

	<h1>AVS</h1> <h2>Quality Management System</h2>	QPM # AIR-001-007-F1	Revision 0
		Title: Document Review Log	Date: June 19, 2009

1. Document No.: 33.87-1A, Engine Overtorque Test, Calibration Test, Endurance Test, and Teardown Inspection for Turbine Engine Certification (§§ 33.84, 33.85, 33.87, 33.93)	2. Project Manager: Dorina Mihail, 781-238-7153 Daniel Tibuni 781-238-7181 ANE-111	3. Reviewing Office: Reviewer's Name & phone #: GE Aviation Peter G Thompson (513) 552-3388	4. Date of Review: 7/9/ 2014	5. Date of Disposition: 9/8/ 2014
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Project manager's disposition in comments in the last column below. Enter the reasons for non-incorporated comments. Identify each disposition as:

- **Adopted;**
- **Partially Adopted;**
- **Non-Concur;**
- **Concur but Outside of Scope (Will be considered in next change/revision); or**
- **Answer to Question or Statement.**

Item No:	Page and Paragraph No:	Comment:	Reason:	Recommendation:	Disposition:
1.	Chapter 1. General 1-1. Definitions Page 1	Revise: "f. Triple redline test condition. The engine operation at simultaneous redline rotor speeds, redline gas temperature, and full rated thrust or torque, as required by § 33.87(a)(3)."	The commenter believes that clarification that the term "triple" refers to simultaneous redline operation of 2 rotor speeds and gas temperature, as opposed to rotor speed + gas temperature + thrust, is warranted.	"f. Triple redline test condition. The engine operation at simultaneous redline two (2) rotor speeds (e.g. low pressure and high pressure rotor systems) and redline gas temperature, in addition to full rated thrust or torque, as required by § 33.87(a)(3)."	Partially Adopted. The proposed revision applies to engines with two shafts and would not apply to engines with a three shaft system. We did not revise the text, but added the suggested wording as an example.

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2.	Paragraph 2-2.c Page 2	Revise: “c. Applicants should run the calibration tests with a clean inlet and exhaust, and without special test equipment, such as inlet screen, pre-swirler, mixer screen, or non-type design exhaust nozzles.”	The commenter believes that the additional wording is needed because it is common to use slave test exhaust nozzle equipment during calibration testing since type design nozzle hardware is rarely available or not practical for use in this type of test environment. Furthermore, as long as a slave nozzle can be shown to be representative of the intended type design, with respect to pertinent characteristics such as internal and external flowpath profiles along its length and around its circumference (including nozzle inlet and exit areas). then its use should be permitted.	“c. Applicants should run the calibration tests with a clean inlet and exhaust, and without special test equipment, such as inlet screen, pre-swirler, mixer screen, or non-type design exhaust nozzles <i>that cannot be demonstrated to be suitably representative of intended type design.</i> ”	Concur. We concur with this comment. However, we did not make a change to the AC because the recommended guidance already exists in the same (cited) paragraph 2-2.c. It states: “When special test equipment is necessary to obtain simultaneous redline conditions during the endurance test, applicants must address the engine configuration changes. See paragraph 3.1.c. and Appendix 4 of this AC for further guidance.”
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3.	Paragraph 2-2.c Page 2		The commenter knows that past practice of some applicants has been to provide such adjustment proposals within FAA-approved 33.85 test plans.	Within 2-2.c. or possibly within a new subparagraph guidance should be provided to allow measured test engine calibration power or thrust to be adjusted in order to provide direct comparison to TCDS rated power or thrust. Suggested wording: "With prior approval the applicant may apply adjustments to the power or thrust values measured during the calibration tests in order to provide a direct comparison to the values the values to be included on the TCDS. All adjustment parameters and methodologies should be provided."	Partially Adopted. The recommended guidance already exists in this AC in paragraphs 3-4.a.(2)(a) and (b), page 18. However, for clarity, we added a reference to these paragraphs. Also for clarity, we added the same reference to paragraph 3-2.c.(2), page 10.
4.	Paragraph 3-1.a.(1)(a) Page 4	Revise: “(a) Continue to produce its rated power or thrust at the end of the test in §§ 33.87(b), (c), (d), (e), or (g) without exceeding any of the operating limitations prescribed in the TCDS or §§ 33.4, 33.5, and 33.7.”	Although the commenter does not understand the reason for adding the word “or” to this sentence. TCDS limitations should be the same as those defined by compliance to 33.4, 33.5 and 33.7 and believes the suggested wording to be more appropriate.	“(a) Continue to produce its rated power or thrust at the end of the test in §§ 33.87(b), (c), (d), (e), or (g) without exceeding any of the operating limitations <i>defined by compliance with</i> §§ 33.4, 33.5, and 33.7, <i>and as prescribed in the TCDS.</i> ”	Adopted.

