SUPPLIER QUALITY MANUAL

Rev. February 2023

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AM GENERAL LLC
SUPPLIER QUALITY MANUAL
QUALITY ASSURANCE REQUIREMENTS AND PERFORMANCE EXPECTATIONS
(For use with ISO 9001/IATF 16949)

1.0 General Information:

This document establishes quality requirements and defines the supplier's responsibilities for ensuring that all Goods (e.g. purchased materials for the direct production of finished goods, a.k.a. 'direct material' and service materials) all conform to AM General LLC ("AMG") drawings, specifications and other procurement requirements. This document shall be incorporated by reference into every Order issued by AMG.

It is the supplier's responsibility to understand and comply with all the requirements within this document, its supplements, and addendums.

If supplier has any questions about this document, please contact your AMG Supply Chain Management or Quality Assurance point of contact.

All capitalized terms that are not defined in this document have the meanings given to them in the then-current version of the AM General LLC Standard Terms and Conditions of Purchase (the "Terms and Conditions") unless the context clearly requires otherwise. All references to "supplier" or "Supplier" shall be deemed to be references to "Seller" as defined in the Terms and Conditions and all reference to AMG shall be deemed to be references to "Buyer" as defined in the Terms and Conditions.

This document is supplemental to, and does not otherwise modify or amend the Terms and Conditions.

2.0 Quality Management System ("QMS"):

2.1 Quality System Certification Requirements:

For Suppliers of HMMWV Components: All current and new suppliers to AMG are required to be ISO 9001 or IATF16949 registered by an accredited third party registrar or to have an AMG approved plan to achieve registration or compliance.

Suppliers providing Goods or Services that have special characteristics including, but not limited to the following, must be ISO 9001:2015 or IATF16949 registered by an accredited third party to deliver production approved parts to AMG.

HMMWV Special Characteristics	JLTV Special Characteristics
<SC> Safety Critical	<SC> Significant Characteristic
<FF> Fit/Function	<CC> Critical Characteristic
CSI - Critical Safety Item	CSI - Critical Safety Item
R - Regulated	

For Suppliers of JLTV Components: AMG requires all suppliers, at a minimum, to be certified to the requirements of the ISO 9001:2015 or IATF 16949 standards.

3.0 Sub-Tier Supplier Quality Management:

The supplier is responsible for ensuring all sub-tier suppliers comply with all Order requirements.

3.1 Sub-tier Supplier QMS Qualification: The supplier shall have a process in place to ensure that all sub-tier suppliers maintain or achieve a Quality Management System ("QMS") that is compliant to the requirements of the ISO 9001 or IATF 16949 standards. The QMS compliance plan should target completion within 12 months of contract award. This process shall include:

- All applicable statutory and regulatory requirements and special product and process characteristics shall be flowed down to sub-tier suppliers.
- Required adherence to the AM General Supplier Quality Manual on all Purchase Orders issued that are related to the manufacturing or processing of AMG components and assemblies.
- A documented procedure or workflow which describes how parts are qualified and approved for use within the supplier's facility. This procedure or workflow shall address how sub-tier process changes will be communicated to the supplier and in turn submitted to AMG.

4.0 Supplier Site Assessment and Audit:

4.1 AMG and Government Audits: AMG's or the Government's Quality Assurance representative(s) or third party resources may conduct joint periodic audits of the supplier's and/or sub-tier facilities Quality Management System to include product, process and manufacturing systems. Upon request, records and documentation shall be made available for audit. The list of records and documentation may include but are not limited to:

- Inspection evidence assuring product adherence to design records and revisions.
- Material/Performance and acceptance test results.
- Production processes, standard work and manufacturing records.
- Training of personnel and Certifications for special processes such as heat treating, plating, anodizing, magnetic particle inspection, etc.
- Periodic calibration of inspection equipment and control of certification records.
- Documentation of changes to process inputs and communication to AMG.
- Failure analysis and corrective action reports.

4.2 AM General Special Process Audits:

AMG and/or third-party resources may conduct individual or joint periodic audits of the supplier's and/or the sub-tier supplier's specialized processes (e.g. weld, coatings, etc.). All suppliers with specialized processes are required to conduct yearly special process audits using the AM General AIAG CQI (Continuous Quality Improvement) format or other special process audit formats as required by AM General. These audits may include but are not limited to:

- CQI-9 Heat Treat Assessment

- CQI-11 Plating System Assessment
- CQI-12 Coating System Assessment
- CQI-15 Welding System Assessment
- CQI-17 Soldering System Assessment
- CQI-23 Molding System Assessment
- CQI-27 Casting System Assessment

4.3 Software Development and Quality Assurance Audits:

AMG requires suppliers who provide products programmed with embedded software to maintain a process for software quality assurance, and to conduct audits on: Software development process, Software Quality Assurance, and Software Quality Control processes. Audit formats adhering the ISO/IEC 330XX family of standards are acceptable, i.e. - VDA/QMC Automotive SPICE. Audit records for annual audits shall be kept on file and available for request.

Software changes will also be a reason to submit updated PPAP documentation per the general guidelines for Production Part Approval Process AIAG PPAP Manual, Fourth Edition (March 2006) or latest (IE. AIAG PPAP Manual).

4.4 Source Inspection and Surveillance: AMG and/or the Government may also send a representative to the supplier's and/or sub-tier supplier's facilities to perform any of the following activities:

- Source Inspection (mechanical, visual inspection and/or test): All items and tests may be subject to inspection/witness at the supplier's and/or sub-tier supplier's facility before shipment.
- Source Surveillance: All items are subject to surveillance by AMG Quality Assurance personnel. This may include the review of the supplier's and/or sub-tier supplier's inspection system, procedures and quality or test records during the production run to ensure conformance to drawing, specification and supplier procedure requirements.

5.0 Record Retention:

5.1 Quality Records: The supplier is responsible for maintaining quality records of inspections and outgoing product quality for all lots of material shipped to AMG. These records include but are not limited to inspection records, certificates of compliance and control test reports. The supplier is required to maintain these records for a minimum of seven (7) years after completion of AM General's order with the supplier in which the parts were delivered against, unless otherwise agreed in writing by AMG. The supplier shall advise AMG in advance of any intended disposition of such records. The supplier is responsible for ensuring all sub-suppliers comply with this requirement.

5.1.1 Record Retention and Storage Procedure: The supplier shall have a documented procedure or workflow which describes how records are controlled including retention, security and disposition.

5.1.2 Availability of PPAP Documentation: The supplier shall deliver the full PPAP record for any part number when requested by AM General within 24 hours of the request.

6.0 Pre-Award Potential Supplier Assessment:

Potential new suppliers are identified by AM General Supply Chain Management to be evaluated using the AM General Potential Supplier Assessment. This assessment evaluates a supplier's General Quality Management Systems and production capability. The supplier must complete the Supplier Information Section, generate an evidence book addressing all audit questions, and undergo both electronic and on-site audits as determined appropriate by AMG. Potential new suppliers are required to provide acceptable corrective action plans for any assessment findings prior to contract award.

7.0 Advanced Product Quality Planning ("APQP"):

7.1 Advanced Product Quality Planning Requirements:

APQP is defined process or methodology as documented by the Automotive Industry Action Group ("AIAG") to develop products or services.

The supplier shall adopt this structured methodology for any new or revised process/part utilizing the AIAG's APQP and Control Plan manual for all parts produced for AMG. This structured approach to new and revised product planning will enable the supplier to effectively launch new and revised products and ensure controls are established to achieve quality standards and customer satisfaction.

The supplier should possess the latest edition of all AIAG Core Quality Tool Manuals including the AIAG manuals listed below:

APQP – Advanced Product Quality Planning and Control Plans
PPAP – Production Part Approval Process
FMEA – Failure Modes Effects Analysis
SPC – Statistical Process Control
MSA – Measurement Systems Analysis

The above manuals can be obtained at www.aiag.org

7.1.1 Team Feasibility Commitment: At the technical review stage of the supplier selection or Engineering Change Notice ("ECN") process, the supplier's product planning team shall assess requirements, resolve concerns and commit that they can produce products to consistently meet requirements set forth in the design drawing and AMGs Purchase Document.

AM General Supply Chain Management will supply the Supplier Feasibility and Technical Review Form during the RFQ process. The Supplier is expected to complete the AMG Feasibility Form tab as part of the Quoting process and may be expected to complete the Technical Review Checklist upon request from AM General.

7.2 Production Part Approval Process ("PPAP"):

PPAP defines the common requirements and process for how production parts are approved. The purpose of PPAP is to determine if all customer engineering design

record and specification requirements are properly understood by the supplier and that the manufacturing process has been verified to produce product consistently meeting these requirements during an actual production run.

PPAP shall apply to internal and external organizational sites supplying production parts, service parts, production materials or bulk materials.

For Retention/Submission Level Requirements, see Table 4.2, of the AIAG PPAP Manual, 4th Edition. For all current and future supplied product, internal PPAP's shall be conducted annually and made available upon request.

JLTV Specific
For JLTV the PPAP submission is level is 3 only. (Ref. Supplement 1) No JLTV parts may be shipped without PPAP approval.

HMMWV Specific
The default submission level for all HMMWV PPAP submission is Level 3. However, submission requirements for HMMWV components may vary at the discretion of the AMG Supplier Quality representative ("SQE"), depending on the change, AMG production site or program. The process requirements may include but not be limited to Process Flows, FMEA's, Control Plans, and other AIAG core tools listed in section 7.1 for any new PPAP submission.

The appropriate SQE will guide the supplier in the submission process. All suppliers submitting parts for AMG programs will provide PPAP submissions for part approvals. The supplier shall not ship parts to AMG without PPAP approval, unless authorized by AMG Supplier Quality, this applies to HMMWV only. For further details on AMGs PPAP requirements refer to Supplement 1. Refer to section 8.2 of this document and Section 3 of the AIAG PPAP manual for additional detail and guidance on when a PPAP submission is required.

7.3 Additional Customer Requirements and Supplements:

For some components, certain processes or design requirements may require that additional levels of control or documentation be provided with the PPAP submission such as, for example, fasteners, welded components, castings, parts with paint or finish requirements, parts with special characteristics, and armored material components. Specific supplements are provided to define additional customer requirements beyond those standards listed under the PPAP requirements. Refer to the following supplements for additional detail:

Supplement 2 – Fastener Requirements
Supplement 3 – Welding Requirements
Supplement 4 – General Paint/Coatings Requirements
Supplement 5 – Armor Material Requirements
Supplement 6 – Radiographic Inspection (castings) – JLTV Program only
Supplement 7 – Special Characteristics Requirements – JLTV Program only

Any questions with regards to submission requirements or applicability of any of these supplements should be directed to your AMG SQE.

8.0 Process / Product Change Notifications:

8.1 Supplier Change Notification:

Suppliers may propose design or process changes to help reduce cost, improve quality, increase reliability and process capability of the product. All proposed design changes or modifications, whether permanent or temporary, including proprietary designs, must be reviewed, approved and authorized by AMG through the Order Change process and otherwise in accordance with the Terms and Conditions. Authorization, in writing or electronic, must be obtained prior to implementation of any change including those listed in Section 8.0. Any change implemented by the supplier without AMGs authorization may, in AMGs sole discretion, be classified as a breach of such supplier's obligations under the applicable Order.

The supplier must communicate all change requests utilizing the Process Change Notification/Request ("PCN") form. The PCN form must be submitted as soon as possible, but in all cases at least 12 weeks prior to the targeted change implementation. The form is available on the AM General website at http://www.amgeneral.com/our-suppliers/military-programs-resources/. The completed forms must be sent to the AMGs Supply Chain Management Representative via electronic transmittal.

A PPAP submission in accordance with Section 7 must be made and approved prior to implementation of any change in production or service part builds. With any PPAP submission approval, the supplier must continue to supply the same version/revision of the part in accordance with the approved requirements. Any changes described in Section 8.2 could require a resubmittal of the PPAP associated with the change content.

