POLARIS®

Production Part Approval Process (PPAP) Training – SQE/SDE Department

Agenda

Learning Objectives
Purpose
Table of Contents Overview
PPAP Overview / Expectations
References / Resources
Learning Objectives Recap
Wrap Up (FAQ / Q&A / Feedback)

Learning Objectives

At the end of this training, participants will be able to:

- What is the Purpose of PPAP?
- When is PPAP Required?
- What are the Elements of the submission?
- How are the Levels of PPAP applied?
- Details on successful PPAP submission to Polaris' facilities

Document Purpose

- The sole purpose of this document is to provide additional information, training and guidance to Polaris' supply base to ensure all PPAP documentation is provided in a manner consistent with expectations.
- This document is **not** intended to be all encompassing. PPAPs are to be created and submitted on the basis of AIAG standards.

Additional resources:

- **Automotive Industry Action Group (AIAG)**

  26200 Lahser Road, Suite 200
  Southfield, MI 48034
  Phone 248-358-3570
  www.aiag.org

  Training options available:
  - Courses at AIAG's headquarters in Southfield, MI
  - Onsite training
  - Webcasts

- **Quality-One**

  Detroit, MI USA
  1333 Anderson Road
  Clawson, Michigan 48017
  Phone: 248-280-4800

  Online training courses available for purchase at http://quality-one.com/online-training/
  - Production Part Approval Process (PPAP)
  - Process and Design Failure Mode and Effects Analysis (PFMEA & DFMEA)
  - Measurement System Analysis (MSA)
  - Eight Disciplines of Problem Solving (8D)
  - Advanced Product Quality Planning (APQP)
  - Six Sigma Black, Green, White and Yellow Belt training

- It is the supplier's responsibility to reach out to a Polaris representative if there are questions or concerns regarding PPAP preparation/submission. If you are unsure of anything, please ask.

Table of Contents

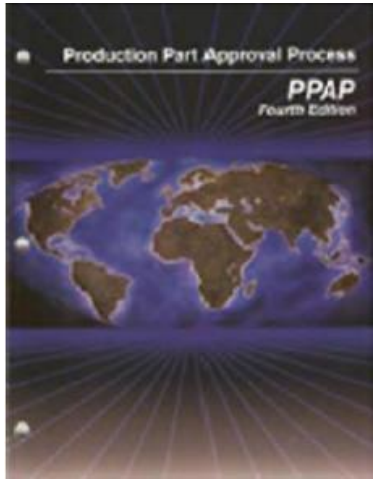
Note: Hyperlinks only work in presentation mode

What is PPAP?

Production Part Approval Process

- Rigorous and structured process for part qualification used to formally reduce risks prior to product or service release, in a team oriented manner using well established tools and techniques.
- Initially developed by AIAG (Auto Industry Action Group) in 1993 with input from the Big 3 - Ford, Chrysler, and GM.
- All AIAG forms are acceptable

Contact AIAG At:
Automotive Industry Action Group
26200 Lahser Road, Suite 200
Southfield, MI 48034
Phone 248-358-3570
www.aiag.org



Purpose of PPAP

- Provide evidence that all customer engineering design records and specification requirements are properly understood by the organization and achievable.
- To demonstrate that the manufacturing process has the potential to produce product that consistently meets all requirements during an *actual production run,* at the quoted production rate.
- All PPAP submission data/documentation shall be based on a *significant production run* as defined as any time period/quantity used to establish process capability, with all normal process variation accounted for.

PPAP manages change and ensures product conformance!

When is PPAP Required?

- PPAP submission required when:
  - New part released for production
  - Engineering change order (ECO)
  - Correction from previous submission discrepancy
  - Process Change Request (PCR) – any change to product or process. Note: Reference the *Polaris PCR Training Guide* for further details / guidance. Some examples:
    - *Alternative construction or materials*
    - *Tooling or equipment refurbishment, replacement, transfer or additional*
    - *Production at new or additional location*
    - *Change of or at a subcontractor or material source change*
    - *Product or process changes to component*

Note: At the discretion of Polaris, a PPAP submission may be requested at any time.

PPAP is required for *any* new or changed part/process!!

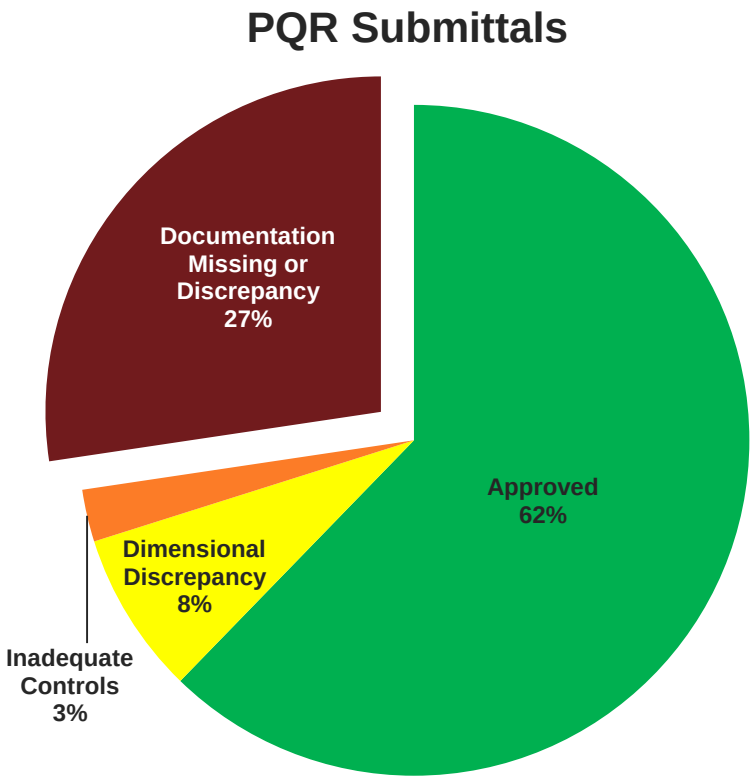
Benefits of PPAP Submission

- Forces formal part conformance and approval
- Ensures formal quality planning
- Helps to maintain design integrity
- Identifies issues early for resolution

- Reduces warranty charges and prevents costs of poor quality
- Assists with managing supplier changes
- Prevents use of unapproved and nonconforming parts
- Identifies suppliers that need more development
- Improves the overall quality of the product & customer satisfaction

Importance of Attention to Detail

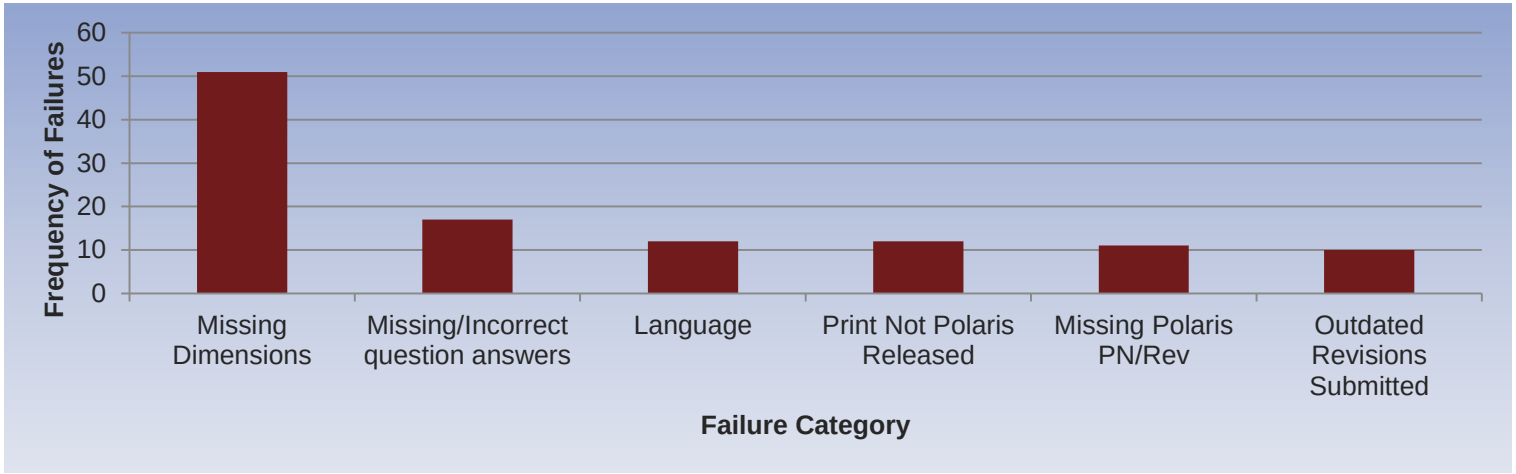
- In the last three months an analysis was completed on rejected PPAP submissions.
  - The majority of the rejected submissions were easily preventable (not filling out forms properly and/or not following simple directions/requirements).



- **62% Approved**
- **38% Rejected**
  - Majority due to documentation missing or discrepancy

~ 70% of PPAP submission failures due to *documentation*

Top Documentation Related PQR Failures



Missing Dimensions
- Dimensions and KPCs missing on required documents
- Balloon drawings not submitted
- Variable data missing

27%

Missing/Incorrect Question Answers
- PSW missing responses or not pertaining to the question

43%

Language
- Documents not submitted in English

57%

Print not PII Released

59%

Missing Polaris PN/Rev

65%

Outdated Revisions Submitted

70%

These are EASILY preventable!!

The Basics of PPAP

Submission requirements are called

Elements

Any element not submitted MUST be retained

Which element is required is determined by the submission

Level

18 Elements of PPAP

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

1. Design Record
2. Authorized Engineering Change Documents, if any
3. Customer Engineering Approval, if required
4. Design FMEA
5. Process Flow Diagrams
6. Process FMEA
7. Control Plan
8. Measurement System Analysis Studies
9. Dimensional Results
10. Records of Material / Performance Test Results
11. Initial Process Studies
12. Qualified Laboratory Documentation
13. Appearance Approval Report, (AAR) if applicable
14. Sample Production Parts
15. Master Sample
16. Checking Aids
17. Customer–Specific Requirements
18. Part Submission Warrant (PSW)

PPAP Levels – Submission & Retention Requirements

Requirement	Level 1	Level 2	Level 3	Level 4	Level 5
1. Design Record	R	S	S	*P	R
2. Authorized Engineering Change Documents, if any	R	S	S	*	R
3. Customer Engineering Approval, if required	R	R	S	*	R
4. Design FMEA	R	R	S	*P	R
5. Process Flow Diagrams	R	R	S	*P	R
6. Process FMEA	R	R	S	*P	R
7. Control Plan	R	R	S	*P	R
8. Measurement System Analysis Studies	R	R	S	*P	R
9. Dimensional Results	R	S	S	*P	R
10. Records of Material / Performance Test Results	R	S	S	*P	R
11. Initial Process Studies	R	R	S	*P	R
12. Qualified Laboratory Documentation	R	S	S	*	R
13. Appearance Approval Report, (AAR) if applicable	S	S	S	*P	R
14. Sample Production Parts	R	S	S	*P	R
15. Master Sample	R	R	R	*	R
16. Checking Aids	R	R	R	*	R
17. Customer–Specific Requirements	R	R	S	*	R
18. Part Submission Warrant (PSW)	S	S	S	S	R

S = The organization shall submit to the customer and retain a copy of records or documentation items at appropriate locations (AIAG std. requirement)

R = The organization shall retain at appropriate locations and make available to the customer upon request (AIAG std. requirement)

* = The organization shall retain at the appropriate location and submit to the customer upon request (AIAG std. requirement)

*P = Polaris default submission level - subject to modification

NOTE: Level 5 PPAP may be reviewed at supplier's manufacturing location

Level 4 is Polaris' default and the most common level requested

Submission Requirements (cont.)

- Polaris requests that all PPAPs be submitted electronically or scanned / uploaded into electronic PPAP system.
- Submissions must be in English.
- Submission must be received prior to the PPAP due date in order to allow for processing time at Polaris.
- Review and Approval Process:
  - *Samples are received into PPAP request system when package is delivered to the designated Quality Lab.*

Note: Reference the *Polaris PQR System Guide* for further submission details / guidance.