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5.	Paragraph 3-1.a.(1)(d) Page 4	Revise: “(d) Demonstrate the maximum compressor bleed air capability for engine and aircraft use.”	The commenter believes that the domestic bleed exclusion is appropriate and consistent with past applicant and FAA agreements on engine bleed demonstration requirements.	“(d) Demonstrate the maximum compressor bleed air capability for engine and aircraft use. <i>Excluded here is compressor bleed air used for internal engine (domestic) cooling and purge and also bleed air used for engine flow path active clearance control purposes.</i> ”	Partially Adopted. The guidance in the cited paragraph is a general, top level guidance not intended to provide the recommended level of detail. However, the detailed air bleed guidance is provided in paragraph 3-2.e., page 12; the specific concern is addressed in paragraph 3-2.e.(5), page 13. For clarity, we added the reference to paragraph 3-2.e.
6.	Paragraph 3-1.a.(1)(e) Page 4	Revise: “(e) Demonstrate acceptable operation at minimum and maximum fuel and hydraulic fluid pressure limit conditions.”	The commenter believes that clarification that the pertinent fuel pressure location is at the engine fuel inlet, rather than locations such as aircraft tank outlet, engine fuel pump inter-stage, fuel pump outlet, etc. is appropriate.	“(e) Demonstrate acceptable operation at minimum and maximum <i>engine</i> fuel <i>inlet</i> and hydraulic fluid pressure limit conditions.”	Partially Adopted. The fuel pressure is a limitation under § 33.7(c)(6)(i). AC 33.7-1 provides guidance for the fuel pressure limit(s) locations. It specifies that the recommended “fuel inlet” as a location is not sufficient. For clarification, we added a reference to AC 33.7-1 in the cited paragraph.

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7.	Paragraph 3-1.c.(1) Page 6		The commenter believes the removal of the statement regarding the use of less capable non-type design hardware and conversely the exclusion of more capable hardware is redundant and not required in light of the preceding statement regarding the need to provide evidence that non-type design hardware is representative of type design capabilities, durability, etc.	Delete the following sentence: “The applicant may use non-type design parts that are less capable than type design parts to withstand the rigors of the test environment, but may not use parts that are more capable than typical type design parts.”	Adopted.
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8.	Paragraph 3-1.c.(1)(a) Page 7		The commenter believes this guidance should not be limited to just triple redline test operations and that removal of the "...and that the engine still complies with § 33.87 requirements." is appropriate since following this guidance requires proof before the fact on the part of the applicant.	"(a) The standard type design configuration and operating characteristics of some turbine engines may preclude achieving <i>all test conditions required</i> for compliance with § 33.87(a)(3). Modification of certain test equipment, engine configurations, and test sequences may be necessary to run the test at triple redline conditions. The applicant should show through analysis that the test engine, with any modifications, still represents the durability and operating characteristics of a typical type design engine, and that the engine still complies with § 33.87 requirements. "	Partially Adopted. (1) We did not concur with the first recommendation. The guidance provided in this paragraph specifically applies to the triple redline test conditions required by § 33.87(a)(3). We did not make any change. (2) We revised the sentence suggested for deletion to read: "...and that the engine still complies is capable of complying with § 33.87 requirements." This revision rules out the commenter's interpretation that "proof before the fact on the part of the applicant" is required.
9.	Paragraph 3-1.c.(3) Page 7		The commenter believes that this information is not appropriate for this section of the AC and would be better placed in appendix 5 with all other conformity and TIA information. The note to review appendix 5 (below this item) would direct the reader to this information.	Move this paragraph to Appendix 5.	Adopted.

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10.	Paragraph 3-1.d.(4) Page 8			(4) Applicants should <i>maintain instrumentation and measurement system calibrations</i> throughout the duration of the test. <i>This may be accomplished using established, recognized and documented applicant procedures which are made available to the FAA when requested.</i>	Adopted.
11.	Paragraph 3-1.e.(1) Page 8		The commenter believes that the information related to 33.63 and 33.83 is not appropriate for this AC.	Delete paragraph 3-1.e.(1)	Partially Adopted. We did not delete the entire paragraph. We removed all references to § 33.63 and § 33.83 compliance, but maintained the vibration signature test needed for compliance with § 33.87.
12.	Paragraph 3-1.e.(2) Page 9		The information related to engine oil consumption monitoring and level maintenance would be better placed in the subsequent sub-item.	Move paragraph 3-1.e.(2) under paragraph 3-1.f. Servicing and repairs during the endurance test	Adopted.

