 10, the Part Supplier shall institute a visual management system that ties PFMEA to Control Plan to Work Cell to Operator Instruction to Verification/Inspection to Inventory control.

**4.6 Rework**

**4.6.1** All inline rework or repair processes in the supplier manufacturing facility shall be incorporated in the production PFMEA and Control Plan and approved via PPAP. Any offline rework or repair processes should not be part of normal process and approved by GM SQE.

**4.6.2** There shall be no rework permitted for failure modes with an 8-10 severity ranking, unless written or electronic approval by the GM Supplier Quality Manager or higher is granted.

**4.6.3** For the purpose of this requirement: “Rework” shall be defined as any work on the product outside the validated or PPAP approved process and/or materials.

**Table 4.7**

**Note: GM reserves the right to amend the exceptions below in the event of requirements changes, technology innovation, etc.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Item | Requirement/  Failure Mode | Severity Score | Minimum Required Detection Score | Minimum Required Quality Controls | Minimum Required Inspection Method/Frequency |
| 4.7.1 | Structural Adhesive – BA1 | 10 or 9 | Detection rating of 3 or less | Part Supplier shall have 100% error proofing in- station to detect adhesive presence, bead size, start and stop of the adhesive application and total length of adhesive application.  There shall be no deviation to the requirement. | Part Supplier shall check 100% of all parts.  Manual/operator visual inspection is not allowable. |
| 4.7.2 | Structural Adhesive – BA2 | 8 or 7 | Detection rating of 4 or less | Part Supplier shall have an in-process detection system in place for 100% adhesive presence, bead size, start and stop of the adhesive application and total length of adhesive application.  There shall be no deviation to the requirement. | Part Supplier shall check 100% of all parts.  Manual/operator visual inspection is not allowable. |
| 4.7.3 | Structural Sealer – BS1 | 10 or 9 | Detection rating of 3 or less | Part Supplier shall have 100% error proofing in- station to detect adhesive presence, bead size, start and stop of the adhesive application and total length of adhesive application.    There shall be no deviation to the requirement. | Part Supplier shall check 100% of all parts.  Manual/operator visual inspection is not allowable. |
| 4.7.4 | Structural Sealer – BS2 | 8 or 7 | Detection rating of 4 or less | Part Supplier shall have an in-process detection system in place for 100% adhesive presence, bead size, start and stop of the adhesive application and total length of adhesive application.  There shall be no deviation to the requirement. | Part Supplier shall check 100% of all parts.  Manual/operator visual inspection is not allowable. |
| 4.7.5 | Weld Nut Failures (CTA) – refer to GM1927 03a Weld Nut Stud, Cage Nut & Clinch Nut Stud Process Requirements | Will vary based on product intent; reference DFMEA | If Severity 7, 8, 9 or 10, Detection rating of 3 or less | Part Supplier shall have tooling and Equipment Capability to prevent/detect incorrect, mislocated, misoriented and improperly welded projection weld nuts from processing through the equipment. The best practice weld nut error proofing technology is the Centerline VeriFast LVDT System.  Part Supplier shall adhere to current requirement which is 100% downstream presence detection on all weld nuts: (1) 100% verification in station for proper installation and (2) 100% verified in a subsequent operation for presence. | All key product characteristic (KPC, PQC, DR) and other critical characteristics must be verified through weld destruct validation at least once per ship window and must adhere to Batch & Hold Requirements. |
| 4.7.6 | 100% validate (and/or monitor) weld quality without destruct testing of welds/parts | Will vary based on product intent; reference DFMEA | If Severity 9 or 10, Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for welding due to technology limitations.  There shall be a deviation to the requirement. | Specific Minimum Process Control Plans (PCP) required for all Body Structure Parts and Assemblies:  Weld Quality: Weld Validation and welding process verification is in place and compliant with all applicable GMW Welding specifications. PCP includes both destruct and non-destruct testing with batch and hold process compliant with GMW related Welding specs. |
| 4.7.7 | 100% check and monitor for no burrs or sharp edges relating to safe handling in-station in Stamp/Ship processes. | 10 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for no burrs or sharp edges relating to safe handling on Stamp and Ship Parts due to technology limitations.  There shall be a deviation to the requirement. | Specific Minimum Process Control Plans (PCP) required for all Body Structure Parts and Assemblies: Post Stamping Visual Inspection per Process Control Plan.  Operators required to wear appropriate PPE when handling. |
| 4.7.8 | Incorrect stud selection | 10 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 to 100% verify stud size/type 100%.  There shall be a deviation to the requirement. | Stud Size and Thread Type only verified at manfacturing work center periodically using thread gage and part # for correct component is also verified. |
| 4.7.9 | Insufficient material gage for welding/staking | 10 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for insufficient material gage for welding/staking.  There shall be a deviation to the requirement. | Material thickness verified from material certification and each coil measured when hung at stamping press. |
| 4.7.10 | 100% check and monitor Part GD&T in-station in Stamp/Ship processes. | 9 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for Part GD&T on Stamp and Ship Parts due to technology limitations.  There shall be a deviation to the requirement. | Specific Minimum Process Control Plans (PCP) required for all Body Structure Parts and Assemblies: Post Stamping Process Check Fixture Inspection per Process Control Plan. |
| 4.7.11 | 100% check and monitor material properties of steel in stamping processes | 9 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for material properties due to technology limitations.  There shall be a deviation to the requirement. | Specific Minimum Process Control Plans (PCP) required for all Body Structure Parts and Assemblies:  Proper Material Specifications: Verification source documentation is based on Steel Certification from approved GM Steel Mill. PCP includes verification that proper material has been ordered, received, and placed to the production line for each production run. Production and Quality records are able to trace coil certification to production run. |
| 4.7.12 | Over/Under Compression of Tank due to Thick/Thin PVC Coat | 10 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for material properties due to technology limitations.  There shall be a deviation to the requirement. | Demonstrate Cpk performance for coating thickness capabilty and coating presence validation at shipping dock audit for every lot. |
| 4.7.13 | Tank Straps crack due to fatigue/corrosion due to incorrect material or coating for steel | 10 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for material properties due to technology limitations.  There shall be a deviation to the requirement. | Proper material specifications required. Verification source documentation is based on steel certification from approved GM Steel Mill. PCP includes verification that proper material has been ordered, received and placed to production line for each production run. |
| 4.7.14 | Corrosion due to missing E-COAT | 10 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for material properties due to technology limitations.  There shall be a deviation to the requirement. | Visual inspection at E-COAT supplier at time of shipment. Incoming visual inspection at PVC Coating supplier to detect parts without E-COAT. Process control plan requirement: E-COAT coverage to be verified at every layer during scheduled tear down events (i.e. weld teardown, process change, etc.) |
| 4.7.15 | Tank Strap could bend due to tear through the fastener holes | 10 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for material properties due to technology limitations.  There shall be a deviation to the requirement. | Die recipe, transfer system programming, 1st and Last Off parts, in process control card, CMM layouts, sensors, pinning through hole during welding operation and 100% visual check. |
| 4.7.16 | Riv Nut Application – Verify Presence and Proper Installation | Will vary based on product intent; reference DFMEA | If Severity 9 or 10, Detection rating of 3 or less  If Severity 7 or 8, Detection rating of 4 or less. | Part supplier shall use installation equipment with a feedback mechanism (Pull force, torque/torque angle, or equivalent) to ensure proper crimp was achieved and as-installed riv nut will meet torque-out requirements. Installation shall either use position control/count feedback or in-station presence check to detect misplaced/missing riv nuts. | Part supplier shall check 100% of riv nuts, as installed. |
| 4.7.17 | Flow Drill Screw Application – FDS not penetrating specified GMW material | Will vary based on product intent; reference DFMEA | If Severity 9 or 10, Detection rating of 3 or less  If Severity 7 or 8, Detection rating of 4 or less. | Part Supplier shall ensure the process equipment can perform the following:   1. Measure correct force required for FDS Gun Pressure 2. Measure Pressure required to heat material to allow pentration 3. Monitor Screw Angle – 90º ideal 4. Monitor Flowing Material 5. Monitor Pressure required to drive FDS into full seated position 6. Monitor RPM required to drive FDS into full seated position | Part Supplier shall inspect 1st piece and last piece during production runs and any destructive testing to ensure compliance to GMW requirements. |
| 4.7.18 | Self Piercing Rivets (SPR) | Will vary based on product intent; reference DFMEA | If Severity 9 or 10, Detection rating of 3 or less  If Severity 7 or 8, Detection rating of 4 or less. | Part Supplier shall ensure the process equipment can perform the following:   1. Measure rivet height before insertion (correct size) 2. Measure joint stack-up before insertion (all sheets present) 3. Monitor distance traveled to ensure rivet fully inserted 4. Monitor force curve to ensure no rivet collapse / machine or die damage / proper material shingling 5. Successful rivet count per cycle to ensure we do not “skip” a rivet | Part Supplier shall inspect 1st piece and last piece during production runs and any destructive testing to ensure compliance to GMW16383 requirements. |
| 4.7.19 | Weld Studs Strength and Integrity for Drawn Arc Weld Studs | Will vary based on product intent; reference DFMEA | If Severity 9 or 10, Detection rating of 3 or less  If Severity 7 or 8, Detection rating of 4 or less. | Part Supplier shall use Mountz Clicker Wrenches for any weld studs, ground studs and any other stud application.  Other OE equipment providers with similar tools shall be used, but only approved by GM SQE.  Tee Handle – Force shall be applied in a direct forward push and when set force is registered the tee handle breaks forward similar to a torque wrench click only handle disengages force and handle rotates forward 30 degrees under no load. This signifies that the calibrated set torque moment has been applied to the DAW stud. | Part Supplier shall implement inspection frequency approved by GM SQE and protect production steady-state  Operator visual inspection is not allowable.  Manual tools such as hammers, mallets or other hand held tools are not allowed. |
| 4.7.20 | Poor Welds and Weld Porosity due to poor preventative maintenance | Will vary based on product intent; reference DFMEA | If Severity 9 or 10, Detection rating of 3 or less  If Severity 7 or 8, Detection rating of 4 or less. | Worn diffusers resulted in loose nozzle/falling off due to lack of retention and excessive clearance therefore suppliers must use screw-on nozzles on all mig-welding applications. Slip-on nozzles are not permitted.  See Section 5.6.2 of this document.  See GRA 2097. | Part Supplier shall demonstrate compliance to GM SQE at first welded assembly part runoff, Homeline buyoff and through Preventative Maintanence documentation. |
| 4.7.21 | Crack or Split in Critical Stamping Component due to inadaquete draw bead | Will vary based on product intent; reference DFMEA | If Severity 9 or 10, Detection rating of 3 or less  If Severity 7 or 8, Detection rating of 4 or less. | The tool repair verification process should include material thickness checks after a major draw die event. A 30 piece material thickness check has been added to the tool repair verification process for the first run on major die events in areas prone to thinning based on form simulations on draw dies with floating draw beads with mechanical drivers. | Verify visual 1st off review of part. 1st off dimensional checks verified prior to production authorization. In process inspection and last off part reviewed and signed off for OK to ship |
| 4.7.22 | Burrs / Sharp Edges on Roof Rail Inner Assemblies | 10 or 9 | Detection rating of 3 or less | Part Supplier shall have parts free of defects (burrs, sharp edges, etc.) and shall follow Process Control Plan to institute Batch & Hold Methodology to ensure book ends are validated.  There shall be no deviation to the requirement. | Part Supplier shall institute the following into Preventative Maintenance planning for a frequency of every 5000 hits:   * Sharpening of all punches and trim steels * Complete review of all dies within die operation lineup of physical die |
| 4.7.23 | No Burrs or Sharp Edges  relating to safe handling on Stamp and Ship Parts | 10 or 9 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for material properties due to technology limitations.  There shall be a deviation to the requirement. | Specific Minimum Process Control Plans (PCP) required for all Body Structure Parts and Assemblies with Proper Material Specifications: Verification source documentation will be based on Steel Certification from approved GM Steel Mill. PCP includes verification that proper material has been ordered,  received, and placed to the production line for each production run. Production and Quality records are able to trace coil certification to production run. |
| 4.7.24 | 100% Laser Welding Verification & Detection | 10 or 9 | Detection rating of 3 or less | Unable to meet GM's detection requirements of 3 or 4 for material properties due to technology limitations.  There shall be a deviation to the requirement. | Specific Minimum Process Control Plans (PCP) required for all Body Structure Parts and Assemblies: Process Control Plans required to detail inspection type and frequency. Weld Quality: Validation and welding process verification is in place and compliant with all Mig Welding specification. Incuding GMW Welding Speafications, GMW17330, and GMW CGS615 Section 4.7 6 and 4.7 20. PCP includes destruct testing with batch and hold process compliance. |