8.2 Supplier Initiated Changes (when PCN and PPAP Required): The following changes require a PCN and PPAP:

- Supplier driven engineering change;
- Tooling transfer, replacement or refurbishment. (Note: For parts produced with prototype "soft" tooling, another submittal is required following adoption of the production "hard" tooling. Final PPAP approval will not be granted until the production tool and process is validated.);
- Correction of a discrepancy;
- Changing to optional material;
- Sub-supplier or material source change;
- Change in part processing;
- Parts produced at an additional location;
- Change of ownership;
- Changes that impact the Performance Test method or results as defined on the drawing or within required specifications. (At times referred to as a First Article Test (FAT) or Component First Article Test (CFAT)); and
- Significant production rate changes.
- Software changes

Contact your SQE or buyer for questions concerning when a PCN and resulting PPAP is required. Refer to Section 3 of the AIAG PPAP manual for additional detail and guidance.

8.3 AMG Initiated Changes (PCN Not Required): AMG initiated changes do not required a PCN including, without limitation, the following changes:

- AM General initiated Engineering change; and
- At request of AM General.

9.0 Supplier Performance Monitoring:

The purpose of Supplier Performance Monitoring is to ensure the supplier's conformance to AMG standards and requirements. Supplier performance will be continuously monitored and reported at a defined frequency from AMG using a supplier scorecard. Supplier Performance Monitoring is scheduled to roll out in the 1st quarter of 2019.

9.1 Scorecard: Individual supplier performance will be measured and reported with an AMG provided supplier scorecard. This scorecard will include a Total Performance Score comprised of the following five Key Performance Indicators (KPI):

- On-time Delivery (%)
- Defect Rate (Parts Per Million - PPM)
- Disruptions
- Invoice Accuracy

9.1.1 On-time Delivery: This measurement is the percentage of planned deliveries of direct materials to the appropriate AMG delivery dock that are delivered on-time (as defined by AMGs Materials Department).

9.1.2 Defect Rate: Parts Per Million (PPM) is a measure of the supplier's actual non-conforming material rate as a ratio applied to a million parts. PPM is calculated using the following formula:

(Total Nonconforming Quantity / Total Receipt Quantity) X 1 million = PPM

9.1.3 Disruptions: The Disruption score measures the number of distinct production disruption events that occurred at AMG that were the result of non-conforming parts and missed/late deliveries.

9.1.4 Invoice Accuracy: This measurement evaluates the accuracy of the invoices that are able to be entered by AM General Accounts Receivable that do not require additional processing due to missing or incorrect information on the invoice.

9.1.5 Total Performance Score: This measurement uses a weighted average of the four individual KPI's to produce a single score.

9.2 Supplier Performance Classifications: For the Supplier Total Performance Score and the four individual KPIs, there are classification categories based off of the results of the

scorecards. Suppliers will be given a rating from one of the following four classifications and these classifications will assist with AM General in the monitoring and sourcing of suppliers.

- **Premier:** Supplier meets all expectations and should be looked upon as being a better choice for new business.
- **Preferred:** Supplier generally meets expectations and should be looked at as being acceptable for new business.
- **Satisfactory:** Supplier meets some, but not all expectations and will need to have a credible improvement plan in place before being considered for new business.
- **Poor:** Supplier does not meet expectations and, unless the supplier implements a credible action plan, the supplier should be looked at as a candidate for exit, resourcing, or a new business hold.

10.0 Supplier Performance Requirements:

10.1 Consequences of a Below 'Satisfactory' Classification:

Suppliers not meeting at least a 'Satisfactory' classification in all Scorecard performance monitoring categories will be required to submit remedial action plans in order to return the required performance to a Satisfactory status and may be issued a Corrective Action per section 11.4.

A credible remedial action plan should, at a minimum, include a detailed plan to return the supplier to 'Satisfactory' status in all areas and the timing for the completion of the plan.

Failure to comply with these requirements may lead to one or all of the following:

- Termination of any applicable Order for default
- New Business Hold

10.2 Consequences of 'Poor' Classification:

A supplier that receives a 'Poor' classification in one or more Scorecard monitoring catagories may, in AMGs sole discretion, be classified as being in breach of such supplier's obligations under the Order and AMG may terminate the Order for default.

11.0 Nonconforming Product:

11.1 Nonconforming Product Definition: Product (i) known, or suspected, to not meet design record specification and requirements, (ii) that fails to conform to fit, form, or function design record specifications and requirements,(iii) that is derived in any way from non-approved sources (including from sub-tier suppliers not approved in writing by AMG), (iv) that is counterfeit; or (v) does not meet the other requirements of the Order, in each case, shall be classified as nonconforming product.

11.2 Counterfeit Electronic Part Definition: The U.S. Department of Defense (DOD) definition for a Counterfeit Electronic Part is as follows: An unlawful or unauthorized reproduction, substitution, or alteration that has been knowingly mismarked, misidentified, or otherwise misrepresented to be an authentic, unmodified electronic

part from the original manufacturer, or a source with the express written authority of the original manufacturer or current design activity, including an authorized aftermarket manufacturer. Unlawful or unauthorized substitution includes used electronic parts represented as new, or the false identification of grade, serial number, lot number, date code, or performance characteristics.

11.3 Customer Notification: Suppliers must notify AMG Materials Planning and Supplier Quality functions when there is a potential quality disruption to AMGs facilities. If the material may have been shipped, the supplier must immediately initiate a Quality Alert to the AMG Supplier Quality Engineer and initiate appropriate containment actions.

11.4 Corrective Action Request ("CAR") Issuance:

11.4.1 Supplier Performance Notification: AMG may issue CARs for the receipt of non-conforming, mis-identified and or damaged product caused by the supplier and for other performance discrepancies that lead to disruptions or are related to Customer Satisfaction. However, CARs will not be issued in those instances where suppliers notified AMG in advance of non-conforming material reaching any portion of the AMG assembly process where enough conforming material is found available to not cause disruption. A failure by AMG to issue a CAR is not a waiver of any right or remedy by AMG.

11.4.2 Problem Identification: CARs will include the following information:

- CAR Number
- Issue Date
- Vendor Number
- Originator
- Part Number
- Part Description
- Quantity
- Problem Definition (Sort requirement will be indicated as needed.)

11.4.3 Return Material Authorization: AMG may notify the supplier of known and suspect nonconforming material and, if AMG notifies the supplier, AMG will request a Return Material Authorization (RMA). The supplier will have 48 hours to provide an RMA after receiving a written request to avoid potential scrapping of material by plant or return at supplier cost.

11.5 Supplier Response Requirements:

11.5.1 Supplier Initial Response: With every request for material sort and certification, the supplier must consider and analyze the entire delivery chain to identify all locations where suspect material may be located (e.g. Customer, Supplier, Sub-Tier, AFTC, In-Transit). The supplier (or through third-party sort resource) must provide written response within one business day which summarizes activities, findings, and quantifies how many parts were contained, sorted, reworked, and confirmed as either conforming or non-conforming. The supplier's response must include, but is not limited to the following:

- **Containment at Customer Site:** The supplier must affect the immediate containment, sorting, and reworking of parts at the affected AMG receiving sites. The supplier's "reaction plan" response representatives may be requested to be on site within two (2) hours of notification to minimize impact to downtime or spill size. This may be accomplished in one of the two following ways:
  - Identify a Quality resource from your organization that can be on-site within two hours.
  - Secure the services of the AM General approved third-party sort resource, Sustained Quality. (http://www.sustained-quality.com/)

  Once supplier reaction plan has been confirmed, please provide chosen method and confirmation of primary and secondary contacts along with complete contact information to AMG Supplier Quality. AMG will only be using e-mail (manual or system generated) to inform your designated contacts of the need to sort and will no longer be attempting to communicate this information with repeated calling efforts. Sorts not responded to within a requested 2- hour requirement will immediately default to AMG internal standard sort charges.

- **Containment at supplier site:** Initiate immediate and ongoing containment actions to prevent further shipment of nonconforming material. Containment activities and results shall be documented and shall remain in place at the supplier's location until permanent corrective action has been implemented and proven effective. The supplier must provide ongoing internal containment data as partial supporting documentation for any associated CAR closure.

- **Product Status**: 100% identification of all product verified as conforming must be utilized. Marking method and location for containers and parts must be agreed to at the discretion of the CAR Issuing SQE (e.g. signage, paint dot, mark, stamp, etc.). The chosen identification method will also be implemented at the supplier's site.

- **Certified Material:** The supplier must identify the date of the next shipment of conforming parts including how it will be identified. The conforming material ship date should apply to all customer locations including service.

Customer Satisfaction of Initial Response: Customer Satisfaction CARs may be issued for Initial Response not received within one business day.

11.5.2 Root Cause Anaylsis and Corrective Action: The supplier must submit the Final CAR response in a 3x5 Why 8D format within a due date required by SQE and potentially soon as 14 days. CAR's issued with no priority final response due date and not having a repeat occurance are to be closed within 120 days. The supplier is permitted to use an alternative CAR 3x5 WHY 8D format. The CAR, utilizing any 3x5 WHY 8D format response, must include:

- Containment Response actions taken and summary of findings;

- Contact/Team information for those assigned action responsibility;
- Problem Description Clarified, Background information (indicate sub-tier supplier responsibility, if applicable);
- Interim/Short Term Corrective Action;
- 3X5 WHY Root Cause (Why made? Why shipped? What caused the system failure?) including root-cause verification. (Turn it on, turn it off);
- Corrective and Preventive Action Plans/Timing;
- Implemented Corrective and Preventive Actions taken, with verification of effectiveness;
- Systemic Read across to other like parts and processes; and
- Provide supporting documentation to include updates to key control documents, verification data, training verification, etc.

11.5.3 Customer Satisfaction of Final Response: Customer Satisfaction CARs may be issued for Final Response not received within in suitable time as determined by SQE. Final Response time extension may be obtained with prior notification and agreement by the reviewing SQE.

11.6 Controlled Shipping Entry. Controlled Shipping is applied by AMG when a supplier's specific value add process and/or Quality Operating System has proven to be consistently ineffective in delivering quality product to AMG. Suppliers are notified of entry into controlled shipping through direct e-mail letter outlining start date and exit requirements.

11.6.1 Controlled Shipping includes:

- Redundant inspection processes located downstream after failed process.
- Data gathered at redundant inspection for feedback upstream to failed process and to Customer as required.
- Corrective Actions taken to bring redundant inspection results to Zero Defects.

11.6.2 Levels:

Controlled Shipping Level 1: Includes redundant inspection processes, data gathered at redundant inspection, and resultant corrective action. Supplier employees who are outside of the normal failed process are specially trained to conduct the redundant inspection and data gathering process at supplier's location.

Controlled Shipping Level 2: Includes the same process as Level 1 with an added layer of third party inspection representing AMGs interest. The third party is to be: Paid by the supplier, selected by the supplier or AMG, and agreed by AMG if selected by supplier. In special cases, the Level 2 inspection may be required to be performed outside the supplier's facilities at a facility deemed appropriate by AMG.

11.6.3 Exiting Controlled Shipping: The supplier may exit Controlled Shipping by meeting the following criteria:

- The AMG SQE provides on site approval of supplier corrective action that is supported by point of cause/escape/systemic verification as identified in 11.5.2, and accompanied by Controlled Shipping data achieving zero defects over a duration agreed to by the AMG SQE.
- The AMG SQE provides approval of re-PPAP Submission or validation to complete design record specification and requirements.

11.7 Cost Recovery Process: AMG recovers costs for supplier-caused waste resulting from the receipt of non-conforming materials and late deliveries. Accordingly, upon the issuance of a CAR, the supplier will be liable to AMG for the below amounts (as applicable). Notwithstanding the amounts set forth below, supplier will be responsible for all costs imposed on AMG pursuant to a Customer and/or Government mandated CAR.

