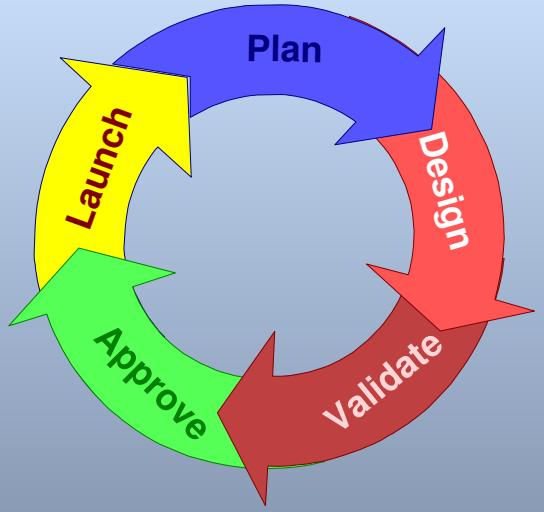
Introduction to APQP

Powering Business Worldwide



Advanced Product Quality Planning

Maintain high quality products while keeping projects on schedule with transparent task management and collaboration tools.

APQP – Advanced Product Quality Planning overview

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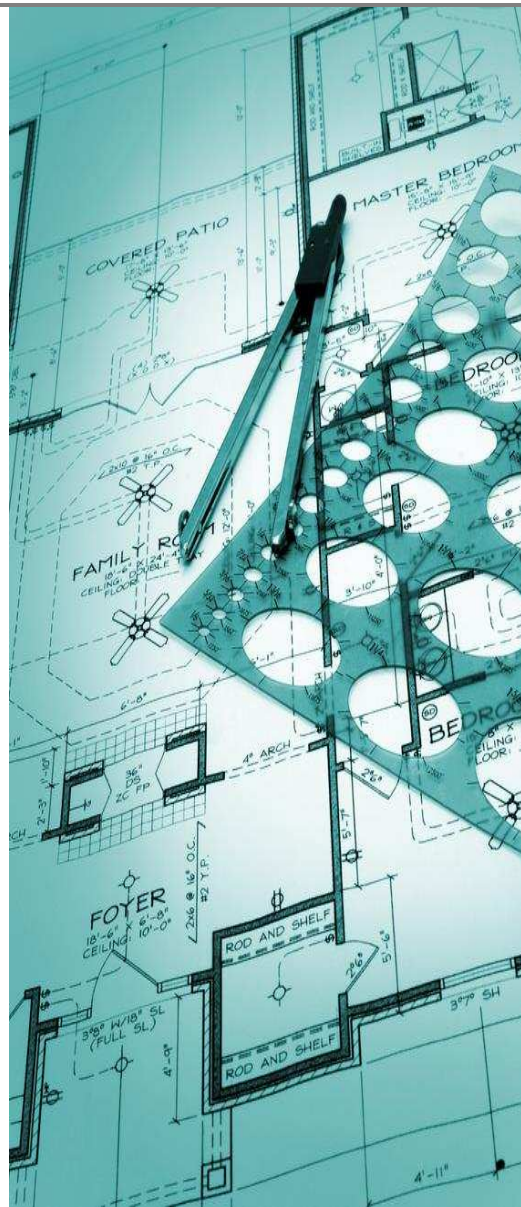
Presentation Overview

- Scope of Training
- What is APQP
- Project Requirements
- Detail on APQP phase – inputs and outputs
- Why Do APQP
- Lessons learned
- Key Take Aways



Training Scope – Need to accomplish

- **Introduces** the concept of Advanced Product Quality Planning (APQP) process.
- **Defines** a typical program management phase review discipline (PRD)
- **Highlights** the Inputs/Outputs of each stage
- **Details** process interfaces
- **Relates** importance of each element to the whole
- **Steps** through APQP Tool Kit
- **Explains** Levels and Elements of PPAP
- **Highlights** Eaton's expectations for external suppliers.

What is APQP?

Advanced Product Quality Planning Cycle

- Advanced Product Quality Planning method to assure that a *product satisfies the customer* (both internal and external).
- The goal of APQP is to facilitate *communication* with everyone and to assure that all required steps are *completed on time*

- Each Advanced Product Quality Plan is unique and is *a living document*.
- Particular emphasis must be placed on *identifying high risk long lead requirements* or items which require focused upfront, effort.

APQP Background

Automotive industry

Automotive Industry Action Group

Automotive industry challenges:

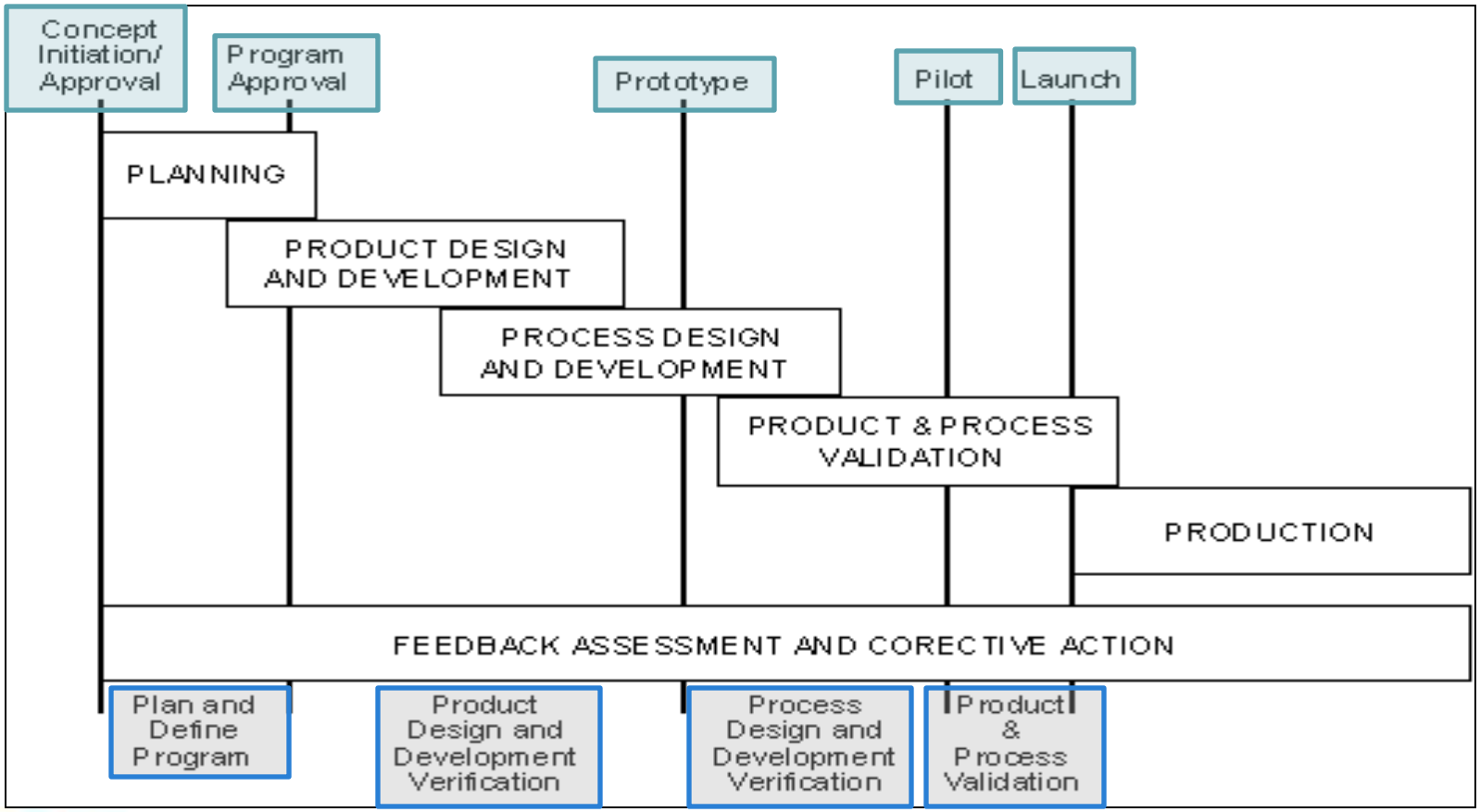
- Innovation, more complex product
- Reduce NPD times
- Complicated Supply chain
- Increasing customer and quality requirements

Solution:

- Ford, GM, Chrysler APQP Task Force jointly developed in the late 80's to standardize their respective supplier quality systems.

APQP – timing chart and phases - AIAG

The Advanced Product Quality Planning process consists of **four** phases and **five** major activities and has some 20+ supporting tools (e.g. DFMEA, PFMEA, CTQ, Special Characteristics, Control Plan, SPC) along with ongoing feedback assessment and corrective action.



APQP Inputs and Outputs

Prepare for APQP

Input

- Organize the Team
- Define the Scope
- Establish Team-to-Team Communication
- Provide Core Tools Training
- Involve Customers and Suppliers
- Implement Simultaneous Engineering
- Develop Control Plan Format
- Decide on Concern Resolution
- Develop Product Quality Timing Plan

Plan & Define Program

Input

- Voice of the Customer
- Business Plan/ Marketing Strategy
- Product/ Process Benchmark Data
- Product/ Process Assumptions
- Product Reliability Studies
- Customer Inputs

Output

Product Design & Dev

Input

- Design Goals
- Reliability and Quality Goals
- Preliminary Bill of Material
- Preliminary Process Flow Chart
- Preliminary Listing of Special Product and Process Characteristics
- Product Assurance Plan
- Management Support

Output

Input

- Design Failure Mode and Effects Analysis (DFMEA)
- Design for Manufacturability and Assembly
- Design Verification
- Design Reviews
- Prototype Build – Control Plan
- Engineering Drawings (Including Math Data)
- Engineering Specifications
- Material Specifications
- Drawing and Specification Changes
- New Equipment, Tooling and Facilities Requirements
- Special Product and Process Characteristics
- Gages/Testing Equipment Requirements
- Team Feasibility Commitment and Management Support

Process Design & Dev

Output

Input

- Packaging Standards
- Product/Process Quality System Review
- Process Flow Chart
- Floor Plan Layout
- Characteristics Matrix
- Process Failure Mode and Effects Analysis (PFMEA)
- Pre-Launch Control Plan
- Process Instructions
- Measurement Systems Analysis Plan
- Preliminary Process Capability Study Plan
- Packaging Specifications
- Management Support

Product & Process Validation

Output

Input

- Production Trial Run
- Measurement Systems Evaluation
- Preliminary Process Capability Study
- Production Part Approval
- Production Validation Testing
- Packaging Evaluation
- Production Control Plan
- Quality Planning Sign-Off and Management Support

Production Part Approval Process

Feedback, Assessment & Corrective Action

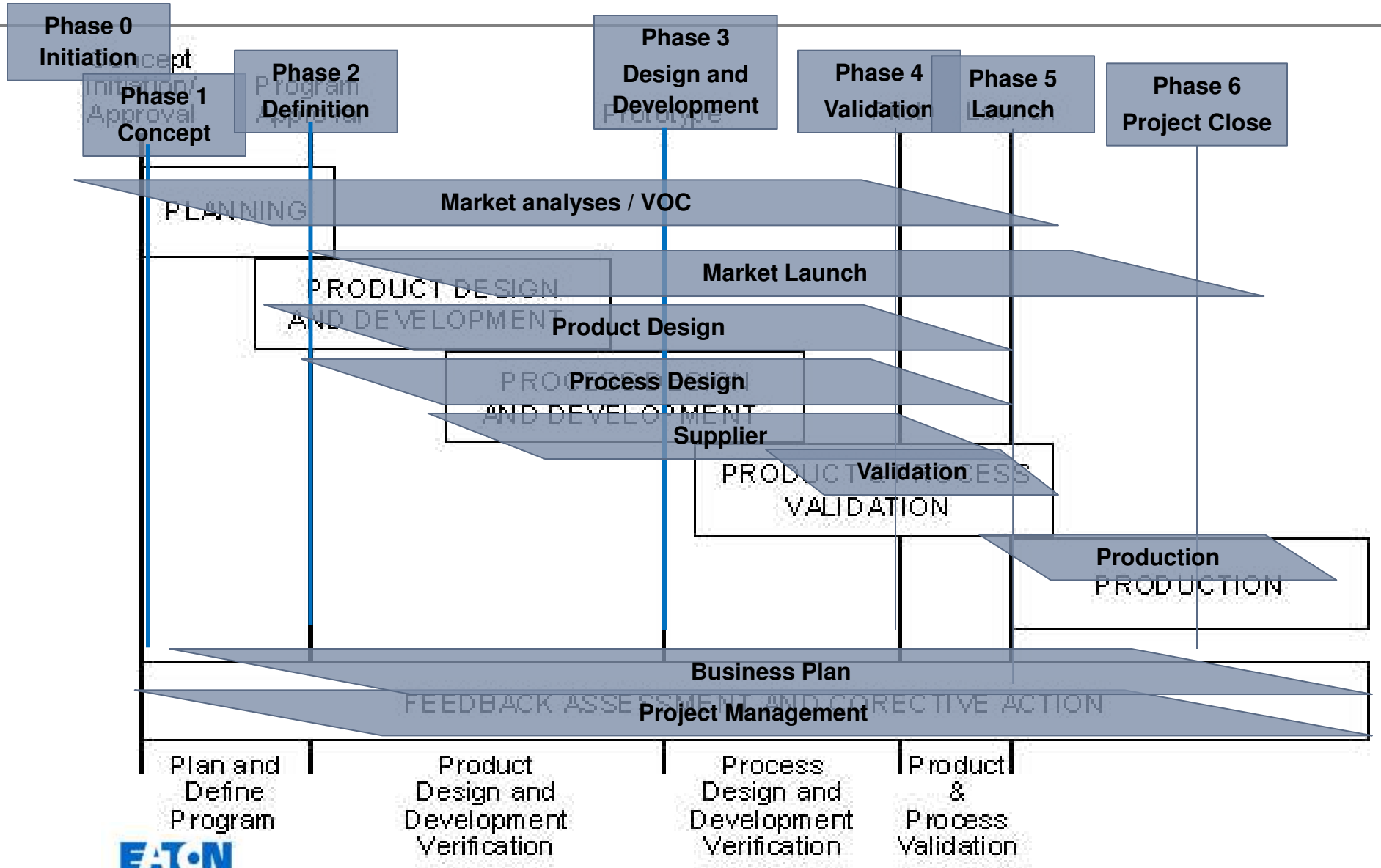
Output

- Reduced Variation
- Customer Satisfaction
- Delivery and Service

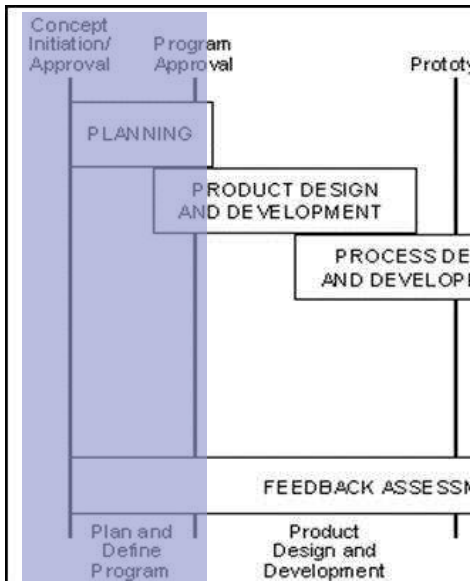
The **key to success** is the development of a comprehensive **project quality plan**:

- Identify all tasks;
- Assure the effort for all tasks is planned for all functions involved;
- Monitor progress and effort against the plan.

APQP – timing chart in relation to Phase Gate Review Discipline



1. Plan and Define Program



Assure that customer needs and expectations are clearly understood.

INPUTS:

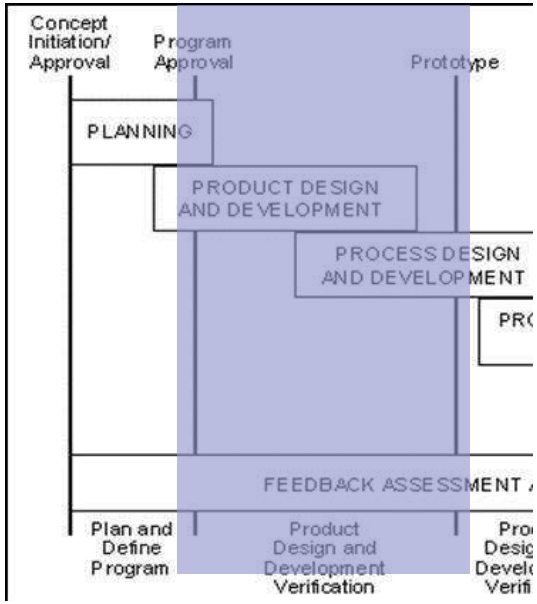
- Voice of the Customer
  - Market Research
  - Historical Warranty and Quality Information
  - Team Experience
- Business Plan/Marketing Strategy
- Product/Process Benchmark Data
- Product/Process Assumptions
- Product Reliability Studies

OUTPUTS:

- Design Goals
- Reliability & Quality goals
- CONC* targets
- Preliminary Bill of Materials
- Preliminary Process Flow Chart
- Preliminary list of Special Product and Process Characteristics
- Product Assurance Plan
- Management Support

- The inputs and outputs applicable to the process may vary according to the product process and customer needs and expectations.
- *CONC = Cost of Nonconformance – New with Eaton Integration

2. Product Design and Development - 1



Develop design into a near final form.

Prototype and feasibility studies – volumes, schedule, manufacturing.

INPUTS:

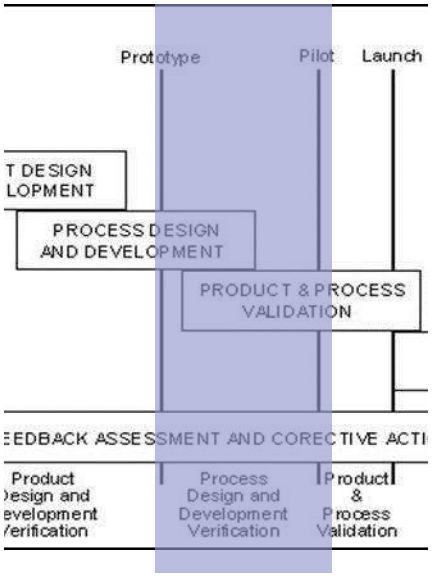
- Design Goals
- Reliability & Quality goals
- Preliminary Bill of Materials
- Preliminary Process Flow Chart
- Preliminary list of Special Product and Process Characteristics *
- Product Assurance Plan

OUTPUTS:

- Design Failure Mode and Effects Analysis (DFMEA)
- Design For Manufacturability and Assembly
- Design Verification
- Design Reviews
- Prototype Build – Control plan
- Engineering Drawings (Including Math Data)
- Engineering Specifications
- Material Specifications
- Drawing and Specification Changes
- New Equipment, Tooling and Facilities Requirements
- Special Product and Process Characteristics
- Gages/Testing Equipment Requirements
- Team Feasibility Commitment
- Management Support

* New with Eaton Integration – Added granularity around Critical To Quality (CTQ) special characteristics – Two Types now available to select from Required Control Dimensions (RCD) and Statistically Toleranced Dimensions (STD).

3. Process Design and Development



Develop a manufacturing system and its related control plans to achieve quality products.

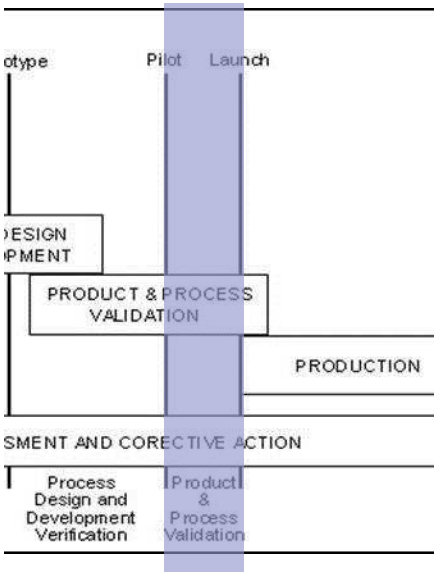
INPUTS:

- Design Failure Mode and Effects Analysis (DFMEA)
- Design For Manufacturability and Assembly
- Design Verification
- Design Reviews
- Prototype Build – Control Plan
- Engineering Drawings (Including Math Data)
- Engineering Specifications
- Material Specifications
- Drawing and Specification Changes
- New Equipment, Tooling and Facilities Requirements
- Special Product and Process Characteristics
- Gages/Testing Equipment Requirements
- Team Feasibility Commitment
- Management Support

OUTPUTS:

- Packaging Standards
- Product/Process Quality System Review
- Process Flow Chart
- Floor Plan Layout
- Characteristics Matrix
- Process Failure Mode and Effects Analysis (PFMEA)
- Pre-Launch Control Plan
- Process Instructions
- Measurement Systems Analysis Plan
- Preliminary Process Capability Study Plan
- Packaging Specifications
- Management Support

4. Product and Process Validation



Validate manufacturing process through production trial run.

Validate that the control plan and process flow chart are effective and that the product meets customer expectation.

