Introductions

- Name
- Organization
- Current Role
- Experience with PPAP
- Experience or training with tools of PPAP: MSA & Capability Studies
Roles/ Responsibilities

**Eaton Supplier Quality**

- Qualify suppliers
- Determine PPAP requirements
- Request PPAP (WISPER/QPulse) from Supplier
- Facilitate Design and Specification Review (DSR/PFA)
- Track/review APQP activities for accuracy and completion
- Assist with supplier’s activities as necessary
- Review and approve PPAP submission
- Monitor production, including SC process capability

**Supplier**

- Complete systems level corrective actions as necessary per Supplier Assessment
- Obtain and review complete design record, including all necessary design drawings and specifications
- Review design for manufacturability
- Participate in DSR and sign off
- Develop and validate manufacturing process, including APQP activities
- Submit PPAP to Eaton
- Maintain “Living” documents with respect to product/process quality control
What is APQP?

- 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.
Expectations:

Supplier/external:
• 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!)
4. Product and Process Validation

**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

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.
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)”

Eaton’s Cooper Power Systems Division
What is the **Purpose** of PPAP?

When is PPAP **Required**?

What are the **Elements** of the submission?

How are the **Levels** of PPAP applied?

Details on successful PPAP submission to **CPSD facilities**
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
• Outlines customer requirements that must be delivered and approved prior to production of product
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
Implementing PPAP with Value to the business

- The Automotive Industry applied PPAP to all parts sourced from suppliers.
- Eaton requires all purchased direct material components to have some level of PPAP.
  - CPSD will determine what level to apply to specific products based on criteria:
    - High Risk Part
    - High Volume or Spend
    - New Technology
    - New Supplier
- PPAP is applied to both:
  - New Products
  - Changes to existing products
Benefits of PPAP Submissions

- Forces formal part conformance and approval
- Ensures formal quality planning
- Helps to maintain design integrity
- Identifies issues early for resolution
- Reduces warranty charges and prevents costs of poor quality
- Assists with managing supplier changes
- Prevents use of unapproved and nonconforming parts
- Identifies suppliers that need more development
- Improves the overall quality of the product & customer satisfaction
PPAP Requirements

What are the actual requirements?
The Basics of PPAP

Submission requirements are called **Elements**

Which element is required is determined by the submission **Level**
<table>
<thead>
<tr>
<th></th>
<th>PPAP “Elements” (Requirements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Part Submission Warrant</td>
</tr>
<tr>
<td>2</td>
<td>Design Record</td>
</tr>
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<td>3</td>
<td>Engineering Change Documents, if any</td>
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<td>4</td>
<td>Customer Engineering approval, if required</td>
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<td>5</td>
<td>Design FMEA</td>
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<td>6</td>
<td>Process Flow Diagrams</td>
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<td>7</td>
<td>Process FMEA</td>
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<td>8</td>
<td>Control Plan</td>
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<td>9</td>
<td>Measurement System Analysis studies</td>
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<td>10</td>
<td>Dimensional Results</td>
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<td>11</td>
<td>Material, Performance Test Results</td>
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<td>12</td>
<td>Initial Process Studies</td>
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<td>13</td>
<td>Qualified Laboratory Documentation</td>
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<td>14</td>
<td>Appearance Approval Report (AAR), if applicable</td>
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<tr>
<td>15</td>
<td>Sample Product</td>
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<td>16</td>
<td>Master Sample</td>
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<td>17</td>
<td>Checking Aids</td>
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<tr>
<td>18</td>
<td>Records of Compliance With Customer Specific Requirements</td>
</tr>
<tr>
<td>19</td>
<td>Part Submission Warrant</td>
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<tr>
<td>20</td>
<td>Bulk Material Checklist</td>
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</tbody>
</table>
## PPAP Submission Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Production Warrant and Appearance Approval Report (if applicable) submitted to Eaton</td>
</tr>
<tr>
<td>Level 2</td>
<td>Production Warrant, product samples, and dimensional results submitted to Eaton</td>
</tr>
<tr>
<td>Level 3</td>
<td>Production Warrant, product samples, and complete supporting data submitted to Eaton</td>
</tr>
<tr>
<td>Level 4</td>
<td>Production Warrant and other requirements as defined by Eaton</td>
</tr>
<tr>
<td>Level 5</td>
<td>Production Warrant, product samples and complete supporting data (a review will be conducted at the supplier's manufacturing location)</td>
</tr>
</tbody>
</table>
# PPAP Submission Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
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<tbody>
<tr>
<td>1. Design Record</td>
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<td>2. Engineering Change Documents, if any</td>
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<td>3. Customer Engineering approval, if required</td>
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<td>7. Control Plan</td>
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<td>8. Measurement System Analysis studies</td>
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<tr>
<td>9. Dimensional Results</td>
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<tr>
<td>10. Material, Performance Test Results</td>
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<td>11. Initial Process Studies</td>
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<td>12. Qualified Laboratory Documentation</td>
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<td>14. Sample Product</td>
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<td>15. Master Sample</td>
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<td>16. Checking Aids</td>
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<tr>
<td>17. Records of Compliance With Customer Specific Requirements</td>
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<tr>
<td>18. Part Submission Warrant</td>
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</table>

- **S** = The organization shall submit to the customer and retain a copy of records or documentation items at appropriate locations
- **R** = The organization shall retain at appropriate locations and make available to the customer upon request
- *** =** The organization shall retain at the appropriate location and submit to the customer upon request

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Supplier PPAP Checklist

- Checklists are generated electronically within our CPSD Q-Pulse Database
- Supplier Quality in conjunction with plant representatives determine which elements of a specific level will apply
- Suppliers use this as a guide to ensure all requested elements have been submitted
- This template represents the default expectations of each level, however SQ can elect to add or decrease requirements within any level
- Level 3 is the default level for submission unless otherwise communicated
**Dear Supplier:**

The Production Part Approval Process (PPAP) is an integral part of the Eaton Electrical quality commitment and properly prepared documentation of your sample submission is a vitally important part of this process. The documentation indicated is to be completed in accordance with Eaton Corporation's Supplier Excellence Manual.

To ensure prompt evaluation of PPAP samples (as well as approval and payment for any tooling), please use the following checklist as a guide to complete your sample submission prior to shipment. If a check exists in the **S** box, then a corresponding check should exist beside the item number as verification of submittal. Items (# 22-25) are intended as reference only to aid in clarification of expectations, but should be checked off as proof of review and acceptability.

<table>
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</tbody>
</table>

Submit (S) = Supplier shall submit to Eaton & retain a copy of records or documentation items at appropriate locations.

Retain (R) = Supplier shall retain at appropriate locations and make **readily available** to Eaton upon request.

Waive (W) = Eaton waives supplier responsibility of performing an activity.

Not AIAG
Importance of Due Diligence through PPAP

Eaton Requirements
1. Part Submission Warrant (PSW)
2. Design Records
3. Engineering Change Documents
4. Customer Engineering Approval
5. DFMEA
6. Process Flow Diagram
7. PFMEA
8. Control Plan
9. Measurement System Analysis (MSA)
10. Dimensional Results
11. Material, Performance Results
12. Initial Process Study
13. Qualified Laboratory Documentation
15. Sample Product
16. Master Sample
17. Checking Aids
18. CPSD specific requirements
   ▪ Tooling Information Form
   ▪ Packaging Form
   ▪ Specification Deviation
   ▪ Supplier PPAP Checklist

Element Links
2. Design Records
5. DFMEA
7. PFMEA
8. Control Plan
9. MSA
12. Initial Process Study
18. CPSD Specific

Critical Systems
Requirements (Special Characteristics)
More Robust Design
Robust Process
Develop Process Control
Confirm Measurement
Verify and Improve capability
Customer Requirements

Submit

Diligence is critical because elements relate and build on each other
Example: 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 eg heat treatment

• **Medium Risk**
  - Parts that have at least one critical feature

• **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
Electronic Submission Requirements

- Eaton requests that all PPAPs be submitted electronically or scanned / uploaded into WISPER
- Use of paper submission must have prior approval by the SQ.
- Submission must be received on or prior to the PPAP due date
- Review and Approval Process:
  - Eaton will attempt to review and provide feedback within 10 business days
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 or piece quantity basis

• 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
## Public Location of Forms

### Supplier Information

<table>
<thead>
<tr>
<th>Topic</th>
<th>Title</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Part Approval Process (PPAP)</td>
<td>CPSD Industries PPAP Manual</td>
<td>PDF</td>
</tr>
<tr>
<td></td>
<td>CPSD Industries PPAP Forms Kit</td>
<td>Excel</td>
</tr>
<tr>
<td>PPAP Forms Quick Reference</td>
<td>Supplier PPAP Checklist</td>
<td>Excel</td>
</tr>
<tr>
<td></td>
<td>(SCR) Supplier Change Request</td>
<td>Excel</td>
</tr>
<tr>
<td></td>
<td>(PSW) Part Submission Warrant (required)</td>
<td>Excel</td>
</tr>
<tr>
<td></td>
<td>Dimensional Data Sheet (required)</td>
<td>Excel</td>
</tr>
<tr>
<td></td>
<td>CPSD Tooling Form</td>
<td>Excel</td>
</tr>
<tr>
<td></td>
<td>CPSD Packaging Plan</td>
<td>Excel</td>
</tr>
<tr>
<td></td>
<td>Specification Deviation Form</td>
<td>Excel</td>
</tr>
</tbody>
</table>
Element 1: Part Submission Warrant
Part Submission Warrant (PSW)

What is It?
- Document required for all newly tooled or revised products in which the supplier confirms that inspections and tests on production parts show conformance to Eaton requirements

Objective or Purpose
Used to:
- document part approval
- provide key information
- declare that the parts meet specification

When to Use It
- Prior to shipping production parts

Now, let’s take a closer look
Part Submission Warrant (PSW)
Part Submission Warrant (PSW)

<table>
<thead>
<tr>
<th>Does this part utilize CPSD owned tooling? Is it properly identified?</th>
<th>□ Yes □ No</th>
<th>If yes, P.O. #</th>
<th>__________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does this part contain any restricted substances or require IMDS submission?</td>
<td>□ Yes □ No</td>
<td>Substance(s)?</td>
<td>__________</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
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</tr>
<tr>
<td>Are plastic or polymeric parts identified with appropriate ISO marking codes?</td>
<td>□ Yes □ No</td>
<td>IMDS Number</td>
<td>__________</td>
</tr>
</tbody>
</table>

**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 Non-conformance or discrepancy
- Change to optional construction, material or component

**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 limiting 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)
- 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)

**DEFAULT CPSD SUBMISSION LEVEL**

**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 __________
Part Submission Warrant (PSW)

The approved Part Submission Warrant officially warrants the parts and process are ready for production.
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!
Run @ Rate

• The purpose of a **Run @ Rate** is to verify the supplier’s manufacturing process is capable of producing components that meet Eaton’s quality requirements, at quoted tooling capacity, for a specified period of time.

• Verification of the Run @ Rate will be at the Supplier Quality Engineer’s (SQE) discretion. The supplier will be notified of the need to perform a Run @ Rate as early in the process as possible.

• The number of components to be produced during the Run @ Rate should be sufficient to demonstrate process capability and will be predetermined by the SQE and the supplier.
  
  ➢ Factors such as product complexity, shelf life, storage, cost and single shift vs. multiple shift operations will be taken into consideration.
Part Submission Warrant (PSW)

• **Reviewers Checklist**
  ✓ 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 & Bubbled Part Prints
Objective or Purpose:

- To document & provide a copy of the formal part print
- To provide any additional engineering records for reference
E2 Requirements

➢ All submission should have 1 copy of the formal print
  ➢ Bubble print that supports the dimensional report
    ❖ Must have all notes and specification circled and numbered
    ❖ Must be clear and legible
    ❖ Must include any reference dimensions
    ❖ Start numbering in upper Left and continue clockwise
  ➢ Any additional supporting information including
    ❖ Reference prints
    ❖ Sub-Assembly prints
    ❖ Component prints with a different part number
    ❖ Applicable material specifications
    ❖ Applicable reference specifications
    ❖ Customer specified workmanship standards
Print bubble number must correspond to the “Item” number on the Dimensional Report
Special Characteristics

What is It?

✓ A method of communicating specific requirements that require additional control or care by personnel at the point of manufacture or assembly.

✓ Includes both product and process characteristics communicated on product requirements such as:
  - Part drawing
  - dFMEA
  - pFMEA
  - Process Control Plan

Design Special Characteristics:

Component features that are critical to the safety or functionality of the final product. Denoted on the component part drawing and/or material specifications. Selected by the customer during the design phase.