11.7.1 Defective Material Processing Cost Recovery Flat Rate: Defective materials (DMR) processing waste are those costs incurred by AMG pursuant to the verification process for confirming supplier was the cause of the non-conformance and CAR issuance. This process typically includes: lineside investigation, specification retrieval and review, lab analysis, photographic documentation, system defect entry, material handling, issuance of corrective action, and ongoing communication with supplier. Flat rate defective material processing cost recovery will be standardized and applied consistently.

Defective material processing costs are independent of any costs related to in-plant containment, sort, re-work labor, downtime costs, or field warranty related costs that would be recovered using Cost Recovery Form 1AF0001.

11.7.2 In-plant Cost Recovery: Requests may include adequate supporting documentation, as summarized on Cost Recovery Request Form 1AF0001, as well as supporting departmental raw data regarding the issue. Typically, labor hours, downtime, number of vehicles, or units impacted, investigation costs, travel expenses and various administrative costs may be used to calculate the amount of cost recovery.

11.7.3 Field or Warranty Cost Recovery: Requests may include adequate supporting documentation, as summarized on Cost Recovery Request Form 1AF0001, as well as supporting raw data regarding the issue. Typically, part cost, service mark-up, standard labor hours, investigative costs, travel expenses and various administrative costs may be used, along with the total number of claims, to calculate the amount of cost recovery.

11.7.4 Cost Recovery Appeal Process: The supplier may appeal a Cost Recovery request as follows:
- Appeal should be directed at the AMG Supply Chain Management (SCM) Manager, and copied to the AMG Supplier Quality Manager.
- The supplier shall initiate any appeal within 14 calendar days of the Cost Recovery request by contacting the SCM Manager.
  All appeals should strive for resolution within the month the Cost Recovery was incurred.

SUPPLEMENT 1 TO AM GENERAL SUPPLIER QUALITY MANUAL
PPAP REQUIREMENTS

1. General PPAP Requirements and guidelines:

1.1. The general guidelines for Production Part Approval Process will be the AIAG PPAP Manual, Fourth Edition (March 2006) or latest (IE. AIAG PPAP Manual).

1.2. PPAP forms and the AM General PPAP Workbook will be available on the AM General Homepage at http://www.amgeneral.com/our-suppliers/military-programs-resources/.

1.3. All parts shall achieve Interim or Full PPAP Approval to the requirements specified herein. Note, that AM General is not authorized to waive or modify any PPAP requirement without Government approval for the JLTV Program.

1.4. PPAP process requirements and definitions are set forth in Section 2 of the AIAG PPAP manual.

1.5. PPAP FOR COMPONENTS WITH CFAT REQUIREMENTS:

1.5.1. For components with Component First Article Testing (CFAT) Requirements specified on the component drawing, all PPAP requirements apply. In addition, AM General will require additional Government PPAP approval authority prior to issuance of PPAP Approval.

1.5.2. CFAT requirements are noted on the part prints and all requirements must be tested and met prior to PPAP approval.

1.5.3. Supplier must notify AM General 30 days in advance of conducting a CFAT to allow proper scheduling for onsite viewing by AMG and Government representatives.

1.5.4. NUMBER OF COMPONENTS REQUIRED: The Supplier shall perform CFAT testing on a minimum of two component units. All testing shall be performed on the two component units. If a test results in degradation or damage to a test component while successfully completing a specified CFAT test (i.e. reduced life, performance, destructive testing, etc.) and additional CFAT tests are required, additional component units shall be tested to complete all specified CFAT tests with a minimum of two component samples for each test.

1.5.4.1. New electrical components (not included in JLTV FoV TDP and CSP Package baseline) with water resistance/protection requirement(s) shall require four (4) CFAT components

1.5.5. COMPONENT FIRST ARTICLE TEST FAILURE: If a component fails the specified CFAT requirements, the Supplier shall notify AMG within 24 hours of the failure. Upon CFAT failure, supplier must immediately establish containment, and investigate root cause. Within 7 days, supplier must also implement corrective action, repeat the CFAT with the revised component or

test criteria (if applicable), and achieve customer approval prior to incorporation of parts onto the assembly line (vehicles, trailers, and kits). Root cause and corrective action activities shall meet the requirements of section 11.

1.5.6. MANUFACTURE: The Component First Article units offered for test(s) shall be manufactured at the facilities in which that item(s) is to be produced and shall be manufactured using the final production process and production released tooling. The Supplier shall certify to this requirement within the applicable PPAP document. In the event CFAT reveals deviations from contract requirements, the Supplier shall, at the location designated by AM General / Government, make the required changes to the items, or replace all the items manufactured within 3 months of failure.

1.5.7. CFAT SAMPLES: The CFAT samples shall be taken from within the first 10 component units produced unless otherwise approved by AM General / Government. If the first 10 component units are not available, AM General / the Government reserves the right to select the CFAT quantity from any lot.

1.5.8. SUBCOMPONENT FIRST ARTICLE CONDITIONS: Subcomponent FAT requirements may be met during the performance of the FAT of a higher assembly, only if the required characteristics can be tested. If any characteristic of the subcomponent is not or cannot be tested during the higher assembly testing (as determined solely by AM General or the Government), the subcomponent shall be tested separately. If tested separately, all conditions listed above shall apply to the subcomponent first article test.

1.5.9. ELECTRICAL COMPONENTS/DEVICES (NOT INCLUDING WIRING/HARNESS) WITH WATER RESISTANCE/PROTECTION REQUIREMENT(S): For all new electrical components (not included in JLTV FoV TDP and CSP Package baseline) that have any water resistance/protection requirement, the supplier shall propose a CFAT test sequence (and order) that includes the following:

1	Initial performance/functional test
2	Durability • Vibration • Shock • Handling drop
3	Electrical

4	Environmental • Storage temperatures • Powered temperature cycles - preconditioning • Powered salt spray • Powered humidity • IP66* • IP67* or IP68* • Powered temperature cycle – lifecycle/extended *Note: for these items, contact SQE for specific (as required) testing criteria.
5	Final performance/functional test
6	Destructive disassembly

For this test sequence the total number of CFAT parts shall increase to four (4). AM General and the Government will assess the Supplier proposed CFAT sequence and tests. The Supplier to determine applicability and tailor the testing as appropriate. Deviations to the proposed sequence and tests shall require AM General / Government approval.

1.6. Upon approval of a PPAP submission, AM General will provide written approval of the PPAP package using the AM General Part Submission Warrant (PSW) found within the PPAP Workbook.

1.7. Written PPAP approval from AM General is required prior to the supplier shipping any production products to AM General production or aftermarket part facilities unless authorized by AMG Supplier Quality.

1.8. Interim PPAP approvals may be granted to authorize a supplier permission to ship for a limited period, or a in a limited quantity. Interim approvals require action plans in place to meet full production PPAP approval and must be agreed to by AMG Supplier Quality.

1.8.1. Supplier must submit both a PSW and an Interim Recovery Worksheet for materials in need of Interim approval.

1.8.2. Interim approval will only be granted up to an expiration date or a maximum quantity of parts or material. Interim approval will expire upon the occurrence of the specified expiration date or the shipment of the specified maximum quantity. Supplier must closely track Interim approval expiration and must cease shipment of interim product pending full PPAP approval.

1.8.3. For product supplied on JLTV production units, Interim approval will only be granted for a period of time not to exceed 120 days.

1.9. PPAP submissions must be submitted per the direction of the AMG SQE via the AMG IntellaQuest Portal, e-mail sent to submission.data@amgeneral.com, or hardcopy.

2. **PPAP Submission Levels:** Refer to AMG PPAP Workbook Submission Requirements Page 0b.

3. **PPAP Submission Content:**

3.1. PPAP submission content shall be defined in accordance with the AIAG PPAP manual, Section 2, PPAP Process Requirements.

3.2. PPAP submission content shall be provided using the AM General PPAP workbook, or supplier equivalent PPAP forms. Supplier forms must be reviewed and approved by AMG Supplier Quality prior to submission. This is to ensure that AMG can perform a clear, thorough, and efficient review of the PPAP content.

3.3. PPAP content requirements shall be adhered to in accordance with AIAG PPAP Manual, Fourth Edition. Further clarification of some requirements as well as some definitions are provided below.

3.3.1. Design Record, Print, Specification (Reference AIAG PPAP Manual 2.2.1)

3.3.1.1. All notes, dimensional features, and callouts shall be numerically identified on a ballooned print and accounted for within dimensional, material and performance test results and submitted with each PPAP.

3.3.2. Authorized Engineering Change Documents (Reference AIAG PPAP Manual 2.2.2)

3.3.2.1. If authorized by a Government-approved Request for Deviation (RFD), the Government approved redlined drawing shall accompany the PPAP submittal.

3.3.3. Customer Engineering Approval (Reference AIAG PPAP Manual 2.2.3)

3.3.3.1. Only fully released and approved drawings shall be utilized for PPAP unless a Government approved RFV is in place.

3.3.4. Design Failure Mode and Effects Analysis (Design FMEA) (Reference AIAG PPAP Manual 2.2.4)

3.3.4.1. DFMEA is required at the component level for all parts where the manufacturer is design responsible. This includes product built by the Contractor at the Contractor's facilities.

3.3.5. Process Flow Diagram(s) (Reference AIAG PPAP Manual 2.2.5)

3.3.5.1. Process Flow Diagrams are required for all PPAP submittals

3.3.6. Process Failure Mode and Effects Analysis (Process FMEA) (Reference AIAG PPAP Manual 2.2.6)

3.3.6.1. All notes, dimensional features, and callouts shall be accounted for within the FMEA. The FMEA shall match process and operation steps with the flow diagram and control plan.

3.3.6.2. Suppliers shall create Process Failure Modes and Effects Analyses (PFMEA) for all processes (manufacturing and assembly) that they perform.

3.3.6.3. JLTV Special Characteristics Definitions and Requirements

3.3.6.3.1. Reference Supplement 7 for the JLTV Special Characteristics Definitions and Requirements

3.3.7. Control Plan (Reference AIAG PPAP Manual 2.2.7)

3.3.7.1. All notes, dimensional features, and callouts numerically identified on the ballooned print shall be accounted for on the control plan. Control plan content including defined SPC performance requirements must be supported and agreed upon by the approving SQE.

3.3.7.2. Special Characteristics identified on the PFMEA shall be incorporated into all associated documents including Control Plans.

3.3.7.3. A list of all error proofing techniques shall be compiled by the supplier and included with the control plan. Error proofing verification or effectiveness monitoring shall be included in the preventive maintenance plans, schedules, and records.

3.3.8. Measurement System Analysis and Calibration (Reference AIAG PPAP Manual 2.2.8)

3.3.8.1. Supplier shall conduct and have applicable MSA studies for all new or modified gages, measurement and test equipment included in the Control Plan.

3.3.8.2. Devices used within control plans should also have appropriate MSA studies completed.

3.3.8.3. Reference AIAG MSA Book as suggested in Section 7.1 for additional guidance.

3.3.8.4. Reference AMG PPAP Workbook requirements for AMG MSA requirements.

3.3.9. Dimensional Results (Reference AIAG PPAP Manual 2.2.9)

3.3.9.1. 100%-dimensional inspection is required for a minimum of six (6) parts for each PPAP submittal, including subcomponents if the part or assembly is purchased at a higher level than the lowest level defined in the JLTV Technical Data Package and Computer Software Package. If less than three parts are ordered, all parts shall be subject to 100%-dimensional inspection. For parts produced from more than one cavity, mold, tool, die, pattern or production process, the supplier shall provide a group sample dimensional evaluation from each.

3.3.9.2. Additional requirements shall be in accordance with PPAP Manual (Fourth Edition) Appendix H.

3.3.9.3. Dimensional inspection shall include evidence of conformance to all dimensions (to include basic dimensions), tolerances, and Geometric Dimensioning and Tolerancing (GD&T) requirements found on the applicable component drawing.

3.3.9.4. If the product drawing relies upon the 3D CAD model to fully define the part, the PPAP shall include evidence that all measured samples conform to the geometry and associated GD&T requirements defined by the 3D CAD model.

