DEFENSE

GLOBAL SUPPLIER QUALITY MANUAL

NGDV ADDENDUM

REVISION 1.0

DECEMBER 2022

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1. INTRODUCTION

Thank you for taking time to review this Addendum. The content within is a compilation of key requirements to assist you in meeting Oshkosh expectations. As a Supplier / Partner your organization's Quality is directly related to the NGDV Supplier Quality Mission:

"To be a strategic advantage for our corporation and customers by empowering our suppliers to achieve more through mutually beneficial partnerships and by delivering components of the highest possible quality on time and at cost."

Please endeavor to communicate and apply these requirements throughout your enterprise and join Oshkosh NGDV in Pursuing Quality Excellence

2. NGDV SEGMENT QUALITY ASSURANCE REQUIREMENTS

NGDV Suppliers shall have a Quality Management System that is registered to ISO 9001: 2015. The 3rd party ISO registrar is to be accredited, bearing the accreditation mark of a recognized IAF MLA (International Accreditation Forum Multilateral Recognition Arrangement) member (A2LA, ANSI, and ANAB for example). For a listing of accredited ISO registrars, visit: https://www.iaf.nu

2.1. Supplier Audits

All suppliers shall have a quality management system that meets the requirements of the Oshkosh GSQM. Suppliers are subject to on-site audits, remote audits, or self-audits by Oshkosh Corporation to ensure that a documented quality system is in place, which includes development, implementation, and maintenance of Control Plans for all NGDV programs and products.

2.2. Maturity Assessment

There are a set of common practices and disciplines that characterize the most successful companies in the marketplace today. The following traits describe the Quality approach that Oshkosh NGDV is fully pursuing, and we recommend you do the same. We are using a "Maturity Assessment" to practically evaluate the application of these traits within our organization, and it is available to use within yours also.

2.2.1. Statistical Process Control (SPC) - Real-time SPC is used with observed processes in statistical control. Proper specification limits are monitored to address outputs that fall outside of the control limits before producing non-conforming product.

2.2.2. Work Instructions and Training - Work instructions are up to date and readily available for assembly / operators. Work instructions are thorough, detailed, complete, and align with engineering specifications and the assembly process. Work instructions are linked to applicable tooling within station. Quality aids are posted within station. Training content addresses all required skills and is successfully completed by personnel before being permitted to manufacture product.

2.2.3. Error Proofing - Error proofing is commonly used, it is challenged to ensure it is effective, and cannot be defeated. It successfully detects a defect and does not permit it to leave the workstation before corrected.

2.2.4. Supply Chain Management - Parts used in production have been approved as conforming before assembly. The part approval process-documents are thorough and establishes that supplier processes are capable to consistently produce conforming product. Supplier performance metrics are used to identify and mitigate risks to manufacturing conforming product.

2.2.5. Tooling / Calibration - Tooling is present within the applicable workstations, and is error proof enabled, and calibrated. There is alignment between the tooling and work instructions. A robust tooling tracking management system is used.

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2.2.6. PFMEA / Control Plans - PFMEA / Control Plans exist for each unique assembly process / work cell content. They demonstrate comprehensive thought and consideration for likely failure modes and corresponding mitigating controls. PFMEA's demonstrate linkages to the applicable DFMEA's, engineering drawings, and engineering specifications. PFMEA's demonstrate robust failure mode documentation, proper severity, occurrence, and detection scoring, RPN assignment, proper special characteristic assignment, and failure mode mitigation actions. The post-improvement severity, occurrence, and detection scoring are captured. PFMEA's and Control Plans are observed to be living documents evidenced by updates due to engineering changes, lessons learned, and process improvements over time.

2.2.7. Production Traceability - Extensive use of product traceability captures raw material lots and sub-tier supplier components that is retained for future use and enables Oshkosh NGDV to link your parts from specific PO's and deliveries onto the finished vehicle serial number.

2.2.8. Control of non-conforming products and defects - The production process identifies and corrects defects in station and does not pass them downstream during the assembly process. There is no opportunity to mix non-conforming product with conforming product during the process. Production processing does not permit the release of product to the customer with defects present.

2.2.9. Control of Special Characteristics - All Special Characteristics are properly controlled using SPC data. SPC metrics demonstrate that the required Cpk is being achieved. All Special Characteristics are conforming prior to releasing product to the customer.

2.2.10. Production / Quality Metrics - Production processes use extensive metrics which drive process improvements back to the responsible work area. First Pass Yield Metrics or Defects per Unit for internal show evidence of continuous process improvement. Corrective Action Feedback demonstrates that corrective actions prevent issues from recurring.

2.2.11. In-process testing is robust and ensures product is conforming to specifications and is defect free prior to being released to the next operation. Testing is conducted frequently enough (with sufficient Cpk) to ensure conforming product is produced.

2.2.12. Change Control- is robustly managed with sufficient definition of what constitutes a process change and/or a product change. Change Control includes awareness to internal stakeholders that are responsible to communicate externally, and it is supported with documented procedures and systems-enabled checks and balances. Any change (except that which is already PPAP approved) that can have a potential downstream consequence to your customer and/or end users must begin with notification to Oshkosh NGDV. See the section on Supplier Change Requests.

3. SOFTWARE / EMBEDDED SOFTWARE

NGDV Suppliers of product-related software, or products with embedded software, shall implement and maintain a process for software quality assurance. The Quality Assurance methodology shall prioritize and mitigate risks based-upon the potential impact to the customer, and the organization shall retain documented information of the assessments conducted. The supplier shall provide the Oshkosh NGDV Software C of C (certificate of conformance) and engineering approval letter with their PPAP submittal Including verification that required software is being verified and tested for use.

4. RECORD AND DOCUMENTATION RETENTION REQUIREMENTS

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While in storage, records and documents shall be protected from damage, loss, and deterioration due to environmental conditions. Records shall be maintained for (5) years. At the end of (5) years, the Supplier shall provide Oshkosh Defense with the option of having the records forwarded to Oshkosh Defense for further retention, as required by the contract, or authorizing disposal of the records and documents at the Supplier's location. Production-related documents (PPAP or Certificates of Conformance) are required to be retained for Current Year (CY) plus 20 years. Disposition shall be done in a timely and appropriate manner. Oshkosh Defense shall be notified when disposition has taken place

5. CERTIFICATE OF CONFORMANCE

The Supplier shall establish, implement, and maintain documented procedures, which ensure adherence to the Oshkosh Defense Certificate of Conformance requirement. The supplier shall have an authorized representative certify that the parts ordered have been processed to procedures that ensure the material is conforming and free of counterfeit material. The certificate of conformance will also acknowledge proper adherence to Purchase Orders, drawings, and contract requirements. Suppliers shall utilize the Oshkosh Certificate of Conformance form (QC-0899) located on http://osn.oshkoshcorp.com/ or another Certificate of Conformance form that at that location for 20 years. This document must be made available at the request of Oshkosh within 24 hours.