All submissions to be done electronically

PPAP Submission Status

Notification through PPAP request system

- Must be Approved or have Interim Approval granted prior to shipping product

- Full Approval
  - *Meets requirements*
  - *May ship product*
- Interim Approval
  - *Approved until specified date*
  - *Must meet condition by specified date*
  - *May ship product*
- Rejected
  - *Submission does not meet specifications*
  - *Do not ship product*

Production quantities may *not* be shipped without approval

Design Record – Definition/Purpose

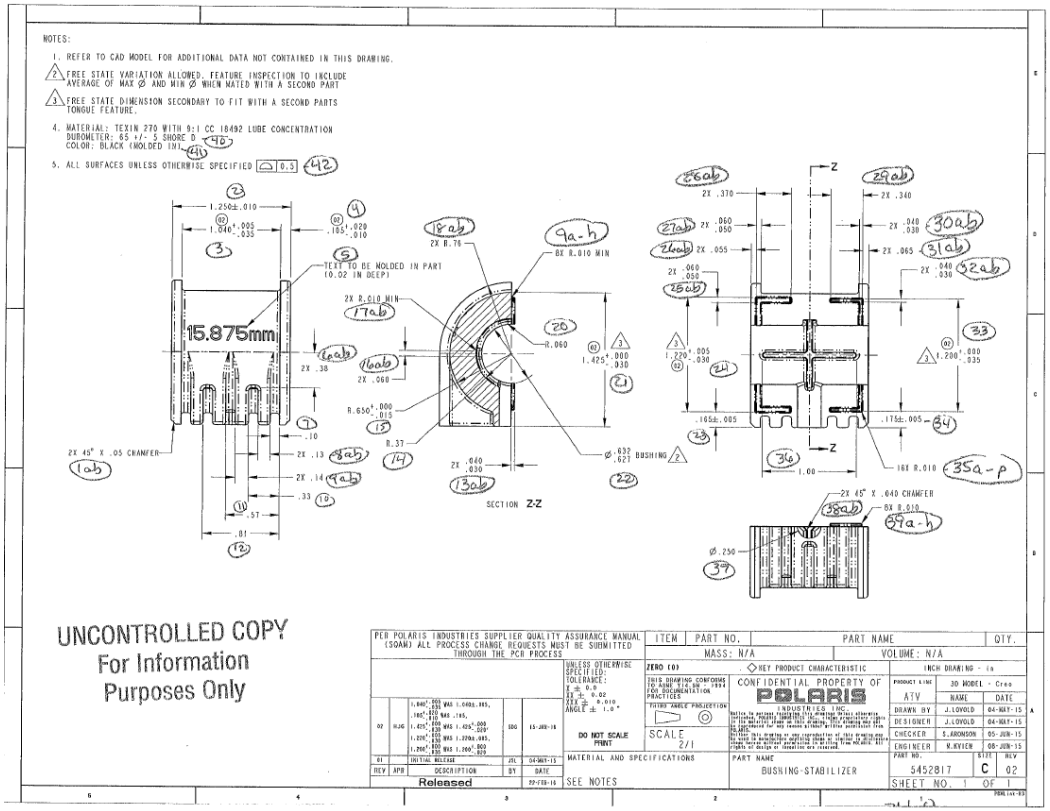
Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

- The Design Record is what the supplier has contracted to provide per the Polaris Purchase Order (PO). Examples would include, but not limited to:
  - *Polaris drawings (as defined by a unique Polaris part number) to the latest Engineering Change Level (ECL) or Rev Level as defined on the Purchase Order (PO).*
  - *Engineering specifications*
  - *Special notes added to the PO (i.e., paint it black or special packaging)*
- The engineering drawing portion of the Design Record is often used to provide a ballooned drawing when submitting Element 9 – Dimensional Results.
- Supplier drawings (if defined on the Polaris drawings or PO) would also be part of the Design Record.

Design Record – Ballooned Print Requirements

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

- Bubble print supports the dimensional report
  - *Must have all notes and specifications circled and numbered*
  - *Must be clear and legible*
  - *Must include any reference dimensions*
  - *Ideally, start numbering in upper-left and continue clockwise (maintain a logical pattern)*

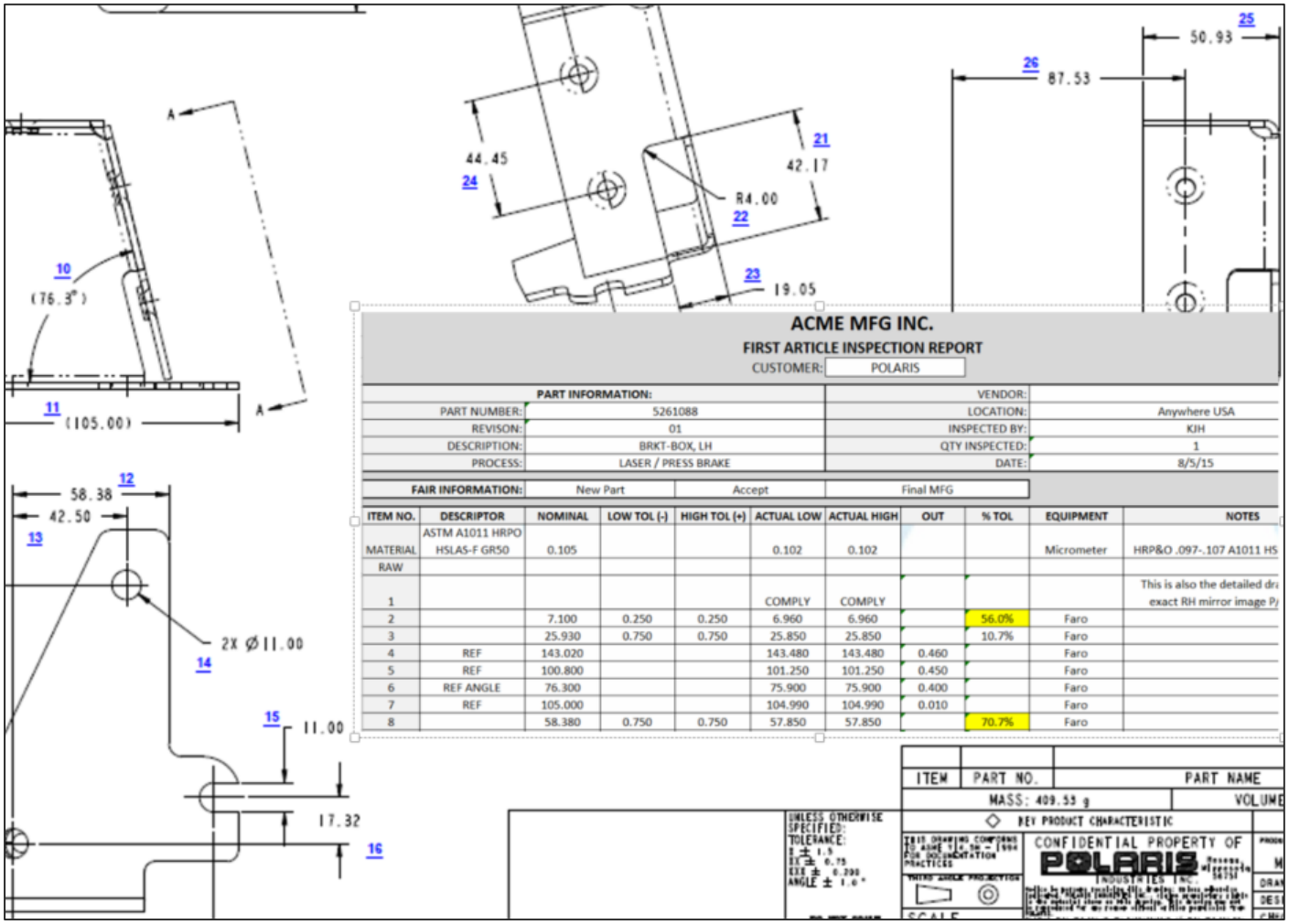


- Any additional supporting information:
  - *Reference prints*
  - *Sub-Assembly prints*
  - *Component prints with a different part number*
  - *Applicable material specifications*
  - *Applicable reference specifications*
  - *Customer specified workmanship standards*

All submissions should have one copy of the *Polaris* print

Design Record – Ballooned Print Example

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18



ACME MFG INC.

FIRST ARTICLE INSPECTION REPORT

CUSTOMER: POLARIS

PART INFORMATION:		VENDOR:	
PART NUMBER:	5261088	LOCATION:	Anywhere USA
REVISON:	01	INSPECTED BY:	KJH
DESCRIPTION:	BRKT-BOX, LH	QTY INSPECTED:	1
PROCESS:	LASER / PRESS BRAKE	DATE:	8/5/15

FAIR INFORMATION:	New Part	Accept	Final MFG

ITEM NO.	DESCRIPTOR	NOMINAL	LOW TOL (-)	HIGH TOL (+)	ACTUAL LOW	ACTUAL HIGH	OUT	% TOL	EQUIPMENT	NOTES
MATERIAL	ASTM A1011 HRPO HSLAS-F GR50	0.105			0.102	0.102			Micrometer	HRP&O .097-.107 A1011 HS
RAW										
1					COMPLY	COMPLY				This is also the detailed dr exact RH mirror image P
2		7.100	0.250	0.250	6.960	6.960		56.0%	Faro	
3		25.930	0.750	0.750	25.850	25.850		10.7%	Faro	
4	REF	143.020			143.480	143.480	0.460		Faro	
5	REF	100.800			101.250	101.250	0.450		Faro	
6	REF ANGLE	76.300			75.900	75.900	0.400		Faro	
7	REF	105.000			104.990	104.990	0.010		Faro	
8		58.380	0.750	0.750	57.850	57.850		70.7%	Faro	

ITEM	PART NO.	PART NAME
MASS: 409.53 g		VOLUME

◇ KEY PRODUCT CHARACTERISTIC

UNLESS OTHERWISE SPECIFIED: TOLERANCE: X ± 1.5 XX ± 0.75 XXX ± 0.200 ANGLE ± 1.0°

CONFIDENTIAL PROPERTY OF POLARIS INDUSTRIES INC.

SCALE

Print balloon number must correspond to the "Item" number on the Dimensional Report

Design Record – Reviewer's Checklist

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Reviewer's Checklist

- ✓Must be a Polaris print
- ✓Ballooned drawing must be clean and legible
- ✓Must be correct part number and revision
- ✓Every requirement must have a separate balloon
  - ❑Dimensions
  - ❑Notes
  - ❑Special Characteristics
  - ❑Referenced specifications
- ✓Verify that no other prints need to be submitted
  - ❑Sub-assemblies
  - ❑Component level detail

Attention to detail!!

Authorized Engineering Change Documents (if any) – Purpose

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Purpose:

- To provide any pertinent change information for reference
- This is a placeholder for all authorized engineering change documents not yet recorded in the design record but incorporated in the product, part or tooling:
  - *Engineering Change Orders (ECOs)*
  - *Approved deviations*
  - *Approved Process Change Requests (PCRs)*
  - *Specifications*
  - *Feasibility studies*
  - *Sub-assembly drawings*
  - *Life or reliability testing requirements*

Note: PPAPs may be approved with approved engineering change documents.

This element is typically used when changes occur to the design documentation

Authorized Engineering Change Documents – Reviewer's Checklist

Reviewer's Checklist

- ✓ECOs must be approved, not pending
- ✓Marked up prints are not acceptable for PPAP
- ✓Feasibility studies included (if applicable)
- ✓Life or reliability testing requirements included (if applicable)
- ✓Submission must include copies of approved change requests

Attention to detail!!

Customer Engineering Approval (if required)

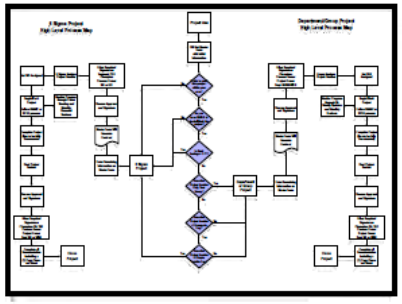
Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

- If required, customer Engineering Approvals are used to demonstrate pre-approval of a supplier's design/testing by Polaris.

FMEA – Tool Interaction

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

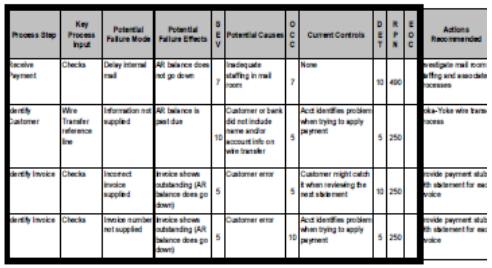
Tool Interaction



Process Flowchart

Process Steps

New/Revised Process Steps



Process FMEA

Process Steps

New/Revised Process Steps

Control Plan

Risk Prioritized Process Steps

Improved Controls

The interaction of these three elements is the *CORE* of PPAP!!

FMEA – Definition

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

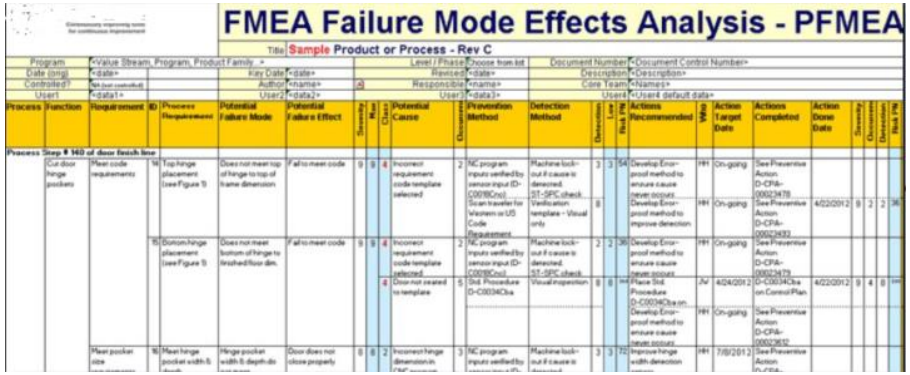
Failure Mode and Effects Analysis

- Industry accepted process to assess risk before completing design of product and processes.
  - *DFMEAs shall be complete before tooling PO is launched (ideal state)*
  - *PFMEAs shall start upon handoff of DFMEA driven KPCs*
  - *PFMEAs shall be completed in time to have a control plan in place before product ramp-up (run at rate or pulse order)*
  - *Control Plans shall be derived from KPC and other risks identified through the PFMEA*
- FMEAs are generated for:
  - *New designs, technology or processes*
  - *Modifications to existing design or process*
  - *New environment, location or application*
  - *Root cause analysis*
- FMEAs are generated by:
  - *Cross-functional team from Polaris and Supplier, consisting of Design Engineers, Process/Manufacturing Engineers, Project Leaders, etc.*
- Reference AIAG FMEA Manual and/or SAE J1749

