ONE HOUR PROCESS CONTROL ASSESSMENT

Webinar sponsored by the AESQ Process Control Methods SMIG
May 16, 2023
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Pratt & Whitney
Senior Fellow, Quality Eng.
PCM SMIG Team Leader

- In 39th year at RTX; 27 at HS, 12 at PW
- ASQ CQE, CQA, CMQ/OE
- Adjunct Professor, CCSU – 24 years
- CQE Instructor for 28 years
- Co-author AS13006/RM13006/RM13000
- AS13100 contributor

Dr Ricardo Banuelas
Rolls-Royce
Head of Continuous Improvement and Quality
NA-Defense

- In 18th year at Rolls-Royce (10 in Indianapolis and 8 in the UK)
- Master Black Belt
- Regular lecturer at MSU
- Co-author RM13000
- Co-author of the book “World Class Applications of Six Sigma”
ONE HOUR PROCESS CONTROL ASSESSMENT

**Agenda – 60 minutes**

- Purpose
- AS13100 Chapter B – APQP & PPAP
- AS13100 Chapter C – Defect Prevention Tools
- Fast review of PFMEA and Control Plans
- Training Availability
- The One-Hour Process Control Assessment
- Implementation Tips
- Q & A
WEBINAR OVERVIEW

We are recording today’s webinar and will distribute the video link following the close of the webinar. It will also be posted on the AESQ website for free viewing.

We will take questions during today’s webinar using the Chat feature.

Please remain on Mute during the presentation to prevent background noise. We will also be muting all lines at the start of the session.
PROCESS CONTROL METHODS PER RM13006

Purpose of this reference manual

RM13006 provides the user with an array of practical approaches to process control used to ensure consistent product quality.

The purpose of this reference manual is to raise the overall capability of the aerospace engine supply chain, standardize the process control requirements across AESQ suppliers, and build on the requirements for Defect Prevention Quality Tools (ref. RM13004).

RM13006 supports AS9145 - Requirements for Advanced Product Quality Planning and Production Part Approval Process, and AS9103 - Variation Management of Key Characteristics, supported by detailed guidance and case studies.

This reference manual was developed by a dedicated team from AESQ member companies with expert knowledge and experience in the areas of process control, process improvement, quality systems, and supplier engagement.
The purpose of the PCM Subject Matter Interest Group is to promote the effective deployment of the process control methods across the AESQ Supply Chain.

The Group is made up of Subject Matter Experts from the AESQ Member Companies.

The Group is accountable for the AS13100 related Requirements and associated Reference Manual content, ensuring that it is up to date and reflects current knowledge and best practice.

It shall promote the effective deployment of the Reference Manual using Communities of Practice (CoP). The CoP is open to anyone with an interest in process control from the AESQ Member Companies and the wider AESQ supply chain.

Activities may include webinars, best practice sharing, development of shared training materials, conferences and published papers.

### PROCESS CONTROL METHODS SUPPORT

**What is the Process Control Methods SMIG Group?**

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<tr>
<th>NO.</th>
<th>FUTURE WEBINAR TOPICS</th>
<th>TARGET DATE/TIME</th>
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<tr>
<td>1</td>
<td>Process Control Methods - What is RM13006? Interaction with other AESQ Reference Manuals</td>
<td>12/6/2022 (completed)</td>
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<td>2</td>
<td>What makes a good Process Capability Study?</td>
<td>1/26/2023 (completed)</td>
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<td>3</td>
<td>Process Capability Study for True Position (handling MMC)</td>
<td>2/8/2023 (completed)</td>
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<td>4</td>
<td>The use of non-statistically based process control methods</td>
<td>3/8/2023 (completed)</td>
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<td>6</td>
<td>The One-Hour Process Control Assessment</td>
<td>5/16/2023 (11 AM U.S. Eastern)</td>
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<td>7</td>
<td>Why is statistical control a prerequisite for process capability?</td>
<td>Target 2nd Qtr (June)</td>
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<td>Dealing with Non-Normal Data</td>
<td>Target 3rd Qtr (September)</td>
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<td>9</td>
<td>Conducting capability studies for one-sided geometric tolerances</td>
<td>Target 4th Qtr (October)</td>
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Go to [https://aesq.sae-itc.com/events](https://aesq.sae-itc.com/events) for webinar schedule.
Who is the Process Control Methods SMIG Team?

