#### Herein are the minimum requirements that shall be incorporated into the manufacturing process for the above commodity. This Part Specific CG 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.**

**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 CG 4338 GM 1927 03 SQ SOR, 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, Interior Trim Assemblies and Safety 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
* GMW14149 Fastening Requirements for supplier component and Sub-Assembly Sourcing
* GMW14669 Organic Coating Performance for Exterior and Interior Metallic Components
* GMW15049 Key Characteristic Designation System Process
* 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
* 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)
* GMW 16804 Joint Acceptance Criteria and Repair Method Self Piercing and Extruding Screws
* GMW17000 General Motors Global Fastening Catalog
* GMW17533 Process Requirements for Steel Stamping Suppliers
* CG4287 Fasteners
* CG4209 Electrical & Electronics Modules & Assemblies
* CG4931 Resistance Spot Welding
* CG4352 Gas MIG Braze Weld Quality Verification Procedure
* GM Global Formability Analysis Standard R10
* Global Vendor Assembly Tool Design and Construction Specifications (GVATDCS1)

**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
* GM 1927 16a Structures Commodity Part Specific Audit

#### **SCOPE:** Provide a common means and understanding for the supply base on where to find and verify the torque specifications to meet customer validation requirements.

**2.3 Responsible Parties**

#### **2.3.1 Design and Release Engineer (DRE)**

#### The GM DRE is responsible for identifying the torque specifications of the joint, **if the supplier is NOT DESIGN RESPONSIBLE.** The DRE should collaborate with the fastener engineer when specific joints require additional analysis. Torque specifications are found in the Part Action Tab of the EWO, and in some commodities are duplicated on the drawing, or available in the DCS File Log Notes (i.e. chassis/seats/frames).

**2.3.2 Fastener Engineer**

For GM design responsibility, the GM DRE shall collaborate with the GM Fastener Engineer in determining the correct torque values.

#### **2.3.3 Supplier NOT Design Responsible**

If the supplier is not design responsible, they shall review the Part Action Tab of the EWO, drawing, or DCS File Log Notes to verify the torque specifications. Supplier Program Lead shall assure torque specifications are released per their internal operating procedure to the respective tooling, production, process, and quality engineers of the manufacturing facility. Supplier manufacturing facility shall have a sign off document to confirm all responsible parties have received released torque specifications. If a mismatch is found between the Part Action Tab of the EWO, drawing, or DCS File Log Notes, contact the responsible DRE immediately.

**2.3.4 Supplier Design Responsible**

#### If the supplier is **Design Responsible,** the torque specifications released for production shall **meet all customer validation requirements**. Supplier Program Lead shall assure torque specifications are released per their internal operating procedure to the respective tooling, production, process, and quality engineers of the manufacturing facility. Supplier manufacturing facility shall have a sign off document to confirm all responsible parties have received released torque specifications.

**2.4 Supplier Requirements**

**2.4.1** The supplier shall demonstrate via a capability study that the designated tooling effectively secures the fastener to the joint consistently.Supplier shall verifystatic (audit) torque specification(s) by use of industry standard tools.

**2.4.2** If the joint is determined to be critical per the DFMEA (KCDs) the supplier shall have 100% error proofing and traceability in their respective manufacturing process. If a repair to the joint is approved by engineering, then supplier shall mark the fastener with a visible marking (i.e. paint stick) to identify repair meets torque specifications. Supplier shall maintain such records in accordance with their quality operating system.

2.4.3 The supplier shall implement an audit torque process for 1st off, in cycle, and last off to assure static torque is in specification, and to assure the dynamic torque tool is meeting the dynamic torque specification. Supplier shall assure a batch and hold process is in place and shall not ship components/assemblies until verification of the Static (Audit) Torque Specification.

**2.4.4** In the event of any major incidents that cause significant downtime to the torque tool while in in cycle the supplier shall repeat the 1st off, in cycle, and last off audit torques to assure the static torque is in specification, and assure the dynamic torque is meeting the dynamic torque specification. A new batch and hold process shall be initiated from the time of production restart and no components/assemblies shall be shipped until verification of the Static (Audit) Torque Specification.