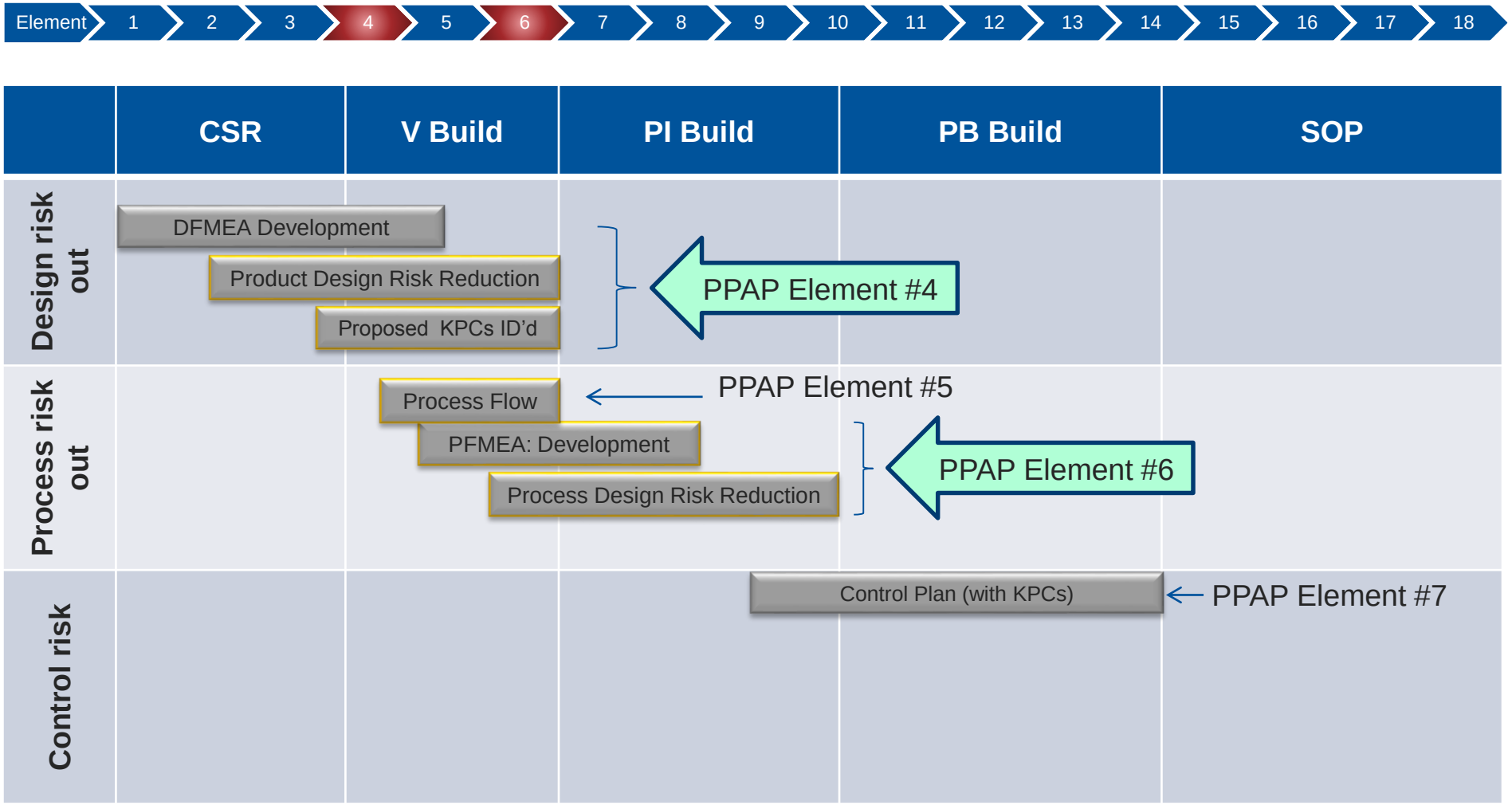
FMEA – Benefits

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

- A 3 phase approach to proactively identify and prioritize potential risk and drive corrective actions before production launch.
  - *Design risk out by implementing robust design solutions*
  - *Process risk out by implementing robust process solutions (i.e. mistake-proofing)*
  - *Control risk by developing a control plan to audit Design (KPC) and Process risk*
- Reduce costly design changes by catching errors and oversights up-front before capital investments are launched.
- Improved safety
- One safe source for historical issues, lessons learned, warranty, etc.



FMEA – Proactive Quality Tools/Process



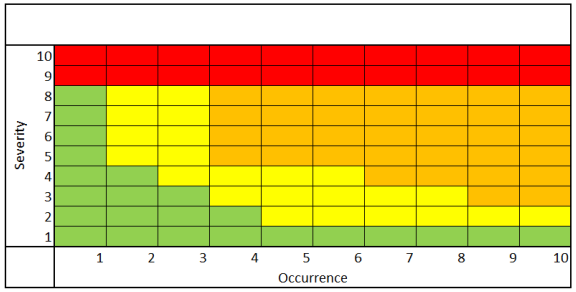
3 phases of risk mitigation

DFMEA – Procedure

Element 1 2 3 **4** 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Item / Function	Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Classification	Potential Causes(s) of Failure	Current Design Controls Prevention	Occurrence	Current Design Controls Detection	Detection	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
														Actions Taken & Effective Date	Severity	Occurrence	Detection	RPN

- Reference AIAG FMEA Manual for process and category definitions.
- DFMEA is only required if designed by the supplier.
- Must address all KPCs from previous designs with similar requirements. For new designs KPCs should be developed by the DFMEA.
- Document is reviewed by a team not a single engineer.
- Severity, Occurrence and Detection must be compliant with AIAG or Polaris guidelines.
- Must take the technical/physical limits of the manufacturing/assembly process into consideration.
- Use RPN or Severity vs. Occurrence (red, orange, yellow, green) to drive action to reduce risk.

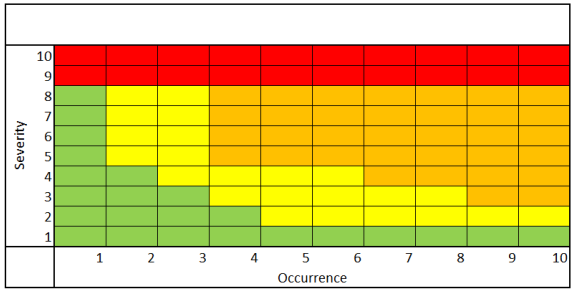


PFMEA – Procedure

Element 1 2 3 4 5 **6** 7 8 9 10 11 12 13 14 15 16 17 18

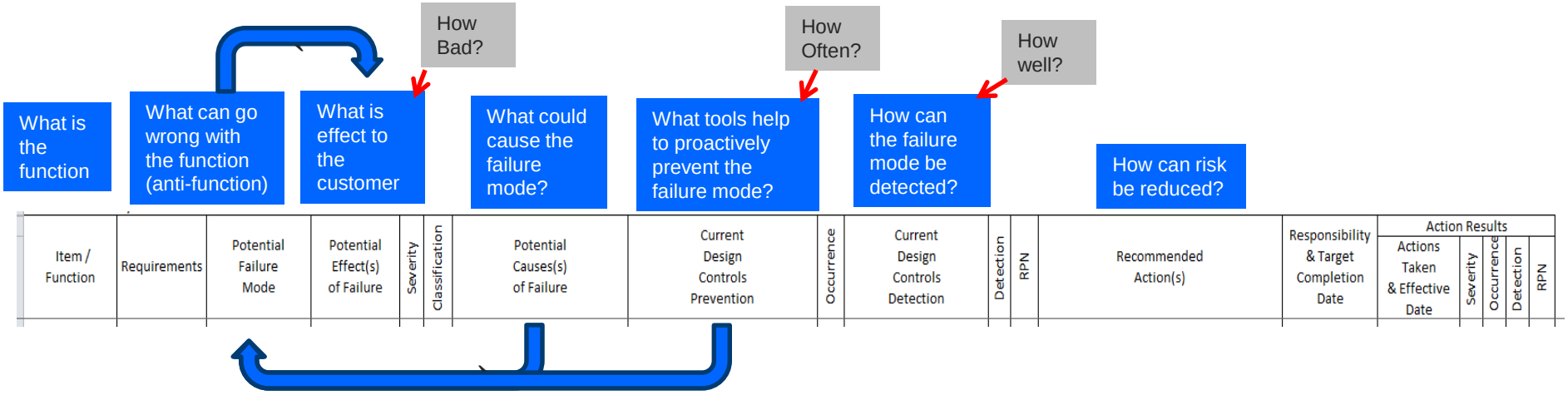
Item / Function	Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Classification	Potential Causes(s) of Failure	Current Design Controls Prevention	Occurrence	Current Design Controls Detection	Detection	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
														Actions Taken & Effective Date	Severity	Occurrence	Detection	RPN

- Reference AIAG FMEA Manual for process and category definitions.
- Requirements, Effects of Failure, Severity and KPCs should be directly linked to the DFMEA. If DFMEA is not available, Polaris Product Engineering may develop these categories.
- Must address all KPCs from previous designs with similar requirements.
- Document is reviewed by a team not a single engineer.
- Severity, Occurrence and Detection must be compliant with AIAG or Polaris guidelines.
- Control Plan should be generated by PFMEA Risk.
- Use RPN or Severity vs. Occurrence (red, orange, yellow, green) to drive action to reduce risk.



FMEA – Tips

- Forming the team is critical, the team should be comprised of design, test, quality, manufacturing engineers and subject matter experts. Make sure the right skillset of people are in the meeting to encourage brainstorming.
- Pre-work drives efficiency and accuracy. The first meeting should start by reviewing the pre-work prepared for the FMEA sessions. Process flow charts, boundary diagrams, parameter diagrams, warranty and supplier quality data are a few examples of pre-work that will assist in FMEA development.
- Debating Severity, Occurrence and Detection ratings. In most cases there will be very little difference in rankings that are 1 point apart. To keep the FMEA moving it is a best practice to just take the higher of the 2 rankings if the team can not agree after a short period of time.
- A Recommended Action shall be defined for all items with a severity of 9/10 regardless of occurrence or detection and should be defined for all items with a high severity x occurrence or RPN
- Don't set an RPN threshold. If RPN Is used to prioritize work, the actions should be sorted and worked from highest to lowest.
- If possible, have many short sessions (1-1.5 hours) rather than one or two all day sessions.
- Before a design or process change occurs, the FMEA should be used to ensure no other risks are being introduced.



FMEA – Reviewer's Checklist

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Reviewer's Checklist

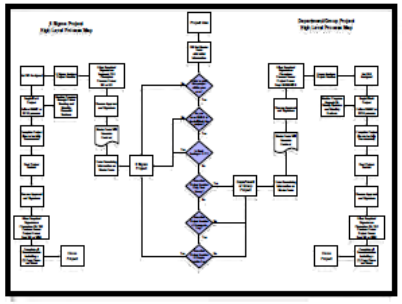
- ✓All KPCs have been addressed and labeled in the FMEA.
- ✓Make sure action is being taken on high severity and higher RPN line items and the outlined action will actually have an impact.
- ✓Make sure that high RPN process concerns and KPCs are carried over into the control plan.
- ✓Make sure that all critical failure modes are addressed:
  - ❑Safety
  - ❑Form, fit, function
  - ❑Material concerns
- ✓Severity, Occurrence and Detection must be compliant with AIAG guidelines and scored within reason.

Attention to detail!!

Process Flow Diagrams (PFD) – Tool Interaction

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

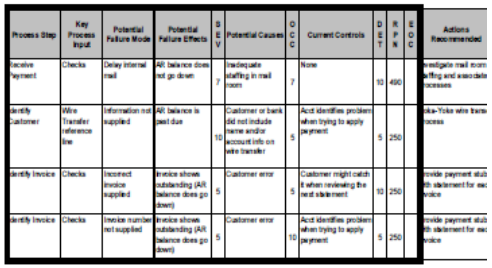
Tool Interaction



Process Flowchart

Process Steps

New/Revised Process Steps



Process FMEA

Process Steps

New/Revised Process Steps

Control Plan

Risk Prioritized Process Steps

Improved Controls

The interaction of these three elements is the *CORE* of PPAP!!

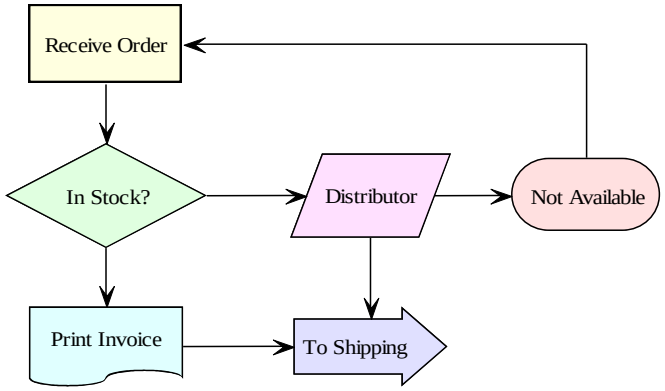
PFD – Definition/Purpose

What is it?

- A visual diagram of the entire process from receiving through shipping, including outside processes and services.