**5.0 Requirements – Manufacturing Process**

Supplier confirms, that the Structures and Stamping products will be manufactured, produced and supported under the eSOR requirements issued at the time of sourcing, as well as CG4338 GM 1927 03 SQ SOR requirements listed in the GM Supplier Quality Manual.

**Note.1:** Supplier shall comply with all welding requirements in GMW’s and CG4352 (Mig, Gas and Braze Welding) and CG4931 (Resistance Spot Welding).

**Note.2:** Supplier should reference GMW17533 regarding process requirements for Steel Stamping Suppliers.

**Note.3:** The Part Supplier must have all tool, manufacturing and assembly sources on contract (approved within supplier’s financial process and legally committed to perform work) four weeks after GM Purchasing (Buyer) awards the contract. This includes Tier-2 Suppliers.

**Note.4:** For any low-volume program containing aluminum assembly welding content, supplier shall quote robotic welding. If supplier can demonstrate GM weld compliance using their own equipment, the supplier would not have to purchase GM's aluminum spot welding capital. The supplier is required to pass the weld verification tests when requested by the BIW Welding & Joining Execution Team.

**5.1 Manufacturing Capacity**

**5.1.1** Supplier shall ensure that the design and construction of all assembly tools and associated checking / CMM fixtures are consistent to producing the required quantity with the operating schedule of the customer assembly plant 1:1. Associated Checking and CMM Fixtures must also be capable and support the “Batch and Hold” process to meet these requirements. For example: If the GM customer plant operates 2 shifts 16 hours each day, the supplier must meet, at a minimum, the same daily thru-put requirement (LCR) at the same 2 shifts 16-hour operating schedule as their customer. The supplier must match the Body Shop 1:1 rate (plant consumption rate vs. end of day yields) as well as supporting MCR levels 1:1.

