THE USE OF NON-STATISTICALLY BASED PROCESS CONTROL METHODS

Tools & Tips Webinar sponsored by the AESQ Process Control Methods SMIG

March 8, 2023

Non-Statistical Methods
Agenda – 60 minutes

Overview – P. Teti

Who is the PCM Subject Matter Interest Group – P. Teti

Why this webinar? Where can we find help?

PCM Community of Practice – Linked In

Non-Statistical Methods Walk Through – Paul Gorg

Case Studies – Paul Gorg

Q&A – PCM SMIG Team

Summary and Close – P. Teti

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PCC Structurals

Pete Teti
Fellow, Quality Engineering
Pratt and Whitney

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.

The use of non-statistically based process control method

Why this webinar?

Identify non-statistical methods and when they can be used. Discuss advantages and disadvantages.

Show practical applications and examples of common methods. Generate thought about using alternate methods.

Promote the available free documents and tools that can be used by any AESQ supplier

Answer questions suppliers may have about non-statistical based process oontrol methods.

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 process control methods (ref. RM13006).

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.


AEROSPACE STANDARD

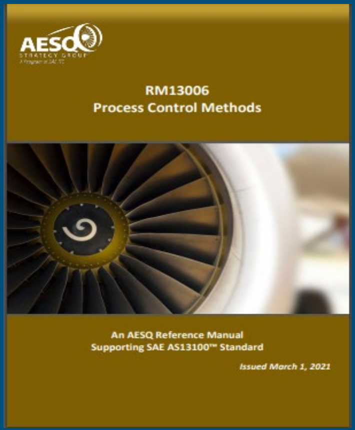
AS13100™

Issued 2021-03

AESQ Quality Management System Requirements for Aero Engine Design and Production Organizations

RATIONALE

This standard has been created by the SAE G-22 Aerospace Engine Supplier Quality (AESQ) Technical Committee to harmonize and simplify supplier quality requirements that are in addition to the requirements of 9100 Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations and 9145 Advanced Product Quality Planning and Production Part Approval Process.



PROCESS CONTROL METHODS SUPPORT

What is the Process Control Methods SMIG Group?

- 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 any subject matter expert or individual experienced or trained in process control from the aero engine community.
- Activities may include webinars, best practice sharing, development of shared training materials, conferences and published papers.

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

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

SUBJECT MATTER INTEREST GROUPS

Who is the Process Control Methods SMIG Team?

Pete Teti
PWA
(Leader)

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Marnie
Ham
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Shailesh
Shinde
RR

Curator for RM13006

Experts who you may address process control related question to

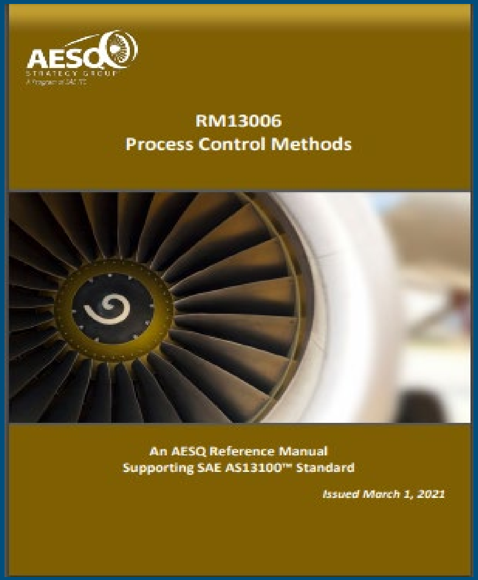
Provider of process control related webinars. See Slide 6 for webinar schedule which is subject to change based on your feedback

PROCESS CONTROL METHODS CoP

Where to get help

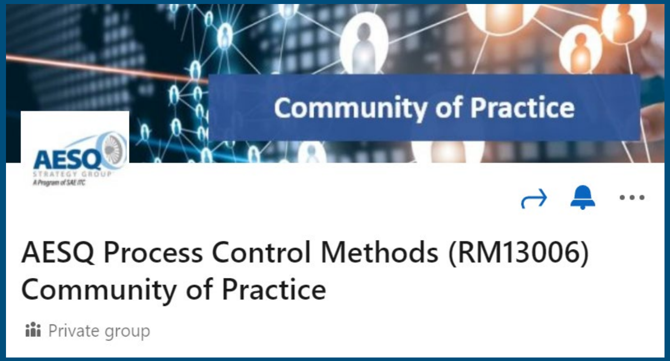
AESQ Supplementary Materials webpage for a copy of RM13006 and supporting templates

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 175 – let's get some more!!

https://www.linkedin.com/groups/12647920/

A WALK THROUGH OF NON-STATISTICAL PROCESS CONTROL METHODS MATERIAL IN RM13006

<u>SECTIONS INVOLVING PROCESS CAPABILITIES IN RM13006</u>

- TABLE 1 OVERVIEW OF RECOGNIZED PROCESS CONTROL METHODS
- 5.1 ERROR / MISTAKE PROOFING
- 5.4 RUN CHARTS WITH NON-STATISTICAL LIMITS
- 5.6 LIFE / USAGE CONTROL
- 5.8 VISUAL PROCESS CHECK AND CHECKLIST
- 5.9 FIRST PIECE CHECK
- 5.10 TEST PIECE EVALUATION FOR PROCESS CAPABILITY

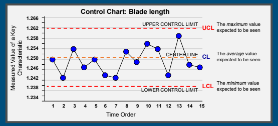
WHAT IS PROCESS CONTROL?

