Production Part Approval Process
AIAG PPAP 4\textsuperscript{th} Edition

Supplier Production Part approval process GHSP
11/24/2014
What is PPAP?

Defines generic requirements for production parts approval, including production and bulk materials

Applies to internal and external suppliers of:
- Bulk materials
- Production materials
- Production or service parts

For bulk materials, PPAP is NOT required unless requested by the customer
Why do we PPAP?

- To demonstrate we (the manufacture) have met our commitments to the customer and are ready for production. **Quality & Delivery**
- To communicate we know we are adequately controlling the quality of the product.
- To obtain reimbursement for the capital investing (Tooling) that was put forth in good faith to meet expectations.
- PPAP is a **process** for the supplier NOT for the customer. The PPAP submission is an event for the customer to review and approve.
- PPAP submissions should **not** be treated in a way that is intended to use the customer to inspect in the quality (find the issues). The supplier should be submitting a fully complete package with the expectation of approval.
Objectives

- Understand the Purpose of PPAP
- Understand what PPAP does NOT do
- Understand each element of PPAP including the evidence required to demonstrate conformance.
- Communicate what GHSP quality professionals do and do not do.
- Question and Answers

* Fourth Edition PPAP Manual, 2006,
## Elements of PPAP

GHSP defaults to level 3 unless otherwise specified. SDE or SQE determines what evidence they want submitted.

<table>
<thead>
<tr>
<th>ELEMENTS OF PPAP</th>
<th>LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Design Records</td>
<td>I</td>
</tr>
<tr>
<td>2 Engineering Change Documents, if any</td>
<td>II</td>
</tr>
<tr>
<td>3 Customer Engineering Approval, if required</td>
<td>III</td>
</tr>
<tr>
<td>4 Design FMEA</td>
<td>IV</td>
</tr>
<tr>
<td>5 Process Flow Diagrams</td>
<td>V</td>
</tr>
<tr>
<td>6 Process FMEA</td>
<td></td>
</tr>
<tr>
<td>7 Control Plan</td>
<td></td>
</tr>
<tr>
<td>8 Measurement System Analysis Studies</td>
<td></td>
</tr>
<tr>
<td>9 Dimensional Results</td>
<td></td>
</tr>
<tr>
<td>10 Material, Performance and Test Results</td>
<td></td>
</tr>
<tr>
<td>11 Initial Process Studies</td>
<td></td>
</tr>
<tr>
<td>12 Qualified Laboratory Documentation</td>
<td></td>
</tr>
<tr>
<td>13 Appearance Approval Report (AAR) if applicable</td>
<td></td>
</tr>
<tr>
<td>14 Sample Product</td>
<td></td>
</tr>
<tr>
<td>15 Master Sample</td>
<td></td>
</tr>
<tr>
<td>16 Checking Aids</td>
<td></td>
</tr>
<tr>
<td>17 Records of Compliance with Customer-Specific Requirements</td>
<td></td>
</tr>
<tr>
<td>18 Part Submission Warrant (PSW) Note Bulk Material Checklist</td>
<td></td>
</tr>
</tbody>
</table>

| R | The Supplier (Organization) shall retain AND submit to the customer upon request |

* Fourth Edition PPAP Manual, 200; 2nd printing November 2009,
“The organization shall meet all specified PPAP requirements…elements 1 thru 18. The organization shall also meet all customer-specific PPAP requirements.” PPAP 4th Edition, March 2006, p3
**PPAP process flowchart**

