**Geometry and Dimensional Considerations for Comparative Test and Analysis for Turbine Engine and Auxiliary Power Unit Replacement, Redesign, and Repaired Parts**

Comments on the Draft Advisory Circular 33-Geometry
published online for public comment at http://www.faa.gov/aircraft/draft_docs/ac/

Submitted to Mark Bouyer via email to mark.bouyer@faa.gov

**Submitted by the**
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July 7, 2014

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Dear Mr. Bouyer:

Please accept these comments in response to Draft AC 33-Geometry, Geometry and Dimensional Considerations for Comparative Test and Analysis for Turbine Engine and Auxiliary Power Unit Replacement, Redesign, and Repaired Parts, which was published for public comment at http://www.faa.gov/aircraft/draft_docs/ac/.

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## 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 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 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.

## Comments

### Paragraph 4.a. could cause confusion regarding existing standards

#### Issue

Paragraph 4.a. states that "Generally accepted industry standards for establishing the dimensions and tolerances of engine parts don't exist." This statement is partly inaccurate and could lead to confusion.

#### Discussion

It is accurate that there is no single industry-wide accepted standard for establishing dimensions and tolerances; however, there are numerous standards that have been developed and which are accepted throughout the industry. Additionally, the FAA itself provides some guidance for reverse engineering and technical data development, including tolerance development, in Advisory Circulars AC 33-8 and AC 33-9.

While each engine and APU manufacturer has developed its own accepted standard, the industry has a number of standards for dimensions and tolerances. One example of this would be the American Society of Mechanical Engineers Y14.5-2009. Another example is the American Bearing Manufacturers

Association standards. Further, the FAA provides its own standards in the form of Technical Standard Orders. In each case, the standards are widely and publicly available.

### Recommendation

Because there are many publicly available and accepted industry standards, we recommend deleting Paragraph 4.a. and beginning the section at Paragraph 4.b. This will eliminate possible confusion with respect to publically available standards.

## Section 5.j. appears inconsistent with existing FAA guidance.

### Issue

The statistical dimensioning described in Section 5.j. appears out of step with current FAA guidance on the subject and should therefore be reworked for consistency.

### Discussion

FAA AC 21.303-4 and FAA Order 8110.42D already provide guidance with respect to tolerances outside of measured data. These guidance documents have been vetted by the FAA and industry, finalized, and issued for use.

Multiple explanations of the same principles create the possibility of confusion both within the industry and within the FAA. Whenever possible, we should endeavor to avoid reinventing the wheel and rely on and replicate already-existing language, when that language is sufficient to serve our purposes.

FAA AC 21.303-4 Paragraph 26 (c) provides instructive language that should be relied on here, explaining the current practice for min-max testing of articles: "the resulting tolerances for the PMA article should not exceed the minimum and maximum dimensions measured on the sample approved articles…." Such language addresses the concern that arise out of statistical dimensioning described in this section.

### Recommendation

We recommend the conflicting paragraphs be deleted and a cross reference to AC 21.303-4 and Order 8110.42D be included at the end of the section. Corresponding references to these documents should also be included at the beginning of the AC.

## Paragraph 5.l.1 may cause confusion by implying that articles that interact with critical parts may be nearly impossible to develop without access to the type design and manufacturing details.

### Issue

Paragraph 5.l.1. explains that dimensional variations of replacement parts could have an effect on the integrity of critical parts, however, proper reverse engineering techniques will address these concerns.

### Discussion

Paragraph 5.l.1 explains that "[i]nteractions occur at interfaces where the parts make physical contact, and at interfaces that do not touch but provide the boundary conditions to maintain the operating environment

within certain limits." It further states that "[i]f the dimensioning techniques allow for more variation in the replacement part, then differences could exist in the replacement part. The effect of dimensional differences in parts that interact with critical parts is very difficult to assess without substantial type design and manufacturing details."

It is true that if improper dimensioning techniques are applied then the resulting measurements may not produce an accurate design. However, it is inaccurate to assert that type design and manufacturing details are necessary to develop accurate dimensional measurements. Rather, it should be emphasized that the proper application and execution of reverse engineering techniques will ensure the dimensional considerations are properly accounted for when developing both critical parts and those parts that interact with critical parts.

Application of proper reverse engineering techniques should be emphasized to make applicants aware of the importance of developing accurate measurements, as type design and manufacturing information are unlikely to be available.

### Recommendation

We recommend revising the paragraph to emphasize the importance of taking into account the effect dimensional differences may have on part that interact with critical parts. Applicants should be advised to ensure use of proper reverse engineering techniques to account for all dimensional considerations.

## Paragraph 5.l.3 implies that product testing is the only method for obtaining necessary data for life limited parts.

### Issue

Paragraph 5.l.3. states that "[n]ormally, the information required for a lifing method is only available through product testing." However, other methods are available to collect data for lifing methods.