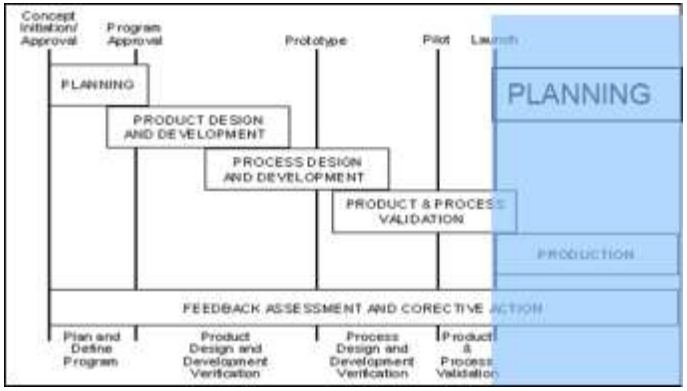
INPUTS:

- Packaging Standards
- Product/Process Quality System Review
- Process Flow Chart
- Floor Plan Layout
- Characteristics Matrix
- Process Failure Mode and Effects Analysis (PFMEA)
- Pre-Launch Control Plan
- Process Instructions
- Measurement Systems Analysis Plan
- Preliminary Process Capability Study Plan
- Packaging Specifications
- Management Support

OUTPUTS:

- Measurement Systems Evaluation
- Significant Production Run
- Preliminary Process Capability Study
- Production Part Approval
- Production Validation Testing
- Packaging Evaluation
- Production Control Plan
- Quality Planning Sign-Off - formal
- Management Support

Feedback, Assessment, Corrective actions



Evaluate outputs, effectiveness of the product quality planning efforts.

INPUTS:

- Production Trial Run
- Measurement Systems Evaluation
- Preliminary Process Capability Study
- Production Part Approval
- Production Validation Testing
- Packaging Evaluation
- Production Control Plan
- Quality Planning Sign-Off and Management Support

OUTPUTS:

- Reduced Variation
- Improved Customer Satisfaction
- Improved Delivery and Service
- Effective use of best practice, lessons learned
- Maximum ROI
- Minimum Waste
- Minimum CONC

APQP Summary:

What we do:

- Design Quality
  - DFMEA / PFMEA / DFM/A
- Manufacturing Quality
  - Control Plans
  - Process Flows
  - Measurement System Analysis
  - Capability Analysis
  - Process Validation
  - Run at rate
- Supplier Qualification & Quality Requirements
- Product Qualification
  - 1st Article Inspection
  - PPAP
  - Tooling & Gauges
  - Testing

Up

Front

Detailed

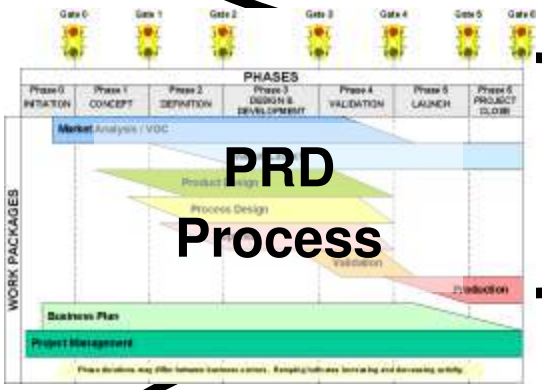
Quality

Planning

How we do it:

Phase Review

Discipline



What we get:

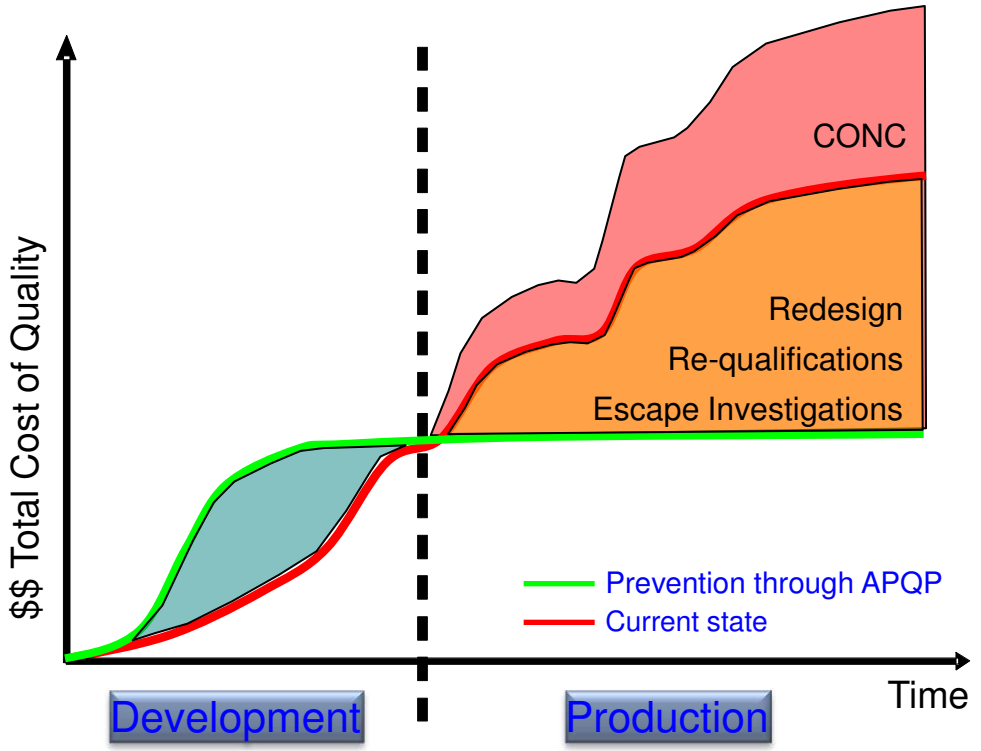
- Defect Free Launches
- Reduced Warranty Claims
- Zero Spills
- Customer Satisfaction
- Robust Products
- Greater Supplier Control
- Reduced supplier cost

APQP…… Leadership Engagement is Critical

APQP Benefits:

Manufacturing process functions that are clearly planned, validated, documented and communicated will result in:

- ✓ Robust and reliable designs
- ✓ Reduced process variation
- ✓ Enhanced confidence in supplier's capabilities
- ✓ Better controlled process changes
- ✓ Defect free launches
- ✓ Improved Customer satisfaction
- ✓ Improved Delivery and Service
- ✓ Maximum ROI
- ✓ Minimum Waste
- ✓ Minimum CONC



Phase/Gate Process

What is a phase/gate process?

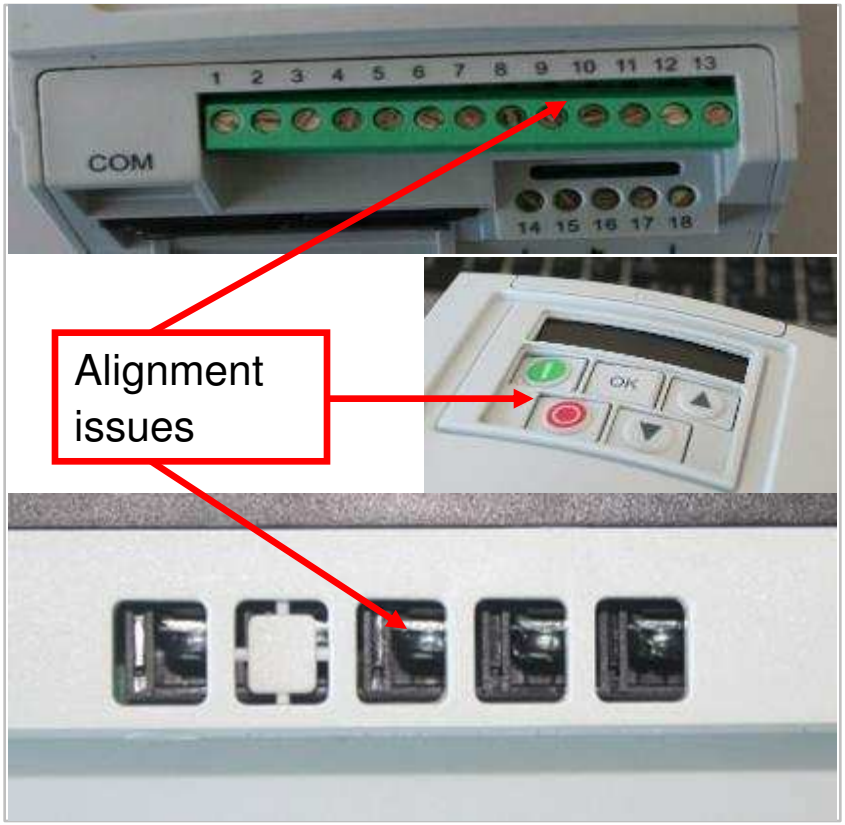
- Process steps are organized into phases
- Decision gates are used to prevent later phase steps from being executed before earlier phase steps are complete and the project is ready

- **What is the responsibility of a Reviewers?**
  - Stop the project from advancing if current phase activities are not done, or not done well
- **Who should participate in the review?**
  - Senior functional and business leaders that are not directly involved in the program
- **How can a reviewer understand the status of Phase deliverables prior to the gate review?**
  - Typically requires an expert to review deliverable details and report on quality and completion of deliverables

DA1 IP20 – Variable Frequency Drive (Phoenix)

12.04.2013 – Invertek DS Supplier, ICD, EMEA - Electrical
P. Raas = +49 151 161-67329

Lessons Learned



Incident description:

On receipt of the initial batch of product it was found that the alignment of the external housing with the internal connectors was out of position.

Investigation findings:

- The buttons are too loose in the recesses in the plastics.
- The control PCB clip is not holding the control PCB close enough to the front plastic.
- Clip design for holding PCB to housing not correct

Root Causes and Management System Gaps:

- Design error on the plastic housing not identified through risk assessment.
- No sign off from Eaton on plastic housing or final unit sample.

How would APQP have prevented this incident ?

- DFMEA of the new PCD and housing assed the risk
- PPAP/FAI – dimensional checks of the key dimensions
- Finalised samples for approval
- PSW sign off and PPAP approval
- Run at Rate analysis at supplier

Preventive & corrective actions:

- The plastic clip design has been changed. The holes for the buttons have been reduced in size to more closely match the button shapes: this reduces button wobble and secures housing correctly.

Direct Source Supplier Circutor – NZM-XMC-MB (measurement device)

19.04.2012 – PDCD, EMEA – Electrical
20.01.2013 – PDCD, EMEA – Electrical
D. Schwellenbach = +49 151 277- 45370

Lessons Learned

Incident description:

Two issues reported from this direct source supplier.

1. Incorrect component used causing a defect with the component memory. 5v used instead of the required 3.3v component. Resulting in a field campaign to update the firmware.
2. Potential of an arc caused by reversed polarity on the 24DC-connection and the inner insulation concept of the product (intolerable wiring) does not fulfill the required double insulation standard. Field campaign initiated to exchange products.

Investigation findings:

- Integration of the product line quality manager for brand products not completed
- Supplier not qualified correctly prior to supplying products to Eaton.
- No test plan or product qualification completed.

Root Causes and Management System Gaps:

- Validation of key components
- Supplier R&D wrongly classified the terminals of the equipment as not accessible, but in fact the terminals are accessible.
- Design failure unfortunately not been detected during the conformity testing in the lab in Circutor.

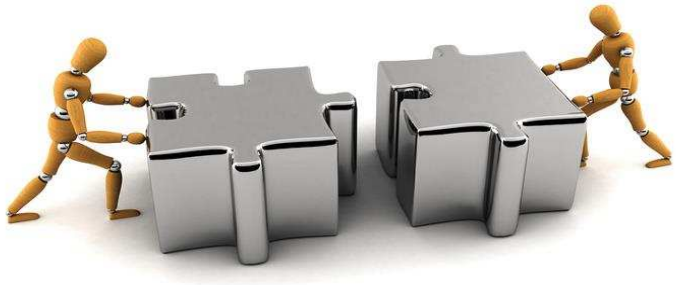
How would APQP have prevented this incident ?

- CTQ analysis of key components.
- DFMEA risk assessment
- Prototype samples and product qualification
- PPAP and FAI
- Supplier Qualification
- Validation of design and test results
- Sample testing

Preventive & corrective actions:

- Design improvement to ensure correct components used.
- Extra control point added into the testing and qualification
- Updated build instructions and training

Expectations:



Supplier:

- Understand Eaton APQP / Phase Review Discipline requirements.
- Attend web overview training sessions.
- Review AIAG manuals for APQP & PPAP and work accordingly.
  - www.aiag.org
- Submit PPAP's on required product, parts, products or components.
- Focus on up front quality planning.
- Follow Supplier Excellence Manual dictates
- Provide PPAP submissions compliant with the Latest CPSD PPAP Manual (Level 3 is default!)
- Be a part of our team!

Key Take Aways:

- ✓ APQP is cross-functional planning and execution to produce product that fully meets the customer's expectations ***the first time*****.**
- ✓ AIAG APQP phases are Planning, Product Design, Process Design, Validation, Production.
- ✓ PRD phases are Concept, Definition, Design, Validation, Launch, Close.
- ✓ Cross-functional – means multiple functions input requirements Marketing/Design/Manufacturing/SCM/Quality.

APQP: Process Design/Development and Validation

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APQP: Key Elements For Our Training

Process Design

- PFC (Process Flow Chart)
- FMEA (Failure Mode Effects Analysis)
- Control Plan

Process Validation

- MSA (Measurement System Analysis)
- Process Capability Study

PROCESS FLOW DIAGRAM

Process Flow Diagram

What is It?

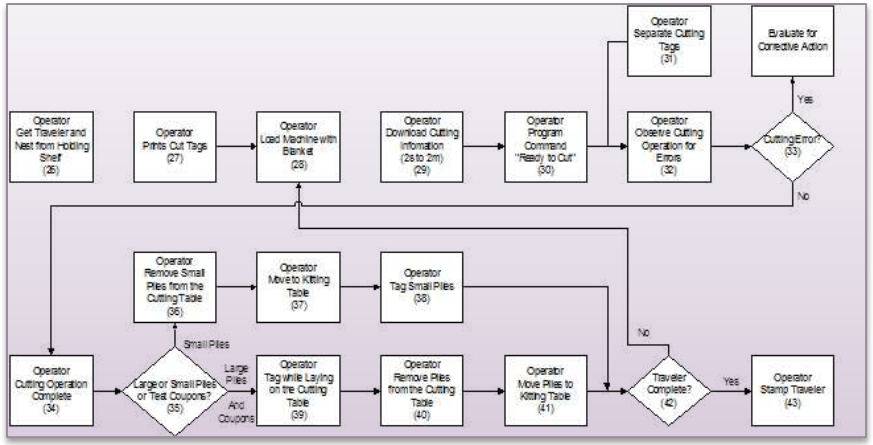
- A visual diagram of the entire process from receiving through shipping, including outside processes and services

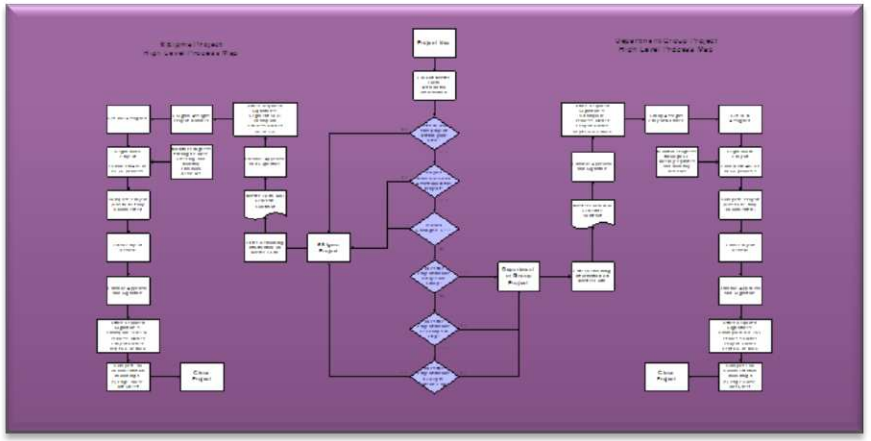
Purpose?

- To help people “see” the real process. Process maps can be used to understand the following characteristics of a process:
- Set-by-step process linkage
- Offline activities (measurement, inspection, handling)
- Rework, scrap

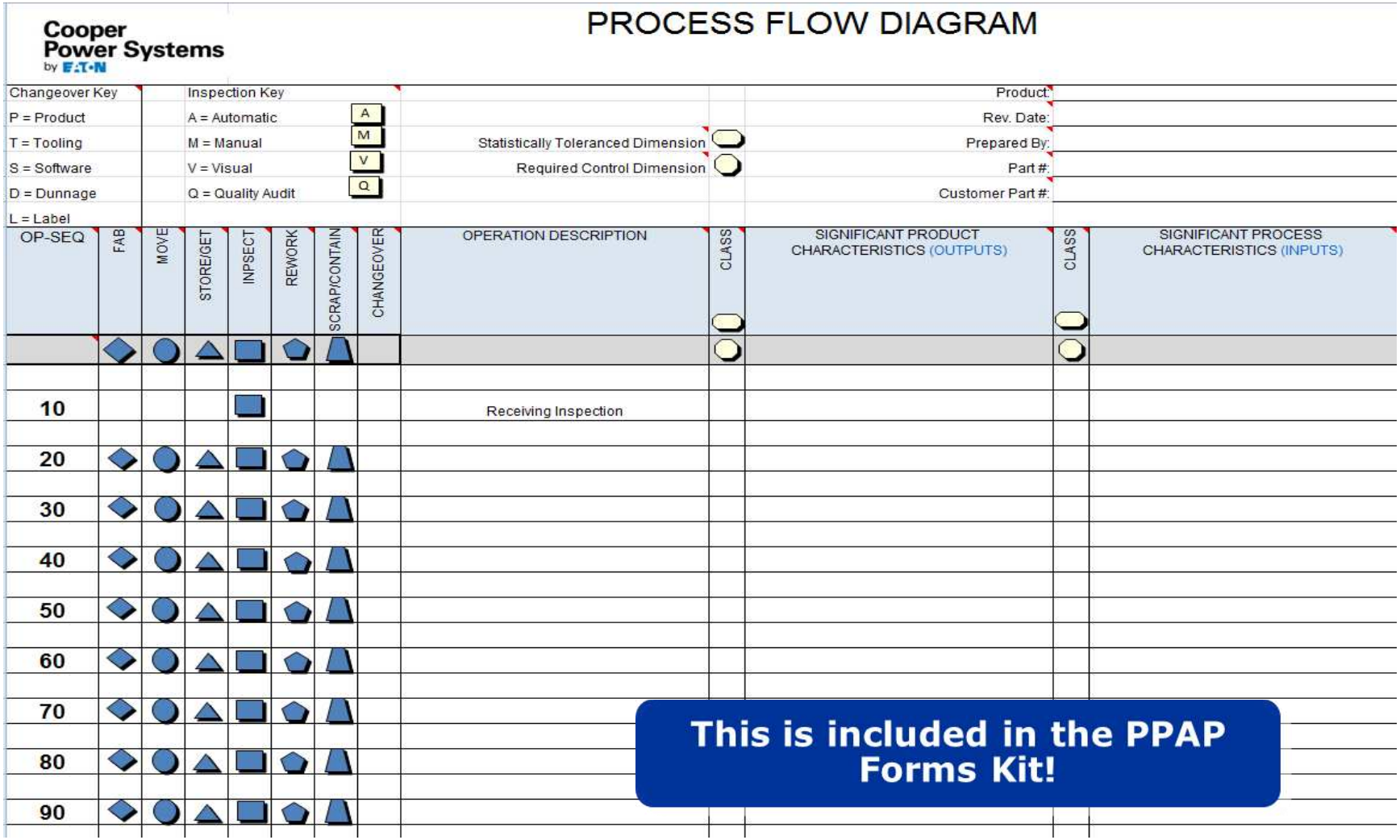
When to Use It?