Process Special Characteristics:

Special Characteristics are those features that most affect the outcome of a product or process. Controls must be designed and implemented as part of your company’s advanced quality planning. Special attention is required during this phase to identify and control variables that affect the conformance of the product.

Eaton’s expectation is that you will address all Special Characteristics (both Design and Process Characteristics) in the Control Plan and ensure that you have a robust process for consistently achieving all CTQ (Critical to Quality) requirements as that are defined in the CPSD part print.
Eaton Special Characteristic Types

Required Control Dimension (RCD):

A required control dimensions (RCD) is one of two types of Design Special Characteristics that requires special care in the form of additional control or capability. The control is required to be in place during both startup and on an ongoing basis. This can be done through statistical techniques, but can also be accomplished through techniques such as 100% inspection, poke-yoke (error-proofing) etc.. Power Systems designates an RCD using the Octagon symbol placed on the left-hand side of the stated requirement.

Statistically Toleranced Dimensions (STD):

A statistically tolerated dimension (STD) is one of two types of Design Special Characteristics that requires special care in the form of additional control and capability. All the same requirements of an RCD apply except that in addition a STD has been found to have statistical significance and therefore capability is required. This means that regardless of any other control method this dimension must demonstrate an initial and ongoing process capability. Power Systems designates an STD design characteristic using the ASME Y14.5M ST Symbol (elongated hexagon) placed on the right-hand side of the stated requirement. Capability index requirements should follow the guidelines provided in this PPAP manual.
Design Records & Bubbled Prints

• Reviewers Checklist
  ✓ Must be clean and legible “Bubble print
  ✓ Must be correct CPSD Part # and Revision
  ✓ Every requirement must have a separate bubble
    ➢ Dimensions
    ➢ Notes
    ➢ Special Characteristics
    ➢ Referenced specifications
  ✓ Verify that no other prints need to be submitted
    ➢ Sub-assemblies
    ➢ Component level detail
Morning Break

10 Minutes
Element 3: Authorized Engineering Change Documents
Objective or Purpose:

- To provide any pertinent change information for reference
- This is a placeholder for all relevant information not covered in the part print:
  - ECN's
  - Specifications
  - Feasibility studies
  - Supplier Change Requests
  - Emails
  - Sub-assembly drawings
  - Life or reliability testing requirements

This element is typically used when changes occur to the design documentation
Reviewer's Checklist

- CPSD ECN’s must be approved, not pending
- Print change submissions must have current prints
- Marked up prints are not acceptable for PPAP
- Supplier initiated changes must have approved Supplier Change Request (SCR) form in this section.
- Emails can only clarify requirements, not define them
- Emails cannot re-define a requirement in lieu of an upcoming print change

Example: I am submitting REV A even though a REV B print is coming because this email requested me to make the change.

Answer: Then submit PPA to REV B not REV A
Element 4: Customer Engineering Approvals
Customer Engineering Approvals

- Customer Engineering Approvals are used to demonstrate pre-approval by Eaton’s customer 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 the Power Systems requirements.
Element 5: Design FMEA (DFMEA)
Design FMEA

**Objective or Purpose:**
- To show evidence that potential failure modes and risks have been addressed at the design level.
  - Materials selection
  - Tolerance stack-up
  - Software
  - Interfaces
  - DVP&R (life cycle tests)

**When is it Required?**
- Required only when the part is designed by the supplier.

**Guidance:**
- DFMEA must follow AIAG compliant format/guidelines
- Must incorporate all design special characteristics
- Can be applied to a family of parts
- Can be proprietary and if there is a concern notify Quality

DFMEA highlights and reduces design risks
DFMEA Common Pitfalls

- One time document
  - Must be continuously reviewed and updated
    - What if the latest change or revision has a significant impact?
- Not submitted or reviewed with supplier
- The After Thought
  - Completed after drawing and production release
- Does not consider all potential failure modes
- Assumes singular or linear failure points
  - Star/Planet Alignment Phenomenon
- Tolerance is theoretical and not reviewed with consideration of available manufacturing technologies
- Detection are over stated
- Single sample test
- Critical and/or Special Characteristics not identified
- Only considers full assembly
- Not completed to correct level – component, sub assembly, assembly, product
- Family based DFMEA not all inclusive
  - Not reviewed for specific/custom application/designs
Design FMEA

- **Reviewers Checklist**
  - DFMEA is only required if designed by the supplier.
  - Must address all special characteristics
  - Must show evidence of objective design evaluation
  - Document is reviewed by a team no a single engineer
  - State should show release prior to print release
  - Severity, Occurrence and Detection must be compliant with AiAG guidelines
  - Must take the technical/physical limits of the manufacturing/assembly process into consideration.
Key Relationships

- Characteristic Matrix
- Process Flowchart
- Control Plan
- Process FMEA
- Process Instructions
Element 6: Process Flow Diagrams
Holy Trilogy of Control Documentation

### Tool Interaction

#### Process Flowchart

#### New/Revised Process Steps

#### Process FMEA

#### Risk Prioritized Process Steps

#### Improved Controls

#### Control Plan
Process Flow Diagrams (Maps)

Objective or Purpose:
- To document the entire manufacturing process for a part
- To clarify the steps in manufacturing the part
- To look for waste (lean manufacturing)

Guidance:

- Process flow must include:
  - The entire manufacturing process (receiving through shipping)
  - All key steps in the process
  - All offline activities (such as measurement, inspection and handling)
  - Identification of areas containing nonconforming material
    - Scrap, defective and rework parts

- Process steps must match both the Control plan and the PFMEA

DFMEA highlights and reduces design risks
What is It?
- A visual diagram of the entire process from receiving through shipping, including outside processes and services

Objective or 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 Diagrams

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

This is included in the PPAP Forms Kit!
Process Flow Diagram - Examples
# Process Flow Diagram - Examples

## Process Flow Diagram

<table>
<thead>
<tr>
<th>Changeover Key</th>
<th>Inspection Key</th>
<th>Product:</th>
</tr>
</thead>
<tbody>
<tr>
<td>P = Product</td>
<td>A = Automatic</td>
<td></td>
</tr>
<tr>
<td>T = Tooling</td>
<td>M = Manual</td>
<td></td>
</tr>
<tr>
<td>S = Software</td>
<td>V = Visual</td>
<td></td>
</tr>
<tr>
<td>D = Dunnage</td>
<td>Q = Quality Audit</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OP-SEQ</th>
<th>FAB</th>
<th>MOVE</th>
<th>STORE/GET</th>
<th>INSPECT</th>
<th>REWORK</th>
<th>SCRAP/CONTROL</th>
<th>CHANGEOVER</th>
<th>OPERATION DESCRIPTION</th>
<th>CLASS</th>
<th>SIGNIFICANT PRODUCT CHARACTERISTICS (OUTPUTS)</th>
<th>CLASS</th>
<th>SIGNIFICANT PROCESS CHARACTERISTICS (INPUTS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Receiving Inspection</td>
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<tr>
<td>20</td>
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</tbody>
</table>
Break Out Session. 30 minutes

Completing a Process Map.
Process Mapping


In your team I want you to develop a process map for each stage in the process to construct a Lego set.

Reviewing all the steps, inputs and outputs of this process.
Preparing the Process Map

• Team Effort:
  • Manufacturing engineers
  • Line operators
  • Line supervisors
  • Maintenance technicians

• Possible Inputs to Mapping:
  • Brainstorming
  • Operator manuals
  • Engineering specifications
  • Operator experience
  • 6M’s
    • Man, Machine (Equipment), Method (Procedures), Measurement, Materials, Mother Nature (Environment)
Team Report Outs 15 minutes (3 teams)
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
  ✓ Match both PFMEA and Control Plan
  ✓ Should include abnormal handling processes
    ▪ Scrap
    ▪ Rework
    ▪ Extended Life Testing
  ✓ Process Flow must include all phases of the process
    ▪ Receiving of raw material
    ▪ Part manufacturing
    ▪ Offline inspections and checks
    ▪ Assembly
    ▪ Testing
    ▪ Shipping
    ▪ Transportation
Element 7: Process FMEA (PFMEA)
Holy Trilogy of Control Documentation

Tool Interaction

Process Flowchart

New/Revised Process Steps

Process Steps

Process FMEA

New/Revised Process Steps

Risk Prioritized Process Steps

Improved Controls

Control Plan

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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.

➢ Objective or 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

IMPORTANT!

The PFMEA should be completed using a cross-functional team!
# Process FMEA (PFMEA)

## Potential Failure Modes and Effects Analysis

### Process FMEA

<table>
<thead>
<tr>
<th>Print #</th>
<th>Process Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item Name</td>
<td>Contact Number</td>
</tr>
<tr>
<td>Rev #</td>
<td>Key Date</td>
</tr>
<tr>
<td>Core Team</td>
<td>Customer Manufacturing Site</td>
</tr>
<tr>
<td>FMEA Number</td>
<td>Prepared By</td>
</tr>
<tr>
<td></td>
<td>FMEA Date (Orig.)</td>
</tr>
<tr>
<td></td>
<td>FMEA Date</td>
</tr>
</tbody>
</table>

### Potential Failure Modes and Effects Analysis Table

<table>
<thead>
<tr>
<th>Number</th>
<th>Process/Step Function</th>
<th>Requirements</th>
<th>Potential Failure Mode</th>
<th>Potential Effects of Failure</th>
<th>Severity (S)</th>
<th>Potential Cause(s)/Failure Mechanisms</th>
<th>Occurrence (O)</th>
<th>Detection (D)</th>
<th>Prevention (P)</th>
<th>Recommended Action(s)</th>
<th>Responsibility and Completion Date</th>
<th>Action Results</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

This is included in the PPAP Forms Kit!
## PFMEA – Step 1

Using the completed Process Flow Diagram, enter the process step.

### Concisely list the performance requirement(s).

### Failure Modes
For each Process Input, determine the ways in which the input can go wrong.

### TIPS
- There should be at least one failure mode for each input.
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.

<table>
<thead>
<tr>
<th>Burred</th>
<th>Bent</th>
<th>Hole off location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracked</td>
<td>Hole to shallow</td>
<td>Hole missing</td>
</tr>
<tr>
<td>Handling Damage</td>
<td>Dirty</td>
<td>Hole to deep</td>
</tr>
<tr>
<td>Surface too rough</td>
<td>Corrosion</td>
<td>Open circuit</td>
</tr>
</tbody>
</table>
## PFMEA – Step 2

### TIPS
- There should be at least one failure effect for each failure mode.
- Effects should be specific, clear, and leave no doubt to the uninformed reviewer.

### Potential Failure Effects

For each Failure Mode, determine what effect the specific failure could have on the process output.

<table>
<thead>
<tr>
<th>Number</th>
<th>Process/Step Function</th>
<th>Requirements</th>
<th>Potential Failure Mode</th>
<th>Potential Effects of Failure</th>
<th>Potential Cause(s)/Failure Mechanisms</th>
<th>Current Process Controls</th>
<th>DETRN</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>Wax application</td>
<td>No unwaxed areas inside door panel</td>
<td>Corrosion</td>
<td>Door Strength compromised</td>
<td>Manually inserted spray head</td>
<td>Process will</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>not fire</td>
<td>Alarm sounds</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sprays not evenly</td>
<td></td>
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<td></td>
<td></td>
<td>Viscosity too high</td>
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<td></td>
<td></td>
<td>Viscosity checks at start-up and changeovers</td>
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<td>Temp too low</td>
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<td></td>
<td>Auto controller</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Pressure too low</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Auto controller</td>
<td></td>
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</tr>
</tbody>
</table>
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:

<table>
<thead>
<tr>
<th>Noise</th>
<th>Rough</th>
<th>Erratic Operation</th>
<th>Excessive</th>
<th>Effort</th>
<th>Inoperative</th>
<th>Unpleasant Odor</th>
<th>Unstable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation Impaired</td>
<td>Draft</td>
<td>Intermittent Operation</td>
<td>Poor Appearance</td>
<td>Leaks</td>
<td>Control Impaired</td>
<td>Rework Repairs</td>
<td>Scrap</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Cannot fasten</th>
<th>Does not fit</th>
<th>Cannot bore/tap</th>
<th>Does not connect</th>
<th>Cannot mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not match</td>
<td>Cannot face</td>
<td>Causes Excessive tool wear</td>
<td>Damages Equipment</td>
<td>Endangers Operator</td>
</tr>
</tbody>
</table>
PFMEA – Step 3

Potential Causes
For each Failure Mode, determine the possible cause of the failure.