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13.	Paragraph 3-2.(b) Page 10		The commenter believes that the terminology “type design”, rather than “final production” is more appropriate and consistent. Additionally that a reference to the section of the AC related to test engine configuration is appropriate for software modifications that may be needed and avoids duplication of content.	Revise the last sentence to read: “Software used for engine control should be representative of the <i>type design</i> version. <i>See 3.1.c for additional guidance related to test engine configuration.</i> ”	Adopted.
14.	Paragraph 3-2.(c)(1) Page 10		The commenter believes that the proposed clarification of the minimum demonstrated values is appropriate.	Revise the second sentence to read: “This means that applicants must run the endurance test to <i>no less than</i> the maximum permissible (or redline) rotor speeds, gas temperature, and rated power, torque, or thrust values proposed for certification and prescribed in the engine TCDS.”	Non-Concur. The clarification is already provided in the next sentence, which is the last sentence of the paragraph. That clarification is more comprehensive.
15.	Paragraph 3-2.(c)(2) Page 11		The commenter finds that the definition of physical power, thrust and torque have been removed from 1.1 in this draft AC so this reference is not appropriate.	“(2) At each rating condition during the endurance test, the test engine must maintain rated power, thrust, or torque, which are the minimum physical power, thrust, or torque values meeting <i>the definition in § 1.1 and</i> the requirements of §§ 33.7(a), (c), and 33.8(b).”	Partially Adopted. § 1.1 refers to 14 CFR part 1, § 1.1 General definitions, not the definitions section of this AC. However, to avoid confusions we revised the text.

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16.	Paragraph 3-2.(c)(4) Page 11		The commenter believes that the proposed rewording clarifies and simplifies the guidance without modifying its intent.	Revise last sentence to read: "However, all endurance testing should be conducted on <i>a single</i> set of engine hardware that the applicant presents for certification. "	Adopted.
17.	Paragraph 3-2.(c)(5) Page 11		The commenter believes that the elimination of the quotations marks around the word redline is appropriate and consistent with the remainder of the draft AC content.	Remove quotation marks around the word "redline"	Adopted.
18.	Paragraph 3-2.(e)(1) Page 12		The commenter believes that the proposed clarification of the minimum required value is appropriate.	Revise the second part of the second sentence to read: "...:however, the gas temperature must be maintained <i>to at least</i> the 100 percent redline value."	Adopted.