### Discussion

A large number of various inputs are used to develop lifing methods. Paragraph 5.l.3 suggests that the only test method available for obtaining these inputs is through product testing. For small businesses, and even for many large businesses, full product testing is simply not feasible; either from a cost perspective in obtaining the product, or a competition perspective whereby a TC holder may be unwilling to sell the product to a competitor.

Data used for developing lifing methods can be, and is, obtained from a number of different test methods. These methods may include specimen test data, component testing, engine testing, and burner rig testing. The use of these and other methods, in isolation or in combination as may be required, can also provide the necessary data to develop lifing methods.

### Recommendation

The paragraph should be revised to explain that other testing methods may be used other than product testing alone.

## Section 5.n. Selective Assembly does not accurately reflect the state of the industry.

### Issue

Section 5.n. Selective Assembly asserts that certain parts of a given part number may be selected for use in particular higher-level assemblies, but for various reasons, such as high operating severity, other parts of the same part number may not be appropriate for use in the same assembly. This implies a dangerous practice currently exists with respect to select use of discrete units within the same part number that may be undiscoverable not only to replacement parts manufacturers, but operators and maintenance providers as well.

### Discussion

Paragraph 5.n.1. states that "[a] single part number could be eligible for installation in a variety of engine models with different ratings, operational limits, and missions, but only some of the parts are considered eligible for installation in products with the highest operating severity." This statement alone seems to suggest that those particular parts "eligible for installation in products with the highest operating severity" should be called out with a unique part number.

Paragraph 5.n.2 elaborates:

> Selecting the most desirable part for a specific engine model can include criteria that identify dimensional attributes that are either biased to one side of a tolerance band, or are closest to nominal dimensions. For example, parts manufactured closest to the nominal shape might be selected for the most severe operating conditions, if the nominal drawing dimensions represent the ideal design, while the remaining parts are used in less severe environments. Also, TC holders may hand-select parts and group them together, based on their dimensional properties to preserve key characteristics in a higher level assembly. This criterion can effectively restrict certain parts from being mixed at random, or distribute parts for assembly into a family of product models. Examples of the kinds of parts that could be managed by selective assembly are interfacing gears, piston and sleeve combinations, parts that assemble with interference fits, and parts where average moment weight is maintained below a specified limit to preserve the integrity of interfacing life-limited parts. Higher level assembly drawings, which have this dimensional criterion for selective assembly, would not necessarily be discovered by examining type design parts.

This is cause for significant concern. Current industry practice does not anticipate or provide for a selection process to identify within a particular part number those discrete units that are "most desirable" for a specific engine. Maintenance manuals call out a specific part number for the application rather than call out a part by its characteristics within a tolerance band.

Nowhere in Appendix A to Part 33 of the Federal Aviation Regulations is there any indication that the Instructions for Continued Airworthiness (ICA) should include instructions or criteria that would inform a maintenance provider in the appropriate technique for selecting the "most desirable" part from a lot of a

given part number. This seems to suggest that such a practice is unnecessary, or at a minimum not currently contemplated by the regulations. That such a selection practice is unnecessary is supported by current airline maintenance practices.

When an airline or other operator is operating a family of engines, a particular work card identifies a part only by its assigned part number. The use of that part number is permitted through the engine family as permitted by the engine manual. The engine manuals and ICA do not identify specific physical properties of parts within a given lot of a part number as being applicable to only certain serial numbers of engines. A given part number is either the correct part for the application or it is not; such appropriateness is indicated by the part number alone. If additional selection criteria are required for use of part numbers within an engine family, these criteria must be provided in the maintenance manual and ICA. This is not current practice.

### Recommendation

Because it is not currently necessary to select a specific "most desirable" part for a specific engine to maintain airworthiness, we recommend omitting section 5.n. Selective Assembly from the final version of the AC. If selective assembly is current industry practice, then we recommend the FAA immediately issue Airworthiness Directives for all applications for which selective assembly considerations are necessary.

## Paragraph 5.t.4 contains guidance that appears beyond the scope of the AC.

### Issue

The concluding sentences of paragraph 5.t.4. address influencing parts in general rather than specific geometric concerns.

### Discussion

The final two sentences of paragraph 5.t.4. address influencing parts listed in ICA maintenance manuals. The paragraph admonishes that reverse engineering techniques commensurate with the complexity of the parts and assemblies in which they operate should be used. However, no specific guidance with respect to geometry, tolerances, data collection, or testing is provided.

FAA Order 8110.42D and FAA AC 21.303-4 already provide information about influencing parts. Because this information is already available, and because no additional guidance is provided here, the final to sentences of this paragraph seem unnecessary.

### Recommendation

We recommend deleting the final two sentences of paragraph 5.t.4.

# Conclusion

MARPA looks forward to working with the FAA to better improve aviation safety. We are happy to sit down with you to work on ways to improve the guidance if you would like further input. Your consideration of these comments is greatly appreciated.

Respectfully Submitted,

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