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#### 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 GM 1927 03 Supplier Quality SOR. It is understood that advances in technology may require modifications to the following requirements to ensure state of the art processing and testing. It is the responsibility of the supplier to ensure that the process is state of the art and that the GM SQE is both informed and in agreement to any modifications of the requirements below.

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

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

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**References**

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| CG4338 GM 1927 03 | CG4878 GM 1927 03a Fasteners |  |
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1. **General Equipment Requirements**
   1. The following test equipment is required to consistently make and ship good parts. Inspection gages and relevant test equipment must be certified annually by a nationally recognized accredited certification body and verified regularly in-house.
      1. Various Production Line Gauges (variable and attribute)
      2. Tensile tester with capacity to test the size of fastener produced
      3. Hardness testers with HRC, HRB or equivalent HV scales and fixtures for fastener core and surface hardness testing
      4. Metallographic equipment with 100x, 200x, and 500x magnification and image capturing capability. Equipment must be capable of clearly identifying micrographic features such as decarburization, retained austenite, martensite, and pearlite at 500x.
      5. Projector (shadowgraph) for dimensional/thread analysis.
      6. Acid etch station with microscope with at least 15x magnification to identify thread forming defect and grain flow.
      7. Automated laser/camera inspection system.
   2. We also require having the following equipment/test capability in house or actively contracted locally:
      1. Automated eddy-current testing capability.
      2. Fatigue testing capability.
      3. Torque-tension (CoF) testing machine.
      4. Corrosion testing cabinet (Neutral Salt Spray)
      5. Plating/coating thickness measurement machine
      6. Chemical analysis of steel (XRF and carbon-sulfur)
2. **General Engineering Requirements**
   1. The appropriate licenses and certification for producing fasteners with certain features. I.e. MAThread, Taptite, etc.
   2. GM fastener drawings supplied to a tier supplier shall have all dimensional, technical, and quality notes and information intact. It is especially important for finish (coating) and patch applicators to know what the type of material and specification they are processing to.
   3. All suppliers and their tier suppliers to GM MUST have access to the latest GM and international standards applicable to the GM product being produced at your facilities.
   4. Fastener drawing details take precedent over any referenced GM and other specifications.
3. **General Process Requirements**
   1. Raw Material
      1. An internationally recognized steel mill and an automotive/aerospace fastener-grade wire-drawing mill shall be used. The mill shall understand and agree to the chemical and internal cleanliness requirements of GMW25 and other applicable specifications that are called out on the drawing or identified in the math model.
      2. It is required that chemistry and formability of incoming material be checked prior to usage. i.e. each individual coil, bar or billet.
      3. All steel wire before cold forming is expected to be stored indoors in a clean and organized manner and shall be properly tagged with the material grade, size, and heat number. Records shall be retained for traceability per industry standards or GM requirements.
      4. Raw material that will go through further drawing, annealing, and pickling may be stored outside. However, proper protection from damage and excessive corrosion shall be provided.
   2. Wire Drawing/Annealing/Pickling
      1. Wire drawing, annealing, and pickling operations must be performed in a clean and organized environment. Annealing furnaces must conform to CQI-9 requirements. Pickling operation must conform to CQI-12 requirements for "pretreatment".
   3. Cold Forming and Thread Forming
      1. Small lot quality gates and regular in-process gauging (check every 2 hours minimum) is required with each attribute that is checked and recorded.
      2. Effective tool life monitoring system is required. Tool life and tool maintenance shall be documented. Grain flow check shall be made during every start-up, material lot change, tool change, and repair.
      3. A procedure must be in place to check for thread forming defects (laps, voids, cracks, etc.). This includes acid-etch and visual inspection of the threads under a microscope at startup, end of shift/batch, and at regular intervals.
      * For cold-forming setup, grain flow check per SAE/USCAR8 shall be performed as part of first-piece qualification during setup, material lot change, tool change and repair. Head soundness check shall be made at the same frequencies as grain flow check for fastener types defined in GMW25.
      1. All heat treat lines (including outside heat treaters) must be audited and approved by a qualified GM Engineer. (Per CQI 9 requirements).
      2. De-phosphating of externally threaded fasteners 10.9 grade and above shall be performed before heat treatment. (If phosphate coating is used on steel wire.)