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19.	Paragraph 3-2.(e)(5) Page 13		The commenter believes that this statement should be removed because it is not clear what “amount of air bleed” and “should function as specified in the type design” because 1) internal bleed air amounts are not specified and 2) the guidance is not consistent with related guidance provided in Appendix 4, 3.a.	Delete this paragraph.	Partially Adopted. (1) We did not delete the paragraph as suggested; instead we revised this paragraph to clarify that the secondary airflow system should function as intended and not as specified in the type design. (2) The guidance in this paragraph applies to the typical running of the engine endurance test and expected air bleed configuration; the guidance in Appendix 4 applies to cases when engine modifications are needed to run the endurance test. Therefore, the guidance provided in paragraph 3-2.(e)(5) and in the Appendix 4, 3.a. apply to different scenarios.
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20.	Paragraph 3-4.(b)(3) Page 20		The commenter believes that sub-section as written does not recognize the most recent applicant methods of compliance and FAA guidance materials related to 33.63 and 33.83 and therefore, if those guidance materials found in AC 33.63-1 and 33.83-1 are addressed by the applicant for the subject certification project then the incorporation of the content found in this sub-section of the draft AC does not need to be addressed under 33.87 for this project.	Add the following at the beginning of this paragraph: <i>“The guidance provided in this sub-section (3.4.b.(3)) should be addressed unless the applicant has provided suitable and equivalent methods of compliance related to § 33.63 and § 33.83.”</i>	Non-Concur. The incremental test is required by § 33.87(b)(4). The required test is intended to address the engine deterioration effects on the engine vibration behavior and capability. The deterioration occurs during the 150 hours endurance test. Applicants have the choice to propose common methods of compliance with the regulations cited in this comment. However, compliance with § 33.87(b)(4) is expected to be provided.
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21.	Paragraph 4-1.b(1)(b) Page 34	The current AC33.87-1 appendix 10 (Instructions for Continued Airworthiness and Teardown Inspection Criteria) has been removed. It should be maintained and referenced as suggested.	The commenter believes that the current AC's appendix 10 provides useful and appropriate guidance material in the event that post-test teardown inspection findings are not completely consistent with available engine ICA material.	(b) The phrase, "eligible for incorporation into an engine for continued operation," means that the installation of the part will continue to keep the engine in an airworthy condition. <i>See Appendix XX for information related to the term "airworthy".</i>	Partially Adopted. (1) Appendix 10 of the current AC 33.87-1 defines the term "airworthy." We removed this appendix because the term "airworthy" is already defined in other FAA regulation and guidance. For clarity we added a reference to § 21.1(3)(b)(1) that specifies what the airworthiness approval means. (2) We do not concur with the comment that the current AC 33.87-1, Appendix 10, provides for "teardown inspection findings [that] are not completely consistent with available engine ICA material." AC 33.87-1, Appendix 10, paragraph 3, refers to the requirement of § 33.93(b)(2) that "Each engine part must conform to the type design and be eligible for incorporation into an engine for continued operation, in accordance with information submitted in compliance with § 33.4." The AC further states that "the ICAs are used as standards for pass/fail criteria in compliance with this subparagraph."
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22.	Appendix 2, Paragraph 2.b. Page A2-1.		<p>The commenter believes that the additional wording is appropriate in order to directly connect the use and justification of non-type design hardware and software in the test vehicle back to the intended purpose of showing compliance to the regulation(s).</p>	<p>“b. Test engine configuration. The applicant should identify the test engine configuration. The configuration of the test engine must substantially conform to the final type design, however, non-type design hardware, components <i>and software</i> may be used in the test engine to achieve certain test conditions when approved by us. For example, the applicant may need to modify test equipment, engine configurations, and test sequences in order to run the test at simultaneous triple redline conditions. In this case, the applicant should identify, in the test plan, the parts and components in the test engine that are non-type design. The applicant should also validate that the non-type design parts and components will not adversely affect the test outcome nor the test integrity <i>be contrary to the purposes of the test in showing of compliance as described in 3-1.a. of this AC.</i>”</p>	<p>Partially Adopted. We added “software” to the non-type design list. We did not adopt the suggested revision at the end of the paragraph since it does not provide further clarification.</p>
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23.	Appendix 2, Paragraph 2.d. Page A.2-1		The commenter believes that including conformity inspection results within a test plan is not practical and that all pre-test conformity information can be requested and reviewed by the FAA prior to the start of the test if desired or required. Also the correct appendix reference is appendix 5 rather than 6.	Delete the last part of the 2 nd sentence, as follows: "... The applicant should also list the components that require pre- and post-endurance test bench calibration, and the results of hardware conformity inspections. " In the last sentence, replace Appendix 6 with Appendix 5.	Adopted. Recommendation was adopted by revising the sentence suggested for deletion. Also, corrected the appendix number to read Appendix 5.
24.	Appendix 2, Paragraph 2.e.(5) Page A.2-2		The commenter believes that including expected engine oil consumption is not relevant pre-compliance test information.	Remove paragraph 2.e.(5) by deleting the phrase " expected oil consumption".	Partially Adopted. We deleted the word "expected" and retained the oil consumption as a consideration for compliance.