### Tiered PPAP Process Flowchart from OEM to Tier 3 suppliers

<table>
<thead>
<tr>
<th>OEM Provides (Ford, Chrysler, Honda)</th>
<th>Tier 1 (GHSP)</th>
<th>Tier 2 (Supplier 1:N to GHSP)</th>
<th>Tier 3 (Supplier A:Z to Supplier 1:N)</th>
<th>OEM Receive &amp; Decide (OEM, Tier 1, Tier 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Purchase Order/Customer Specific Requirements</td>
<td>Tier 1 Sources Tier 2 and communicates PPAP date</td>
<td>Tier 2 Sources Tier 3 and communicates PPAP date</td>
<td>Tier 3 Sources Tier 3 and communicates PPAP date</td>
<td>Assign Project Owner and Assemble Team (APQP)</td>
</tr>
<tr>
<td>Customer Part Design Requirements (Design Records)</td>
<td>Assign Project Owner and Assemble Team (APQP)</td>
<td>Assign Project Owner and Assemble Team (APQP)</td>
<td>Assign Project Owner and Assemble Team (APQP)</td>
<td>Gather information</td>
</tr>
<tr>
<td>Customer Process Design Requirements (Continuous Quality Improvement CQI)</td>
<td>Gather information</td>
<td>Gather information</td>
<td>Gather information</td>
<td>Gather information</td>
</tr>
<tr>
<td>Customer Specifications</td>
<td>Evaluate situation and determine applicable PPAP elements including customer specific</td>
<td>Evaluate situation and determine applicable PPAP elements including customer specific</td>
<td>Evaluate situation and determine applicable PPAP elements including customer specific</td>
<td>Evaluate situation and determine applicable PPAP elements including customer specific</td>
</tr>
<tr>
<td>Customer Logistics Requirements</td>
<td>Complete, analyze and resolve issues until part is ready for PPAP</td>
<td>Complete, analyze and resolve issues until part is ready for PPAP</td>
<td>Complete, analyze and resolve issues until part is ready for PPAP</td>
<td>Complete, analyze and resolve issues until part is ready for PPAP</td>
</tr>
<tr>
<td></td>
<td>Complete and Submit PPAP with approved PSW</td>
<td>Complete and Submit PPAP with approved PSW</td>
<td>Complete and Submit PPAP with approved PSW</td>
<td>Complete and Submit PPAP with approved PSW</td>
</tr>
<tr>
<td></td>
<td>Tier 2: Initiated Changes to Part, specs etc.</td>
<td>Tier 3: Initiated Changes to Part, specs etc.</td>
<td>Tier 3: Initiated Changes to Part, specs etc.</td>
<td>Tier 3: Initiated Changes to Part, specs etc.</td>
</tr>
</tbody>
</table>

**OEM starts first and ends last.**

The Tiers start after each other (sequential) but end before each other (reverse order)
1. Design Records

- The supplier shall have all design records for saleable product
  - Includes an approved design record for components or details
  - There is only one design record regardless of who has design responsibility
  - If the supplier is design responsible, GHSP may release the supplier’s design records into our system for documentation and data control. This may include supplier performance specifications.
  - For catalog parts, the design record may only consist of functional specs or a recognized industry standard. Example: MOSFET 60V, 3a, AEC 201 qualified
- When the “master” design record is in electronic format, hard copy must be supplied

GHSP SDE/SQE Responsibilities:

- Verify Design Records submitted with PPAP are a controlled version, at the correct revision level and includes any design records incorporated by reference.
2. Engineering Change Documents

- Any authorized engineering change documents not yet recorded on the design record but incorporated in the product, part or tooling
- Approved customer engineering changes
  - Approved Change Notifications
  - Approved Change Authorizations awaiting drawings
- Approved Supplier SREAs that will generate CAs

GHSP SDE/SQE Responsibilities:
- If we are asked to have suppliers PPAP to a marked up drawing, this may be acceptable for short term as long as we have a ECR # and action plan to complete the change with clear responsibilities (owners).
  - When the change officially is complete we may ask for an updated PSW only and file in same PPAP folder that we used for marked up change.
3. Customer Engineering Approval

• Where specified by the design record, the supplier shall have evidence of customer engineering approval

GHSP SDE/SQE Responsibilities:

• To obtain customer (OEM) Engineering approval if required as a part of customer specific requirements. Generally this is not required.
4. Design FMEA

- Suppliers shall have a Design FMEA for parts for which they are design-responsible.

- Compliant to Potential Failure Mode and Effects Analysis reference manual 4th Edition
  - Need to have RPN values calculated for each item
  - Need to have actions identified with dates and results for those items that are considered high risk

- Need to have all critical, significant, and pass thru characteristics identified in the appropriate column.

GHSP SDE/SQE Responsibilities:

- If GHSP is design responsible, provide a copy of GHSP DFMEA(s) to suppliers.