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* + 1. During parameter change (temperature change of at least 100ºC or any carbon potential change), the austenitizing furnace shall be emptied before parameter change and remain so until the parameters are reached and stabilized.
    2. For washers and other delicate parts, special procedures and fixtures are required to prevent parts from stacking and from nesting of parts, especially at quench.
    3. The heat treat parameters (load speed, temperature, atmosphere, etc.) for each grade of material and required strength/hardness shall be fixed (documented in work instruction) and strictly followed. Any deviation must require heat-treat manager approval and be documented.
    4. A continuous and consistent heat treat process is required. If a power or atmospheric interruption occurs for more than 4 minutes, the event must be documented and 100% eddy-current testing along with random hardness testing of the fasteners is required to assure conformity to drawing requirements. Testing method should be documented and approved by the customer’s quality representative.
    5. There shall be a physical separation of non-heat-treated (Green) parts prior to furnace loading and heat-treated parts within heat treat operations. Usage of barriers at the heat treat area and usage of distinctly different containers for heat treated and non-heat-treated parts is required. Green parts and heat-treated parts shall be stored in designated labeled areas and shall not be stored close together such that mixing may occur by spillage or handling. Containers must be visually different. Removable tags or signs on otherwise identical containers are not acceptable.
    6. Shipping of green or insufficient heat-treat parts will place the supplier’s and all the supplier’s DUNS numbers in a New Business Hold for a minimum of six months.
    7. When external heat treatment sources are used, additional safeguards shall be in place to prevent green parts from getting to the customer. One of the following methods are acceptable:
       1. Eddy-current check of 100% externally heat-treated parts before packing/shipping to customer.
       2. Each container of parts to be hardness tested by someone other than heat treater and coating applicator.
       3. Other method with written agreement by SQ. This should be documented in the control plan.
  1. Finish / Coating
     1. GM finish specifications require the use of GM approved plating and coating materials and applicators. A list of approved finish suppliers is available on [www.gmsupplypower.com](http://www.gmsupplypower.com/) (search for "approved materials").
     2. Finished parts are to be placed into clean containers to avoid contamination with residual quench oils and other debris from fastener manufacturing and heat treat processes.
     3. Some surface finish applicators do not have a testing facility for torque tension or hydrogen de-embrittlement (per USCAR-7). It is the fastener supplier's responsibility to ensure these tests are performed as required (per print or specification).
     4. Salt Spray test results are required as specified by the PPAP process, if Salt Spray results are incomplete by time of the PPAP submission, surrogate data can be used for an interim PPAP submission/approval, and an action plan will not be required. However, documented results are required to be submitted to receive full PPAP approval at the completion of the salt spray testing.
     5. Coefficient of Friction (CoF) testing, as specified in the GMW finish specifications.
     6. Shipment of parts to/from surface finish applicators shall not be by open-top trucks. Shipment of finished (plated/coated/patched) parts shall be transported with a cover or sealed in plastic to avoid contamination or parts mixing. Note: Some finishes cannot be sealed air-tight within 24 hours after coating.
  2. Sorting and Packing
     1. GM may identify specific parts that require 100% automated sorting for specific dimensional characteristics and heat treat. Any deviations shall be proposed during the M7 tech review for consideration of approval.
     2. Sorting machines must have borderline go/no-go samples (Rabbits) for dimensional and heat treat verification. These samples must be used to verify the sorting machine during each startup of the machine and each lot of products. (See BIQS error proofing section for more details).
     3. Sorting machines transport mechanism shall default to rejection of all parts in the last step of the transport mechanism. I.e., if the machine is somehow disabled (broken air blower, malfunctioning arms, etc.), parts automatically go into the reject box.
     4. Sorting shall be performed as the last step before packing. Packing shall be performed at the sorting machine during or immediately after sorting.
  3. Miscellaneous:
     1. Containers for formed parts (before or after heat treat and surface finish) shall be solid, clean, and have smooth surfaces with no holes or sharp edges that cause damage to parts. If containers are stacked, they must be designed so that there is no chance of part damage. Overfilling of part containers is not allowed. Parts shall be 15 cm (6 inches) below the top of the container.
     2. If WIP (Work in Process) parts are to be transported to a different building/company during manufacturing, care must be taken to prevent handling damage. Also, parts must be protected from part mixing and contamination by using clean containers with a protective covering. Shipment of parts to/from outside processes shall not be by open-top trucks.
     3. Finished and semi-finished products shall not be stored outdoors.
     4. Full traceability of each lot of delivered product to heat of steel, heading, threading, heat treat, and finish lot is required.
     5. Head Markings shall be clear and legible to the naked eye after plating/finishing.
     6. Suppliers identified as a “distributor” by GM fastener purchasing will be exempt from all cottage DUNS contract requirements. Distributors will maintain the responsibility for the quality level of the received parts. All distributors are required to have the ability to verify all blueprint specifications including mechanical, material, and finish requirements, via PPAP documentation and/or accredited laboratory report. Note: Heat treatment and coating/plating processes shall be performed by a GM approved supplier and identified through PPAP documents.

