Comments on DRAFT **Advisory Circular (AC) 33-13 "Sample Size Considerations for Comparative Test and Analysis for Turbine Aircraft Engine and APU, PMA, and Third-Party Repair Parts"**

Submitted to the FAA email
9-AVS-TechWriters@faa.gov
September 12, 2025

Submitted by the
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with support from Aviation Suppliers Association, Aeronautical Repair Station Association, Commemorative Air Force, International Air Transport Association, National Air Carrier Association

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Submitted to the FAA email
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Dear Mr. Harrison

Please accept these comments in response to the DRAFT **Advisory Circular (AC) 33-13 "Sample Size Considerations for Comparative Test and Analysis for Turbine Aircraft Engine and APU, PMA, and Third-Party Repair Parts."**

Contents

1. Executive Summary

This is not a new proposal. It duplicates a proposal from a decade ago that was a bad idea then, and continues to be a bad idea now.

The draft AC 33-13 rehashes an unwieldy approach to statistical analysis that fails to contribute to aviation safety. It is contrary to the normal methods for demonstrating compliance for many certification and approval projects. The FAA has not offered a safety justification for this guidance.

In past meetings between the FAA and industry, FAA employees have admitted a desire to move the industry to a statistical sampling size approach as the primary approach to performing compliance showings. Such a move would be increasing costs (making it more difficult to demonstrate compliance for reliability-increasing projects) without offering any correlative safety benefit that would justify such cost increases. In many cases, the reason that alternatives are being developed is because of supply chain problems that would make it practically impossible to gather the sample sizes called for by this guidance. The approach proposed in this guidance could have the practical effect of limiting safety-enhancing improvements.

MARPA fears that guidance dictating sample sizes will be used as the basis for sample sizes for other compliance-showing methodologies. Such sample-size formulae are not necessary for other methodologies.

MARPA suggests that this draft advisory circular should be shelved until such time as the FAA can offer a safety justification for it, and then the advisory circular should be narrowly drafted to achieve the safety goals that the FAA has identified.

2. Who is MARPA?

The Modification and Replacement Parts Association was founded to support PMA manufacturers and their customers. Aircraft parts are a vital sector of the aviation industry, and MARPA acts to represent the interests of the manufacturers of this vital resource before the FAA and other government agencies. MARPA's members typically hold production approval in the form of parts manufacturer approval (PMA).

MARPA is a Washington, D.C.-based, non-profit association that supports its members' business efforts by promoting excellence in production standards for PMA parts. The Association represents its members before aviation policy makers, giving them a voice in Washington D.C. to prevent unnecessary or unfair regulatory burden while at the same time working with aviation authorities to help improve the aviation industry's already-impressive safety record.

MARPA represents a diverse group of manufacturing interests – from the smallest companies to the largest - all dedicated to excellence in producing aircraft parts.

MARPA members are committed to supporting the aviation industry with safe aircraft components. MARPA members manufacture and sell aircraft components that typically provide equal or better levels of reliability when compared to their original equipment manufacturer competitors.

MARPA supports efforts to produce guidance that increases the aviation industry's already excellent safety record.

3. Background and History

PMA applicants (and third-party repair developers) use observed/measured ranges and an engineering understanding of the candidate part's Form Fit and Function to develop technical requirements for the PMA design and repair processes.

In some cases, statistical analysis of data can be used to substantiate a particular showing of compliance. Typically, these methods do not directly compare populations but instead compare population ranges. In other cases, statistics of the proposed design are used to support a showing of compliance without comparison to the existing design.

Timeline

The following is a brief history of guidance around statistical guidance and the 'min-max measured' guidance:

> Prior 2005: Typical PMA guidance/practice established that the a +/- 2 standard deviations of the original part could be used to establish the PMA part tolerance.
>
> 2005: FAA Order 8110.42B "Parts Manufacturer Approval Procedures" Chapter 2 paragraph 2-6.c provided sample size guidance and established the 'min-max measured' paradigm.

2008: FAA Order 8110.42C "Parts Manufacturer Approval Procedures" Chapter 2 paragraph 6.c retained the sample size guidance and 'min-max measured' paradigm.

2009: AC 33-8 "Guidance for Parts Manufacturer Approval of Turbine Engine and Auxiliary Power Unit Parts under Test and Computation" paragraph 7.b reaffirmed the 'min-max measured' paradigm and commented that "A purely statistical method for determining the sample size may result in a sample size which is extensive but not practical."