TIPS
- There should be at least one potential cause for each failure mode.
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:

<table>
<thead>
<tr>
<th>Improper torque – over/under</th>
<th>Improper weld current, time, pressure</th>
<th>Inaccurate Gauging</th>
<th>Improper Heat Treat – time, temperature</th>
<th>Inadequate gating/venting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate or no lubrication</td>
<td>Part missing or mislocated</td>
<td>Worn locator</td>
<td>Worn Tool</td>
<td>Chip on locator</td>
</tr>
<tr>
<td>Broken tool</td>
<td>Improper Machine Setup</td>
<td>Improper programming</td>
<td>Incorrect Software version</td>
<td>Non validated test system</td>
</tr>
</tbody>
</table>
## PFMEA – Step 4

**Current Controls**

For each potential cause, list the current method used for preventing or detecting failure.

### TIPS

- This step in the FMEA begins to identify initial shortcomings or gaps in the current control plan.
- If a procedure exists, enter the document number.
- If no current control exists, list as “none.”

<table>
<thead>
<tr>
<th>Number</th>
<th>Process/Step Function</th>
<th>Requirements</th>
<th>Potential Failure Mode</th>
<th>Potential Effects of Failure</th>
<th>Potential Cause(s)/Failure Mechanisms</th>
<th>OCC</th>
<th>Current Process Controls</th>
<th>DET</th>
<th>RPN</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>Wax application</td>
<td>No unwaxed areas inside door panel</td>
<td>Corrosion</td>
<td>Door Strength compromised</td>
<td>Manually inserted spray head not inserted far enough</td>
<td>8</td>
<td>Process will not start if head is not inserted to correct depth</td>
<td>Alarm sounds</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>daily PM's for spray heads</td>
<td>Viscosity checks at start-up and changeovers</td>
<td>5</td>
</tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Auto controller</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Pressure too low</td>
<td></td>
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</tr>
</tbody>
</table>

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PFMEA – Step 5

Assign Severity (How serious is the effect if it fails?)

Assign Occurrence (How likely is the cause to occur?)

Assign Detection (How easily can the cause or failure mode be detected?)

Severity, Occurrence and Detection rating details on next slide
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!
An Example of Rating Definitions

### Process PFMEA evaluation criteria

<table>
<thead>
<tr>
<th>Severity evaluation criteria</th>
<th>Occurrence evaluation criteria</th>
<th>Detection evaluation criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking</td>
<td>Effect</td>
<td>Final customer effect</td>
</tr>
<tr>
<td>10</td>
<td>Hazardous without warning</td>
<td>Very high severity when a PFME affects may operation of product</td>
</tr>
<tr>
<td>9</td>
<td>Hazardous with warning</td>
<td>Very high severity when a PFME affects may operation of product</td>
</tr>
<tr>
<td>8</td>
<td>Very high</td>
<td>Product impossible (loss of primary function)</td>
</tr>
<tr>
<td>7</td>
<td>High</td>
<td>Product impossible (loss of primary function)</td>
</tr>
<tr>
<td>6</td>
<td>Moderate</td>
<td>Product possible but with reduced level of performance (loss of secondary function)</td>
</tr>
<tr>
<td>5</td>
<td>Low</td>
<td>Product possible but with reduced level of performance (loss of secondary function)</td>
</tr>
<tr>
<td>4</td>
<td>Very low</td>
<td>Major aesthetic etc. defect</td>
</tr>
<tr>
<td>3</td>
<td>Minor</td>
<td>Aesthetic etc. defect</td>
</tr>
<tr>
<td>2</td>
<td>Very minor</td>
<td>Minor aesthetic etc. defect</td>
</tr>
<tr>
<td>1</td>
<td>None</td>
<td>No discernable effect</td>
</tr>
</tbody>
</table>

**Note:** All items ranking 10 on any of the three criteria must be reviewed, however, how their total PPM.  

**Inspection Types:**
- A: Entrapment
- B: Gauging
- C: Manual

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### PFMEA – Step 5

**Calculate the Risk Priority Number**

\[ \text{RPN} = \text{Severity} \times \text{Occurrence} \times \text{Detection} \]

- **TIPS**
  - The RPN is used to prioritize the most critical risks identified in the first half of the FMEA.
  - High RPNs are flags to take effort to reduce the calculated risk.
  - Regardless of RPN, *high Severity* scores (9 or 10) should be given special attention.
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.

How many items should be the focus of the next steps?

Pareto Chart for RPN
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
PFMEA – Step 7

Determine **Actions Recommended** to reduce High RPNs

<table>
<thead>
<tr>
<th>RPN</th>
<th>Recommended Action(s)</th>
<th>Responsibility and Completion Date</th>
<th>Action Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>175</td>
<td>Change to self cleaning nozzles</td>
<td>Mfg Eng by 5/25/13</td>
<td>Rejected as technology was not proven reliable in production</td>
</tr>
<tr>
<td>175</td>
<td>Complete DOE on viscosity vs temp vs pressure</td>
<td>Mfg Eng by 5/31/13</td>
<td>Temp and Press limits were determined and limit controls have been installed - Control charts show process is in control Cpk= 1.85</td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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</tbody>
</table>
PFMEA – Step 8 and 9

<table>
<thead>
<tr>
<th>RPN</th>
<th>Recommended Action(s)</th>
<th>Resp (responsibility)</th>
<th>Actions Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>Mfg Eng by 5/25/13</td>
<td>Assign a specific person who will be responsible for recommended actions.</td>
<td>Rejected as technology was not proven reliable in production</td>
</tr>
<tr>
<td>35</td>
<td>Mfg Eng by 5/31/13</td>
<td></td>
<td>Temp and Press limits were determined and limit controls have been installed - Control charts show process is in control Cpk = 1.85</td>
</tr>
</tbody>
</table>

Actions Taken
As actions are identified and completed, document in the “Actions Taken” column.

SEV, OCC, DET, RPN
As actions are complete reassess Severity, Occurrence, and Detection and recalculate RPN.
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.
Lunch

45 minutes
Break Out Session. 20 minutes

Completing a PFMEA.
“Lego” PFMEA.

In your team, using the PFC you just created, develop a PFMEA for your planned Lego assembly process.

Choose a PFMEA template from the AIAG Core Tools file.

Use the provided evaluation criteria to rank severity, occurrence and detection.
### FMEA for Low Voltage Busway Epoxy Insulation - GF&P

**Process or Product Name:** Low Voltage Busway Epoxy Insulation - GF&P

**Prepared by:** D. Yount

**Responsible:** Mario Seppulveda, GF&P, Ladd Kelly C-H

**FMEA Date (Orig):** July 99
**Rev:** 2, Nov 99
**Rev 3:** Nov 99

---

<table>
<thead>
<tr>
<th>Process Step/Input</th>
<th>Potential Failure</th>
<th>Potential Failure Effects</th>
<th>Potential Causes</th>
<th>Current Controls</th>
<th>RPN</th>
<th>Actions Recommended</th>
<th>Resp.</th>
<th>Actions Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grind (12)</td>
<td>Sanding disk grit incorrect</td>
<td>Irregular contact surface, plating surface rough</td>
<td>Vendor supplied incorrect disk</td>
<td>Supervisor inspects incoming material, then releases for use</td>
<td>20</td>
<td>Need to create work instruction to document inspection</td>
<td>M. Sepulveda</td>
<td>Target complete 11/99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masking (2)</td>
<td>Rough surface where the part will be coated w/epoxy</td>
<td>Failed visual or high pot test</td>
<td>Poor sanding, weld slag, metal chips on bars</td>
<td>Operator training OJT, visual inspection, (SOP ?)</td>
<td>504</td>
<td>Re train operators both shifts, review design &amp; operation</td>
<td>Ladd Kelley</td>
<td>Target complete 11/99</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment failure, pins break, welds break on rack</td>
<td>Bar falls off carrier, possible to damage tank or other equipment, or damage bar</td>
<td>Part fatigue, part failure</td>
<td>Loader visual inspection</td>
<td>New racks, re train operators to inspect, review PM schedule</td>
<td>280</td>
<td></td>
<td>M. Sepulveda, L. Kelley</td>
<td>Target complete 10/00</td>
</tr>
<tr>
<td>De Masking (8)</td>
<td>Tape not removed correctly</td>
<td>Epoxy on contact surfaces, damaged epoxy from contact</td>
<td>Bars hung to close together, too many bars on a rack, not enough resources demasking,</td>
<td>Operator training OJT, work instruction for masking SOP</td>
<td>270</td>
<td>Review modified rack design, eliminate demask where possible</td>
<td>M. Sepulveda, L. Kelley</td>
<td>Target complete 11/99</td>
</tr>
</tbody>
</table>

---

**Table Notes:**
- **S:** Severity
- **E:** Effect
- **V:** Occurrence
- **O:** Controls
- **C:** Current Controls
- **RPN:** Risk Priority Number
- **Resp.:** Responsible
- **Actions Taken:** Date of Completion

---

**Example Diagram:**

- **What is the Input?**
- **What can go wrong with the Input?**
- **What is the Effect on the Outputs?**
- **What are the Causes?**
- **How are these found or prevented?**
- **How Bad?**
- **How Often?**
- **How well?**
- **What can be done?**

---

**Example Entries:**
- **Grind (12):** Sanding disk grit incorrect - Irregular contact surface, plating surface rough - Vendor supplied incorrect disk - Supervisor inspects incoming material, then releases for use - Need to create work instruction to document inspection - M. Sepulveda - Target complete 11/99
- **Masking (2):** Rough surface where the part will be coated w/epoxy - Failed visual or high pot test - Poor sanding, weld slag, metal chips on bars - Operator training OJT, visual inspection, (SOP ?) - Re train operators both shifts, review design & operation - Ladd Kelley - Target complete 11/99
- **Equipment failure, pins break, welds break on rack:** Bar falls off carrier, possible to damage tank or other equipment, or damage bar - Part fatigue, part failure - Loader visual inspection - New racks, re train operators to inspect, review PM schedule - M. Sepulveda, L. Kelley - Target complete 10/00
- **De Masking (8):** Tape not removed correctly - Epoxy on contact surfaces, damaged epoxy from contact - Bars hung to close together, too many bars on a rack, not enough resources demasking, - Operator training OJT, work instruction for masking SOP - Review modified rack design, eliminate demask where possible - M. Sepulveda, L. Kelley - Target complete 11/99

---

**Diagram Instructions:**
- **How Bad?**
- **How Often?**
- **How well?**
- **What can be done?**

---

**Footer:**

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# PFMEA - Example

<table>
<thead>
<tr>
<th>Process Step/Input</th>
<th>Potential Failure Mode</th>
<th>Potential Failure Effects</th>
<th>SEV</th>
<th>Potential Causes</th>
<th>OCC</th>
<th>Current Controls</th>
<th>DET</th>
<th>RP N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unload and Pack</td>
<td>Scratched</td>
<td>Part rejected at next dept.</td>
<td>3</td>
<td>Improper Handling</td>
<td>4</td>
<td>No written (attended training)</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

**Hint:** Follow the flow shown above, where the team exhausts causes and controls for one failure mode and each related effect before moving on to another.
Report Outs

2 Teams – 10 minutes
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
✓ All special characteristics have been addressed as individual line items
✓ Shows evidence of cross functional participation
✓ Severity, Occurrence and detection must be compliant with AIAG guidelines and scored within reason
✓ Make sure that action is being taken on higher RPN line items & the action will actually have impact.
PFMEA: Tips and Lessons Learned

• Collaborative Effort: *Do not try alone*, use a group
• Very laborious: Time consuming process for initial construction. Take necessary breaks
• Action items are required for completion
• Train team ahead of time by explaining scoring criteria
• Proper preparation is needed for meetings
• Summarize often: FMEA is a *living* document, continual updates makes this a routine part of the process, can be done on quarterly or semi-annual basis or as required by a generated defect.
Examples of typical PFMEA Mistakes

- Misapplication of Severity, Occurrence and Detection
- Redefining Severity, Occurrence and Detection
- Over estimating the effectiveness of the “Recommended Action”
- Applying thresholds
- Not recognizing all potential failures
- Failure to properly identify the customer
- Misapplication of ranking scales
- Confusing the Failure modes with Effects or Causes
- Allowing the PFMEA to turn into a design review
Element 8: Control Plan
Holy Trilogy of Control Documentation

Tool Interaction

Process Flowchart

Process Steps

New/Revised Process Steps

Process FMEA

Risk Prioritized Process Steps

Improved Controls

Control Plan

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## Control Plan

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

### Purpose:
- To communicate the supplier’s decisions during the entire manufacturing process from materials purchase through final packaging.