Purpose:

- To help people “see” the real process



When to Use It:

- To understand how a process is done
- Prior to completing the PFMEA

Guidance – Process Flow Must Include:

- All manufacturing and key processes to be included
- All offline activities (such as measurement, inspection and handling)
- Identification of areas containing nonconforming material
- Scrap, defective and rework parts
- Process steps must match both the Control Plan and the PFMEA
- PFDs for ‘families’ of similar parts are acceptable if the new parts have been reviewed for commonality by the supplier and/or Polaris.
- Reference PFD Checklist (A-6 of the AIAG APQP Manual) for additional guidance

PFD – Benefits

Benefits for Supplier:

- Provide a system overview allowing the study of an entire process at once
- Illustrates relationships between and dependencies of process steps
- Display all process inputs and outputs
- Expose process or system inefficiencies and problem areas. Document a process or system.
- Planning tool to aid in design of new products

Benefits for Polaris:

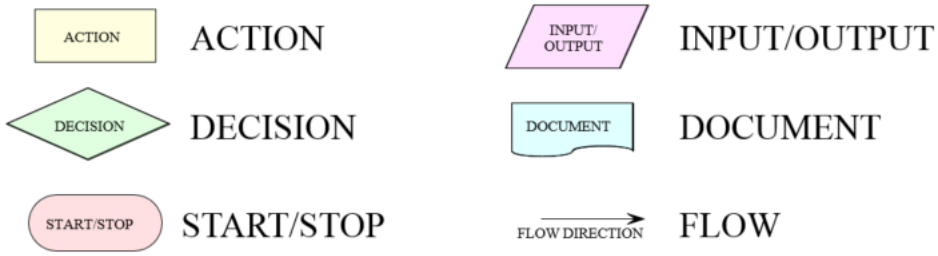
- Supplier identifies and resolves gaps in quality component of process
  - *Higher quality parts*
- Supplier identifies and eliminates areas of inefficiency
  - *Lower cost parts*
- Serves as formal documentation of the process
  - *Decreases chance for variation*
- Clearly displays all steps in process and provides consistent frame of reference
  - *Improves communication*

Conclusion:

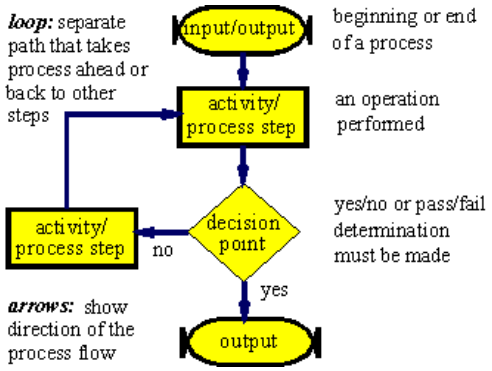
- A Process Flow Diagram (PFD) provides a pictorial description of all the major steps in a process
- If used properly, it can result in a higher quality, lower cost part

PFD – Common Flow Chart Symbols

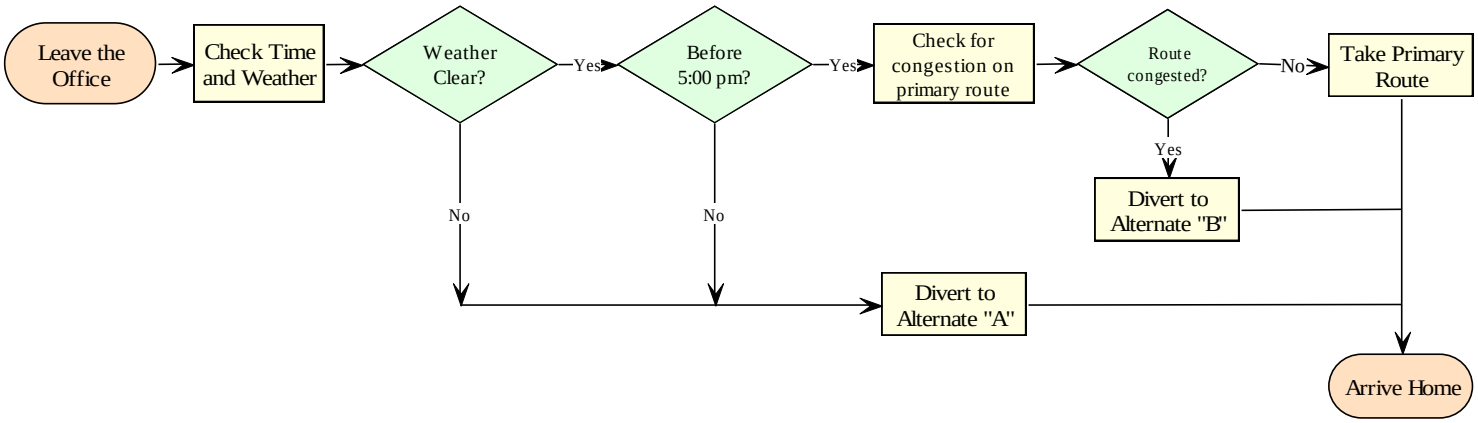
This slide illustrates some of the most commonly used symbols in a flow chart. However, hundreds of symbols exist and companies can actually create there own symbols to meet their needs.



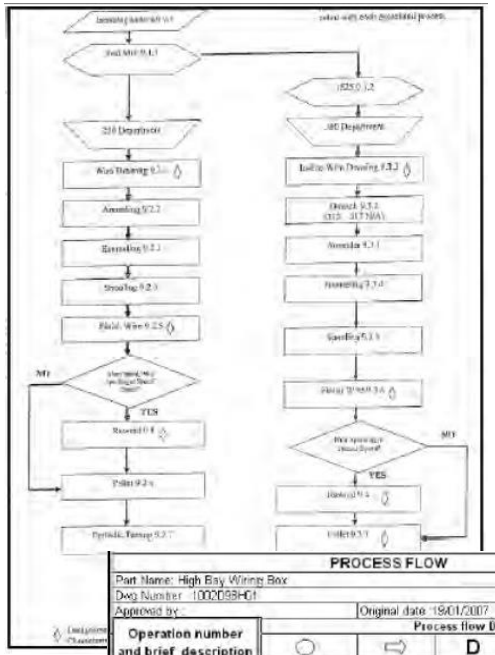
PFD Example

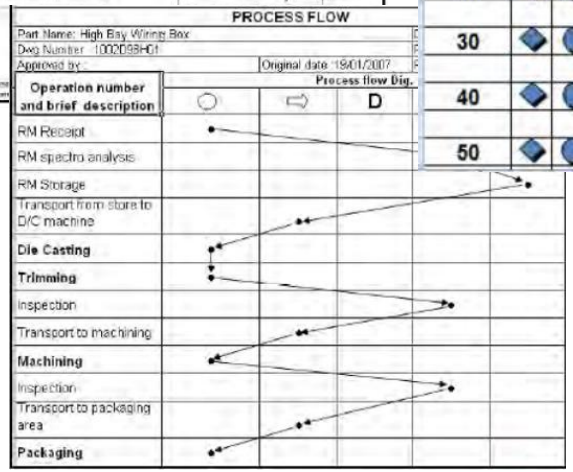


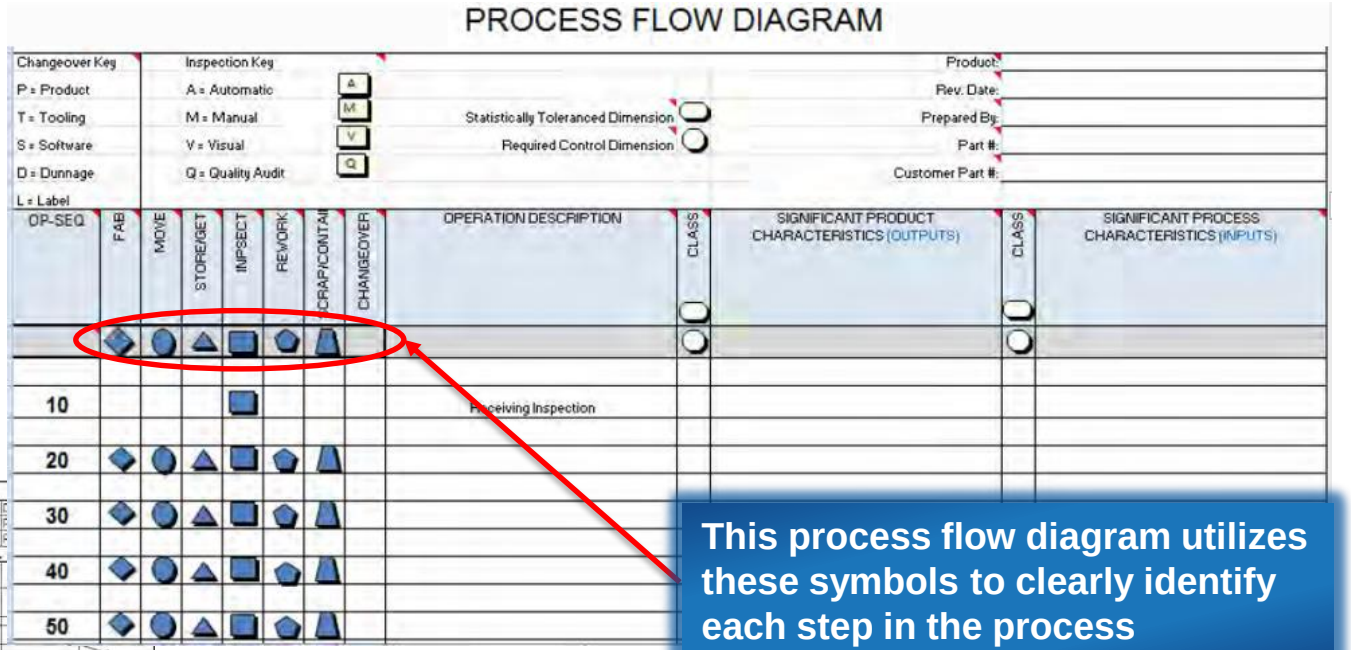
PFD Example



PFD - Examples







This process flow diagram utilizes these symbols to clearly identify each step in the process

More process flow diagram examples

PFD – Reviewer's Checklist

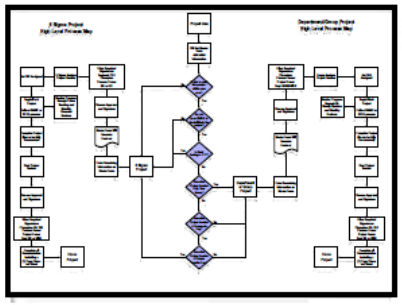
Reviewer's Checklist

- ✓Process Flow must identify each step in the process
- ✓Match both PFMEA and Control Plan
- ✓Should include abnormal handling processes
  - ❑Scrap
  - ❑Rework
  - ❑Extended Life Testing
- ✓Process Flow must include all phases of the process
  - ❑Receiving of raw material
  - ❑Part manufacturing
  - ❑Offline inspections and checks
  - ❑Assembly
  - ❑Testing
  - ❑Shipping
  - ❑Transportation

Attention to detail!!

Control Plan – Tool Interaction

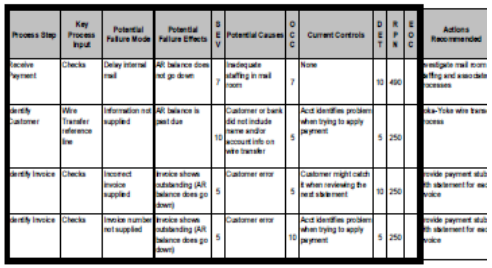
Tool Interaction



Process Flowchart

Process Steps

New/Revised Process Steps



Process FMEA

Process Steps

New/Revised Process Steps

Control Plan

Risk Prioritized Process Steps

Improved Controls

The interaction of these three elements is the *CORE* of PPAP!!

Control Plan – Definition/Purpose

Element 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 16 17 18

What is it?

- A document that defines the operations, processes, materials, equipment, methodologies and special characteristics integral to the manufacturing process.

Purpose:

- To communicate the supplier's decisions during the entire manufacturing process (materials purchase through final packaging).
  - *It does not replace the information contained in detailed operator instructions.*
- Reflects methods of monitoring, control, and the measurement system used.

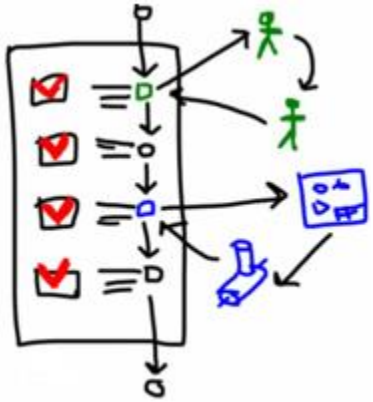
Guidance:

- Identify Key Product Characteristics (KPCs) and their source of variations.
- Develop using a cross-functional team.
- Generate using the PFD, FMEA, design reviews, special characteristics, and knowledge of process.
- The Control Plan is a living document reflecting the current product and process designs, control methods, and measurement systems.
  - *As these change and/or improvements are made, the control plan needs to be updated*.
- Reference Control Plan Checklist (A-8 of the AIAG APQP Manual) for additional guidance

Control Plan – Benefits

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

- Quality Improvement
  - *Identify, monitor, & control variation*
  - *Reduce rejects and waste*
  - *Provides a structured approach towards control methods*
- Customer Satisfaction
  - *Focuses on characteristics important to the customer*
- Cost Reduction
  - *Reduce scrap, rejects, and waste*
- Communication



Control Plan – Form Details

Element 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 16 17 18

CONTROL PLAN

☐ Prototype ☐ Pre-Launch ☑ Production

Control Plan Number 002	Key Contact/Phone T. Smith / 313-555-5555	Date:(Org.) 11/29/2009	Date (Rev.) 2/20/2010
Part Number/Latest Change Level 54321231 / D	Core Team Erin Hope, Alan Burt, Ken Light	Customer Engineering Approval/Date (If Req'd.)	
Part Name/Description Electronic Circuit Board	Supplier/Plant Approval/Date	Customer Quality Approval/Date(If Req'd.)	
Supplier/Plant ACR Control / Supplier Code 439412	Other Approval/Date (If Req'd.)	Other Approval/Date (If Req'd.)	

Part / Process Number	Process Name / Operation Description	Machine, Device, Jig, Tools, for MFG.	Characteristics No.	Characteristics Product	Characteristics Process	Special Char. Class	Methods Product/Process Specification/ Tolerance	Methods Evaluation / Measurement Technique	Methods Sample Size	Methods Sample Freq.	Methods Control Method	Reaction Plan
2	Soldering Connections	Wave solder machine		Wave solder height			2.0 +/- .25 mc	Sensor continuity check	100%	Continuous	Automated inspection (error proofing)	Adjust and retest
					Flux concen - tration		Standard #302B	Test sampling lab environment	1 pc	4 hours	x-MR chart	Segregate and retest

3. Production – a comprehensive documentation of product/process characteristics, process controls, tests, and measurement systems that will occur during mass production.

Administrative Section
Identifies part number and description, supplier, required approval signatures, and dates.

Note: Must submit a Production Control Plan for PPAP approval

Reference Section 6 of AIAG's APQP Manual for in-depth instruction

Control Plan – Form Details (cont.)

