Below are the minimum requirements, which shall be incorporated to help identify and verify dynamic and static torque specifications for suppliers to GM. This Part Specific SOR is in addition to and not intended to replace any requirements as outlined in the GM Supplier Quality Requirements (Appendix F17). All suppliers are expected to supply parts to General Motors with zero defects. Parts shall meet all engineering specifications and function with no abnormalities and according to intent. It is understood that advances in technology may require modifications to the following requirements to ensure state of the art processing and verification. It is the responsibility of the supplier to ensure that the process is state of the art and assures the GM SQE is informed and in agreement to any modifications of the requirements below.

***Note:* The word “Shall” in this document is mandatory. The word “Should” is highly recommended**.

#### **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.

#### **Responsible Parties**

#### **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).

**1.2 Fastener Engineer**

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

#### **1.3 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.

**1.4 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.

#### **Supplier Requirements**

**2.1** 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.

* 1. 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. 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.
  3. 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.**

* 1. All dynamic torque values identified as 5 Nm or less must have FDSNS (Fully Driven, Seated, Not Stripped) torque designation.
  2. For Self Piercing and Extruding Flow Drill Screws (FDS) requirements ref GMW 16804
  3. Supplier shall have a Preventative Maintenance Program in place and all PM shall be documented.
  4. Joints having a severity rating of 10, 9 must meet min 1.67 Cpk. (Cpk shall be measured for Dynamic Torque, and Angle Monitoring. .
  5. 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.

1. **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.

**Definitions Cont’d**

* 1. 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.
  2. 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**.

1. **Torque Revisions**

**4.1** When GM is design responsible suppliers are not authorized to revise fastener and torque values without an initiation of a 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 design 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. 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.

**DFMEA/PFMEA &Control Plan Requirements cont’d**

**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 DIAGRAM 1 and 2.

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 DIAGRAM 1 and 2.

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. 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 sufficient 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.

**Torque Monitoring cont’d**

* 1. Dropped wrenches, shall be replaced immediately with a certified replacement.
  2. 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.
  3. 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 diagram 1). 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 GP12 process. Supplier shall assure process is stable before reverting to a standardize static (audit) inspection frequency (1st off, in cycle and last off).

**7. 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. 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.

**Torque Tools cont’d**

**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 joints.

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 is capable of achieving 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 BIQS element 24)