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25.	Appendix 4 Paragraph 4.d. Page A4-2		The commenter believes that including this additional engine modification note will assist the applicant in recognizing the need to identify and discuss with the FAA the subject slave hardware to be used during the test.	Insert the following sub-paragraph: “(1) The addition of engine-installed, test-facilitating or slave hardware to the test vehicle may be permissible. The installation and use of this type of hardware should be clearly identified in the test plan. The slave hardware’s test-enabling purpose explained and its impact on the engine’s other type design hardware and operation (as relevant) explained in the test plan. Pre-coordination with the FAA should be done in the case where the use of new or novel test-facilitating or slave hardware is being considered”	Partially Adopted. (1) The recommended guidance is already provided in Appendix 4, paragraphs 1 and 2, and Appendix 2, paragraph 2.c. For clarity, we added to paragraph 4.1 of Appendix 4 in the AC, a reference to Appendix 2. (2) The pre-coordination is addressed in this AC, paragraph 2.b, page i, stating, “We (the FAA) will consider other methods of demonstrating compliance that an applicant may present.” Pre-coordination with the FAA is not needed when the methods of compliance in this AC are followed.
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26.	Appendix 5 Paragraph 5.d. Page A4-2		<p>The commenter believes that the use of the terminology “documented assembly procedures” is more appropriate because in the case of a new TC or ATC project effort assembly procedures used will or may not yet be approved, but do need to be documented for use by the applicant and therefore support its conformity process.</p>	<p>Replace the word “approved” with “documented” in the last part of the 2nd sentence: “... the engine is built to the approved assembly procedures” To read: “... the engine is built to the documented assembly procedures”</p>	<p>Adopted. We revised the sentence to read: “...the engine is built to the assembly procedures specified in the type design.” As per Order 8110.4C, paragraph 2-6.b.(1)(d), page 44. This revision is addressing the concern raised by the commenter.</p>
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27.	Paragraph 3-3a. Page 17	Delete “parts manufacturer approvals (PMAs), repairs, and alterations” from the title of paragraph a. and delete paragraph 3-3.a.(3).	PMAs, repairs and alterations are by definition not major changes to the type design otherwise they would require an STC approval (CFR 21.113). Therefore it is inappropriate to include them in this AC and imply that they need to undergo block tests. Also regarding PMA, it is redundant to include PMAs in this AC since they are already covered by AC 33.87-2.	Delete “parts manufacturer approvals (PMAs), repairs, and alterations” from the title of paragraph a. and delete paragraph 3-3.a.(3).	Non-Concur. The referenced paragraph 3-3.a.(3) in the public version of the AC, now paragraph 3-3.a.(2), does not state that the PMAs, repairs, and alterations are by definition major changes to the type design as stated in this comment. We retained paragraph 3-3.a.(2) because it is the reference to AC 33.87-2, which provides the methods of compliance for comparative test and analysis for PMAs. This action is also in agreement with the comment from HEICO regarding PMAs, refer to comment 46.
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28.	Paragraph 2-2.e Page 2	Revise second sentence.	Current wording can be read that gas temperature cannot be stabilized, changing wording clarifies that the gas temperature can be stabilized, but it doesn’t have to be.	Revise text to read: The only exception is the recording of data at the 30-second and 2-minute OEI rating conditions described in § 33.85(d), during which the gas temperature may need not be stabilized at the end of the rating time limit	Adopted. Revision was made as recommended.

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29.	Paragraph 3-1.e.(2) Page 9	Revise this sentence: “Applicants should monitor oil consumption during the test and keep it within the allowable limits prescribed in the engine operating documents.”	Current wording implies some sort of change in operation should be enacted to maintain oil consumption during the test. If the intent is to monitor the consumption (which would be consistent with the wording of section 3-2d(4)), then the wording should be changed to clarify that is the intent	Applicants should monitor oil consumption during the test and keep it ensures it remains within the allowable limits prescribed in the engine operating documents. Any exceedances of the allowable limits should be addressed in the test report or by revising the engine operating documents as appropriate.	Partially Adopted. We revised the guidance to allow exceedance provided corrective action is taken during the test, or otherwise the applicant should revise the engine manuals as recommended. We did not adopt the recommendation to address in the test report any exceedance because it implies that the endurance test was run above the manuals limits. The intent of the test is to maintain the engine running within the prescribed limits. This paragraph was moved to paragraph 3-1.f, page 9.
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30.	Paragraph 3-2.g.(11) Page 16	Revise the last 2 sentences of this paragraph.	Current wording explicitly addresses one way to achieve the desired results, but no other examples are given of how to achieve the desired results. Additional examples added to give clear definition of other types of off design conditions that may be acceptable to the FAA.	During each of these two cycles, the fuel, oil, and hydraulic fluid pressures must be maintained at their maximum or minimum values simultaneously. Pressure regulating valves in the fuel, oil or hydraulic systems may be adjusted to achieve the desired values, or fluid levels may be increased or reduced as necessary to ensure maximum or minimum pressure are achieved. The applicant may also artificially adjust the fluid temperature with a test facility heat exchanger to achieve the desired value.	Partially Adopted. We did not adopt the specific example, but instead specified that the applicant may use other means for maintaining the hydraulic fluid pressures if such means do not affect the test outcome.
31.	Paragraph 3-4.b.(3)(a)2(aa) Page 21	Current text: (aa) Amplitudes that indicate stresses near the endurance limits, and	The previous sentence in §3-4b (3) (a) 2 says “any of the following” and not “all of the following”, “or” is the correct conjunction	(aa) Amplitudes that indicate stresses near the endurance limits, and or	Adopted. Revised as recommended.
32.	Paragraph 3-4.b.(5).(g) Page 23		Clarification that limitations related to engine starting should also be included in the installation instructions.	Any limitations associated with the normal start, such as the starting time or other engine operating parameters, should be specified in the TCDS, the engine installation instructions , and in the ICA	Adopted. The recommendation was adopted.