3.3.10. Records of Material / Performance Test Results (Reference AIAG PPAP Manual 2.2.10)

3.3.10.1. Material Test Results shall be performed for all parts and product materials where chemical, physical or metallurgical requirements are specified by the design record or Control plan.

3.3.10.1.1. Armor materials: reference Supplement 5 to AM General Supplier Quality Manual for detailed requirements.

3.3.10.2. Performance Test Results shall be performed when performance or functional requirements are specified by the design record or Control Plan.

3.3.10.2.1. Weld performance: The supplier shall provide documented evidence of weld validation in accordance with the welding standards called out in the design record, or through AMG approved general welding guidelines. For additional welding requirements, refer to Supplement 3 of the AM General Supplier Quality Manual.

3.3.10.2.2. Functional Performance: The supplier shall provide documented evidence of performance to functional requirements stated on the design record.

3.3.10.2.3. Paint Performance: The supplier shall provide documented evidence that coatings/paints/other finishes conform to the requirements of the design record. For additional requirements which may apply, refer to Supplement 4 of the AM General Supplier Quality Manual.

3.3.10.3. Compliance to the following is required to be documented, as applicable:

3.3.10.3.1. Raw Material Certification

3.3.10.3.2. Performance Test Reports which identify that all specified performance requirements on the Design Record have been demonstrated

3.3.10.3.3. Surface Finish Requirements

3.3.10.3.4. Marking/Labeling Requirements

3.3.10.3.5. Welding documentation necessary to demonstrate conformance to specified weld requirements. (Welding Procedures Specifications, Welder Certifications, Weld Procedure Qualification Requirements, etc.)

3.3.10.4. Compliance information for any other material or material processes (e.g., heat treatment) or performance test requirement specified in the Design Record but not included in the list in section 3.3.10.3.5 shall be included.

3.3.11. Initial Process Studies (Reference AIAG PPAP Manual 2.2.11)

3.3.11.1. Process capability studies shall be required for all special characteristics identified in the design record and shall be determined to be acceptable prior to submission to AMG.

3.3.11.2. Where no special characteristics have been identified on the design record, AMG reserves the right to require demonstration of capability on other characteristics based off identified risk.

3.3.11.3. Capability studies will be performed on a sample size to be determined with your AMG SQE.

3.3.11.4. Requirements for process capability indices:

3.3.11.4.1. Critical Safety Characteristics <SC> or (CSI) shall maintain a Cpk index equal to or greater than 1.67 and inspection results be supplied to the SQE for each lot/shipment of material.

3.3.11.4.2. Major characteristics will be agreed to with AMG and shall maintain a Cpk index equal to or greater than 1.33.

3.3.11.4.3. All other Fit/Function or Minor characteristics must maintain a Cpk of 1.0 or greater.

3.3.11.4.4. QAP or other design record requirements may override these general process capability requirements.

3.3.11.5. Upon PPAP or sample submission approval by AMG, supplier is not to modify requirements or processes without a full re-submittal of samples and submission data for approval.

3.3.11.6. The requirements for significant production runs (PPAP Manual 2.1) and Quality Indices (PPAP Manual 2.2.11.2) shall be in accordance with PPAP Manual (Fourth Edition) Appendix H.

3.3.11.7. Any HMMWV part having special characteristics, including but not limited to <SC> Safety Critical; <FF> Fit/Function; (CSI) Critical Safety Item; [R] Regulated, Major or Minor Characteristics, must have the following submitted with the submission: Process Flow, PFMEA, Control Plan.

Reference Supplement 7 for JLTV specific Special Characteristic Marking and process capability requirements.

3.3.12. Qualified Laboratory Documentation (Reference AIAG PPAP Manual 2.2.12)

3.3.12.1. No additional guidance is required.

3.3.13. Appearance Approval Report (AAR) (Reference AIAG PPAP Manual 2.2.13)

3.3.13.1. Required when appearance requirements are specified in the Design Record.

3.3.14. Sample Production Parts (Reference AIAG PPAP Manual 2.2.14)

3.3.14.1. PPAP must be performed on production parts.

3.3.15. Master Sample (Reference AIAG PPAP Manual 2.2.15)

3.3.15.1. As part of a PPAP submission, AMG may request PPAP Samples. These samples will be sent to the attention of the appropriate SQE and marked as PPAP Samples per the labeling provided in the PPAP Workbook. The standard sample request is 6 pieces unless otherwise agreed to by AMG. The sample request may be waived, in AMGs discretion, due to size or other considerations.

3.3.15.2. Supplier must include a photo of conforming parts with the PPAP submission.

3.3.15.3. Paint / Coating / Welding, or other samples from PPAP testing may also be requested as part of a PPAP submission, contact the appropriate SQE for guidance and requirements.

3.3.16. Checking Aids (Reference AIAG PPAP Manual 2.2.16)

3.3.16.1. Required when aids are utilized to determine conformance with specified requirements.

3.3.17. Customer Specific Requirements (CSR) Reference AIAG PPAP Manual 2.2.16)

3.3.17.1. It is the responsibility of the supplier to contact AMG to understand whether there are any Customer Specific Requirements in addition to the design record which may be applicable for a PPAP submission.

3.3.17.2. AMG reserves the right, based off part/process risk to require other specific requirements which may not be listed either in this Supplement, or the AIAG PPAP Manual.

3.3.17.3. Supplier shall have records of compliance to all Customer Specific Requirements.

3.3.17.4. Sampling: for some parts, sampling may be required per the design record. Examples of acceptable sampling plans include MIL-STD-1916, “DoD Preferred Methods for Acceptance of Product”, or ANSI/ASQ Z1.4, “Sampling Procedures and Tables for Inspection by Attributes”. Verify with AMG Supplier Quality as to whether Sampling is required as a CSR.

3.3.17.5. Reference the additional AM General Supplier Quality Manual supplements provided to ensure compliance.

3.3.17.6. When a Component First Article Test (CFAT) is required, Documentation shall be included. CFAT Documentation shall include a matrix summary of the results of each test performed, test procedures and test equipment utilized, detailed results of each test (to include raw data), and any applicable calibration or certification documentation. Labs certified to ISO 17025 are exempt from the requirement to furnish calibration information. Supplier certification cannot be used to fulfill CFAT requirements unless otherwise specified.

3.3.18. Part Submission Warrant (Reference AIAG PPAP Manual 2.2.18)

3.3.18.1. Supplier shall complete a Part Submission Warrant for each customer part number unless otherwise agreed to by AMG Supplier Quality.

3.3.18.2. Components from varying molds, dies, etc.… shall be identified appropriately on the PSW, or in a separate attachment.

3.3.18.3. The supplier's submission of a Part Submission Warrant will be the supplier's representation and warranty to AMG that the part meets all required specifications, quality requirements, and warranties required by AMG in this Supplier Quality Requirements manual and in the Order.

4. Commercial Off The Shelf (COTS) Components

4.1. Commercial off the Shelf (COTS) Components are items sold in the commercial marketplace. These parts are commercially available, unaltered, and may be procured through distributors. The contractor shall always request the production process documentation prior to receiving the PPAP submittal from vendor. At times the contractor may be unable to attain the data for all 18 elements specified above to include within the PPAP package for COTS components. In these cases, the supplier shall provide the minimum PPAP elements (1, 2, 3, 9, 14, 15, 17, and 18). The sub tier supplier is expected to demonstrate / affirm conformance with supporting PPAP documents or Certificates of Conformance (C of C). In cases when the sub tier supplier does not have the remaining PPAP elements, a C of C shall be attained. The C of C letter shall; affirm the article is commercially available, be on the supplier's company letterhead, include the part number, include the part revision level, be signed by a representative within the contractor's organization that has decision making authority. The C of C letter shall positively affirm that the part meets the requirements within the print.

4.1.1. "COTS Plus": Parts that are commercially available, but have additional performance requirements, or parts that are deemed important to the JLTV system design (because of the part's application). If the suppliers catalog page does not include all print specifications, the contractor is responsible to complete the remaining testing.

5. Interim and Full PPAP Approval (Reference AIAG PPAP Manual 5.2)

5.1. Interim Approval for parts without CFAT requirements, granted by the Contractor to its supplier, shall be given prior to introduction of parts at the point of assembly or fabrication into the end item once the PPAP has achieved all the requirements identified for Interim Approval as outlined in Section 5.3. Full PPAP approval is required no later than 120 days after interim approval is issued.

5.2. Interim Approval for parts with CFAT requirements for which the Government is the final approval authority, must be received from AMG / Government prior to the introduction of parts at the point of assembly or fabrication into the end item. Full PPAP approval from the AMG / Government is required no later than 120 days after the interim approval.

5.3. The following table depicts the minimum required elements necessary for Interim and Full PPAP Approval:

Element	Description	Interim Level 3	Full Level 3	COTS
1	Design Record	X	X	X
2	Authorized Engineering Change Documents	X	X	X
3	Customer Engineering Approval (if required)	X	X	X
4	Design Failure Mode and Effects Analysis (Design FMEA)		X	
5	Process Flow Diagram(s)		X	
6	Process Failure Mode and Effects Analysis (Process FMEA)		X	
7	Control Plan		X	
8	Measurement Systems Analysis (MSA) Studies		X	
9	Dimensional Results	X	X	X
10	Records of Material / Performance Test Results	X	X	
11	Initial Process Studies		X	
12	Qualified Laboratory Documentation	X	X	
13	Appearance Approval Report (AAR)		X	
14	Sample Production Parts	X	X	X
15	Master Sample (Actual or Picture)	X	X	X
16	Checking Aids	X	X	
17	Customer Specific Requirements, i.e., Component First Article Test (CFAT) Results.		X	X
18	Part Submission Warrant	X	X	X

SUPPLEMENT 2 TO AM GENERAL SUPPLIER QUALITY MANUAL FASTENER REQUIREMENTS

1.0 Scope: This Supplement establishes Supplier Quality requirements for all threaded steel fasteners of Grade 5 and higher (as defined by SAE-J429) and metric fasteners with strength designations of 8.8 and higher (as defined by SAE-J1199).

1.1 **Quality Management System (QMS)**: Suppliers subject to this supplement shall document, implement and maintain a fastener QMS which:

1.1.1 **Homogeneity:** Assures the homogeneity of fastener lots. A homogeneous fastener lot is defined as a quantity of parts produced from the same heat of steel, using the same production process, and where applicable, heat treated and plated/coated at the same time.

1.1.2 **Manufacturing Symbol:** Assures that individual fasteners are identified by a fastener manufacturer symbol (logo). The manufacturer's symbol (logo) shall be listed in MIL-HDBK 57.

1.1.3 **Changes:** Changes described in paragraph 2.10 of the AM General Supplier Quality Manual main document must be reviewed, approved and authorized in writing by AMG through Purchase Order Change (POC). Consumable tooling used to manufacture fasteners is exempt from additional sample submissions.

1.2 **Supplier inspection:** Sampling plans per paragraph 3.3.7.4 of Supplement 1 PPAP Requirements may be used to support supplier inspection processes. In addition to these standards, fastener suppliers may use ASTM F1470 or ASME B18.18.

1.2.1 Fastener dimensions shall be inspected to assure conformity to requirements.

1.2.2 Plating/coating (when specified) shall be inspected to assure complete coverage.

1.2.3 The grade and manufacturer symbol (logo) for each bolt in the lot sample shall be the same.

1.3 **Qualified laboratory documentation:** Inspections shall be performed by a qualified laboratory (an accredited laboratory or one whose QMS complies with an industry recognized standard such as ISO 17025.

SUPPLEMENT 3 TO AM GENERAL SUPPLIER QUALITY MANUAL
WELD REQUIREMENTS

1.0 Weld Processes, Classes and Types of Welds: ALL Weld Processes (e.g., SMAW, GMAW, GTAW), Classes (Class 1, 2 and 3) and TYPES (e.g., Fillet, groove) of welds shall be submitted to AMG Supplier Quality for review. The supplier remains responsible for compliance and ensuring weld procedure specification (WPS) / procedure qualification records (PQRs) are compliant with applicable American Welding Society (AWS) welding standards. Submittal is required as follows:

- PRIOR to production, at time of sample submission.
- When drawing revisions occur that affect welding requirements.
- When welding procedure revisions occur.
- When during AMG Supplier Technical Visits, Source Audits, or at any time when weld quality issues are identified by AMG, the suspect welding procedure(s) or welder(s)/welding operator(s) shall be submitted for review.