### When to Use It
- Implementation of new process
- Implementing a process change

---

**Since processes are expected to be continuously updated and improved, the control plan is a living document!**
Control Plan - Goals

Specifically the control plan should address the following:

- Methods of production
- Identification of Special Characteristics controls
- Secondary or outsourced operations
- Materials and their physical and chemical characteristics
- Types of process equipment at each operation
- Types of test equipment at each operation
- Types of test equipment used to measure each characteristic
- Specifications, sampling strategy, control and reaction methods used
- Periodic conformance testing and product verification

Control Plans address all key process steps
## The Control Plan Form

**CONTROL PLAN**

<table>
<thead>
<tr>
<th>Control Plan Number</th>
<th>Key Contact/Phone</th>
<th>Date (Orig.)</th>
<th>Date (Rev.)</th>
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<tr>
<td>FILE .XLS</td>
<td>555-555-5555</td>
<td>1/1/1996</td>
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<table>
<thead>
<tr>
<th>Part Number/Latest Change Level</th>
<th>Core Team</th>
<th>Customer Engineering Approval/Date (If Req'd.)</th>
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<th>SPECIAL CHAR. CLASS</th>
<th>PRODUCT/PROCESS SPECIFICATION/TOLERANCE</th>
<th>EVALUATION/MEASUREMENT TECHNIQUE</th>
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<th>FREQ.</th>
<th>CONTROL METHOD</th>
<th>REACTION PLAN</th>
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<td>PROCESS</td>
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<td>METHODS</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| This is included in the PPAP Forms Kit! |
## The Control Plan Form

### Administrative Section
Identifies part number and description, supplier, required approval signatures, and dates.
The Control Plan Form

### 3 Distinct Phases

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

---

### Control Plan Form

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<th>PART/PROCESS NUMBER</th>
<th>PROCESS NAME/OPERATION DESCRIPTION</th>
<th>MACHINE, DEVICE JIG, TOOLS FOR MFG.</th>
<th>CHARACTERISTICS NO.</th>
<th>PRODUCT</th>
<th>PROCESS</th>
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<th>PRODUCT/PROCESS SPECIFICATION/TOLERANCE</th>
<th>METHODS</th>
<th>REACTIVE PLAN</th>
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</thead>
</table>

- **METHODS**
  - **EVALUATION/MEASUREMENT TECHNIQUE**
  - **SAMPLE SIZE**
  - **FREQ.**
  - **CONTROL METHOD**

---

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The Control Plan Form

### CONTROL PLAN

<table>
<thead>
<tr>
<th>Part Number/Latest Change Level</th>
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<td>PART/PROCESS NUMBER PROCESS NAME/OPERATION DESCRIPTION MACHINE DEVICE JIG, TOOLS FOR MFG. NO. PRODUCT PROCESS SPECIAL CHAR. CLASS PRODUCT/PROCESS SPECIFICATION/ TOLERANCE EVALUATION/MEASUREMENT TECHNIQUE SAMPLE SIZE FREQ. CONTROL METHOD REACTION PLAN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each stage of *production and testing*. Can be:
- Each operation indicated by the process flow
- Each workstation
- Each machine

Include testing and audits

“Process Number” should cross reference with PFMEA and Process Map
## The Control Plan Form

**CONTROL PLAN**

- **Prototype**  
- **Pre-Launch**  
- **Production**

<table>
<thead>
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</table>

- **Product characteristics** that are important. These can be determined by referencing:
  - ST Dimensions on the drawing
  - Customer critical characteristics
  - Process critical characteristics

There may be several for each operation. Can be dimensional, performance or visual criteria.
Process parameters that are important. A process parameter is a setting made within a process that effects the variation within the operation. Examples include:

- Temperature (molding, heat treat, etc.)
- Pressure
- Fixture settings
- Speed
- Torque

Best if determined with DOE or other structured tool.
The Control Plan Form

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</table>

**Class** refers to whether the characteristic is denoted as a Statistical Tolerance (ST) or Required Control (RC) dimension on the drawing. If so, then some sort of statistical evaluation & control must be used during production. This is linked to PR4 special characteristics in EQS.
# The Control Plan Form

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<tbody>
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<td></td>
<td>NO. PRODUCT</td>
<td>PROCESS</td>
<td>FREQ.</td>
<td>CONTROL METHOD</td>
<td></td>
</tr>
</tbody>
</table>

The criteria the product characteristic needs to meet. This can either be taken from the drawing or be visual criteria not listed in engineering documentation.

OR

This is the process parameter setting value that the process must be run to ensure acceptable product.
# The Control Plan Form

The Control Plan Form is a document used to outline the procedures and specifications for controlling the quality of a product. It includes details such as the characteristic or parameter to be measured, the method of measurement, and the reaction plan in case of any out-of-control situations.

### Control Plan Form

<table>
<thead>
<tr>
<th>CONTROL PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Plan Number</td>
</tr>
<tr>
<td>FILE.XLS</td>
</tr>
</tbody>
</table>

### Part Number/Latest Change Level

- **Part Number**: ECL
- **Latest Change Level**: Core Team
- **Number**: 555-555-5555

### Part Name/Description

- **Name**: Organization/Plant Approval/Date
- **Description**: Customer Engineering Approval/Date (If Req'd.)

### Organization/Plant

- **Organization**: Organization/Plant Approval/Date
- **Code**: Customer Quality Approval/Date (If Req'd.)

### Part/Process Evaluation/Sample

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<thead>
<tr>
<th>CHARACTERISTICS</th>
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</thead>
<tbody>
<tr>
<td>NO.</td>
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</tr>
<tr>
<td>FREQ.</td>
</tr>
<tr>
<td>METHODS</td>
</tr>
</tbody>
</table>

### How is the characteristic or parameter going to be measured?

Examples include:
- Caliper
- Visual
- Fixture
- Test equipment

Note that for critical characteristics and ST dimensions, a gage R&R should be performed.
### The Control Plan Form

#### CONTROL PLAN

<table>
<thead>
<tr>
<th>Control Plan Number</th>
<th>Key Contact/Phone</th>
<th>Date (Orig.)</th>
<th>Date (Rev.)</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Part Number/Latest Change Level</th>
<th>Core Team</th>
<th>Customer Engineering Approval/Date (If Req’d.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER</td>
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<th>Other Approval/Date (If Req’d.)</th>
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<tr>
<td>ORGANIZATION</td>
<td>CODE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART/PROCESS NUMBER</th>
<th>PROCESS NAME/OPERATION DESCRIPTION</th>
<th>MACHINE, DEVICE JIG, TOOLS FOR MFG.</th>
<th>CHARACTERISTICS</th>
<th>SPECIAL CHAR. CLASS</th>
<th>PRODUCT/PROCESS SPECIFICATION/TOLERANCE</th>
<th>EVALUATION MEASUREMENT TECHNIQUE</th>
<th>SAMPLE</th>
<th>SIZE</th>
<th>FREQ.</th>
<th>METHODS</th>
<th>CONTROL METHOD</th>
<th>REACTION PLAN</th>
</tr>
</thead>
</table>

- **Prototype**
- **Pre-Launch**
- **Production**

**How many parts will be measured and how often.**

**Examples:**
- Final testing, visual criteria
  - **100%**
- SPC, Audit,
  - The sample size and frequency
# The Control Plan Form

## CONTROL PLAN

<table>
<thead>
<tr>
<th>FILE</th>
<th>XLS</th>
<th>Key Contact/Phone</th>
<th>Date (Orig.)</th>
<th>Date (Rev.)</th>
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<td>1/1/1996</td>
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<td>Other Approval/Date (If Req’d.)</td>
<td></td>
</tr>
</tbody>
</table>

### How the characteristic or parameter will be controlled (this is the record)

Examples include:
- Xbar/R Chart
- NP Chart
- Pre-control Chart
- Checklist
- Log sheet
- Mistake proofing
- 1st piece inspection
- Lab report
# The Control Plan Form

## Control Plan Form

### Prototype, Pre-Launch, Production

<table>
<thead>
<tr>
<th>Control Plan Number</th>
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</table>

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<thead>
<tr>
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<th>Core Team</th>
<th>Part Name/Description</th>
<th>Organization/Plant Approval/Date</th>
<th>Part Name/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER</td>
<td>ECL</td>
<td>NAME</td>
<td>Organization/Plant Approval/Date</td>
<td>NAME</td>
</tr>
</tbody>
</table>

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<tr>
<th>Organization/Plant ORGANIZATION</th>
<th>Organization Code CODE</th>
<th>Other Approval/Date (If Req'd.)</th>
<th>Other Approval/Date (If Req'd.)</th>
</tr>
</thead>
</table>

### Control Plan Form

- **What happens when the characteristic or parameter is found to be out of control.** Must include:
  - Segregation of nonconforming product
  - Correction method

**May include (as appropriate):**
- Sorting
- Rework/Repair
- Customer notification
Control Plans: Audit Plans

- 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.
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**

<table>
<thead>
<tr>
<th>Part / Process Number</th>
<th>Process Name / Operation Description</th>
<th>Machine, Device, Jig, Tools, for MFG.</th>
<th>Characteristics</th>
<th>Special Char. Class</th>
<th>No.</th>
<th>Product</th>
<th>Process</th>
<th>Control Method</th>
<th>Reaction Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Soldering Connections</td>
<td>Wave solder machine</td>
<td>Wave solder height</td>
<td>2.0 +/- .25 mc</td>
<td></td>
<td></td>
<td></td>
<td>Sensor continuity check</td>
<td>Automated inspection (error proofing)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Flux concentration</td>
<td>Standard #302B</td>
<td>1 pc</td>
<td>4 hours</td>
<td>x-MR chart</td>
<td>Test sampling lab environment</td>
<td>Segregate and retest</td>
</tr>
</tbody>
</table>
Control Plan Common Pitfalls

- One time document
  - Must be continuously reviewed and updated
    - What if the latest change or revision has a significant impact?
- Not consistent with Process Flow or PpFMEA
- Reaction Plan not specific enough the tell an operator or supervisor what to do
- Assumes singular or linear failure points
  - Star/ Planet Alignment Phenomenon
- Process Characteristics not identified
- Evaluation Measurement/ Detection tools not specifically identified
- Critical and/or Special Characteristics not identified
- Family based Control Plan not all inclusive
  - Not reviewed for specific/ custom application/ designs
Break Out Session. 30 minutes
Completing a Control Plan.
Create a Control Plan

“Lego” Control Plan

In your teams, using the PFC and PFMEA you just created, develop a Control Plan for your process to construct a Lego model.

For assembly process steps, invent your own specifications

For receiving inspection of Lego blocks, you may use the dimensions on this picture and a ±.01mm tolerance
Break

10 Minutes
Report Outs – 2 Teams 10 mins
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 but robust.
- 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
  - All rework loops
  - All Special Characteristics as independent line items
- The control method should be based on an effective analysis of the process
  - Such as SPC, Error Proofing, Inspection, Sampling Plan
  - Cannot be excessively dependent on visual inspection
- Control plans should reference other documentation
  - Specifications, tooling, etc.
Element 9: Measurement System Analysis Studies
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!!
MSA – Importance (Value Add)

- Ensures we are using the right measurement system for running production. There are two fundamental questions:
  1. Are we using the right gage?
  2. Are we using it correctly?

- Measurement variation can make our processes look worse than they really are with respect to capability.

Reduces the opportunity for passing a bad part & rejecting a good part
MSA – CPSD Specific Requirements

- CPSD requires an analysis of the capability of ALL measurement tools identified in the Control Plan required to assess special characteristic features

- Minimum requirement for CPSD suppliers are:
  - Gage R&R study using Total Tolerance on each measurement tool used to assess a special characteristic feature.
  - % R&R should be at 10% or less for any Special Characteristic.
  - Gage R&R results between 10% and 30% are considered marginal, meaning the supplier has to take or suggest action to improve.
  - Gage with R&R at 30% or more cannot be used on CPSD product.
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?

P is the True Process Variation.