**5.1.2** For parts associated with this program, Suppler shall ensure that their stamping and/or assembly process is aligned with the assigned Assembly Plant operating pattern.

**NOTE: If the GM assembly plant operating pattern information has not been provided in SOR, the Part Supplier’s operating pattern shall mimic or be less than the operating pattern of their customer but shall never exceed 5 days / 3 shift operating pattern.**

**5.1.3** Assembly line production equipment shall not be shared with another OEM product unless agreed in advance with both the GM Buyer and the GM SQE. Component processes that are shared (such as stamping, assembly, etc.) shall be documented on Shared Capacity Form 1199 as part of the GM 1927 35 Run @ Rate approval process.

**5.1.4** Supplier needs to contact SQE and Buyer regarding any capacity or additional capacity changes to manufacturing process.

**5.2 Manufacturing Process Flow**

**Note.1:** The Part Supplier shall ensure proper material utilization is considered for die processing to reduce scrap and waste.

**5.2.1** The PartSupplier Shall deliver on request all Process Flow Diagrams that Include: (1) Rudimentary Die Process Flow (2) Parts are added at each station(s) within Welded Assembly, (3) Critical Dimensional Features used in each station(s) and (4) Weld and Sealer Content at each station(s), upon requirement.

**5.2.2** Process layout and flow is to be organized in a way to prevent unnecessary or incorrect handling of component parts or final assemblies. Process design is to incorporate the DFMEA, PFMEA and resulting Control Plan distributed to the manufacturing floor.

**5.2.3** Error proofing procedures will be implanted to avoid causing damage, mixing, incompleteness, contamination or other quality concern. One-piece flow in assembly is recommended.

**5.2.4** Wherever practical, the error proofing of mixed components between Product styles shall include physical feature differences to physically block, or bar code scanning to electronically block a mistake in loading the wrong component.

**5.3 Manufacturing Tooling Execution**

**5.3.1** The supplier shall incorporate into all assembly tooling fixture design and construction error proofing mechanisms to ensure but not limited to the location and fusion of all bracketry, weld nuts, drawn arc weld studs and attachments. Multiple methods of error proofing to be used can include vision systems, part present proximity switches, part nesting, locating pins, wipers as well as other means part design specific to ensure part geometry and adhesion to meet GM Engineering Specifications.

**5.3.2** The Part Supplier shall identify any manufacturing issues and concerns documentation, list of problem areas requiring engineering support, recommendations to improve manufacturing process and provide any recommendations to improve quality and timing in CG3404 M7 Technical Issues List.

**5.4 Manufacturing Tooling Specifics**

**Note.1:** Suppliers must reference Global Vendor Assembly Tool Design and Construction Specifications (GVATDCS1), GM Vendor Tooling Standards for Stamping Dies (VTSSD) and GM 1927 10 Fixture Standards.

**Note.2:** For any PAPT, the Part Supplier shall follow guidelines outlined in Appendix B General Program Description for specific criteria and requirements.

**Note.3**: GM reserves the right to direct and/or co-source die and assembly tooling to meet cost, quality and timing challenges of global programs which may involve multiple suppliers. GM may direct a predetermined tool source at the technical review. GM Manufacturing Engineering may evaluate and recommend potential tool sources of Critical Parts production tools/dies during the Technical Review.

**Note.4:** All in-process and final process tooling fixtures shall follow datum and pinning as per defined in final assembly GD&T drawing.

**Note.5:** At Tech Review, the Part Supplier shall ensure state of the art processing that can achieve an 85% OEE metric to ensure only the best manufacturing practices are taken into account during quoting and to protect the program by being able to provide good parts, on-time, and with minimal unplanned downtime.

**5.4.1 Tooling Source**

**5.4.1.1** When applicable, supplier must choose Tool Shops from the approved shortlist per Appendix F47 which will be attached to SOR package. When applicable, supplier must also verify Tool Shops from the non-approved shortlist per Appendix F47 will not be selected during sourcing process. Any deviations must be approved by General Motors during the Technical review and documented in the CG3404 M7 Technical Issues List.

**5.4.1.2** The selection of gage suppliers must be discussed with the GM SQE to ensure a solid selection and coordination of gauging criteria. Where multiple gages are required, there must be continuity in gage design and sourcing.

**5.4.1.3** When applicable, supplier must choose PHS Tier #2 Suppliers from the GM Approved PHS supplier list. See GMW16579 for Material and Process Testing Requirements.

**5.4.2 Tooling Strategy**

**5.4.2.1** The Part Supplier shall incorporate a Nominal Tool and Hole to Hole philosophy during Tool Construction and Certification process. The H2H strategy is one part of a total quality system that drives discipline throughout the Stamping and Assembly process. This strategy yields improved quality in the following: single parts, assemblies and complete Body-in-Whites. Parts that are not at nominal are quickly identified in the Hole-to-Hole philosophy. “Bad” parts will not fit into weld fixtures.

**5.4.2.2** The Part Supplier shall conduct Welded Assembly Processing Plan Reviews will take place at a minimum of four times: More reviews may be required based on issues from each review: Concept Review, Design Review, Construction Review and Buy-of Review.

**5.4.3 Tooling Repeatability**

**Note.1:** The Part Supplier shall perform tooling repeatability studies prior and post Homeline Requirement, in addition to at GM SQE request.

**5.4.3.1** Supplier shall perform Tooling Repeatability and Reproducibility (R&R) tests on tooling equipment to assure that the equipment performs within allowable tolerance per GVATDCS1 specification.

**5.4.3.2** Supplier shall perform part position repeatability study, using means such as drill panel, white light scan, blue and scribe or other GM SQE approved means to validate the process of a tool, station and dimensional repeatability to assure process datum locations, clamping sequence, weld sequence and weld locations are robust and acceptable.

**5.4.4 Tooling Certifications**

**5.4.4.1** Supplier shall provide tooling certification documentation from: (1) Tool Supplier Design & Build Shop before buyoff and teardown AND (2) after Homeline installation.

**5.5 Manufacturing Tooling Homeline Requirements**

**Note.1:** The Part Supplier should consider integrating assembly homeline tooling on homeline manufacturing location floor to reduce long-lead timing and enable faster program execution.

**5.5.1** The Part Supplier shall have all production tools including die tooling, assembly weld tooling and checking gage fixtures residing and in use at their Homeline DUNS destination for MVBns1 (Non-Saleable 1).

**5.5.2** In the event, if tooling, secondary equipment or capital equipment is moved from Homeline location after sourcing then the Part Supplier is required to reaffirm process setup requirements, complete an A to B to C Dimensional Comparison of the part to last known good part and notify GM SQE. Any tooling movement under original sourced DUNS Location requires further evaluation by GM SQE.

**5.6 Manufacturing Best Practices**

**5.6.1** Supplier shall implement 100% in process controls of the following when necessary for: Missing components, holes, part deformation in form or function, unless specifically waived by the GM DRE and SQE.