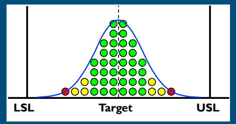
The *overall strategy employed to reduce and mitigate product & process risks* resulting in the full achievement of Customer requirements.

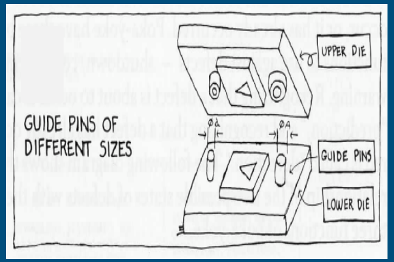
Process Control *includes the use of statistical and* ***<u>non-statistical methods</u>*** that work to prevent and detect errors such that defects/defective parts are not created in the first place.

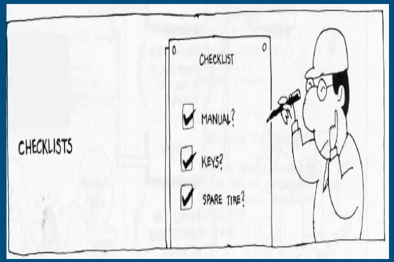
Statistical techniques include such tools as control charts for variable & attribute data

<u>Non-statistical techniques</u> include the use of mistake-proofing devices to control process inputs. Such devices may take the form of asymmetrical fixture designs, one-way fits, alarms, buzzers, work instructions, procedures, checklists, and set-up qualification & lot monitoring using PreControl to name a few.









<u>Statistical and…………..Non-Statistical Methods together drive reduction and control of variation</u>

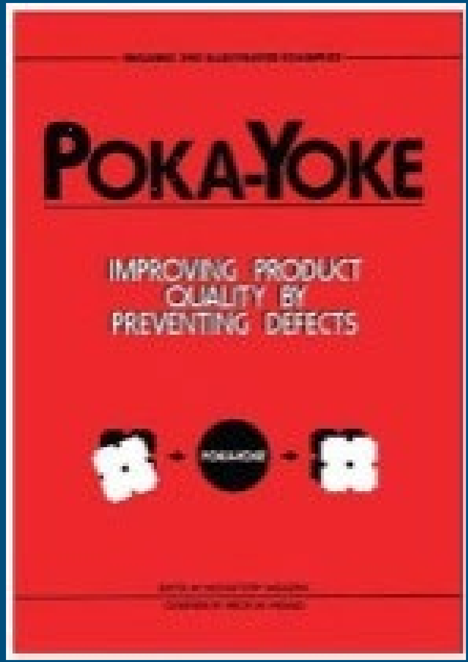
THE USE OF NON-STATISTICALLY BASED PROCESS CONTROL METHODS

Highlights

Why non-statistical methods

When to use non-statistical methods

Methods and examples



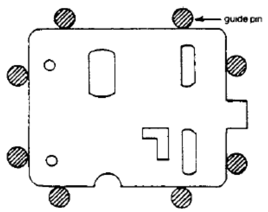
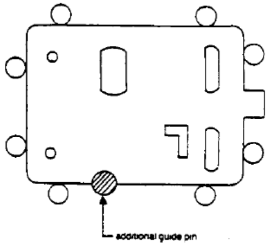
"240 solutions; every ME and QE should have"
www.productivitypress.com

Prevention Control

One-Way Fits

Process: Processing chassis

Problem: Chassis set backwards in jig

Description of Process: A chassis was placed in a jig for machining.	
Before Improvement:	**After Improvement:**
It was possible to insert the chassis in the jig backwards. Correct operation depended on the worker's vigilance.	A guide pin was added, keyed to an asymmetrical feature of the chassis. This completely eliminates the danger of backward processing.
	

Prevent the cause of the failure mode

WHY USE NON-STATISTICAL PROCESS CONTROL METHODS

When to use and advantages

- Process can be Error or Mistake proofed. Elimination of defect is possible.
- If process data does not easily lend itself to statistical methods
- Easier for operators to understand and accomplish
  - Can be done on shop floor
  - Immediate feedback, waiting for data analysis not required
- Cost, may be less expensive to organization.