1.1 Weld Standards:

- Welds shall be free from defects indicative of poor workmanship. All welding shall be in accordance with the following documents listed in Table 1. The edition (year) to be used shall be the year in effect at time of solicitation release date. If new materials are to be used that do not follow the guidelines in the applicable standard in Table 1, then the Supplier is responsible to demonstrate the correct standard to AM General for engineering approval.

Table 1	
STRUCTURAL WELDING STANDARDS	
Structural Steel, Fusion Welding	American Welding Society (AWS) D1.1/D1.1M
Structural Aluminum, Fusion Welding and Friction Stir Welding	American Welding Society (AWS) D1.2/D1.2M
Structural Sheet Metal, Fusion Welding	American Welding Society (AWS) D1.3/D1.3M
Stainless Steel, Fusion Welding	American Welding Society (AWS) D1.6/D1.6M
Titanium, Fusion Welding	American Welding Society (AWS) D1.9/D1.9M
AUTOMOTIVE WELDING STANDARDS	
Steel, Resistance Spot Welding	American Welding Society (AWS) D8.1M
Steel, Arc Welding	American Welding Society (AWS D8.8M
Steel, Laser Beam Welding	American Welding Society (AWS) D8.10M
Aluminum, Arc Welding	American Welding Society (AWS D8.14M
Steel, Resistance Spot Welding	American Welding Society (AWS) D8.1M
ROBOTIC WELDING STANDARDS	
Specification for Robotic Arc Welding Safety	American Welding Society (AWS) D16.1M/D16.1
Guide for Components of Robotic Arc Welding Installations	American Welding Society (AWS) D16.2M/D16.2
Risk Assessment Guide for Robotic Arc Welding	American Welding Society (AWS) D16.3M/D16.3
Specification for the Qualification of Robotic Arc Welding Personnel	American Welding Society (AWS) D16.4M/D16.4

Robotic Arc Welding Personnel, Certification	American Welding Society (AWS) QC19
WELDING STANDARDS FOR OTHER APPLICATIONS	
Specification for Welding Procedure and Performance Qualification	American Welding Society (AWS) B2.1/B2.1M
Sheet Metal Welding Code	American Welding Society (AWS) D9.1/D9.1M
Specification for Welding Earthmoving, Construction, Agricultural, and Ground-Based Material Handling Equipment	American Welding Society (AWS) D14.3/D14.3M
Specification for Fusion Welding for Aerospace Applications	American Welding Society (AWS) D17.1/D17.1M
Specification for Resistance Welding for Aerospace Applications	American Welding Society (AWS) D17.2/D17.2M
Specification for Friction Stir Welding of Aluminum Alloys for Aerospace Applications	American Welding Society (AWS) D17.3/D17.3M
Recommended Practices for Resistance Welding	American Welding Society (AWS) C1.1M/C1.1
Carbon and Low-Alloy Steels, Resistance Welding	American Welding Society (AWS) C1.4M/C1.4
Friction Welding of Metals	American Welding Society (AWS) C6.2/C6.2M
MILITARY WELDING STANDARDS	
Armor and High Strength Steel, Fusion Welding	JLTV MIL-STD-3040A Interim (Attachment 0182)
Armor Grade Aluminum, Fusion Welding	MIL-STD-3057
BOILER AND PRESSURE VESSEL CODE	
Section IX qualification standard for welding and brazing procedures, welders, braziers, and welding and brazing operators	ASME Section IX

2.0 Records: Following AMGs review/acknowledgement of the supplier's procedures, control plans and weld samples, all records shall be maintained and made available to AMG for review upon request. See paragraph 5.0 of the AM General Supplier Quality Manual main document for further requirements.

3.0 Arc Welding Process Submissions shall include:

3.1 **Cover Sheet:**

- Part drawing and revision number(s).
- Applicable AWS standard, latest revision in effect at the time of contract or later if specified.
- Date of weld sample submittal.
- Signature of the supplier's Certified Weld Inspector (CWI), Quality or other Authorized Representative showing submittal packet has been reviewed for completeness/accuracy and approved.
- A space for AMGs Supplier Quality representative's signature to indicate acknowledgement of the Welding Sample submission.

3.2 **Welding Procedures (PQR/WPS):** Equal to or Greater Than AWS D1.1 Annex N Form N-1. Ballistic welding shall be performed IAW MIL-STD-3040 for steel and MIL-STD-3057 for Aluminum

- **Alternate Welding Standards**: Subject to AM General written engineering approval, the Supplier may utilize alternate standards or codes supplier has demonstrated that equivalent or better quality and performance can be obtained by their use. It is the Supplier's responsibility to demonstrate such equivalence to AM General and the Government. If the Supplier does not release specific proprietary information, Am General and the Government reserve the right to conduct an on-site review of the Supplier, and Sub Supplier's quality system and weld processes to verify the capability of producing acceptable welds. AM General and the Government reserves the right to approve/disapprove the use of any and all such alternative weld standards and specifications. The demonstrated equivalent shall be verified prior to fabrication of any weldment under AM General and Governmental guidance.

3.3 **Shielding Gas:** Welding gas certificate of material in accordance with AWS A5.32.

3.4 **Weld Repair Procedure:** Weld repair shall only be allowed per the applicable weld procedure or as is otherwise specified on the drawing and only when a written procedure is approved by AM General for repairs.

3.5 **Control Plan:**

Production Control Plan per AIAG APQP and Control Plan manual including, as a minimum:

- Types of welds inspected.
- Frequency of visual inspection and cut/etch weld sampling.
- Control Plan shall directly reference documentation for welders qualified for the job.
- All welds found to be non-conforming **SHALL** be brought back into control and confirmed by cut and etch.

3.6 **Cut and Etch Samples:** Supplier shall cut and etch sample(s) of each type of weld on the part. It is recommended that suppliers be capable of preparing any required samples in-house. However, sample removal, sectioning, preparation and etching may be performed by a qualified outside source. The sample(s) shall exhibit the minimum acceptable weld quality per the applicable code and shall be prepared as follows:

3.6.1 **Sample Submittals:**

- A drawing of the part showing the removal location(s) for each sample (cut location drawing).
- Samples shall be removed from an actual production part. In cases where the cost of the part(s) is prohibitive, this requirement may be waived if prior approval is granted by AMG Supplier Quality.
- Identification of each sample shall be clearly identified in the supplied images.
- Each sample shall include a full cross-section of the welded joint.
- The weld cross-section shall be polished and etched with a suitable etchant so that the weld is clearly visible, showing sharp contrast between the parent metal and fusion depth.
- Suppliers shall use appropriate equipment for proper measuring, magnification and storage of cut and etch samples.
- Cut and etch photos shall include superimposed dimensional references to show conformance to minimum weld size.

- For retention of physical samples as required: Once prepared and etched, the sample shall be thoroughly dried and coated with a thin layer of clear lacquer or other suitable preservative that will both protect the etched cross-section and permit visual examination by AMG Supplier Quality.
- Physical Samples shall be retained and preserved for life of the contract plus 7 years

3.7 **Welder/Welding Operator Qualification Records:**

- Manual weld operations shall have the welding operators certified for all types of welding performed and required for the product. And shall maintain the certification for the duration of production.
- Certification of welding operators shall be attained by using an approved third party source for the specific type of weld being performed or in-house CWI.
- Records shall be provided with the PPAP submission and maintained at the source.
- Similar to AWS D1.1 Annex N Form N-4.
- Qualification records for welding operator changes after PPAP shall be kept on file at the supplier for review upon request of AM General.

4.0 Resistance Weld Process Submissions shall include:

4.1 **Cover sheet (same as Arc Process):**

- Part drawing and revision number(s).
- Applicable AWS standard, latest revision in effect at the time of contract or later if specified.
- Date of weld sample submittal.
- Signature of the supplier's Certified Weld Inspector (CWI), Quality or other Authorized Representative showing submittal packet has been reviewed for completeness/accuracy and approved.
- A space for AMGs Supplier Quality representative's signature to indicate acknowledgement of the Welding Sample submission.

4.2 **Resistance Weld Data Sheet:**

- Equal to or Greater than AWS C1.1M/C1.1:2000, fig. 34 pg. 99.

4.3 **Control Plan:**

- Production Control Plan per AIAG APQP and Control Plan manual including, as a minimum.
- Types of welds inspected.
- Frequency of visual inspection and destructive weld sampling.
- Control Plan shall directly reference documentation for welders qualified for the job.
- All welds found to be non-conforming SHALL be brought back into control and confirmed by destructive testing or other means of industry standard nondestructive testing (NDT) method.

4.4 **Sample Submittal:**

- A drawing of the part showing the removal location(s) for each sample (nugget tear-out location drawing).

- Samples shall be removed from an actual production part. In cases where the cost of the part(s) is prohibitive, this requirement may be waived if prior approval is granted by AMG Supplier Quality.
- Identification of each sample shall be clearly identified in the supplied images.
- Suppliers shall use appropriate equipment for proper measuring (nugget tear-out size or force testing equipment).
- Dimensional Report.
- When required, submittal photos shall include superimposed dimensional references to show conformance to minimum weld size.

4.5 **Dimensional Report:**

- For Spot Welding: Button/Nugget dimensional size report for all spot welds.
- For Projection Welding: Button/Nugget dimensional size report for all projection welds, and/or Force Test for all projection welds

5.0 Armor Steel Heat Affect Zone (HAZ) Hardness Test:

- When required, materials covered under MIL- DTL-46100, Armor Plate, Steel, Wrought, and High-Hardness (HH) or MIL-DTL-12560 Rolled Homogenous Armor (RHA) are utilized on the vehicle, the following requirements shall apply for this steel:
    - On any ballistic surface 5/8 inch (15.9mm) from the toe of the weld, at any location of weldment, the Brinell hardness shall not be lower than that permitted minimum hardness requirements if the materials are qualified under MIL-DTL-46100 or MIL-DTL-12560

6.0 Weld Equipment:

- The Supplier shall develop and maintain a welding equipment calibration program. This program shall consist of, at a minimum, an annual comparison checks of the machine output with instrumentation that has been certified and calibrated using standards traceable to the National Institute of Standards and Technology (NIST).

7.0 Weld Inspection and Validation:

- All Welding inspection and verifications must be done by a Qualified inspector who is trained to perform weld inspections in accordance with at least one of the following:

    a. Current certification in accordance with the American Welding Society (AWS), Certified Welding Inspector (CWI)

    b. Senior Certified Welding Inspector (SCWI),

    c. Current Certified Welding Inspectors Qualified by the Canadian Welding Bureau (CWB) to level II or to level III

8.0 Non-destructive Testing:

- All welds shall be visually inspected IAW the applicable weld standards. Armor steel(s) and quenched and tempered steel(s) shall be visually inspected after the welds have been completed and cooled to ambient temperature and after no less than a 48 hour hold period.

- **Non-destructive Critical Weld Joint:** The Supplier shall clearly identify in the product drawings, all critical joints required for Non-Destructive Testing (NDT) other than visual inspection.

- **Non-destructive Testing Frequency:** For all weldments that require a CFAT each weldment shall undergo a CFAT every 500 pieces from the last approved CFAT. This testing satisfies the NDT sampling plan required.

- **Non-destructive Inspectors:** When NDT is required, the inspectors shall be qualified IAW the current addition of American Society for Nondestructive Testing Recommended Practice No. SNT-TC-1A. Only individuals qualified for NDT LEVEL I and working under the NDT LEVEL II or individuals qualified for NDT LEVEL II may perform nondestructive testing except visual examination. The NDT personnel need not be an AWS CWI. The contractor shall make available all NDT personnel qualification records upon request by the Government.