**5.6.2** Suppliers MUST use Screw-on Nozzles on all Mig Welding applications. Pressure Nozzles using retention rings for specific applications are not permitted unless approved by the GM SQE. (Will need further discussion)

**5.6.3 Post Process:**

**5.6.3.1** Where heat treating/annealing/tempering is required, the Supplier shall choose a suitable method to identify any part as being from before or after the heat-treating process. The identification method shall be agreed with the responsible GM SQE, per AIAG CQI-9 Requirements.

**5.6.3.2** For ELPO and Organic Coating Performance Requirements – See GMW14669.

**5.6.4 Required for use in general die tooling:**

**Note:** These example controls need to be used in conjunction with each other and may require the introduction of complimentary methods to fully control the system. It is the supplier’s responsibly to design a system that is robust, and error proofed.

**5.6.4.1** When multiple die cavities tools are required, the supplier shall use ID designator to identify which specific cavity produced specific part for root cause and verification purposes, downstream.

**5.6.4.2** When multiple die cavities tools are required, the supplier shall scan each die cavity to ensure matching dimensional integrity and prevent dimensional disconnects between parts built off multiple die cavities.

**5.6.4.3** When draw beads are required in stamping dies, the supplier should notify GM SQE when floating draw beads with mechanical drivers will be used in draw die designs for processing of stamping components.

**5.6.4.4** For RRAB parts when trim direction for has been specified, a burr rollover operation shall be implemented that conditions the part periphery.

**5.6.5 Required for use in general welding systems:**

**Note:** These example controls need to be used in conjunction with each other and may require the introduction of complimentary methods to fully control the system. It is the supplier’s responsibly to design a system that is robust, and error proofed.

**5.6.5.1** When multiple tools / parts are processed through the same welder a tool ID should be used so custom controls can be applied to each part automatically.

**5.6.5.2** Weld cycle complete requires weld controller completion signal and verification of projection collapse from a monitoring device.

**5.6.5.3** Any weld failure requires the machine to lock the part in the machine requiring a Supervisor and Quality to provide proper disposition of part. For any process parameters: sealer, adhesive, etc., badge swipe, biometrics and electronic controlled manufacturing process controlled settings are the required methods to unlock the machine, so the event can be documented. Weld cell shall not be reactivated until discrepant part is properly dispositioned.

**5.6.5.4** In the event of a long term power outage, the suppliers shall have a backup generator per AIAG CQI 15 Welding Document section 1.18 Page 19 under Requirement/Guidance.

**5.7 Manufacturing Rework**

**5.7.1** The rework process and procedures of a repair must be outlined in a visual summary package, conform to GM specifications with the approval of the GM DRE and GM SQE and confirm adequacy of resulting repair.

**5.8 Manufacturing Environment**

**5.8.1** Only clean packaging and boxes will be used for storage and shipment of materials, components, and assemblies, and will be stored only in appropriate locations (no storage outdoors) and ensure parts are properly protected from potential damage.

**5.8.2** Special attention must be made to cleanliness of the production area and environment.

**5.9 Training**

**5.9.1** Documented process procedures and specifications shall be defined as part of the manufacturing process to assure quality parts can be manufactured at each step by qualified operators or labor. These shall include the equipment to be used as well as approved process steps.

**5.10 Plan for Every Part (PFEP)**

**5.10.1** The Part Supplier, upon receiving GM request for quote, shall complete Plan For Every Part file found in Appendix F16.

**5.10.2** The Part Supplier, upon GM business award, shall complete Plan For Every Part Tracking Sheet which will be supplied by GM SQE with the following information which will be used to track all parts for any given supplier and provide to GM SQE: (1) Processing (Die and Stamping), (2) Blank size & shape, (3) Tier two suppliers and locations, (4) Tier two suppliers onboard date, (5) Timing Plan to Execute to program requirements, (6) Assembly Cell timing, (7) Checking Fixture timing, (8) PAST Score for each build.

**5.10.3** The Part Supplier shall provide an updated supplier contact list including: key stakeholders including but not limited to Program Manager, Die and Stamping Manager(s), Weld Tool Engineers, Production, Quality & Sales Manager along with a complete Organizational chart. Key representatives of Tier 2 suppliers providing Engineering support & their location, Formability Analysis and Development, Die Processing / Layouts and Design, Die Design, Construction and Tryout, Welded Assembly Process for Design and Integration sources and CMM Programmer to ensure all dimensional layout programs are completed prior to MRD Mini-Match or MRD Matching (whichever event comes first) and to refine CMM routines throughout life of program.

**5.10.4** The Part Supplier shall provide timing information Including on the PFEP: Key Benchmark Milestones, Start-Finish Dates on PFEP supplied by GM, for overseas parts or tooling this must include shipping dates, Material required dates for Mini Match, CVER, SVER, IVER and System Tryout , Bi-Weekly updates and percent (%) completion required and updated % completion added to PFEP prior to Bi-Weekly reviews.

**5.10.5** The Part Supplier shall provide a complete and detailed timing chart for the entire program elements. These elements shall include, but are not limited to: 1) Prototype and/or Production tool(s) timing, 2) Manufacturing tool(s)/Fixtures/Machines/Product MRD etc. timing, 3) PPAP Timing including: Validation plan, Dimensional qualification plan, Materials testing plan, SPC including capability studies, preliminary process flow, PFMEA and control plan, 4) Subcontract Parts Approval Plan, 5) Advanced Development Validation Plan & Report (ADVP&R) timing plan, 6) Run @ Rate Plan and 7) Tier supplier PPAP, etc.

**6.0 Requirements – Quality Process, Dimensional & Frequency Checks**

Supplier confirms, that the Structures and Stamping products shall meet all engineering specifications and function with no abnormalities according to design intent under the eSOR requirements issued at the time of sourcing, as well as CG4338 GM 1927 03 SQ SOR requirements listed in the GM Supplier Quality Manual.

**Note.1:** In the case of a change in steel material suppliers, the Part Supplier shall perform (at a minimum) a 5 piece dimensional measurement study, to ensure quality level has not changed. In addition, the Part Supplier shall check for any other potential issues such as splits, thinning, thickening, etc. will require the issuance of new PPAP and approval by GM SQE.

**Note.2:** At the minimum, the supplier shall submit for Non-Saleable PPAP approval with Action Plan(s) (2) weeks prior to APPV, PPV or NS MRD (whichever comes first) in SQMS as per the AIAG PPAP Manual and CG4338 GM 1927 03 SQ SOR.

**Note.3:** The supplier shall submit for 100% Full PPAP approval (2) weeks prior to MVB Saleable in SQMS as per the AIAG PPAP Manual and GM Customer Specific Requirements.

**6.1 Quality Process Audits**

**6.1.1** The Part Supplier shall develop a consistent audit with the requirements of AIAG CQI and IATF 16949 Standard.

**6.1.2** The Part Supplier shall complete GM 1927 16a Structures Upper and Lower Commodity Audit with appropriate SQ personnel throughout each critical GM Milestone.

**6.1.3** The Part Supplier shall review all applicable Specific Process Audit GM 1927 16b packages in the SupplyPower Document Library and identify appropriate audit questions to incorporate into their internal reviews and Best Practice procedures.