**Barcode/Label & Traceability Requirements**

1. **Ref the packaging standard 1738**
   1. There shall be traceability of the part from the final assembly station to customer shipment.
      1. Traceability data shall include, but not be limited to the following:
         1. A unique serial number
         2. The GM part number
         3. An assembly-line identifier/number
         4. An off-line rework identifier (where applicable)
         5. The date & time of assembly and all subsequent operations
      2. All pass/fail traceability data of subsequent tests (e.g., functional testing, ring-out board, clip checking) shall be stored for each part and available upon request.
      3. A final label shall be printed for packing/shipment only if:
         1. All previous operations’ scans have successfully passed.
         2. All harnesses with reworks identified have “pass” records for additional testing after the time of the rework.
         3. All harnesses scanned have unique serial numbers (prevent double scanning).
   2. Before shipment, a final 100% inspection shall be performed to ensure all barcodes used by GM are in the correct position and are readable.
   3. The supplier shall ensure through testing that all part markings and labels do not degrade in appearance from any used solvent or cleaning system.
2. **Rework Requirements**
   1. All rework or repair processes in the supplier manufacturing facility shall be incorporated in the production control plan and PFMEA and approved via PPAP.
   2. Reworks made to a part shall be inspected by someone different than who performed the repair and documented it for traceability.
   3. All rework tools shall be kept in a secured area, and it shall be ensured that only authorized operators can access.
   4. All reworked areas shall be visually identified (e.g., paint marking, sticker).

**Appendix A** – Revision History

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| --- | --- | --- | --- | --- | --- |
| **Rev** | **Date** | **Remark** | **Responsible** | **Approver** | **Approving Organization** |
| 1 | 12/14/15 | Initial release | S. Miller, P. Dias | Scott E Miller | Supplier Quality |
| 2 | 08/30/16 | Add GM Confidential | S. Miller | Scott E. Miller | Supplier Quality |
| 3 | 10/15/17 | 1.1.4 change photographic to image  1.1.6 add “with at least 15x magnification”  1.1.7 change vision to camera  1.2.3 add “CoF”  2.1 – 2.2 reworked  2.3 - 2.4 new items  3.1.1 or changed to and, GM removed  3.1.4 can changed to may, “and excessive corrosion” added  3.3.4 new item  3.4.3 monitor and removed, “and data recording” added  3.4.4 updated  3.4.7 eddy-current and conveyed now “approved by”  3.4.8 “shall” added, new requirements added  3.4.9 new item  3.5 remove fastener  3.5.1 removed  3.5.2 “material and” and “approved materials” added  3.5.5 – 3.5.7 added  3.6.1 & 3.6.3 revised  3.8.1 added comment  3.8.3 “outdoors” added  3.8.6 “including mechanical, material, and finish requirements” added  4.1 “failure” added  4.2 new item | A. Ghazala | Scott E. Miller | Supplier Quality |
| 4 | 6/23/2022 | 1 The requirements for Sections 1,2 and .3. Revised   1. Assembly Requirements Removed 2. Inspection Requirements removed | Ayad Ghazala | Scott E Miller | Supplier Quality |
|  |  |  |  |  |  |

**Appendix B** – Definitions & Acronyms

**Definitions**

**Acronyms**

**APQP:** Advanced Product Quality Planning

**FMEA:** Failure Mode and Effects Analysis

**PPAP:** Production Part Approval Process

**SOR:** Statement of Requirements

**SQE:** Supplier Quality Engineer

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

**Notes:**

**Required features to inspect:**

**Grain flow, friction, hardness, case, hydrogen embrittlement.**

**Required Processes:**

**In house heat treat & visual/electronic inventory managed part flow management.**

**In house immediate, on demand traceability for all aspects of the value stream**

**Sampling plan for critical fasteners - by shift, stratified if operation s bulk process, by time if belt feed. Type of inspection must be explicit and defined. I.e.; level 2 technician, cut and etch, sampling rate**

**and point of shipment, with traceability and sample storage.**

**EWO – Sourcing involving Sub System to Component DFMEA linkage to dictionary split between a critical and shoot/ship fastener - including both vehicle & Propulsion Systems**

**John Dinovski, Steve Kwong, Dan Wuhlbrecht, Shri, Dan De Groote**

**This Document Reviewed and approved by Fastener commodity team:**

**Fastener Engineering: Larry Russel , Michael Kardaz**

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**Supplier Quality: Ayad Ghazala, Mohsin Kan**