PPAP for Aerospace

QUIZ: What does PPAP stand for?

Production Parts Approval Process

Disclaimer: All suggestions presented here are for reflection and negotiation with your customers
Start with WHY

Unfortunately, most of the time we start with HOW
Start with WHY

• Supplier has necessary information to produce a part
  – Corollary: Holds customer accountable to provide

• Supplier has reviewed all information and knows that they comply
  – Corollary: Customer requirements are right

• Supplier is prepared to start “production”
  – Corollary: Customer is not surprised at the wrong time

• Supplier’s processes are capable of producing conforming product
  – Corollary: Customer is assured a steady stream of product

• Key Characteristics are in control and capable to 1.33 CPK
WHAT

- AIAG PPAP
  - First published in 1993
  - At third edition now (2006)
  - 18 elements (1 of them is really 2 different items)
WHAT – AIAG PPAP 18 elements

(1) Design Record
(2) Authorized Engineering Change (for changes incorporated, but not in design record)
(3) Customer Engineering approval
(4) Design Failure Mode and Effects Analysis (DFMEA)
(5) Process Flow Diagram
(6) Process Failure Mode and Effects Analysis (PFMEA)
(7) Control Plan
(8) Measurement System Analysis Studies
(9) Dimensional Results
(10) Record of material and/or Performance test results (often 2 items)
(11) Initial Process Studies
(12) Qualified Lab Documentation
(13) Appearance Approval Report
(14) Sample Production Parts
(15) Master Sample
(16) Checking Aids
(17) Customer Specific Requirement
(18) Parts submission Warrant
WHAT – Aerospace PPAP

• Aerospace customers
  – Boeing and Airbus started the ball rolling
  – Kudos to UTC (UTAS) to be first engine prime
  – Snecma, Rolls-Royce following suit
  – GE seems to be the major exception

• Requirements
  – Variations to the 18 elements
  – Additional elements
  – Some elements, like PRS, have 6-7 more elements
WHAT – UTC PPAP vs AIAG

**AIAG PPAP**

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**UTC PPAP**

1. Released Production Drawings
2. SPD/SMD and SI sheets
3. Production PO and Demand Fulfillment
4. Design Failure Mode and Effects Analysis (DFMEA)
5. Process Flow
6. Process Failure Mode and Effects Analysis (PFMEA)
7. Process Control Plan
8. Process Readiness Study (PRS)
9. Initial Process Studies
10. Measurement System Analysis Studies
11. Engineering Frozen Planning/Source Approval (EFP/ESA)
12. Dimensional Report
13. Production Verification Testing (PVT)
14. Special Process Approval and Nondestructive Test (NDT)
15. Material Certification Documentation
16. Raw Material Approval
17. Part Marking Approval
18. Packaging, Preservation & Labeling Approval
19. Review and Sign-Off
WHAT – UTC PRS

- Production readiness: Tooling, fixtures, Gages
- Gage suitability
- Work Instructions
- Process Control methods
- Supply chain readiness
- TPM
- FOD program

Is supplier ready for production?
WHAT - Resubmission

- Part number changes
- Source changes
- Lapse in production >2 Years
- Process changes – too wide open
  - Manufacturing methods
  - Operators? Tooling changes? Gage changes?

Negotiate “Process Change definition up-front
Howard

• Can we meet the intent without being prescriptive?
• Can a supplier show they have other system checks and balances?
• Can a supplier maintain elements elsewhere in their system?
  – Aero suppliers already have most of the elements as part of their system based on the evolution of AS9100
• Can PPAP flow-down be risk-based?
• Should PPAP be Process based?

If these make sense to you, negotiate these up front
Can the elements be “in system”

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Red elements have been part of Aero for decades – incorporated into systems
Can PPAP be risk-based?

- Classify parts based on risk
- Riskiest parts require higher levels of PPAP
- Low risk parts may require less
- Industry Standard Parts may require nothing
- Have a standard defined process for identifying risk

Risk based PPAPs focus attention on the right components
Can alternatives make more sense?

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Pragmatic suggestions for red items discussed on the next few slides
Design Record

• Part Drawing
  – Required as part of configuration Management
  – Check: FAI cannot be done without drawing
  – Check: Product Release cannot happen without drawing/specification

  – Pragmatic suggestion: Point to where the data is stored in the supplier’s system
Process Flow

• Requirement: Flowchart using standard symbols
• Complex assemblies require many steps
  – Aerospace requires documented Build Instructions
• Parts manufacturing requires routed instructions
• Prescriptive:
  – Draw a flow chart regardless
  – Non-value added
• Pragmatic suggestion: Use the Instructions
  – Connect PFMEA and Control plan to the Instructions
PFMEA

• Requirement: Part by Part based on routing

• Pragmatic Suggestion: Process by process
  – Start at the process flow of the process

• Advantage: More details in PFMEA
  – Part routing step says “heat-treat”
    • Potential failure modes: missed, softer, harder
  – Process routing steps: clean, bake, quench etc
    • Potential failure modes for each of these detail steps

• Advantage: Leverage to all parts that require process
Control Plan

• Requirement:
  – How the part/assembly is checked ("inspection")
  – How to react when the check is out of control

• Prescriptive: Record reaction plan for each step
  – Even if they are the same

• Pragmatic suggestion:
  – Inspection parameters recorded
  – Reaction plan can be part of Quality Systems
Initial Process Study
Key Characteristic Control

• KC: Most misunderstood concept
  – Commonly confused with Critical Characteristic
  – AAQG even wrote a white paper to differentiate
  – AS9100 blurs this definition

• Simplified Definition
  – If variation within tolerance has a significant effect on performance, reliability etc, then it is key
  • Example: gear-meshing versus bolt-on pattern

• For a true KC, show capability, monitor

Differentiate between KC and Critical Characteristic
MSA

• Why MSA and not GR&R?
• Gage uncertainty
  – How important is this?
  – Is error perceptible?
• Pragmatic suggestion
  – GR&R on gages for KCs only
  – Gage Family GR&R for other gages
Dimensional study

• Used to be FAI

• Now required for every dimension
  – Reality of 30 FAIs in a low-volume world!
  – Sometimes 3, sometimes 5

• Pragmatic suggestion
  – Use dimensional studies from equivalent characteristics on existing products
  – $CPK > 1.00$ or 100% inspect
Conclusions

• Considerable redundancy between Aero systems requirements and PPAP elements
• Pulling together package may be non-value added if you can show the elements exist in the system
• Prescriptive requirements can lead to “checking the box”, not meeting the WHY
• Basing PPAP on risk has high value-add

Know what is being required of you

NEGOTIATE TERMS UP FRONT
No one likes late-in-the-game surprises