- If Supplier is design responsible, review the DFMEA and check that recommended actions have been completed, all special characteristics are represented and look for evidence of past problem history (PTR references) as appropriate.
5. Process Flow Diagrams

• Process flow diagram format that clearly describes production process steps and sequences
  – Compliant to Advanced Quality Product Planning and Control Plan Manual (APQP 2\textsuperscript{nd} Edition).

GHSP SDE/SQE Responsibilities:

• Review PFD for linkage to D/PFMEA’s (special characteristics) and Control Plan. Has receiving and outgoing quality checks if applicable.
6. Process FMEA

- The supplier shall have a Process FMEA
  - Compliant to Potential Failure Mode and Effects Analysis reference manual 4th Edition
  - Includes all Critical, Significant and Pass-Through characteristics

- A single Process FMEA may be applied to a process manufacturing a family of similar parts or materials

GHSP SDE/SQE Responsibilities:

- Review PFMEA for linkage to PFD, CP, DFMEA and that past problems PTR’s are easily identifiable to demonstrate systemic incorporation of permanent corrective actions.
GHSP SDE/SQE Requirements Cont’d

• We are looking for evidence that the supplier understands how their component or sub-assembly interfaces with the overall product.
• We are looking for evidence that the supplier used the PFMEA to predict, learn and implement additional process controls to decrease occurrence and detection rankings.
• Critical Characteristics (open stars) are safety critical… Severity of failure effects are expected to be in the 9 or 10 range.
• Performance requirements may be identified as special characteristics!
7. Control Plan

- The control plans define the specific methods used to control the Process and Product requirements. Take note:
  - SPC is NOT control method; Xbar/R control chart is a method.
  - Include Sample sizes & frequencies that are specified in performance specifications.
  - Product requirements include performance and annual validation.
  - References to other quality system documents are not sufficient.
  - Must include special characteristics.

- The control plans required at launch are to include safe launch/flawless/GP-12 with increased inspection frequencies / sample sizes.

- An exit strategy from safe launch/flawless/GP-12 is also required. An example is 60 consecutive production runs with 0 defects found at inspection.

- Control Plans for “families” of similar parts are acceptable if the new parts have been reviewed for commonality.

- Include the following sections: Incoming, in process, finished part audit, containment, annual verifications (eg: performance or dimensional).

- Certain OEM customers may require Control Plan approval.
GHSP SDE/SQE Responsibilities

• Review the CP for linkage to the DFMEA, PFMEA and PFD
• Verify control methods and reaction plans make sense
• Verify all Special Characteristics are documented
• Verify Annual Revalidation is included
8. Measurement System Analysis

- MSA studies e.g., Gage R&R, bias, linearity, stability for all new or modified gages, measurement and test equipment shall be completed and acceptable.
- ANOVA based Gage R&R should be used as it includes Operator interactions
- Acceptability criteria may be found in the MSA manual.
  - Generally <10% error is acceptable; 10%-30% may be acceptable depending on the initial process capability, importance of the application or cost of measurement device.
  - Number of distinct categories needs to be greater than or equal to 5.*
  - %Study Variation (%SV) denotes the gauge’s ability for use for process control (SPC)
  - %Tolerance Variation (%TV) denotes the gauge’s ability to determine if parts are in tolerance
  - %TV alone may be used in special cases where capability is over 2.5 Ppk
- Typical issues we are finding are around missing linearity, bias and stability studies
- Parts used for Gage R&R must be representative of the capability of the process. Process variation is a significant component of the R&R study.
- We are also finding parts in the study that are outside the process variation that was submitted in the initial process capability studies. This raises questions over the integrity of the Cpk studies.

  * While this is a requirement, we need to look at the MSA in a holistic sense and if there is a rational reason such as understanding the sensitivity of the GRR over various degrees of variation then we are open to deviating from this as long as the science supports the situation.
GHSP SDE/SQE Responsibilities

• Review MSA package for completeness
• Verify gauges meet requirements listed in AIAG MSA manual for both variable and attribute gauges
9. Dimensional Layout

• The dimensional layouts are to be done on every dimension, note and specification. It is recommended that reference and basic dimensions are listed on the report.
• The layout should be numbered in accordance to a pictorial (ballooned) print and tracings or equivalent.
• The dimensional layouts are to include 6 samples with all cavities represented if mold has $\leq 6$ cavities.
• The dimensional report submitted is expected to show conformance. Don’t pass a defect (out of tolerance or TBD)-initiate problem solving.