6. COUNTERFEIT / USED PARTS (ELECTRONICS)

The NGDV Supplier shall establish, implement, and maintain documented procedures, which shall preclude and/or detect the use of counterfeit/used parts. All Suppliers providing "electronic parts" shall have developed and documented Purchasing procedures that reduce the risk of purchasing and utilizing counterfeit material. Suppliers shall have defined and documented Product Verification procedures that assure the detection of counterfeit parts prior to formal product acceptance. Suppliers shall have developed and documented a Material Control Procedure that includes quarantining, reporting, and dispositioning suspect and/or counterfeit components. Reference the Supplier Standard Guide, Section F, Attachment 2, Contractor Counterfeit Electronic Parts Detection and Avoidance for compliance requirements.

7. 3D SOLID MODEL SPECIFICATIONS (IF APPLICABLE WORK WITH AQE)

If the product drawing (composites, castings, etc.) 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.

The supplier shall:

a) assure that the correct 3D solid model revision level is utilized
b) assure that proper tolerances have been applied
c) assure that the parts surface profile adheres to the model.

The supplier shall provide Oshkosh NGDV the 3D Model C of C (certificate of conformance) with their PPAP submittal (provided within the Oshkosh NGDV PPAP workbook). Including an excerpt of the actual scanned part as an overlay to the 3D model is recommended as supportive documentation.

8. SOURCE INSPECTION

During performance on this subcontract, the Supplier's manufacturing and associated processes, products, and inspection and/or test data are subject to review, verification, examination, test and/or analysis by authorized USPS and/or Oshkosh representatives.

9. SUPPLIER NON-CONFORMING MATERIAL

9.1. Rejected and suspect part concerns will be communicated to suppliers using the Reliance 8D process. Spartanburg Assembly Plant. (SAP) will provide the part number, name, mfg date/lot and the nature of the problem and pictures if necessary. Suppliers are expected to provide an initial response to acknowledge the issue within

24 hours. SAP and the supplier jointly decide whether the parts are going to be returned for analysis or scrapped locally. If the parts are returned for analysis, the supplier must submit an 8D within 1 week. If the supplier does not respond to the initial Reliance communication within 1 week, AND the cost of the part is $100 or less, each part will be scrapped, and the total cost will be charged to the supplier.

9.2. Suppliers are encouraged to immediately notify Oshkosh NGDV Purchasing or Supplier Quality if non-conforming tickets are erroneously assigned to your organization. We strive to keep performance data accurate, and early notification helps to properly reflect your PPM (parts per million) metric.

10. OSHKOSH / CUSTOMER RETURNED PARTS

When a customer owned vehicle experiences component failure, these components may be returned for analysis. Oshkosh will receive failure notification from the customer with a Report Control Number (RCN). Oshkosh will then contact the applicable supplier requesting their Return Goods Authorization number (RGA). The supplier shall reference the RCN and their RGA with assurance that parts will not be discarded until authorized by Oshkosh. The supplier shall conduct and submit a root cause analysis and corrective action to Oshkosh Defense in a timely manner. The 8D format is preferred but not required. It is advisable to include evidence(s) of process improvement(s) to substantiate the corrective actions taken.

11. QUALITY ISSUE CONTAINMENT

11.1. If the supplier has a quality issue that requires containment on-site, the preferred method is for the supplier to send their own employee to the Spartanburg Assembly Plant (SAP) to sort and repair/rework if necessary. Initial containment to keep the line stocked with certified parts will be done by SAP personnel if necessary. This cost for material handling, sorting and repair/rework will be billed back to the supplier.

11.2. If the supplier is sending their own people for the sort activity, they must arrive within 24 hours of the incident being reported to the supplier. These resources will stay on-site until all suspect stock has been certified. This would include any stock that is in transit. The SAP Quality Department will advise the supplier on when their resources are no longer required.

11.3. Should the supplier not be able to send their own people to sort/rework, there will be one authorized third-party supplier to perform on-site sort, rework/repair, and onsite representation. This is the only third-party inspection company that can be used at SAP. The supplier will engage the third-party sort company, communicate the issue and quantities to the on-site lead. The supplier will provide the sorting and rework/repair instructions to the third party. The third-party inspection will continue until the SAP quality department authorizes it to end. This will be based on the inspection data that will be provided to the supplier and SAP by the third-party inspection company. The supplier will have access to all the same data that SAP has. The supplier will pay the cost for the third-party inspection/sorting directly to the third-party. Any associated material handling costs will be billed to the supplier by SAP.

12. PACKAGING AND SHIPPING

The Supplier shall provide for adequate facilities and instructions for handling, packaging, and shipping to preserve the products and prevent damage during storage and transit. See Section 23 from the Global Supplier Quality Manual and Section J of the Supplier Standards Guide for more detail.

For part-specific labeling requirements listed on drawings refer to Part Identification Requirements see 5082115 Technical Requirements Drawing, NGDV, Label Requirements. Section J labeling does not take the place of any other required labels, and each label requirement must be individual and exclusive.

13. SURFACE PREPARATION, PAINTING, AND FINISHING

The Supplier must comply with the Oshkosh finish requirement specified on the drawing. When finish requirements are “silent”, suppliers shall reference the Oshkosh NGDV PS 5082115 Finish Requirements. Work with the Buyer or AQE to ensure current reference drawings requested in part drawings are current.

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It remains the responsibility of the tier 1 supplier to ensure that finish requirements are upheld by the sub tier finish suppliers. USPS contracts mandate qualification and sustaining quality requirements, which are specified inside of the pertinent finish requirements drawings (example- 5082115). Additionally, it is highly recommended that tier 1 suppliers mitigate risks by requiring sub tier suppliers to document process flows, Process FMEA, and Process Control Plans in accordance with Oshkosh NGDV PPAP format.