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





Process Flow Diagram



Cooper Power Systems by EATON

PROCESS FLOW DIAGRAM

Changeover Key	Inspection Key		Product:
P = Product	A = Automatic	A	Rev. Date:
T = Tooling	M = Manual	M	Prepared By:
S = Software	V = Visual	V	Part #:
D = Dunnage	Q = Quality Audit	Q	Customer Part #:
L = Label			

Statistically Toleranced Dimension

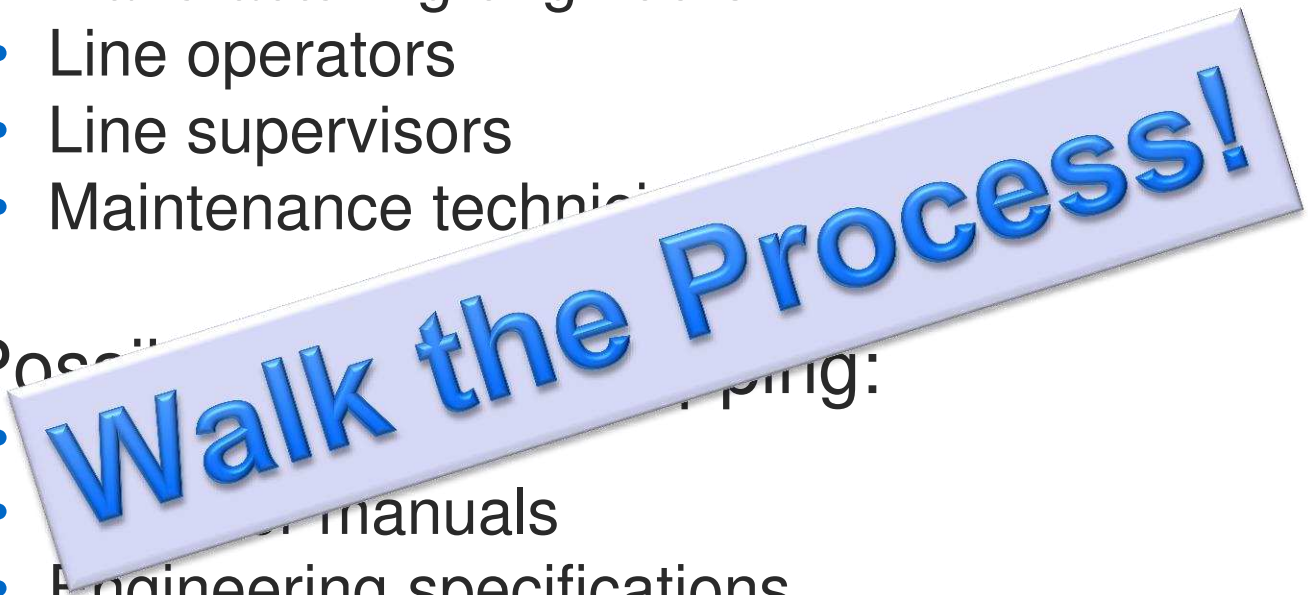
Required Control Dimension

OP-SEQ	FAB	MOVE	STORE/GET	INPSECT	REWORK	SCRAP/CONTAIN	CHANGEOVER	OPERATION DESCRIPTION	CLASS	SIGNIFICANT PRODUCT CHARACTERISTICS (OUTPUTS)	CLASS	SIGNIFICANT PROCESS CHARACTERISTICS (INPUTS)
10				■				Receiving Inspection				
20	◆	●	▲	■	⬟	⏢						
30	◆	●	▲	■	⬟	⏢						
40	◆	●	▲	■	⬟	⏢						
50	◆	●	▲	■	⬟	⏢						
60	◆	●	▲	■	⬟	⏢						
70	◆	●	▲	■	⬟	⏢						
80	◆	●	▲	■	⬟	⏢						
90	◆	●	▲	■	⬟	⏢						

This is included in the PPAP Forms Kit!

Preparing the Process Map

- Team Effort:
  - Manufacturing engineers
  - Line operators
  - Line supervisors
  - Maintenance techni
- Possi ping:
  -
  - manuals
  - Engineering specifications
  - Operator experience
  - 6M's
    - Man, Machine (Equipment), Method (Procedures), Measurement, Materials, Mother Nature (Environment)



Process Map Summary

- Process Mapping Provides Inputs to
  - Potential Failure Mode Effect Analysis
  - Control Plan
  - Capability Studies
  - MSA

Process Mapping helps us gain process knowledge!

Process Flow Diagrams

- Reviewers Checklist

✓ Process Flow must identify each step in the process

✓ 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

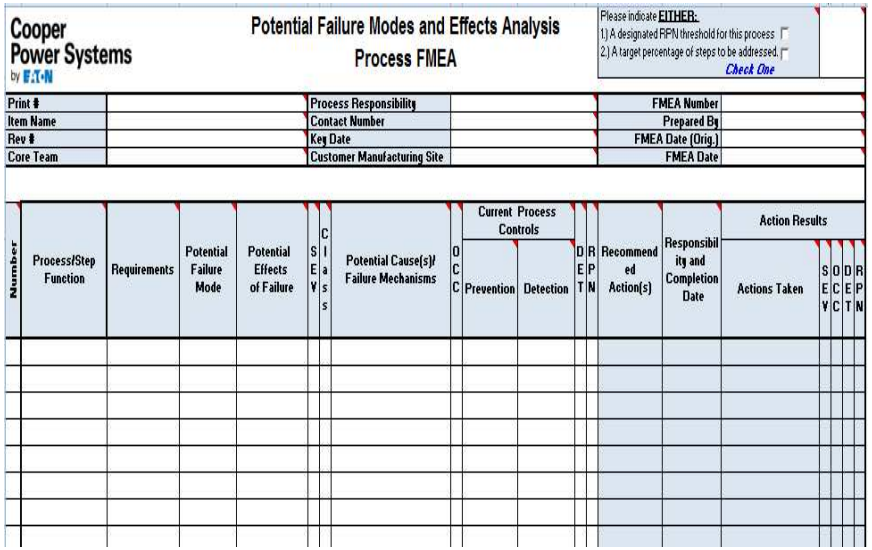
PROCESS FMEA

FMEA Origin

- Created by NASA following Apollo 1 mission failure
- Allows us to take a proactive approach to what can go wrong in a process and manage our risks better

Process FMEA (PFMEA)

- What is It?
  - A tool used to identify and prioritize risk areas and their mitigation plans.
- Purpose
  - Identifies potential failure modes, causes, and effects. Inputs come from the process flow diagram.
  - Identifies key inputs which positively or negatively affect quality, reliability and safety of a product or process.
  - Denotes Special Characteristics of Product/Process that impact the ultimate safety/performance of the end product.
- When to Use It
  - After completion of the process flow diagram.
  - Prior to tooling for production



Cooper Power Systems by EATON

Potential Failure Modes and Effects Analysis
Process FMEA

Please indicate EITHER:
1) A designated RPN threshold for this process ☐
2) A target percentage of steps to be addressed. ☐
Check One

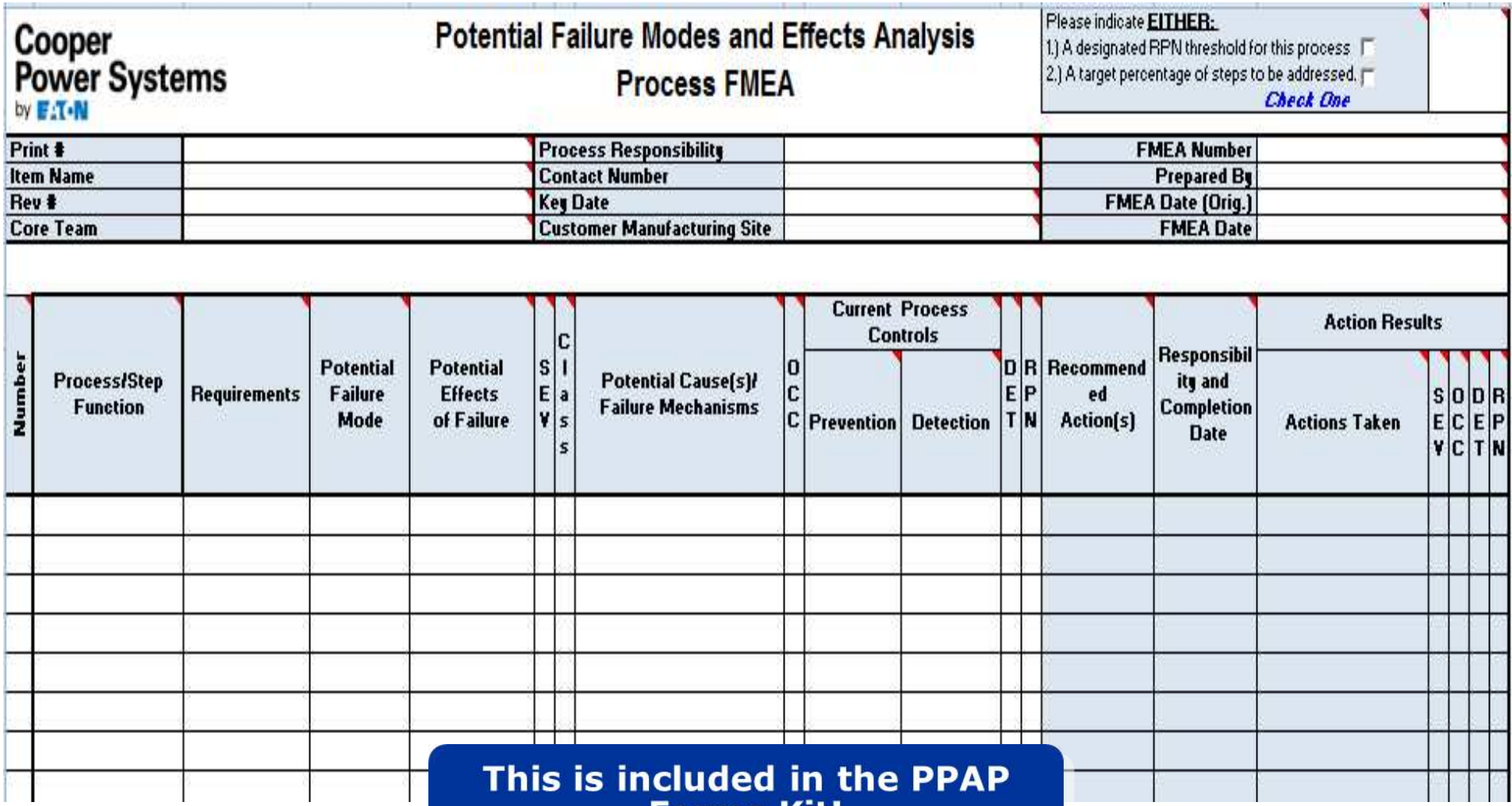
Print #		Process Responsibility		FMEA Number	
Item Name		Contact Number		Prepared By	
Rev #		Key Date		FMEA Date (Orig.)	
Core Team		Customer Manufacturing Site		FMEA Date	

Number	Process/Step Function	Requirements	Potential Failure Mode	Potential Effects of Failure	SEV	Class	Potential Cause(s)/ Failure Mechanisms	OCC	Current Process Controls: Prevention	Current Process Controls: Detection	DET	RPN	Recommended Action(s)	Responsibility and Completion Date	Action Results: Actions Taken	Action Results: SEV	Action Results: OCC	Action Results: DET	Action Results: RPN

IMPORTANT!

The PFMEA should be completed using a *cross-functional* team!

Process FMEA (PFMEA)



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Potential Failure Modes and Effects Analysis

Process FMEA

Please indicate **EITHER:**
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Print #		Process Responsibility		FMEA Number	
Item Name		Contact Number		Prepared By	
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Number	Process/Step Function	Requirements	Potential Failure Mode	Potential Effects of Failure	SEV	Class	Potential Cause(s)/ Failure Mechanisms	OCC	Current Process Controls		DET	RPN	Recommended Action(s)	Responsibility and Completion Date	Action Results					
									Prevention	Detection					Actions Taken	SEV	OCC	DET	RPN	

This is included in the PPAP Forms Kit!

Potential Failure Mode

- Discuss with the team all credible Potential Failure Modes.

  Team should be able to pose and answer the following questions:
  - How can the process/part fail to meet requirements?
  - Regardless of Eng specs, what would a customer consider objectionable?

- In each instance, the assumption is made that the failure could occur, but will not necessarily occur:
  - Each failure mode should be credible
  - Do not list acts of God or freak accidents
  - A description of non-conformance
  - **Assume incoming parts are correct**
  - Remember to consider subsequent operations
  - Examples of failure modes include:

- Potential failure modes should be described in “physical” or technical terms, not as a symptom noticeable by the customer.

Burred	Bent	Hole off location
Cracked	Hole to shallow	Hole missing
Handling Damage	Dirty	Hole to deep
Surface too rough	Corrosion	Open circuit

Potential Effect(s) of Failure

Potential effects of failure are defined as the effects of the failure on the customer(s)

- Describe in terms of what the customer might notice or experience
- State clearly if the failure mode could impact safety or cause noncompliance to regulations

For the end user the effects should always be stated in term of product or system performance such as:

Noise	Rough	Erratic Operation	Excessive	Effort	Inoperative	Unpleasant Odor	Unstable
Operation Impaired	Draft	Intermittent Operation	Poor Appearance	Leaks	Control Impaired	Rework Repairs	Scrap

If the customer is the next operation the effects should be stated in terms of process/operation performance, such as:

Cannot fasten	Does not fit	Cannot bore/tap	Does not connect	Cannot mount
Does not match	Cannot face	Causes Excessive tool wear	Damages Equipment	Endangers Operator

Potential Cause(s) of Failure

Potential causes are defined as how the failure could occur, and described in terms of something that can be corrected or controlled.

Only specific errors should be listed, ambiguous phrases such as “operator error”, “machine malfunction”, etc., should be avoided. Acceptable alternatives would be operator failed to install seal, or over temperature set incorrectly.

The causes should be described so that remedial efforts can be aimed at those causes which are pertinent. Typical failure causes may include but are not limited to:

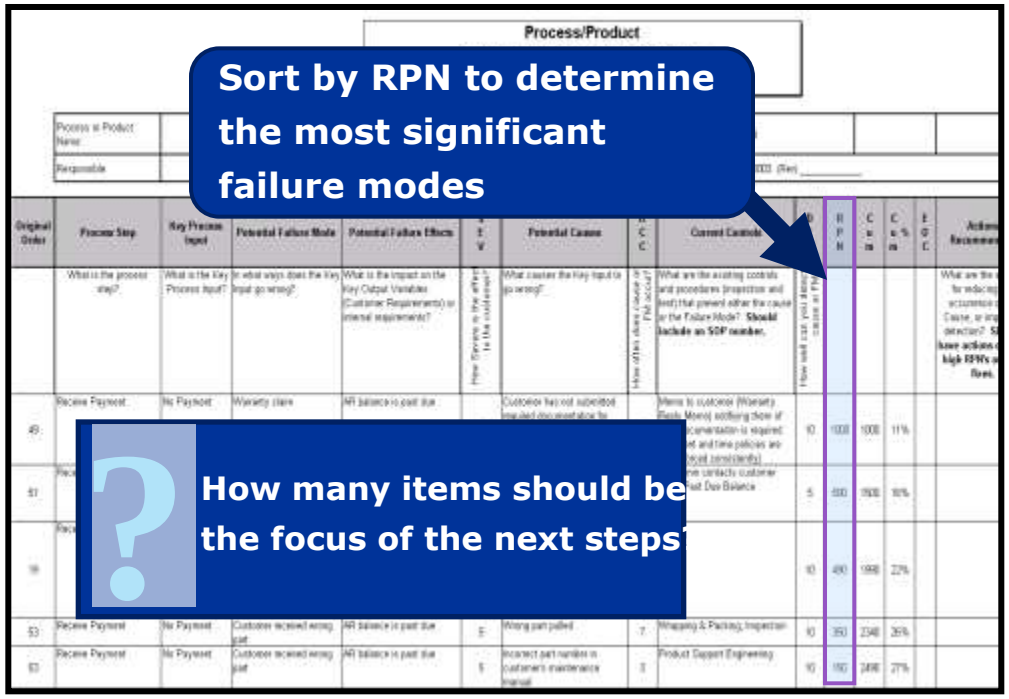
Improper torque – over/under	Improper weld current, time, pressure	Inaccurate Gauging	Improper Heat Treat – time, temperature	Inadequate gating/venting
Inadequate or no lubrication	Part missing or mislocated	Worn locator	Worn Tool	Chip on locator
Broken tool	Improper Machine Setup	Improper programming	Incorrect Software version	Non validated test system

PFMEA - Definition of Terms

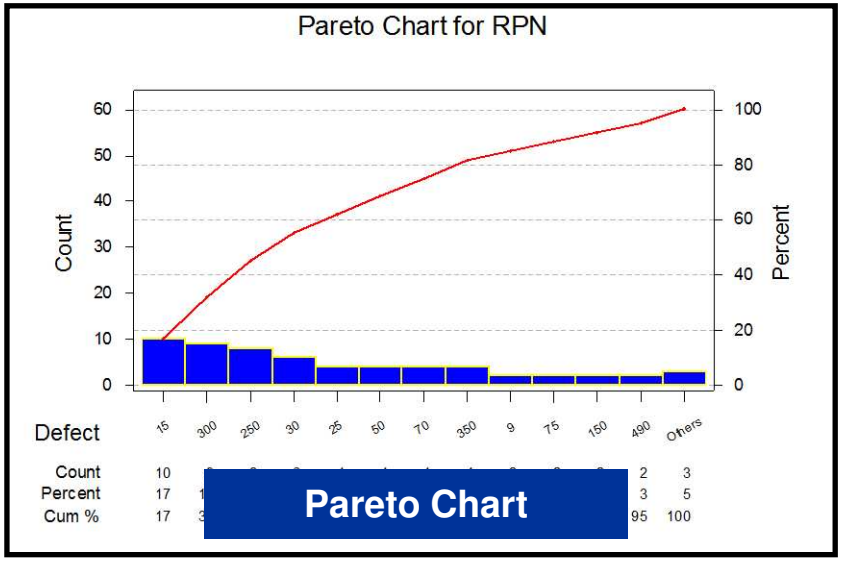
- Severity (of Effect) - severity of the effect on the Customer and other stakeholders (Higher Value = Higher Severity)
- Occurrence (of Cause) - frequency with which a given Cause occurs and creates Failure Mode. (Higher Value = Higher Probability of Occurrence)
- Detection (Capability of Current Controls) - ability of current control scheme to detect the cause before creating the failure mode and/or the failure mode before suffering the effect (Higher Value = Lower Ability to Detect)

Caution: Notice the scale difference for Detection!

Analyzing the PFMEA



- Once the RPN Numbers are determined, they can be used to prioritize the most significant failure modes.
- Sort the FMEA by the RPN numbers. Graphical and statistical tools can help the team to continually improve.



RPN's

- DO NOT set a threshold for RPN.
- Focus on Continuous Improvement.
- DO NOT forget to address high *Severity* scores first.

PFMEA – Remediation Guidelines

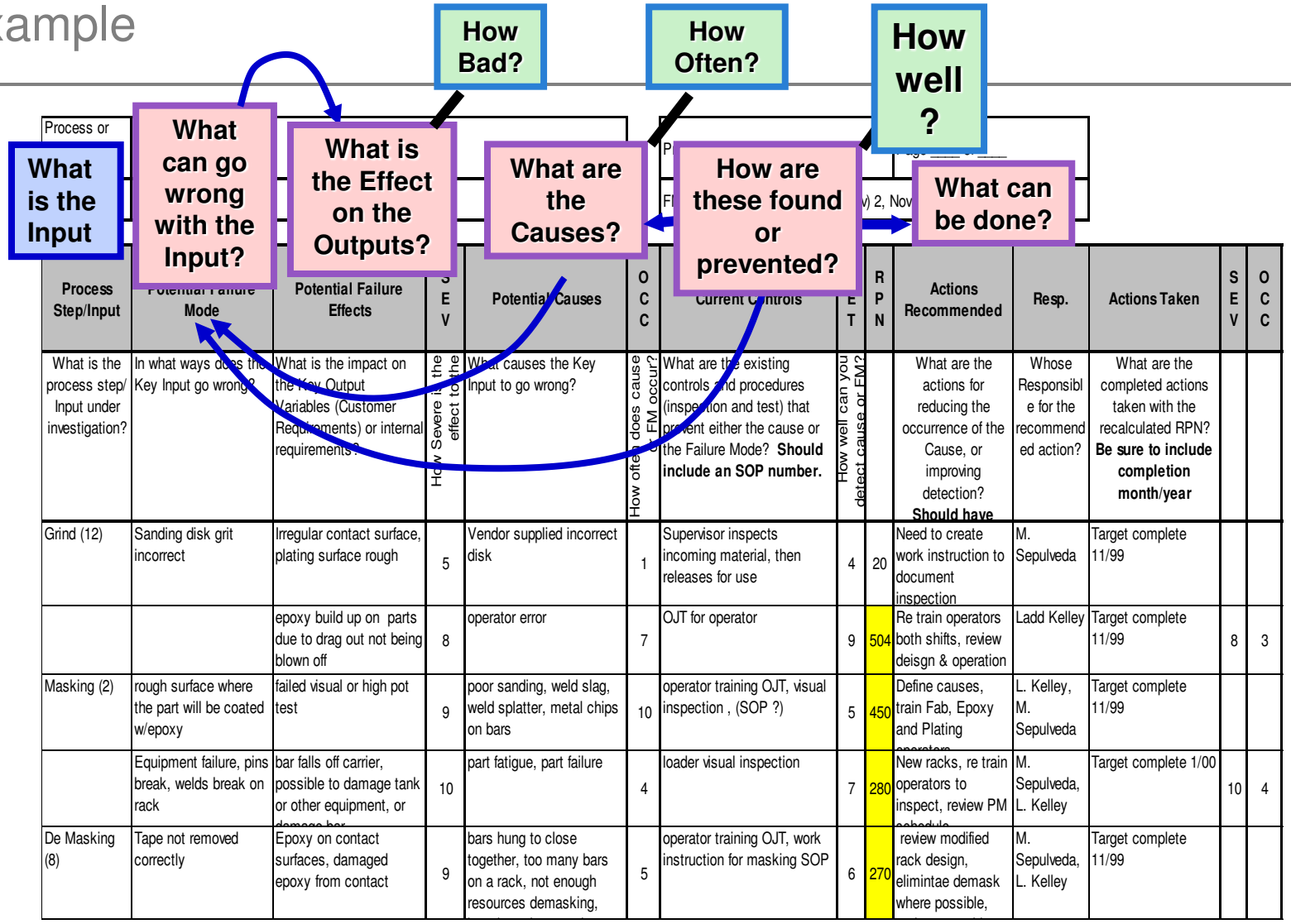
- **Severity** – can only be improved by a design change to the product or process
- **Occurrence** – can only be reduced by a change which removes or controls a cause. Examples are redundancy, substituting a more reliable component or function or mistake-proofing.
- **Detection** – can be reduced by improving detection. Examples are mistake-proofing, simplification and statistically sound monitoring.

