

PPAP Tutorial

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About this “tutorial”

- This is not a tutorial
- The subject material is not sufficiently consistent
- “Automotive” depends on who you are and who your supplier is.
- What’s included in a PPAP depends on who you are and who your supplier is.
- The rules for “automotive” and “PPAP” are defined by the interested parties.
- Ask questions as they come to you.
 - Don’t bother going to a microphone. I’ll repeat the question for the audience.

What's a PPAP?

- Production Part Approval Process
- Defined by the AIAG (Automotive Industry Action Group) aiag.org along with APQP
- PPAP is not EEE-specific. PPAP also applies to nuts, bolts, windshield wipers, tires, brake pads, plastic clips, and mud flaps.
- As such, some of the elements of a PPAP don't make sense for EEE parts
- PPAP is not the end-all magic document that retires all risk

18 Elements make up a PPAP

- PPAP elements and whether they are included in Level 2 and Level 3 PPAP
- Level 1 is Part Submission Warrant only

2,3	Design Record	2,3	Records of Material / Performance Test Results
2,3	Authorized Engineering Change documents	3	Initial Process Studies
3	Customer Engineering Approval	2,3	Qualified Laboratory Documentation
3	Design Failure Mode and Effects Analysis (Design FMEA)	NA	Appearance Approval Report (AAR)
3	Process Flow Diagram(s)	NA	Sample Production Parts
3	Process Failure Mode and Effects Analysis (Process FMEA)	NA	Master Sample
3	Control Plan	NA	Checking Aids
3	Measurement System Analysis Studies	NA	Customer-Specific Requirements
2,3	Dimensional Results	All	Part Submission Warrant (PSW)

Will a manufacturer give me a PPAP?

- Depends on your relationship with the manufacturer
- Some will provide what appears to be pre-canned PPAPs
- Some will provide a Level 2 PPAP without resistance
- Some will provide a Level 3 PPAP. This requires nontrivial effort by the manufacturer.

PPAP Elements

Just the facts

1. Design Record

- Datasheet – Big deal
- CDCQ – Certificate of Design Construction and Qualification
 - BIG DEAL!!! Specified by AEC-Q100,101,200
 - [http://www.aecouncil.com/Documents/AEC Q100 CDC Rev H.doc](http://www.aecouncil.com/Documents/AEC_Q100_CDC_Rev_H.doc)

2. Authorized Engineering Change documents

- Any PCNs that aren't captured by the current datasheet

3. Customer Engineering Approval

- If applicable.

PPAP Elements – cont

The page turners

4. Design Failure Mode and Effects Analysis (Design FMEA)

- Mature parts typically don't have this
- Many parts leave this out as proprietary (available for review on site)

5. Process Flow Diagram(s)

- Are resistors singulated first or terminations applied?
- How many times is resistance value checked?

6. Process Failure Mode and Effects Analysis (Process FMEA)

- Have seen 400 pages, with ~5 rows/page for FAB
- Risk Priority Number (RPN) = How well is this failure mode controlled?
 - calculated by multiplying Severity (S), Occurrence (O) and Probability (P)

7. Control Plan

- All process steps with methods, measurements, machines, etc used to monitor or control the process

PFMEA example

- This FAB PFMEA goes on for 630 pages
- Has 190 rows for Aluminum deposition
- Potential Failure Modes include: Thick metal, thin metal, no metal, wrong metal, non-uniform metal, low reflectance, high reflectance, non-uniform reflectance, mobile ion contamination, particle contamination, wafer breakage, wafer lost in chamber.....

SEV x OCC x DET = RPN
RPN>100? TAKE ACTION

Process Function / Requirements	Potential Failure Mode	Potential Effect(s) of Failure	S E V	C l a s s	Potential Causes of Failure	O C C	Current Process Control		D E T	R P N	Root Cause
							Prevention	Detection			
To deposit an Aluminium layer using a Varian 3290 sputter tool. Aluminium being used to connect distinct areas of the device together.	Thick Metal	Functional fails at ET or Wafer Sort for metal shorts. Possible overetch issues at metal mask. Poor Metal 2 step coverage. Possible Alignment issues at metal mask.	4		Wafers Processed Twice	3		Station controller with recipe download, Operator certification/training. One test wafer at set intervals determined by station controller. Masking Etch Time twice the standard. Metal 1 Res. change at wafer test.	3	36	

PPAP elements - cont

8. Measurement System Analysis Studies

- Are my instruments capable of distinguishing between good and bad units?
 - determine the total observed variability due to the instrument
 - isolate the components of variability in the system
 - assess if the instrument is suitable or capable for the intended application.