Note: Become familiar with and enforce these flow-down requirements to prevent product recalls and product rework. Costs resulting from Supplier product recall and/or rework shall be borne by the Supplier.

Note: The purchase order may contain specific instructions regarding paint applications to facilitate subsequent operations.

As referenced in Section D.32 of the Oshkosh Supplier Standards Guide, the use of any pretreatment, plating, painting, or coating of any kind that contains Hexavalent Chrome is strictly prohibited. Any supplier to Oshkosh Corporation shall have systems in place to monitor and control the coating processes used by upstream suppliers when plating requirements are not strictly defined within the Oshkosh design record. Hexavalent Chrome can appear in several forms and can be known by many several nomenclatures. Regardless of the specific nomenclature referenced on the coating certification, usage is strictly prohibited.

Different ways of representing Hexavalent chromium are given below:

- Hexavalent chromium
- Hexavalent chrome
- Hex chrome

Different plating specifications that may contain Hex Chrome (the specifications below may be prohibited. Due diligence is required to verify conformance).

- ASTM B633 (Standard for Electro deposited coatings of Zinc on Iron and Steel)
- ASTM B633 (Coating thickness) Type II
- ASTM B633 (Coating thickness) Type III
- Zn/Fe SC (Coating thickness in micrometers) Type II
- Zn/Fe SC (Coating thickness in micrometers) Type III
- Zinc Yellow
- Zinc Clear
- Chromate
- Chromate conversion coating
- Zinc chromate
- Zinc Dichromate

In addition, Dacromet is not specifically a chromate coating, but a type of Zinc-Rich paint which contains Hex chrome.

14. PART MARKING / IDENTIFICATION AND TRACEABILITY

The Oshkosh drawings provides guidance for part marking identification in accordance with Part Identification Requirements (5082115)

15. CASTINGS

Castings shall be in accordance with CORP-PROC-ENG002, unless specified otherwise.

15.1. INSPECTION

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Radiographic inspection reports shall be signed by a certified ASNT (American Society for Non-Destructive Testing) inspector, level II minimum.

Radiographic procedures shall be signed by a ASNT level III certified technician.

If the casting / machine 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.

The supplier shall:

a) assure that the correct 3D solid model revision level is utilized
b) assure that proper tolerances have been applied
c) assure that the parts surface profile adheres to the model.

The supplier shall provide the Oshkosh NGDV 3D Model C of C (certificate of conformance) with their PPAP submittal (provided within the Oshkosh NGDV PPAP workbook). Including an excerpt of the actual scanned part as an overlay to the 3D model is recommended as supportive documentation.

15.2. INSPECTION FREQUENCY

The first casting shall be radiographed in all routine and random positions described on the position chart (or in the supplier's Control Plan if not detailed on the drawing).

15.2.1. RADIOGRAPHIC INSPECTION PROCESS

1. PPAP submission: One part per mold cavity. PPAP submittals to include:
   a) Radiographic inspection reports
   b) Radiographic images (with evidence that IQI's were utilized)
   c) ASNT Certifications
   d) Laboratory accreditations

2. Initial Production (first 10 lots): One part per mold cavity from every 30 molds poured

15.3. REWORK / REPAIR

Rework is defined as bringing a non-conforming part back into conformance by simply reprocessing a prior sequence. Repairs are defined as bringing a non-conformance part back into conformance using methods outside the original process.

All non-conforming repairs require an approved and qualified repair procedure and must meet the specified standard on applicable position chart. Suppliers shall utilize a Supplier Change Request (RCM- Reliance) form to initiate an Oshkosh approval.

15.4. RADIOGRAPHY POSITION REQUIREMENTS

All routine and random positions shall be radiographed for initial production castings 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 for initial production castings exceeds the maximum capability of facilities, random position shall be selected for radiography by an ASNT qualified operator and rotated in such a manner that complete coverage is achieved within a cycle of five castings radiographed.

16. WELDING

The Supplier shall conform to requirements stated in NGDV Technical requirements drawing 5082115. Oshkosh specification DVQS-0001 will be referenced.

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17. SUPPLIER CHANGE REQUESTS

Notifying and attaining authorization for proposed changes is of the highest importance. Suppliers (Tier 1 and Tier 2 suppliers) must notify Oshkosh NGDV of any proposed changes in processing or product modifications for any reasons such as to help reduce cost, improve quality, alleviate constraints, increase reliability, and process capability of the product.

ALL proposed design changes or modifications, whether permanent or temporary and including proprietary designs, MUST be approved in writing by Oshkosh NGDV prior to implementing.

The supplier must communicate all change requests using the Reliance Change Management (RCM) process within the Oshkosh NGDV Supplier Portal at the link below. This should be submitted at least 12 weeks prior to the planned change implementation.

Suppliers shall have a documented procedure that requires all temporary and/or permanent process or product changes to be communicated and approved by their customer prior to implementation.

Once the RCM approval is granted, the supplier shall submit a corresponding PPAP for Oshkosh NGDV approval

There are four types of Change Requests:

1. Temporary Process Change – A change to the current PPAP approved process such as a tooling move, plant move, improved/new tooling, etc., however it may be functionally acceptable temporarily
   Example: You / Your sub-tier supplier wants to use different equipment or parts from another facility to process the product

2. Temporary Product Change – A change to the current PPAP approved product such as part geometry / dimensions, design intent, material change, etc. however it may be functionally acceptable temporarily
   Example: You / Your sub-tier supplier wants to use an alternate material due to a supply chain issue

3. Permanent Process Change – A change to the current PPAP approved process, tooling move, plant move, improved/new tooling etc. on a permanent basis
   Example: You / Your sub-tier supplier is moving their processing facility to a different state

4. Permanent Product Change – A change to the current product or design such that it meets the current design intent and requires a design change
   Example: You / Your supplier have a product Improvement proposal

18. PPAP REQUIREMENT OVERVIEW

The NGDV PPAP requirements are primarily based upon the AIAG PPAP Manual 4th edition and Appendix H. Exceptions to AIAG are referenced within this manual, the PPAP workbook (OSK F2000), and the PPAP procedure (OSK P2000). In the event of a conflict, the text of this document and the references cited herein takes precedence. It is expected that Oshkosh NGDV Quality requirements flow down to the sub tier suppliers to fully support PPAP fulfillment. *While exceptions exist for the heavy truck industry, NDGV PPAP expectations are that all 18 PPAP elements are required to be completed, but the only submittals needed are designated by the Oshkosh PPAP workbook by PPAP level.*

Suppliers shall manage the completion, and submittal of Level 3 PPAP's 7 calendar days (minimum) prior to the Purchase Order due date (PPAP Levels 1, 2, and 4 are submitted with the product shipment). This time is needed to review / approve / correct the documents for accuracy and completion. Timeliness and thoroughness of the PPAP submittals will impact the supplier PPAP First Pass Yield metric that guides business decisions.