In general, reducing the Occurrence is preferable to improving the Detection

Summary Steps To Complete a FMEA

1. For each Process Input, determine the ways in which the Process Step can go wrong (these are Failure Modes).
2. For each Failure Mode associated with the inputs, determine Effects on the outputs.
3. Identify potential Causes of each Failure Mode.
4. List the Current Controls for each Cause.
5. Assign Severity, Occurrence and Detection ratings after creating a ratings key appropriate for your project.
6. Calculate RPN.
7. Determine Recommended Actions to reduce High RPNs.
8. Take appropriate Actions and Document.
9. Recalculate RPNs.
10. Revisit steps 7 and 8 until all the significant RPNs have been addressed.

Example



Process Step/Input	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	ET	RPN	Actions Recommended	Resp.	Actions Taken	SEV	OCC
What is the process step/ Input under investigation?	In what ways does the Key Input go wrong?	What is the impact on the Key Output Variables (Customer Requirements) or internal requirements?	How Severe is the effect to the	What causes the Key Input to go wrong?	How often does cause or FM occur?	What are the existing controls and procedures (inspection and test) that prevent either the cause or the Failure Mode? **Should include an SOP number.**	How well can you detect cause or FM?		What are the actions for reducing the occurrence of the Cause, or improving detection? **Should have**	Whose Responsible for the recommended action?	What are the completed actions taken with the recalculated RPN? **Be sure to include completion month/year**		
Grind (12)	Sanding disk grit incorrect	Irregular contact surface, plating surface rough	5	Vendor supplied incorrect disk	1	Supervisor inspects incoming material, then releases for use	4	20	Need to create work instruction to document inspection	M. Sepulveda	Target complete 11/99		
		epoxy build up on parts due to drag out not being blown off	8	operator error	7	OJT for operator	9	504	Re train operators both shifts, review deisgn & operation	Ladd Kelley	Target complete 11/99	8	3
Masking (2)	rough surface where the part will be coated w/epoxy	failed visual or high pot test	9	poor sanding, weld slag, weld splatter, metal chips on bars	10	operator training OJT, visual inspection , (SOP ?)	5	450	Define causes, train Fab, Epoxy and Plating	L. Kelley, M. Sepulveda	Target complete 11/99		
	Equipment failure, pins break, welds break on rack	bar falls off carrier, possible to damage tank or other equipment, or	10	part fatigue, part failure	4	loader visual inspection	7	280	New racks, re train operators to inspect, review PM	M. Sepulveda, L. Kelley	Target complete 1/00	10	4
De Masking (8)	Tape not removed correctly	Epoxy on contact surfaces, damaged epoxy from contact	9	bars hung to close together, too many bars on a rack, not enough resources demasking,	5	operator training OJT, work instruction for masking SOP	6	270	review modified rack design, elimintae demask where possible,	M. Sepulveda, L. Kelley	Target complete 11/99		

Process FMEA (PFMEA)

Reviewers Checklist

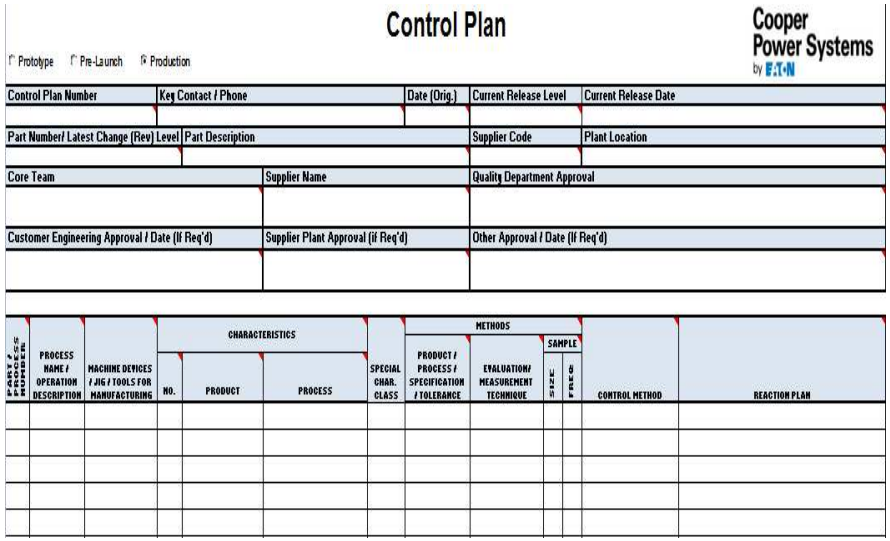
- ✓ Verify there is a system for prioritizing risk of failure such as high RPN numbers
- ✓ Make sure that high RPN process concerns are carried over into the control plan
- ✓ Make sure that all critical failure modes are addressed
  - Safety
  - Form, fit, function
  - Material concerns

See AIAG Core Tools for detailed checklist

Control Plan

Process Control Plan (PCP)

- What is It?
  - A tool used to define the operations, processes, material, equipment, methodologies and special characteristics for controlling variation in key product or process characteristics within the manufacturing process.
- Objective or Purpose
  - Communicates the supplier's decisions during the entire manufacturing process from material receipt to final shipping.
  - Verifies existence of production controls at each step defined in the Process Flow/PFMEA
  - Defines reaction plans at each step should a nonconformance be detected
  - Denotes Special Characteristics of Product/Process that impact the ultimate safety/performance of the end product.
- When to Use It
  - After completion of the process flow diagram/pFMEA.
  - At Prototype, Prelaunch and Production
    - Implementation of new process
    - Implementing a process change



Control Plan

Cooper Power Systems by EATON

☐ Prototype ☐ Pre-Launch ☒ Production

Control Plan Number	Key Contact / Phone	Date (Orig.)	Current Release Level	Current Release Date

Part Number/ Latest Change (Rev) Level	Part Description	Supplier Code	Plant Location

Core Team	Supplier Name	Quality Department Approval

Customer Engineering Approval / Date (If Req'd)	Supplier Plant Approval (if Req'd)	Other Approval / Date (If Req'd)

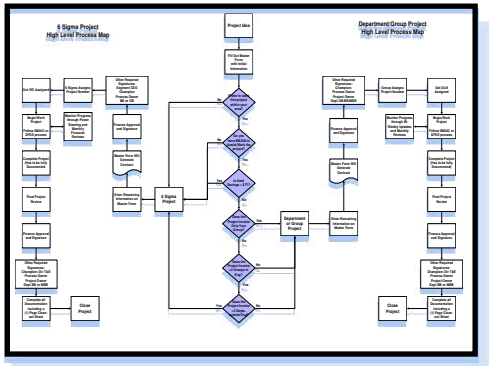
PART/PROCESS NUMBER	PROCESS NAME / OPERATION DESCRIPTION	MACHINE DEVICES / JIG / TOOLS FOR MANUFACTURING	CHARACTERISTICS			SPECIAL CHAR. CLASS	METHODS				CONTROL METHOD	REACTION PLAN
			NO.	PRODUCT	PROCESS		PRODUCT / PROCESS / SPECIFICATION / TOLERANCE	EVALUATION/ MEASUREMENT TECHNIQUE	SAMPLE SIZE	SAMPLE FREQ		

IMPORTANT!

Since processes are expected to be updated as changes are made Control Plans are LIVING documents that need to be changed in step with manufacturing

Control Plan

Tool Interaction



Process Flowchart

Process Steps

New/Revised Process Steps

Process Step	Key Process Input	Potential Failure Mode	Potential Failure Effects	S E V	Potential Causes	O C C	Current Controls	D E T	R P N	E O C
Receive Payment	Checks	Delay internal mail	AR balance does not go down	7	Inadequate staffing in mail room	7	None	10	490	
Identify Customer	Wire Transfer reference line	Information not supplied	AR balance is past due	10	Customer or bank did not include name and/or account info on wire transfer	5	Acct identifies problem when trying to apply payment	5	250	
Identify Invoice	Checks	Incorrect invoice supplied	Invoice shows outstanding (AR balance does go down)	5	Customer error	5	Customer might catch it when reviewing the next statement	10	250	
Identify Invoice	Checks	Invoice number not supplied	Invoice shows outstanding (AR balance does go down)	5	Customer error	10	Acct identifies problem when trying to apply payment	5	250	

Process FMEA

Process Steps

New/Revised Process Steps

Control Plan

Risk Prioritized Process Steps

Improved Controls

The Control Plan Form

Control Plan

Cooper Power Systems by EATON

☐ Prototype ☐ Pre-Launch ☒ Production

Control Plan Number	Key Contact / Phone	Date (Orig.)	Current Release Level	Current Release Date

Part Number/ Latest Change (Rev) Level	Part Description	Supplier Code	Plant Location

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PART / PROCESS NUMBER	PROCESS NAME / OPERATION DESCRIPTION	MACHINE DEVICES / JIG / TOOLS FOR MANUFACTURING	CHARACTERISTICS			SPECIAL CHAR. CLASS	METHODS				CONTROL METHOD	REACTION PLAN
			NO.	PRODUCT	PROCESS		PRODUCT / PROCESS / SPECIFICATION / TOLERANCE	EVALUATION/ MEASUREMENT TECHNIQUE	SAMPLE SIZE	SAMPLE FREQ		

This is included in the PPAP Forms Kit!

Control Plan Sections - 1

Control Plan

Cooper Power Systems by EATON

Prototype | Pre-Launch | Production

Control Plan Number	Key Contact / Phone	Date (Orig.)	Current Release Level	Current Release Date

Part Number/ Latest Change (Rev) Level	Part Description	Supplier Code	Plant Location

Core Team	Supplier Name	Quality Department Approval

Customer Engineering Approval / Date (If Req'd)	Supplier Plant Approval (if Req'd)	Other Approval / Date (If Req'd)

Administrative:

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

Phases:

- Prototype – a description of the dimensional measurements and material and performance tests that will occur during Prototype build.
- Pre-Launch – a description of the dimensional measurements and material and performance tests that will occur after Prototype and before full Production.
- Production – a comprehensive documentation of product/process characteristics, process controls, tests, and measurement systems that will occur during mass production

Control Plan Sections - 2

PART / PROCESS NUMBER	PROCESS NAME / OPERATION DESCRIPTION	MACHINE DEVICES / JIG / TOOLS FOR MANUFACTURING	CHARACTERISTICS			SPECIAL CHAR. CLASS
			NO.	PRODUCT	PROCESS	

Body of Document:

- Since the Control Plan is Keyed to the Flow Chart and pFMEA, replication of the steps listed in those documents is done as the first step in producing your control plan.
- Each step, in the same order, listed in the pFMEA is documented on the Control Plan
- In addition any Special Characteristics listed on the pFMEA are replicated in the control plan as individual line items
- For each step you determine the characteristics of either the product or the process or both that need to be controlled in order to repeatedly and reproducibly manufacture the component.
- If the feature has been denoted on the drawing or specification as a Special Characteristic by Eaton or your internal analysis place the required symbol in the Spec Char Column

Control Plan Sections - 2

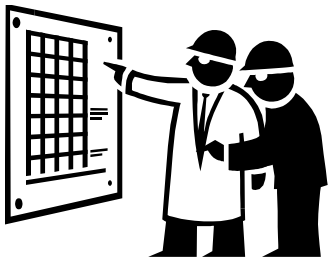
METHODS					
PRODUCT / PROCESS / SPECIFICATION / TOLERANCE	EVALUATION/ MEASUREMENT TECHNIQUE	SAMPLE		CONTROL METHOD	REACTION PLAN
		SIZE	FREQ		

Body of Document:

- List the Product Specification tolerance required by the drawing or the process specification required to produce the product specification.
- List how you will measure or evaluate your product/process to determine if specification has been met.
- Specify the sample size and the frequency at which you will monitor the product produced at each step.
- List what documents the control. This could be a work instruction, a control chart, material certificate, set-up sheet, log sheet etc. AVOID statements such as, OPERATOR TRAINING, UNKONWN or BLANKS
- Provide specific guidance for the operator to carry out if a defect or issue is detected. Typical Reaction Plans include, Segregate Product, Stop Process, Contact Supervisor, Scrap, Contact Engineering, Rework, No Blanks.

Control Plans: Audit Plans – WALK THE WALK

- Audit plans can be included in the control plan as a separate line.
- Auditing is an important tool for control.
- Process auditing should be a key element of the quality system of a business.
- Audits generally cover:
  - Effectiveness of controls
  - Control plan (say) vs. what is actually done (do)



- Audits should be objective (done by internal or external third parties if possible).
- Audit frequencies should be based on balancing level of risk (FMEA) and cost.

Control Plan – Example

A supplier manufactures a circuit board with electronic components soldered on the board. Properly soldered connections are the major product characteristics. Two major process characteristics for the wave solder machine are solder level and flux concentration. An automated feeder controls the solder level by sensing the level of solder and feeding in additional solder as the level is reduced. This characteristic is measured 100% by checking electrically for continuity. The flux must be sampled and tested for the concentration level.

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.)	

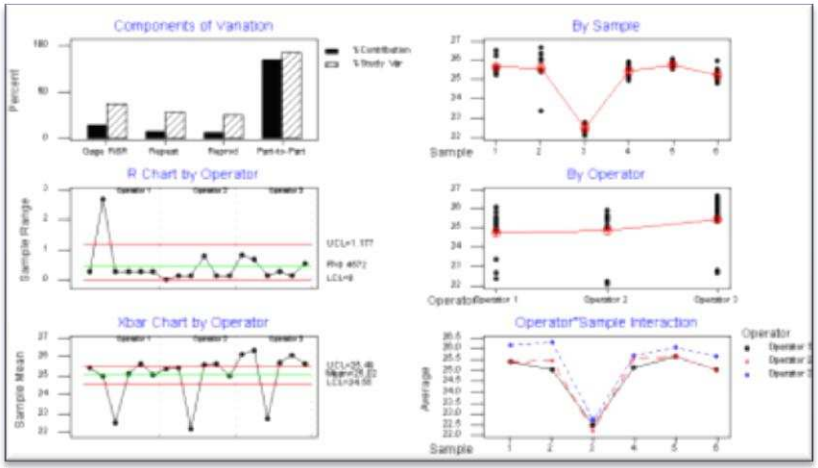
Part / Process Number	Process Name / Operation Description	Machine, Device, Jig, Tools, for MFG.	Characteristics			Special Char. Class	Methods					Reaction Plan
			No.	Product	Process		Product/Process Specification/ Tolerance	Evaluation / Measurement Technique	Sample Size	Sample Freq.	Control Method	
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

Control Plan: Reviewer's Checklist

- ✓ Remember the Control Plan is a planning tool –
  - Use it to decide what you should be doing
  - The AIAG format will help make sure the plan makes sense and is complete
- ✓ Use process flow diagram and PFMEA to build the control plan; keep them aligned
- ✓ Controls should be effective. Keep it simple.
- ✓ Ensure that the control plan is in your document control system
- ✓ Good control plans address:
  - All testing requirements - dimensional, material, and performance
  - All product and process characteristics at every step throughout the process
- ✓ The control method should be based on an effective analysis of the process
  - Such as SPC, Error Proofing, Inspection, Sampling Plan
- ✓ Control plans should reference other documentation
  - Specifications, tooling, etc.

Measurement System Analysis (MSA)

Measurement System Analysis (MSA)



What is It?

An MSA is a statistical tool used to determine if a measurement system is capable of precise measurement.

Objective or Purpose

- To determine how much error is in the measurement due to the measurement process itself.
- Quantifies the variability added by the measurement system.
- Applicable to attribute data and variable data.

When to Use It

- On the **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.

Who Should be Involved

Everyone that measures and makes decisions about these measurements should be involved in the MSA.

IMPORTANT!

Measurement System Analysis is an analysis of the measurement process, *not* an analysis of the people!!

Two Types of Study - Attribute and Variable MSA

Attribute Data Examples:

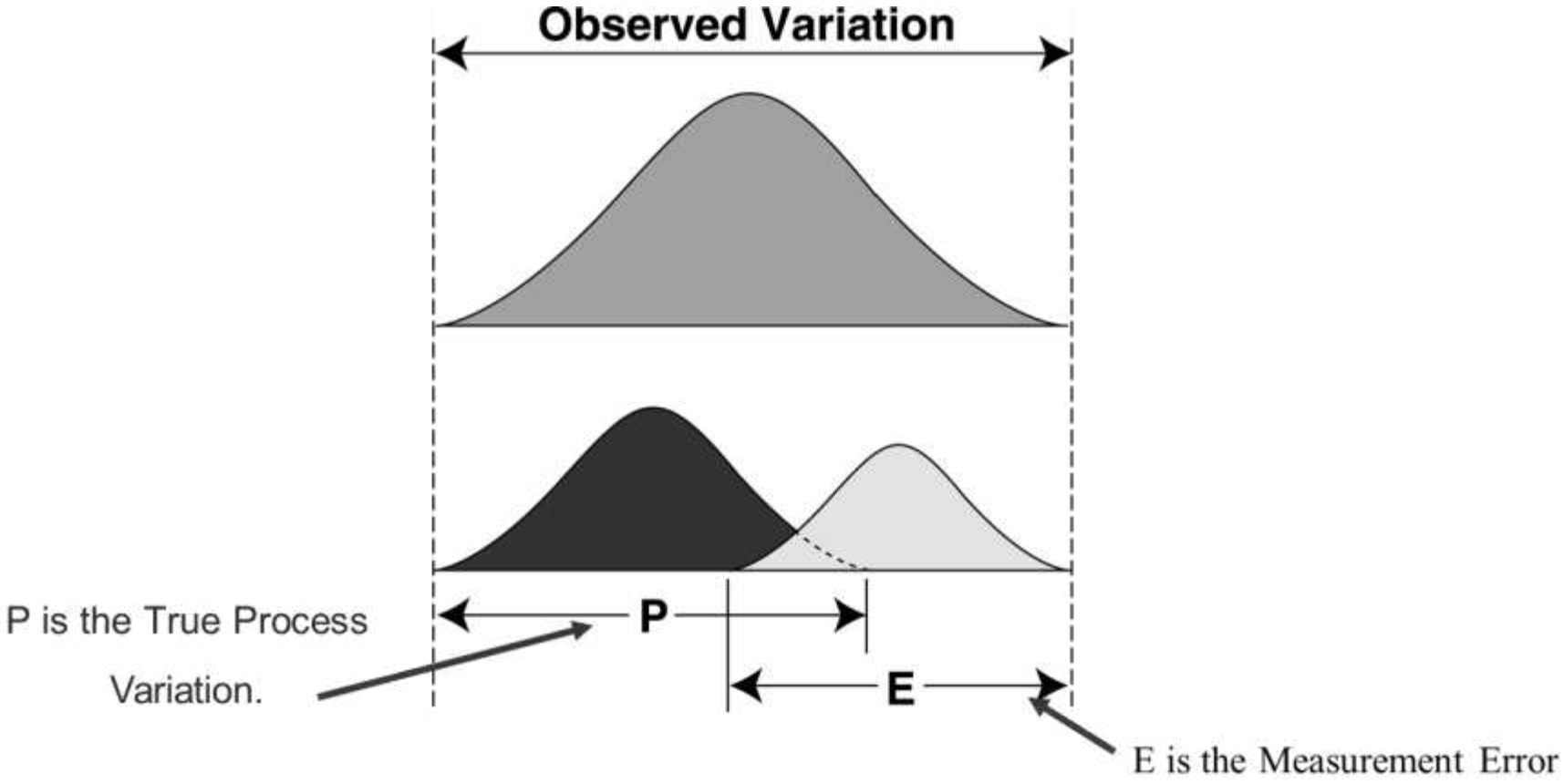
- Count, Pass/fail, yes/no, red/green/yellow, timekeeping buckets

Variable Data Examples:

- Physical measurement (length, width, area, …)
- Physical conditions (temperature, pressure…)
- Physical properties (strength, load, strain…)
- Continuous or non-ending

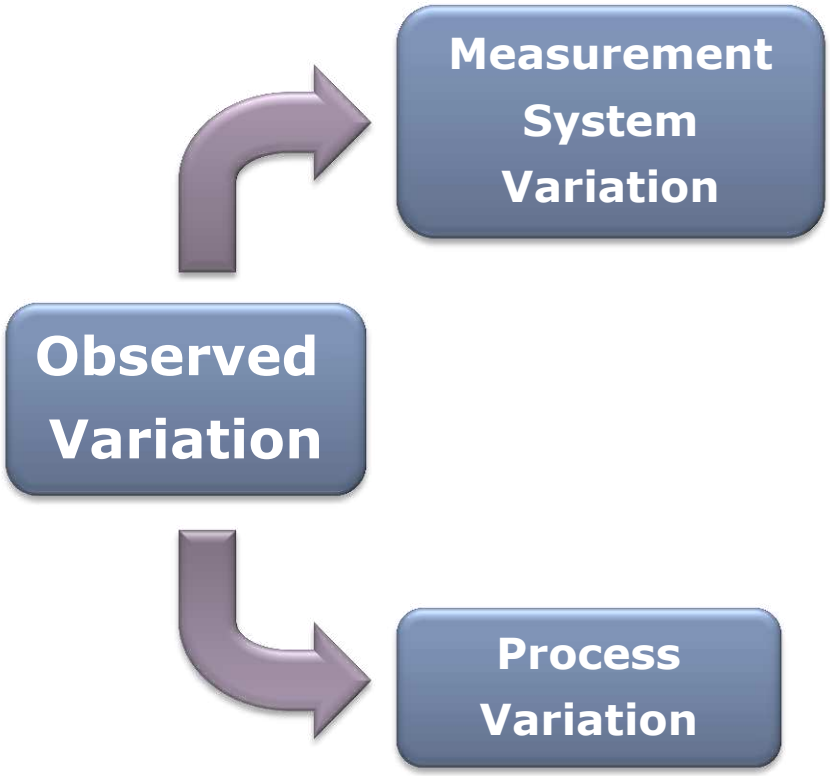
Unless approved by Eaton, attribute data is not acceptable for PPAP submission

Inspection – what do you really see?