2009: AC 33.83-1 "Comparative Method to Show Equivalent Vibratory Stresses and High Cycle Fatigue Capability for Parts Manufacturer Approval of Turbine Engine and Auxiliary Power Unit Parts" paragraphs 8.a.(5) and 9.(c) established recommended samples sizes and paragraphs 8.b.(2), 8.c.(2) and 9.h pass/fail criteria for showing compliance to § 33.83.

2013: Draft AC 33-X "Statistical Analysis Considerations for Comparative Test and Analysis Based Compliance Findings for Turbine Engine and Auxiliary Power Unit Replacement, Redesign and Repaired Parts" was issued for public comments.

2014: FAA Order 8110.42D "Parts Manufacturer Approval Procedures" Chapter 2 paragraphs 2-8 and 2-9 retained the sample size guidance and 'min-max measured' paradigm.

2014: FAA AC 21.303-4 "Application For Parts Manufacturer Approval Via Tests And Computations Or Identicality" paragraph 26 retained the sample size guidance and 'min-max measured' paradigm.

2014 (August): AC 33-10 "Statistical Analysis Considerations for Comparative Test and Analysis Based Compliance Findings for Turbine Engine and Auxiliary Power Unit Replacement, Redesign and Repaired" was published, attempted to establish a 'means testing / statistical equivalency' paradigm.

2014: MARPA, AIR and ANE met in Washington, DC to discuss AC 33-10. The FAA agreed to withdraw/cancel AC 33-10.

2015: (January): AC 33-10 cancellation published in the Federal Register (80 F.R. 5182).

2016: MARPA met with ANE to discuss the 'means testing / statistical equivalency' paradigm. The FAA proposed limiting the scope and potentially describing non-statistical methods ('min-max measured') as the primary approach and statistical methods as a secondary approach. The result of the meeting was that the FAA agreed to withdraw and revise the project and provide safety data to justify its decisions.

> 2025: Draft AC 33-13 Sample Size Considerations for Comparative Test and Analysis for Turbine Aircraft Engine and Auxiliary Power Unit (APU), Parts Manufacturer Approval (PMA), and Third-Party Repair Parts" issued for public comments.

In summary, the "Min-Max Measured' paradigm and its associated sample size guidance has been the accepted, reaffirmed, and the preferred methodology for approximately 20 years. There appears to be no data showing that statistical analysis is significantly used, nor that it reflects a safety issue.

'Min-Max Measured' paradigm

FAA Order 8110.42B established the 'min-max measured' paradigm.

> "Variations in the sample measurements and accepted engineering practices determine the tolerances in part dimensions. The resulting tolerances for the PMA part should not exceed the minimum and maximum dimensions measured on the sampled approved parts. Exceeding these limits requires substantiation."

Updates to Order 8110.42 and the issuance of AC 21.303-4 have continued to reinforce that guidance. The current guidance in Order 8110.42D Change 2 is

> "Variations in the sample measurements and accepted engineering practices determine the tolerances in article dimensions. The resulting tolerances for the PMA article cannot exceed the minimum and maximum dimensions measured on the sampled approved parts. Exceeding these limits requires further substantiation and acceptance by the certification branch."

For Turbine Engine and Auxiliary Power Unit Parts, AC 33-8 proposes the same measured data methodology.

> "b. When reverse engineering, we recommend taking measurements from multiple type design samples to create the tolerance bands for the drawings and specifications of the proposed PMA part. These tolerance bands tend to be tighter than those of the type design, particularly if based on a limited sample size. A purely statistical method for determining the sample size may result in a sample size which is extensive but not practical. The drawing tolerances determined by reverse engineering for the proposed PMA part should not exceed the measured data (unless substantiated). Applicants should verify that their proposed PMA part can be manufactured to these tighter tolerances. If tighter tolerances cannot be achieved, then the applicant may either:
>
> (1) Analyze more type design parts to expand the reverse-engineered tolerances, change the drawing requirements, and support the manufacturing process; or
>
> (2) Use a more precise manufacturing method (for example, grinding versus milling) to bring the proposed manufactured part within tolerances."

As discussed in the FAA guidance, the 'min-max measured' methodology is more conservative with smaller sample sizes.

MARPA and ANE (now AIR-625) meeting on AC 33-10

In 2016, MARPA and ANE met to discuss case study on the application of AC 33-10 statistics regarding the effect of FAA proposal on mean-testing and sample size. The intent was to show the FAA what are the consequences of applying the Statistics AC to an existing population of parts known to be airworthy and have successfully flown for 15 years. The use of the then-proposed Statistics AC would have caused that population to be rejected despite the fact that it was known to be airworthy and safe.