NGDV PPAP's are considered "living documents" and are expected to be maintained to represent the current production process. Additionally, it is expected that Corrective and Preventative Actions prompt updates to the PFMEA and Control Plan.

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PPAP re-submittals are required when; a part drawing is revised, a supplier process change is made (and approved), or a lapse in order fulfillment occurs. In these instances, the supplier is required to re-submit a completed PPAP (and not the delta information only). Legacy elements of the original PPAP may be utilized, but the PPAP in general needs to be representative of the process and be updated (current material certifications for example).

Oshkosh's P2000 PPAP Instructions Manual and F2000 PPAP Workbook (located at http://osn.oshkoshcorp.com) must be adhered to for Approval status to be granted.

Interim Approval may be temporarily granted by the assigned Oshkosh Quality Engineer and must be considered the exception.

Interim PPAP approval will not be granted if the following elements are missing or incomplete.

- The QC-112 PPAP check list (within the PPAP workbook)
- Design Record (Bubble Print)
- Engineering Change Documents (If applicable)
- Customer Engineering Approval (If applicable)
- Dimensional Results / Print Notes Verification
- Material / Performance test results
- Qualified Lab Documents
- Sample Production Parts
- Master Sample Photos
- Part Submission Warrant

18.1.QC-112 PPAP CHECK LIST

The supplier shall complete and submit the PPAP check list with every level 3 PPAP. This document will assist in ensuring all elements are present and complete.

18.2.COMMERCIAL OFF THE SHELF (COTS)

Commercial off the Shelf (COTS) Components are items sold in the commercial marketplace. These parts are commercially available (and at times procured through distributors). They cannot be modified, combined, evolved, or "of-a-type" commercial items. They must truly be "as-is". For further definition, refer to FAR 2.101.

When providing a PPAP for COTS parts, Oshkosh's suppliers are expected to submit all 18 elements of PPAP. At times, due to the nature of COTS parts, Oshkosh's suppliers may be unable to obtain all data for all 18 elements for a level 3 PPAP. In these cases, the supplier is expected to demonstrate / affirm conformance with supporting PPAP documents or Certificates of Conformance by supplying the following minimum PPAP elements:

- Design Record (Bubble Print)
- Engineering Change Documents (If applicable)
- Customer Engineering Approval (If applicable)
- Dimensional Results / Print Notes Verification
- Sample Production Parts
- Master Sample Photos
- Customer Specific Requirements (CFAT- if applicable)
- Parts Submission Warrant
- Catalog Page or equivalent from OEM to demonstrate commerciality (if available)

When the supplier cannot attain all PPAP elements, a Certificate of Conformance (C of C) will be required in addition to the above elements. The C of C letter shall:

- Confirm the article is commercially available

- Be on the supplier's company letterhead
- Include the Oshkosh part number
- Include the part revision level,
- Be signed by a representative within the contractor's organization that has decision making authority.
- Positively affirm that the part meets the requirements within the print.

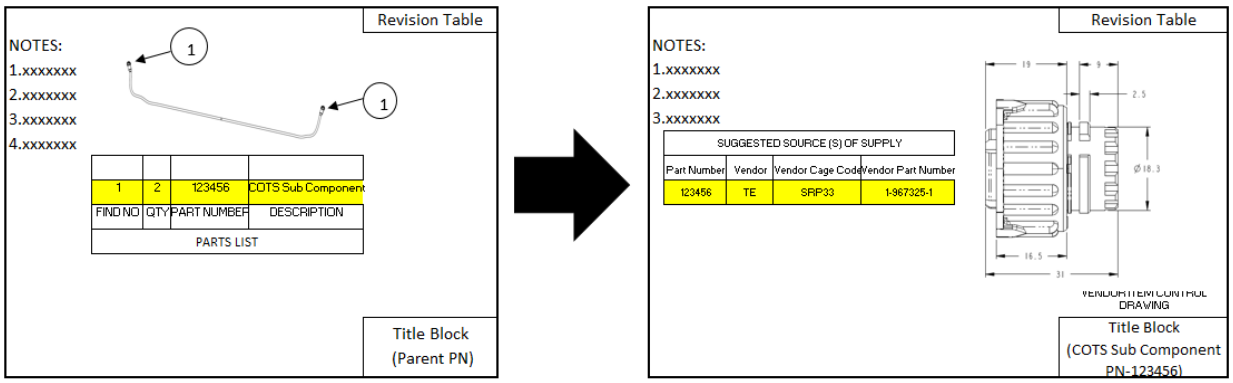
18.2.1. "COTS PLUS"

Parts that are Commercial Off the Shelf (as defined above) but have additional print or performance requirements that Oshkosh has deemed important (because of the part's application). If the OEM catalog page or product data sheet that does not include all Oshkosh NGDV print specifications, the supplier is responsible to provide objective evidence that the part meets the requirement within the Oshkosh NGDV print and a L3 PPAP is required.

NOTE: Caution is needed when a COTS component is "modified" with additional specifications. Modifications to COTS parts re-classify it as a COTS Plus part. If a modification alters the original specifications, re-testing the part in its entirety is required to demonstrate that no unintended performance shortcoming will occur because of the modification.

18.2.2. COTS SUBCOMPONENTS

For COTS subcomponents within the Purchased Part Level (Parent), only the certificate of conformance and design record are required if COTS Vendor Part Number specified by subcomponent drawing is used. If no Vendor Part Number is specified, a one-piece dimensional result, print note verification, design record, and Supplier Change Request (if applicable) are required.



19. DESIGN RECORD (AIAG PPAP 2.2.1)

The Supplier shall comply with the Oshkosh NGDV Design Record for the product/part referenced on the Purchase Order. This includes sub-components (drawings) associated with Purchased product/part. Where the Design Record is in electronic format, the Supplier shall produce a hard copy. Examples include, but are not limited to pictorial of the parts, GD&T sheets, drawings, and identifications of measurements taken. Engineering Drawings (Balloon Prints) shall accompany each PPAP submittal.