GHSP SDE/SQE Responsibilities
• Review Dimensional Results for completeness
10. Material Performance Test Results

- The expectation is that all material and performance requirements on the design record(s) including the requirements incorporated by reference are met:
  - Material Certs <1 yr old
  - Tested against standard (ex: ASTM A204 304 Stainless Steel)

- The expectation is that all performance requirements are documented to have been tested:
  - To the specification(s)
  - In the right quantity
  - **EX:** Subgroup & sample sizes, per R&C requirements
  - CQI-9 audit form for heat treated components
  - CQI-11 audit for plated components
  - CQI-12 audit for coated / painted parts
  - All sub-suppliers must be on the approved supplier list for the appropriate OEM
10. Material Performance Test Results

Material Test Results
- Perform tests for all parts and product materials when requirements are specified by design record

Performance Test Results
- Perform tests for all parts and product materials when performance or functional requirements are specified by design record

Tests shall be listed in convenient format

Indicate:
- Design level of part
- Change level of specifications tested to
- Date tested

GHSP SDE/SQE Responsibilities

- Review Material Performance Test Results for completeness and accuracy
11. Initial Process Studies

- An initial process study must be completed for all agreed-upon GHSP Significant and Critical characteristics. If no Special characteristics are designated select a part characteristic that is an indicator of the process.

- Process capability studies need to be evaluated for statistical control, stability and normality before one can even consider doing an initial process study in order to ensure the capability calculations are accurate.

- A minimum of 100 parts in 25 subgroups is required by AIAG (note Ford requires 125 parts in 25 subgroups). GHSP Defaults to 125 parts in 25 subgroups, subgroup size = 5.

- Control charts need to be submitted to show evidence of statistical control. The preference is Xbar/R but IMR may be approved upon request.

- If process is not normal, further analysis is required such as transforming the data or looking to long term historical data from a like process with similar level of precision requirements. Minitab Capability Six Pack does an efficient job at showing all the needs in 1 snapshot.

- Index > 1.67 is acceptable. GHSP requirement is Ppk > 1.67

- Index > 1.33 but < 1.67 may be acceptable. Contact Customer; GHSP requires 100% verification through gauging, testing, poke-yoke or alternate method agreed upon. Why? GHSP Deviates from this as our expectation is 0 PPM & index of 1.33 = 34 PPM

- Index < 1.33 not acceptable

- Suppliers should validate their method of calculating initial capability. GHSP offers an input data set on their website with known capability outcomes. Suppliers should verify this data set, when ran through their software, calculates the same capabilities.
11. Initial Process Studies

GHSP SDE/SQE Responsibility

• Verify stability, control and normality
• If not normal have actions been taken to understand why or transform the data?
• Verify capability index is acceptable
12. Qualified Laboratory

- Performance and Material testing need to be conducted by a qualified laboratory (e.g. an accredited laboratory)
- The scope of the laboratory accreditation/certification must show that the laboratory is qualified for the type of measurements or testing conduction. (TS16949, ISO, ISO/IEC 17025)
- If an outside laboratory is used, the organization shall submit the test results on the laboratory letterhead or the normal laboratory report format. The name of the laboratory that performed the tests, the date(s) of the tests and the standards used to run the tests shall be identified.
- Common mistakes
  - No data provided (“Meets” or Passes”)
  - Not on lab letterhead
  - Not accredited to complete the testing
  - Not tested to a industry standard or specific requirement

GHSP SDE/SQE Requirement
- Verify lab scope and letterhead
- Verify test data meets specification
A separate AAR form CFG-1002 is the standard and documents each part or series of parts meets appearance requirements are on the design record.

GHSP accepts this standard for all OEM’s. We expect all the form to be completed entirely. Internal GHSP quality professionals can translate the information into customer specific as needed.

If the part being PPAP’ed does not have a appearance requirement, this section of the submission should be identified as not applicable.

Multiple reasons for submissions may apply. For example, supplier may be submitting for full PPAP approval (PSW) AND a re-submission if the prior PPAP was rejected for aesthetic concerns.