Curator for RM13006

Experts who you may address process control related question to

Provider of process control related webinars. See Slide 23 for webinar schedule which is subject to change based on your feedback
PROCESS CONTROL METHODS COP

Where to get help

AESQ Supplementary Materials webpage for a copy of RM13006 and supporting templates

https://aesq.sae-itc.com/supplemental-material

Subject Matter Interest Group – meets monthly – supports continuous improvement of RM13006 and supporting templates & tools

AESQ Process Control Methods Community of Practice (COP) on Linked-In

Current membership is 200 – let’s get some more!!

https://www.linkedin.com/groups/12647920/
ONE HOUR PROCESS CONTROL ASSESSMENT

KEY POINTS
• Basic fundamentals required to be in place
• Linkage to AS13100 Chapters B & C
• Assessing a process control system does not have to take long
• Key questions to ask
• What to look for and who to talk to
ONE HOUR PROCESS CONTROL ASSESSMENT

Why this webinar?

• To provide a brief guideline used to assess a supplier’s process control system in meeting AS13100 Chapter’s B and C with the following goals:

- Try not to boil the ocean; get to the point; complete it quickly

- Understand if supplier is working to implement process control for their good or just for customer compliance

- What to do if implementation is poor
AS13100 REQUIREMENTS HIGHLIGHTS
Chapter B APQP & PPAP

AS9145 APQP & PPAP required to manage:
• New Product Introduction
• Product & Design Changes
• Source Changes
• Major Quality Issues

Flow down
1. Look for AS13100 to be required by engine OEM spec on purchase order (e.g., PW ASQR-01, RR Sabre, GE S1000, etc.)

Defines Submission Requirements for PPAP based on Supplier Performance:
1. Submit Warrant only to customer, Retain evidence at Supplier
2. Submit PPAP evidence to customer and Retain all documents
3. Witness at Supplier

So what should we look for to see evidence of process control implementation?
This is good but a lot to digest. What should we look for if time is short?
AS13100 REFERENCE MANUALS

AS13100 Standard defines mandated requirements.

Reference Manuals provide industry best practice guidance and case study material on how to deploy quality tools effectively.

Reference Manuals are maintained and updated by the AESQ Subject Matter Interest Groups and may be updated at any time when new or revised information becomes available.

The Standard is supported by free issue Reference Manuals from the AESQ Website:

https://aesq.sae-itc.com/supplemental-material
**RM13006 TRAINING SYLLABUS**

Details the minimum content that a Process Control Methods training syllabus needs to contain to support continued competence in the application of this standard.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Outcomes</th>
<th>Minimum Content</th>
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</table>
| The importance of Process Control | Appreciation of customers’ needs and the benefits to the organization, industry and society | • Examples and discussion on process control failures  
• Reputational impact  
• Effect on the Aerospace industry  
• Benefits of achieving design nominal (Taguchi’s Loss Function)  
• Understanding and importance of a closed loop control system  
• Effectiveness of in process control over end-of-line inspection |
| Process Control in Context of Quality Planning | Understanding of the linkages between the quality planning activities | • Linkage between PFMEA, Control Plans, and work instructions  
• Purpose and content of a Control Plan |

**RM13006 APPENDIX C FOCUS AREAS**

- The importance of Process Control
- Process Control in context of quality planning
- Selection of Process Control Methods
- Data Collection
- Process Capability Analysis
- Basic Root Cause Analysis and Process Improvement
- Application of Control Charts
- Error-Proofing

Partial syllabus shown

Refer to Appendix C for the full training syllabus
The AESQ reference manuals ("Gold Books") on previous slide are designed to aid a supplier to implement the key PPAP elements shown on this slide.

Are they aware of this free material and the webinars offered by AESQ?
ASSESSMENT PREPARATION

1) Pull a PPAP P/N with list of KC features defined by the Customer, self-selected by the supplier or both

2) Have supplier pull out Process Flow Diagram, PFMEA, Control Plan and operator work instruction documents for a couple of process steps that have either Customer defined KC’s and/or supplier self-selected KC’s.

3) Try to schedule your visit on a day the supplier is running those parts.

4) Schedule at least one hour on the agenda for a “Process Control Quick Assessment”.
THE REFERENCE MANUAL INTERACTIONS

Process Control Methods (RM13006) will interact with failure mode and cause identification (RM13004), which includes Human Factors (RM13010), and 8D Problem Solving Method (RM13000).

- **RM13004** - PFMEA & Control Plans
- **RM13006** - Process Control Methods
- **RM13010** - Human Factors
- **RM13000** - 8D Problem Solving Method

**Proactive**
- Identify failure modes and causes (risk identification & mitigation)
- Identify and implement preventive and detection based controls

**Reactive**
- Look for sources of human error as part of root cause investigation
- Identify root causes and corrective actions when investigating customer, supplier or internal escapes & defects

Failure modes, causes and controls that were not initially anticipated are fed back to the PFMEA and Control Plan.
BOTTOM LINE – EVIDENCE TO LOOK FOR

Process Flow Diagram with KC’s identified (where produced/inspected)

PFMEA with KC’s accounted for

Control Plan accounting for all KC’s and other high-risk areas

Gage Capability Studies for gages used to measure KC’s

Use of non-statistical methods such as error proofing devices for high-risk areas

Use of Control Charts for KC’s at point of manufacturing

Is a process control subject matter expert on staff (e.g., Six Sigma GB/BB or CQE)

How an operator responds to an out-of-control condition

Evidence of process control training

Use of process control data by company’s engineering department
QUESTIONS TO ASK

1) Is supplier familiar with RM13004 (PFMEA), RM13006 (Process Control Methods) and RM13003 (MSA)?