- **Non-destructive Testing Criteria for Armor Material:** When NDT is required for armor the procedures and acceptance criteria shall be IAW Armor Welding MIL-STD-3040A Interim or MIL-STD-3057. Steel Armor materials MIL-DTL-46100, MIL-DTL-12560, or low alloy steels that are 1/8 inch (3mm) or thicker with a minimum specified yield strength greater than 100ksi (600MPa) shall be held for a minimum of 48 hours and inspected after welding is completed and has cooled to an ambient temperature.

- **Non-destructive Testing Acceptance Criteria for Non-armor and Structural Material:** When NDT is required for non-armor and structural material(s) the acceptance criteria shall be as stated in the applicable standard. Acceptance criteria differ based on the design loads. The Supplier shall state what joints are critical load bearing members and clearly identify these weldments for inspection purposes. In the case of critical structures, the acceptance criteria for cyclic loads will be as stated in AWS D1.1, and Class II structures for Aluminum welds IAW AWS D1.2.

SUPPLEMENT 4 TO AM GENERAL SUPPLIER QUALITY MANUAL GENERAL PAINT/COATINGS REQUIREMENTS

This requirement does not supersede the paint/coating requirements designated on drawings.

1.0 Coating Process Control Documentation: All paint/coating systems utilized shall have documented procedures detailing how the processes are controlled and verified to assure compliance to the drawing requirements of the parts or components. These procedures shall be made available to AMG or its customers when requested. When Chemical Agent Resistant Coatings ("CARC") are used, these procedures shall be submitted to AMG Supplier Quality for review and approval.

2.0 Contract Requirements:

Unless otherwise specified in the TDP drawings and specifications, all coating and coating qualifications shall be performed IAW drawing 12585018. In the event of a conflict between specifications, the component drawing shall take precedence.

2.1 Exclusion: On Type III systems, the use of vinyl wash primer (DOD-P15328) and MIL-C-8514 containing Hexavalent Chromium is prohibited when used on Stainless Steel Substrates.

2.2 Requirements and Exceptions:

2.2.1 MIL-DTL-81706 Type I or Type II Class 1A is allowed in lieu of MIL-DTL-5541. Applications, quality assurance, and coating requirements in MIL-DTL-81706 shall be IAW spec MIL-DTL-5541 Chemical Conversion Coatings on Aluminum and Aluminum Alloys.

2.2.2 The use of 5200 or 5700 Alodine is approved per TACOM letter concerning the "Qualification Limits for Alodine 5200/5700 Pretreatment Process" dated July 30, 2007.

2.2.2.1 Qualification Limits are as follows:

- The required coating weight for 5000 and 6000 series aluminum alloys is 5 to 59 mg per square foot. The low coating weight value only applies to those processes not employing a deoxidizer step. For processes employing a deoxidizer step, the minimum coating weight is 15 mg per square foot.
- The appearance of a powdery pretreatment (heavy coating) is acceptable provided the pretreatment product will be electrocoat primed per MIL-DTL-53084.

- A powdery pretreatment (heavy coating) is unacceptable if a solvent borne primer such as MIL-DTL-53022 or MIL-DTL-53030 is used.
- The coating weight test must be performed by x-ray spectrograph. Testing shall be performed for five consecutive days showing compliance to the requirements. After the five consecutive days of compliant tests, the frequency can be reduced to monthly.
    - The process must be monitored to assure that drag in of cleaning products into the Alodine product does not occur.

2.2.2.2 Primer shall be applied within 24 hours of pretreatment apply.

2.2.3 Anodize – Anodic coatings shall be IAW MIL-APRF-8625 anodic coatings for aluminum and aluminum alloys.

2.2.4 Stainless Steel Pretreatment: Stainless steel surfaces shall be pretreated using one of the following methods:

2.3.4.1 Mechanical Blasting IAW SSPC-10. Note: Mechanical blasting may not be suitable for thin sheet stainless steel.
2.3.4.2 Conversion Coatings: A non-hexavalent chromium substitute that meets the performance of DOD-P-15328 may be used.
2.3.4.3 Passivation to ASTM 380 or A967.

2.2.5 Powder Coat (Primer) Selection, Application and QC Requirements:

2.2.5.1 All cleaning and conversion coatings prior to powder coating of surfaces and quality inspection shall be IAW MIL-DTL-53072D and 12585018.
2.2.5.2 Cleaning and pretreatment shall be IAW TT-C-490 that addresses the substrate being used.
2.2.5.3 Powder coat primer shall be selected from the qualified products list or qualified products database for MIL-PRF-32348 or MIL-PRF-24712 Type I or meets the performance requirements of MIL-PRF-24712.

2.2.6 Electrocoat Primer ("E-Coat"): Shall be per IAW MIL-DTL-53084

2.2.6.1 Ferrous and zinc/zinc alloy coated surfaces shall be cleaned and pretreated with a Type I zinc phosphate coating per IAW Fed spec TT-C-490E plus any additional requirements from the cleaner/chemical QPL or QPD Supplier.
2.2.6.2 E-Coat application shall be done per IAW written instructions from the E-Coat QPL or QDP Supplier unless otherwise approved by TACOM.

2.2.6.3 All pre-production E-Coat test panels shall be scribed per ASTM D1654- 08, Section 5 and then undergo 1008 hours of salt spray per ASTM B117 for non-galvanized surfaces or 40 cycles of SAE J2334 or GMW14782 for galvanized surfaces.

2.2.6.4 Once samples are approved and production has begun, the finishing contractor shall, on a monthly basis, perform a corrosion audit by E-Coating two (2) test panels through the actual production line. The test panels shall then be tested as listed in 2.2.6.3.

2.2.6.5 After corrosion testing, all samples shall pass the requirements of:

2.2.6.5.1 ASTM D3359- 17: Standard Test Method for Rating Adhesion by Tape Test. Adhesion rating shall be a minimum of rating 4B per Fig. 1.

2.2.6.5.2 ASTM D610- 08: Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces. Rust Ratings shall be no lower than grade 9 per Table1.

2.2.6.5.3 ASTM D714-02: Standard Test Method for Evaluating Degree of Blistering of Paints. Blistering of paint, shall be no greater than Few, Blister size 4 Fig. 2 and no more than 5 blisters per 24 in square.

2.2.6.5.4 ASTM D1654-08: Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments. Creepage from the scribe shall be no greater than Rating 6 of Table 1. Evaluation of un-scribed area shall be no greater than rating number 9 of Table 2.

3.0 Government / AMG Approval: TT-C-490 Type I and V require TACOM or AMG approval of pre-treatment systems prior to coating production parts. Painting shall be IAW the Chemical Agent Resistant Coatings (“CARC”) Application Procedures and Quality Control Inspection specification MIL-DTL-53072D and 12585018 or later revision as it pertains to TT-C-490 Type I and V pre-treatment approvals. Suppliers shall use only TACOM or AMG approved TT-C-490E or later revision Type I or V pre-treatment facilities.

3.1 Pre-Production Testing for Type I and V Pretreatment: Pre-production testing of pretreatment will be performed as specified in TT-C-490F, MIL-DTL-53072D and 12585018.

3.1.1 Preproduction Corrosion Testing: Preproduction corrosion test will be performed per the requirements of TT-C-490F, MIL-DTL-53072D and 12585018 except for the following:

- The paint supplier shall coat fifteen (15) panels (see 3.2.2 of TT-C-490F) with the proposed zinc phosphate coating procedure outlined for use.
- Three (3) of the fifteen (15) panels shall be tested for coating weights and the results of this test submitted showing compliance to the requirement per paragraph 3.4.1 of TT-C-490F.

- Three (3) of the fifteen (15) panels with zinc phosphate only will be coated with the primer to be used in production and meeting the requirements of MIL-DTL-53072D and 12585018. The primer dry film thickness shall be per Table III of TT-C-490F. These three (3) panels shall be subjected to salt spray testing for the number of hours indicated in Table III of TT-C-490F and the results of this test submitted showing compliance to the requirement.
- The remaining nine (9) panels, three (3) zinc phosphate only, three (3) zinc phosphate and primer and three (3) zinc phosphate, primer and top coat shall be properly packaged and sent to AMG Supplier Quality. When sending the remaining nine (9) panels to AMG, the supplier shall provide the procedures and process controls detailing the processes used for cleaning, pre-treating, priming, and top coating used in production to process the panels. The panels must be submitted to AMG Supplier Quality for approval prior to production.
- AMG Supplier Quality will review the test results, procedures, and control plan submitted. AMG Supplier Quality will test the panels submitted as it deems necessary, and notify TACOM of the approval of acceptable test results, procedures, and control plans.
- Any changes to this approved procedure shall be resubmitted for testing and approval by AMG Supplier Quality and the TACOM IAW paragraph 3.1 of this document.
- Any previously government approved paint suppliers of TT-C-490E or later are approved for this contract as long as there are no changes to the written procedures or products being used within the system.

3.1.2 Pre-production Corrosion Testing of Pretreatment Systems for Galvanized Substrates

3.1.2.1 Pre-production corrosion testing of pretreatment systems for galvanized substrates shall be performed using Laboratory Cyclic Corrosion Test per GMW14872 or Cyclic Corrosion Laboratory Test per SAE J2334.

3.1.2.2 Test coupons with primer only shall be aged for seven days and scribed through the primer per ASTM D1654- 08, Section 5

3.1.2.3 The coupons shall be tested for 40 cycles per GMW14872 or SAE J2334.

3.1.2.3.1 After 40 cycle test exposure, the test coupons shall be scraped at a 30 degree contact angle (approximate) with a one inch (approximate) metal blade, such as a flexible putty knife, both parallel and perpendicular to the scribe.

3.2.1.3.2 There shall be no more than 3mm of rust creep (zinc corrosion products), blistering or loss of paint adhesion from the scribe line and no more than 5 blisters in the field with none greater than 1mm.

3.1.2.3.3 This test shall be performed at two month intervals (two test coupons) to ensure that the process is in control.

3.1.2.3.4 An alternative test for verifying process control is GMW15288 Scab Corrosion Creep-back of Paint Systems on Metal Substrates.

3.1.3 Production Ongoing Corrosion Testing

3.1.3.1 Corrosion resistance tests shall be conducted on a monthly basis by E-Coating two (2) test coupons through the actual process that has been found to be in statistical control. Test coupons shall then be described in accordance with Section 5 of IAW ASTM D1654-08.

3.2 TT-C-490 Documentation Submittal: Submit all TT-C-490 documentation, along with the system documented procedures, to AMG Supplier Quality for review and approval. Please include any previous letter of government approval to Revision E or later along with this submission.

3.3 Prior Government Approval: If the system has prior government approval to Revision E or later with no change in chemicals or process, the supplier shall submit to AMG Supplier Quality those approved procedures, letter of approval and the system documented procedures for our review and acknowledgement. This acknowledgement does not relieve the supplier of their responsibility to meet all requirements of the drawings and applicable specifications.

4.0 Changes: Prior to making any changes to chemicals, processes or procedures, the supplier must notify AMG Supplier Quality in accordance with the changes section of this document, see section 8 of the AM General Supplier Quality Manual document for further requirements.

5.0 Test Data and Records: All test data records shall be available upon request for any and all test required by this supplement. See section 5 of the AM General Supplier Quality Manual document for further requirements. Test records shall be kept for a minimum of 7 years and test specimen shall be available for a minimum of 1 year after testing is complete.

COMMERCIAL FINISHES

6.0 Parts supplied by Purchase Order number prefixed by the letters “COM” requiring prime or topcoat paint application must meet the quality acceptance criteria determined by AMG Supplier Quality.