Measurement System Analysis (MSA)

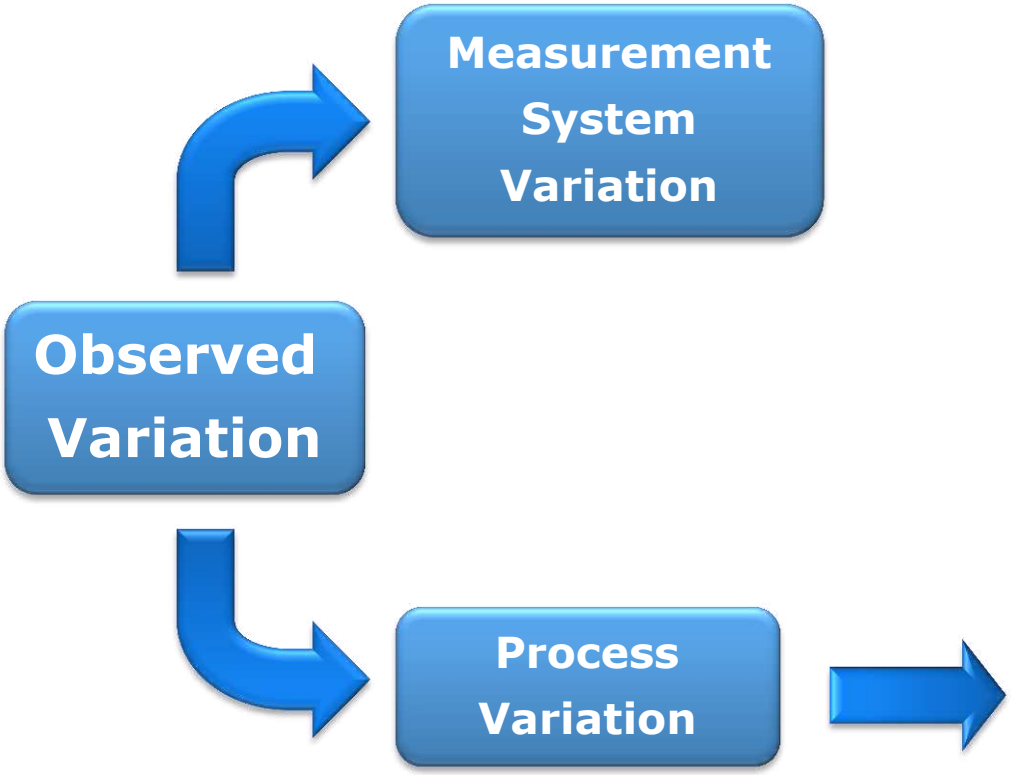
The observed variation in process output measurements is not simply the variation in the process itself; it is the variation in the process plus the variation in measurement that results from an inadequate measurement system.

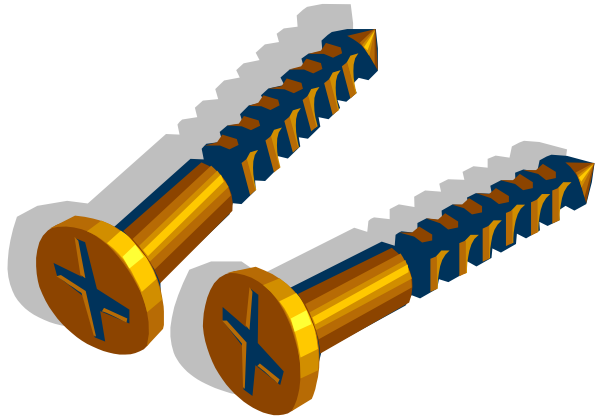


Conducting an MSA reduces the likelihood of passing a bad part or rejecting a good part

Measurement System Analysis (MSA)

Observed Variation

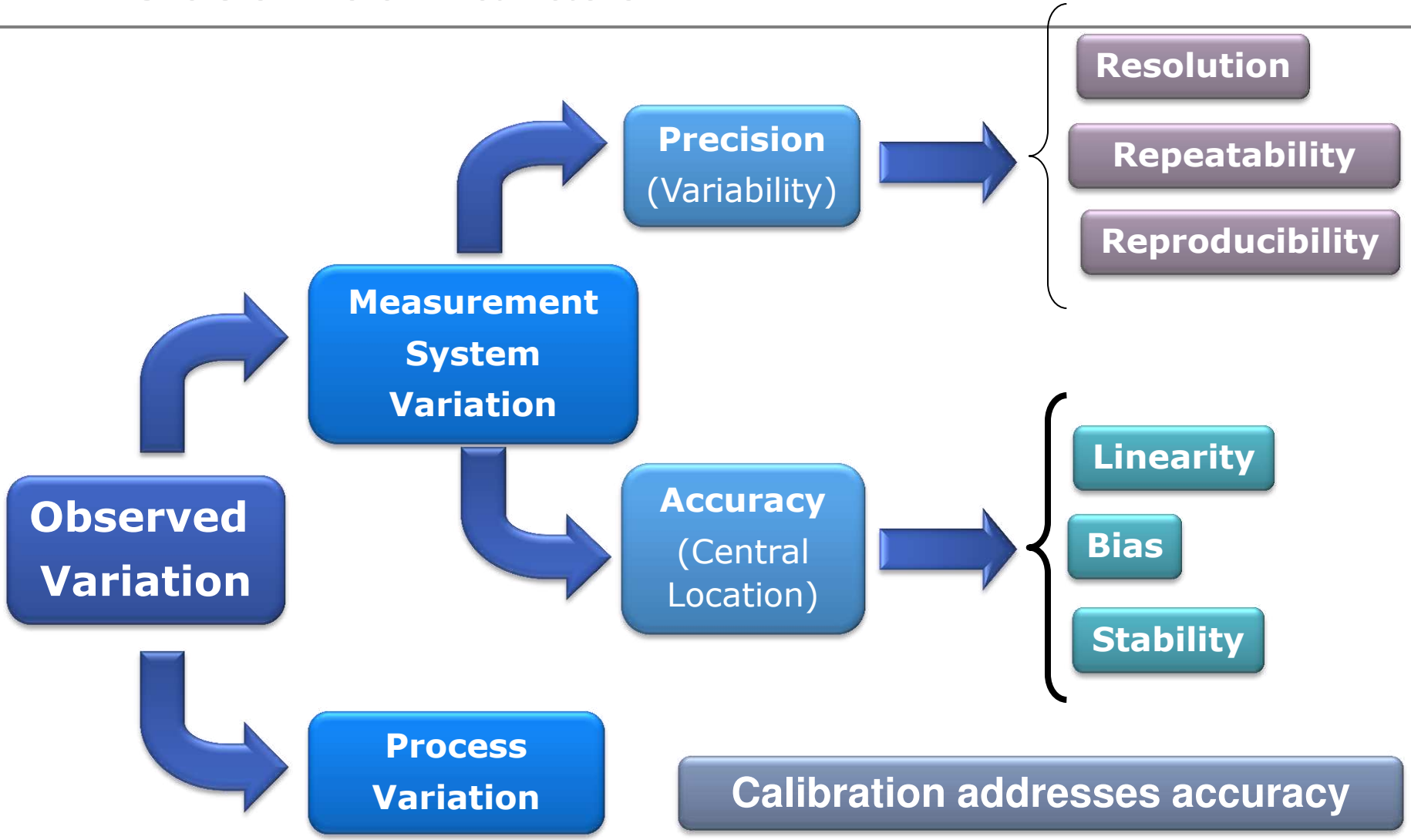




Differences between individual parts – often caused by:

- Material variation
- Machine variation
- Set-up variation
- Operator variation

Observed Variation



Elements of Precision

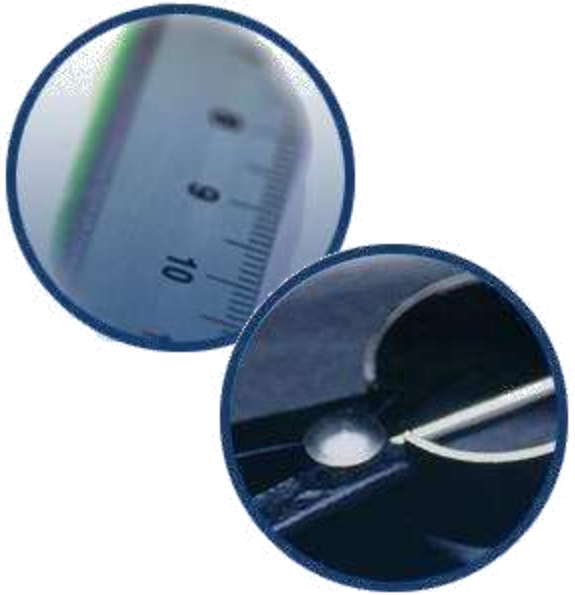
Resolution

Error in Resolution

The inability to detect small changes.

Possible Cause

Wrong measurement device selected - divisions on scale not fine enough to detect changes.



Elements of Precision

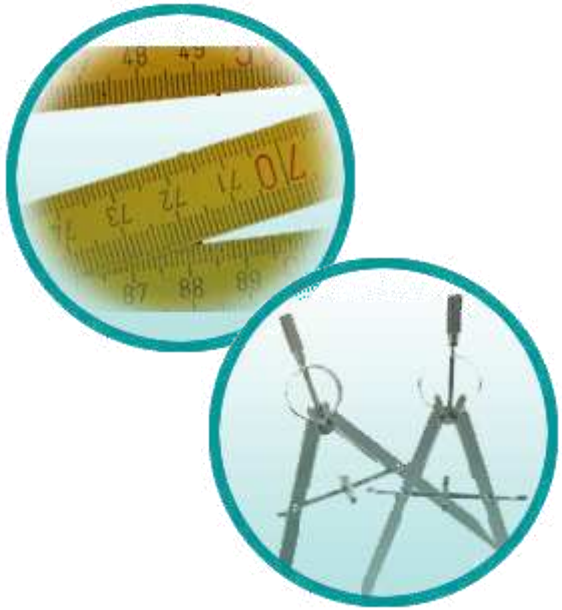
Repeatability

Error in Repeatability

The inability to get the same answer from repeated measurements made of the same item under absolutely identical conditions.

Possible Cause

Lack of standard operating procedures (SOP), lack of training, measuring system variability.



Equipment Variation

Elements of Precision

Reproducibility

Error in Reproducibility

The inability to get the same answer from repeated measurements made under various conditions from different inspectors.

Possible Cause

Lack of SOP, lack of training.

Appraiser Variation

Variable MSA – Gage R&R Study

Gage R&R is the combined estimate of measurement system Repeatability and Reproducibility

- Typically, a 3-person study is performed
  - Each person randomly measures 10 marked parts per trial
  - Each person can perform up to 3 trials
- There are 2 key indicators
  - % P/T or Measurement System or Equipment Variation
  - % R&R or Process Improvement or Appraiser Variation

Variable MSA – AIAG GR&R VAR(Tol)

GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET
VARIABLE DATA RESULTS

Part Number NUMBER	Gage Name		Appraiser A	
Part Name NAME	Gage Number		Appraiser B	
Characteristic / Specification Lower Upper	Gage Type		Appraiser C	
Characteristic Classification	Trials	Parts	Appraisers	Date Performed

Included in AIAG Core Tools

Automatically calculates %GRR and %PV

4.	AVE										X_a=
5.	R										r_a=
6.	B 1										
7.	2										
8.											
9.											
10.											
11.	C										
12.	2										
13.	3										
14.	AVE										X_c=
15.	R										r_c=
16.	PART AVERAGE										X= R_p=
17.	$(r_a + r_b + r_c)$ / (# OF APPRAISERS) =										$\bar{R}$=
18.	x_{DIFF} = (Max X - Min X) =										x_{DIFF}=
19.	* $UCL_R = \bar{R} \times D_4$ =										UCL_R=

* D_4 =3.27 for 2 trials and 2.58 for 3 trials. UCL_R represents the limit of individual R's. Circle those that are beyond this limit. Identify the cause and correct. Repeat these readings using the same appraiser and unit as originally used or discard values and re-average and recompute R and the limiting value from the remaining observations.

Notes:

GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET
VARIABLE DATA RESULTS

Part Number NUMBER	Gage Name		Appraiser A	
Part Name NAME	Gage Number		Appraiser B	
Characteristic	Gage Type		Appraiser C	
Characteristic Classification	Trials	Parts	Appraisers	Date Performed

Measurement Unit Analysis

Repeatability - Equipment Variation (EV)

EV = $R \times K_1$

Trials	K_1
2	0.8862
3	0.5908

Reproducibility - Appraiser Variation (AV)

AV = $\{(x_{DIFF} \times K_2)^2 - (EV^2/nr)\}^{1/2}$

n = parts r = trials

Appraisers	2	3
K_2	0.7071	0.5231

Repeatability & Reproducibility (GRR)

GRR = $\{(EV^2 + AV^2)\}$

	K_3
2	0.7071
3	0.5231
4	0.4467
5	0.4030
6	0.3742
7	0.3534
8	0.3375
9	0.3249
10	0.3146

Part Variation (PV)

PV = $R_P \times K_3$

Tolerance (Tol)

Tol = Upper - Lower / 6

= (Upper - Lower) / 6

% Tolerance (Tol)

% EV = 100 (EV/Tol)

% AV = 100 (AV/Tol)

% GRR = 100 (GRR/Tol)

% PV = 100 (PV/Tol)

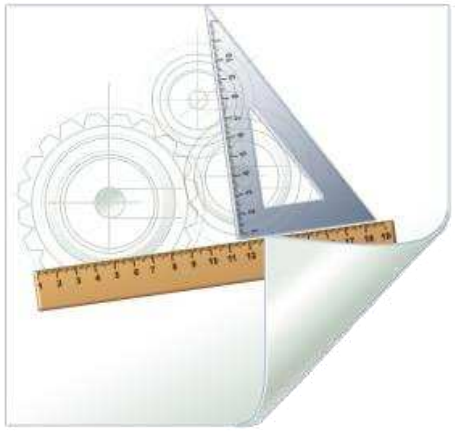
ndc = 1.41(PV/GRR)

For information on the theory and constants used in the form see *MSA Reference Manual*, Fourth edition.

Measurements Systems Analysis MSA

Tips and Lessons Learned

- ✓ Important: An MSA is an analysis of the process, not an analysis of the people. If an MSA fails, the process failed.
- ✓ A Variable MSA provides more analysis capability than an Attribute MSA. For this and other reasons, always use variable data if possible.
- ✓ The involvement of people is the key to success.
  - ➢ Involve the people that actually work the process
  - ➢ Involve the supervision
  - ➢ Involve the suppliers and customers of the process
- ✓ An MSA primarily addresses precision with limited accuracy information.



MSA: Reviewer's Checklist

- ✓ If the gage/inspection measures a special characteristic or other important feature, then conduct a Gage R&R
- ✓ Make sure the study is recent - less than 1 year
- ✓ Compare the control plan gages against the Gage R&Rs
- ✓ % R&R and %P/T must be less than 30%
- ✓ If you question that gage, then
- ✓ Question the technique and part sampling
- ✓ Ask for additional studies

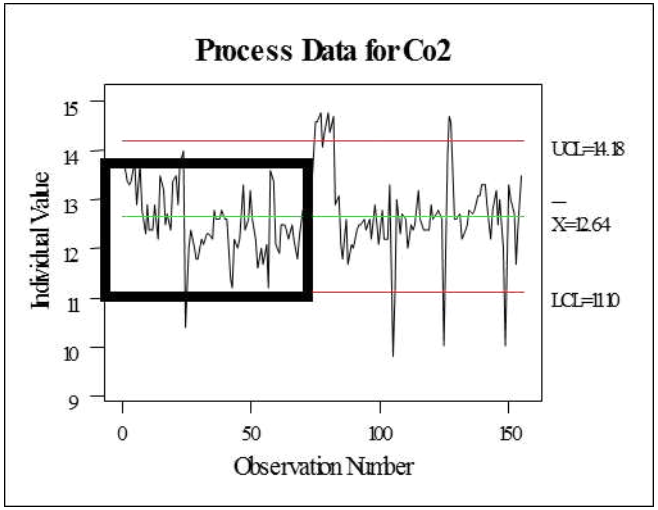
MSA Summary

- Measurement systems must be analyzed BEFORE embarking on process improvement activities
- MSA helps understand how much observed variation is from the measurement system
- MSA will tell you about the repeatability, reproducibility and discrimination
- Sample selection is very important – sample during normal production to capture total range of process variation
- MSA assessors should be operators that would normally use the measurement system
- MSA should be done on a regular basis

Initial Process Study

Purposes of Initial Process Study

- To evaluate how well a process can produce product that meets specifications
- To provide guidance about how to improve capability
  - better process centering
  - reduced variation
- Capability studies can be used to define a problem or to verify permanent corrective actions in the problem solving process.



Initial Process Studies

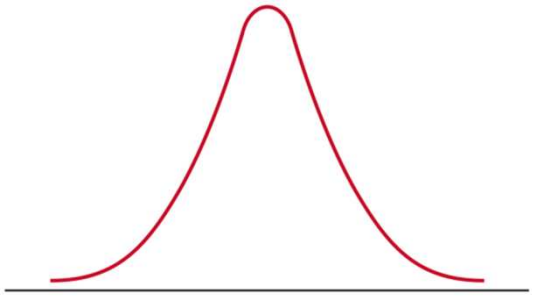
Is the process employed Stable and Capable?

- MSA before Cpk
  - MSA must be acceptable and should represent tools used for Initial Process Studies
- How many samples? What frequency?
  - Recommend minimum 30 pieces per cavity, line, etc
  - Data should be time based sequential when possible
    - (2 each hr/line)
  - Where to look for opportunities
  - Cpk & Ppk minimums are higher for initial release vs. ongoing

Capability Studies

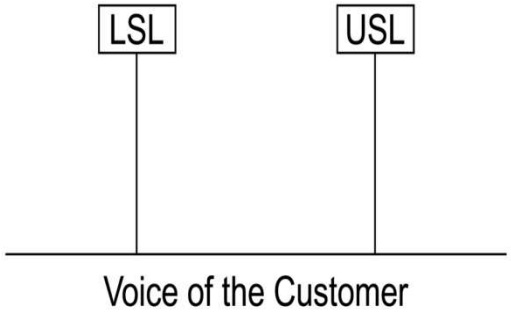
Capability studies are measures of how well the process is meeting the design requirements.

In performing a capability study, the team determines from sample data the process average and a spread (capability) of the process, and compares this variation with the specifications.



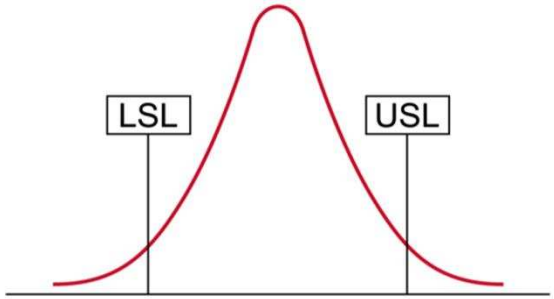
Voice of the Process

The normal distribution is the voice of the process—it's how the process behaves.



Voice of the Customer

The goal posts are the voice of the customer. They're our spec limits.

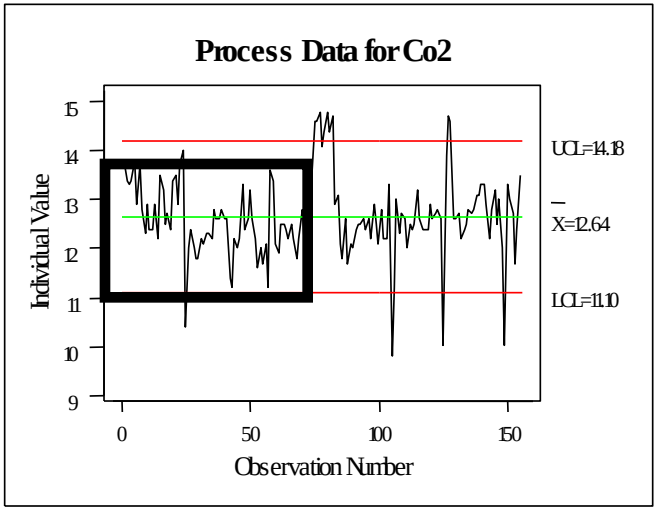


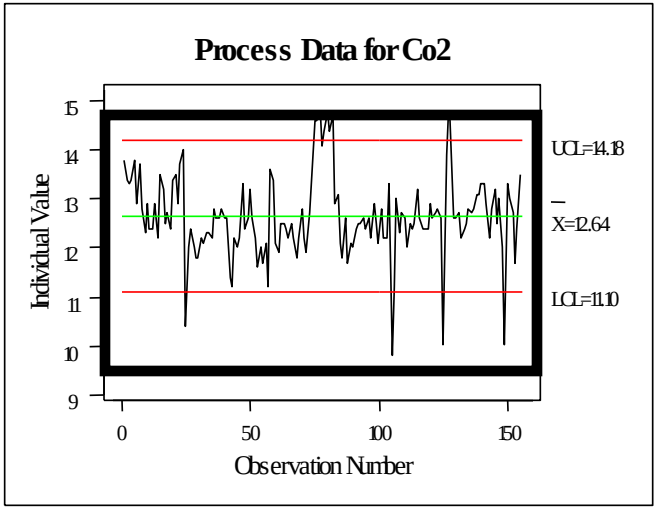
Voice of the Process

Voice of the Customer

PLUS ⟶ Equals ⟶ CAPABILITY!!