Element 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 16 17 18

CONTROL PLAN

54321231 / D																	
Part Name/Description Electronic Circuit Board																	
Supplier Plant ACR Control		Supplier Code 439412		Other Approval/Date (If Req'd.)								Other Approval/Date (If Req'd.)					
Part / Process Number	Process Name / Operation Description	Machine, Device, Jig, Tools, for MFG.	Characteristics No.	Characteristics Product	Characteristics Process	Special Char. Class	Methods Product/Process Specification/ Tolerance	Methods Evaluation / Measurement Technique	Methods Sample Size	Methods Sample Freq.	Methods Control Method	Reaction Plan					
2	Soldering Connections	Wave solder machine		Wave solder height			2.0 +/- .25 mc	Sensor continuity check			Automated inspection (error	Adjust and					

Part/Process
Use this area to define part/process number and description.

Product Characteristics
Define the characteristics of the product. There may be several for each operation. Can be dimensional, performance or visual criteria.

Specifications/Tolerance
Use this area to define upper/lower spec limits for each control element or a visual criteria not listed in the engineering documentation.

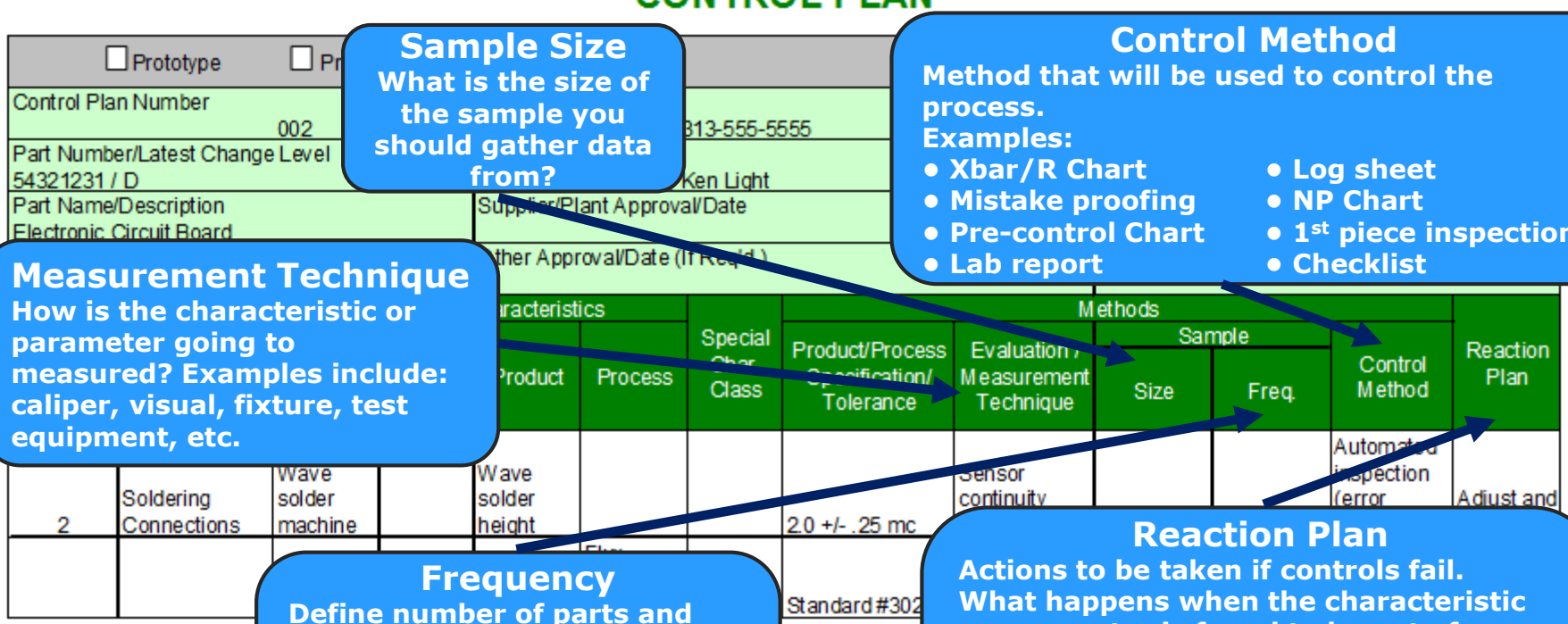
Machine/Tools
List the machine, device, jig, or tools that will be used in the manufacturing process

Process Parameters
Process parameters that are important. A process parameter is a setting made within a process that effects the variation within the operation.
Examples include:
- Temperature (molding, heat treat, etc.)
- Pressure
- Fixture settings
- Speed
- Torque

Special Characteristic Classification
Use as required to designate "Critical", "Key", "Safety", "Significant" classifications

Control Plan – Form Details (cont.)

Element 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 16 17 18



Sample Size

What is the size of the sample you should gather data from?

Control Method

Method that will be used to control the process.

Examples:

- Xbar/R Chart
- Mistake proofing
- Pre-control Chart
- Lab report
- Log sheet
- NP Chart
- 1st piece inspection
- Checklist

Measurement Technique

How is the characteristic or parameter going to measured? Examples include: caliper, visual, fixture, test equipment, etc.

Frequency

Define number of parts and the frequency for which the measurement will be taken.

Examples:

Final testing, visual criteria

- 100%

SPC, Audit,

- The sample size/frequency

Reaction Plan

Actions to be taken if controls fail. What happens when the characteristic or parameter is found to be out of control.

Must include:

- Segregation of nonconforming product
- Correction method

May include (as appropriate):

- Sorting
- Rework/Repair
- Customer notification

Control Plan – Common Pitfalls

Element 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 16 17 18

- One time document
  - *Must be continuously reviewed and updated - what if the latest change or revision has a significant impact?*
- Not consistent with process flow or PFMEA
- Reaction plan not specific enough to tell an operator or supervisor what to do
- Process characteristics not identified
- Evaluation measurement / detection tools not specifically identified
- Critical and/or special characteristics not identified
- Family based control plan is not all inclusive
- Inspection frequency/gaging not appropriate for inspected feature

Control Plan – Reviewer's Checklist

Element 1 2 3 4 5 6 **7** 8 9 10 11 12 13 14 15 16 17 18

Reviewer's Checklist

- ✓Use PFD and PFMEA to build the control plan; keep them aligned
  - ❑"Process Number" should cross reference with PFMEA and PFD
- ✓Keep it simple but robust. Controls should be effective.
  - ❑Such as SPC, Error Proofing, Inspection, Sampling Plan
  - ❑Cannot be excessively dependent on visual inspection
- ✓Ensure that the control plan is in the document control system and matches the current design record revision.
- ✓Good control plans address:
  - ❑All testing requirements - dimensional, material, and performance
  - ❑All product and process characteristics at every step throughout the process
  - ❑All rework loops
  - ❑All Special Characteristics as independent line items
- ✓Control plans should reference other documentation
  - ❑Specifications, tooling, etc.

Attention to detail!!

Measurement System Analysis (MSA) – Definition/Purpose

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

What is MSA?

- MSA is a method used to assess the quality of a measurement system, and make judgment of fitness for its intended use.

Purpose:

- Quantify the amount and sources of variability in the measurement system.
- Assess whether the measurement system is usable for its intended application.

When to use it:

- On critical inputs and outputs prior to collecting data for analysis.
- For any new or modified process in order to ensure the quality of the data.
- When KPCs are identified and an Initial Process Study (Element #11) is required.

Further Guidance:

- Providing detailed guidance on conducting and analyzing GR&R studies is beyond the scope of this document. For further information:
  - *Refer to AIAG's Measurement Systems Analysis manual*
  - *See an example at www.MoreSteam.com's link:* https://www.moresteam.com/toolbox/measurement-system-analysis.cfm

MSA Terms

Repeatability: Variation in measurements obtained with one measuring instrument when used several times by an appraiser, while measuring the identical characteristic on the same part (this is often referred to as Equipment Variation, or EV).

Reproducibility: Variation in the average of the measurements made by different appraisers, using the same gage when measuring a characteristic on one part (this is often referred to as Appraiser Variation, or AV).

Gage Repeatability and Reproducibility (GR&R): The combined estimate of measurement system repeatability and reproducibility. GR&R is typically expressed as "% Tolerance" when the measurement process is used to judge compliance to specifications.

GR&R Study: A study where multiple parts are measured repeatedly by multiple appraisers. In a typical study, 5-10 parts are measured 2-3 times each by 3 appraisers (people that actually make these measurements).

Discrimination, Resolution: The smallest unit of output for a measurement instrument. 10 to 1 rule of thumb: there should be at least 10 units of measurement contained in the specifications, and in ±2 standard deviations of measurement.

Reference Value: Accepted value of a standard.

Bias: Difference between the observed average of measurements and the reference value.

Stability: A stable measurement process which is in statistical control.

Linearity: Change in bias over the normal operating range. A measurement process with good linearity will operate consistently across the range of values.

MSA – Polaris Specific Requirements

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

- Polaris requires an analysis of the capability of all measurement processes identified in the Control Plan required to assess KPCs.
- Minimum requirement for Polaris suppliers are:
  - *Gage R&R study using total tolerance on each measurement tool used to assess a KPC.*
  - *Percentage of R&R should strive to be less than 10%.*
  - *Gage R&R results between 10% and 30% are considered marginal, meaning the supplier has to take or suggest action to improve.*
  - *If greater than 10%, an explanation of why the measurement tool is used shall be included.*
- Every effort shall be made to include samples that represent the full range of process variation.

MSA – Reviewer's Checklist

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Reviewer's Checklist

- ✓If the gage/inspection measures a KPC or other important feature, then conduct a Gage R&R. The gage used must be the same gage specified in the Control Plan.
- ✓Make sure the study is recent - less than 1 year
- ✓Gage R&R results must follow the approval %
  - ❑Gages >30% cannot be used on Polaris product
  - ❑Gages between 10% and 30% require highlighted actions
- ✓Make sure discrimination vs. tolerance makes sense
  - ❑Rule = 1 level MORE than the tolerance (i.e. tolerance = .01, gage should measure to .001)
- ✓Does Study provide data on the %GRR, %EV, %AV?

Attention to detail!!

Dimensional Results – Definition/Purpose

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

What is It?

- Provides evidence that dimensional verifications required by the design record and the control plan have been completed and results indicate compliance with specified requirements.

Purpose:

- To show conformance to the customer part print on dimensions and all other noted requirements.

When to Use It:

- For each unique manufacturing process
  - *Each cell, production line and all cavities, molds, patterns and dies require a Dimensional Result submission.*

Dimensional Results – Requirements

Element 1 2 3 4 5 6 7 8 **9** 10 11 12 13 14 15 16 17 18

Dimensional Results Report Must Include:

- Date of the design record
- Change level
- Authorized engineering change documents

Sample Production Part (see Element 14):

- Supplier must send the part measured (and specified as such) in the Dimensional Results Form.
- Send to Polaris Quality Assurance Representative (as designated in the PPAP request).
- Must be clearly labeled as the sample part with the Polaris part number.

Additional Guidance:

- All dimensions (except reference dimensions), characteristics, specifications, material types, all notes, and any corresponding color or length dash codes should be listed in a convenient format, with actual variable results recorded.
- Nonconforming Measurements:
  - *If any dimensions / characteristics do not meet the specifications, interim approval may be granted if additional documentation is submitted and approved prior to the PPAP submission (i.e. approved deviation or drawing change request).*
  - *Must be identified on PSW*

The dimensional report is evidence of conformance to print

Dimensional Results – Example

INITIAL SAMPLE INSPECTION REPORT

NO 056/2016 — *Page 1 of 1*

ACME Anvils

Description	Part Number	Drawing NO.	Issue Date
Gear, Large	27256542	27256542	14/03/2016

Customer	Customer's Part Number
Polaris Industries	27256542

Norms: ******

Purchase Order NO PO0001476 Date

Kind of Delivery: ☐ Prototypes ☑ Production lot/batch — Quantity: 5

ITEM PRODUCED BY: ☐ Temporary tools ☑ Production tools

REASON FOR SUBMISSION

☑ NEW PART ☐ NEW TOOLING ☐ START OF PRODUCTION

☐ INSPECTION COMMENTS REQUEST ☐ DEROGATION REQUEST ☐ SYSTEMATIC INSPECTION ☐ PERIODICAL INSPECTION

CHANGE OF ☐ DESIGN ☐ TOOLING ☐ PRODUCTION CYCLE ☐ MATERIAL ☐ TREATMENT

N° RIFERIMENTO	Description	Characteristic	(min e max) Resulted From Control	Quantity	Measurement on the Samples – Sample Number 1	2	3	4	5	6	CO
1	Length of 382 mm	382 mm ± 1,2	381,19 / 381,31	5	381,19	381,28	381,29	381,28	381,31		
2	Wheelbase of 276 mm	276 mm ± 1,2	275,98 / 276,05	5	276,04	276,02	275,98	276,01	276,05		
3	Length of 382 mm	382 mm ± 1,2	382,79 / 382,90	5	382,89	382,79	382,86	382,90	382,82		
4	Wheelbase of 276 mm	276 mm ± 1,2	276,36 / 276,49	5	276,49	276,41	276,36	276,47	276,43		
5	Diameter of 390 mm	390 mm ± 1,2	390,47 / 390,89	5	390,89	390,59	390,73	390,79	390,47		
6	Holes of Ø8 mm	8 mm ± 0,5	7,83 / 7,86	5	7,86	7,83	7,86	7,85	7,84		
7	Height of 78,7 mm	78,7 mm ± 0,8	78,51 / 78,71	5	78,51	78,61	78,54	78,62	78,71		

Dimensional Results – Reviewer's Checklist

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Reviewer's Checklist

✓Make sure the dimensional report addresses all print requirements.
✓Ensure "Method" is noted for every measurement and it makes sense for the dimension.
✓If requested, the agreed upon number of parts from the production run must be shipped to Polaris for verification of form, fit and function.
✓The same parts will be used to verify both critical and non-critical dimensions.
✓Supplier must send the part measured (and specified as such) in the Dimensional Results Form.
✓Supplier should make every effort to ship parts that represent the normal process variation.