WHY USE NON-STATISTICAL PROCESS CONTROL METHODS

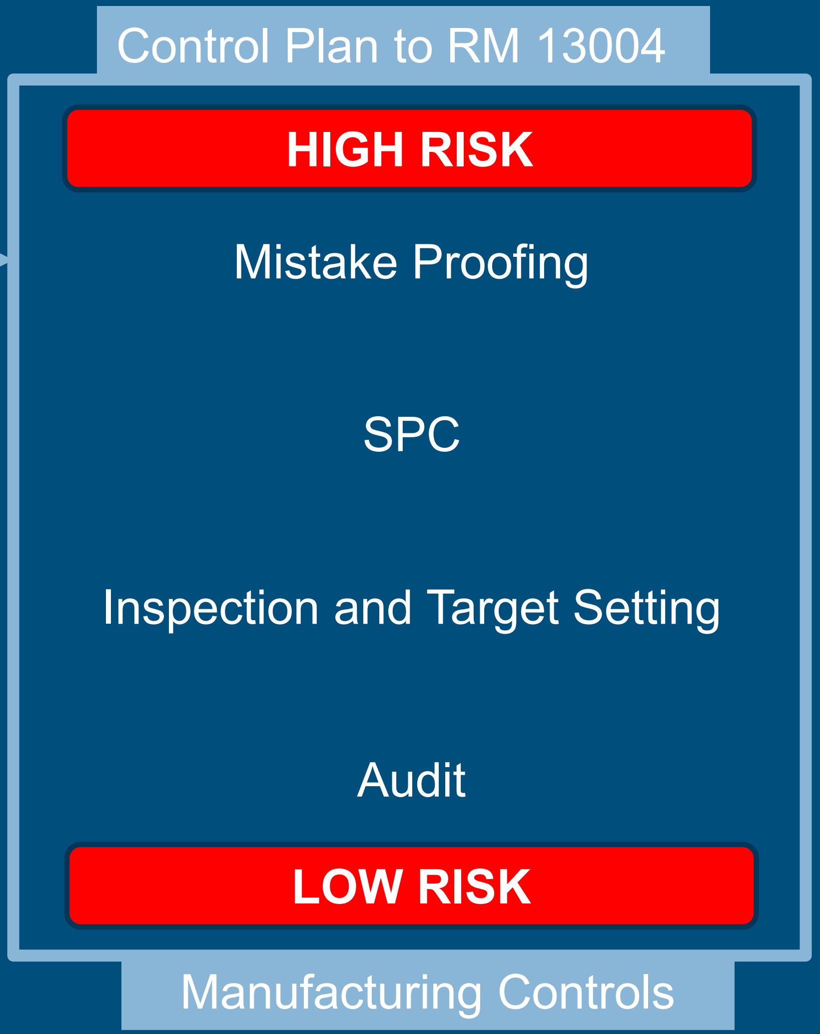
When not to use and dis-advantages

- Process data lend itself to statistical analysis and is easily collected.
- Process capability metrics are needed to meet customer or organizational requirements.
- Data is needed forr process development / improvement.

NON-STATISTICAL METHODS

Error / Mistake Proofing

A key goal of Process Control is to help mitigate risks. Non-statistical methods such as Mistake-Proofing is applied for the highest risks identified on a PFMEA.



Definition:

Using *wisdom* and *ingenuity* to provide methods and devices that allow you to do your job

100% defect free - 100% of the time

NON-STATISTICAL METHODS

Error / Mistake Proofing

Linkage to RM13010 – Human Factors

Human Error

- Humans make mistakes (errors) because of……
  - Forgetfulness' / misunderstanding requirements
  - Lack of experience/skills – Lack of concentration
  - Lack of standards
  - Rushing – Taking short cuts
  - Malicious intent (deliberate action; this is rare)
  - Errors that lead to defects

- Defects are not inevitable and can be eliminated by use of simple, low cost methods to achieve zero defects

- Mistake proofing should take over repetitive tasks that depend on vigilance or memory.

NON-STATISTICAL METHODS
Error / Mistake Proofing

Mistake Proofing History

- Dr. Shigeo Shingo attributed with developing methods
- Originally called idiot proofing but recognized this label could offend workers so changed to mistake proofing (Poka-Yoke in Japanese.
- Literally translated
  - Yokeru: To avoid
  - Poka: Inadvertent errors
- Target of zero defects and elimination of QC inspection

NON-STATISTICAL METHODS
Mistake Proofing Most Common Errors

- Incapable or improper measurement system employed
- Skipping a process step or tasks
- Performing process steps incorrectly or in the wrong order
- Using the wrong part or tool
- Leaving out a part
- Misunderstanding requirements
- Adjustment mistakes
- Timing mistakes
- Contamination

NON-STATISTICAL METHODS
10 key sources of defects

1. Omitted processing
2. Processing errors
3. Errors setting up workpiece
4. Missing parts
5. Wrong parts
6. Processing wrong workpiece
7. Wrong operation performed
8. Adjustment error
9. Equipment not set up properly
10. Tools & jigs improperly prepared

NON-STATISTICAL METHODS

Error/ Mistake-Proofing

Error proofing devices can take four forms. The hierarchy (1. being the best) of these is:

1. Elimination – design the product or process hardware/software in such a way that an error is not possible.
2. Control – prevent an error being made by detecting it before it has an effect.
3. Signal – provide an immediate and obvious warning to prevent or highlight an error.
4. Facilitation – methods of guidance that make error less likely or will catch it.

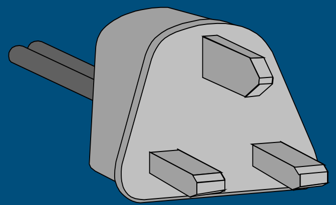
NON-STATISTICAL METHODS

Levels of Error/ Mistake-Proofing

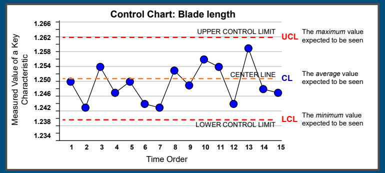
MISTAKE PROOF EFFECTIVENESS

Level 1 ***Best***	**Method eliminates the Mistake and the Defect from occurring at the source**
Level 2 ***Better***	**Method detects mistake while alerting Operator to take appropriate action resulting in zero defects**
Level 3 ***Good***	**Method detects defect resulting from a mistake and stops from further processing**