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33.	Paragraph 3-7.a.(2).(a) Page 26			Add missing word "or" at the end of paragraph (a)	Adopted. Added the missing word.
34.	Appendix 2, paragraph 2.d Page A2-1	In the last sentence of this paragraph, the reference to Appendix 6 for additional information on conformity inspections is wrong. Should be Appendix 5		Correct reference to Appendix 6 to state reference to Appendix 5.	Adopted. Correction made.
35.	Appendix 3, Paragraph 2b(1)(a) Page	(a) The core rotor speed at least at the rated takeoff speed,**	The correct reference appears to be to the note identified as "**", which addresses takeoff conditions, not "***", which addresses max continuous conditions	(a) The core rotor speed at least at the rated takeoff speed,*	Adopted. The guidance was revised by incorporating this recommendation and for further clarification.

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1. Document No.: 33.87-1A , Engine Overtorque Test, Calibration Test, Endurance Test, and Teardown Inspection for Turbine Engine Certification (§§ 33.84, 33.85, 33.87, 33.93)	2. Project Manager: Dorina Mihail, 781-238-7153 Daniel Tibuni 781-238-7181 ANE-111	3. Reviewing Office: Reviewer's Name & phone #: Williams International	4. Date of Review: July 18, 2014	5. Date of Disposition: 9/27/2014
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Project manager's disposition in comments in the last column below. Enter the reasons for non-incorporated comments. Identify each disposition as:

- **Adopted;**
- **Partially Adopted;**
- **Non-Concur;**
- **Concur but Outside of Scope (Will be considered in next change/revision); or**
- **Answer to Question or Statement.**

Item No:	Page and Paragraph No:	Comment:	Reason:	Recommendation:	Disposition:
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36.	Page 4-5 Para. 3-1.a.(2)(a)	List of other regulations should include 33.63 and 33.83.	As indicated on Pages 20-21 Para. 3-4.b.(3), the incremental stairstep dwells may be modified to dwell at engine resonances and should include consideration of hardware such as blades, stators, turbine or compressor assemblies, pumps and the oil tank. Based on these example parts aligning with the requirement of 33.83 for blades, vanes, disks, shafts and spacers and the entire engine under consideration in 33.63, the addition of 33.63 and 33.83 is proposed.	Recommend adding §33.63 and §33.83 to the list of regulations which may be able to use data from the endurance test for showings of compliance.	Non-Concur. This comment does not specifically identify the type of data obtained from the endurance test that would qualify for compliance with § 33.63 and/or § 33.83 requirements. AC 33-83A and AC 33.63-1 provide the methods of compliance with the two regulations. The applicant always has the option to propose use of endurance data believed to qualify for compliance with § 33.63 and § 33.83 under the engine certification program.
37.	Page 8 Para. 3-1.e.(1)	Running engines at unbalance levels in excess of the acceptance test limits should be allowed.	Any significant change in the vibration signature whether increasing or decreasing in magnitude or frequency can be an indication of damage to the engine. Also, the applicant may choose to run the endurance test above the maximum unbalance levels intended to be demonstrated in 33.63, so it would not then be possible to demonstrate post-test unbalance levels below these limits. It is proposed	IS: "... Post-endurance test vibration signatures should not show a significant change from the data recorded during the pre-endurance vibration survey, and should still be at or below the allowable limits established for compliance with § 33.63. The only purpose of the surveys conducted during endurance testing is to determine potential vibration signature changes due to engine	Partially Adopted. We revised the guidance to state that the post-endurance test vibration level should remain at or below the allowable limits that were established for compliance with part 33 requirements, in lieu of § 33.63 requirements. Since the endurance test engine must conform to the type design, rotor unbalance should not fall outside what is allowed by type design.