E is the Measurement Error.
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

Measurement System Variation

Precision (Variability)

Resolution

Repeatability

Reproducibility

Accuracy (Central Location)

Linearity

Bias

Stability

Calibration addresses accuracy

Observed Variation

Process Variation
Observed Variation

Let’s take a closer look at Precision

Measurement System Variation

Precision (Variability)

Resolution
Repeatability
Reproducibility

Linearity
Bias
Stability

Observed Variation

Process Variation

Accuracy (Central Location)
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.
Discrimination

Discrimination is the technological ability of the measurement system to adequately differentiate between repeated measurements. Also thought of as “gauge resolution.”

Discrimination asks if the measurement units are adequate. It doesn’t necessarily mean more decimal places, it means BETTER MEASUREMENT SYSTEMS!
For Example
Discrimination Requirements

• Rule of Tens
  • Also called 10-to-1 Rule
  • Instrument discrimination should divide the tolerance (or process variation) into ten parts or more
  • Considered practical starting point for selection of gauges
Measurement System Analysis (MSA)

**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**
Measurement System Analysis (MSA)

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
Are there Bias Effects?

A measurement process is biased if differences exist in the average of the measurements made by different persons, machines, etc. when measuring the identical characteristic. The average of measurements are different by a fixed amount.
Accuracy

Accuracy is about calibration, and it is important to know if our measurement system also includes bias effects.

Bias Effects Include:

- **Operator Bias** – different operators get different averages for the same parts. *Note: We will be talking about “REPRODUCIBILITY” which is the capability of operators to get the same average measurements for the same parts in a short while.*

- **Machine Bias** – Different machines get different averages for the same parts

- **Other Biases** – Day-to-day, fixture-to-fixture, supplier-to-supplier, etc. differences in averages.
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
Repeatability and Reproducibility

Repeatability (Gage Precision)

➢ The variation in measurements obtained with one gage when used several times by an operator while measuring the identical characteristic on the same part.

➢ Referred to as **Equipment Variation** in a Gage R&R study.

Reproducibility (Operator Precision)

➢ The variation in the average of the measurements made by different operators using the same gage when measuring a characteristic on one part.

➢ Referred to as **Operator Variation** in a Gage R&R Study.
### Variable MSA – AIAG GR&R VAR(Tol)

#### Included in AIAG Core Tools

- Automatically calculates %GRR and %PV

#### Measurement Unit Analysis

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Gage Name</th>
<th>Appraiser A</th>
<th>Part Number</th>
<th>Gage Name</th>
<th>Appraiser A</th>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
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#### % Tolerance (Tol)

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<tr>
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<th>K_1</th>
<th>% EV</th>
<th>Tol</th>
<th>% AV</th>
<th>Tol</th>
<th>% GRR</th>
<th>Tol</th>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

#### Notes:

- For information on the theory and constants used in the form see MSA Reference Manual, Fourth edition.
- UCL_R represents the limit of individual Rs. 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.
Selecting Samples for the MSA.

- Samples should be pulled from the process that span the normal variation of the process
  - **Example:** If you produce a material with a mean thickness of 1.00mm and a sigma of 0.01mm, get samples that go from 0.98 - 1.02mm thick (95% of the range)

- **BE CAREFUL!**
  - If you produce different thickness’ of material with the same process, perform a separate R&R study for each group of thickness’
  - **Example:**
    - A process produces 1.00mm, 2.00mm, and 4.00mm materials all with a +/- 0.03mm tolerance, all measured with the same system
    - Perform 3 studies - one for each thickness
  - If you lumped the above samples together, the GR&R value will be artificially low
MSA Common Pitfalls

• One time document
  • Must be continuously reviewed and updated
    • Date of Record should be within past 12 months

• Tools shown not consistent PpFMEA or Control Plan
  • I.E.
    • Caliper shown in MSA, but measurement is overall outside dimension made with a ruler for 36 +/- .5"

• Sample use is not representative of PPAP parts
  • I.E.
    • Metal gage blocks used in MSA, but PPAP is for small plastic parts

• MSA is marginal, but no additional action plans are provided
• Supplier states “MSA are not required for attribute data”
• Critical and/or Special Characteristics not consistent with MSA tools
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

☑ Key gages & Inspection processes that are part of the manufacturing processes should also have a Gage R&R

☑ Make sure the study is recent - less than 1 year

☑ Compare the control plan gages against the Gage R&Rs

☑ Gage R&R results must follow the approval %
  - Gages > 30% cannot be used on CPSD product and
  - Must have a corrective action implemented if other methods or gages are not available

☑ If you question that gage, then ask questions
  - Question the technique and part sampling
  - Ask for additional studies
  - Request Bias, Linearity & Stability

☑ Make sure discrimination vs tolerance makes sense
  - Rule = 1 level MORE than tolerance (i.e., tolerance = .01, gage should measure to .001

☑ Does Study provide data on the %GRR, %EV, %AV
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
Element 10: Dimensional Results
### Dimensional Results

**What is It?**

Evidence that dimensional verifications have been completed and results indicate compliance with specified requirements.

**Objective or Purpose**

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

**When to Use It**

For each unique manufacturing process (e.g., cells or production lines and all molds, patterns, or dies)

---

**Table: Dimensional Data Sheet**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description of Check</th>
<th>Measurement Method</th>
<th>Target</th>
<th>Bonus Applied (Y/N)</th>
<th>Min</th>
<th>Max</th>
<th>Data Set Sample Number</th>
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</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Judgement Legend**

- **OK**: Meets Requirements
- **OK/I**: OK But Need Improvement
- **NS**: Does Not Meet Requirements
# Header Information

<table>
<thead>
<tr>
<th>Supplier Name:</th>
<th>Reason for Data Submission (check all that apply):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Name:</td>
<td>- Initial submission</td>
</tr>
<tr>
<td>Part Number:</td>
<td>- New/revised item, material or product component</td>
</tr>
<tr>
<td>Drawing Number:</td>
<td>- Correction of Non-conformance</td>
</tr>
<tr>
<td>Revision Level:</td>
<td>- New Supplier</td>
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<td>Revision Date:</td>
<td>- New/Revised drawing or other specification</td>
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<tr>
<td></td>
<td>- New or significantly modified process or routing</td>
</tr>
<tr>
<td></td>
<td>- Change to optional construction or material</td>
</tr>
<tr>
<td></td>
<td>- Change of location, sub-supplier or material</td>
</tr>
<tr>
<td>Tooling:</td>
<td>- Other - please specify</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplier Representative:</th>
<th>Supplier Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Supplier Signature</td>
</tr>
<tr>
<td>Title</td>
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</tr>
<tr>
<td>Phone Number</td>
<td></td>
</tr>
<tr>
<td>Email</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Supplier Code:</td>
</tr>
</tbody>
</table>

## Judgement Legend
- **OK**: Meets Requirements
- **OKNI**: OK But Needs Improvement
- **NG**: Does Not Meet Requirements

*Hover over the red triangles to get in form help*
Body of Form

<table>
<thead>
<tr>
<th>ITEM #</th>
<th>Required Cpk (Y/N)</th>
<th>Data Type: V=Variable A=Attribute</th>
<th>REQUIREMENT: Description of Check</th>
<th>Measurement Method</th>
<th>REQUIREMENT: Target</th>
<th>Bonus Applied (Y/N)</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
</table>

**Item#:** Corresponds to the item on the Bubbled print

**Required Cpk (Y/N):** Answer Yes/No. If the dimension/note has an elongated Octagon next to it on the print than it is a Statistically Toleranced dimension indicating capability is required to be shown.

**Data Type:** V = Variable means you can actually measure, A = Attribute which is an observed characteristic

**Requirement/Description of check.** This is the feature on the print being reported on. (Example: 2.35 +/- .01, Or part to be free of contamination)

**Measurement Method:** How did you measure the dimension or attribute, with what gage, (Example: Caliper, Functional Fixture XYZ, Visual, etc.)

**Requirement/Target:** This is the nominal dimension or value (Example: 2.35, Clean, Blue)

**Bonus Applied (Y/N):** Indicate Yes or No if in the case of a dimension described with GD&T that a bonus tolerance was included.

**Min:** Minimum acceptable value for the dimension based on print tolerance

**Max:** Maximum acceptable value for the dimension based on print tolerance
Body of Form

Data for Sample #: Record actual measured or observed results

Average: Record Average of the entered values, can add formula if desired.

Range: Max – Min = Range (Record one value here)

Judgment:

Supplier: If test results are mid range list them as OK, if they are at the top or bottom of the range lists them as OKNI, and if they are out of range lists them a NG. For any item listed as OKNI or NG please add comments or action plan in the last column. You may ask for deviation, increased allowance or recommend a tooling/process change to correct the issue.

ETN: CPSD indication if measurement is acceptable or not. If they determine the measurement to be acceptable even though it is presently not in range or does not show capability, they will add comments in the comments/action plan column.

Comments/Action Plan: The Action Plan specifies the Corrective Actions necessary to avoid producing nonconforming products or operating out of control. The actions should normally be the responsibility of the people closest to the process.
Dimensional Results - Requirements

- Must be submitted on CPSD specific form
- Required on all Levels of PPAP submissions except Level 1
- Must address all of the following:
  - All dimensions (including reference only)
  - All applicable notes
  - Any dimensions contained on referenced prints
  - Tolerances that include bonus for Geometric Dimensioning & Tolerancing (GDT)
- With GDT callouts, make sure each requirement is listed as a line item with tolerances:
  - Example:
    1. Hole Diameter 25 +/- 0.2
    2. True Position (MMC) Bonus 0.05
    3. Cylindricity 0.1

The dimensional report is evidence of conformance to print
### Dimensional Report – Showing Issues

<table>
<thead>
<tr>
<th>Item</th>
<th>Dimension/Specification</th>
<th>Specification / Limits</th>
<th>Test Date</th>
<th>Qty Tested</th>
<th>Organization Measurement Results (Date)</th>
<th>OK</th>
<th>NOK</th>
<th>OK</th>
<th>NOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>3) Insert</td>
<td>8.085 ± .015</td>
<td>8.080 : 8.095</td>
<td>10/17/08</td>
<td>30 pcs</td>
<td>0.0635 : 0.0640 : 0.0025 : 0.0075 : 0.0615 : 0.0635</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0640 : 0.0625 : 0.0055 : 0.0035 : 0.0620 : 0.0620</td>
<td></td>
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</tr>
<tr>
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<td></td>
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<td></td>
<td>0.0650 : 0.0655 : 0.0045 : 0.0065 : 0.0660 : 0.0625</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.0635 : 0.0645 : 0.0015 : 0.0065 : 0.0665 : 0.0625</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td>0.0625 : 0.0655 : 0.0070 : 0.0085 : 0.0640 : 0.0695</td>
<td></td>
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</tr>
</tbody>
</table>

*Customer should have been Contacted Prior to shipment*
Dimensional Results

Reviewer’s Checklist

✓ Ensure “Method” is on every measurement, and it makes sense for the dimension
✓ Critical and non-critical data points must be taken from the same 30-piece sample*
✓ The agreed upon # of parts from the production run must be shipped to Eaton for verification of form, fit, and function
✓ The same parts will be used to verify both critical and non-critical dimensions
✓ Supplier must clearly identify which of the 30 parts are being shipped
✓ Supplier should make every effort to ship parts that represent the normal process variation
✓ Capability must be greater than 1.67 for critical dimensions and greater than 1.33 for non-critical dimensions
✓ Make sure you agree and question the dispositions
✓ Make sure the dimensional report addresses all print requirements

* Samples need to be consistent with expected volumes and costs.
Element 11: Material, Performance Test Results
CPSD Specifics – Material, Performance Test Results

- Broad category for the majority of all test results
  - Material testing (ex. Material Composition Reports)
  - Performance testing (ex. EOL and offline final test results)
  - Life test results (ex. Summary of all life cycle testing performed on the part)

- CPSD requires results for all print requirements that require testing
  - “Notes” that specify a requirement (ex. Tensile Strength, Plating thickness)
  - “Specifications” detailed on a print (ex. NEMA, CSA or UL specs)

- CPSD requires the following for all submissions:
  - Material confirmation in the form of lab data
  - Preferred is COA Certificate of Analysis
  - Performance testing (evidence of how the product performs, ie. Fit test)
CPSD Specifics – Material, Performance Test Results

Eaton Engineering or Supplier Quality will communicate specific material, performance, and testing requirements either through the part print, reference specification or by specific request prior to PPAP approval. **It is the responsibility of the supplier to confirm the data and format for this requirement with their Eaton Supplier Quality representative.**
Records of Material/Performance Test Results

**Material Test Results**

- The supplier shall perform tests for all parts and product materials when *chemical, physical, or metallurgical* requirements are specified by the design record or Control Plan.
  - For products with Eaton-developed material specifications and/or an Eaton-approved supplier list, the supplier shall procure materials and/or services from suppliers on that list.