During the meeting, the FAA admitted that the draft did not respond to any known safety issue. FAA employees also asserted that they wanted to change industry paradigms to follow the model that would have been prescribed by AC 33-10. Due to the likelihood that FAA employees might require this compliance demonstration method, this would have an adverse effect on costs, including costs that affect small businesses without resolving any correlative safety benefit. The adverse impact on costs could have had a negative impact on safety by inhibiting development of alternatives and reliability-enhancing aircraft parts.

Statistical Equivalency

In the draft AC, the FAA states that they have "observed that PMA applicants use a variety of statistical principles and methods in their comparative test and analyses to show the proposed PMA part meets airworthiness standards by substantiating that it is at least equal to the original article approved under a type certificate in a particular area or attribute." MARPA has polled its members and did not find any member who is using "statistical equivalency" to support a showing of compliance.

The methodology presented for showing 'statistical equivalency' is accurate, but as the AC states, it relies on some assumptions. In particular, the populations need to:

1. be normally distributed (or convertible into a normal distribution)[1]
2. have the same variance
3. not be truncated or "inspected in"

Appendix A paragraph A.2.5 of the draft AC addresses some potential issues with the 'statistical equivalency' approach.

1. A.2.5.3 provides examples of transformations of other distributions into a normal distribution.

[1] Unlike a human population in a drug trial, there is no reasonable way to validate that a distribution is "normal" among aircraft parts. Because the distribution of approved parts is known to be airworthy, it is common for the FAA to only permit geometries and dimensions within measured ranges. Such ranges can typically be measured directly.

2. A.2.5.2 cautions that "In addition, any attempt to identify statistical tolerance limits, as opposed to using measured tolerance limits, will likely result in a proposed part that is not within demonstrated experience, because it is not within the approved part tolerance."

   Note: A.2.5.2 is pointing the applicant back to the 'min-max measured' paradigm, which is the current supported methodology for setting tolerances.

The draft AC does not address the 2nd condition, but we will here.

3. The populations must have the same variance.
   a. If the proposed part had a smaller variance than the approved part, the populations would, by definition, be statistically different. So long as the range of the proposed part is within the 'min-max measured' range of the approved part, the proposed part is better controlled than the approved part.
   b. If the proposed part has a larger variance than the approved part, the populations will, by definition, be statistically different. In this case the proposed part would have values outside of the 'min-max measured' range of the approved part, and the PMA applicant would need to either 'inspect in" the quality or improve the manufacturing process control.

The draft AC's guidance on 'statistical equivalency':

- points back to the 'min-max measured' methodology is more appropriate.
- would reject the proposed part with better process control.

The 'statistical equivalency' methodology could accept proposed parts that go beyond the approved part tolerance and could reject proposed parts that are well within the approved part tolerance. Whereas the 'min-max measured' methodology is more conservative and consistent with the desired outcome (PMA parts within the observed range of the approved parts).

Design vs Production

During PMA development, including reverse engineering, the drawing is developed before any parts are manufactured. The typical PMA process shows that the drawing (proposed design) is equivalent to the approved parts. Production of the initial lots cannot begin, nor can conformity be shown, until the approved (by the applicant) drawing is in place.

FAA Order 8110.42 and ACs 21.303-4 and 33-8 provide adequate guidance on the process of developing compliance data to support the various showings of compliance required for any project. AC 21.303-4 paragraph 25 describes the three typical methodologies for showing compliance. Paragraph 26 goes on to provide reverse engineering guidance, including sample sizes and the 'min-max measured' methodology. This methodology is used in advance of producing any parts. Once the descriptive data (drawing) of the design is set, then the produced parts must be produced and conform to the drawing.

Depending on the applicants' proposed compliance methodology, the produced parts may be tested to find direct compliance with a particular regulation or be used for a comparative test analysis. "For example, showing compliance with 14 CFR 33.83 for replacement blades in turbine engines entails comparing their vibratory characteristics to those from a type certificate. See AC 33.83-1 for specific guidance." AC 21.303-4 paragraph 25(b).

Focus on specific Use Cases

In the example above, showing compliance with 14 CFR 33.83, the FAA developed specific guidance, AC 33-83-1. This guidance does not seek 'statistical equivalency.' The pass/fail criteria in that AC specifically look for the (statistical) natural frequency ranges of the PMA part to be within the (statistical) ranges of the approved part it is replacing. Similarly, the pass/fail criteria for strength, looks for the (statistical) minimum fatigue strength to be at least equal to the approved part.