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			<p>that reconciling significant changes in the vibration signature will meet the requirements of 33.87 and that if the engine has pre-test vibrations within limits, then it would be expected that the post-test vibration survey would be within limits.</p>	<p>deterioration. ...”</p> <p>RECOMMENDED: “... Post-endurance test vibration signatures should not show a significant change from the data recorded during the pre-endurance vibration survey, and should still be at or below the allowable limits established for compliance with § 33.63. The only purpose of the surveys conducted during endurance testing is to determine potential vibration signature changes due to engine deterioration. ...”</p>	
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38.	Page 21 Para. 3-4.b.(4)(b)1	Data showing the 30-second stabilization capability of an engine should not be required to be demonstrated in both the test plan and test report.	Location of the data supporting the stabilized temperature exception has the opportunity to be approved in either the test plan or test report, so either location should be acceptable.	IS: “ The applicant should supply data in the test plan and test report showing that the time required to achieve gas temperature stabilization at or above the 100 percent value...” RECOMMENDED: “ The applicant should supply data in the test plan or test report showing that the time required to achieve gas temperature stabilization at or above the 100 percent value...”	Adopted. We removed the guidance that the information should be added to the test report. This section of the AC provides the guidance needed before the applicant can use the temperature stabilization exception, refer to the last sentence in paragraph 3-4.b.(4)(b), page 22. Therefore, the information is needed in the test plan.
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39.	Paragraph 3-4.b.(5)(e) Page 23	The guidance on the 55 remaining normal starts does not provide the options for length of time between starts that the 33.87 rule allows.	14 CFR 33.87 (b)(6) requires 25 starts with 2-hour shutdown preceding, 10 false starts and at least 10 normal restarts and a total of 100 starts. Based on the rule text stating at least 10 normal starts with not longer than 15 minutes between starts, the remaining 55 normal starts could be chosen to run with less than 15 minutes between shutdown and start. As stated in paragraph 2.b. of this draft AC, “should” indicates that the test in para. 3-4.b.(5)(e) is applicable if this AC is used. In the context of para. 3-4.b(5)(e), “should” implies a requirement for the method of compliance. However, an alternative to allow more than 10 normal restarts should also be acceptable based on the rule text.	IS: “The remaining 55 normal starts in paragraph 3-4.b(5)(b)4 above should be preceded by shutdown periods that are greater than 15 minutes, but less than 2 hours. These starts may be completed anytime during and after the endurance test.” RECOMMENDED: “It is recommended that the remaining 55 normal starts in paragraph 3-4.b(5)(b)4 above should be preceded by shutdown periods that are greater than 15 minutes, but less than 2 hours. These starts may be completed anytime during and after the endurance test. As an alternative, any number of the remaining 55 starts may be preceded by shutdown periods of less than 15 minutes.”	Partially Adopted. We revised the AC, paragraphs 3-4.b.(5)(b). <u>3</u> and (b). <u>4</u> , on page 22, and paragraph 3-4.b.(5)(e) on page 23 to clarify that the remaining number of starts can be less than 55. We replaced references to “55 normal starts” with the phrase “remaining starts” as stated in § 33.87(b)(6). Of the 100 starts required by § 33.87(b)(6), 25 must be starts preceded by at least 2 hours of engine shut-down. However, the rule allows for more than 10 false starts and more than 10 normal restarts. Therefore, any number of the 55 starts may be run as restarts or false starts, thus in agreement with this recommendation. In such case, the “remaining starts” would be less than 55. This revision also applies to the start requirements for rotorcraft engines having OEI ratings, refer to the AC, paragraph 3-5.f., for guidance related to § 33.87(c)(7) and paragraph 3-6.e for guidance applicable to § 33.87(d)(7).
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40.	Page 23 Para. 3-4.b.(5)(g)	All start limits should not be required on the TCDS. TCDS start limits should be limited to those parameters required by 14 CFR 33.7.	14 CFR 33.4(b)(3)(i) already requires that the starting limits be prescribed in the engine operating instructions. Adding a requirement to include the start requirements on the TCDS would be redundant. The TCDS start requirements should be limited to those that correspond to the requirements of 14 CFR 33.7. As an example if bleed air extraction is required or limited during starts, then this limit is appropriate to include under 14 CFR 33.7(c)(11). Otherwise other engine parameters required such as temperatures and speed are only required to be listed for maximum continuous and takeoff conditions.	IS: “Any limitations associated with the normal start, such as the starting time or other engine operating parameters, should be specified in the TCDS and in the ICA.” RECOMMENDED: “Any limitations associated with the normal start, such as the starting time or other engine operating parameters, should be specified in the TCDS and in the ICA and engine operating instructions per 14 CFR 33.4(b)(3)(i).”	Partially Adopted. We made the change by identifying the operating instructions required by § 33.4(b)(3)(i). We did not remove the TCDS as recommended because limitations associated with engine starts are currently listed in the TCDS. The TCDS data is inclusive but not limited to the limitations prescribed in § 33.7, refer to CFR part 21 and Order 8110.4C.
41.	Page 34 Para. 4-1.b.(2)(a)	The TCDS is not a typical location to include used part acceptance criteria.	The ICA’s are the type design data for determining if a part is acceptable for continued use. The TCDS may include additional hardware limits, but it is unusual to have a TCDS requirement defining hardware acceptability without a corresponding ICA	IS: “The applicant should inspect all engine parts and components in both “dirty” and “cleaned” conditions using the ICA inspection instructions. The applicant should record the findings in the certification report. The engine parts and components	Adopted. The AC was revised as recommended. (page 35)