**NOTE: Static torque verifies dynamic torque is correct.**

**2.4.5** All dynamic torque values identified as 5 Nm or less must have FDSNS (Fully Driven, Seated, Not Stripped) torque designation.

**2.4.6** For Self Piercing and Extruding Flow Drill Screws (FDS) requirements ref GMW 16804

**2.4.7** Supplier shall have a Preventative Maintenance Program in place and all PM shall be documented.

**2.4.8** Joints having a severity rating of 10, 9 must meet min 1.67 Cpk. (Cpk shall be measured for Dynamic Torque, and Angle Monitoring. .

**2.4.9** Unless stated elsewhere, there shall be a min 5mm separation between the fastener and any adhesive/sealers in order to prevent runoff during torque application.

**3.0 Definitions**

**Definitions:** Torque values identify the degree of tightness required by a specific part in a specific location on a sub assembly. Torque values are unique for each fastener location and the respective application.

* 1. Dynamic torqueis the peak value of torque measured as a fastener is being installed. A hand or power tool can apply dynamic torque. Dynamic torque **cannot** be checked after the fasteners are installed.
  2. Dynamic Torque is the installation requirement– *Dynamic -* Moving – In Motion.
     1. Example D25+/-5Nm - Install target is 25Nm with a 5Nm allowance on either side.
  3. Static (Audit) torqueis the torque required, after initial tightening, to overcome the friction holding a fastener in a still or “static” state. Static (Audit) torque is measured using a calibrated hand torque wrench in the tightening direction.
  4. Static Torque-Static-Still-At Rest- This is the check requirement after installation with a maximum of

5-degree rotation

**3.4.1** Example S18-26Nm- Static spec ranges from minimum 18Nm to a maximum of 26Nm.

**Note: Dynamic torque is the design released torqued value to tighten the joint. In general, dynamic torque tools are Electric, Air, or Battery continuous drive tools. In some cases hand torque wrenches can be used for initial tightening, although should be approved by the GM engineering representative overseeing the project**.

**4.0 Torque Revisions**

**4.1** When GM is design responsible suppliers are not authorized to revise fastener and torque values without an initiation of an EWO by the GM DRE. If a mismatch is found between the Part Action Tab of the EWO, drawing, or DCS File Log Notes, contact the responsible DRE immediately. Supplier shall repeat Section 2 of this document if torque specifications are changed.

#### **4.2** **If the supplier is designing responsible** the supplier’s internal change management system must authorize a change and such change shall be documented and communicated to the respective tooling engineer, production engineer, process engineer, and quality engineer of the manufacturing facility. Supplier manufacturing facility shall have a sign off document to confirm all responsible parties have received the required torque specification change. The supplier shall repeat Section 2 of this document if torque specifications are changed and shall inform the respective GM DRE of any such changes to the torque specifications.

**NOTE:**   Torque specifications shall be revised by an approved EWO and may require a PTR (production trial Run).  Supplier shall verify PTR is required by the GM Assy facility.

**5.0 DFMEA, PFMEA & Control Plan Requirements**

**5.1** Critical KCDs are noted in the DFMEA. The supplier shall assure the PFMEA is aligned to the DFMEA.

The Process FMEA shall be reviewed with the responsible GM Supplier Quality Engineer.

1. As a base, all Lessons Learned from previous projects shall be used.
2. Error proofing is preferred to error detection.
3. The PFMEA is as a living document with updates posted as quality issues arise and during Risk Reduction Initiatives. PFMEA shall be reviewed with the GM SQE yearly as a minimum frequency.

**5.2** The PFMEA shall align to the DFMEA. Critical joints identified with severity rating of 10 or 9 shall have a detection rating of 3 or less. Therefore, supplier shall have 100% error proofing in station in place

to assure the torque and angle process conforms to the specified torque and angle specifications. There shall be no deviation to this requirement. Reference AIAG FMEA VDA Handbook or AIAG PFMEA 4th Edition and CG4338 GM 1927 03 SQ SOR.

Joints that have severity ratings of 8 or less shall have a minimum detection rating of 4. Therefore, the supplier shall have an in process detection system in place to assure the torque and angle process conforms to the specified torque and angle specifications. Reference AIAG FMEA VDA Handbook or AIAG PFMEA 4th Edition and CG4338 GM 1927 03 SQ SOR.