The completed AAR must accompany production parts that represent production process. Use caution in sending in the best of the best (BOB) if you know that the product process produces variation is likely to vary. The vendor may accept this risk if they have an internal improvement plan. When subjective concerns arise later, we ALWAYS go back to the AAR samples as first reaction to calibrate ourselves. Manage this well.

We encourage duplicate AAR samples to be developed, submitted, tagged and retained by both manufacture and within GHSP. Why do you think this is a recommended practice?
14. Sample Product

- The organization shall provide sample product as specified by the customer.
- GHSP combines element #14 with element #15 (Master Samples). In PPAP packages, it would be recommended to refer to element #15.
15. Master Sample Parts

- The organization shall provide sample product as specified by the customer that are manufactured from the same time period as the PPAP submission.
- Each PPAP should have sample parts retained to that level (including annual revalidation). What is the benefit of this in your opinion?
- Master samples shall be retained for each position of a multi cavity die, mold, tool or pattern or production process. GHSP does not deviate from this.
- Master samples that are used for inspection, are often referred to as boundary samples. In this application of master samples, 2 sets shall be created tagged, purpose(e.g.max knit line), approved by the GHSP quality representative and 1 set shall be retained by the vendor. The other set should be provided to the GHSP receiving location.
16. Checking Aids

- What is a Checking Aid?
  - Fixture used to hold a part during manufacturing (example: heat treat holding fixture)
  - Attribute & Variable gages
  - Models
  - Templates (example: pattern for cutting fabric)
  - Mylars (example: overlay mylar to verify job set up of a gluing operation is putting glue in right area)

- Supplier may be required to submit the checking aids/fixtures. GHSP has substituted this requirement with our Tool and Gage Data Form.
- Supplier shall certify that all aspects of the checking aid agree with the part dimensional requirements.
- Supplier shall document that all engineering changes are reflected in and certified to be represented in the checking aids.
- MSA Studies shall be conducted in compliance with element #8 and incorporate by reference, the AIAG MSA standard manual.
17. Customer Specific Requirements

- **Capacity** – We must use the *Ford Capacity Analysis Report* (aka CAR) to show the ability to meet APW and MPW requirements. Most suppliers have done this but we found a few errors that need correction.

- **Sub-Supplier PPAP’s** – For product that is sold through a 2nd party such as distribution or value add, the level 3 sub supplier PPAP must be submitted with the vendors submission to GHSP. We need to assess the conformance of quality back to the source of where defects are produced. Distribution is source of where defects are detected.

- **Validation of Software** – For MSA and initial process capability studies, the supplier must validate that the software used is constructed to provide accurate calculated results. Validation data may be found on GHSP’s website under Policies&Procedures.

- **Dimensional Layout** –
  - A 6 piece dimensional layout per feature, per area, with all cavities represented if mold has <= 6 cavities. For example Feature is a hole diameter in 5 locations (0.1000 +/- 0.01" 5 pcs) and the tool has 2 cavities we would expect to see 6 measurements between cavities (2) in 5 place for a total of 30 points, 15 from each cavity.
  - The layout must follow the Ford Tag (T) numbering system, if applicable, as shown on design record.
17. Customer Specific Requirements

- **GHSP Packaging Sketch Form**
  - A Packaging Sketch form may be required as a PPAP deliverable. This form may be found on GHSP’s website under Policies & Procedures.

- **GHSP Tool and Gauge Data Form**
  - A Tool and Gauge Data form may be required as a PPAP deliverable. This form may be found on GHSP’s website under Policies & Procedures.

- **NAFTA Country of Origin Form**
  - A NAFTA CoO form may be required as a PPAP deliverable. An example form may be found on GHSP’s website under Policies and Procedures.

- **Run at Rate Form**
  - A completed Run at Rate form may be required as a PPAP deliverable. Any RED or at-risk items must have a corrective action plan documented and pre-approved.

- **Packaging Label**
  - A sample packaging label may be listed as a PPAP deliverable. All packaging labels shall meet GHSP’s required format. Label format requirements may be found in our Supplier Manual on GHSP’s website under Policies & Procedures.