SUPPLEMENT 5 TO AM GENERAL SUPPLIER QUALITY MANUAL
ARMOR MATERIAL REQUIREMENTS

1.0 Traceability of Armor Materials: The supplier shall maintain a program that enables traceability of any armor material (opaque armor and transparent armor) used as a component of system survivability back to its source of supply. At a minimum, the following requirements shall apply:

1.1 Ballistic Grade Steel and Aluminum:

1.1.1 **Traceability:** The supplier shall ensure all materials are traceable from the heat and plate lot acceptance and ballistic test report through processing such as cutting, blanking or other operations resulting in the final part configuration. Traceability up to the point of the plate cutting does not release the supplier from the responsibility that the final system meets all the specifications of the drawing.

1.1.2 **Hardness Testing:** For steel armored components, hardness testing to the applicable specification must be completed prior to cutting, blanking or other operations resulting in the final part configuration. Test results must be included with the traceability record.

1.2 Transparent Armor:

1.2.1 **Traceability:** The supplier shall ensure that all materials are traceable to the manufacturing lot and ballistic test results from the source of supply.

1.3 Composite Armor:

1.3.1 **Traceability:** The supplier shall ensure that all materials are traceable to the manufacturing lot and ballistic test as defined on the drawing or specification.

1.4 Control Plan: A control plan per AIAG APQP and Control Plan Manual that defines the process to control, document traceability and testing of these materials must be submitted to AMG Supplier Quality for review and acknowledgement.

1.5 Records: Records of traceability must be retained in accordance with the record retention requirements of the Purchase Order.

1.6 Ballistics Testing: Ballistic testing shall be conducted with Government approved sources recognized by AMGs contract with the Government.

1.7 Shipment: Supplier shall not ship any products that do not have verifiable material certifications without prior approval from AMG Supplier Quality.

2.0 Armor Manufacturing

Suppliers are prohibited from using thermal cutting methods (plasma cutting, laser cutting, etc.) for the manufacture of components constructed with ferrous armor materials that exceed the Brinell hardness specification contained within MIL-DTL-46100. Additionally,

all components constructed with ferrous armor materials that exceed the Brinell hardness specification contained within MIL-DTL-46100 that are formed during fabrication (bent, pressed, stamped, etc.) shall be subjected to non-destructive testing suitable to ensure that no cracks have formed during the manufacturing process.

SUPPLEMENT 6 TO AM GENERAL SUPPLIER QUALITY MANUAL
Radiographic Inspection

Scope: Radiographic inspection of production castings as required by applicable drawings and/or specifications shall be accomplished as follows:

1.1 Operators and radiographic equipment shall be qualified in accordance with NAS 410, prior to radiography of production castings.

1.2 The first casting shall be radiographed in all routine and random positions described on the position chart.

1.3 Subsequent castings shall be radiographed in those areas that were defective in the immediately preceding castings, until compliance with the required standard has been obtained. Objective evidence shall be provided by the contractor or subcontractor (whomever manufactures the part) that corrective action has been taken to eliminate the deficiency.

1.4 All rejectable areas may be repaired in accordance with an approved and qualified repair procedure (when required by applicable specification), and shall meet the standard specified on applicable position chart. The contractor or subcontractor (whomever manufactures the part) retains the responsibility to repair or scrap defective material.

1.5 After above requirements have been accomplished, normal sampling shall be applied.

1.6 Normal sampling shall consist of radiographing one control casting selected by the AM General / Government Quality Assurance Representative, out of each thirty produced.

1.7 All routine and random positions shall be radiographed on each control casting except when the total exceeds the established number of radiographs that can be taken in a normal eight hour day. When the total number of positions to be radiographed on a control casting exceeds the maximum capability of facilities, random position will be selected for radiography by the AM General / Government Quality Assurance Representative and rotated in such a manner that complete coverage is achieved within a cycle of five castings radiographed.

1.8 The occurrence of a rejectable defect in any area on a casting shall require the radiographic inspection of each subsequently poured casting in that area until the defective condition is corrected.

1.9 If the results of radiographic inspection on 10 consecutive lots of material indicate that a satisfactory uniform product meeting the soundness requirements is being produced, the amount of radiographic testing may be reduced in accordance with a system established by AM General and approved by the Procuring Contracting Officer.

1.10 The occurrence of a rejectable defect in any area on a casting shall require return to normal sampling and the radiographic inspection of each subsequently poured casting in that area until the defective condition is corrected.

SUPPLEMENT 7 TO AM GENERAL SUPPLIER QUALITY MANUAL
JLTV Special Characteristics Requirements

1.0 Scope: The requirements herein provide additional guidance for the assignment and management of Special Characteristics while performing Failure Mode and Effects Analyses in accordance with the latest Edition of the Automotive Industry Action Group (AIAG) Potential Failure Mode and Effects Analysis (FMEA) manual.

2.0 Special Characteristic Definitions and Requirements:

In accordance with the AIAG PPAP Manual (Fourth Edition), special characteristics are defined as product characteristics or manufacturing process parameters which can affect safety or compliance with regulations, fit, function, performance, or subsequent processing of product. There are two types of special characteristics: Critical Characteristics and Significant Characteristics:

- Critical Characteristic: A product characteristic or process parameter that can potentially affect compliance with government regulations, safe vehicle operation, or safe equipment function. <CC>

- Significant Characteristic: A product characteristic or manufacturing process parameter which can affect fit, function, performance, or impact subsequent processing of product. <SC>

Critical and Significant Characteristics shall be assigned based on the Severity and Occurrence data derived from the Design and/or Process Failure Mode and Effects Analyses (DFMEA and PFMEA). Criteria for assignment of special characteristics shall be in accordance with the below Criticality Matrix (Figure 1). All special characteristics shall be documented on the corresponding control plan.

- Critical Characteristics shall be identified, recorded, and implemented when a DFMEA or PFMEA Severity Rank of 9 or 10 is identified regardless of the corresponding Occurrence Rank. All items identified as a Critical Characteristic shall demonstrate a minimum CpK of 1.67, shall demonstrate a robust Government-approved error proofing system that ensures product conformance, or be subject to 100% inspection.

- Significant Characteristics shall be identified, recorded, and implemented when a DFMEA or PFMEA Severity Rank of 5, 6, 7, or 8 is identified with a corresponding Occurrence Rank of 4, 5, 6, 7, 8, 9, or 10. All items identified as a Significant Characteristic shall demonstrate a minimum CpK of 1.33, shall demonstrate a robust Government-approved error proofing system that ensures product conformance, or be subject to 100% inspection.

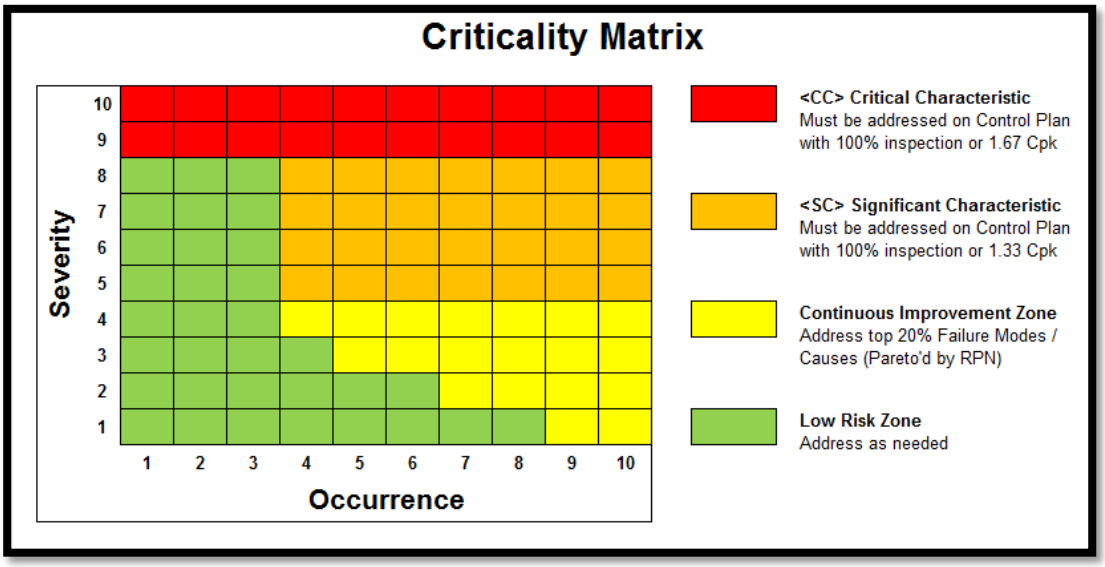

Figure 1 - Criticality Matrix

100% inspection shall be treated as a last resort for the control of special characteristics and shall only be permitted for a period of 6 months from initial implementation. If 100% inspection is employed, the inspection must be performed as a separate inspection task after the specific assembly, manufacturing, or installation task is complete. 100% inspection shall not be performed by the employee performing the initial assembly, manufacturing, or installation task.

3.0 Traceability Marking for Components with Special Characteristics

3.1 All parts with special characteristics need to be traceable to the lot or date of manufacturing relevant to the special characteristic. They must be marked such that AM General can ensure traceability to the end item produced or installed kit. Marking must include scannable format which could include barcode, QR codes, RFID or agreed upon scanning methodology to ensure AM General can read and store lot or date of manufacturing information.

3.2 For specific Armor or Transparent Armor traceability requirements, reference Supplement 5.

4.0 Assignment of DFMEA & PFMEA Severity Ranks

4.1 Assignment of DFMEA and PFMEA **Severity** Rank values shall be in accordance with Figures 2 and 3 below, respectively. If there is any disagreement between criteria for assignment of Severity Rank in the table, the most severe (highest) rank value shall always be utilized.

4.2 The following definitions apply:

4.2.1 Primary Function: A function for which loss or degradation:

- incurs a Hardware Mission Failure (HMF) in accordance with the JLTV Failure Definitions and Scoring Criteria (FDSC), or
- results in a Non-Mission Capable (NMC) status, or

- results in failure of the vehicle/item to achieve a Tier 1 Requirement identified in the JLTV Purchase Description (Attachment 0101).

4.2.2 Secondary Function: A function for which loss or degradation:

- incurs Essential Function Failure (EFF) in accordance with the JLTV Failure Definitions and Scoring Criteria (FDSC), or
- results in failure of the vehicle/item to achieve a Tier 2 Requirement identified in the JLTV Purchase Description (Attachment 0101).

4.2.3 Tertiary Function: A function for which loss or degradation:

- incurs a Non-Essential Function Failure (NEFF) in accordance with the JLTV Failure Definitions and Scoring Criteria (FDSC), or
- results in failure of the vehicle/item to achieve a Tier 3-5 Requirement identified in the JLTV Purchase Description (Attachment 0101), or
- results in on-condition maintenance actions of consumable items (tires, filters, etc.

