Advanced Product Quality Planning and Control Plans based on *APQP 2nd Edition*

Mark A. Morris
ASQ Automotive Division Webinar

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Five Fundamental Principles

Cleanliness and safety come first; then accuracy.

Slow accuracy is no longer valuable; therefore speed is the fourth ideal.

Fifth is originality, the ability to develop better methods and better work.

Henry Ford Trade School
“What was it in your quality system that allowed you to ship us this junk?”

Hank Nichol
Agenda

1. Working within a Quality System
2. Fundamentals of Quality Planning
3. AIAG Model for Quality Planning
4. Control Plans
5. Summary and Closure
Course Goals

1. To provide a fundamental understanding of the language that guides APQP efforts.

2. To use APQP strategies to determine where to assess special characteristics.

3. To use APQP as a means to achieve robust capable processes for special characteristics.
Working within a Quality System
Quality System Requirements

• The ISO Philosophy is based on the following:
  – Say What You Do
  – Do What You Say
  – Be Able to Prove It

• These three points are necessary, but they are not sufficient. Two other points are needed:
  – You Must Meet the Requirements of the Standard
  – It Must be Effective
Quality System Requirements

Say what you do!

Procedures comply with the Standards?

Do what you say!

Actions comply with Procedures?

Be able to prove it!

Actions are Effective?

Increase Profits

Rules of the Game
Motivation and Intent

• There are two things a Quality System must do if it is to pay for itself:

  – Increase Marketability

  – Reduce the Frequency of Errors
Motivation and Intent

• Quality System documentation provides the means to fix communications:
  – Document Explicit Accountability
  – Procedurally Define Important Communications
ISO 9001 Quality Systems Model

Control of Documents

- Resource Management
- Management Responsibility

Control of Records

- Product Realization
- Measurement, Analysis, and Improvement

General Requirements
The Juran Trilogy® Diagram

<table>
<thead>
<tr>
<th>Quality Planning</th>
<th>Quality Control (during operations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Poor Quality</td>
<td>Sporadic Spike</td>
</tr>
<tr>
<td></td>
<td>Original Zone of Quality Control</td>
</tr>
<tr>
<td></td>
<td>New Zone of Quality Control</td>
</tr>
<tr>
<td></td>
<td>Quality Improvement</td>
</tr>
<tr>
<td>Start of Operations</td>
<td>Lessons Learned</td>
</tr>
</tbody>
</table>
PPAP Documentation Requirements

- 2.2.1 Design Record
- 2.2.2 Authorized Engineering Changes
- 2.2.3 Customer Engineering Approval
- 2.2.4 Design FMEA
- 2.2.5 Process Flow Diagrams
- 2.2.6 Process FMEA
- 2.2.7 Control Plan
- 2.2.8 MSA Studies
- 2.2.9 Dimensional Results
- 2.2.10 Material and Test Results
- 2.2.11 Initial Process Studies
- 2.2.12 Qualified Laboratory Documentation
- 2.2.13 Appearance Approval Report
- 2.2.14 Sample Production Parts
- 2.2.15 Master Sample
- 2.2.16 Checking Aids
- 2.2.17 Customer Specified Requirements
- 2.2.18 Part Submission Warrant
Significant Production Run

• For production parts, product for PPAP should be taken from a significant production run.

• This significant production run shall consist of from one hour to eight hours of production, and with the specific production quantity to total a minimum of 300 consecutive parts, unless otherwise specified by the authorized customer representative.
Significant Production Run

• This significant production run shall be:
  – conducted at the production site,
  – at specified production rates,
  – using the production tooling,
  – production gaging,
  – production process,
  – production materials,
  – and production operators.

• Parts from each unique production process shall be measured and tested.
Part Submission Status

• Upon approval of the submission, the organization shall assure that future production continues to meet all customer requirements.

• Customer PPAP Status:
  1. Approved
  2. Interim Approval
  3. Rejected
Teams

• Multi-functional teams are essential.
• Ensure expertise from appropriate sources.
• Select team with ability to contribute:
  – Knowledge
  – Information
  – Experience
  – Equity
  – Empowerment
• In addition to the team
  – Call in Experts as Needed
Considerations for **Meetings**

- Team Facilitation
- Good Communication
- Agree upon Team Goals
- Clearly Defined Roles
- Establish Ground Rules
- Beneficial Team Behaviors
Common Team Problems

• No Common Understanding
• Overbearing Participants
• Reluctant Participants
• Opinions Treated as Facts
• Rush to Accomplishments
• Digression and Tangents
• Hidden Agendas
• Going through the Motions
Managing Teams

• Select the Right Members
• Gain a Sense of Common Purpose
• Set Clear Expectations
• Assign Responsibility with Due Dates
• Insist on Tasks Completed on Time
Rules for *Brainstorming*