- **PPAP Checklist**
  - A GHSP specific PPAP checklist may be required as a PPAP deliverable. This checklist may be found on GHSP’s website under Policies & Procedures.
17. Customer Specific Requirements

- **Control Plans**
  - Process controls such as speeds and feeds need to be specified.
  - Special Characteristics need to be identified and have appropriate controls.

- **Initial Process Studies**
  - Must use minimum of 125 pieces from the 300 piece production run.
  - Randomly select 125 parts and record on Xbar/R in subgroup sizes of 5 for 25 subgroups.
  - Must be stable in statistical control and normal (p value > .05)*
  - If normality cannot be established, either transform the data or model the study after an known distribution. (see any Six Sigma blackbelt for help on this if needed)

- **PFMEA**
  - Need to show failures from customer and consumer viewpoint.
  - Special Characteristics need to be identified, have appropriate severities and controls.
18. Part Submission Warrant

- PSW are completed once ALL other PPAP elements have been completed.
- All fields must be filled out appropriately.
- The PSW shall be completed for each CUSTOMER part number. GHSP does not deviate on this.
- The organization shall verify that all the measurement and test results show conformance with customer requirement and that all required documentation (elements 1-18) are available.
- PSW’s are legally binding documents, admissible to legal proceedings and declare conformance. Definition of Affirm: Means to declare positively something to be true; Confirm something as binding or valid. Let’s consider the following statements:

“Declaration: I affirm that the samples represented by this warrant are representative of our parts which were made by a process that meets all PPAP Manual 4th Edition Requirements. I further affirm that these samples were produced at the rate of ___/____ hours. I also certify that documented evidence of such compliance is on file and available for review. I have noted deviations from this declarations below.”

What does this mean to you?
18. Bulk Material Requirements Checklist

Applies only to Bulk Material PPAP
GHSP does not generally apply Bulk PPAP currently
Documentation is Critical

No interim approval if documentation is not complete

- Failure to meet customer requirements for level of submission results in rejection REGARDLESS of part performance
- Signing the PSW is a guarantee that documentation meets customer requirements AND part performs as represented
PPAP Approval

Three levels of approval

– Full Approval
  • Part or material meets all customer specifications.
  • Authorized to ship production quantities of the product

– Interim Approval
  • Permits shipment for production on limited time or quantity
  • Only granted if root cause identified and action plan agreed by the customer

– Rejected
  • Submission, the production lot and accompanying documentation do not meet requirements
  • Corrected product, process and/or documentation must be submitted before product can be shipped
Let’s Review

You have learned that:

Supplier PPAP submission requirements vary but the PPAP REQUIREMENTS (elements) are the same.

AIAG has identified 17 elements to a generic PPAP

AIAG has identified 1 element that is customer specific

AIAG has 18 elements in total.

Responsibilities for completing the evidence ranges across the company, not just with the Quality Professional Function
Which of the following is a requirement for a process flow diagram?

A. Must clearly describe production process steps
B. Must clearly describe production process sequence
C. Must be in format determined by supplier
D. All of the above
E. None of the above
Dimensional Information supplied to the customer should **not** include which of the following items?

A. Design Record at appropriate revision level  
B. Data supporting parts meet all dimensions and notes  
C. Data supporting parts meet all dimensions without notes
Let’s Review

Who makes the final decision that a separate PSW is required for each part number?

A. Customer
B. Supplier
C. Both
Is the statement below true? Answer Yes or No. Retain master samples for the same period as production part approval records.
All 18 elements of the PPAP package should be included in a electronic folder and remain intact

PPAP packages are required to be stored at SOP

- Review and update applicable items in the file to reflect production process even if formal submission is not required
- Retain record of customer waiver of formal submission
PPAP Takes Time

• PPAP is a process, not an event. Each PPAP element is a tool to help a manufacturer develop and measure their process in addition to providing documentation showing compliance to the customer engineering record.

• The purpose of the PPAP process is to create and document a process that is able to produce a product to a customer’s engineering design record consistently.

• It is important to understand AIAG and GHSP PPAP requirements and ensure PPAP submissions meet all requirements prior to submitting. Do not expect your customer to verify submission quality!

• It is important to submit PPAP on time to program timing. A late submission results in timing slip at your customer!
THANK YOU!