*See if at least one person is well versed in these manuals and has a solid process control background with professional credentials such as Six Sigma Greenbelt/Blackbelt or ASQ CQE certification.*

2) Are Operator’s work instructions identified with KC features on them?

*Look to see if the work instruction identifies somehow the KC KC feature and the need to apply SPC control chart data collection and monitoring.*
QUESTIONS TO ASK

3) How does the operator collect the KC data? Look for a control chart and the Western Electric Rules at their workstation.

Go out to the factory to witness the data collection system looking to ensure the operator is utilizing a SPC control chart. This is very important as many just collect the data and analyze it in a software such as Minitab afterwards for PPAP submission. This nullifies the use of a control chart as a control method called out on a control plan per RM13006. It is important to see the control chart being used as a control method by the operator at the transformational process step. This is done with the Western Electric Rules that identify out-of-control patterns. If this is not happening, then you’ve identified a key weakness in the supplier’s process control system.
QUESTIONS TO ASK

4) Has a Gage Capability Study been done?
   Look at the results. Examine what happens when it is over 20% of Tolerance. See if the supplier practices guard banding as a containment method per RM13003.

5) What SPC and MSA training do your operators & engineers get and who provides the training?
   Inquire if there is documented, formal process control and MSA training provided to key personnel. Ask if there is a process control engineer with some sort of credential (e.g., Six Sigma Greenbelt/Blackbelt, ASQ CQE) that has been trained in the curriculum suggested in RM13004/RM13006/RM1003 who provides their internal training. Determine if operators understand the Western Electric Rules for control chart signals of out-of-control and what their reaction plan is.
QUESTIONS TO ASK

6) How do you handle when Cpk < 1.0?
   Look to see if process capability data is reviewed at a monthly Quality Improvement Meeting. If no such meeting exists, then this would be a sign that process control is for compliance purposes only. Dig into that.

7) Does the supplier self-select their own KC’s based on the risks coming out of their PFMEA?
   This will tell a lot about the supplier’s commitment to process control and their true understanding. If they are not self-selecting their own KC’s they are probably in it for compliance purposes only.

8) Does the supplier highlight processes that are incapable and what is being done about it in the factory where operators can see what you are doing with the data they collect.
   It’s important the operator sees that the data collection and SPC monitoring is being used to help make process capability improvements. Look for supplier highlighting the worst three Cpk’s of the month with a story about what actions are being taken. Ideal is posted in the shop.
9) Describe how you handle (or would handle) when the Customer defined KCs are produced by a sub-tier supplier?

This situation may not be applicable at the present time. But what if that changes? And the 1st tier contracts out the part manufacturing or does a vendor assist that involves the KC transformation operation at a 2nd tier? Does the 1st tier flow down the data collection and monitoring requirements of AS13100? Do they assure control and capability of the KC by the 2nd tier?
FOLLOWING THE ASSESSMENT

• Point supplier to AESQ “Past Events” website for access to webinar videos and material that have already been conducted.

• Refer supplier to AESQ “Upcoming Events” website for webinars and training programs related to process control and other topics.

• Refer the supplier to the AESQ website for information on free reference manuals and templates.

Past Events
https://aesq.sae-itc.com/past-events

Upcoming Events
https://aesq.sae-itc.com/events

Aerospace Engine Supplier Quality Supplemental Material Page
https://aesq.sae-itc.com/supplemental-material
RED FLAGS TO LOOK OUT FOR

RICARDO BANUELAS
HEAD OF CONTINUOUS IMPROVEMENT AND QUALITY NORTH AMERICA - DEFENSE / LEAN SIX SIGMA MBB
ROLLS ROYCE
**RED FLAGS**

**PROCESS FLOW DIAGRAM – RM13004**

Process Flow does not link or align with job router/traveler/shop order.

Not accounting for multiple stations where process step may be performed; control system may be different depending where the process step is run.

**PFMEA – RM13004**

PFMEA documents are dated even when changes to process plan have occurred.

Failure modes and causes are combined making it hard to determine the control strategy.

Misalignment between requirements, failure modes, causes and controls.