Supplier to confirm severity ratings align to the DFMEA and shall collaborate with the responsible DRE prior to completing the initial PFMEA and Process Control Plan(s).

**6.0 Torque Monitoring**

**6.1** AllDriven Fasteners shall be monitored to the appropriate sample size as outlined in the suppliers Process Control Plans.

* 1. Static (Audit) Torque Approved Tools: Torque wrenches for the sole purpose of taking audit torque of dynamically driven joints must be of the following types: Digital, Beam and Dial torque wrenches, sized properly and with enough fidelity to provide meaningful discrimination in data readings to assure proper dynamic torque output to customer specifications.
  2. Click wrenches can be used for joints that have a FDSNS (Fully Driven, Seated, and Not Stripped) audit torque spec of M4.2 and M5 screws with torques less than 5.0 Nm.  Click wrench shall be set to the nominal value of the torque spec and used in the torque audit.
  3. Static torque readings shall be taken within 5 minutes after initial torque. The only exception is when there is need for PERSONNEL SAFETY and the 5-minute time requirement cannot be safely completed. Supplier shall identify a safe work area designated.
  4. If the static torque cannot be verified within the 5-minute time requirement, then a correlation study shall be conducted to assure dynamic torque is within specification. **NOTE: Fasteners with adhesive shall be checked for Static Torque within 5 minutes of the initial dynamic torque setting**.
  5. GM Initial torque releases are Dynamic = Static. Rational is laboratory tested joints does not capture full manufacturing variation. If it is found that the Static (Audit) torque collected does not match the released Static specification, then a dynamic/static correlation study must be performed and provided to the GM engineering release representative to review and determine if change approval is warranted. Caution: Problem – solving techniques must be implemented first to assure correct process, tool, part(s) and part changes have changed expected audit readings.
  6. Torque wrenches and Small Screw Wrenches (for torque <3.5 Nm) shall be recertified every month and must be marked with the expiration date and new making applied.
  7. Wrenches with a certified expiration date shall not be used.
  8. Dropped wrenches, shall be replaced immediately with a certified replacement.
  9. Only use right sized torque wrenches for the joint being checked. NOTE: If the torque on the joint is less than 10 percent of the maximum reading on the wrench, use a smaller wrench. If the torque on the joint is more than 90 percent of the maximum reading on the wrench, use a bigger wrench. For example, if you are taking a torque reading at 5Nm, a wrench with a scale reading of 100Nm is too big to assure an accurate verification of the joint.
  10. Angle Monitoring is required for all joints with DFMEA severity ratings of 10 and 9 and the PFMEA shall align to the DFMEA. Supplier shall have an in process detection level of 3 or less and shall have 100% error proofing in station reference AIAG FMEA VDA Handbook or AIAG PFMEA 4th Edition and CG4338 GM 1927 03 SQ SOR. Supplier shall conduct a capability study to validate correct torque to angle traces to assure fastener is completely seated, and at the correct clamp load.
      1. For PFMEA severity ratings of 10/9, the supplier shall have their system networked to record all torque/angle data for life of the program. Supplier shall assure recorded data is traceable to a Part Unique Number (PUN). For PFMEA severity ratings of 8 or less supplier shall record torque/angle data from start of fulfilling MRDs thru end of GM 1927 28 Early Production Containment Process. Supplier shall assure process is stable before reverting to a standardize static (audit) inspection frequency (1st off, in cycle and last off).

**7.0 Rework**

**7.1** All elements of this CG must be implemented for any reworked joints/assemblies.

**7.2** Joints with prevailing torque fasteners can be reworked by replacing the original fastener with the same prevailing torque fastener part number. Original fastener shall be placed in a **Non-Conforming** **RED LOCKED BIN** and scrapped per the supplier PCP.

**7.3** Repairs (both on and offline) shall be compliant with approved standardized work.

**7.4** Repaired, reworked or reprocessed material shall be processed at a minimum through an independent repair confirmation (2nd person or machine after repair).