**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**.**

**References: Diagram 1**



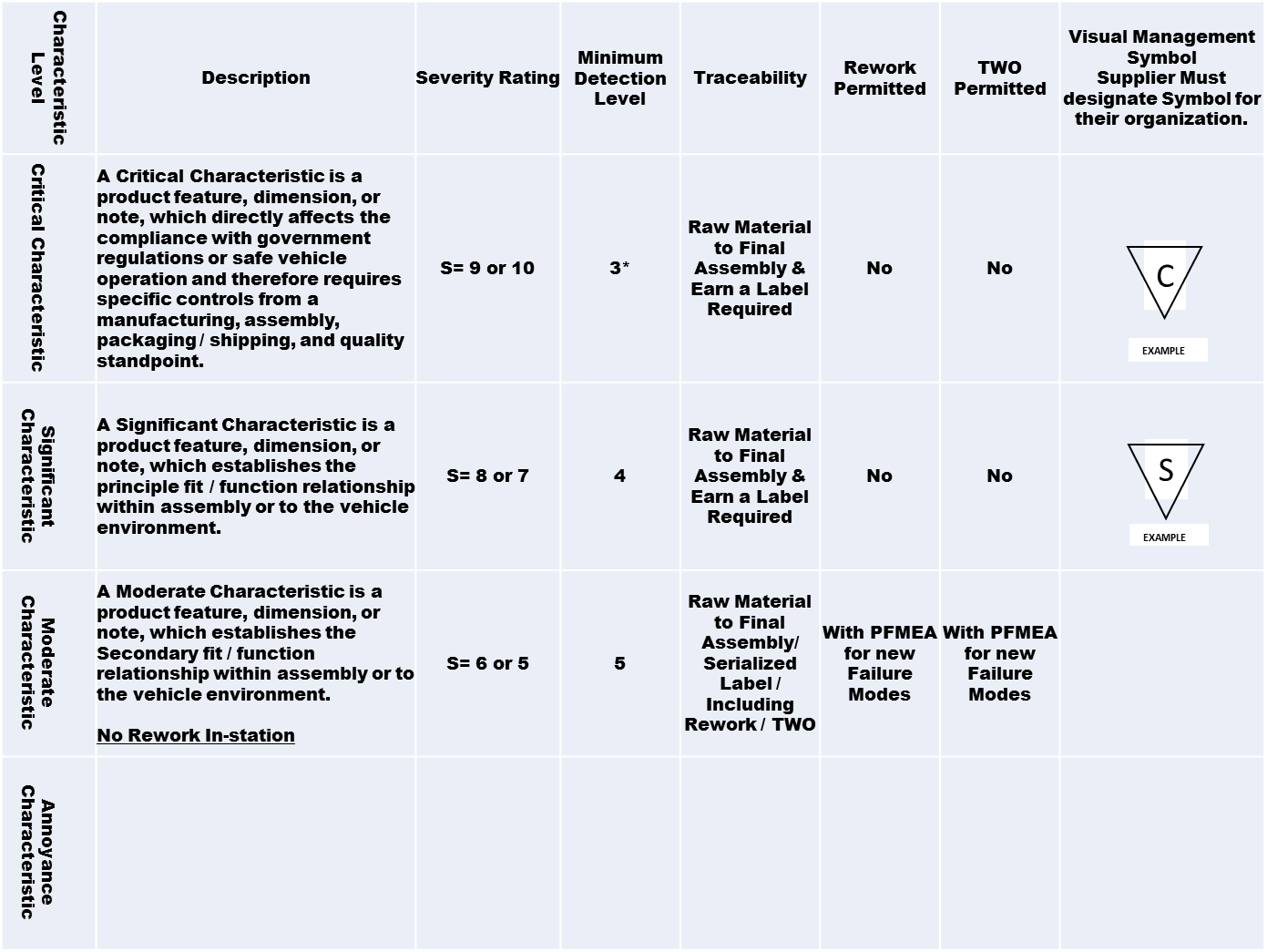
**Diagram 2**

\****Detection rankings of “4” are also acceptable if either of the following conditions are met:***

* + ***Traceability back to the original operation where the failure mode occurs.***
  + ***No manual operations between detection and the original operation (i.e. automated line)***

***\*\* Clarification: No Rework or TWO on the work step that is the Point of Cause for the failure mode.***

***Example: If a safety critical screw is driven into a plastic screw boss, it cannot be backed or and re-driven unless it was validated as part of the normal process that way.***



**Appendix A** – Revision History

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Date** | **Remark** | **Author** | **Approver** | **Approving Organization** |
| 1 |  | Initial release | Pat LaLama | Regine Bile | Supplier Quality |
| 2 | 5/18/2018 | Revised section 8.6 added reverse feature lockout | Pat LaLama | Regine Bile | Supplier Quality |
| 3 | 8/1/2018 | Removed Appendix F21 from the header | Pat Lalama | Shelly Hlifka | Supplier Quality |
|  |  |  |  |  |  |
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**Appendix B-Acronyms**

**AIAG**- Automotive Industry Action Group

**APQP**- Advanced Product Quality Planning and Control Plan

**BIQS-** Built In Quality Supply Based

**EWO-** Engineering Work Order

**FDSNS**- Fully Driven, Seated, Not Stripped

**FMEA-** Failure Mode and Effects Analysis

**GFC-** (General Motors)Global Fastening Catalog

**GPDS-** Global Product Description System

**KCDs-** Key Characteristics Designation System

**PCP-** Process Control Plan

**PPAP-** Production Part Approval Process

**Pset-** Program Set

**PTR-** Production Trial Run

**PUN-** Part Unique Number

**SCMS**- Supplier Certification Management System

**SOR-** Statement of Requirements

**SQE: -** Supplier Quality Engineer

**SQMS**- Supplier Quality Management System

**TWO-** GM *Temporary Work Order* authorizing a product or supply chain change

**GM Standards/Specifications**

**GMW14149 Fastening Requirements for supplier component and Sub-Assembly Sourcing**

**GMW17000 General Motors Global Fastening Catalog**

**GMW15049 Key Characteristic Designation System Process**

**CG 4209 Electrical & Electronics Modules & Assemblies**

**CG 4460 Body Exterior Structures and Stampings**

**CG 4287 Fasteners**

**CG 4338 Supplier Quality SOR**

**GMW 16215 Welding Acceptance Criteria and Repair Procedures: Resistance Projection Welded Steel, Nuts, Studs, Cages, and other parts with solid coined projections**

**GMW 16804 Joint Acceptance Criteria and Repair Method Self Piercing and Extruding Screws**

**Authorized Supplier Management:** Please print and sign name below showing that you received this SOR.

Initial each section below and mark whether you agree or disagree. Marking agree means that you are in agreement and will comply with the **entire** section and take no exception with any line item.  If there is exception(s), mark disagree, add item to Appendix M7 and create one deviation request form for each exception. Bring a signed hard copy & electronic version of this SOR, Appendix M7, deviation request(s), and documents from Section 5 to your technical review.

|  |  |
| --- | --- |
| Initials | Section |
|  | 1.0 – Responsible Parties |
|  | 2.0 – Supplier Requirements |
|  | 3.0 – Definitions |
|  | 4.0 – Torque Revisions |
|  | 5.0 – DFMEA/PFMEA &Control Plan Requirements |
|  | 6.0 – Torque Monitoring |
|  | 7.0 – Rework |
|  | 8.0 – Torque Tools |
|  | 9.0 – Torque Process Strategy |
|  | 10 – Training Requirement for Employees involved with Torque Application |

|  |  |  |
| --- | --- | --- |
| Print Name | Signature | Title |
|  |  |  |
| Date | Program & Model Year | Part Name |
|  |  |  |
| Supplier | Manufacturing Location | DUNs |
|  |  |  |

Suppliers are not allowed to make any changes to this Supplier Quality Part Specific SOR.