Figure 2 – DFMEA Severity Rating Scale

DFMEA SEVERITY RATING SCALE	
SEVERITY OF EFFECT	**RANK**
Affects safe operation of the vehicle and/or other vehicles, the health of the driver or passenger(s) or road users or pedestrians.	**10**
Noncompliance with government regulation(s).	**9**
Loss of a primary vehicle function at any time during the expected service life.	**8**
Degradation of a primary vehicle function at any time during the expected service life.	**7**
Loss of a secondary vehicle function at any time during the expected service life.	**6**
Degradation of a secondary vehicle function at any time during the expected service life.	**5**
Condition impacting a tertiary function but vehicle remains operable, or a very objectionable appearance, sound, vibration, harshness, or haptics.	**4**
Condition impacting a tertiary function but vehicle remains operable, or a moderately objectionable appearance, sound, vibration, harshness, or haptics.	**3**
Condition impacting a tertiary function but vehicle remains operable, or a slightly objectionable appearance, sound, vibration, harshness, or haptics.	**2**
No discernible effect	**1**
Source: Table D1 - DFMEA SEVERITY (S) AIAG VDA Failure Modes Effects Analysis FMEA Handbook June 2019	

Figure 3 – PMEA Severity Rating Scale

PFMEA SEVERITY RATING SCALE			
SEVERITY OF EFFECT: IMPACT TO PRODUCTION	**SEVERITY OF EFFECT: IMPACT TO SHIP PRODUCT**	**SEVERITY OF EFFECT: IMPACT TO END USER**	**RANK**
Failure may result in an acute health and/or safety risk for the manufacturing and assembly worker	Failure may result in an acute health and/or safety risk for the manufacturing and assembly worker	Affects safe operation of the vehicle and/or other vehicles, the health of the driver or passenger(s) or road users or pedestrians.	**10**
Failure may result in in-plant regulatory noncompliance	Failure may result in in-plant regulatory noncompliance	Noncompliance with regulations.	**9**
100% of production run affected may have to scrapped. Failure may result in in-plant regulatory noncompliance or may have a chronic health and/or safety risk for the Manufacturing working or assembly worker	Line shutdown greater than full production shift; stop shipment possible; field repair or replacement required (Assembly to End User) other than for regulatory noncompliance. Failure may result in in-plant regulatory noncompliance or may have a chronic health and/or safety risk for the manufacturing or assembly worker	Loss of primary vehicle function at any time during expected service life.	**8**
Product may have to be sorted and a portion (less than 100%) scrapped; deviation from primary process; decreased line speed or added manpower	Line shutdown from 1 hour up to full production shift; stop shipment possible; field repair or replacement required (Assembly to End User) other than for regulatory noncompliance	Degradation of primary vehicle function at any time during expected service life.	**7**
100% of production run may have to be reworked offline and accepted	Line shutdown up to one hour	Loss of secondary vehicle function.	**6**
A portion of the production run may have to be reworked off line and accepted	Less than 100% of product affected; strong possibility of defective product; sort required; no line shutdown	Degradation of secondary vehicle function.	**5**
100% of production run may have to be reworked in station before it is processed	Defective product triggers significant reaction plan; additional defective products not likely; sort not required	Very objectionable appearance, sound, vibration, harshness, or haptics.	**4**
A portion of the production run may have to be reworked in-station before it is processed	Defective product triggers minor reaction plan; additional defective products not likely; sort not required	Moderately objectionable appearance, sound, vibration, harshness, or haptics.	**3**
Slight inconvenience to process, operation, or operator	Defective product triggers no reaction plan; additional defective products not likely; sort not required; requires feedback to supplier	Slightly objectionable appearance, sound, vibration, harshness, or haptics.	**2**
No discernible effect	No discernible effect or no effect	No discernible effect.	**1**
Source: Table P1 - PFMEA-SEVERITY (S) AIAG VDA Failure Modes Effects Analysis FMEA Handbook June 2019			

5.0 Assignment of DFMEA and PFMEA Occurrence Rank values shall be in accordance with Figures 4 and 5 below, respectively. If there is any disagreement between criteria for assignment of an Occurrence Rank in the table, the most severe (highest) rank value shall always be utilized. When determining occurrence scores, data from all sources shall be considered, including but not limited to the following items:

- Test failures and Test Incident Reports (TIR's)
- Defects identified in the production process
- Defects identified during inspection for Government acceptance
- Defects identified after the product has been delivered to the field

Figure 4 – DFMEA Occurrence Rating Scale

DFMEA OCCURRENCE RATING SCALE		
PREDICTION OF FAILURE CAUSE OCCURRING	**OCCURRENCE CRITERIA FOR DFMEA**	**RANK**
Extremely High	-First application of new technology anywhere without operating experience and/or under uncontrolled operating conditions. No product verification and/or validation experience. -Standards do not exist and best practices have not yet been determined. Prevention controls not able to predict field performance or do not exist.	**10**
Very High	-First use of design with technical innovations or materials within the company. New application or change in duty cycle / operating conditions. No product verification and/or validation experience. -Prevention controls not targeted to identify performance to specific requirements.	**9**
	-First use of design with technical innovations or materials on a new application. New application or change in duty cycle / operating conditions. No product verification and/or validation experience. -Few existing standards and best practices, not directly applicable for this design. Prevention controls not a reliable indicator of field performance.	**8**
High	-New design based on similar technology and materials. New application or change in duty cycle / operating conditions. No product verification and/or validation experience. -Standards, best practices, and design rules apply to the baseline design, but not the innovations. Prevention controls provide limited indication of performance.	**7**
	-Similar to previous designs, using existing technology and materials. Similar application, with changes in duty cycle or operating conditions. Previous testing or field experience. -Standards and design rules exist but are insufficient to ensure that the failed cause will occur. Prevention controls provide some ability to prevent a failure cause.	**6**
Moderate	-Detail changes to previous design, using proven technology and materials. Similar application, duty cycle or operating conditions. Previous testing or field experience, or new design with some test experience related to the failure. -Design addresses lessons learned from previous designs. Best practices re-evaluated for this design but have not yet been proven. Prevention controls capable of finding deficiencies in the product related to the failure cause and provide some indication of performance	**5**
	-Almost identical design with short-term field exposure. Similar application, with minor change in duty cycle or operating conditions. Previous testing and field experience. -Predecessor design and changes for new design conform to best practices, standards, and specifications. Prevention controls capable of finding deficiencies in the product related to the failure cause and indicate likely design conformance.	**4**
Low	-Detail changes to known design (same application, with minor change in duty cycle or operating conditions) and testing or field experience under comparable operating conditions, or new design with successfully completed test procedure. -Design expected to conform to Standards and Best Practices, considering Lessons Learned from previous designs. Prevention controls capable of finding deficiencies in the product related to the failure cause and predict conformance of production design.	**3**
Very Low	-Almost identical mature design with long term field exposure. Same application, with comparable duty cycle and operating conditions. Testing or field experience under comparable operating conditions. -Design expected to conform to standards and best practices, considering Lessons Learned from previous designs, with significant margin of confidence. Prevention controls capable of finding deficiencies in the product related to the failure cause and indicate confidence in design conformance.	**2**
Extremely Low	Failure eliminated through prevention control and failure cause is not possible by design.	**1**

Product experience: History of product usage within the company (Novelty of design, application or use case). Results of already completed detection controls provide experience with the design.

Prevention Controls: Use of Best Practices for product design, Design Rules, Company Standards, Lessons Learned, Industry Standards, Material Specifications, Government Regulations and effectiveness of prevention orientated analytical tools including Computer Aided Engineering, Math Modeling, Simulation Studies, Tolerance Stacks and Design Safety Margins

Source: Table D2 - DFMEA-OCCURRENCE (O) AIAG VDA Failure Modes Effects Analysis FMEA Handbook June 2019

Figure 5 – PFMEA Occurrence Rating Scale

PFMEA OCCURRENCE RATING SCALE			
PREDICTION OF FAILURE CAUSE OCCURRING	**PREVENTION CONTROL**	**TYPE OF CONTROL**	**RANK**
Extremely High	No prevention controls.	None	**10**
Very High	Prevention controls will have little effect in preventing failure cause.	Behavioral	**9**
			8
High	Prevention controls somewhat effective in preventing failure cause.	Behavioral or Technical	**7**
			6
Moderate	Prevention controls are effective in preventing failure cause.		**5**
			4
Low	Prevention controls are highly effective in preventing failure cause.	Best Practices: Behavioral or Technical	**3**
Very Low			**2**
Extremely Low	Prevention controls are extremely effective in preventing failure cause from occurring due to design (e.g. part geometry) or process (e.g. fixture or tooling design). The Failure Mode cannot be physically produced due to the Failure Cause.	Technical	**1**

Prevention Control Effectiveness: Consider if prevention controls are technical (rely on machines, tool life, tool material, etc.), or use best practices (fixtures, tool design, calibration procedures, error-proofing verification, preventative maintenance, work instructions, statistical process control charting, process monitoring, product design, etc.) or behavioral (rely on certified or non-certified operators, skilled trades, team leaders, etc.) when determining how effective the prevention controls will be.

Source: Table P2 - PFMEA-OCCURRENCE (O) AIAG VDA Failure Modes Effects Analysis FMEA Handbook June 2019

6.0 Assignment of DFMEA and PFMEA **Detection** Potential Ranks shall be in accordance with Figures 6 and 7 below, respectively. Detection Potential Ranks are not considered in the assignment of special characteristics, but shall be utilized in determining Risk Priority Number (RPN) values.

Figure 6 – DFMEA Detection Potential Rating Scale

DFMEA DETECTION POTENTIAL RATING SCALE			
ABILITY TO DETECT	**DETECTION METHOD MATURITY**	**OPPORTUNITY FOR DETECTION**	**RANK**
Very Low	Test procedure yet to be developed.	Test method not defined	**10**
	Test method not designed specifically to detect failure mode or cause.	Pass-Fail, Test-to-Fail, Degradation Testing	**9**
Low	New test method; not proven.	Pass-Fail, Test-to-Fail, Degradation Testing	**8**
	Proven test method for verification of functionality or validation of performance, quality, reliability and durability; planned timing is later in the product development cycle such that test failures may result in production delays or re-design and/or re-tooling.	Pass-Fail Testing	**7**
Moderate		Test-to-Failure	**6**
		Degradation Testing	**5**
High	Proven test method for verification of functionality or validation of performance, quality, reliability and durability; planned timing is sufficient to modify production tools before release for production.	Pass-Fail Testing	**4**
		Test-to-Failure	**3**
		Degradation Testing	**2**
Very High	Prior testing confirmed that failure mode or cause cannot occur, or detection methods proven to always detect the failure mode or failure cause.		**1**
Source: Table D3 - DFMEA-DETECTION(D) AIAG VDA Failure Modes Effects Analysis FMEA Handbook June 2019			

Figure 7 – PFMEA Detection Potential Rating Scale

PFMEA DETECTION POTENTIAL RATING SCALE			
ABILITY TO DETECT	**DETECTION METHOD MATURITY**	**OPPORTUNITY FOR DETECTION**	**RANK**
Very Low	No testing or inspection method has been established or is known.	The failure mode will not or cannot be detected.	**10**
	It is unlikely that the testing or inspection method will detect the failure mode.	The failure mode is not easily detected through random or sporadic audits.	**9**
Low	Test or inspection method has not been proven to be effective and reliable (e.g. plant has little or no experience with method, gauge R&R results marginal on comparable process or this application etc.)	Human inspection (visual, tactile, audible) or use of manual gauging (attribute or variable) that should detect the failure mode or failure cause.	**8**
		Machine-based detection (automated, semi-automated with notification by light, buzzer, etc.) or use of inspection equipment such as coordinate measuring machine that should detect failure mode or failure cause.	**7**
Moderate	Test or inspection method has been proven to be effective and reliable (e.g. plant has experience with method; gauge R&R results are acceptable on comparable process or this application etc.).	Human inspection (visual, tactile, audible) or use of manual gauging (attribute or variable) that will detect the failure mode or failure cause (including product sample checks).	**6**
		Machine-based detection (automated, semi-automated with notification by light, buzzer, etc.) or use of inspection equipment such as coordinate measuring machine that will detect failure mode or failure cause (including product sample checks).	**5**
High	System has been proven to be effective and reliable (e.g. plant has experience with method on identical process or this application), gauge R&R results are acceptable, etc.	Machine-based automated detection method that will detect the failure mode downstream, prevent further processing or system will identify the product as discrepant and allow it to automatically move forward in the process until the designated reject unload area. Discrepant product will be controlled by a robust system that will prevent outflow of the product from the facility.	**4**
		Machine-based automated detection method that will detect the failure mode in-station, prevent further processing or system will identify the product as discrepant and allow it to automatically move forward in the process until the designated reject unload area. Discrepant product will be controlled by a robust system that will prevent outflow of the product from the facility.	**3**
	Detection method has been proven to be effective and reliable (e.g. plant has experience with method, error-proofing, verifications, etc.).	Machine-based detection method will detect the cause and prevent the failure mode (discrepant part) from being produced.	**2**
Very High	Failure mode cannot be physically produced as-designed or processed, or detection method proven to always detect the failure mode or failure cause.		**1**
Source: Table P3 - PFMEA-DETECTION (D) AIAG VDA Failure Modes Effects Analysis FMEA Handbook June 2019			