Attention to detail!!

Records of Material / Performance Test Results – Definition/Purpose

Definition:

- The supplier shall have records of material and/or performance test results for tests specified on the Design Record or Control Plan.

Purpose:

- The test reports shall include:
  - *Design record revision and the specifications to which the part was tested*
  - *Any authorized engineering change documents*
  - *Date the tests were performed*
  - *Indication of pass or fail*
  - *The actual results of each test*
    - Material test result examples:
      - Chemical
      - Physical
      - Metallurgical
    - Performance test result examples:
      - Fuel pump flow and pressure
      - Regulator voltage or current capacity
      - Seat bun dynamic fatigue test

Confirm the data and format with Polaris Quality Representative

Records of Material / Performance Test Results – Reviewer's Checklist

Reviewer's Checklist

- ✓Performance test documents should include confirmation of:
  - ❑Any formal specification referenced
  - ❑Any formal life testing
  - ❑Any specific functional test
- ✓Sometimes performance is not directly addressed via the part print but it may be:
  - ❑Referenced through a specification or a drawing note
  - ❑Implied through a requirement
- ✓Always ask about the need to demonstrate performance if it is not listed on the print.
- ✓Material results should be compared against a known standard. Do not assume the test specification is correct.
  - ❑Verify the correct specification (i.e. ASTM D2000 Rev 2015)
  - ❑Verify the composition breakdown
- ✓Verifying composition is NOT just for PPAP, it should be a periodic check that is identified in the Control Plan.

Attention to detail!!

Initial Process Studies – Definition/Purpose

What is it?

- Statistical tools are applied to data from a production run to provide an early assessment of process stability and capability.

Purpose:

- To determine if the production process is likely to produce product that will meet Polaris requirements.

When to use them:

- In the development process, initial process studies are conducted for all KPCs (and other characteristics as identified by Polaris), based on a significant production run.

Initial Process Studies: Section 2.2.11 in AIAG's PPAP, Fourth Edition

Initial Process Studies – Approach

Element 1 2 3 4 5 6 7 8 9 10 **11** 12 13 14 15 16 17 18

Gather → Analyze → Calculate → Apply

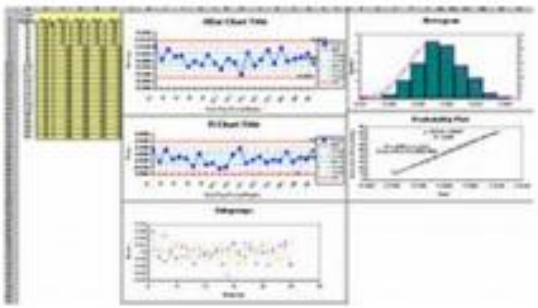
For each KPC and/or identified dimension:

- Perform measurement system analysis (MSA) to understand how measurement variability affects the study measurements.
  1. Gather data for the study.
  2. Analyze the data in the order produced using control charts.
  3. Calculate the appropriate quality indices and create a histogram from the data.
  4. Apply acceptance criteria and determine next steps.

Initial Process Studies – Gather Data for the Study

Gather

- Polaris requires at least 30 observations gathered from the production process for initial process studies.
  - *Although the PPAP manual calls for a minimum of 25 subgroups containing at least 100 readings, we have reduced this because of our lower volumes versus the automotive industry.*
- Data should be gathered and recorded in the order of production.
- The intent of initial process studies is to identify the amount and sources of variation present in the production process. The data requirements may be replaced by longer-term historical data from the same or similar processes, with Polaris concurrence, if it is judged that the longer-term historical data will better achieve that intent.



Initial Process Studies – Analyze the Data

Element 1 2 3 4 5 6 7 8 9 10 **11** 12 13 14 15 16 17 18

Analyze

- Data should be plotted in the order produced, preferably using control charts.
  - *With small data sets, we cannot make conclusions about long-term process stability (effects of time and variations in people, materials, methods and environment), but we can understand whether the process is stable over the short time involved, and possibly identify key sources of variation for control and improvement.*
- Look for signals of instability (special causes of variation)
  - *With small data sets, we cannot make conclusions about long-term process stability (effects of time and variations in people, materials, methods and environment).*
- If there are signs of instability, the supplier shall identify, evaluate and wherever possible, eliminate special causes of variation prior to PPAP submission.

For details about process control charts, see AIAG's SPC manual, Chapter I-Section G through Chapter II

Initial Process Studies – Quality Indices

Calculate

- C_{pk} - The capability index for a stable process
  - *C_{pk} is a measure of process capability based on process variation within each subgroup of a set of data.*
  - *It does not include the effect of process variability between subgroups.*
  - *It provides a prediction of what the process might deliver if the process is in statistical control.*
- P_{pk} - The performance index
  - *P_{pk} is an indicator of process performance based on process variation throughout the full set of data.*
  - *It does include all sources of process variability in the data set, and provides a summary of what the process has done during generation of the data.*
  - *If a process is in statistical control C_{pk} and P_{pk} will have similar values.*
- The quality indices are designed to provide a numerical indication of how the process performs compared to specifications. However, a histogram of the data, with specification limits indicated, should accompany the indices to provide a visual sense of how the data in the study relate to the specification limits.

For details about quality indices, see AIAG's SPC manual, Chapter IV

Initial Process Studies – Acceptance Criteria

Element 1 2 3 4 5 6 7 8 9 10 **11** 12 13 14 15 16 17 18

Apply

C_{pk} or P_{pk} will be chosen as the Index, as appropriate.

Results	Interpretation
Index > 1.67	The process currently meets the acceptance criteria.
1.33 ≤ Index ≤ 1.67	The process may be acceptable. Contact the authorized Polaris representative for a review of the study results.
Index < 1.33	The process does not currently meet the acceptance criteria. Contact the authorized Polaris representative for a review or the study results.

Initial Process Studies – Miscellaneous

Element 1 2 3 4 5 6 7 8 9 10 **11** 12 13 14 15 16 17 18

- Unstable (out of statistical control) processes may not meet Polaris requirements. The supplier shall notify the authorized Polaris representative of an unstable process and submit a corrective action plan prior to submission.
- Action to be taken when acceptance criteria are not satisfied:
  - *The supplier shall contact the authorized Polaris representative if acceptance criteria cannot be attained by the required PPAP submission date.*
  - *The organization shall submit to the authorized Polaris representative for approval a corrective action plan and a modified Control Plan normally providing for 100% inspection.*
  - *Variation reduction efforts shall continue until the acceptance criteria are met, or until customer approval is received.*
- The quality indices are designed to provide a numerical indication of how the process performs compared to specifications. However, a histogram of the data, with specification limits indicated, should accompany the indices to provide a visual sense of how the data in the study relate to the specification limits.

Initial Process Studies – Process Capability

Element 1 2 3 4 5 6 7 8 9 10 **11** 12 13 14 15 16 17 18

Reviewer's Checklist

- ✓Ensure the supplier has evaluated measurement processes and they are adequate.
- ✓Review control charts to assess statistical process control.
- ✓Review histogram to evaluate distribution of the data.
  - ❑Is the measure centered in the specification? (Note: This isn't absolutely necessary, but if the process is not centered, have a conversation with the supplier about why it isn't centered and whether they intentionally run the process centered at the location indicated by the data.)
  - ❑Does it show a coherent distribution (i.e. are there multiple modes or clear "flyers" that raise questions about using the data to represent the ongoing process)?
- ✓Review reported quality indices to ensure they meet requirements.

Qualified Laboratory Documentation – Purpose

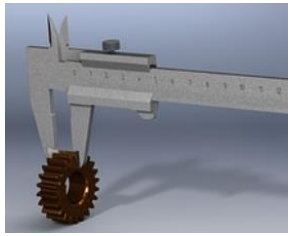
Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Purpose:

- Inspection and testing for PPAP shall be performed by a qualified laboratory as defined by Polaris requirements (i.e. an accredited laboratory).
- The qualified laboratory (internal or external to the supplier) shall have a laboratory scope and documentation showing that the laboratory is qualified / accredited for the type of measurements or tests conducted.
  - *When an external laboratory is used, the supplier 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.*

Internal / External Recommendations:

- Recommendation for performing testing or measurement (INTERNAL)
  - *Record/Scope that identifies the testing to be done and it must include a list of all test equipment, methods and standards used to calibrate the equipment.*
- If you are sending out for measurement and testing (EXTERNAL)
  - *Provide a copy of the company's THIRD PARTY accreditation*
  - *Results must be on company letterhead and include:*
    - The name of the Lab
    - Date of testing
    - Standards used for testing are identified



Qualified Laboratory Documentation – Reviewer's Checklist

Reviewer's Checklist

✓Third party labs that measure parts for performance, material or dimensional must be accredited.

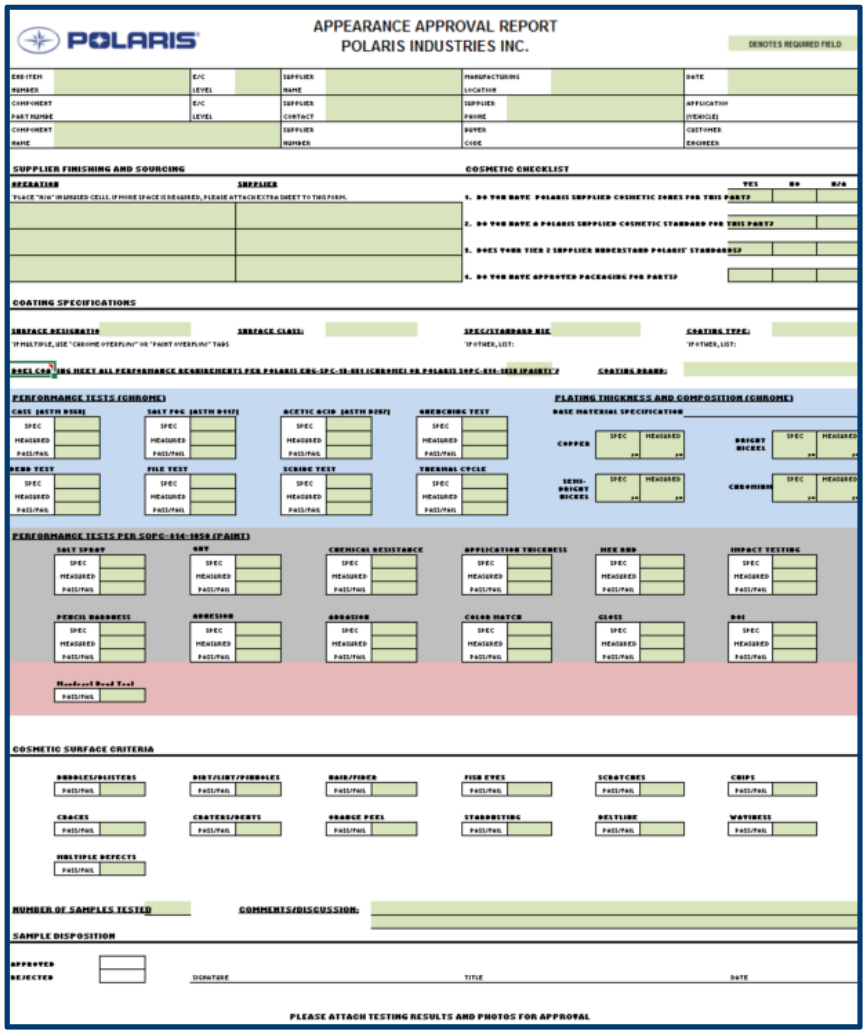
✓If any testing is performed to measure or monitor part quality the test organization must have:

- ❑Lab scope
- ❑Evidence of calibration (in-process)

✓Lab Scope: Make sure internal labs have a "system" defining what can be measured, method, training, etc.

Attention to detail!!

Appearance Approval Report (AAR) – Definition/Purpose



APPEARANCE APPROVAL REPORT
POLARIS INDUSTRIES INC.

What is It?

- A Polaris supplied form: OPS-FORM-0151, completed by the supplier containing appearance and performance criteria.

Purpose:

- To demonstrate that the part has met the coating cosmetic and performance requirements in the design record.

When to Use It:

- Testing completed on production level parts.
- AARs only required for cosmetic parts.

Note:

Typically only applies for parts with color, grain, or surface appearance requirements. The use of limit samples help to distinguish acceptable vs. unacceptable parts.

AAR – Form Breakdown

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Form Breakdown:

- **Pretreatment Process Information**
  - *Defines the cleaning and preparation process including details of the process type, chemical composition and product identification.*
- **Coating Specifications**
  - *Provides the coating brand and details as well as the substrate conditions. Substrate conditions are identified by Polaris and are to be found in the design record.*
- **Performance Tests**
  - *Location for documenting all test results pertaining to coating performance, broken down into chrome and paint.*
  - *Performance requirements will come from the appropriate Polaris standard as found in the design record.*
  - *Examples: adhesion, hardness, and corrosion testing are a few of the results reported here.*
- **Cosmetic Surface Criteria**
  - *Cosmetic sections are broken down into Liquid Paint, Powder Paint, Colored Plastic, and Chrome.*
  - *Documents pass/fail for the supplied part on defects such as blisters, scratches, fibers, waviness, etc.*

AAR - Instructions

Element 1 2 3 4 5 6 7 8 9 10 11 12 **13** 14 15 16 17 18

Instructions for completing the Polaris AAR Form

1. Please fill out this form as completely as possible. All light green areas must be completed before submission.
2. Drop down boxes are used throughout the form. If a test or surface defect is not applicable, select "N/A".
3. If the coating and specification used are not listed, select "OTHER" and manually enter the coating and specification below the drop down box.
4. If more than one surface designation is present on a part, use the Overflow tabs to enter data for each surface designation.
5. This form is intended to be used as a vehicle to report results and not intended to determine requirements.