- Everyone Contributes
- Don’t Hold Back Ideas; More Ideas are Better
- No Discussion during the Brainstorm
- No Judgment; No Criticism
- Build on the Ideas of Others
- Write ALL of the Ideas so they are Visible
A Rational Structure for Quality Planning™

Product
Design FMEA

Process
Process FMEA

Customer Plant Control Plan

Tool Design
Machinery FMEA

Internal Processes
Process FMEA

Internal Process Control Plan
Motivation for Specific FMEAs

- **Life Cycle Cost**
  - **Customer Plant Control Plan**
  - **First-Time Capability**

- **Product**
  - **Design FMEA**
  - **Process**
    - **Process FMEA**

- **Process**
  - **Internal Processes**
    - **Process FMEA**
    - **Internal Process Control Plan**

- **Tool Design**
  - **Machinery FMEA**

- **Customer Satisfaction**
  - **R&trade; M**
Three Phases of Control Plan

Phase 1 Control Plan for Prototype
- Product Design FMEA
- Process Process FMEA
- Customer Plant Control Plan

Phase 2 Control Plan for Pre-Production
- Tool Design Machinery FMEA
- Internal Processes Process FMEA
- Internal Process Control Plan

Phase 3 Control Plan for Production
Rational Structure and Project Specific Control Plans

Product
Design FMEA

Process
Process FMEA

Tool Design
Machinery FMEA

Internal Processes
Process FMEA

Internal Process Control Plan

Identify and Manage
Information Required for Contract Review

Identify and Manage Deliverables Required for Design Review

Identify and Manage Deliverables Required for Build & Buy-Off
Fundamentals of Quality Planning
PPAP Documentation Requirements

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Fundamentals of Quality Planning

Advanced Product Quality Planning
  – Organize the Team
  – Define the Scope
  – Team to Team Communication
  – Training Requirements
  – Customer and Organization Involvement
  – Simultaneous Engineering
  – Control Plans
  – Concern Resolution
  – Product Quality Timing Plan
  – Plans Relative to the Timing Chart
Containment Considerations

- Cost of Defects
- Risk of Defects
- Bracketing Strategies
- Protecting On-Time Delivery
- Cost of Stopping Production
- Cost of Recall Campaigns
- Benefits of Traceability
Practical Issues of Quality Planning

- What is the cost of inspection?
- What is the risk of not inspecting?
- How often should we inspect?
- How many parts should we inspect?
- When this 100% inspection make sense?
- How should the need for destructive tests impact our decisions?
AIAG Model for Quality Planning
AIAG Model for Quality Planning
## Plan and Define Program

### Input Documents
- Voice of the Customer
- Business Plan
- Marketing Strategy
- Product & Process Benchmarking
- Product & Process Assumptions
- Product Reliability Studies
- Customer Inputs

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

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*Image: ASQ logo*
Product Design and Development

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

**Design Outputs**
- Design FMEA
- Design for Mfg & Assy
- Design Verification
- Design Reviews
- Prototype Build – Control Plan
- Engineering Drawings
- Engineering Specifications
- Material Specifications
- Drawing & Specification Changes
Product Design and Development

• APQP Outputs
  – New Equipment, Tooling and Facilities Requirements
  – Special Product and Process Characteristics
  – Gages / Testing Equipment Requirements
  – Team Feasibility Commitment
  – Management Support
Process Design and Development

Input Documents
• Design FMEA
• Design for Mfg & Assy
• Design Verification
• Design Reviews
• Prototype Build – Control Plan
• Engineering Drawings
• Engineering Specifications
• Material Specifications
• Drawing & Specification Changes

Output Documents
• Packaging standards & Specs
• Product and Process Quality System Review
• Process Flow Chart
• Floor Plan Layout
• Characteristic Matrix
• Process FMEA
• Pre-Launch Control Plan
• Process Instructions
• Measurement System Plan
• Preliminary Process Capability Study Plan
• Management Support
AIAG Model for Quality Planning

- Concept Initiation Approval
- Program Approval
- Planning
- Prototype
- Pilot
- Production
  - Planning
- Product Design and Development
- Process Design and Development
- Product and Process Validation
- Production
- Feedback Assessment and Corrective Action
Product and Process Validation

Input Documents
- Packaging standards & Specs
- Product and Process Quality System Review
- Process Flow Chart
- Floor Plan Layout
- Characteristic Matrix
- Process FMEA
- Pre-Launch Control Plan
- Process Instructions
- Measurement System Plan
- Preliminary Process Capability Study Plan
- Management Support

Output Documents
- Significant Production Run
- Measurement Systems Evaluation
- Preliminary Process Capability Study
- Production Part Approval
- Production Validation Testing
- Packaging Evaluation
- Production Control Plan
- Quality Planning Sign-Off
- Management Support
AIAG Model for Quality Planning
Production and Feedback