**Performance Test Results**

- The supplier shall perform tests for all parts or product materials when *performance or functional* requirements are specified by the design record or Control Plan.
Material Results

Material results shall include:

- The name of the laboratory that conducted the test
- The type of test that was conducted
- The number, date, and specification to which the part was tested
- The actual test results

Production Part Approval Material Test Results

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>ORGANIZATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLIER / VENDOR CODE</td>
<td>CODE</td>
</tr>
<tr>
<td>MATERIAL SUPPLIER</td>
<td>*CUSTOMER SPECIFIED SUPPLIER / VENDOR CODE</td>
</tr>
</tbody>
</table>

| PART NUMBER | NUMBER |
| PART NAME | NAME |

| DESIGN RECORD CHANGE LEVEL | ECL |
| ENGINEERING CHANGE DOCUMENTS | |

| MATERIAL SPEC. NO. / REV / DATE | SPECIFICATION / LIMITS | TEST DATE |
| QTY. TESTED | SUPPLIER TEST RESULTS (DATA) | OK | NOT OK |

Material results shall include:

- The name of the laboratory that conducted the test
- The type of test that was conducted
- The number, date, and specification to which the part was tested
- The actual test results

Blanket statements of conformance are unacceptable for any test results.

| SIGNATURE | TITLE | DATE |

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**Performance Test Results**

Performance Test Results shall include:

- The name of the laboratory that conducted the test
- The type of test that was conducted
- A description of the test
- The parameters tested
- The actual test results

Blanket statements of conformance are unacceptable for any test results.

<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>ORGANIZATION</th>
<th>SUPPLIER / VENDOR CODE</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART NUMBER</td>
<td>NUMBER NAME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESIGN RECORD</td>
<td>CHANGE LEVEL</td>
<td>ECL ENGINEERING CHANGE DOCUMENTS</td>
<td></td>
</tr>
</tbody>
</table>

- NAME of LABORATORY:  
* If source approval is req’d, include the Supplier (Source) & Customer assigned code.

<table>
<thead>
<tr>
<th>TEST SPECIFICATION / REV / DATE</th>
<th>SPECIFICATION / LIMITS</th>
<th>TEST DATE</th>
<th>QTY. TESTED</th>
<th>SUPPLIER TEST RESULTS (DATA) / TEST CONDITIONS</th>
<th>OK</th>
<th>NOT OK</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

**Signature**

**Title**

**Date**

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Material, Performance Test Results

Reviewer’s Checklist

✓ Performance should include confirming:
  - Any formal specification referenced
  - Any formal life testing
  - Any specific functional test

✓ Sometimes performance is not directly addressed via the part print but it may be:
  - Referenced through a specification
  - Referenced through a Note
  - Implied through a requirement

✓ The resource for performance and functionality is CPSD design engineering

✓ Always ask about the need to demonstrate performance if it is not listed on the print

✓ Utilize this section to get more information that could become a significant quality issue at a later date

✓ Most parts have some type of material requirement so make sure the supplier has a system for checking

✓ Material results should be compared against a known standard. Do not assume the test spec is correct
  - Verify the correct specification (ex ASTM D2000 Rev 2015)
  - Verify the composition breakdown

✓ Verifying composition is NOT just for PPAP, it should be a periodic check that is identified in the Control Plan
Element 12: Initial Process Study (Cpk/Ppk)
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
    o (2 each hr/line)
  • 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.
The normal distribution is the voice of the process—it’s how the process behaves.
The goal posts are the voice of the customer. They’re our spec limits.
Process Capability Ratios
“Merge the Voices”
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.)
### One-Sided Capability Ratios

<table>
<thead>
<tr>
<th>Formula</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C_{PU} )</td>
<td>[ \frac{USL - \bar{X}}{3\sigma} ]</td>
</tr>
<tr>
<td>( C_{PL} )</td>
<td>[ \frac{\bar{X} - LSL}{3\sigma} ]</td>
</tr>
</tbody>
</table>

- If a process has just one spec (either USL or LSL), a one-sided capability ratio (\( C_{PU} \) or \( C_{PL} \)) is calculated. It takes into account process spread and location.

- Typical Values (when the “shift” is taken into consideration):
  - **Marginal**, \( C_{PU} \) or \( C_{PL} \) = 1
  - **Good**, \( C_{PU} \) or \( C_{PL} \) = 1.33
  - **Six Sigma**, \( C_{PU} \) or \( C_{PL} \) = 1.5
Capability versus Performance

- **Capability Ratios** (\(C_P\) and \(C_{PK}\))
  - use a *short-term* estimate of sigma (\(\sigma\)) 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 (\(\sigma\)) 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
Cpk & Ppk guidelines

Index < 1.33
- Does not meet acceptance criteria
- Critical Questions…
  - Data Review
  - Measurement Validation
  - Specification adjustment
- Corrective Action and resubmission required unless otherwise waived in writing by Eaton
- 100% Inspection required until approved Cpk > 1.33 is achieved
- Should be captured on Control Plan

1.33 ≤ Index ≤ 1.67
- Maybe acceptable
- Careful consideration for data and potential future risk
  - IE a molded part dimension measures at the bottom of spec limit.
- Critical questions…
  - Will the tool wear based on EOI?
  - If so, will the dimension move toward nominal or out of spec?
  - What are the tolerance stack up implications
- Annual Re-validation

Index > 1.67
- Process is Capable and currently meets the acceptance criteria
- Critical Questions…
  - Future monitoring
  - Annual Re-validation
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.

- Can the supplier set warning tolerances and track changes – to give a pre-emptive warning
Steps for Determining Process Capability

1. Decide on the product or process characteristic to be assessed
2. Verify the specification limits
3. Validate the measurement system
4. Collect data
5. Assess data characteristics
6. Assess process stability
7. Calculate process capability
Step 1: Which Characteristic

Decide on the product or process characteristic to be assessed.

- **Required for all special characteristics coded STD**
- **EATON reserves the right to require demonstration of initial process capability on other characteristics**
Step 2: Specification Limits

Verify the specification limits by reviewing the released engineering drawing.

Why is validation of the specification limits important?

• Documents on the production floor may not reflect the current design record
• They may be based on previous designs and no longer be valid
• May contain “guard banding” as a result of past problems or measurement error
Step 3: Measurement System

Validate the measurement system through the appropriate MSA

Why is validation of the Measurement System important?

- If there is significant error in your measurement system, then decisions are influenced by the error not just the measurements themselves.
Step 4: Data Collection

When collecting data, consider the following:

- **Short term data**
  - Free of special causes
  - Collected across a narrow inference space
    i.e. one shift, one machine, one operator, etc..

- **Long term data**
  - Subjected to the effects of both random and special cause variation
  - Collected across a broad inference space
    i.e. multiple shifts, machines, operators, etc.
Step 4: Data Collection

When collecting data, consider the following:

- **Rational sub-grouping**
  - A group of units produced under the same set of conditions
  - Mean to represent a “snapshot” of the process
  - Must be taken close together in time, but still be independent of each other
  - Use subgroups to separate the 2 types of variation in a process:
    - **Within subgroup:** The variation among measurements within subgroups; also known as common cause variation
    - **Between subgroup:** variation between subgroups that may be caused by specific identifiable factors, or special causes
  - To improve process quality, every effort should be made to eliminate between subgroup variation and reduce within subgroup variation

Example:
A machine produces 100 plastic parts per hour. The quality engineer measures 5 randomly selected parts at the beginning of every hour. Each sample of 5 parts is a subgroup.
Step 5: Data Characteristics

Assess data characteristics

Examine the shape of your data.

- Is it what you would expect?
  If not, investigate.

The shape of your data is important for determining which type of Capability Analysis applies.
Step 6: Process Stability

Assess process stability in order to understand how your process behaves over time. Control charts are the recommended tool.

Control Chart Examples

Process is stable and in control
Process is not stable and therefore not in control

Capability is only valid when the process being studied is stable!
Step 7: Process Capability

Calculate the appropriate statistical metrics in order to determine how the “Voice of the Process” compares to the “Voice of the Customer.”

Capability Metrics: PPM, DPMO, Cp, Cpk, Pp, & Ppk; Sigma Levels (Z Scores)

If you were driving a truck, and the dotted lines were the construction barriers, what would be happening in each situation?
Focus on Variable Data

• The initial process study should be focused on variable, not attribute data.
• Assembly errors, test failures, and surface defects are examples of attribute data, which is important to understand, but is not covered in this initial study.
• To understand the performance of characteristics monitored by attribute data will require more data collected over time.
• Unless approved by an authorized Eaton representative, attribute data are not acceptable for PPAP submission.
## Capability Indices

<table>
<thead>
<tr>
<th>Capability Index</th>
<th>Formula</th>
<th>What it shows</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cp</strong></td>
<td>( \frac{(USL - LSL)}{6 \times s_{\text{short-term}}} )</td>
<td>Relates short term (within subgroup) standard deviation to tolerance. Sometimes called “Entitlement,” meaning it is the best the current process can do, if centered.</td>
</tr>
<tr>
<td><strong>Cpk</strong></td>
<td>( \frac{\min{(USL - \bar{X}), (\bar{X} - LSL)}}{3 \times s_{\text{short-term}}} )</td>
<td>Relates short term mean &amp; short term (within subgroup) standard deviation to tolerance. Only tells you about the nearest spec limit; doesn’t tell anything about the other side.</td>
</tr>
<tr>
<td><strong>Pp</strong></td>
<td>( \frac{(USL - LSL)}{6 \times s_{\text{long-term}}} )</td>
<td>Relates long term (overall) standard deviation to tolerance.</td>
</tr>
<tr>
<td><strong>Pk</strong></td>
<td>( \frac{\min{(USL - \bar{X}), (\bar{X} - LSL)}}{3 \times s_{\text{long-term}}} )</td>
<td>Relates mean &amp; long term (overall) standard deviation to tolerance. Only tells you about the nearest spec limit; doesn’t tell anything about the other side.</td>
</tr>
</tbody>
</table>

*Cp/Cpk are used to estimate potential process capability. Pp/Ppk are used to measure actual process performance.*
Difference between Cp & Cpk

- **Cp** – determines capability of producing to specification
- **Cpk** – same as Cp, but also measures how centered the process is
- It is important to look at both!

<table>
<thead>
<tr>
<th>Cp</th>
<th>Cpk</th>
<th>LSL</th>
<th>USL</th>
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</thead>
<tbody>
<tr>
<td>&gt;= 1.67</td>
<td>&gt;= 1.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capable, Centered</td>
<td>Capable, Not Centered</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cp</th>
<th>Cpk</th>
<th>LSL</th>
<th>USL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.00</td>
<td>&lt; 1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Capable, Centered</td>
<td>Not Capable, Not Centered</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Acceptance Criteria

### Acceptance criteria for critical vs. non-critical characteristics

<table>
<thead>
<tr>
<th></th>
<th>Critical</th>
<th>Non-Critical</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red (Bad)</strong></td>
<td>&lt;1.33</td>
<td>&lt;1.00</td>
<td>Red (Bad)</td>
</tr>
<tr>
<td><strong>Yellow (Marginal)</strong></td>
<td>1.33-1.67</td>
<td>1.00-1.33</td>
<td>Yellow (Marginal)</td>
</tr>
<tr>
<td><strong>Green (Good)</strong></td>
<td>&gt;1.67</td>
<td>&gt;1.33</td>
<td>Green (Good)</td>
</tr>
</tbody>
</table>

**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.**
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

✓ Capability is preferred as follows unless otherwise defined:
  - 1.67 or higher for all print ST special characteristics
  - 1.33 or higher for items as requested by Eaton

✓ Capability template is in the AIAG Core Tools
Element 13: Qualified Lab Documentation
Qualified Laboratory Documentation

• Inspection and testing for PPAP shall be performed by a qualified laboratory as defined by EATON requirements (e.g., an accredited laboratory).