Best Practice: *Layout the balloon print so the numbering of all features is formatted sequentially in a left-to-right, clockwise pattern on the first page of the drawing, and continues sequentially and clockwise for pages, 2, 3, … when design records have multiple pages. This pattern expedites the review and approval process.*

20. AUTHORIZED ENGINEERING CHANGE DOCUMENTS (AIAG PPAP 2.2.2)

Only production-released / approved drawings shall be utilized for PPAP submittals.

The Supplier shall maintain copies of any authorized engineering change documents for those changes not yet recorded in the Design Record but incorporated in the product, part, or tooling. Marked drawings are acceptable for PPAP submission when a released drawing is not available due to timeline constraints. Any marked drawings from Oshkosh NGDV must be

signed and approved by Oshkosh Design Engineering, and a copy of the approved Oshkosh NGDV Supplier Change Request (RCM) must accompany the PPAP submittal.

21. CUSTOMER ENGINEERING APPROVAL (AIAG PPAP 2.2.3)

Where specified by the customer, the organization shall have evidence of customer engineering approval.

22. DESIGN FMEA (AIAG PPAP 2.2.4)

DFMEA is required at the component level for all parts where the Supplier is considered design responsible for all Level 3 PPAP submittals.

22.1. FMEA SPECIAL CHARACTERISTICS

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:

22.1.1. CRITICAL CHARACTERISTIC (CC)

A Critical Characteristic is defined as a product characteristic or manufacturing process parameter that can potentially affect compliance with government regulations, safe vehicle operation, or safe equipment function.

22.1.2. SIGNIFICANT CHARACTERISTIC (SC)

A Significant Characteristic is defined as a product characteristic or manufacturing process parameter which can affect fit, function, performance, or impact subsequent processing of product.

Examples of Special Characteristic symbols

22.2. FMEA CHARACTERISTIC ASSIGNMENT PROCESS

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 (see Figure 1 below). All special characteristics shall be documented on the corresponding control plan.

22.2.1. CRITICAL CHARACTERISTIC

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 or be subject to 100% inspection.

22.2.2. SIGNIFICANT CHARACTERISTICS

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 or be subject to 100% inspection.

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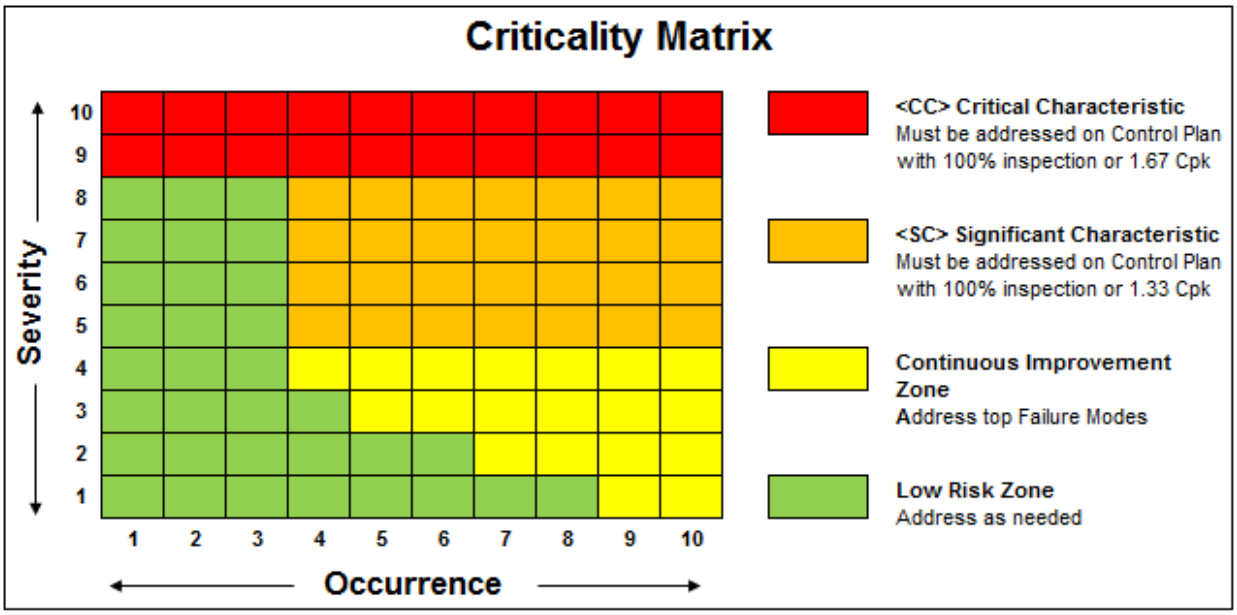

Figure 1: Criticality Matrix to be used for identification and Classification of Special Characteristics

22.3. FMEA SEVERITY RANKING ASSIGNMENT

Assignment of DFMEA and PFMEA Severity Rank values shall be in accordance with Figure 2 below. If there is any disagreement between criteria for assignment of Severity Rank in the table while performing DFMEA or PFMEA analysis, the more severe (higher) rank value shall always be utilized.

22.4. FMEA OCCURRENCE RANKING ASSIGNMENT

Assignment of DFMEA and PFMEA Occurrence Rank values shall be in accordance with Figure 3 below. If there is any disagreement between criteria for assignment of an Occurrence Rank in the table while performing DFMEA or PFMEA analysis, the more severe (higher) rank value shall always be utilized. Note that the Occurrence column pertaining to Testing applies to both DFMEA and PFMEA.

22.5. FMEA DETECTION RANKING ASSIGNMENT

Detection Ranks are not to be considered in the assignment of special characteristics. However, for the purposes of conducting DFMEA and PFMEA analyses and determining Risk Priority Number (RPN) values, the Oshkosh NGDV standard table within the PPAP workbook (Table Cr3 from the AIAG Potential Failure Mode and Effects Analysis Manual Fourth Edition) shall be utilized.