Mistake Proofing Levels are not designed to prevent circumvention



Level 1
One-Way Fit



Level 2
Warning Device

Level 3
Overcome existing hazard

NON-STATISTICAL METHODS

Levels of Error/ Mistake-Proofing

LEVEL I

Mistake cannot be made

No need to inspect that oil fill tube is installed in wrong port

Defect is not possible since mistake is not possible

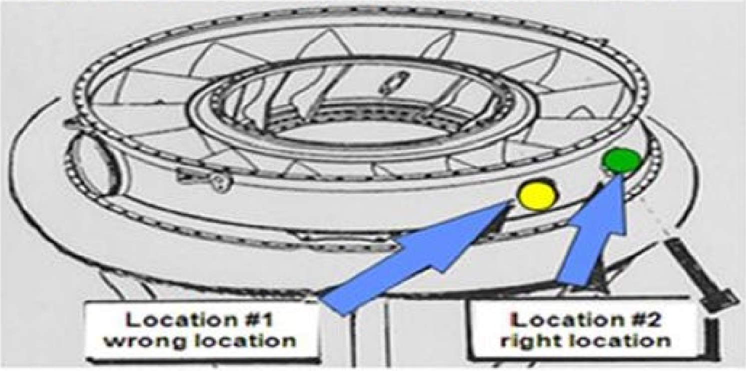
MISTAKE PROOF LEVEL 1

Level of Mistake Proof		
Level 1 - *Eliminate the Mistake and the Defect from occurring at the source* [X]	**Level 2 -** *Detect Mistake and Stops from further processing* [ ]	**Level 3 -** *Mistake occurs resulting in Defect and Stops from further processing* [ ]

Brief description of process and situation: Compressor part – an oil fill tube can be installed in two locations with identical hole patterns, resulting in significant damage to part during engine test.

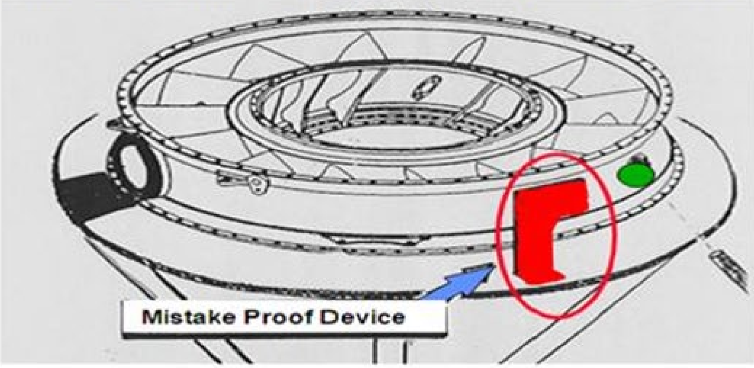
Condition Before Improvement: An oil tube can be installed at two different, but identical, ports resulting in a major non-conformance.

Tube can be installed in either location



Condition After Improvement: The holding fixture was redesigned, adding a permanent bracket that prevents an oil tube from being installed in anything but the correct port.

Tube is installed in only the correct location



NON-STATISTICAL METHODS

Levels of Error/ Mistake-Proofing

<u>LEVEL II</u>

Mistake has been made

Mistake is caught by the control (the fixture)