Capability Studies





A **short-term** capability study covers a relative short period of time during which extraneous sources of variation have been excluded. (Guideline: 30-50 data points.)

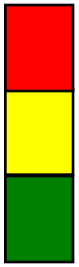
A **long-term** capability study covers a longer period of time in which there is more chance for a process shift. (Guideline: 100-200 data points.)

Capability versus Performance

- **Capability Ratios (C_P and C_{PK})**
  - use a ***short-term*** estimate of sigma (σ) obtained from the ***within-*** subgroup variation
  - show what the process would be capable of if it did not have shifts and drifts ***between*** subgroups
- **Performance Ratios (P_P and P_{PK})**
  - use a ***long-term*** estimate of sigma (σ) obtained from ***within-*** subgroup plus ***between-***subgroup variation
  - Show what the overall variation is
- Performance ratios will be worse (smaller) than the corresponding capability ratios if the process has shifts and drifts

Acceptance Criteria

Acceptance criteria for critical vs. non-critical characteristics

	Critical	Non-Critical	Decision
Red (Bad)	<1.33	<1.00	
Yellow (Marginal)	1.33-1.67	1.00-1.33	
Green (Good)	>1.67	>1.33	

Cpk must be greater than or equal to 1.67 for *critical* processes

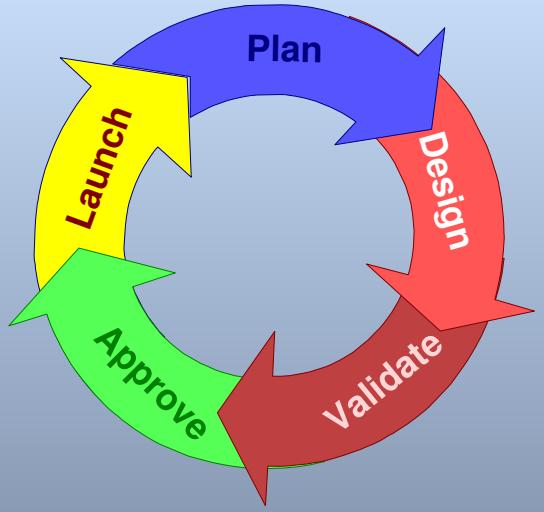
Cpk must be greater than or equal to 1.33 for *non-critical* processes

Capability Summary

- ✓ Capability ratios are used to compare the Voice of the Customer (specs) to the Voice of the Process (natural process limits).
- ✓ For a capability ratio to be a good predictor of future performance, the process must be **stable**. Otherwise, the ratio is just a descriptor of past performance!
- ✓ The two key ways to improve process capability are to reduce variation and to improve centering.
- ✓ A capability ratio should never be interpreted without also looking at a control chart to verify stability and a histogram of the process to ensure normality.
- ✓ The supplier should set warning tolerances and track changes – to give a pre-emptive warning

Initial Process Study: Reviewer's Checklist

- ✓ Ensure that the results are acceptable, and that the process is stable and capable of producing a quality part
- ✓ PPAPs should only be approved if the capability is greater than 1.67 for critical dimensions and greater than 1.33 for non-critical dimensions
- ✓ Capability template is in the AIAG Core Tools



Advanced Product Quality Planning

Maintain high quality products while keeping projects on schedule with transparent task management and collaboration tools.

"Production Part Approval Process (PPAP)"

APQP TEAM 2013

EATON
Powering Business Worldwide

What is PPAP?

- Production Part Approval Process
- Standard 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
- AIAG's 4th edition effective June 1, 2006 is the most recent version
- PPAP has now spread to many different industries beyond automotive

Purpose of PPAP

- Provide evidence that all customer engineering design record and specification requirements are properly understood by the organization

- 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

When is PPAP Required?

- New part
- Engineering change(s)
- Tooling: transfer, replacement, refurbishment, or additional
- Correction of discrepancy
- Tooling inactive > one year
- Change to optional construction or material
- Sub-supplier or material source change
- Change in part processing
- Parts produced at a new or additional location

PPAP is required with any significant change to product or process!

Benefits of PPAP Submissions

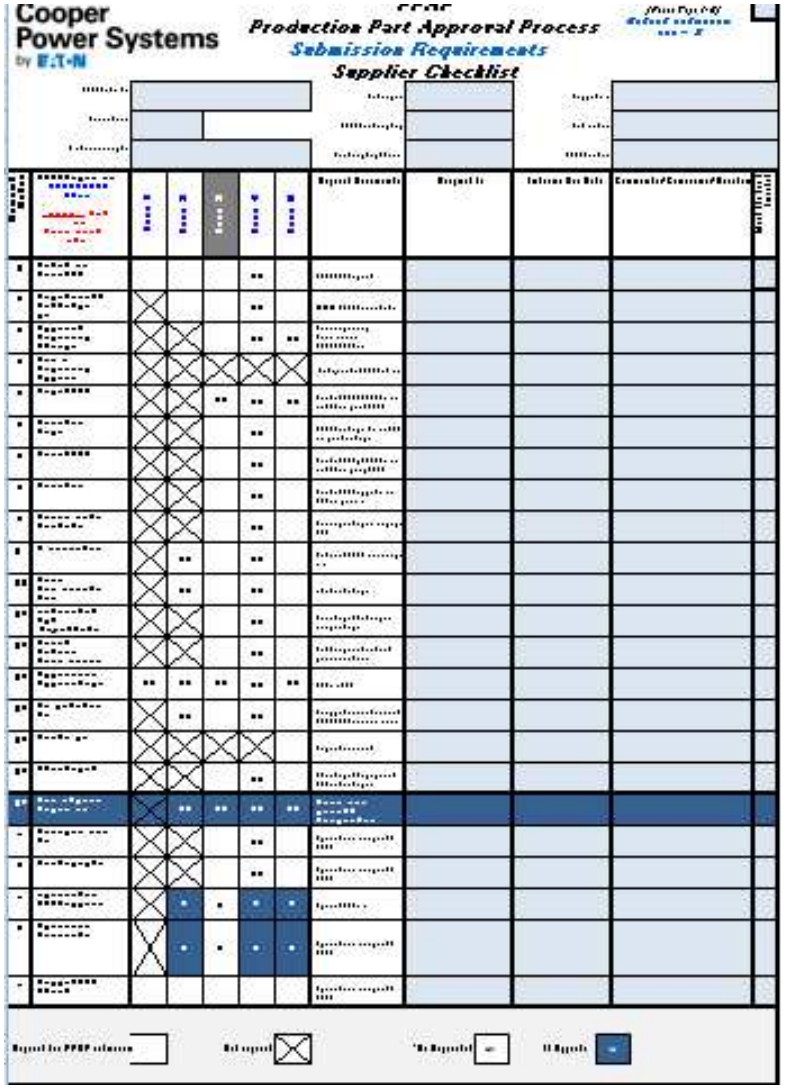
- Helps to maintain design integrity
- Identifies issues early for resolution
- Reduces warranty charges and prevents cost of poor quality
- Assists with managing supplier changes
- Prevents use of unapproved and nonconforming parts
- Identifies suppliers that need more development
- Improves the overall quality of the product & customer satisfaction

Paying for PPAPs?

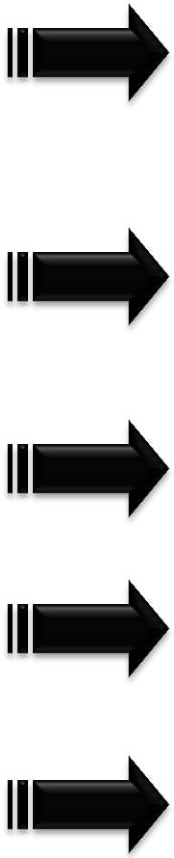
- What is wrong with paying a PPAP charge?
  - 2 primary cost drivers with APQP
    - Process design
    - Process validation
  - Are these 1 time expenses?
    - Consider year over year cost out
    - Process maintenance
    - Other continuous improvement activities
- Where does overhead belong in a quote?

Full Level Official PPAP Requirements

1. Part Submission Warrant
2. Design Records & Bubbled Print(s)
3. Approved Engineering Change Documentation, if any
4. Customer Engineering Approvals
5. Design FMEA
6. Process Flow Diagrams
7. Process FMEA
8. Control Plan
9. Measurement System Analysis (MSA)
10. Dimensional Results
11. Material, Performance Test Results
12. Initial Process Study (CPK) Capability studies
13. Qualified Lab Documentation
14. Appearance Approval Report
15. Sample Product Parts
16. Master Samples
17. Checking Aids
18. Customer Specific Requirements
    a. Tooling Information Form
    b. Packaging Form
    c. Inspection Plan (ASC ONLY)
    d. Specification Deviation Form
    e. Supplier PPAP Checklist



PPAP Submission Levels



Level 1	Warrant Only and Appearance Approval Report as requested. Applied to: Non-critical parts, Non-critical raw/bulk material or catalog/commodity parts for electrical applications and recertification of existing parts previously approved at levels 3, 4 or 5.
Level 2	Warrant with product samples and limited supporting data. Applied to: Critical bulk products such as Paint/Resin/Chemicals, critical fasteners, simple material changes, simple revision level only changes or simple print updates not impacting form-fit-function. This level can also be applied to low risk parts within a product family.
Level 3	Default Submission Level: Warrant with product samples and complete supporting data. Applied to: New parts, changes affecting form-fit-function, reliability or performance. All products resourced to new suppliers, serial production parts, and existing high risk parts undergoing a part number change.
Level 4	Warrant and other requirements as specified by CPSD. This level is reserved for special applications only . Applied to: This level can only be applied with prior approval from Supplier Quality Management.
Level 5	Warrant with product samples and complete supporting documentation reviewed at the supplier's manufacturing location. On-Site Level 3 PPAP!! Applied to: This level is used at the discretion of Supplier Quality for urgent or large components only.

PPAP Submission Requirements

Requirement	Level				
	1	2	3	4	5
1. Part Submission Warrant	S	S	S	AR	S
2. Design Record & Bubbled Print(s)	NR	S	S	AR	S
3. Approved Engineering Change Documentation	NR	NR	S	AR	AR
4. Customer Engineering Approvals	NR	NR	NR	NR	NR
5. Desgin FMEA	NR	NR	AR	AR	AR
6. Process Flow Diagrams	NR	NR	S	AR	S
7. Process FMEA	NR	NR	S	AR	S
8. Control Plan	NR	NR	S	AR	S
9. Measurement System Analysis (MSA)	NR	NR	S	AR	S
10. Dimensional Results	NR	AR	S	AR	S
11. Material, Performance Test Results	NR	AR	S	AR	S
12. Initial Process Study (Cpk) *Capability Studies*	NR	NR	S	AR	S
13. Qualified Laboratory Documentation	NR	NR	S	AR	S
14. Appearance Approval Report	AR	AR	AR	AR	AR
15. Sample Product Parts	NR	AR	S	AR	S
16. Master Samples	NR	NR	NR	NR	R
17. Checking Aids	NR	NR	R	AR	R
18. Customer Specific Requirements	AR	AR	AR	AR	AR
18a. Tooling Information Form	NR	NR	S	AR	S
18b. Packaging Form	NR	NR	S	AR	S
18c Inspection Plan (ASC Only)	NR	IA	IA	IA	IA
18d. Specification Deviation Form	NR	IA	IA	IA	IA
18e. Supplier PPAP Checklist	S	S	S	S	S

S = Supplier **MUST** submit and retain a copy of records or documetantion items
R = Supplier **MUST** retain and make available to customer upon request

Symbol Key	
S	Submit
NR	Not Reuired
AR	As Requested
IA	If Applicable
R	Retain

LEVEL 3 is DEFAULT

Items in Light Blue are **Mandatory** at the listed level

Definition of Risk

High Risk

- Parts associated with multiple critical features, complex design, or high end technology that is not yet established in the general manufacturing environment
- Supplier's quality system and/or quality performance is not to Eaton satisfaction
- Critical process being conducted e.g. heat treatment, leak proof welding
- Parts that impact the safety performance of the final product

Medium Risk

- Parts that have at least one critical feature
- Parts that impact functional performance of the final product

Low Risk

- Parts that have no critical features and can be manufactured by any manufacturer in the commodity category
- Catalogue Parts
- Supplier's quality system is acceptable and
- Supplier's quality performance can be demonstrated over time

PPAP Status

Approved

- The part meets all Eaton requirements
- Supplier is authorized to ship production quantities of the part

Interim Approval

- Permits shipment of part on a limited time (90 days) or piece quantity basis
- Submission must have a specification deviation identifying permanent corrective action to achieve full approval within 90 day period.

Rejected

- The part does not meet Eaton requirements, based on the production lot from which it was taken and/or accompanying documentation

Production quantities may not be shipped before Eaton Approval is provided!!!!

Eaton Corporation Global Supplier Excellence Manual

Last updated September 2014
Available at www.eaton.com

Supplier Excellence Manual

Powering Business Worldwide

Welcome to the Eaton Electrical Sector

Eaton Corporation is a Diversified Power Management Company, who in 2012 acquired all of Cooper Industries. As of 2015 we will be fully integrated into the Eaton Supplier Quality Requirements and enforcing the policies set forth in the Global Supplier Excellence Manual.

Eaton has in excess of 100,000 employees and sells products to customers in more than 170 countries. For more information, visit www.eaton.com.

To learn more about doing business with Eaton, please access our web-site at:
http://www.eaton.com/Eaton/OurCompany/DoingBusiness/SellingtoUs/index.htm

Purpose of the Manual

The purpose of this manual is to communicate expectations to our suppliers and the core set of tools, processes and systems that are to be used in the manufacture, design and development of parts, products and services supplied to Eaton and its business locations.

In this manual, the terms 'shall' and 'must' mean that the described requirement is mandatory, while the term 'should' means that the described requirement is needed and expected with some flexibility in how it can be completed.

Supplier Responsibilities

- To understand and ensure compliance with this manual, quality policies, procedures and work instructions of Eaton Corporation and any business specific requirements.
- To cascade requirements to your sub-tiers.
- To Abide by the Supplier Code of Conduct regarding workplace standards and business practices.
  - Compliance Monitoring
  - Acknowledgement of Acceptance

http://www.eaton.com/Eaton/OurCompany/DoingBusiness/SellingtoUs/SupplierCodeofConduct/index.htm

Quality Management System

Major change as we move to Eaton SEM expectations.

As of Jan 1, 2014 all new suppliers to Eaton MUST hold a valid third party registration certifying their quality system at minimum meets all requirements of ISO 9001 or above.

If you are being considered for new business and do not hold a QMS certification at minimum an On Site Assessment MUST occur.

Quality Management Systems

QMS MUST encompass

- Supplier Confidentiality
- Quality Planning (APQP)
- Sub-tier Supplier Control
- Material Identification
- Lot Traceability
- Problem solving
- Internal Audits
- Operator and Inspection Instructions
- Packaging Plans
- Business Changes – Continuity Planning
- Electronic Communications
- WISPER
- Supplier Visualization
- EHS
- Product Stewardship
- Conflict Minerals
- Supplier Diversity
- DUNS Number

Quality Management Systems - CPSD

Additionally you will notice that the SEM manual has specifics for Aerospace Suppliers. In the case of Power Systems we have also adopted many if not all of those same requirements. The ones below are highlighted for your reference;

- Raw Material (Mill) certificates
- Age-Sensitive Material Certificates
- Supplier Validation of raw Material
- Internal Audit Procedures
- Distributors are treated as First Tier Suppliers and held responsible for the quality of products they distribute even if they don't manufacture.
- Labs are expected to have ISO17025 or A2LA accreditation

Supplier Assessment and Qualification

Each Eaton business group maintains a supplier selection and sourcing process .

Suppliers must be capable of meeting the specific groups' quality, delivery, cost, environmental and health and continuous improvement requirements

Acceptance for use by one Eaton business does not guarantee acceptance by all Eaton business groups.

Quality Planning and Product Approval

General requirements:

- Suppliers **MUST** use APQP
- Suppliers **MUST** approve parts through PPAP
- Suppliers **MUST** retain records Life of Product
- Suppliers **MUST** notify and obtain approval prior to implementing changes

Supplier Assessment and Qualification

The Supplier assessment and qualification process includes:

- Initial Supplier Profile – Accessed through WISPER
- Supplier Screening/Data Analysis Process
  - Suppliers current delivery performance based on 100% OTD expectation
  - Suppliers Quality performance for previous 12 – 24 months
  - Suppliers registration to an industry sector quality system
  - Cost competitiveness
  - Supplier's financial strength for future growth
- Supplier Assessment
  - Typically consists of an On-Site Audit (OSA)
- Assessment Results/Timely Corrective Actions
- Approvals
  - Full Approval
  - Conditional Approval
  - Un-approved (approval can be lost to those previously approved)

Cost of Poor Quality

Major change as we move to Eaton SEM expectations.

All costs incurred by Eaton that are associated with the failure of a supplier to meet Eaton's quality requirements will be charged back to the responsible supplier.

A DMR (Discrepant Material Report) Administrative Fee of $250/DMR shall be charged due to costs associated with dispositioning the DMR and managing the corrective actions process.

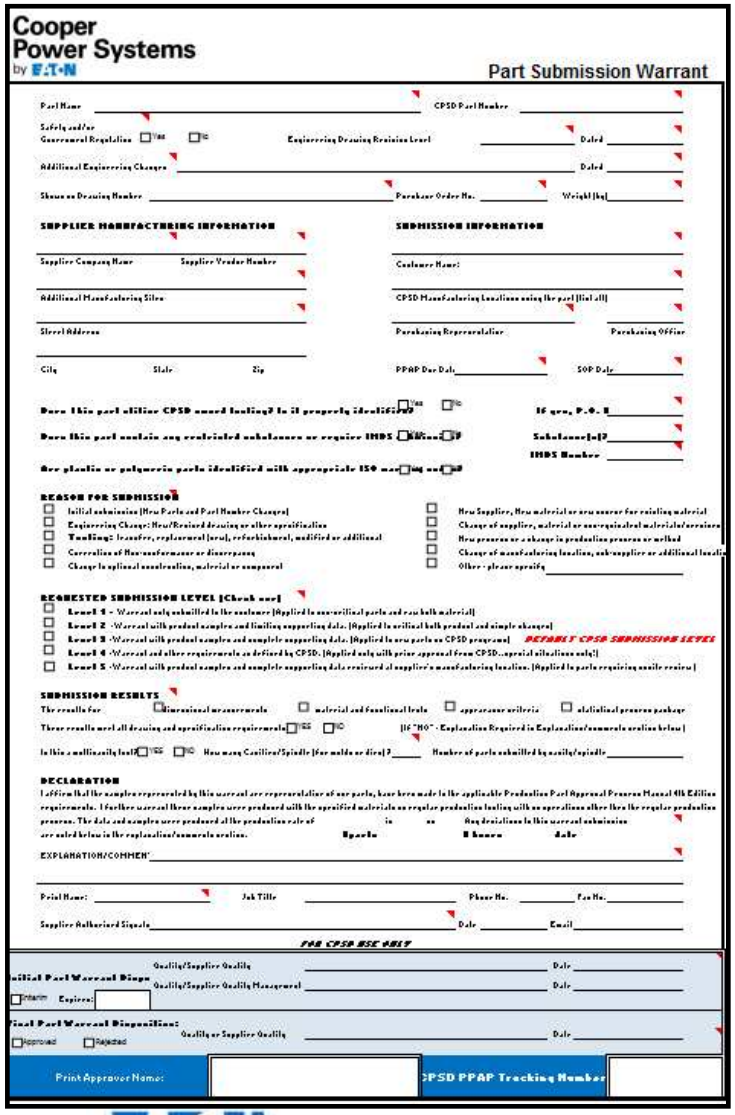
The following is a list of potential Cost of Poor Quality charges (NOT exhaustive!!!)