• The qualified laboratory (internal or external to the supplier) shall have a laboratory scope and documentation showing that the laboratory is qualified for the type of measurements or tests conducted

  ➢ When an external laboratory is used, the supplier shall submit the test results on the laboratory letterhead or the normal laboratory report format
  ➢ The name of the laboratory that performed the tests, the date(s) of the tests, and the standards used to run the tests shall be identified.
  ➢ Proof of accreditation (A2L, ISO17025, etc.)
Qualified Laboratory Documentation

➢ Recommendation for performing testing or measurement (INTERNAL)
   ❑ Record/Scope that identifies the testing to be done and it must include
     ✓ List of your personnel’s competency and training to perform the testing
     ✓ List of all test equipment used in process and offline
     ✓ List of all methods and standards used to calibrate the equipment

➢ If you are sending out for measurement and testing (EXTERNAL)
   ❑ Provide a copy of the lab company’s THIRD PARTY accreditation
   ❑ Results must be on company letterhead and include:
     ✓ The name of the Lab
     ✓ Date of testing
     ✓ Standards used for testing are identified
Qualified Lab Documentation

Reviewer’s Checklist

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

☑ If any testing is performed to measure or monitor part quality the test organization must have:
  ❑ Lab scope
  ❑ Evidence of Calibration (in-process)

☑ Accreditation: Minimum third party accreditation by:
  ❑ Either ISO17025 or A2LA, or Government Agency
  ❑ Note: Some CPSD parts also required product certification through UL or CSA as an example

☑ Lab Scope: Make sure internal labs have a “system” defining what can be measured, method, training etc.
Element 14: Appearance Approval Report
## Appearance Approval Report

### What is It?
- A report completed by the supplier containing appearance and color criteria

### Objective or Purpose
- To demonstrate that the part has met the appearance requirements on the design record

### When to Use It
- Prior to tooling for production

### IMPORTANT!
Typically only applies for parts with color, grain, or surface appearance requirements. The use of limit samples is required to help distinguish acceptable vs unacceptable parts.
### Appearance Approval Report

**Administrative Section**

Identifies part number and description, supplier, required approval signatures, and dates.
Appearance Approval Report

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DRAWING NUMBER</th>
<th>APPLICATION (VEHICLES)</th>
<th>APPEARANCE EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART NAME</td>
<td>NAME</td>
<td>BUYER CODE</td>
<td>E/C LEVEL</td>
</tr>
<tr>
<td>ORGANIZATION</td>
<td>MANUFACTURING</td>
<td>ADDRESS</td>
<td>SUPPLIER / VENDOR CODE</td>
</tr>
<tr>
<td>NAME</td>
<td>LOCATION</td>
<td>CITY STATE ZIP CODE</td>
<td>CODE</td>
</tr>
<tr>
<td>REASON FOR</td>
<td>SUBMISSION</td>
<td>PRE TEXTURE</td>
<td>FIRST PRODUCTION SHIPMENT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ENGINEERING CHANGE</td>
</tr>
</tbody>
</table>

**APPEARANCE EVALUATION**

<table>
<thead>
<tr>
<th>ORGANIZATION SOURCING AND TEXTURE INFORMATION</th>
<th>PRE-TEXTURE EVALUATION</th>
<th>AUTHORIZE CUSTOMER REPRESENTATIVE SIGNATURE AND DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CORRECT AND PROCEED</td>
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<tr>
<td></td>
<td>CORRECT AND PROCEED</td>
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<tr>
<td></td>
<td>APPROVED TO ETA/TOOL/EDM</td>
<td></td>
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</tbody>
</table>

**COLOR EVALUATION**

<table>
<thead>
<tr>
<th>COLOR</th>
<th>TRISTIMULUS DATA</th>
<th>MASTER MATERIAL</th>
<th>MASTER MATERIAL</th>
<th>HUE VALUE</th>
<th>CHROMA GLOSS</th>
<th>BRILLIANCE</th>
<th>SHIPPING PART</th>
<th>PART SOURCE</th>
<th>TYPE</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUFFIX DL* Da* Db* DE* CMC NUMBER DATE TYPE</td>
<td>COLOR</td>
<td>MATERIAL</td>
<td>HUE</td>
<td>VALUE</td>
<td>CHROMA</td>
<td>GLOSS</td>
<td>BRILLIANCE</td>
<td>SHIPPING PART</td>
<td>PART SOURCE</td>
<td>TYPE</td>
</tr>
</tbody>
</table>

Appearance Evaluation Details

Identifies supplier sourcing, texture information and submission customer signature.
### Appearance Approval Report

#### Color Evaluation

<table>
<thead>
<tr>
<th>COLOR SUFFIX</th>
<th>TRISTIMULUS DATA</th>
<th>MASTER NUMBER</th>
<th>MASTER DATE</th>
<th>MATERIAL TYPE</th>
<th>MATERIAL SOURCE</th>
<th>HUE RED</th>
<th>YEL</th>
<th>GRN</th>
<th>BLU LIGHT</th>
<th>DARK</th>
<th>GRAY CLEAN</th>
<th>HIGH</th>
<th>LOW</th>
<th>HIGH</th>
<th>LOW</th>
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#### Comments

- ORGANIZATION SIGNATURE
- PHONE NO.
- DATE
- AUTHORIZED CUSTOMER SIGNATURE
- DATE

### Color Evaluation Details

Identifies supplier part color dimensions, use of color spectrometer or RAL charts to determine finish information. Comments and Sign off.
Qualified Lab Documentation

Reviewer’s Checklist

✔ If no specification or print references exits, the reviewer should use requirement for more “print” definition.
  - Appearance Approval Report
  - Specific testing to a known standard
  - Defining limit samples

✔ Force Actual sign-off of the appearance approval report

✔ When receiving a submission, only accept this requirement if it is clearly defined on the print or supporting engineering documentation.

✔ This requirement should always be in reference to a designated specification such as:
  - Color (ex. ANSI 70 Gray)
  - Texture (ex. surface finish )
Element 15: Sample Product
Sample Production 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
Sample Production Parts

- The sample parts provided should be the same parts measured for the dimensional results.
- PPAP Requestor should consult with Engineering, Manufacturing and Quality to determine the number of samples required. The default quantity for all submissions is **3 parts** unless otherwise requested.
- Verify the MOLDED/STAMPED part quantities required with each submission.
  - 3 parts for every single cavity mold
  - 1 part per cavity on multi-cavity molds

Sample parts must reflect both the submission and actual production.
Sample Production Parts

- Sample production parts **MUST** be properly identified
  - Include the following information on the part label:
    - Date of manufacture
    - Eaton part number
    - Revision level
    - Supplier Name
    - Quantity
    - Serial number (if applicable)
    - Supplier part number (optional)
    - Country of origin
    - Indication of RoHS compliance
    - Approval markings (UL, CE, etc.) where applicable
Sample Parts

Reviewer’s Checklist

- Sample Parts should be received with every PPAP submission and examined thoroughly
- Reviewer needs to determine if any value-added analysis can be gained using the Sample Parts:
  - Get additional dimensional data
  - Feedback and questions from engineering
  - Perform additional testing
  - Functional Analysis
  - Fit Analysis
- Sample parts must be properly tagged, if NOT REJECT!!
Element 16: Master Sample
Master Sample

What is It?
Actual part that represents production quality at time of PPAP submission

Objective or Purpose
To retain in archive throughout a products production life for all revisions, for historical verification in case of nonconformance

When to Use It
When requested by the customer
Master Sample

- CPSD does not require Master Part retention except when:
  - A Level 5 PPAP is requested
    - Typically a high risk part
    - The criticality of the product warranted on-site review
    - The master part will be used as a GO-BY for future manufacturing

- If Master Samples have been required, then maintenance shall be done as follows:
  - 1 Master part for every part number at the most recent revision level by cavity, die, tool or process
  - Must be maintained for the life of the product unless otherwise authorized by CPSD SQE.

Master samples aid in referencing revision differences
Master Sample

Reviewer’s Checklist

✓ If Master Samples are required, ensure the supplier has a system for properly maintaining and periodically reviewing.

☐ Certain materials may deteriorate over time depending on storage conditions (ie. Rust, harden, discolor, warp

☐ Ensure the supplier has contingency plans established to protect samples from loss
Element 17: Checking Aids
Checking Aids

What is It?
Any tools, gauges, etc. used by the supplier to indicate acceptance/ rejection of any assembly or component.

Objective or Purpose
To provide evidence that the devices used to verify product compliance exist and have been properly validated.

When to Use It
As required by Control Plan or Design Print
Checking Aids

➢ There are many different types of checking aids including but not limited to:
  - Certified check fixtures
  - Un-certified check fixtures
  - Templates
  - Custom Gages
  - In-house developed test stands (ex. Leak test)
  - Electrical Testers

➢ CPSD requires the following for all checking Aids
  - Copy of a controlled print that documents the design of the checking aid
  - If the aid confirms FORM or FIT then there should be a third party certification
  - Evidence that the checking aid has been validated and verified (MSA complete)
  - Evidence of a PM plan for tool or device

Checking aids MUST BE VALIDATED!!!!
Checking Aids

Reviewer’s Checklist

- If a fixture is used to check physical print dimensions either in process or offline then it is a checking aid.

- Checking aids must be documented through a print and submitted with PPAP, inclusive of such items as:
  - Check Fixtures
  - Templates
  - Functional fixtures (assembly fixtures) that confirm fit

- Checking aids must have evidence of:
  - Conformance to a provided print
  - Repeatability
  - GRR
  - Preventive Maintenance plan
Element 18: Customer Specific Requirements
CPSD Customer Specific Requirements

**Purpose:** To provide a placeholder for all customer specific requirements that are not covered in the first 17 elements of PPAP.

- Typically all customers use this section differently
- CPSD has **5** specific requirements defined for PPAP submissions
  - Tooling Information Form
  - Packaging Form
  - Inspection Plan (Asian suppliers only)
  - Specification Deviation Form
  - Supplier PPAP Checklist
Eaton Customer Specific Requirements

Supplier shall provide evidence of compliance to all customer specific requirements

- EHS requirements
- Third Party Certification (ISO 9001 or higher)
- WISPER registration
- Code of Ethics
- Supplier Excellence Manual
Purpose: to document important information on all CPSD owned tools.

Applies: Only to CPSD owned tools and is mandatory!

➢ Tooling information form document critical information includeing:
  - New or modified tooling
  - Cost information
  - Dimensional information
  - Capacity information
  - Life Expectancy
  - Location of the tool
# Tooling Information Form

<table>
<thead>
<tr>
<th>Supplier Name</th>
<th>PPAP Submission Level</th>
<th>Affected Feature Number(s)</th>
<th>Part Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>PPAP Due Date</th>
<th>Part Number</th>
<th>Tool Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Facility</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date of Tooling Change</th>
<th>Part Name</th>
<th>Machine</th>
<th>Station</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

- [ ] 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.

<table>
<thead>
<tr>
<th>TOOLING ACTION ITEMS</th>
<th>Who</th>
<th>What</th>
<th>When</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooling Images</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagram or Strip Layout</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool Drawings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool Cost Breakdown</td>
<td></td>
<td></td>
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<tr>
<td>Design Cost</td>
<td></td>
<td></td>
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<tr>
<td>Material Cost</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Labor Cost</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Tool Description</td>
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<tr>
<td>Tool Dimensions</td>
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<tr>
<td>Height</td>
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<td>Daylight Opening</td>
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<tr>
<td>Weight</td>
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<td>Press Size</td>
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<td>Tool Material</td>
<td></td>
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<td></td>
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<tr>
<td>Tool Capacity</td>
<td></td>
<td></td>
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<tr>
<td>Hourly</td>
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<td>Daily</td>
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</tr>
<tr>
<td>Annual</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life Expectancy</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Comments
Tooling Information Form

<table>
<thead>
<tr>
<th>Fig. 1</th>
<th>Top View</th>
<th>Fig. 2</th>
<th>Bottom View</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fig. 3</th>
<th>Left View</th>
<th>Fig. 4</th>
<th>Right View</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Fig. 5</th>
<th>Front View</th>
<th>Fig. 6</th>
<th>Back View</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image9.png" alt="Image" /></td>
<td><img src="image10.png" alt="Image" /></td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fig. 7</th>
<th>Tool Tag View</th>
<th>Fig. 8</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image13.png" alt="Image" /></td>
<td><img src="image14.png" alt="Image" /></td>
<td><img src="image15.png" alt="Image" /></td>
<td><img src="image16.png" alt="Image" /></td>
</tr>
</tbody>
</table>
Tooling Information Form

Reviewer’s Checklist

✅ Ensure that tooling form is completely filled out
✅ Ensure that all required images of the tool have been provided and are clear
✅ For any requirement that is not applied, the supplier must clearly mark as N/A and comment as to why it is N/A

If CPSD has not provided asset tags or direction on how to mark the tooling contact with your SQE or CPSD commodity manager for direction.