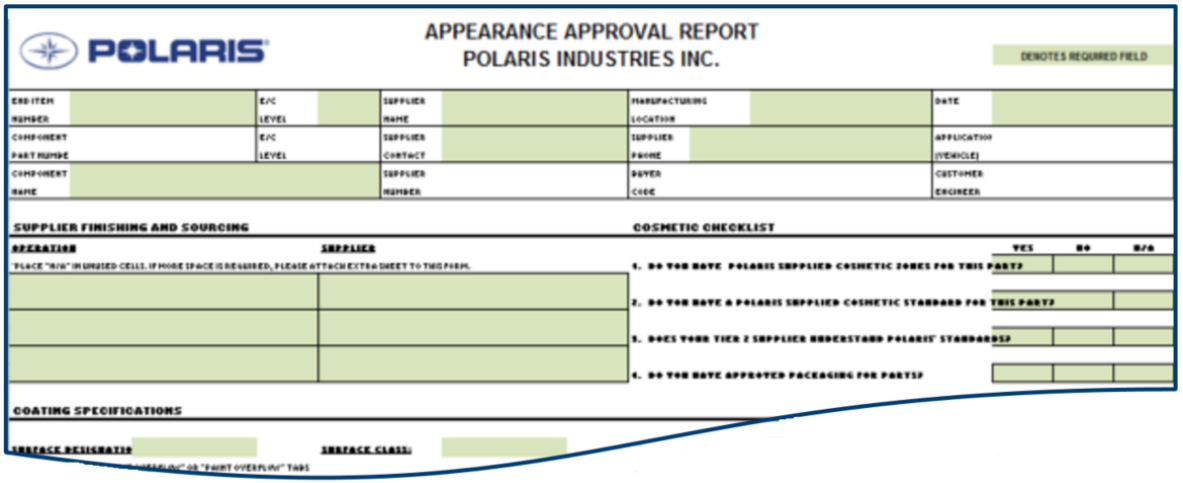
*THIS FORM IS NOT ALL ENCOMPASSING. REFER TO THE DESIGN RECORD (PRINT, STANDARDS, PO) FOR ALL REQUIREMENTS NOT CONTAINED IN THIS DOCUMENT AND PROVIDE RESULTS ACCORDINGLY

* Note on POLARIS SOPC-814-1050-6

When using Polaris approved paint (as defined in the design record) the following tests/sections are required as described by each of the sections including frequency: Tests 4-9 & 14:

If unnapproved paint (formally approved by Polaris) is used all 23 of the tests/sections must be completed and submitted in the AAR

Reminder: The process(s)/materials used to achieve AAR approval cannot be changed without an approved Polaris PCR (Process Change Request) and subsequent PPAP request.


APPEARANCE APPROVAL REPORT
POLARIS INDUSTRIES INC.

DENOTES REQUIRED FIELD

END ITEM NUMBER | E/C LEVEL | SUPPLIER NAME | MANUFACTURING LOCATION | DATE
COMPONENT PART NUMBER | E/C LEVEL | SUPPLIER CONTACT | SUPPLIER PHONE | APPLICATION (VEHICLE)
COMPONENT NAME | SUPPLIER NUMBER | BUYER CODE | CUSTOMER ENGINEER

SUPPLIER FINISHING AND SOURCING

OPERATION | SUPPLIER

COSMETIC CHECKLIST

	YES	NO	N/A
1. DO YOU HAVE POLARIS SUPPLIED COSMETIC ZONES FOR THIS PART?			
2. DO YOU HAVE A POLARIS SUPPLIED COSMETIC STANDARD FOR THIS PART?			
3. DOES YOUR TIER 2 SUPPLIER UNDERSTAND POLARIS' STANDARDS?			
4. DO YOU HAVE APPROVED PACKAGING FOR PARTS?			

COATING SPECIFICATIONS

SURFACE DESIGNATION | SURFACE CLASS

Supplier *MUST* understand the cosmetic expectations & provide specifications or standards for inspection

AAR – Reviewer's Checklist

Reviewer's Checklist

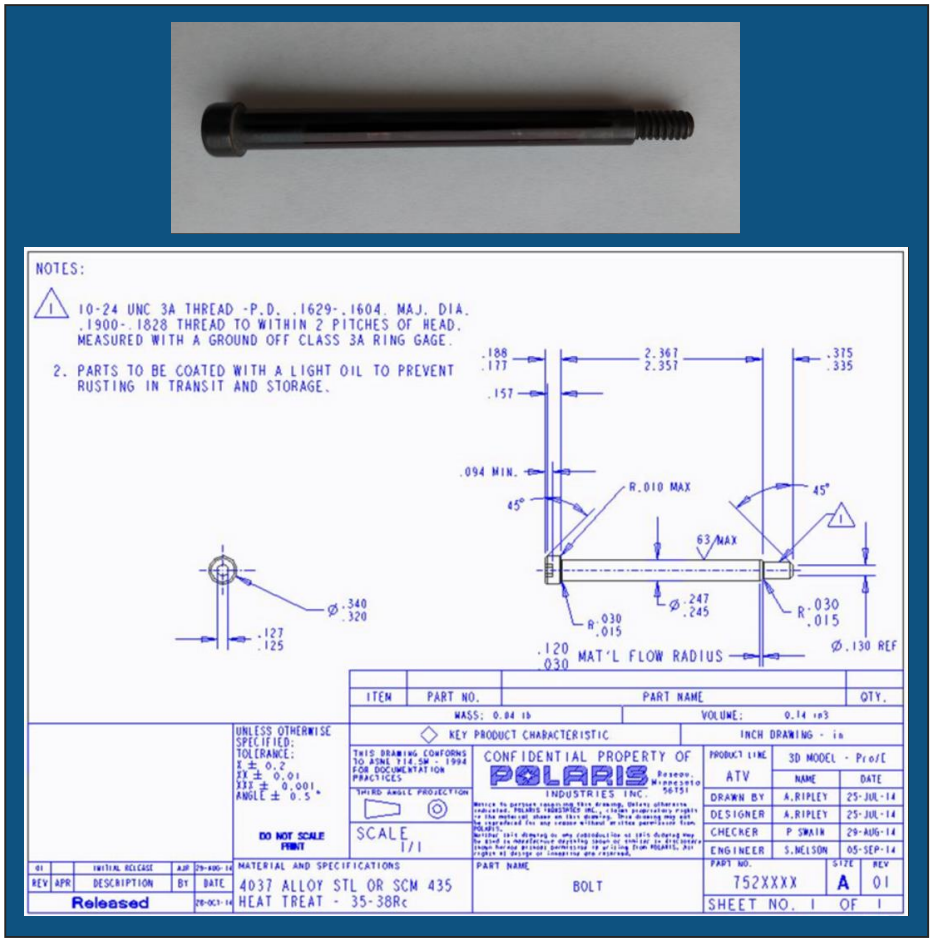
✓Are all green areas on the form populated as outlined in the AAR procedure?

✓Is the information provided on the Appearance Approval Report directly tied to the design record?

- ❑All testing is complete per the Polaris standard referenced on the print.
- ❑Testing results are acceptable and passing according to the Polaris standard.

Attention to detail!!

Sample Production Parts – Definition/Purpose



What is it?

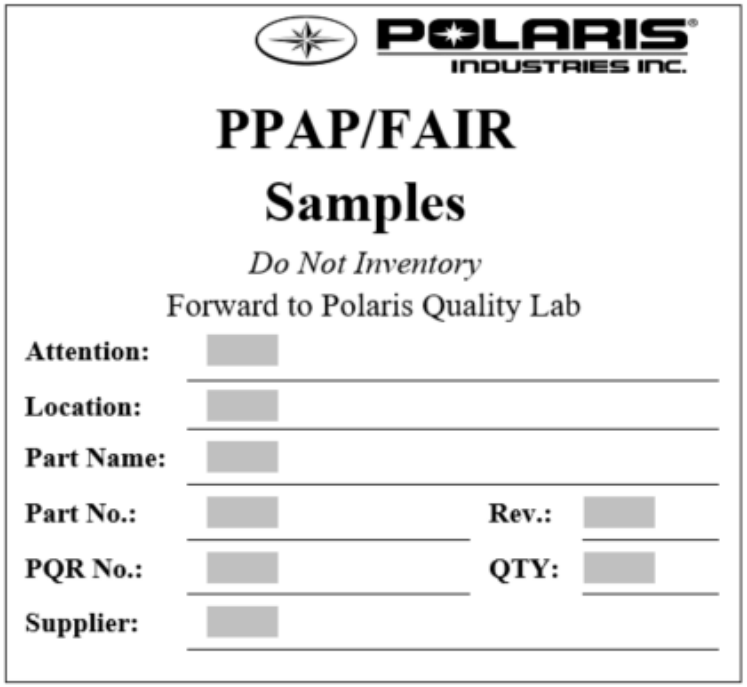
- Product sent by the supplier as defined by the customer on the submission request.

Purpose:

- Sample of Process Output
  - *Sample parts should be representative of a process and taken from a significant production run (as discussed elsewhere in this document).*
- Needs to be the same part measured when creating the dimensional report submitted in response to PPAP request.
- Verify inspection techniques.

Sample parts to be selected at random from the production run

Sample Production Parts – Submission Guidelines



POLARIS INDUSTRIES INC.

PPAP/FAIR

Samples

Do Not Inventory

Forward to Polaris Quality Lab

Attention:

Location:

Part Name:

Part No.: **Rev.:**

PQR No.: **QTY:**

Supplier:

Address the following when submitting Sample:

- Sample sizes for PPAP reporting purposes should be of at least 5 parts.
- Samples provided for Polaris approval can be a minimum of 1 part.
- Ship sample part(s) to the attention of the responsible Polaris quality assurance representative and to the location noted in the PPAP Request.
- Include method of shipment (i.e. UPS, FedEx, etc.) and the shipper's tracking number in the PPAP Request.
- Sample parts are to be shipped shortly after the electronic data is submitted to the Polaris quality assurance representative.
- The Sample Part Label (found in the Polaris Supplier Quality Assurance Manual and shown here) must be affixed to the *OUTSIDE* of shipping containers…not enclosed inside.
- Samples are to be shipped free of charge – DO NOT send sample parts with inventory/production shipments – samples must be separate.
- Do not ship the sample(s) against any purchase order.
- The bill of lading, invoice or packing slip must clearly state the parts are "sample" at no cost to Polaris.
- If samples are shipped against a purchase order they will be received into inventory and will not be considered as PPAP samples – subject to an RMO.

Sample production parts *MUST* be properly identified

Sample Production Parts – Reviewer's Checklist

Reviewer's Checklist

- ✓Sample Parts should be received with every PPAP submission and examined and must be the same part measured and documented in the Dimensional Results paperwork.
- ✓Shipment method and tracking information must be referenced in PPAP submittal.
- ✓Sample parts must be properly tagged, if they are not, they may be *REJECTED*!!

Attention to detail!!

Master Sample – Definition/Guidance

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Definition:

- A sample of the material retained by the supplier from the significant production run which is representative of the yield of the process.

Guidance:

- The Master Sample is retained at the supplier's facility, NOT AT POLARIS.
  - *Material must be retained by the supplier until such a time a new PPAP is submitted OR a change is made to the material.*
  - *In some cases, suppliers maybe required to retain parts for seven years after the end of the build. This condition usually relates to critical operation parts (brakes, drive system, vehicle safety systems, etc.).*
- The Master Sample may be used to:
  - *Confirm fit up and dimensional conformity*
  - *Confirm acceptance to cosmetic criteria*
  - *Used for development of gaging and creation of inspection criteria*
  - *Used for assembly and inspection training*
  - *Verification of production tooling*

Master samples aid in referencing revision differences

Master Sample – Types

Three types of Master Samples:

- **Physical sample** - A part or sample taken from the initial pre-production run and kept in a secure area.
- **Analytical Sample Record** - For materials that breakdown over time (plastics, rubber compounds, chemicals, etc.), a master analysis (test records) along with the test protocol, are kept on file. These records are for baseline comparison in the event the current material fails to perform.
- **Manufacturing Sample Record** - Test records from bulk material produced in the pre-production run (paint, welding shield gases, chemicals).
  - *In some applications, bulk materials are supplied which may contain several different lots of material. To create a master sample:*
    - Record quantity of product produced
    - The important performance results
    - The raw materials utilized (including lot numbers used)
    - Critical equipment used to produce bulk material
    - An analytical sample record
    - Batch ticket used to make bulk material

Master Sample - Requirements

Master Sample Requirements

- The supplier maintains a minimum of one part or applicable records
  - *Exception: If a supplier is unable to safely retain samples due to size or storage constraints, the customer may grant a waiver to the entire master sample requirement.*
  - *A sample from each tool, mold, cavity, etc. must be retained.*
  - *Any differences in the process require sample parts be maintained for future comparison (i.e. injection molding barrel temperature).*
- Each part labeled with the customer part number and PPAP approval date.
- Parts storage
  - *Parts are organized so they are easily locatable.*
  - *Parts are protected from elements that may cause damage (rain, wind, sunlight, etc.), to preserve original production condition.*

Master Sample – Reviewer's Checklist

Reviewer's Checklist

- ✓Ensure there is a system for properly maintaining and periodically reviewing master samples.
  - ❑Certain materials may deteriorate over time depending on storage conditions (i.e. rust, harden, discolor, warp, etc.).
  - ❑Ensure contingency plans are established to protect samples from loss.
- ✓A sample from each tool, mold, cavity, etc. are retained.

Attention to detail!!