This is a good example of crafting statistically based pass/fail criteria for a particular application that considers that the PMA (proposed) part may be better controlled and/or stronger than the approved part that it is replacing.

Indirect features, (i.e. natural frequencies and mode shapes, component fatigue strength) cannot be measured directly but must be tested as a finished part. If there are specific indirect features of concern, the FAA should work with industry to develop guidance on how to show compliance with those specific requirements.

Safety Benefit and Justification

In the draft AC, the FAA states that they have "observed that PMA applicants use a variety of statistical principles and methods in their comparative test and analyses to show the proposed PMA part meets airworthiness standards by substantiating that it is at least equal to the original article approved under a type certificate in a particular area or attribute." MARPA did not find any member who used "statistical equivalency" to support a showing of compliance. Moreover, the FAA guidance for the last 20 years has been to use the 'min-max measured' paradigm and not to use statistically developed tolerances.

Since 2005, when FAA Order 8110.42B introduced the 'min-max measured' paradigm, or since 2013 with the FAA first proposed a draft AC on 'statistically equivalency,' we are not aware of any safety issues that have arisen based on an applicant inappropriately applying statistics in a PMA application.

In 2016 the FAA committed to provide safety justification, to limit the scope, and to point to the 'min-max measured' as the primary methodology and 'statistical equivalency' as secondary.

Under a risk-based approach, this draft guidance appears to (1) be an approach that is not common and is therefore a low level of likelihood and (2) be an approach that does not mitigate a high level of risk because inadequate statistical analysis would already be rejected as non-compliant, even without this guidance.

4. Specific Comments

Focus on Specific Use Cases

These comments are about the draft AC in general. The FAA should focus on the particular problem that has been identified as a safety concern. The FAA should provide the safety justification for any concerns that it raises. The remainder of the comments are areas that are particularly objectionable.

PAGE#	PARA#	C, E, OR F	COMMENT/RATIONALE	RECOMMENDED CHANGE/PROPOSED REWRITE	RESOLUTION OF COMMENT
All	All	C	The FAA has existing guidance (AC 21.303-4, AC 33-8 and Order 8110.42) on sample sizes and tolerancing methodologies for PMA parts. There is no need for a new, contradictory piece of guidance that would add confusion. If the FAA perceives gaps in applicant showings of compliance, the FAA should either work with the specific applicants or develop specific guidance for those particular showings.	Do not issue this AC. Work with the specific applicants on closing compliance / understanding gaps. Develop specific guidance for showing compliance to particular regulations, similar to AC 33.83-1 and AC 33.87-2.	
4	5.2	C	The draft AC states that "In the past, some applicants…" If the issue is a past issue that has been addressed by Order 8110.42 revisions, AC 21.303-4 and AC 33-8 issuance, then there is no need to issue this AC. MARPA has polled its members and did not find any member who is using "statistical equivalency" to support a showing of compliance.	Do not issue this AC if it attempts to address an issue that is not a current issue.	

'Min-Max Measured' vs 'Statistical Equivalency'

The following comments are areas that are particularly objectionable specific to prioritizing the 'min-max measured' methodology over the 'statistical equivalency' model. (See above for additional rationale.)

PAGE#	PARA#	C, E, OR F	COMMENT/RATIONALE	RECOMMENDED CHANGE/PROPOSED REWRITE	RESOLUTION OF COMMENT
1	1.1	C	'Min-Max Measured' should be the primary methodology recommended and 'Statistical Equivalency' should be secondary. (See above discussion for more rationale.)	This AC should not be issued, since the 'Min-Max Measured' is currently established in AC 21.303-4, AC 33-8 and Order 8110.42.	
3	4	C	For the last 20 years the FAA guidance and industry practice has been to use the 'min-max measured' methodology. MARPA represents a significant fraction of the PMA applicant community. We are not aware of any of our members using statistically incorrect methodologies. (See above discussion for more rationale.)	This AC should not be issued, since the 'Min-Max Measured' is currently established in AC 21.303-4, AC 33-8 and Order 8110.42.	
4	5.3	E	Chapter 5 "STATISTICAL PRINCIPLES DISCUSSION." is focused on the proper use of statistics. As discussed above, 'statistical equivalency' is not typically used when developing PMA parts or Major Repairs.	This AC should not be issued, since the 'Min-Max Measured' is currently established in AC 21.303-4, AC 33-8 and Order 8110.42.	