**6.1.4** The Part Supplier shall also utilize the applicable portions of the GM 1927 forms in their internal and ongoing audit reviews. Results will be reviewed with the GM SQE and the GM DRE as requested.

**6.2 Gauges**

**Note:** All in-process and final assembly process checking fixture gages shall follow datum scheme (nets and pinning) as per defined in final assembly GD&T drawing.

**6.2.1 Gauge Repeatability and Reproducibility (R&R) and Control**

**6.2.1.1** The Part Supplier is responsible to meet the required dimensional requirements, all gages/fixtures/tooling shall be in accordance with GMW15745 and GMW16812 GM Global Dimensioning and Tolerancing (GD&T). GMW16812 is an amended version of ASME Y14.5. Check Fixtures shall comply with GM 1927 10 Fixture Standards.

**6.2.1.2** The Part Supplier shall confirm datum feature size, location, type, datum target sizes, shapes, measurement points, and final Key Product Characteristics (KPC) are in accordance with final GD&T worksheets when designing and constructing checking gage fixture.

**6.2.1.3** The Part Supplier shall have final checking gage fixture construction complete and ready for use by Mini-Match MRD Event.

**6.2.1.4** The Part Supplier shall adhere and complete all Gage Repeatability (R) and Reproducibility (R&R) Requirements per GM10067 and AIAG PPAP Requirements.

**6.2.2 In-Process Gages:**

**6.2.2.1** The Part Supplier shall have in-process checking fixture gages for all components including small sub-assemblies that may build into larger assemblies available and inside production tooling facility to use by GM DRE or SQE during MRD Events, PPAP Approval and any Dimensional concerns that may arise during development.

**6.2.3 Final Process Gages:**

**6.2.3.1** The Part Supplier shall have final assembly checking fixture gages for all end-item components, large sub-assemblies available and inside production tooling facility to use by GM DRE or SQE during MRD Events, PPAP Approval and any Dimensional concerns that may arise during development.

**6.2.3.2** The Part Supplier shall have final assembly checking fixture or alternative checking fixture that allows for full dimensional measurement studies to be completed without any interference or issues to collect dimensional data results.

**6.3 Dimensional**

**Note:** For all KPC/PQC features stated on the drawing, appropriate controls shall be established per GMW15745 and GM10067.

**6.3.1 Dimensional Measurement Control:**

**Note.1:** The Part Supplier shall maintain statistical software and track historical dimensional performance to assess process capability over the life of the program. Capability should be evaluated per short layout submitted for PPAP. Sampling frequency should be developed with GM SQE at launch of program.

**6.3.1.1** The Part Supplier shall implement 100% control of assembled parts through a combination of certified gages and/or CMM measurement of dimensional points and other features established at the MDM reviews, critical points provided by GM or points requested by the GM Cross-Functional Team (GM SQE, GM DRE, GM Plant Launch and GM Dimensional Team)

**6.3.1.2** The Part Supplier shall use and maintain DES File Points (in the event where GM DES File is provided) for dimensional and process capability measurement studies for all MRD Events, PPAP Approval and GM Assembly Plant using an agreed upon submission frequency.

**6.3.2 Dimensional Control for Matching Events**

**Note:** Structures/Stamping products are Matching parts interfacing with multiple body areas per GM10067.

**6.3.2.1** The Part Supplier must support and drive the Matching Events at their facility or integrators per GM10067.

**6.3.2.2** Supplier shall deliver on request all OP and JES sheets prior to Mini-Match including electronic tool drawing files.

**6.3.2.3** Prior to Checking Fixture Construction, an alternative fixture is to be available for CMM dimensional measurement of final assembly according to CAD data.

**6.3.2.4** During each phase of the MRD process, the supplier shall be responsible to carry out 100% of the required dimensional checks as prescribed in the SOR. The supplier shall document the results of the dimensional checks and provide all documentation necessary to achieve appropriate part status in SQMS/GQTS.

**6.3.2.5** For sub-assemblies and stamping components, the supplier shall maintain an appropriate Commodity SOR instruction with their sub-suppliers. That SOR should use published industry standards and applicable GM engineering standards to support its development.

**6.3.2.6** The suppliers must have the resources in place to implement required Matching changes or other quality improvement actions on short notice, even in a holiday phase.

**6.3.2.7** The Part Supplier shall deliver on request all Process Control Plans prior to Mini-Match, and examples of process control graphs and diagrams generated from the PCP requirements.

**6.3.3 Dimensional Capability**

**Note.1:** For Structures/Stamping products, reference CG4338 GM 1927 03.

**Note.2:** The Part Supplier should consider in-process dimensional control of critical components influencing dimensions of final assembly.

**Note.3:** The Part Supplier shall use CMM or Scanning Method of Measurement when submitting dimensional reports for PPAP or MCR Approval.

**Note.4:** The Part Supplier shall submit a 30 piece Capability Study (Control Charting) for PPAP Submission to determine total variability and verify consistency of sample size.

**6.3.3.1** The Part Supplier must prove appropriate capability of the process, and only with written GM SQE approval for the frequency of dimensional verification, can the 100%-dimensional control be changed to sample testing and SPC.

**6.3.3.2** In case the supplier does not prove the Process Capability, GM may require implementation of 100% on-line dimensional inspection.

**6.3.3.4** In the case of Hot Stamped Material where parts change dimensionally after cooling, the supplier shall establish a timely measurement plan that accommodates the cooling effect.

**6.3.3.5** The Part Supplier shall demonstrate if part or assembly fails the dimensional checking gage fixture checks, that CMM is used to assure dimensional integrity for special cause variation is addressed and appropriate action plans are provided to GM SQE.

**6.3.3.6** The Part Supplier shall use Table 6.3.3.7 below for GM PAST Score requirements to achieve 100% Dimensional PPAP at MVBns1 (Non-Saleable 1) and FULL PPAP at MVBs1 (Saleable 1), per GM10067.

**Table 6.3.3.7**

**Note.1: GM reserves the right to amend the exceptions below in the event of requirements changes, technology innovation, etc.**

**Note.2: If the submitted part to GM Stamping or Assembly Plant does not meet the expected quality level or if the part is contributing to vehicle issues, iterations with improved part quality are expected prior to the next MRD.**

|  |  |  |  |
| --- | --- | --- | --- |
| Item | MRD  Build | Dimensional In-Tolerance PAST Score  Minimun Requirement ONLY | If Dimensional In-Tolerance PAST Score Requirement is not met: |
| 6.3.3.7.1 | MRD Matching | 80% | Minimum dimensional requirement is 80%. |
| 6.3.3.7.2 | MRD  APPV | 85% and NS PPAP | Minimum dimensional requirement is 85%, however Action Plan to reach 100% is required, as well. |
| 6.3.3.7.3 | MRD  PPV | 90% and NS PPAP | Mininum dimensional requirement is 90%, however Action Plan to reach 100% is required, as well. |
| 6.3.3.7.4 | MRD  MVBnS-1 | 100% and NS PPAP | Minimum dimensional requirement is 100% and Action Plan to reach 100% is required before next build event. |
| 6.3.3.7.5 | MRD  MVBnS-2 | 100% and NS PPAP | Action Plan to reach minimum requirement before next MRD Build. |
| 6.3.3.7.6 | MRD  MVBS-1 | 100% and Full PPAP | Action Plan to reach minimum requirement before next MRD Build. |

**6.4 Quality Check Frequency**

**Note.1:** The supplier is obliged to transfer GM Customer Specific requirements to their supply base. Where GM funded tools are located at a sub supplier, the supplier must assure that correct handling and maintenance is performed to prevent damage or “out of specification” condition. The supplier will establish an audit schedule for regular verification of the correct status of the tools located at sub suppliers.