9. Dimensional Results

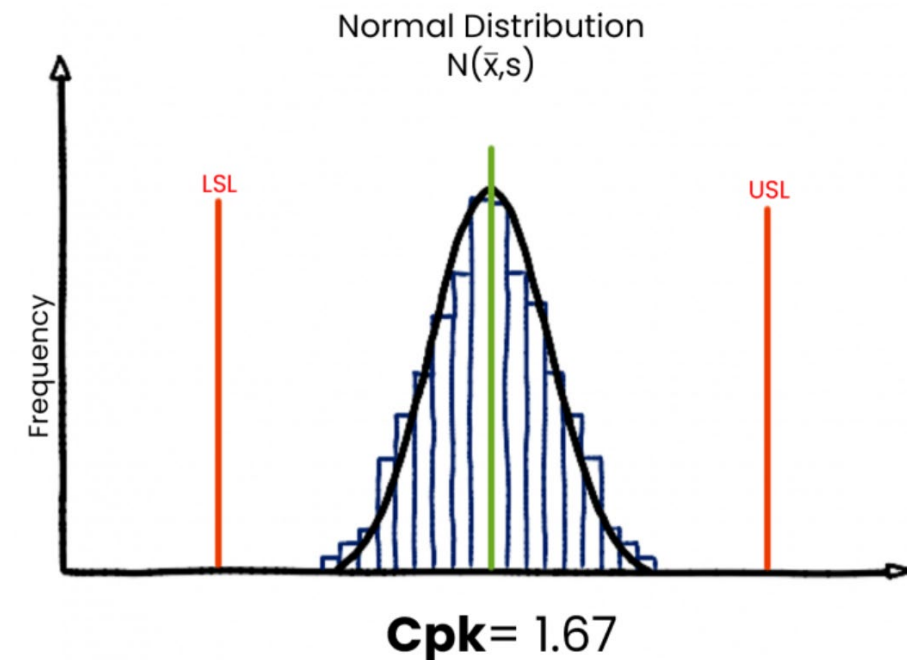
- Dimensional measurement of representative parts

10. Records of Material / Performance Test Results

- Qualification results
- Often significantly QBS

11. Initial Process Studies

- Cpk, Ppk for critical processes
- How many Std Dev is my mean from my nearest spec limit? Divide by 3.
- Cpk=1.67 means we're 5 σ from nearest limit
 - 1 defect / million



Significant Production Run

- The data for items 9, 10, 11 must be must be taken from a “Significant Production Run.”
- The PPAP manual states that the run must be at the production site, using the production tooling, at the production rate, using the production process, materials, and operators.
- The production run must be at least 300 parts unless otherwise specified by the customer representative.

PPAP Elements – cont

The boring or non-existent ones

12. Qualified Laboratory Documentation

- Important, but boring
- The rest are usually not applicable for catalog EEE parts
 13. Appearance Approval Report (AAR)
 14. Sample Production Parts
 15. Master Sample
 16. Checking Aids
 17. Customer-specific Requirements

PPAP Elements - cont

- 18. Part Submission Warrant (PSW)
 - This is the form, signed by the part manufacturer, that attests that all requirements have been met.
 - Of key interest is that the manufacturer states that the parts that were used to create the PPAP were produced at normal production rate (no special runs)
 - It also includes the Engineering revision and change information
 - It must be signed by the manufacturer representative responsible for the parts/process.
 - It includes a statement that production parts are made using the same process as those represented in the PPAP
 - Optionally, it allows for signing by the customer.

What the PPAP is

- It's a piece of paper
- It's a peek into SOME of the key mechanisms used by the part maker
- It MIGHT be an agreement between the customer and the manufacturer
- It MIGHT require customer notification if the manufacturer changes anything.

What a PPAP isn't

- It's not a replacement for an audit
- It usually doesn't describe the part maker's practices for ongoing reliability monitoring
- It usually doesn't describe details about defective part elimination or anomalous lot detection
- Usually doesn't describe dominant wear-out mechanisms or acceleration factors
- Doesn't talk about process qualification
- Doesn't describe how wafer probe is performed
- What about good die in a bad neighborhood?

PPAP and other Automotive resources

- The PPAP Manual and many other automotive resources (not EEE) are available at www.aiag.org
- Automotive Electronics Council www.aecouncil.com
 - Lots of documents/best practices
- IATF 16949:2016 www.iatfglobaloversight.org
 - Supplement to ISO9001 for automotive
- JEDEC
 - AEC specs call out many JEDEC