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SEVERITY RATING SCALE				
CUSTOMER EFFECT	**SEVERITY OF EFFECT ON PRODUCT**	**RANK**	**SEVERITY OF EFFECT ON PROCESS**	**ASSY EFFECT**
Failure to Meet Safety and/or Regulatory Requirements	Potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation without warning.	**10**	May endanger operator (machine or assembly) without warning.	**Hazardous without warning**
	Potential failure mode affects safe vehicle operation and/or involves noncompliance with government regulation with warning	**9**	May endanger operator (machine or assembly) with warning.	**Hazardous with warning**
Loss or Degradation of Primary Function	Loss of primary function (vehicle / item inoperable, but does not affect safe operation).	**8**	100% of production run may have to be scrapped, line shutdown, or stop ship.	**Major Disruption**
	Degradation of primary function (vehicle / item operable but at a reduced level of performance)	**7**	A portion of the production run may have to be scrapped, deviation from primary process including decreased line speed or added manpower.	**Significant Disruption**
Loss or Degradation of Secondary Function	Loss of secondary function (vehicle / item operable, but does not affect safe operation, but secondary functions inoperable)	**6**	100% of production run may have to be reworked off line and accepted.	**Moderate Disruption**
	Degradation of secondary function (vehicle / item operable, but secondary functions operate at reduced level of performance)	**5**	A portion of the production run may have to be reworked off line and accepted.	
Loss or Degradation of Tertiary Function	Condition impacting a tertiary function but vehicle remains operable, appearance or audible noise, or item does not conform and noticed by >75% of customers	**4**	100% of production run may have to be reworked in station before it is processed.	**Minor Disruption**
	Condition impacting a tertiary function but vehicle remains operable, appearance or audible noise, or item does not conform and noticed by ~50% of customers	**3**	A portion of the production run may have to be reworked in station before it is processed.	
	Condition impacting a tertiary function but vehicle remains operable, appearance or audible noise, or item does not conform and noticed by <25% of customers	**2**	Slight inconvenience to process, operation, or operator.	**Annoyance**
No effect	No discernible effect	**1**	No discernible effect.	**None**

Figure 2: Severity Ranking Criteria for DFMEA and PFMEA

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OCCURRENCE RATING SCALE				
LIKELIHOOD OF FAILURE	**OCCURRENCE OF CAUSE FROM TESTING**	**OCCURRENCE OF CAUSE FOR DFMEA**	**OCCURRENCE OF CAUSE FOR PFMEA**	**RANK**
Very High	Observed on over 50% of test assets.	New technology/new design with no history.	One occurrence per part/machine	**10**
High	Observed on >25-50% of test assets.	Failure is inevitable with new design, new application, or change in duty cycle/operating conditions.	One occurrence per shift *(>1 in 5)*	**9**
		Failure is likely with new design, new application, or change in duty cycle/operating conditions.	One occurrence per day *(1 in 5)*	**8**
		Failure is uncertain with new design, new application, or change in duty cycle/operating conditions.	One occurrence per week *(1 in 25)*	**7**
Moderate	Observed on >12.5-25% of test assets.	Frequent failures associated with similar designs or in design simulation and testing.	One occurrence every 2 weeks *(1 in 50)*	**6**
		Occasional failures associated with similar designs or in design simulation and testing.	One occurrence per month *(1 in 100)*	**5**
		Isolated Failures associated with similar design or in design simulation and testing.	One occurrence per 3 months *(1 in 300)*	**4**
Low	Observed on up to 12.5% of test assets.	Only isolated failures associated with almost identical design or in design simulation and testing.	One occurrence per 6 months *(1 in 600)*	**3**
	No occurrences observed during testing.	No observed failures associated with almost identical design or in design simulation and testing.	One occurrence per year *(1 in 1200)*	**2**
Very Low		Failure is eliminated through preventive control.	Less than one occurrence per year *(<1 in 1200)*	**1**
Occurrence frequency for PFMEA should be calculated based upon yearly production volumes (for example, if 1,200 units are produced each year, one occurrence per month equals 1 in 100 units produced)				

Figure 3: Occurrence Ranking Criteria for DFMEA and PFMEA

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Detection Rating Scale		
Rank	**DETECTION PROBABILITY**	**CRITERIA**
10	**No detection opportunity**	No current process control; Cannot detect or is not analyzed.
9	**Not likely to detect at any stage**	Failure Mode and/or Error (Cause) is not easily detected (e.g. random audits)
8	**Problem Detection Post Processing**	Failure Mode detection post-processing by operator through visual/tactile/audible means.
7	**Problem Detection at Source**	Failure Mode detection in-station by operator through visual/tactile/audible means or post-processing through use of attribute gauging (go/no go, manual torque check/clicker wrench, etc.)
6	**Problem Detection Post Processing**	Failure Mode detection post-processing by operator through use of variable gauging or in-station by operator through use of attribute gauging (go/no go, manual torque check/clicker wrench, etc.)
5	**Problem Detection at Source**	Failure Mode or Error (Cause) detection in-station by operator through use of variable gauging or by automated controls in-station that will detect discrepant part and notify operator (light, buzzer, etc.). Gauging performed on setup and first-piece check (for set-up causes only).
4	**Problem Detection Post Processing**	Failure Mode detection post-processing by automated controls that will detect discrepant part and lock part to prevent further processing.
3	**Problem Detection at Source**	Failure Mode detection in-station by automated controls that will detect discrepant part and prevent automatically lock part in station to prevent further processing.
2	**Error Detection and/or Problem Prevention**	Error (Cause) detection in-station by automated controls that will detect error and prevent discrepant part from being made.
1	**Detection not applicable; Failure Prevention**	Error (Cause) prevention as a result of fixture design, machine design or part design. Discrepant parts cannot be made because item has been error-proofed by process/product design.

This scale was adapted from the AIAG FMEA Manual (4th Edition)

22.6. PROCESS FLOW DIAGRAM (AIAG PPAP 2.2.5)
Process Flow Diagrams are required for all Level 3 PPAP submittals.

22.7. PROCESS FMEA (AIAG PPAP 2.2.6)
PFMEAs are required for all Level 3 PPAP submittals. Additional FMEA requirements are outline in section 13.6

22.8. CONTROL PLAN (AIAG PPAP 2.2.7)
Control Plans are required for all Level 3 PPAP submittals.

23. MEASUREMENT SYSTEMS ANALYSIS (MSA) STUDIES (AIAG PPAP 2.2.8)

For all Level 3 PPAP submittals, Oshkosh requires separate GR&R's be submitted for each measurement gage or device family gage that is used to validate Special (Significant, Critical, Major or CSI) Characteristics identified on the Design Record or listed in the Control Plan.