**Note.2:** For product manufactured outside the GM assembly plant region, the supplier shall have the capability to perform a functional containment screen with well certified personnel per GM 1927 17 Supplier Quality Processes and Measurements procedure in the region of the impacted assembly plants.

**Note.3:** All line items in this section apply starting at CVER Builds, through all subsequent MRDs, and will continue throughout the life of the program.

**6.4.1 Dimensional** **Quality Check Frequency**

**Note:** The Part Supplier shall specify a frequency of sample checking dimensional results that must be established to monitor and give immediate feedback to GM SQE and GM Assembly Plant Team to maintain and demonstrate process stability.

**6.4.1.1** Dimensional Quality Checks are to be completed at a minimum at start/end of shift, any tool, secondary equipment, or process change, disruption of normal production, and/or after each scheduled PM of equipment. Final Production Frequency and Lot Acceptance Test size to be developed by the supplier and approved by the SQE at a frequency that supports no product (lot) can leave the supplier facility without every element of the Process Control Plan being complete with satisfactory results for the determined lot.

**6.4.1.2** Upon failure on any element of the Process Control Plan, the Part Supplier shall quarantine all parts between the failed part and last known good part.

**6.4.1.3** In addition the Part Supplier shall document and provide to General Motors upon request the following: (1) Process Parameters and Set-up Sheets, (2) Scan/CMM data of the final assembly prior to each MRD starting at CVER, all subsequent MRDs and upon request thereafter, (3) Conformance to the process checks and steady state monitoring. This includes traceability and (4) Performance to Rate Requirements for each station according to the production process flow.

**6.4.1.4** Every component will have appropriate marks placed manually throughout the GM 1927 28 Early Production Containment Procedure process to identify completion and certifies that every stamping/assembly have the correct number of welds, nuts, studs, holes, brackets, tape, and others required for that specific product.

**6.4.1.5** The GM 1927 28 Early Production Containment Procedure Control plan must be reviewed and approved by the GM SQE.

**6.4.1.6** Controls shall include in-process and final control of dimensions, all critical characteristic and appearance in the case of adhesives/sealers.

**6.4.1.7** Standard duration of GM 1927 28 Early Production Containment Procedure control is to be planned for 3 months after GM SORP without any defect detected by Supplier Early Production Containment Procedure or the GM Assembly Plant.

**6.4.1.8** End of GM 1927 28 Early Production Containment Procedure control is allowed upon written approval from the GM SQE.

**6.4.2 Weld Quality Check Frequency**

**Note.1:** Per PFMEA Requirements, all welds identified in the DFMEA Severity Ratings must be mitigated through Detection (error proofing) correlated to the designated Level of Severity per AIAG FMEA Handbook. Severity 9 and 10 must be error proofed to a level 3 or less Detection and Severity 7 and 8 must be error proofed to a level 4 or less Detection.

**Note.2:** The Part Supplier shall meet all AIAG CQI-15 Special Process: Weld System Assessment regarding certified welding engineer before performing any weld quality verification.

**6.4.2.1** Weld Quality Checks are to be completed at a minimum at start/end of shift, any tool, secondary equipment, or process change, disruption of normal production, and/or after each scheduled PM of equipment. Final Production Frequency and Lot Acceptance Test size to be developed by the supplier and approved by the SQE at a frequency that supports no product (lot) can leave the supplier facility without every element of the Process Control Plan being complete with satisfactory results for the determined lot.

**6.4.2.2** Check of Welding (Pry, Chisel, Cut and Etch) – for all mentioned joints, in-process control is required by “Push-Through” test, “Pull-Off“ test or any appropriate method to verify strength of the weld joint. Minimum frequency must be agreed with the GM SQE and identified in the control plan that supports the PFMEA.

**6.4.2.3** Check of adhesive joints will be monitored with sectioning to confirm proper adhesive location, fill, and adhesion to ensure minimum wet out width dimension (if not defined on the design release documentation) is 7 mm width and the adhesive surface area on each of the flanges in a joint exhibit evidence of adhesive contact (flattening of the dispensed bead) after separation per GMW16537.

**6.4.2.4** There shall be a logistics split for uncured adhesive time on the panels. Supplier will have 3 weeks to build and ship assemblies to GM to then allow GM remaining uncured time allotment to build and ship to Paint. All suppliers must fill in the “use by date” on the container label with the date for MRD Saleable on all material for MRD Matching, MRD APPV, MRD PPV and MRD Non Saleable. Beginning at MRD Saleable, the “use by date” then needs to be calculated to +8 weeks from dispense date. Container label for panels containing adhesive shall include the verbiage “Do not use after Specified Date.” The specified date to be determined based on uncured aging requirements contained in GMW18076 and GMW18077.

**7.0 Requirements – Batch & Hold, Traceability and Labeling**

Suppliers must demonstrate capability within the proper weld equipment potential by certifying that all components or sub-assemblies are dimensionally correct with “Drive to Nominal” strategies in place before staging for usage to assure robust Batch & Hold strategy with proper traceability and labeling processes to ensure robust means for potential containment of non-conforming product.

**Note:** Supplier must follow the defined methods, guidelines and ensure full compliance to Batch & Hold Requirements per Welding CG4931 and CG4352.

**7.1 Batch & Hold:**

**Note:** For all Mig-Welded assemblies the supplier shall ensure full compliance to Batch & Hold Requirements per Welding CG4931 and CG4352.

**7.1.1** This includes sub-assembly weld verification completion if applicable.

**7.1.2** Beginning of Batch 1st off – Visual Inspection and Peel Testing Method. If acceptable to requirements, begin production runs.

**7.1.3** During Batch Build – Visual Inspection and Deformation Test (chisel) Check, or Peel Test. If acceptable to requirements, continue production run.

**7.1.4** End of Batch Last off confirmation by Visual Inspection and Peel Test to verify conformance to specified requirements. If correlation studies for Non-Destructive Testing methods are approved, this may be considered an option if applicable If acceptable, move “BATCHED” product forward through the value stream.

**7.1.5** Ultrasonic Weld Inspection or Non-Destructive Testing (NDT) or Non-Destructive Evaluation (NDE) is NOT an approved substitute for standard Weld Teardown, Destruct, Chisel or Peel Test. Any request to perform or add supplemental NDT testing to PCP, must be approved by GM Welding Global Process Lead.

**7.2 Traceability and Labeling:**

**Note:** For all assemblies the supplier shall have at a minimum the following electronic traceability data readily available upon request by GM per GMW17533 Section 3.9.

**7.2.1** Any tiered, purchased or manufactured component part numbers which are not contained within the GM BOM are to be considered as non-conforming product.