- ❑ Sorting
- ❑ Rework
- ❑ Line disruption
- ❑ Premium Freight
- ❑ Cost of Increased inspection
- ❑ Premium product cost paid to support production
- ❑ Downtime/Overtime
- ❑ Equipment Breakage
- ❑ Travel
- ❑ Warranty costs
- ❑ Containment Activities

Appendix A Elements of PPAP

Powering Business Worldwide

Element 1: Part Submission Warrant (PSW)


Cooper
Power Systems
by EATON

Part Submission Warrant

Part Name _____ CPSD Part Number _____

Safety and/or Government Regulation ☐ Yes ☐ No Engineering Drawing Revision Level _____ Dated _____

Additional Engineering Changes _____ Dated _____

Shown on Drawing Number _____ Purchase Order No. _____ Weight (kg) _____

SUPPLIER MANUFACTURING INFORMATION

Supplier Company Name _____ Supplier Vendor Number _____

Additional Manufacturing Sites _____

Street Address _____

City _____ State _____ Zip _____

SUBMISSION INFORMATION

Customer Name _____

CPSD Manufacturing Locations using the part (list all) _____

Purchasing Representative _____ Purchasing Officer _____

PPAP Due Date _____ SOP Date _____

Does this part utilize CPSD owned tooling? Is it properly identified? ☐ Yes ☐ No If yes, P.O. # _____

Does this part contain any restricted substances or require IMDS ☐ Yes ☐ No Substance(s)? _____

IMDS Number _____

Are plastic or polymeric parts identified with appropriate ISO marking ☐ Yes ☐ No

REASON FOR SUBMISSION

- ☐ Initial submission (New Parts and Part Number Changes)
- ☐ Engineering Change: New/Revised drawing or other specification
- ☐ Tooling: Transfer, replacement (new), refurbishment, modified or additional
- ☐ Correction of Nonconformance or discrepancy
- ☐ Change to optional manufacture, material or component
- ☐ New Supplier, New material or new source for existing material
- ☐ Change of supplier, material or non-equivalent material/services
- ☐ New process or change in production process or method
- ☐ Change of manufacturing location, sub-supplier or additional location
- ☐ Other - please specify _____

REQUESTED SUBMISSION LEVEL (Check one)

- ☐ Level 1 - Warrant only submitted to the customer (Applied to non-critical parts and raw bulk material)
- ☐ Level 2 - Warrant with product samples and limited supporting data. (Applied to critical bulk product and simple changes)
- ☐ Level 3 - Warrant with product samples and complete supporting data. (Applied to new parts on CPSD programs) DEFAULT CPSD SUBMISSION LEVEL
- ☐ Level 4 - Warrant and other requirements as defined by CPSD. (Applied only with prior approval from CPSD - special situations only)
- ☐ Level 5 - Warrant with product samples and complete supporting data reviewed at supplier's manufacturing location. (Applied to parts requiring onsite review)

SUBMISSION RESULTS

The results for: ☐ dimensional measurements ☐ material and functional tests ☐ appearance criteria ☐ statistical process package

These results meet all drawing and specification requirements ☐ Yes ☐ No (If "NO" - Explanation Required in Explanation/comments section below)

Is this a multicavity tool ☐ Yes ☐ No How many Cavities/Spindle (for molds or dies)? _____ Number of parts submitted by cavity/spindle _____

DECLARATION

I affirm that the samples represented by this warrant are representative of our parts, that tests made to the applicable Production Part Approval Process Manual 4th Edition requirements. I further warrant that these samples were produced with the specified materials on regular production tooling with no operations other than the regular production process. The data and samples were produced at the production rate of _____ in _____ hours. Any deviations to this warrant submission are noted below in the explanation/comments section. Quantity _____ Hours _____ Date _____

EXPLANATION/COMMENT _____

Print Name: _____ Job Title _____ Phone No. _____ Fax No. _____

Supplier Authorized Signature _____ Date _____ Email _____

FOR CPSD USE ONLY

Initial Part Warrant Disposition: Quality/Supplier Quality _____ Date _____

Quality/Supplier Quality Management _____ Date _____

☐ Interim Expires: _____

Final Part Warrant Disposition: ☐ Approved ☐ Rejected Quality or Supplier Quality _____ Date _____

Print Approver Name: _____ CPSD PPAP Tracking Number _____

What is It?

- This is the form that summarizes the whole PPAP package. This form shows the reason for the submission (design change, annual revalidation, etc.) and the level of documentation submitted.

Purpose

Used to :

- document part approval
- provide key information
- declare that the parts meet specification

When to Use It

- Prior to shipping production parts

Use Of **CPSD specific format is MANDATORY**, alternate forms are not accepted including the default AIAG format.

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Production Run

PPAP data must be submitted from a *production* run using:

- Production equipment and tooling
- Production employees
- Production rate
- Production process

All data reflects the actual production process to be used at start-up!

Element 1: Part Submission Warrant (PSW)

Reviewers Checklist

- ✓ Must be on CPSD Specific Form
- ✓ Must be completely filled out
- ✓ Must be signed by the supplier
- ✓ P/N 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

Element 2: Design Records & Ballooned Drawings

What is It?

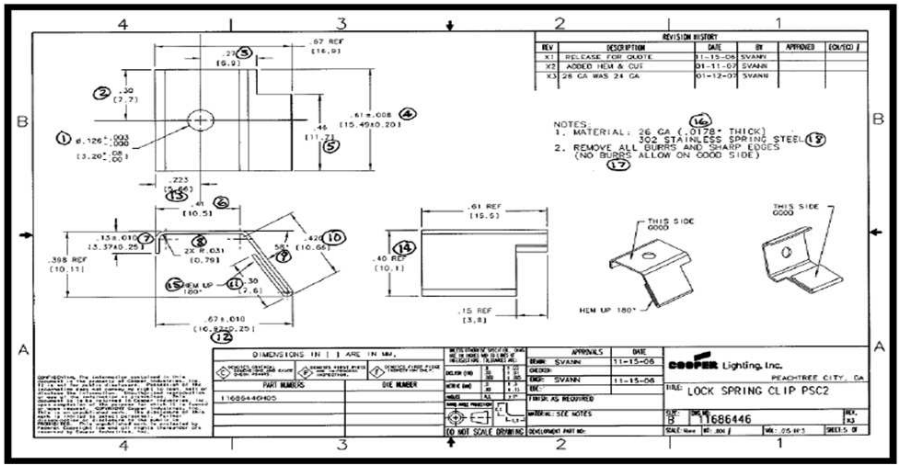
A copy of the current released Engineering Drawing or Specification that documents the item being purchased and qualified.

Purpose:

To document and provide a formal part print and/or specification against which an items' compliance can be determined.

When to use:

This element is required for any submission level 3 or higher.



Example of a Ballooned Drawing

A ballooned drawing must be submitted as part of every PPAP submission where dimensional confirmation is required.

Element 3: Approved Engineering Change Documentation

What is It?

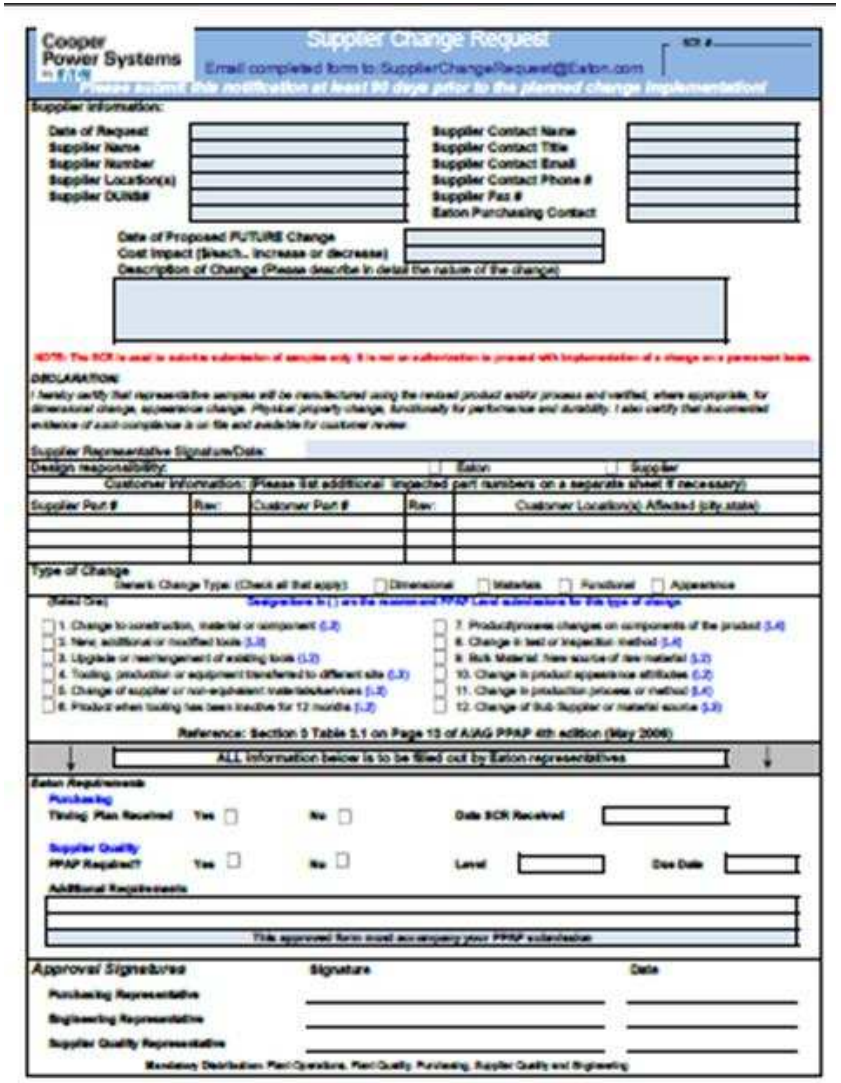
Evidence that any changes from part print or specification have been authorized by Engineering.

Purpose:

To capture approval of changes made through Emails, Supplier Change Requests (SCR), feasibility studies etc.

When to use:

When a change is pending and drawing has been marked up but not formally released into the CPSD SAP business system.



Cooper Power Systems

Supplier Change Request

Email completed form to: SupplierChangeRequest@Eaton.com

Please submit this notification at least 90 days prior to the planned change implementation

Supplier Information:

Date of Request
Supplier Name
Supplier Number
Supplier Location(s)
Supplier DUNS#

Supplier Contact Name
Supplier Contact Title
Supplier Contact Email
Supplier Contact Phone #
Supplier Fax #
Eaton Purchasing Contact

Date of Proposed FUTURE Change
Cost Impact ($each.. Increase or decrease)
Description of Change (Please describe in detail the nature of the change)

DECLARATION:

Supplier Representative Signature/Date:

Design responsibility: Eaton Supplier

Customer Information: (Please list additional impacted part numbers on a separate sheet if necessary)

Supplier Part #	Rev:	Customer Part #	Rev:	Customer Location(s) Affected (city,state)

Type of Change

Generic Change Type: (Check all that apply) Dimensional Materials Functional Appearance

(Select One) Designations in ( ) are the recommended PPAP Level submissions for this type of change

1. Change to construction, material or component (L3)
2. New, additional or modified tools (L3)
3. Upgrade or rearrangement of existing tools (L3)
4. Tooling, production or equipment transferred to different site (L3)
5. Change of supplier or non-equivalent material/services (L3)
6. Product when tooling has been inactive for 12 months (L3)
7. Product/process changes on components of the product (L4)
8. Change in test or inspection method (L4)
9. Sub Material: New source of raw material (L3)
10. Change in product appearance attributes (L3)
11. Change in production process or method (L4)
12. Change of Sub-Supplier or material source (L3)

Reference: Section 3 Table 3.1 on Page 13 of AIAG PPAP 4th edition (May 2006)

ALL Information below is to be filled out by Eaton representatives

Eaton Requirements

Purchasing
Timing Plan Received Yes No Date SCR Received

Supplier Quality
PPAP Required? Yes No Level Due Date

Additional Requirements:

This approved form must accompany your PPAP submission

Approval Signatures: Signature Date

Purchasing Representative
Engineering Representative
Supplier Quality Representative

Mandatory Distribution: Plant Operations, Plant Quality, Purchasing, Supplier Quality and Engineering

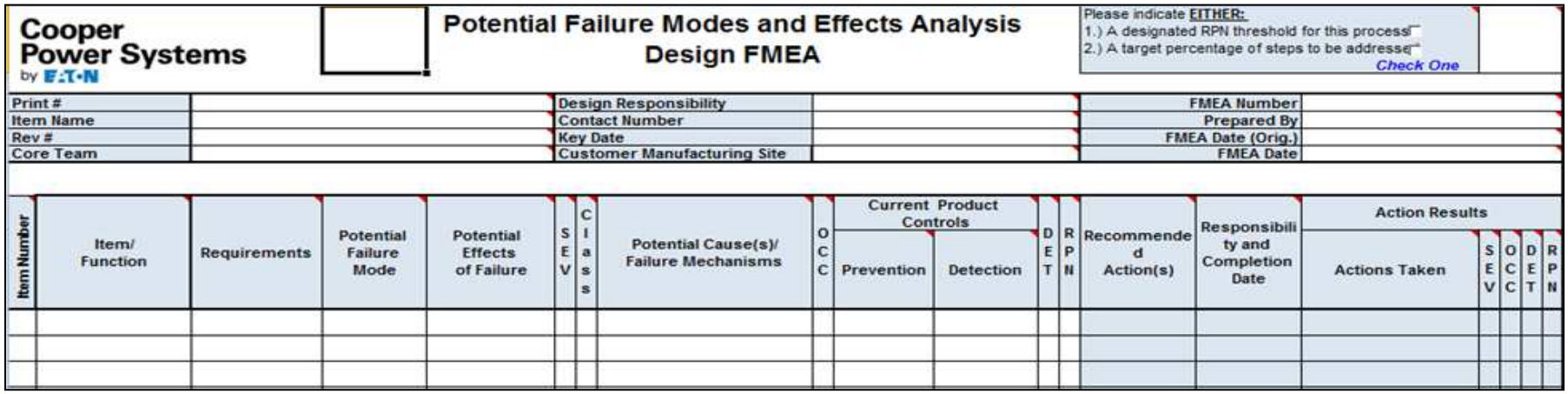
Element 4: Customer Engineering Approvals

Customer Engineering Approvals are used to demonstrate pre-approval of a design.

Customer Engineering Approvals are not required for supplier submissions.

In the event that this would be required in the future we have maintained a placeholder within out requirements.

Element 5: Design FMEA (DFMEA)



Cooper Power Systems by EATON

Potential Failure Modes and Effects Analysis
Design FMEA

Please indicate EITHER:
1.) A designated RPN threshold for this process
2.) A target percentage of steps to be addressed
Check One

Print #		Design Responsibility		FMEA Number	
Item Name		Contact Number		Prepared By	
Rev #		Key Date		FMEA Date (Orig.)	
Core Team		Customer Manufacturing Site		FMEA Date	

Item Number	Item/ Function	Requirements	Potential Failure Mode	Potential Effects of Failure	SEV	Class	Potential Cause(s)/ Failure Mechanisms	OCC	Current Product Controls		DET	RPN	Recommended Action(s)	Responsibility and Completion Date	Action Results				
									Prevention	Detection					Actions Taken	SEV	OCC	DET	RPN

What is It?

A risk analysis of the design for potential failure modes.

Purpose:

To highlight any product design issues that may cause malfunction of the component once industrialized.

When to use:

Used during the design phase. Typically the customer owns this element, unless the design is proprietary to the supplier or developed jointly. If the supplier does own the design their DFMEA is required to be reviewed to ensure that it addresses all Special Characteristics and any potential vice of the customer inputs identified in the Cooper Project Scope.

Element 6: Process Flow Diagram

What is It?

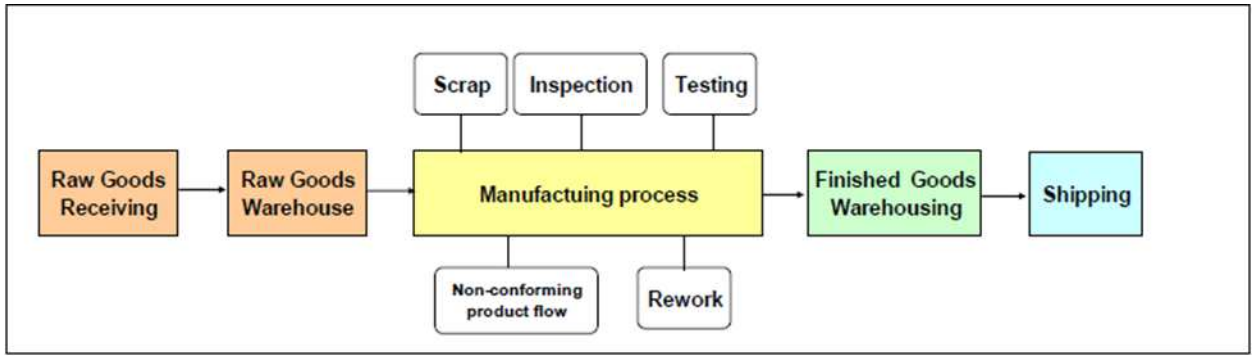
A visual map of the manufacturing process from Receiving to Shipping

Purpose:

To document and clarify all steps required to manufacture the part.

When to use:

As the first step in completing the risk analysis of the current process and prior to development of the control plan. For every step in the flow chart there should be a corresponding step in the pFMEA and Control Plan. The flow chart is the first document in the control documentation trilogy.



Flow Diagram MUST include all key steps in the process and all offline activities (such as measurement, inspection and handling). In addition the flow of non-conforming parts MUST be included.

Element 7: Process FMEA (PFEMA)

What is It?

A risk analysis of the manufacturing process for potential failure modes.

Purpose:

To highlight any process issues that may cause malfunction of the component once industrialized.

When to use:

Used prior to production release to determine potential failure modes that may occur during the manufacturing process that could impact the supplier or the end customer. pFMEA's are constructed as the second phase of the control documentation tribology, immediately after the process flow has been determined.

Important Things to Note in regards to PFMEA!!!!!!

PFMEAs are LIVING documents.

- They are born with award of new business
- They develop as the product manufacturing matures.
- They should be reviewed on regular basis and each and every time a new nonconformance type is identified by either the supplier or customer.

Element 7: Process FMEA (PFEMA)

Examples of common mistakes made on pFMEA:

- Misapplication of Severity, Occurrence and Detection
- Redefining Severity, Occurrence and Detection from AIAG standard
- Over estimating the effectiveness of a "recommended Action"
- Applying RPN thresholds arbitrarily
- Not recognizing all potential failure modes
- Failure to properly identify the customer
- Misapplication of the ranking scales
- Confusing effects with causes
- Allow the pFMEA to turn into a design review

Element 7: Process FMEA (PFEMA)

Important Requirements/Expectations:

- Ranking of Potential Failure Modes is per AIAG guidelines. Guidelines are published within the pFMEA Form in the CPSD PPAP Forms Kit.
- Anything that depends on visual inspection as the control method must be given at least an 8 on the detection scale
- Anything that is given a 1 in the occurrence field indicates that THIS WILL NEVER HAPPEN, think twice and have objective evidence to support this ranking
- Anything that will impact the safety of the end product and customer needs to carry a severity of either a 9 or 10.
- Anything that escapes your facility should be given a Severity of at least a 7 as it WILL cause customer dissatisfaction!
- Anything with a "built-in" rework loop should have an Occurrence ranking of either a 9 or 10. Rework/repair loops need to be eliminated at minimum as product matures.
- ALL SPEICAL CHARACTERISTICS listed on the print and/or material specification must have their own line(s) in the pFMEA!

Element 8: Control Plan

What is It?

A tool to define the operations, processes, materials, equipment, methodologies and Special Characteristics for controlling variation during the manufacturing process.

Purpose:

To communicate the supplier's decisions during the entire manufacturing process from materials purchase through final shipping.

When to use:

Used prior to production release to ensure that each step of the manufacturing process is governed or controlled for desired output. The control plan is prepared using the process flow and pFMEA as inputs. For every step in the process flow and pFMEA there is an identical step in the control plan.

Important Things to Note in regards to Control Plan

Control Plans are LIVING documents.

- They are synchronized with the Flow Diagram and pFMEA. As those documents change so does the Control plan.
- They can be prepared as a family document or by manufacturing FUNCTION or by individual part.

Element 9: Measurement System Analysis (MSA)

What is It?

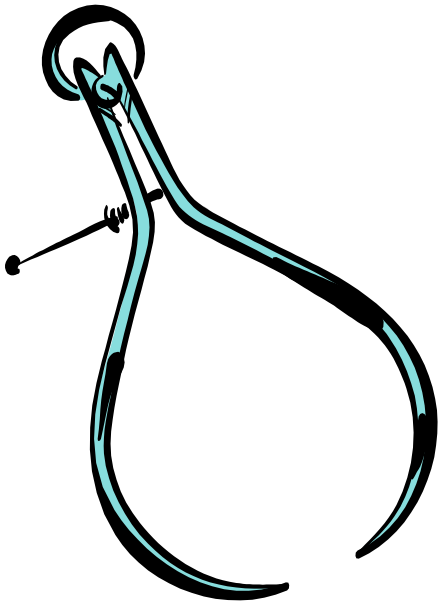
A mathematical method of determining the contribution of variation within the measurement process to overall process variability.

Purpose:

To ensure the use of the right measurement system for running production.

When to use:

For devices measuring data on special characteristics and each measurement device on all Level 3 and Level 5 submissions.



Element 10: Dimensional Results

What is It?