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CPSD Element 18B Packaging Form

**Purpose:** to document the packaging method and material for supplied product prior to first production shipments.

**Applies:** to all CPSD parts

- Suppliers are required to provide packaging to CPSD facilities that:
  - Meet all facility related requirements
  - Prevents shipping and handling defects once it leaves the supplier’s dock
  - Addresses any Hazmat related concern
  - Complies with all Governmental, import/export or labeling requirements

- Packaging information form must be completely filled out and documents:
  - Weight and dimensions of the finished part packaging
  - Pictures of the part, part container, dunnage and packing material
  - The final packaged product load delivered to CPSD with correct labeling

CPSD requires verification of internal and external packaging
## Packaging Form – Production Package

<table>
<thead>
<tr>
<th>Date</th>
<th>Packaging Contact</th>
<th>Part Number</th>
<th>Supplier Responsibilities Completed?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>☐ Packaging Design</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>☐ Packaging that prevents shipping and material handling defects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>☐ Electronic storage of submitted Packaging Data Form</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplier Name</th>
<th>Phone Number</th>
<th>Print Revision Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplier Code</th>
<th>Fax Number</th>
<th>Part Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplier Production Facility</th>
<th>E-Mail Address</th>
<th>HAZMAT?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>☐ Yes ○ No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>In Packaging Position</th>
<th>Container</th>
<th>With Label Shown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DIGITAL IMAGES

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# Packaging Form – Production Package

<table>
<thead>
<tr>
<th>Component</th>
<th>L (mm)</th>
<th>W (mm)</th>
<th>H (mm)</th>
<th>Component</th>
<th>Wt (kg)</th>
<th>Quantities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Size</td>
<td></td>
<td></td>
<td></td>
<td>Part</td>
<td></td>
<td>Qty Parts per Container</td>
</tr>
<tr>
<td>Container Only</td>
<td></td>
<td></td>
<td></td>
<td>Dunnage (Tare)</td>
<td>Container(s) per Layer on Pallet</td>
<td></td>
</tr>
<tr>
<td>Pallet Only</td>
<td></td>
<td></td>
<td></td>
<td>Container (Tare)</td>
<td>Later per Pallet</td>
<td></td>
</tr>
<tr>
<td>Unit Load As Shipped</td>
<td></td>
<td></td>
<td></td>
<td>Pallet (Tare)</td>
<td>Container(s) per Pallet</td>
<td></td>
</tr>
<tr>
<td>In to MM</td>
<td></td>
<td>Lbs to Kg</td>
<td></td>
<td></td>
<td>Container Gross (Inc Parts)</td>
<td>Stacking Rule</td>
</tr>
<tr>
<td>Unit Load Gross (Inc Parts)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## DIGITAL IMAGES

<table>
<thead>
<tr>
<th>Dunnage</th>
<th>In Container Position</th>
<th>Unit Load</th>
<th>As Shipped With Label Shown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## PACKAGING MATERIALS

<table>
<thead>
<tr>
<th>Description</th>
<th>Manufacturer</th>
<th>Material</th>
<th>Lead Time</th>
<th>RET/EXP</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunnage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Container Color</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Container Type</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Cover/Top Cap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pallet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stretch/Shrink Film</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Banding</td>
<td></td>
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</tr>
<tr>
<td>Other</td>
<td></td>
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</tr>
</tbody>
</table>

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Note: It is the supplier’s responsibility to ensure that products are delivered safely and free from contamination.
Packaging and Label Example - Production

Custom format economy finish boxes

Brown corrugated boxes are the standard for large heavy-duty boxes and shipping transport boxes.

Light gray boxes provide a lower-cost solution.

Generic format

See pages 14–15 for more information on the repeat pattern of the Eaton Brand Signature.

Repeat pattern sheets should be used for pallet covers.

Plain OEM boxes

See page 16 for more information on OEM boxes.
Packaging and Label Example - Production

Small carton label; between <2” and >3” (<51mm and >76mm) wide

Medium carton label; between 3” and 6” (76mm and 152mm) wide

Eaton Brand Signature shown printed one-color in black.

Large carton label; between >6” and 12” (>152mm and 305mm) wide
## Appendix C Special Shipment Tag Guidance Document

### Special Shipment Identification Tag

#### When to use

<table>
<thead>
<tr>
<th>When to use</th>
<th>Special Shipment Identification Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Production Components</td>
<td></td>
</tr>
<tr>
<td>PPAP Samples</td>
<td></td>
</tr>
<tr>
<td>Pilot/First Article Samples</td>
<td></td>
</tr>
<tr>
<td>1(^{st}) Shipment of Approved Material</td>
<td></td>
</tr>
<tr>
<td>Concept/Deviated Production Components</td>
<td></td>
</tr>
<tr>
<td>Engineering Samples</td>
<td></td>
</tr>
<tr>
<td>SCR (Supplier Change Request) Samples</td>
<td></td>
</tr>
<tr>
<td>Temporary Deviation</td>
<td></td>
</tr>
<tr>
<td>Certified Shipment</td>
<td></td>
</tr>
<tr>
<td>Production Components shipped as part of Corrective Action</td>
<td></td>
</tr>
</tbody>
</table>
Packaging Information Form

Reviewer’s Checklist

☑ Ensure that packaging form is completely filled out
☑ Ensure that all required images of the package have been provided and are clear
☑ Look for evidence that the supplier validated the packaging to protect the parts contained within from deterioration or damage

It is the supplier’s responsibility to VALIDATE packaging, Eaton has a packaging guidance document to help prepare compliant packaging.
CPSD Element 18C Inspection Plan (Asia Only)

**Purpose:** to apply extra rigor for parts being imported, and support the complete understanding of CPSD requirements in areas where English is not the primary language.

**Applies:** to all CPSD parts

- Suppliers are required to provide their in-process inspection plans for review and acceptance during the PPAP phase, including details of:
  - Item # - corresponds to print item #
  - Inspection criteria
  - Special Characteristics
  - Gage/Equipment
  - Sample Size
  - AQL (Acc, Rej)
  - Record (SPC chart, work instruction, etc)
  - Determination (Acc/Rej)

- Inspector Name/Date

IQC is an extension of Control Plan methodology!!
# Inspection Report – ASIA only

## CPSD Inspection Report

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Insp. Items</th>
<th>Char. Class</th>
<th>Gage/Tool</th>
<th>Sample Size (pcs)</th>
<th>AQL (Acc. Rej)</th>
<th>Record</th>
<th>Acceptance (Acc/Rej)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**Inspection Results:**

**Supplier:**

**CPSD Delegate Inspector:**

<table>
<thead>
<tr>
<th>Product No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part No.</td>
<td></td>
</tr>
<tr>
<td>Inspection Plan No.</td>
<td></td>
</tr>
<tr>
<td>Inspection Plan Revision</td>
<td></td>
</tr>
<tr>
<td>Drawing Revision</td>
<td></td>
</tr>
<tr>
<td>Lot Size</td>
<td></td>
</tr>
</tbody>
</table>

**Sampling Standard:**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Insp. Items</th>
<th>Char. Class</th>
<th>Gage/Tool</th>
<th>Sample Size (pcs)</th>
<th>AQL (Acc. Rej)</th>
<th>Record</th>
<th>Acceptance (Acc/Rej)</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**Inspector:**

**Date:**

**CPSD SQE Review (if needed):**

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ASIA only – Inspection Plan

Reviewer’s Checklist

✓ Ensure that all in process inspection steps have been included
✓ Ensure that any Special Characteristic items have individual inspection plans identified
✓ Take note of the gage/equipment and make sure it has a corresponding MSA if required.
✓ Make sure both the Plan and Report are provided at the time of PPAP
CPSD Element 18d Specification Deviation Form

**Purpose:** To request deviation on any requirement that is non-conforming and requires review by CPSD to provide for approval of the PPAP submission.

- Use to document specific non-conformances that could require exception
- Defines difference between actual and observed results
- Must recommend a specific deviation and requires an interim action plan
- Specification deviation will by default **only** allow for Interim approval
- Specification deviations are not to be used for any purpose other than PPAP non-conformances and do not replace “temporary deviation requests”.

**Used for documenting permission to use non-conforming product!**
# Specification Deviation Form

![Specification Deviation Form](image)

## Interim Action Status

- **Effect on Cost, Quality and/or Delivery**
  - **Choose One**
  - **Due Date**

## Corrective Action(s)

<table>
<thead>
<tr>
<th>#</th>
<th>Action Item</th>
<th>Responsible Party</th>
<th>Due Date</th>
<th>Status</th>
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## Approval Signatures

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<thead>
<tr>
<th></th>
<th>Route To</th>
<th>Approve</th>
<th>Reject</th>
<th>Signature</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>Manufacturing Engineer</td>
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<td>Quality</td>
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**Engineering or Quality Final Disposition**

☐ Approve ☐ Reject

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Specification Deviation Form

Reviewer’s Checklist

- Ensure the specification deviation is being applied to document items within the PPAP that are non-conforming
- Deviations for exiting product should follow the Plant Temporary deviation Process and not the PPAP Spec Dev process
- For every dimension or feature found to be out of tolerance or compliance during the PPAP run, a corrective action must be proposed, and the responsible party must be assigned to close
- Only Interim Approval can be granted while an approved specification deviation is in effect.
# CPSD Element 18e Supplier PPAP Checklist

**Purpose:** to document what elements of PPAP have been requested and supplied and any concerns that have been found during the process.

**Requirement:** a PPAP checklist is generated by Supplier Quality at the beginning of the PPAP process, it **must** be returned with the submission. All PPAP’s require this form to be submitted.
PPAP Checklist

- Required for all levels of PPAP
- Checklist is designed to allow recipient to delegate various portions to various internal teams and assign due dates
- Checklist is also designed to log comments/concerns/questions from any reviewer or action item owner
- Checklist serves to ensure all required elements have been completed and submitted with the final PPAP package
PPAP Checklist

Reviewer’s Checklist

✓ Ensure that every submission includes a copy of the completed PPAP checklist
✓ Ensure all required elements have been submitted
✓ Ensure any non-conformances or concerns have been noted
Customer Specific Requirements

Reviewer’s Checklist

✓ Must be present if required by Level
✓ Must be completely filled out and include pictures
✓ Must be signed if required
✓ Should be confirmed during on-site reviews
Formal PPAP Dispositions

- **Approved**: When all required items have been submitted, reviewed and approved, the PPAP will be signed off by Supplier Quality or Quality as fully Approved. This releases the part(s) for production ordering and completes the cycle.

- **Rejected**: When a submission has been reviewed and determine to be either non-conforming or does not reflect the latest revision. Nonconforming can be due to missing required elements, or elements which are incomplete on non-compliant.

- **Interim Approval**: Interim PPAP can be allowed on a limited basis as long as the following criteria have been met:
  - The part is saleable to the customer in its current state
  - The part has a plan of action detailed on a specification deviation form
  - Interim approval can be extended up to 3 times, with each period not to exceed 60 days.
Importance of Due Diligence through PPAP

Eaton Requirements
1. Part Submission Warrant (PSW)
2. Design Records
3. Engineering Change Documents
4. Customer Engineering Approval
5. DFMEA
6. Process Flow Diagram
7. PFMEA
8. Control Plan
9. Measurement System Analysis (MSA)
10. Dimensional Results
11. Material, Performance Results
12. Initial Process Study
13. Qualified Laboratory Documentation
15. Sample Product
16. Master Sample
17. Checking Aids
18. CPSD specific requirements
   ▪ Tooling Information Form
   ▪ Packaging Form
   ▪ Specification Deviation
   ▪ Supplier PPAP Checklist

Element Links
2. Design Records
5. DFMEA
7. PFMEA
8. Control Plan
9. MSA
12. Initial Process Study
18. CPSD Specific

Critical Systems
Requirements (Special Characteristics)
More Robust Design
Robust Process
Develop Process Control
Confirm Measurement
Verify and Improve capability
Customer Requirements

Diligence is critical because elements relate and build on each other
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.
Standard Response to PPAP Charges

Dear Supplier,

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

Please review the Eaton Supplier Excellence Manual and the current AIAG APQP and PPAP manuals to ensure a complete understanding of Eaton’s expectations.

Regards,
North American SQE Contact Information

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Contact your Business Unit-Division Supplier Quality Engineer with questions!
Questions?
Training Feedback

1. Pace of Training?
   - Too Slow
   - Too fast
   - About Right

2. Material Content?
   - Understandable
   - Confusing

3. Break Out Sessions?
   - Helpful
   - Not Helpful

4. Suggestions for Future Classes?