**7.2.2** In addition, the Part Supplier’s traceability shall be electronically tied to inventory control and production equipment in a way that prevents non-conforming product from being used in manufacturing environment and/or being shipped from the manufacturing location.

**8.0 Notes – Glossary, Acronyms & Diagrams**

**8.1 Glossary**

**Part Supplier:** The Tier I supplier

**Suppliers:** The Tier I supplier including any of its subcontractors, tool shops and/or lower Tier Suppliers

**Onsite:** At the source where part or product is being manufactured or produced

**8.2 Acronyms, Abbreviations and Symbols**

AIAG Automotive Industry Action Group

APQP Advanced Product Quality Planning

BA Body Assembly

BS Ballasted Structure (Part of POC builds)

BOM Bill of Material

BTAB Business Transfer Approval Board

CAD Computer Aided Design

CG Corporate Graphic

CPK Process Capability Designator

CQI Continuous Quality Improvement

CTA Call to Action

CQI Continuous Quality Improvement

CMM Coordinate Measuring Machine

CVER Concept Vehicle Engineering Release

DES Dimensional Execution Strategy

DFMEA Design Failure Mode and Effect Analysis

DRE Design Release Engineer

ECR Engineering Change Request (Formerly known as EWO)

ELPO Electro Coat Paint Operation

eSOR Electronic Statement of Requirements

GDIS Global Dimensional Information System

GD&T Geometric Dimensioning and Tolerancing

GM General Motors

GMW General Motors Worldwide

GP General Procedure

H2H Hole to Hole

ID Inside Diameter

IHS Information Handling Services

*https://global.ihs.com/standards.cfm?publisher=GMW&rid=IHS*

JES Job Element Sheets

KPC Key Product Characteristics

LAT Lot Acceptance Testing

LCR Lean Capacity Rate

LPT Latch-up Protection Technology

LVDT Linear Variable Displacement Transformer

MIG Magnesium Inert Gas

MRD Material Required Date

OD Outside Diameter

OEM Original Equipment Manufacturer

OP Operating Policy

PAPT Pull Ahead Production Tooling

PAST Points Acceptable to Specified Tolerance

PCP Process Control Plan

POC Proof of Concept

PQC Product Quality Characteristic

PPAP Production Part Approval Process

PFMEA Process Failure Mode and Effect Analysis

PHS Press Hardened Steel

RASIC Responsible, Approval, Support, Inform, Consult

RRAB Roof Rail Air Bag

SPC Statistical Process Control

SORP Start of Regular Production

SQ Supplier Quality

SQE Supplier Quality Engineer

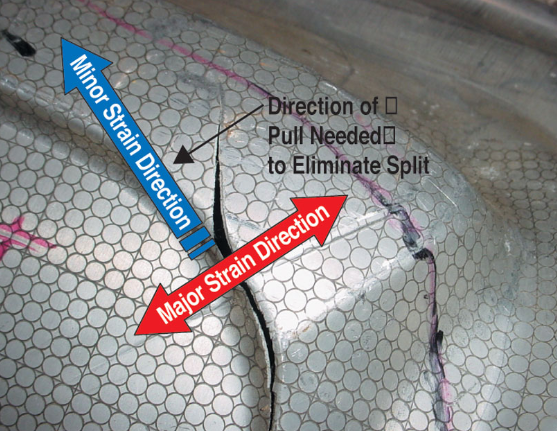
SQMS Supplier Quality Management System

TKO Tool Kick Off

TWO Temporary Work Order

**Diagram 1**

**Method a**

****

**Method A)** Manual Measurements – Used on Shop Floor During Die Tryout to Determine Die Modifications

**Method B)** Digital Measurements Similar to White Light Dimensional Scanning Used for Further Analysis to Determine Further Die

**Note:** Both Methods Are Very Useful in Determining Areas of Concern (Hot Spots, Compression, Etc.)

**Method B**

A close up of a map

Description generated with very high confidence

**Appendix A** – **Process and Product Verification for Surface Quality Requirements**

**In Process Control**

* 1. The supplier shall follow the GM Common Process for Surface Buy-Off:
     1. All Class “A” surfaces provided by the Supplier shall meet the requirements specified in GM SupplyPower Document Library:

**[Reference: GSQE Training Module One 042610]**

**[Reference: GMNA-Die-SOR-Master-Rev-11] *(PAR Process only applies to internal GM Parts; not External Supplier Parts.)***