**8.0 Torque Tools**

**8.1 Impact Tools**

Impact Tools are NOT ALLOWED to be used for the installation of fasteners either production or repair.

**8.2 Air/Flat Ratchet Tools**

These tools are not allowed to be used for the installation of fasteners either production or repair.

**8.3** **Battery Tools**

Joints, which have a DFMEA severity rating of 10 or 9. If battery tools are used, they must be a transducer type model. Line operator shall not have the access to set the torque on the battery tool. Battery tools with different torque setting shall be properly identified/marked to prevent the use of wrong battery tool to fastener/joint application. Supplier shall assure proper error proofing is in place.

Joints, which have a DFMEA severity rating of 8 or less: when battery tools are used for installation/final dynamic torque, they must have internal clutch with low battery shut off function. Line operator shall not have access to set the torque on the battery tool. Battery tools with different torque setting shall be properly identified/marked to prevent the use of wrong battery tool to fastener/joint application. Supplier shall assure proper error proofing is in place.

**8.4** **Air Tools**

All tools shall be targeted to dynamic nominal torque specifications. Air Tool must have an internal clutch setting. Stall Tools shall not be used for final torque settings.

**8.5** **Pulse Tools**

Pulse tools shall not be used on a soft/medium joint.

Pulse tools shall not be used for torque prevailing fasteners (nylon patch, cutting threads, lock nuts).

Pulse tools shall not be used to partially seat or hand start any fastener.

Pulse tools shall not to be used on fasteners releases with TORQUE ANGLE SPECIFICATIONS, SHIFT POINTS and/or speed requirements.

**8.6 Electric Tools**

Electric tools shall have a transducer and have angle capability. Tooling requires Ethernet card, device net card and other features to compliment PCP (Process Control Plan) and error proofing requirements. Supplier shall review common controller specification before purchasing tool**.**

**NOTE: All tool settings shall be verified to assure the setting can achieve the dynamic torque specification(s) and meet all customer validation requirements.**

**All tools used in the initial torque application shall be verified to assure reverse feature is locked out and cannot be overridden by operators.**

**9.** **Torque Process Strategy**

Supplier shall create and maintain Torque Process Strategy List for all fasteners. Recommended Torque process strategy list includes:

1. Fastener information (name, part number).
2. Fastener dynamic torque requirements.
3. Torque Controller information (name, location, IP address, Program Set [Pset]).
4. Torque settings.
5. Rundown and final angle settings and speed settings.
6. Record controller options (re-hit, lock on reject and others).

Supplier shall save an electronic copy and should have a secondary method identified as backup for all torque controller setups at system start up and for production. Document any changes to the Torque Process Strategy.

**10. Training Requirement for Employees involved with Torque Application**

**10.1** The completed training plan shall be documented by the supplier, reviewed, and approved through the GM Supplier Quality Engineer. Training must include topics relative to the torque application/process/repair. Operators shall be able to perform the torque operation with quality, safety and takt time without supervision. (Reference IATF 16949 7.2.1 Supplemental; 7.2.2 On-the-job-training; 7.3 Awareness and BIQS Element Training)

**10.2** Training Records must be properly documented and maintained

**10.3** Supplier shall develop standardized work instructions, visual, for the torque application.

**11. Self-Assessment Torque Audit 1927 16b**

Suppliers who have torque specifications in their assemblies will be required to submit a yearly self-assessment of the Torque Audit 1927 16b into SCMS (Supplier Certification Management System). The responsible GM SQE shall assure supplier self-assessments be submitted on a yearly basis**.**

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

**12.1 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

**12.2 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

# **Appendix A** – 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 | Updated Header | Gjovan Gojcaj | Shelly Hlifka | Supplier Quality |
| 3.0 | 4/29/2022 | 1. Updated Header 2. Updated section 1.2 to add interior trim verbiage 3. Updated section 2.1 outdated fixture spec GM 1925 changed to GM 1927 10 4. Updated section 2.2 to include PFMEA 4th edition 5. Updated section 5.2 to reference AIAG PFMEA 4th edition 6. Removed diagram 1 & diagram 2 | Kara Cox | Shelly Hlifka | Supplier Quality |