Verification that the component was produced to required specifications

Purpose:

To ensure proper measurement techniques and analysis was performed to show conformance with all customer requirements

When to use:

Prior to release of production tooling/process to manufacturing

Unique Requirements for CPSD

- Must be submitted on CPSD Dimensional Analysis template
- Measurements must be on the same parts submitted as formal samples
- Measurements must be provided for a minimum of three unique parts or 1 part per cavity in the instance of multi-cavity or multi-processing paths.
- The report must address all dimensions and any notes that have variable dimensions included. Also all dimensions on reference prints.
- The method of measurement must be documented for every line item.
- Any non-conforming items must list a corrective action and be covered in the specification deviation form.

Element 11: Material and Performance Test Results

What is It?

A place to report all other test results other than the dimensional results.

Purpose:

Primarily used to report conformance of material requirements and part functionality. Together with the dimensional data will provide a complete review of all product specifications and/or part print requirements.

When to use:

Prior to production release to confirm part is conforming in all respects.

Material and Performance Test Result FAQs

- COA Certificate of Analysis from an accredited lab should be used to confirm the composition of the material. A COC is not acceptable for initial submission.
- Performance testing can be done internally or externally but must be credible and conforming to the test requirements.
- Performance testing responsibility needs to be agree upon prior to PPAP submission. By default the supplier is responsible unless they have taken exception during the early design requirements review sessions or noted inabilities on the Production Feasibility Agreements.

Element 12: Initial Process Study (Cpk, Ppk)

What is It?

A method to determine if the manufacturing process is repeatable and reproducible.

Purpose:

To determine if the production process is likely to manufacture product that will meet requirements.

When to use:

At the start up of a new product/process and for all special characteristics indicated on the part print or specification.

Cpk Vs PpK

CpK:

- CpK predicts future capability
- For new or revised parts
- Used when significant changes occur in process or material

Ppk:

- Ppk predicts past performance
- Been manufacturing item for a significant time even if never supplied to CPSD

Capability Thresholds:

Special Characteristics >/= 1.33 or >/= 1.67 for any safety related special characteristics.

Element 13: Qualified Laboratory Documentation

What is It?

Evidence that the lab performing material or functional testing is qualified to perform the test per standard.

Purpose:

To ensure that the testing completed to verify compliance of the component was done by individuals competent in the test methodology using properly calibrated equipment.

When to use:

As part of initial submission and on going verification of component material and performance properties

Internal Labs:

Documentation required to be submitted with PPAP:

- Scope of Testing
- Personnel's competency to perform tests
- Test Equipment used
- Calibration Certificates on equipment

External Labs:

Documentation required to be submitted with PPAP:

- Copy of Lab's third party accreditation + scope
- On company letterhead
  - Name of Lab
  - Date of testing
  - Standards used

Element 14: Appearance Approval Report

What is It?

A method to document the cosmetic requirements of the component.

Purpose:

To ensure that identical methodologies and standards are used by both supplier/customer to evaluate subjective appearance items

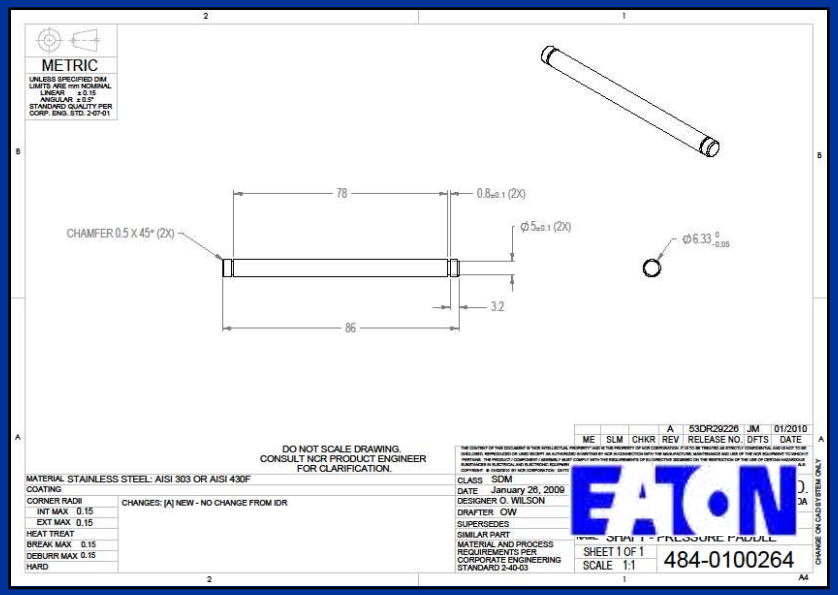
When to use:

Anytime there is an expectation that the part has to be free from contamination, dirt, rust, etc., or it has a specific color, gloss or texture defined on the print or specification

ALERT!!!!!

This is one of the most overlooked areas of any submission. Many times cosmetic issues are not apparent until after the product has been released for production. All parties are cautioned to establish initial criteria at PPAP to avoid expensive rework, sorting or added operations that may become required at a latter date simply because the criteria had never been clarified during early design requirements review steps!

Element 15: Sample Parts



What is It?

Actual samples that reflect the parts documented in the PPAP.

Objective or Purpose

- Confirm cosmetic or functional part approval.

When to Use It

- Sample parts should be delivered WITH the PPAP submission

Element 16: Master Samples

What is It?

Original part used to determine conformance to part print/specification retained at the manufactures site for the life of the product

Purpose:

To allow historical benchmarking of physical component over the course of product life. Becomes a "Go-by" sample for future production builds.

When to use:

Only required for Level 5 on-site PPAP's, usually due to it's extreme size or expense.

Element 17: Checking Aids

What is It?

Any tool, gage or assembly equipment that verifies the physical or performance requirements of a part to print/specification.

Purpose:

To provide evidence that the checking aids used to verify product exist and have been properly validated.

When to use:

During component manufacturing to certify acceptance or compliance to specification.

Checking aids must conform to the following requirements:

- Copy of controlled print that documents the design of the checking aid
- Third party certification if aid is used to confirm form or fit
- Verification of checking aid repeatability

For PPAP Submission:

1. Conformance to the design print
2. Evidence of Repeatability
3. GR&R for all special characteristics

Element 18: CPSD Specific Requirements

What is It?

CPSD has additional requirements based on product, IP and regional criteria that need to be addressed at time production of the component is approved.

Purpose:

To address CPSD specific requirements during PPAP submission

When to use:

When Supplier Quality indicates a need to submit on the PPAP Checklist based on their understanding of the requirements and program.

CPSD Specific Requirements:

- Tooling Information Form
- Packaging Form
- IQC Inspection Plan (ASC only)
- Specification Deviation Form
- Supplier PPAP Checklist

Element 18a: Tooling Form

What is It?

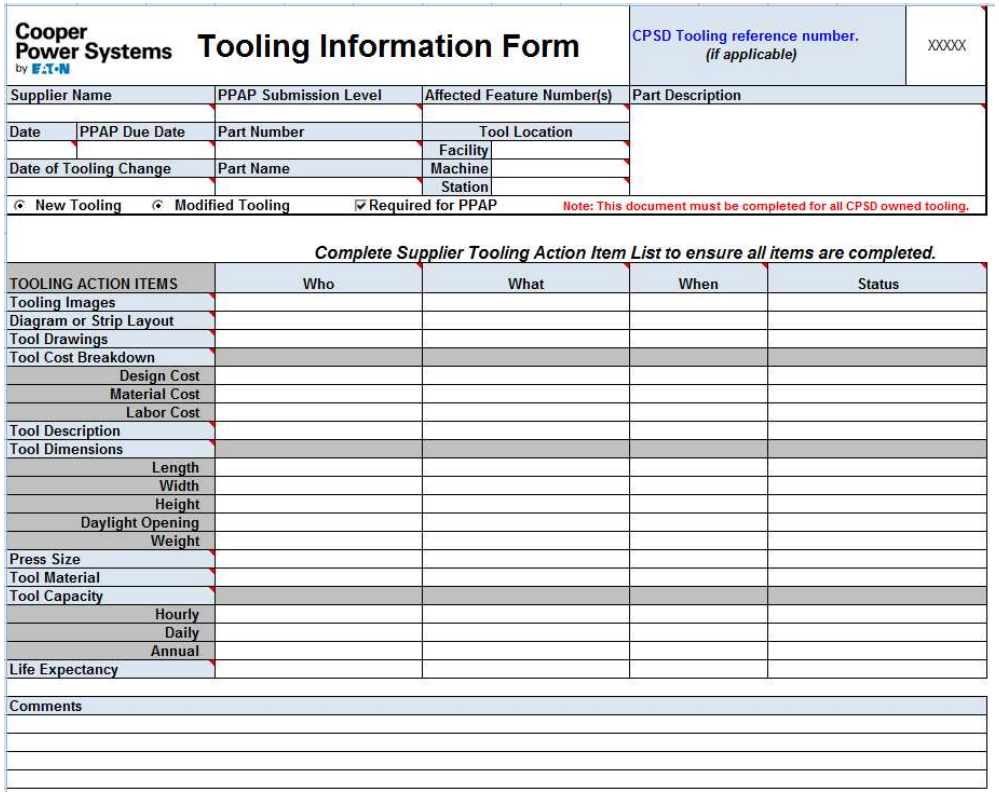
A method to document the condition of any CPSD owned tooling a the start of the program.

Purpose:

To document critical information including, cost, dimensional, capacity and life expectancy as well as location of tooling.

When to use:

At time of production start-up and anytime a tooling update or maintenance is performed that would cause the initial information to change.



Cooper Power Systems by EATON — **Tooling Information Form**

CPSD Tooling reference number. *(if applicable)*: XXXXX

Supplier Name	PPAP Submission Level	Affected Feature Number(s)	Part Description

Date	PPAP Due Date	Part Number	Tool Location	
			Facility	
Date of Tooling Change		Part Name	Machine	
			Station	

(•) New Tooling (•) Modified Tooling ☑ Required for PPAP — Note: This document must be completed for all CPSD owned tooling.

Complete Supplier Tooling Action Item List to ensure all items are completed.

TOOLING ACTION ITEMS	Who	What	When	Status
Tooling Images				
Diagram or Strip Layout				
Tool Drawings				
Tool Cost Breakdown				
Design Cost				
Material Cost				
Labor Cost				
Tool Description				
Tool Dimensions				
Length				
Width				
Height				
Daylight Opening				
Weight				
Press Size				
Tool Material				
Tool Capacity				
Hourly				
Daily				
Annual				
Life Expectancy				

Comments

Element 18b: Packaging Form

What is It?

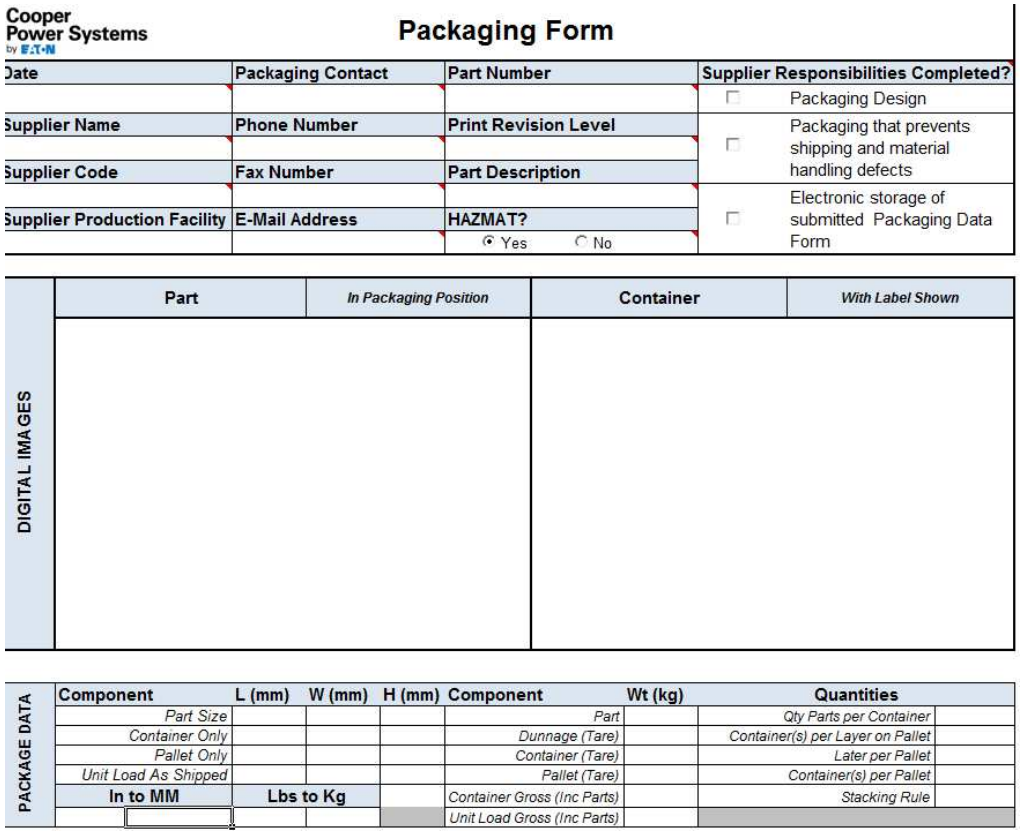
A method to formally plan for the protection of the product during transportation from the supplier to CPSD or our customer.

Purpose:

To pre-approve the packaging method and materials for the supplied product.

When to use:

At time of production start-up and anytime a product change or customer issue is highlighted that may have been caused by shipment handling.



Cooper Power Systems by EATON

Packaging Form

Date	Packaging Contact	Part Number	Supplier Responsibilities Completed?
			☐ Packaging Design
Supplier Name	Phone Number	Print Revision Level	☐ Packaging that prevents shipping and material handling defects
Supplier Code	Fax Number	Part Description	
Supplier Production Facility	E-Mail Address	HAZMAT? ◉ Yes ○ No	☐ Electronic storage of submitted Packaging Data Form

DIGITAL IMAGES

Part	*In Packaging Position*	Container	*With Label Shown*

PACKAGE DATA

Component	L (mm)	W (mm)	H (mm)	Component	Wt (kg)	Quantities	
Part Size				*Part*		*Qty Parts per Container*	
Container Only				*Dunnage (Tare)*		*Container(s) per Layer on Pallet*	
Pallet Only				*Container (Tare)*		*Later per Pallet*	
Unit Load As Shipped				*Pallet (Tare)*		*Container(s) per Pallet*	
In to MM	**Lbs to Kg**			*Container Gross (Inc Parts)*		*Stacking Rule*	
				Unit Load Gross (Inc Parts)			

Element 18c: IQC Inspection Form

What is It?

The inspection plan covers all planned inspection(s) for a specific part for lot sampling and is included with all submissions originating with suppliers located in Asia.

来料检验报告

IQC INSPECTION REPORT

产品编号 Part No:	R000583001	产品描述 Part Description:	CONTACT YOKE MOVING CONTACT ASSY(SLOTTED)
来料检验计划编号 IQC Inspection Plan No:	QAI-PS-06030	来料检验计划版本 IQC Inspection Revision:	B 图纸版本 Drawing Revision: 10
采购订单号 Purchasing Order No.:	4200073888	送检批产品数量 Lot Size:	300 pcs
检验日期 Inspection Date:	9/May/08	送检次数 No. of Submission:	First Inspection
供方商 Supplier:	zunpower	主要联系人 Main Contact:	Paul.xiong
抽样标准 Sampling Standard:	ANSI/ASQC Z1.4	抽样方案 Sampling Plan:	ASC Sampling Plan (A=0.65, B=1.0, C=2.5)

Item No.	检验项目 Insp. Items	特殊特性分类 Char. Class	检验仪具 Gage/Equip.	抽样数量 Sample Size (pcs)	AQL(Ac, Re)	检验结果 Result	接受/拒收 Ac/Re	备注 REMARKS
1	Ø0.50 ± 0.015", 2 places/处	C	Vernier caliper/游标卡尺	5	0.1	OK	AC0	0.486-0.504
2	0.622+0.0005-0.0010, 2 holes/孔	A	Pin gage/销规	125	0.1	OK	AC0	
3	0.015 x 45° chamfer/倒角, 2 places/处	B	Visual/目测	80	0.1	OK	AC0	
4	0.38 ± 0.015", 2 places/处	B	Vernier caliper/游标卡尺	5	0.1	OK	AC0	0.375-0.389
5	0.88 ± 0.015"	B	Depth gage/高度计	5	0.1	OK	AC0	0.875-0.887
6	0.75 ± 0.015"	B	Vernier caliper/游标卡尺	5	0.1	OK	AC0	0.754-0.751
7	0.3125 ± 0.001"	A	Pin gage/销规	125	0.1	OK	AC0	
8	2.250 ± 0.005", 2 places/处	A	Vernier caliper/游标卡尺	5	0.1	OK	AC0	2.240-2.253
9	0.75 ± 0.015"	B	Vernier caliper/游标卡尺	5	0.1	OK	AC0	0.751-0.760
10	0.141 + 0.000/-0.010"	A	Vernier caliper/游标卡尺	125	0.1	OK	AC0	0.130-0.140
11	Material/材料: ALLOY A-380	D	supplier report/供应商报告	N/A	N/A	OK	AC0	A380
12	verify packaging/确认包装	B	Visual/目测	N/A	N/A	OK	AC0	

Purpose:

To clarify inspection requirements in a central location that can be included with the work instructions. This is a common practice in China that predates Americanized control plans.

When to use:

Only required for suppliers located in Asia.

Element 18d: Specification Deviation Form

What is It?

The Spec Deviation form documents variations in the product from the initial specification.

Purpose:

To highlight the variations and provide CPSD with corrective action plan(s) to address the variations so that a full submission approval can be obtained.

When to use:

Specification Deviation forms are submitted:

1. When an existing Production Deviation is in place to document a temporary condition.
2. When documenting issues with the PPAP requirements that are not attainable without print changes
3. To request print changes to accommodate manufacturability issues via capability or test results. This request for change is specifically documented on the Supplier Change Request form, but the specific dimensions in question are noted on the Specification Deviation Form.

Element 18e: Supplier Checklist

What is It?

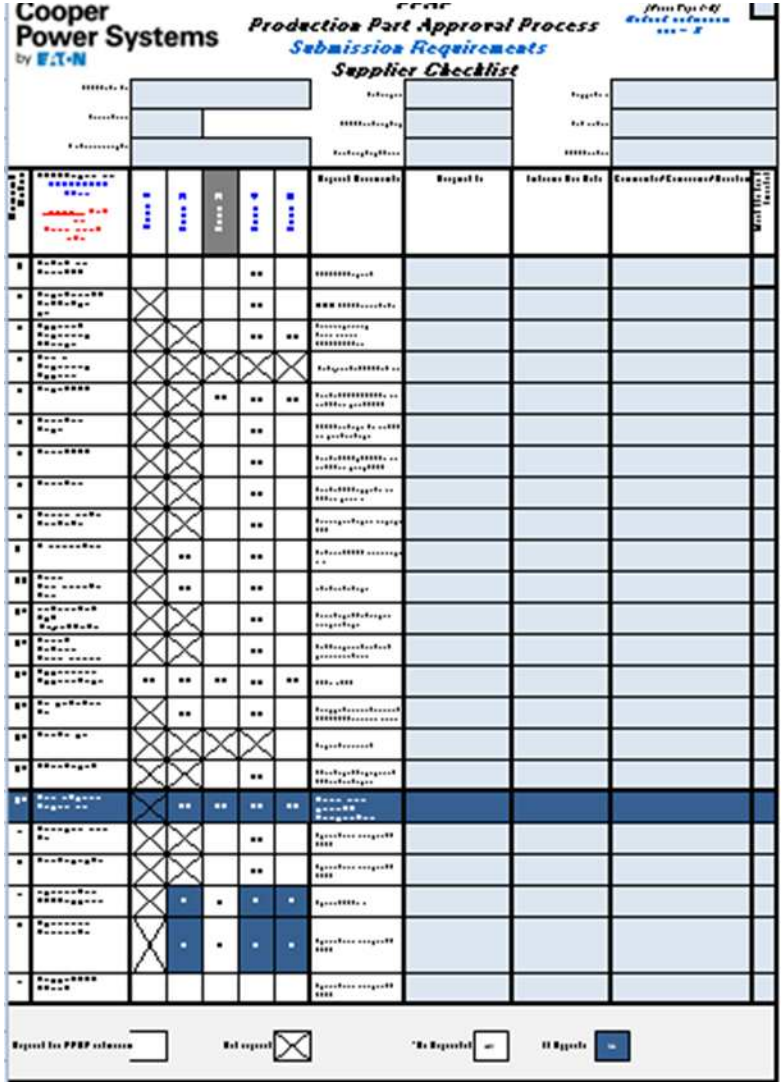
An organizational/communication aid for suppliers to use in preparing the PPAP for submission.

Purpose:

To clearly list which elements of the PPAP are required to be submitted in order to gain full approval of the component for production.

When to use:

The supplier checklist is generated for every PPAP requested and is required regardless of which level of PPAP is requested.



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.**
- **Later changes to the product or process can be expensive and time-consuming!**

Key Take Away:

- Production Part Approval Process is a game changer across the electrical sector.
- AIAG PPAP expects the supplier to do all design and validation activities, regardless of PPAP level request
- Used for both Internal and External Suppliers
- Approval of PPAP submissions
- AIAG Core Tools available to suppliers

The PPAP elements are all requirements of Eaton Quality System. All internal suppliers should be able to give a full level 3 submission

For External suppliers some training may be required but early communication facilitates this and prevents delays to the project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