Mistake can be fixed before a defect is made

MISTAKE PROOF LEVEL 2

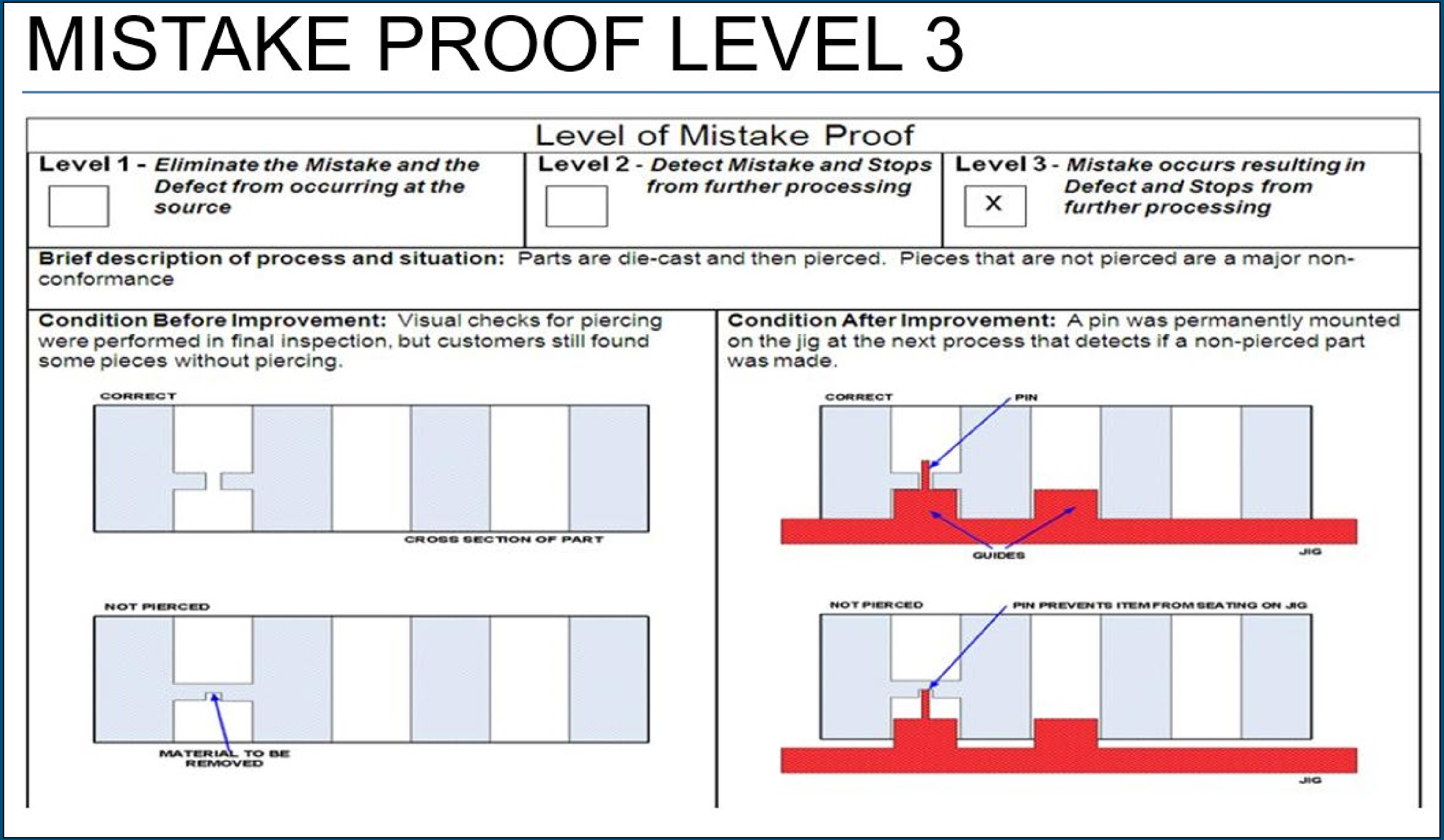
Level of Mistake Proof		
Level 1 - ***Eliminate the Mistake and the Defect from occurring at the source*** ☐	**Level 2 -** ***Detect Mistake and Stops from further processing*** ☒	**Level 3 -** ***Mistake occurs resulting in Defect and Stops from further processing*** ☐

Brief description of process and situation: An assembly requires installing six screws to secure a plate to a collar. Five screws are long, but a short one must be used in position #5. Sometimes a long screw is installed in position 5 by mistake.

Condition Before Improvement: Long screw can be mistakenly installed in position 5.	**Condition After Improvement:** The holding fixture was redesigned, adding a permanent dimple that detects a long screw from being installed in position 5.
	

NON-STATISTICAL METHODS

Levels of Error/ Mistake-Proofing



MISTAKE PROOF LEVEL 3

Level of Mistake Proof		
Level 1 - *Eliminate the Mistake and the Defect from occurring at the source* ☐	Level 2 - *Detect Mistake and Stops from further processing* ☐	Level 3 - *Mistake occurs resulting in Defect and Stops from further processing* X

Brief description of process and situation: Parts are die-cast and then pierced. Pieces that are not pierced are a major non-conformance

Condition Before Improvement: Visual checks for piercing were performed in final inspection, but customers still found some pieces without piercing.

Condition After Improvement: A pin was permanently mounted on the jig at the next process that detects if a non-pierced part was made.

<u>LEVEL III</u>

Mistake has been made

Defect is caught by the control (the jig)

Defect is contained

NON-STATISTICAL METHODS

More Mistake-Proofing Examples

- Guide Pins used to assure a one-way fit of a tool, fixture or part to prevent incorrect orientation.
- An alarm used to alert an operator that a machine cycle has been attempted with a misaligned tool. The operator can take action to correct the
- A limit switch used to detect correct placement of a work piece.
- Counters can be used to help an operator track the correct number of components needed in an assembly.
- A checklist used to assure all key steps are completed by the operator to prevent missing something that could cause an escape and/or defect.
- Use of machine probing as either a control during manufacturing to check a size before final cut or as a signal after final cut to detect an anomaly or identify that an adjustment may be needed.
- Asymmetrical design of a nameplate that assures it is installed in only one possible orientation preventing backwards or upside-down installation.
- A left/right two button hand operated system with foot switch operation to ensure hands are free prior to cycling a press.
- Automated weighing of a part or batch to ensure part is completely processed or batch is complete and present before moving to the next operation.