Checking Aids – Definition/Guidelines

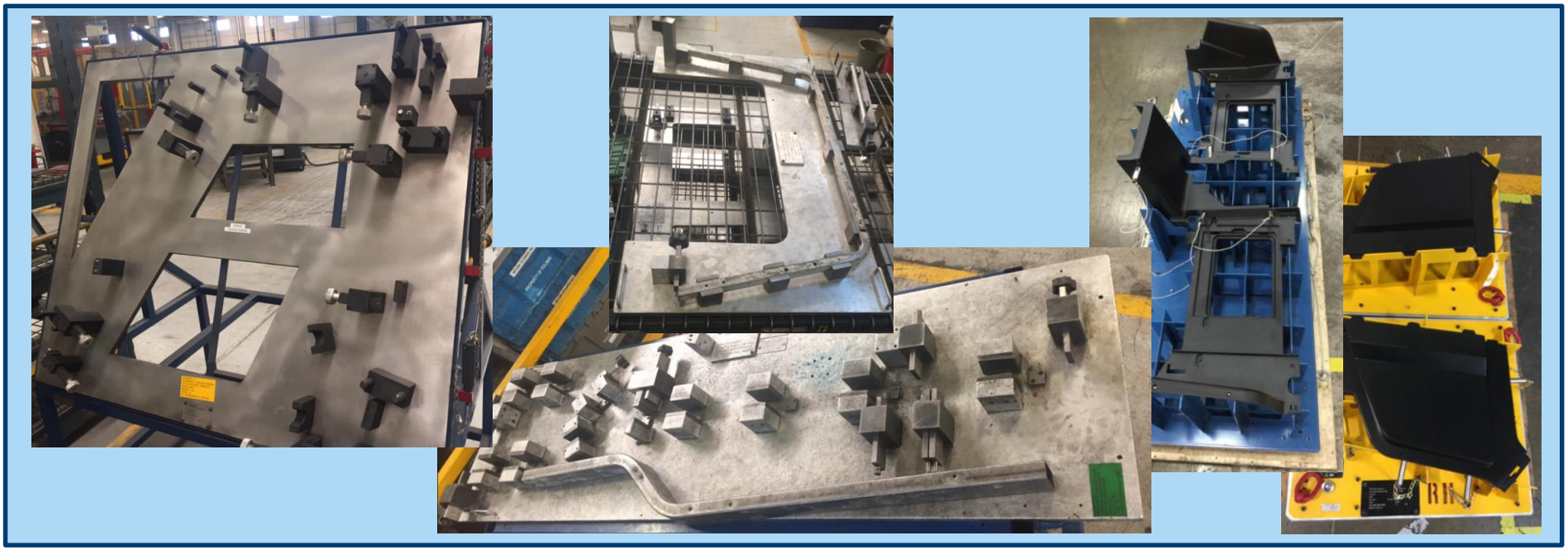
Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Definition:

- Fixtures, templates or special gages where used to measure dimensions or functional integrity of parts.

Guidelines:

- Supplier may be asked to provide gage with PPAP submission.
- Supplier will be responsible for maintenance, calibration and gage R&R.



Checking Aids – Reviewer's Checklist

Reviewer's Checklist

✓If a fixture is referenced in the control plan and used to check physical print dimensions either in-process or offline, then it is a checking aid and subject to this review.

✓Checking aids must have evidence of:

- ❑Conformance to a provided print (if requested)
- ❑Repeatability
- ❑GRR
- ❑Preventive maintenance plan

Attention to detail!!

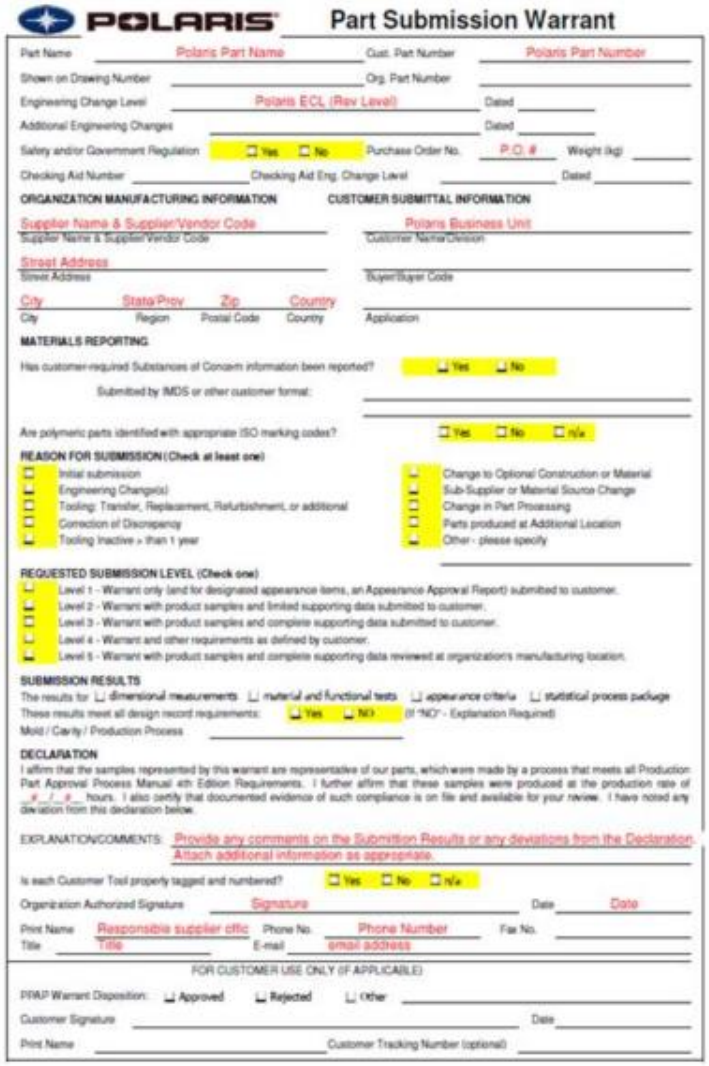
Customer Specific Requirements

Definition:

- Records of compliance to all applicable Polaris-specific requirements as listed below:
  - *Packaging Approval form*
  - *Pre-Delivery Inspection (PDI) checklist (when applicable)*
  - *Others as defined*
- These requirements would be defined by an authorized Polaris quality assurance representative as required.

Part Submission Warrant (PSW) – Definition/Purpose

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18



POLARIS Part Submission Warrant

Part Name: Polaris Part Name | Cust. Part Number: Polaris Part Number
Shown on Drawing Number | Org. Part Number
Engineering Change Level: Polaris ECL (Rev Level) | Dated
Additional Engineering Changes | Dated
Safety and/or Government Regulation: ☐ Yes ☐ No | Purchase Order No.: P.O. # | Weight (kg)
Checking Aid Number | Checking Aid Eng. Change Level | Dated

ORGANIZATION MANUFACTURING INFORMATION
Supplier Name & Supplier/Vendor Code
Street Address
City | State/Prov | Zip | Country

CUSTOMER SUBMITTAL INFORMATION
Polaris Business Unit
Buyer/Buyer Code
Application

MATERIALS REPORTING
Has customer-required Substances of Concern information been reported? ☐ Yes ☐ No
Submitted by IMDS or other customer format:
Are polymeric parts identified with appropriate ISO marking codes? ☐ Yes ☐ No ☐ n/a

REASON FOR SUBMISSION (Check at least one)
☐ Initial submission
☐ Engineering Change(s)
☐ Tooling: Transfer, Replacement, Refurbishment, or additional
☐ Correction of Discrepancy
☐ Tooling Inactive > than 1 year
☐ Change to Optional Construction or Material
☐ Sub-Supplier or Material Source Change
☐ Change in Part Processing
☐ Parts produced at Additional Location
☐ Other - please specify

REQUESTED SUBMISSION LEVEL (Check one)
☐ Level 1 - Warrant only (and for designated appearance items, an Appearance Approval Report) submitted to customer.
☐ Level 2 - Warrant with product samples and limited supporting data submitted to customer.
☐ Level 3 - Warrant with product samples and complete supporting data submitted to customer.
☐ Level 4 - Warrant and other requirements as defined by customer.
☐ Level 5 - Warrant with product samples and complete supporting data reviewed at organization's manufacturing location.

SUBMISSION RESULTS
The results for ☐ dimensional measurements ☐ material and functional tests ☐ appearance criteria ☐ statistical process package
These results meet all design record requirements: ☐ Yes ☐ NO (If "NO" - Explanation Required)
Mold / Cavity / Production Process

DECLARATION
I affirm that the samples represented by this warrant are representative of our parts, which were made by a process that meets all Production Part Approval Process Manual 4th Edition Requirements. I further affirm that these samples were produced at the production rate of __/__/__ hours. I also certify that documented evidence of such compliance is on file and available for your review. I have noted any deviation from this declaration below.

EXPLANATION/COMMENTS: Provide any comments on the Submition Results or any deviations from the Declaration. Attach additional information as appropriate.
Is each Customer Tool properly tagged and numbered? ☐ Yes ☐ No ☐ n/a
Organization Authorized Signature: Signature | Date: Date
Print Name: Responsible supplier offic | Phone No.: Phone Number | Fax No.
Title: Title | E-mail: email address

FOR CUSTOMER USE ONLY (IF APPLICABLE)
PPAP Warrant Disposition: ☐ Approved ☐ Rejected ☐ Other
Customer Signature | Date
Print Name | Customer Tracking Number (optional)

What is it?

- It is an industry-standard document required for all newly-tooled or revised products in which the supplier confirms that inspections and tests on production parts show conformance to Polaris requirements.

Purpose:

- Used to:
  - *Document part approval*
  - *Provide key information*
  - *Declare that the parts meet specification*

When to Use It:

- Whenever PPAP submission is required
- Prior to shipping production parts

PSW submission is *MINIMUM* requirement for *ALL* PPAP levels

Part Submission Warrant (PSW) – Elements

Element 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Elements of the Part Submission Warrant

- Part information
- Supplier Manufacturing Information
- Submission Information
- Reason For Submission
- Requested Submission Level
- Submission results
- Declaration
- Documentation for any non-conformance, deviation or open engineering change requests
- For Customer Use Only (not used – PPAP approval is the acceptance method)

Part Submission Warrant (PSW) – Reviewer's Checklist

Reviewers Checklist

- ✓ Must be completely filled out
- ✓ Must be signed by the supplier
- ✓ Part number must match the PO
- ✓ Product family submissions allowed
- ✓ Submitted at the correct revision level
- ✓ Submitted at the correct submission level
- ✓ Specify the reason for submission
- ✓ Ensure any deviations and/or change requests are documented

Attention to detail!!

PPAP Summary

- The Production Part Approval Process is an extensive approval process for *new or changed* designs or processes.
- It is very formalized, so it inevitably causes some administrative work.
- It can be used in both manufacturing and service industries.
- AIAG PPAP expects the supplier to do all design and validation activities, regardless of PPAP level request.
- Later changes to the product or process can be expensive and time-consuming!

Standard Response to PPAP Charges

Dear Supplier,

Polaris does not pay one-time PPAP charges because it expects the activities that make up APQP and PPAP will not be one-time activities. Process design elements such as FMEAs and Control Plans should be living documents and updated regularly. Process validation activities such as MSAs, Process Capability Studies and part inspections should also be done regularly to monitor and improve processes. Combined, these activities will help suppliers drive continuous process improvement and achieve necessary cost targets.

Please review the Polaris Supplier Quality Assurance Manual (SQAM) and the current AIAG APQP and PPAP manuals to ensure a complete understanding of Polaris' expectations.

Regards,

PPAP – Reviewer's Checklist

Reviewer's Checklist

- ✓Ensure all required elements have been submitted.
- ✓Ensure any non-conformances or concerns have been noted.
- ✓Must verify approval status of any sub-assemblies.
- ✓Thoroughly review all element details prior to submitting/approving.

Attention to detail!!

References / Resources

- **Where are the training, references / resources located?**
  - *Refer to the Polaris Supplier Quality Assurance Manual (SQAM).*
- **Support/Subject Matter Expert (SME)**
  - *Contact your Polaris quality representative for questions or additional guidance.*

Learning Objectives Recap

At the end of this training, participants will be able to:

- ✔ Understand Polaris' expectations regarding the overall process of PPAP preparation, compilation and submittal.
- ✔ What is the Purpose of PPAP?
- ✔ When is PPAP Required?
- ✔ What are the Elements of the submission?
- ✔ How are the Levels of PPAP applied?
- ✔ Details on successful PPAP submission to Polaris' facilities

FAQs

Why will Polaris not accept hard copies of submission data in lieu of electronic data?

- Hard copies cannot be entered into our system and thus viewed by the many people who need access to the data.
- Electronic submissions can also be traced verifying date of submission.

Why does the data need to be submitted in .pdf or .tif format?

- Data must be submitted in acceptable formats which Polaris can open conveniently.

What if multiple revisions exist in the PPAP submission system for the same part number?

- Previous revision requirements can be moved forward to the latest PPAP Submission Request upon supplier request (this is not done automatically and subject to certain conditions).

What if the due date on the PPAP request cannot be met?

- DO NOT ignore the date – your metrics will be negatively affected.
- Notify the Polaris representative PRIOR to the due date and provide a reason.

FAQs – (cont.)

What happens to submitted samples after auditing at Polaris?

- Samples are scrapped after approval.
- Sometimes samples may be used for destructive testing and could be destroyed in the process.

Why must the submitted data be against a RELEASED Polaris drawing?

- Polaris Purchasing Agents and Engineers provide suppliers with pre-released drawings for quoting purposes or early discussion.
- Preliminary, pre-release or WIP drawings can change at any time with no notice and are exempt from the Polaris release cycle.
- The released drawing is a contractual agreement as noted on the PO.
- PPAP submission requests are automatically generated after a print is released.
- Only production POs and production drawings can be PPAP'd.

Questions?