Note: not all product and process characteristics listed in the Control Plan are expected to require extensive measurement systems analysis scrutiny. Suppliers are encouraged to use a risk-based approach when evaluating whether GR&R's should be required for any non-Special Characteristic measurements listed in the Control Plan. However, where no Special Characteristics are identified in the

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Design Record or in the Control Plan, Oshkosh reserves the right to require MSAs and/or demonstration of Initial Process Capability on any characteristics.

23.1. Definitions

a) Measurement Systems are the collection of instruments or gages, standards, operations, methods, fixtures, software, personnel, environment, and assumptions used to quantify a unit of measure or fix assessment to the feature characteristic being measured.
b) Gages are any devices used to obtain measurements or data (includes go/no-go devices).
c) Device Family Gages are standard non-precision gages and measurement tools (such as micrometers or calipers) that are of the same make and model.
d) Measurement System Analysis (MSA) is a mathematical method of determining how much the variation within the measurement process contributes to overall process variability. MSA is used to ensure the use of the right measurement system for running production. Oshkosh requires suppliers to perform MSA in accordance with AIAG MSA Manual 4th edition. Additional training, analysis instruction, and worksheets are available within the PPAP workbook, and on the Oshkosh portal https://osn.oshkoshcorp.com/
e) Gage Repeatability and Reproducibility (GR&R) is used to ensure that measurements used in the manufacturing process are reasonably consistent regardless of how many times they are performed, or by who they are performed. GR&R can be useful to suppliers in that they can identify equipment that needs service, or operators who need additional training on the equipment. In addition to repeatability and reproducibility (GR&R), MSA studies must also address bias, linearity, and stability.

23.2. GR&R Requirements

The minimum number of appraisers, trials and parts when performing GR&R's are as follows:

- Variable data - 3 appraisers, 3 trials, 10 parts
- Attribute data - 3 appraisers, 3 trials, 30 parts

Parts used in the study should represent the entire range of the tolerance. Whenever possible, the appraisers used to conduct the study should be the ones who normally perform the measurements in production. Measurements should be taken in the normal production location utilizing the production measuring equipment for the entire study.

Assessment of the measurement system should be based on the Total Tolerance of the feature being measured (i.e. %GRR to TOLERANCE). Guidelines for measurement system acceptability are as follows (reference Table VIII-A):

- The percent GRR should be less than 10% for gages used to measure Special Characteristics
- Gages whose percent GRR is between 10% to 30% may be acceptable for some applications, but use of the gage must be approved by Oshkosh NGDV Quality Engineering
- Gages whose percent GRR is over 30% are considered unacceptable for the application and cannot be used

GRR	Decision
Less than 10 percent	**Gage considered to be acceptable for application**
10 percent to 30 percent	**Gage may be acceptable for some applications.** **Use of gage must be approved by OSK**
Over 30 percent	**Gage considered to be unacceptable for application**

Table VIII-A: GR&R Criteria

24. DIMENSIONAL RESULTS (AIAG PPAP 2.2.9)

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100%-dimensional inspection is required for a minimum of three (3) parts for each Level 3 PPAP submittal. 100%-dimensional inspection is required for a minimum of one (1) part for each Level 2 PPAP submittal. One (1) piece dimensional results are required for any subcomponent outlined on the drawing being purchased for each Level 2 or Level 3 PPAP submittal.

Dimensional results for PPAP must be taken from production parts. For production parts that are produced from more than one die, mold, tooling, pattern, cavity or production process, the Supplier shall complete full dimensional layouts from each.

Measuring equipment should have a discrimination of at least one-tenth of the total tolerance being measured (AIAG MSA, chapter 1 sect. E)

1. ***Best Practice:*** *it is permissible to add additional tabs to the Excel PPAP workbook to facilitate better organization of the PPAP submittal. Example- separate dimensions and print notes worksheets preceded by the applicable bubbled print for multiple components of an assembly / weldment. Be careful that the embedded formulas also are copied if you add worksheets.*

2. ***Best Practice:*** *True Position specifications. To facilitate better understanding, and standardize documentation, it is recommended to list both the "x" and "y" basic dimensions, the hole/feature size, and true position tolerance zone as shown below. Also, express "Bonus Tolerances" as a separate line item within the dimensional PPAP worksheet. The example below expresses the allowable bonus tolerance that can be added to the True Position feature frame when a maximum material condition (MMC) exists.*

ITEM	DIMENSION / SPECIFICATION	TOLERANCE		SPECIFICATION / LIMITS		GAGE TYPE*	QTY. TESTED	ORGANIZATION MEASUREMENT RESULTS (DATA)			OK	NOT OK
		-	+	MIN	MAX			Piece 1	Piece 2	Piece 3		
88	60.33	Basic		Basic	Basic	Basic	CMM	1	60.266			X	
89	22.23	Basic		Basic	Basic	Basic	CMM	1	22.220			X	
90	9.53	0.500		0.500	9.030	10.030	CMM	1	9.526			X	
91	⌖ Ø0.5Ⓜ A B C	GD&T		GD&T	0	0.500	CMM	1	0.130			X	
	Bonus Tol	GD&T		GD&T	GD&T	GD&T	CMM	1	0.496			X	

25. RECORDS OF MATERIAL / PERFORMANCE TEST RESULTS (AIAG PPAP 2.2.10)

25.1. Material Test Results

It is the Supplier's responsibility to confirm the conformance of their material to applicable standards for PPAP submission. The Supplier shall perform all chemical, physical, metallurgical, or mechanical property tests for all parts and product materials when chemical, physical, metallurgical, or mechanical property requirements are specified by the Design Record or Control Plan.

Examples of Material Test Results that are required for all PPAP submittals include: raw material certifications, painting, plating, heat-treating, welding (documentation necessary to demonstrate conformance to specified weld requirements such as Weld Procedure Qualification Requirements), etc.

When the supplier maintains "design record authority" for the part (and sub-component parts), and material details are not documented on the design record, Oshkosh NGDV requires all material test results (with Qualified Lab documentation) to be maintained by the supplier and made available to Oshkosh NGDV upon request.

Material test results may be presented on any AIAG compliant form (the Oshkosh NGDV PPAP workbook also includes a template). Raw material composition results are to be presented in a Certificate of Analysis (COA) form. Qualified Lab documentation must accompany each material test result form (reference the Qualified Lab Documents section of this Addendum).