NON-STATISTICAL METHODS

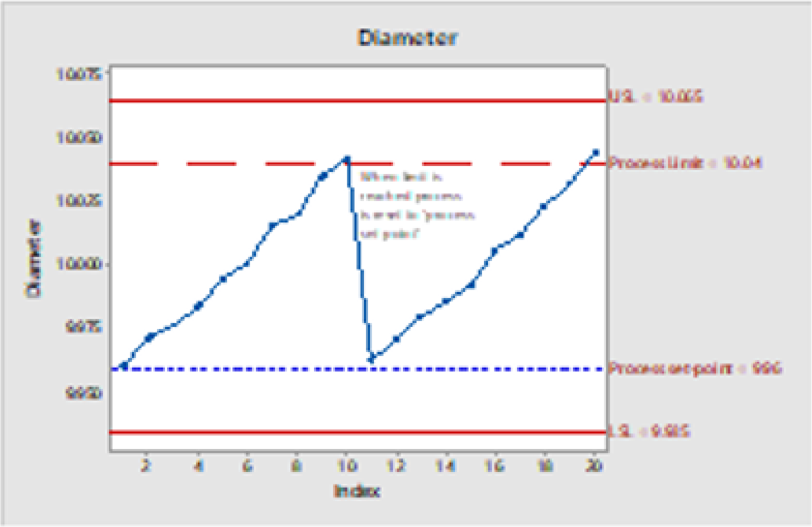
Non-Statistical Control Charts

Non Statistical Control Charts

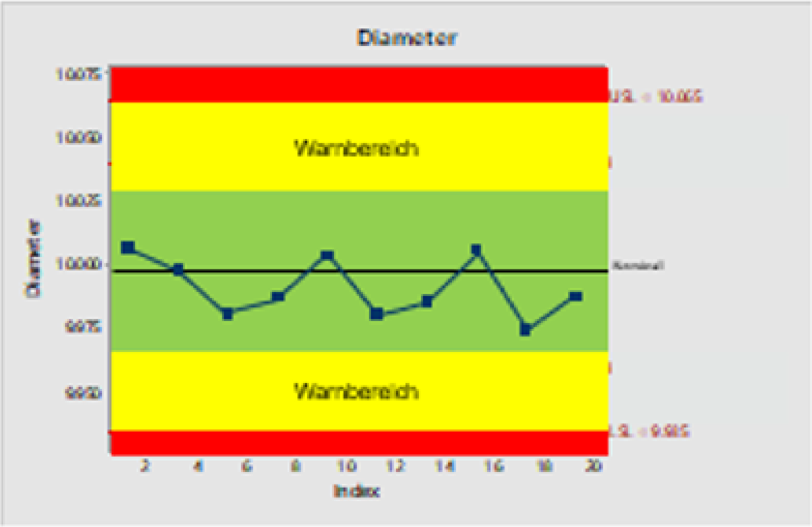
The Run Chart and the Pre-Control Chart differ from the statistical control charts by the following features:

- No statistical intervention limits but self-defined warning limits or warning ranges, starting from the nominal value or from a process point.
- Entry of individual measured values in the control chart and no statistical sampling.

Example Run Chart



Example Pre-Control Chart



NON-STATISTICAL METHODS

Non-Statistical Control Charts

Advantages:

- No prior statistical knowledge required for application.
- No "pre-run" required to set control limits.
- Simple and direct way of guiding a process (can also be done manually).
- Process control also possible with simpler measuring systems (e.g. outside micrometer).

Disadvantages:

- Warning limits are based on assumptions or arbitrary determinations.
- Range control is not part of the monitoring.
- No statement about the natural variation range of the process and when this is left.
- Causes of error sources are often not sufficiently identified and eliminated.

Possible applications:

- Directly at the machine, e.g. as part of the worker's self-inspection. This type of control only makes sense if it is used directly on the process, i.e. if a necessary correction is to take effect immediately on the next component.
- For non-normally distributed processes.
- For characteristics that cannot be produced capable (no or only little distance from control limit to specification limit.
- With a Cpk/Ppk value of > 3. In this case, statistical control limits may be considered too narrow. (Specification limit is far from control limit)

NON-STATISTICAL METHODS
Life / usage control

Processes may have factors that are dynamic in nature and change through use or over time. Such processes may require control methods that prevent the process (or its factors) reaching a condition that will adversely affect the product of the process. Such controls can be placed on, e.g. chemicals, wearable items such as cutting tools, and other consumables.

The control criteria for life/usage controls may be defined in many ways.

For example:
1. Age
2. Number of parts processed
3. Total running time, number of cycles
4. Once opened use by date
5. Weight of parts processed and surface area processed.

The life/usage limits should ideally be determined to maximize the process quality. Statistical studies and experiments will allow the life to be optimized for other factors such as cost. These studies may be performed on test pieces and scaled to the production process. The life/usage limits should be validated however usually at process qualification

NON-STATISTICAL METHODS

Life / usage control

Examples of control application include:

- A cutting tool has a maximum operating time. The tool life is recorded on a machine-readable chip. The machine program includes code that checks the life of the tool prior to use. When cutting tips are replaced and the tool is set a pre-setting operation resets the readable chip to zero.

- A peening operation has media that is controlled based on the total equipment running time. A timer is installed on the equipment to indicate how close the process is to a media change. In addition to this method of control, the process also has assessment for media quality and uses test pieces to qualify the process for correct operation.

- The concentration of a chemical etch bath is routinely maintained with an auto-dosing system. However once a month the entire system is emptied, cleaned out, and refilled. To keep the planning of this control simple this is done at a defined time regardless of use – for example the morning of the first Monday in every month.

- A life/usage limit may also incorporate a check and reset. For example, a wearable item may be tested after a number of cycles and found to have not reached a point where change is required. The tool may be returned for use for a defined number of cycles. It should be noted that this does not imply the tool will be run to the point of failure.

NON-STATISTICAL METHODS

Visual process check and checklist

For characteristics that are not easily measured or are appearance in nature a visual process check or checklist may be appropriate. Checklist and visual standards can be developed to assist in the inspection. A single person check may have some inherent risks of error. To increase robustness, a "double scrutiny", and/or "buddy check" may involve two personnel to positively confirm an action or result of a check; or the check may be performed by someone independent of the operation. A preferred approach is automation or error proofing devices. This method can have weakness since it is still dependent on operator.