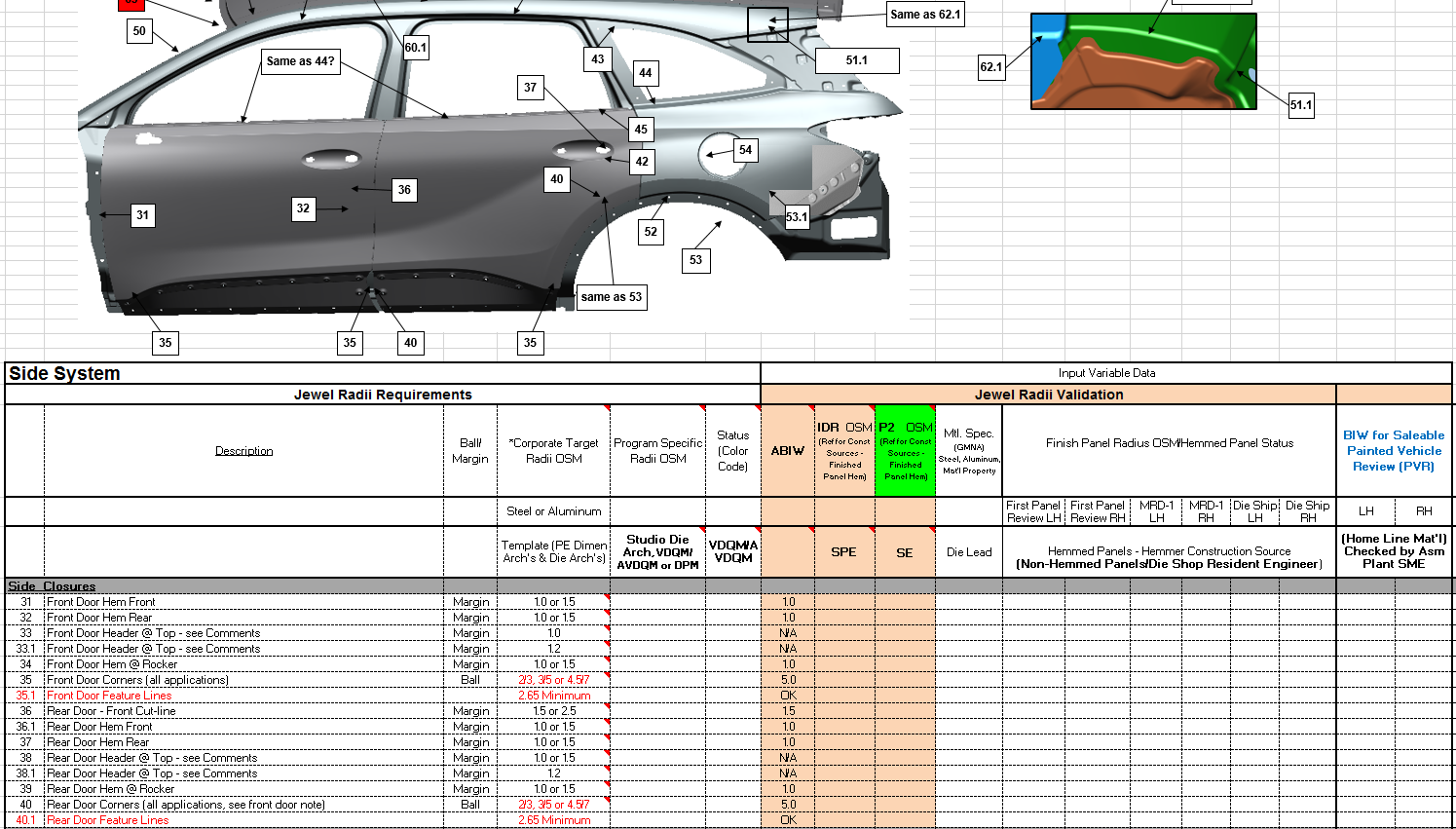
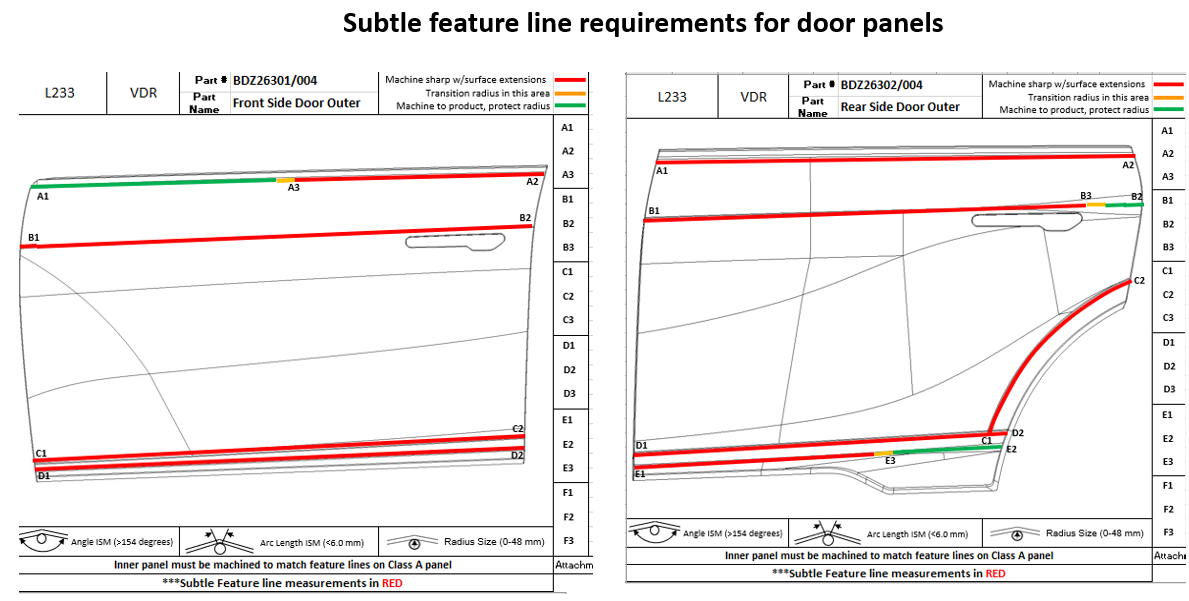
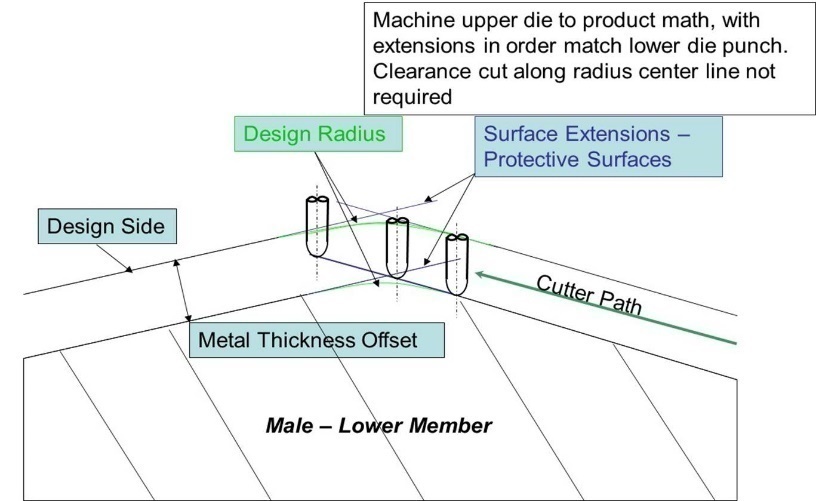
**[Reference: GM10067 Global Matching Part Submission Rev 24]**

**[Reference: GSQE Form-Sheet Metal]**

* + 1. All Die compensation files must be generated by the Supplier to achieve the intended Part Design Features, Dimensional and Surface Quality Requirements. Subtle feature lines, spring back, gap and flush requirements may require unique die-compensated surfaces to meet the final design intent as witnessed from a model, or witness panel. Visual buyoff is required by General Motors

### Class “A” Closure Panel Jewel Radii, Supplier is responsible to meet and document Jewel Radii performance.

Supplier shall request Jewell Radii Specification Sheet for awarded program (Post P-2 Release) from DRE. See example below (Section c.1.)

* + - 1. 
    1. Subtle Features: Some panels may require the lower die to be cut with Surface Extensions to keep the radii that is forming the Subtle Feature as sharp as possible.  The purpose of cutting subtle feature lines is to ensure that the product intent is met with all panels. See example (Sub-Section e.2) below for typical feature lines that require this process, along with high level description of the die machining requirements.
    2. Supplier shall request Subtle Feature Line Requirements for awarded program (Post P-2 Release) from DRE. See example below (Sub-Section e.1.)
       1. 
       2. 
    3. Hem Acceptance Criteria. All hems shall meet the requirements specified in the Global Hemming Standards (GHS1). Supplier to provide verification of hem radii meeting specification.

**[Reference: GHS1 Global Hemming Standards-REV 4-2-2]**

# **Appendix B** – Revision History

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Revision** | **Date** | **Remark** | **Responsible** | **Approver** | **Approving Organization** |
| 1.0 | 12/11/2020 | Initial release | Gjovan Gojcaj | Shelly Hlifka | Supplier Quality |
| 2.0 | 2/1/2022 | Section 3.4.5.1 - Full-Incremental Simulations due 2 wks after TKO.  Table 4.7 – Updated Failure Modes  Section 5.0 (Note.5) – Aluminum Welding Process  Section 5.4 (Note.5) – OEE Requirement  Section 5.6.5.4 – Power Outage Management  Section 5.10 – PFEP Requirements  Section 7.1.5 – No NDT/Ultrasonic Weld Testing in SOR Quotes | Gjovan Gojcaj | Shelly Hlifka | Supplier Quality |
| 3.0 | 4/20/2022 | Updated header; revised to GM nomenclature, removed GM specific PFMEA charts | R. Paul Smith | Shelly Hlifka | Supplier Quality |