No Supplier self-identified KC’s.
RED FLAGS

MEASUREMENT SYSTEMS ANALYSIS – RM13003

Gage Capability Study has unacceptable percent-to-tolerance ratio (> 20%) with no containment plan or corrective action plan in place (i.e., guard banding, new gage on order, calibrating operator methods).
Attribute AbA study conducted with only good parts when nonconforming parts are required in the sample used.

CONTROL PLAN – RM13004

Reaction Plans geared to non-conforming/out of tolerance features only.
Reaction Plans do no align to the established control method or reflect RM13006.
Control Plan does not account for all high risks and/or process variation.
Control Plan does not address Customer KC’s nor Supplier self-selected KC’s.
Operator work instructions lack alignment with Control Plan.
SPC CONTROL CHART AND CAPABILITY STUDIES – RM13006

Control Charts are not in place at transformation operation

No evidence operators are trained in use of control charts or the Western Electric Rules

Data collected at transformation operation but analysis done separately for the purpose of satisfying Customer reporting or PPAP submission

General SPC resistance as described in RM13006, Section 12.3.
SUMMARY AND CLOSE

PETER E. TETI
FELLOW, QUALITY ENGINEERING
PRATT AND WHITNEY
Look for these future topics in the “Upcoming Events” page on the AESQ website:

https://aesq.sae-itc.com/interest-groups

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<th>SUPPORTING SUB-TEAM</th>
<th>BRIEF DESCRIPTION</th>
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<tr>
<td>2</td>
<td>What makes a good Process Capability Study?</td>
<td>1/26/2023 (11 AM U.S. Eastern)</td>
<td>Steve Hampton</td>
<td>Marnie Ham/Karen Scavotto</td>
<td>Cpk values are only as good as what goes into the data used to calculate Cpk, such as the adequacy of the measurement system and achieving statistical control.</td>
</tr>
<tr>
<td>3</td>
<td>Process Capability for Unilateral Tolerances</td>
<td>2/8/2023 (11 AM U.S. Eastern)</td>
<td>Andrew Stout</td>
<td>Grant Braun/Wendy Braunett/Sherleesh Shinde</td>
<td>How do we handle process capability for one-sided or unilateral tolerances including true position where Maximum Material Condition modifiers may play a role.</td>
</tr>
<tr>
<td>4</td>
<td>The use of non-statistically based process control methods</td>
<td>3/8/2023 (11 AM U.S. Eastern)</td>
<td>Paul Gong</td>
<td>Pete Teti/Karen Scavotto/Nicklas Godebu</td>
<td>Process controls need not only be statistically based. Here we explore non-statistical methods such as error-proofing devices, the PreControl method, and the use of run charts with non-statistical limits.</td>
</tr>
<tr>
<td>5</td>
<td>The Power of Precontrol</td>
<td>4/11/2023 (11 AM U.S. Eastern)</td>
<td>Andrew Stout</td>
<td>Steve Hampton/Pete</td>
<td>PreControl is a powerful non-statistical tool that is easy to get up and running with that can be used to qualify the set-up of a lot as well as a control for the production run.</td>
</tr>
<tr>
<td>6</td>
<td>The One-Hour Process Control Assessment</td>
<td>5/16/2023 (11 AM U.S. Eastern)</td>
<td>Pete Teti</td>
<td>Ricardo Banuelas</td>
<td>If you were visiting a supplier and only had time to carve out one hour for a process control assessment, what questions would you ask and where whom would you ask those questions to?</td>
</tr>
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<td>7</td>
<td>Why is statistical control a prerequisite for process capability?</td>
<td>Target 2nd Qtr (June)</td>
<td>Shailesh/Steve</td>
<td>Shailesh/Steve/Pete</td>
<td>Process Capability indexes without the use of SPC Control Charts are invalid. Control Charts are the method to monitor and control a process and are a key prerequisite prior to calculating Cp &amp; Cpk.</td>
</tr>
<tr>
<td>8</td>
<td>Dealing with Non-Normal Data</td>
<td>Target 3rd Qtr. (September)</td>
<td>Karen Scavotto</td>
<td>Marnie Ham/Shaelish Shinde/Andrew Stout</td>
<td>What happens when the data coming from a process is non-normal? What can be done to accurately assess process capability? Will you show you!</td>
</tr>
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<td>9</td>
<td>Conducting capability studies for one-sided geometric tolerances</td>
<td>Target 4th Qtr. (October)</td>
<td>Karen Scavotto</td>
<td>Marnie Ham/Shaelish Shinde/Andrew Stout</td>
<td>Aerospace component manufacturers the world over deal with geometric/one sided features such as runout, flatness, etc. What rules have to change when assessing process capability?</td>
</tr>
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Q & A SESSION

USE THE “CHAT” FUNCTION TO ASK A QUESTION...
SUMMARY

All resources will be available on the AESQ website within a few days.

An email will be sent to all registrants with a link.
THANK YOU FOR PARTICIPATING