The process checks need to become part of routine operation. The personnel conducting the check will ideally understand the importance of the check and also understand the reaction if the check fails against the criteria.

NON-STATISTICAL METHODS

Visual process check and checklist

Another example would be simple count of nut plates or rivets that is counted and then recorded on router or in IT system. This is required to transact the completed operations and move part forward in the process.

Checklist example

Pre-Operation Process Checklist

Note to operator: Use this checklist prior to execution of the process operation and sign off each item below.

Part No:	123456-78	**Process operation number:**		110
Run date:	08/12/2016	**Process step name:**		Machine air holes in Fuel/Air bracket
Check item number	**Check item**	**Result of check (Pass/Fail)**	**Reaction (if Fail)**	**Sign off (initial and date)**
1	Health/Safety check		Stop and isolate equipment. Contact cell leader	
2	Work instructions are latest version		Contact Manufacturing Engineer – obtain instructions	
3	Machine asset care checks complete and correct		Raise issue with cell leader	
4	Gages in calibration		Contact Quality engineer	
5	Fixture damage check		Contact Manufacturing Engineer	
6	CNC programme correct (as per instruction)		Contact Manufacturing Engineer	
7	FOD check		Raise issue with cell leader	
8	Etc			

NON-STATISTICAL METHODS
First piece check

The objective of a first piece check is to validate the set-up and quality of a process prior to the full production run.

Prerequisite to a first piece check should be the adherence and confirmation that all other foundational control requirements are met (e.g., calibration, machine tool diagnostics, tooling within prescribed life limits, acceptable parameter settings, consumables level, etc.)

It may be called out in a control strategy:

- Whenever a new production lot is started
- Following maintenance/repairs of measurement systems and production equipment, as well as after software updates.
- At a defined interval (e.g., at the start of each shift)
- When tools used to produce the component contour are replaced, (e.g., diamond rolls, profiled grinding/cutting wheels, etc.)

First-piece checking/inspection may be independent from the production method in a number of ways:

- Inspection by an operator other than the person having performed the operation (two person rule); thus avoiding risks due to bias and other human factors

- Inspection using another inspection tool or inspection method (where possible); thus avoiding/highlighting measurement discrepancies Inspection using another inspection tool or inspection method (where possible); thus avoiding/highlighting measurement discrepancies

NON-STATISTICAL METHODS
First piece check

Example 1

A machined dimension with a known adequate level of capability, achieved at first part check may be deemed sufficient if within 50% of process tolerance; a measurement close to normal limits of operation may result in adjustment and further measurement to bring the process on target.

Example 2

A process with a tendency towards upward drift may have a zone in the lower region of the specification band that provides a standard for process acceptance. Continued conformity as the process drifts naturally through use is provided by a tool life/usage control and typically a run chart or defined limit. The limits has been determined through a previous tool wear study. If the measurement is outside this zone, the operator refers to a process plan defined by the organizations to determine appropriate action (e.g., tool replacement, or adjustment to the tool life/usage standard).

Example 2 uses two other non-statistical methods to set the defined limits for the first piece checks.

NON-STATISTICAL METHODS

Test piece evaluation for process capability – Section 5.10

Characteristics and properties are not directly measurable other than through destructive testing. Use of test pieces processed alongside the product may help to determine the result of the process and also its stability. These test pieces are tested following processing to validate the products of the process and/or confirm the effectiveness of the other process controls. A test piece/coupon should be to a defined standard (thus minimizing the variation in the test material itself).

Examples of processes that use representative test pieces include the following:
- Heat treatment operations
- Surface treatment operations such as shot peening

Examples of evaluation of test pieces include:
- Mechanical property testing using test bars
- Surface contamination coupons in heat treat or thermal processes
- Coupons determining material removal rates in etch and electro-polish processes
- Cast coupons determining chemical analysis of parts from melts
- A forging that has extra material outside the finished part envelope that will be removed for testing.

Note: Test pieces frequently require customer approval and statistical methods are frequently used with results of test piece data.

NON-STATISTICAL METHODS

Test piece evaluation for process capability – Section 5.10

Tensile Bar Test Pieces

Test (1 per Lot) integral bars attached to set-up or casting.
Ship(0) bars to customer. Attached to casting? ☐ NO ☐ YES

Cut test bars: No. of castings: (_____) Test bars per casting (_____)
Type Test Bars: _____ round _____ flat Location: _____ photo _____ as marked
Send remnants of cut casting to customer? ☒ NO ☐ YES

PROPERTIES REQUIRED: ☐G.E. STRAIN RATE ☒REG. RATE

Stress Level	Bar #s	Ultimate	Yield	Elong. %	Signed
Class 4		32.0	22.0	2	Date
					Rounding Info

Other Info: one intergal cast bar per melt and heat treat cycle

#F28 Rev. A

FUTURE WEBINARS

From the Process Control Methods SMIG Group

Look for these future topics in the "Upcoming Events" page on the AESQ website:

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

NO.	FUTURE WEBINAR TOPICS	TARGET DATE/TIME	WEBINAR LEAD	SUPPORTING SUB-TEAM	BRIEF DESCRIPTION
1	Process Control Methods - What is RM13006? Interaction with other AESQ Reference Manuals	12/6/2022 (11 AM US Eastern)	Pete Teti	Nicklas Godebu/Marnie Ham	Overview of RM13006 and how it interacts with other AS13100 reference manuals.
2	What makes a good Process Capability Study?	1/26/2023 (11 AM U.S. Eastern)	Steve Hampton	Marnie Ham/Karen Scavotto	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.
3	Process Capability Study for True Position (handling MMC)	2/8/2023 (11 AM U.S. Eastern)	Grant Braun	Karen Scavotto/Marnie Ham/Shailesh Shinde/Andrew Stout	How do we handle process capability for one-sided or unlateral tolerances such as true position where Maximum Material Condition modifiers may play a role?
4	The use of non-statistically based process control methods	3/8/2023 (11 AM U.S. Eastern)	Paul Gorg	Pete Teti/Earl Capozzi/Rudi Braunieder/Nicklas Godebu	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 limts.
5	The Power of Precontrol	4/11/2023 (11 AM U.S. Eastern)	Andrew Stout	Steve Hampton/Geoffrey Carpentier	PreControl is a powerpul 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.
6	The One-Hour Process Control Assessment	5/16/2023 (11 AM U.S. Eastern)	Pete Teti	Geoffrey Carpentier	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?
7	Why is statistical control a prerequisite for process capability?	Target 2nd Qtr (June)	Marnie Ham	Andrew Stout/Geoffrey Carpentier/Douglas Dush	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 & Cpk.
8	Dealing with Non-Normal Data	Target 3rd Qtr (September)	Karen Scavotto	Marnie Ham/Shailesh Shinde/Andrew Stout	What happens when the data coming from a process is non-normal? What can be done to accuratly assess process capability? We will show you!
9	Conducting capability studies for one-sided geometric tolerances	Target 4th Qtr (October)	Karen Scavotto	Marnie Ham/Shailesh Shinde/Andrew Stout	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?

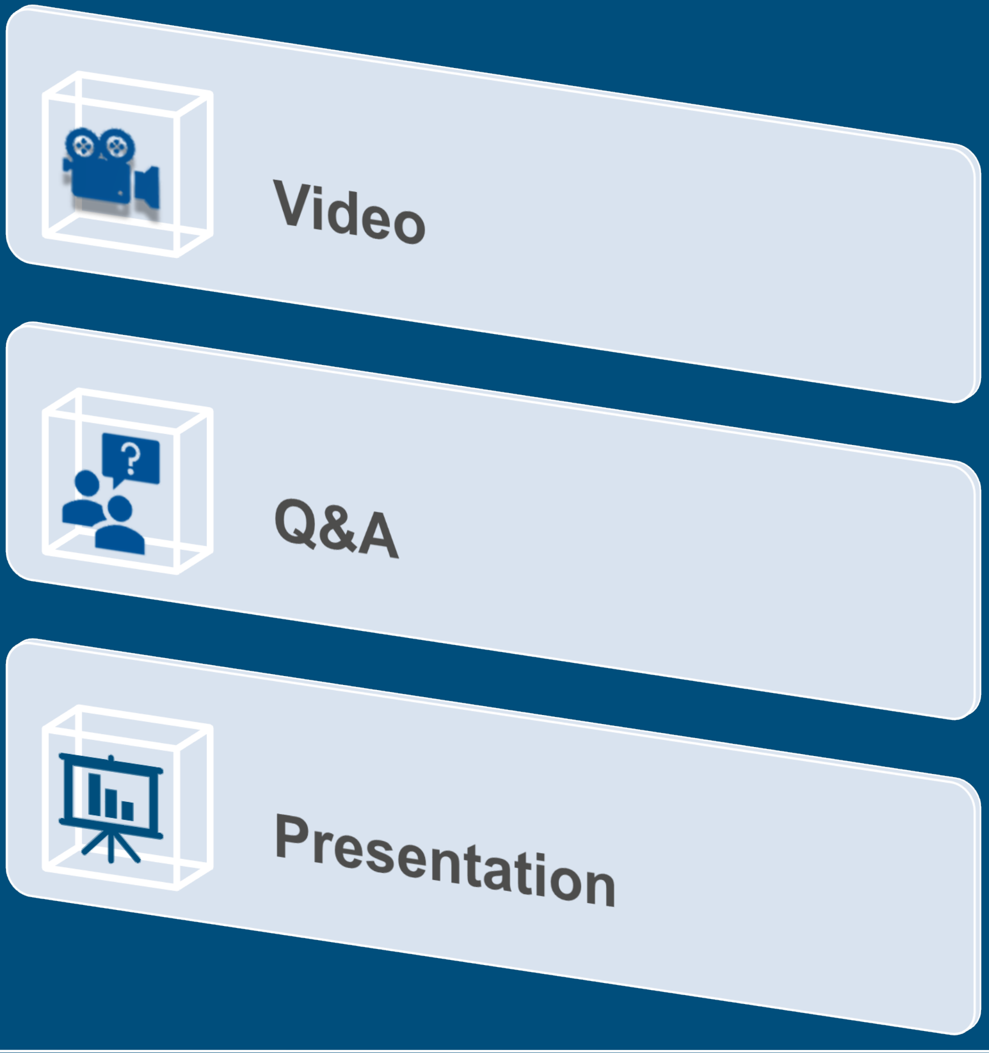
Q & A SESSION

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