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			<p>requirement. Therefore, the ICA is proposed as the source for determining hardware acceptability.</p>	<p>must conform to their type design after accounting for allowances for used parts condition. The ICA and the TCDS should be used for reference on the acceptable used parts condition. Appendix 11 of this AC provides more detailed guidance for teardown inspections.”</p> <p>RECOMMENDED: The applicant should inspect all engine parts and components in both “dirty” and “cleaned” conditions using the ICA inspection instructions. The applicant should record the findings in the certification report. The engine parts and components must conform to their type design after accounting for allowances for used parts condition. The ICA and the TCDS should be used for reference on the acceptable used parts condition. Appendix 11 of this AC provides more detailed guidance for teardown inspections.”</p>	
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42.	Page A6-1 Para 1.	There is a timing issue with the wording for corrective actions as stated in the draft AC revision.	The wording proposed is from the current revision of AC33.87-1 and provides the correct timing of corrective actions.	<p>IS: “The certification test reports should contain sufficient data (for example, plots, tabulations, figures, and photographs) and discussions to show that the engine successfully completed all requirements of the calibration test, endurance test, and teardown inspection. In addition to test results and data analyses, the applicant should include analyses of engine faults, significant hardware deterioration, and corrective actions that will be implemented during or after the test.”</p> <p>RECOMMENDED: “The certification test reports must contain sufficient data (for example, plots, tabulations, figures, and photographs) and discussions to substantiate that the engine successfully completed all requirements of the calibration test, endurance test, and teardown inspection. In addition to test results and</p>	<p>Adopted. We eliminated the timing of corrective actions since it was not needed.</p>
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				analyses of data, the reports should include analyses of engine faults, and significant hardware deterioration and corrective actions implemented during, or that will be implemented after, the test.	
43.	Page A6-3 Para. h.(7)	Running engines at unbalance levels in excess of the acceptance test limits should be allowed.	It is recommended that the test report requirement be a summary of the guidance provided in Para. 3-1.e.(1). This recommended update is related to Comment 2 above.	IS: "Vibration signature analysis. The applicant should analyze the vibrations induced by unbalances in both the high and low speed rotor systems, and assure that the vibration level associated with a deteriorated engine is acceptable. The post-endurance test vibration level should remain at or below the allowable limits that were established during compliance with § 33.63." RECOMMENDED: "Vibration signature analysis. The applicant should analyze the vibrations induced by unbalances in both the high and low speed rotor systems, and assure that the vibration level associated with a	Partially Adopted. We revised the guidance to state that the post-endurance test vibration level should remain at or below the allowable limits that were established for compliance with part 33 requirements, in lieu of § 33.63 requirements. Since the endurance test engine must conform to the type design, rotor unbalance should not fall outside what is allowed by type design.

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				<p>deteriorated engine is acceptable. The post-endurance test vibration level should remain at or below the allowable limits that were established during compliance with § 33.63 All significant changes in vibration signature should be documented and reconciled.”</p>	
44.	Page A7-2 Para. 2.a.(3)	This is a good cross-reference for other regulations that may affect transient overtemperature limit, and it would be helpful to include this note in the corresponding guidance material.	Beneficial cross-reference.	<p>It is recommended that the next revision of AC 33.27-1A include similar cross-reference to AC 33.87-1 to insure the transient overtemperature requirement is clear in the 33.27 guidance.</p> <p>Similarly, it is recommended that the next revision of AC 33-2C include a similar cross-reference to AC 33.87-1 to insure the transient overtemperature requirement is clear.</p>	Noted.

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45.	Multiple	The reformatting to separate some content into more sub-paragraphs and to use underlining to highlight key sections is a great improvement to allow for quick referencing of key elements within this AC.	None required.	No action required.	Noted.
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		Title: Document Review Log	Date: June 19, 2009

1. Document No.: 33.87-1A , Engine Overtorque Test, Calibration Test, Endurance Test, and Teardown Inspection for Turbine Engine Certification (§§ 33.84, 33.85, 33.87, 33.93)	2. Project Manager: Dorina Mihail, 781-238-7153 Daniel Tibuni 781-238-7181 ANE-111	3. Reviewing Office: Reviewer's Name & phone #: HEICO	4. Date of Review: July 10, 2014	5. Date of Disposition: 9/27/2014
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- **Answer to Question or Statement.**

Item No:	Page and Paragraph No:	Comment:	Reason:	Recommendation:	Disposition:
46.	Page 17 Paragraph 3-3 a.(3) Now 3-3.a(2)	The addition of the reference to AC 33.87-2 is helpful to PMA applicants as it provides direction and useful guidance to the applicants.	There has been some confusion in the past related to when a PMA applicant might have to run an endurance test in accordance with §§ 33.87.	Incorporate the proposed draft language.	Concur. We retained the cited paragraph as written for final publication.

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