Materials test results shall indicate and include:

- The design record change level of the parts tested
- Any authorized engineering changes that have not yet been incorporated into the design record (if applicable)
- The number, date, and change level of the specifications to which the part was tested
- The date on which the testing took place (rule of thumb is </= 18 months old)
- The quantity tested

- The specified parameters and actual results
- The material supplier's name

25.2. PERFORMANCE TEST RESULTS

The Supplier shall perform tests for all part(s) or product material(s) when performance or functional requirements are specified by the Design Record or Control Plan. A performance test (unlike in-process checks, which do not require qualified laboratory documentation) is the process of verifying the functionality of the Product (Finished Part) when exposed to the conditions that they will be used in.

The Supplier shall use the performance test form provided in the Oshkosh NGDV PPAP workbook to document and submit the performance test results. Qualified Lab documentation must accompany each performance test result form (reference the Qualified Lab Documents section of this Addendum)

Performance test results shall indicate and include the following:

- The design record change level of the parts tested
- Any authorized engineering changes that have not yet been incorporated into the design record (if applicable)
- The number, date, and change level of the specifications to which the part was tested
- The date on which the testing took place
- The quantity tested
- The specified parameters and actual results

Welding Procedure Specifications (WPS), and Procedure Qualification Records (PQRs) shall be included within the PPAP submittal when applicable, and shall be stamped / signed, dated as "approved" by a Qualified Welding Inspector (see section 12).

25.2.1. ON-GOING TESTING

It is the Supplier's responsibility to plan for ongoing material and performance testing and to identify these as separate line items in the Control Plan. This ensures that the Supplier has a plan for continuous verification of the performance and materials requirements. The interval of inspection is to be recommended by the Supplier; however, Oshkosh reserves the right to request a change in the frequency of this inspection

26. INITIAL PROCESS STUDIES (AIAG PPAP 2.2.11)

Initial Process Studies are required for all Level 3 PPAP submittals where Special (Significant, Critical, Major or CSI) Characteristics identified on the Design Record or listed in the Control Plan. 100% inspection is required until Cpk minimums are achieved.

- All Major or Critical Characteristics shall demonstrate a minimum Cpk of 1.67.
- All Significant Characteristics shall demonstrate a minimum Cpk of 1.33.
- 100% inspection to be conducted until Cpk thresholds met.
  - Inspections to be reflected within the supplier's Process Control Plan
  - Records as evidence of 100% inspection to be maintained, and submitted upon request

The requirements for Significant Production Runs and Quality Indices shall be in accordance with PPAP Manual (Fourth Edition) Appendix H. All other PPAP Manual 2.2.11 requirements apply as written in the PPAP Manual (Fourth Edition).

Where no Special Characteristics are identified in the Design Record or in the Control Plan, Oshkosh reserves the right to require demonstration of Initial Process Capability on any other characteristics.

27. QUALIFIED LABORATORY DOCUMENTATION (AIAG PPAP 2.2.12)

Material or Performance Tests for PPAP shall be performed by a qualified laboratory.

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After Market (GIPS) order quantities of </= 2 within a calendar year will require Material / Performance Certifications, but will not require Qualified Laboratory Documents

If Material or Performance Tests are performed by an Internal or External Lab that:

IS NOT accredited: the Supplier must provide:

- The name of the laboratory that performed the test
- Documentation (work instruction) for each type of test conducted.
- Training records / certifications of personnel who performed the testing (to show competency
- List of all test equipment used to perform testing
- Calibration records of all test equipment used
- The date on which the testing took place

IS ACCREDITED: the Supplier shall submit the test results on the laboratory letterhead or in the normal laboratory report format. The laboratory report must include:

- The name of the laboratory that performed the test
- The laboratory's accreditation standard (and accreditation number and/or name of the 3rd party organization that provided accreditation) *Note: Oshkosh NGDV expects that all accredited labs be accredited to a known lab accreditation standard such as ISO 17025*
- List of standards used for testing
- The date on which the testing took place

28. APPEARANCE APPROVAL REPORT (AAR) (AIAG PPAP 2.2.13)

AAR's are only required when requested by Oshkosh Quality Engineering Representative Appearance Approval Report, Appendix B in the AIAG PPAP manual.

29. SAMPLE PRODUCTION PARTS (AIAG PPAP 2.2.14)

The Supplier shall ensure that the "PPAP Parts Label" is filled out and attached appropriately to the outside of each package. Label should be in plain view of a forklift / material handler / operator. In the event parts are "Loose" shipped, a label should be placed on each part (this would also apply to parts lying on pallets). Label on a painted part must be wire tied or attached in a way such that the painted surface is protected from label adhesion.

30. MASTER SAMPLE (AIAG PPAP 2.2.15)

A master sample is not required to be retained by the supplier unless specifically requested by Oshkosh NGDV, however, the Supplier is required to photo document a Master Sample for all PPAP submittals. Photo documentation should illustrate how the parts will look like in the final state in which they are provided to Oshkosh. Specific focus of photo documentation should be on part labeling (to include any date codes, vendor codes, etc. if applicable), no paint zones if applicable.

31. CHECKING AIDS (AIAG PPAP 2.2.16)

Checking aids include all dedicated instruments, templates, attribute and variable gages, fixtures, or jigs that are used to determine acceptance/rejection of a product characteristic.

- If a device is specifically made for the part being verified, and the part is not available as a catalog item, it is a "checking aid".
- The Supplier shall certify that all aspects of the checking aid agree with part dimensional requirements.
- The supplier shall document all released engineering design changes that have been incorporated in the checking aid at the time of PPAP submission.
- The supplier shall provide for preventative maintenance of any checking aids for the life of the part.

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- If a checking aid is used to verify a Special Characteristic, the Supplier shall conduct the appropriate MSA activities including Gage R&R (see section 14).

32. PART SUBMISSION WARRANT (PSW) (AIAG PPAP 2.2.18)

PSW's are required for all PPAP submissions. It is recommended that suppliers utilize the Oshkosh NGDV version of the PSW. Equivalent forms may be considered.

33. L1 CODE FOR C OF C SUBMISSIONS

34. REVISION CONTROL TABLE

Version	Change Detail	Changed By	Change Date
1.1			
1.2			
1.3			
1.4			
1.5			