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

**Output Documents**
- Reduced Variation
- Improved Customer Satisfaction
- Improved Delivery and Service
- Effective Use of Lessons Learned and Best Practices
Practical Issues of Quality Planning

• What is the cost of inspection?
• What is the risk of not inspecting?
• How often should we inspect?
• How many parts should we inspect?
• When does 100% inspection make sense?
• How should the need for destructive tests impact our decisions?
Strategy for Actionable Data

- No Inspection without Recording
- No Recording without Analysis
- No Analysis without Action

W. Edwards Deming, PhD
Control Plans
### Juran’s Example of a Control Plan

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Drawing Rev. B</th>
<th>Issued By RBD</th>
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<tbody>
<tr>
<td>Casting</td>
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<td></td>
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<tr>
<td>Intended for Structural Support</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Part No. 300 82 95</td>
<td>Date Issued 1-14-2008</td>
</tr>
<tr>
<td>Item Number</td>
<td>Characteristic</td>
<td>Inspection Method</td>
</tr>
<tr>
<td>1.1</td>
<td>Corner Cut Undamaged</td>
<td>Visual Inspection</td>
</tr>
</tbody>
</table>
# AIAG Control Plan Format

**Control Plan**

<table>
<thead>
<tr>
<th>Control Plan Number:</th>
<th>Key Contact – Phone – Email:</th>
<th>Date (original)</th>
<th>Date (latest revision)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Number – Change Level:</td>
<td>Core Team:</td>
<td>Customer Engineering Approval with Date:</td>
<td></td>
</tr>
<tr>
<td>Part Name – Description:</td>
<td>Organization or Plant Approval:</td>
<td>Date:</td>
<td>Customer Quality Approval with Date:</td>
</tr>
<tr>
<td>Organization or Plant:</td>
<td>Organization Code:</td>
<td>Other Approvals and Dates:</td>
<td></td>
</tr>
<tr>
<td>Part/Process Number</td>
<td>Process Name/Operation Description</td>
<td>Machine, Device, Jigs, Tools for Manufacturing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Product</td>
</tr>
<tr>
<td>Reaction Plan</td>
<td></td>
</tr>
</tbody>
</table>

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![ASQ Logo](image-url)
AIAG Identified Dominant Processes

Equipment: set up dominant process.

Equipment: machine dominant process.

Equipment: fixture/pallet dominant process.

Equipment: tooling dominant process.
AIAG Identified Dominant Processes

People: operator dominant process.

Material: material dominant process.

Methods: preventive maintenance dominant.

Environment: climate dominant process.
Reaction Plans

• One of the most significant contributions of a control plan is the reference to explicit reaction strategies when things don’t go as planned.

• The intent of reaction plans are to prevent production of nonconforming product.
Three Specific Questions

• Are reactions planned and documented?

• Are appropriate assignments made to manufacturing, engineering, or other activities in reaction plans?

• Will suspect and nonconforming product be quarantined until appropriate action has been taken?
Reaction Plans

• Reaction plans may provide different specific solutions for situations of instability and lack of process capability.

• Instability exists when special cause variation is present.

• Incapability exists when a stable process exceeds the specification or tolerance limits.
The Appendices
List of Appendices

Appendix A – Product Quality Planning Checklists
- Design FMEA
- Design Information
- New Equipment, Tooling, and Test Equipment
- Product/Process Quality
- Floor Plan
- Process Flow Chart
- Process FMEA
- Control Plan
AIAG Control Plan Questions

- Was the control plan methodology referenced in section 6 used in preparing the control plan?
- Have all known customer concerns been identified to facilitate the selection of special product and process characteristics?
- Are all special product and process characteristics included in the control plan?
AIAG Control Plan Questions

- Were in SFMEA, DFMEA, and PFMEA used to prepare the control plan?
- Are material specifications requiring inspection identified?
- Does the control plan address incoming product through processing and assembly, including packaging?
AIAG Control Plan Questions

- Are engineering performance testing requirements identified?
- Are gages and test equipment available as required by the control plan?
- If required, as the customer approved the control plan?
- Are gage methods compatible between supplier and customer?
List of Appendices

Appendix B – Analytical Techniques
- Assembly Build Variation Analysis
- Benchmarking
- Cause and Effects Diagram
- Characteristics Matrix
- Critical Path Methods
- Design of Experiments
- Design for Manufacturability and Assembly
- Design Verification Plan and Report
- Mistake Proofing and Error Proofing
- Process Flow Chart
- Quality Function Deployment
List of Appendices

Appendix C – Reference Material

Appendix D – Team Feasibility Commitment

Appendix E – APQP Summary and Approvals

Appendix F – Glossary

Appendix G – Index
18 Components of PPAP

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Questions and Answers

Please type your questions in the panel box
Thank You For Attending

Please visit our website www.asq-auto.org for future webinar dates and topics.