Focus the Scope

The following comments are areas that are particularly objectionable or?? specific to scoping this AC. (See above for additional rationale.)

PAGE#	PARA#	C, E, OR F	COMMENT/RATIONALE	RECOMMENDED CHANGE/PROPOSED REWRITE	RESOLUTION OF COMMENT
1 1 1 2 2	Title 1.2 2.1 3.1 3.2	C	Most repairs are out of scope of this AC. Repairs are typically one-off repairs that restore the article "worked on will be at least	This AC should not be issued. Repairs are well outside of the scope.	

3	3.2		equal to its original or properly altered condition." For the vast majority of repairs, there is not a population of repaired parts that can be compared to the original approved part. Each repair should be evaluated based on the existing guidance. AC 33-9 provides guidance for repair development.		
1	2.1	C	New TCs and STCs are out of scope of this AC. New TCs and STCs are, by definition, major changes to type design. Therefore, the TCs and STCs should not be expected to be statistically equivalent to the prior design.	This AC should not be issued. New TCs and STCs are well outside of the scope.	
A-1	A.2.1	C	Features that can be directly measured should be evaluated based on the 'min-max measured' paradigm. Statistical comparisons should be limited to indirect features or parameters. As discussed in other comments, specific guidance for those indirect features or parameters should be developed separately.	This AC should not be issued. Features that can be directly measured are well outside of the scope.	

Production Lots vs Demonstration

The following comments are areas that are particularly objectionable specific to design substantiation vs production control. (See above for additional rationale.)

PAGE#	PARA#	C, E, OR F	COMMENT/RATIONALE	RECOMMENDED CHANGE/PROPOSED REWRITE	RESOLUTION OF COMMENT
A-1	A.2.1	C	The intent of paragraph A.2.1 of using samples across multiple lots of the 'approved part' to "provide a more representative description of the approved part." is sound. This will enable the applicant to better characterize the approved part range.	This AC should not be issued. The AC proposes impractical 'minimums.''	

			However, there is not a consistent methodology for OEMs to identify specific production lots. (There is no requirement in Part 45 for any DAH to mark production lots) so there is no practical way to verify that most parts are from different production lots. There should be recognition that the applicant may not be able to obtain multiple samples from different approved part production lots and/or the applicant may not be able to identify different production lots.		
A-1	A.2.1	C	Since the intent of PMA approval is to show that the Design of the proposed part is equivalent to the approved, the initial Design approval and Production Control are separate items..	This AC should not be issued. Production control is separate from Design approval.	
B-2	B.1.2	C	There should be recognition that the applicant may not be able to identify different production lots.	This AC should not be issued. The AC proposes impractical 'minimums.'	

Other miscellaneous comments

The following comments are areas that are particularly objectionable not specifically related to any of the above major topics.

PAGE#	PARA#	C, E, OR F	COMMENT/RATIONALE	RECOMMENDED CHANGE/PROPOSED REWRITE	RESOLUTION OF COMMENT
4	5.2	E	Paragraph 5.2 starts with 'some applicants' and then states, 'many applicants.' This implies that the misuse of statistical methods is prevalent. MARPA has polled its members and did not find any member who is using "statistical equivalency" to support a showing of compliance.	Do not issue this AC if it attempts to address an issue that is not a current or prevalent issue.	

4	5.4	E	In the 5th sentence of paragraph 5.4, the draft AC states that "The common practice..." MARPA has polled its members and did not find any member who is using "statistical equivalency" to support a showing of compliance. Therefore, we do not think that this is a 'common' practice	Do not issue this AC if it attempts to address an issue that is not a current, prevalent or common practice.	
A-1	A.2.3	E	AC 21.303-4 provides guidance on sample size and the 'min-max measured' paradigm. Since that AC would apply to PMA applications, this paragraph implies that this AC guidance would never apply.	Do not issue this AC. Work with the specific applicants on closing compliance / understanding gaps.	

5. Conclusion

We believe that issuing this AC is not necessary and would only add confusion by adding guidance that disagrees with existing guidance in AC 21.303-4 and AC 33-8. We believe that the FAA should work with specific applicants on closing compliance / understanding gaps. The FAA could also develop specific guidance for showing compliance to particular regulations, like AC 33.83-1 and AC 33.87-2.

The trade associations have identified multiple areas that are particularly objectionable (*as described in the table)*.

Thank you for providing this opportunity to assist in the development of this guidance.

Respectfully Submitted,

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