

**FAA Validation of EASA State of Design Turbine Aircraft Engines
 FAA Significant Standards Difference Summary List
 Per FAA-EASA Technical Validation Procedures (TIP) Revision 6**

**14 CFR Part 33 Amendment 34 compared to CS-E Amendment 4
 Dated March 21, 2018**

<i>SSD</i>	<i>Subject</i>	<i>14 CFR Section</i>	<i>Remarks</i>
1	Instructions for Continued Airworthiness (ICA)	33.4, A33.1(b), A33.3, A33.3(b), A33.4(a)(2), A33.3(c)	1) 33.4 requires ICA instructions to be complete at type certification unless a program exists to ensure their completion prior to delivery of the first aircraft with the engine installed, or upon issuance of a standard certificate of airworthiness for the aircraft with the engine installed, whichever occurs later. 2) A33.1(b) requires that each engine ICA must include ICAs for all engine parts. 3) A33.3 requires ICAs to be in the English language. 4) A33.3(b) requires an Engine Overhaul Manual or Section in the ICAs. 5) A33.4(a)(2) requires an ICA Airworthiness Limitations FAA approval statement to support FAA regulatory authority. 6) A33.3(c) Requires engine condition monitoring for ETOPS eligibility.
2	Durability (Propeller Blade Pitch Control Systems)	33.19(b)	1) 33.19(b) requires each component of the propeller blade pitch control system which is a part of the engine type design to meet the requirements of Sec. 35.21, 35.23, 35.42 and 35.43.
3	Turbine, compressor, fan, and turbosupercharger rotor overspeed.	33.27(d), (f), (f)(6)	1) 33.27(d) requires growth assessment at 105% speed for (b)(3). 2) 33.27(f) is applicable to the fan forward shaft only. 3) 33.27(f)(6) does not allow exclusion of the entire shaft for overspeed loss of load.
4	Induction System Icing	33.68(a), (b), (c), (e)	1) 33.68 (a), (b), (e) Applicable to all engines irrespective of aircraft installation. 2) 33.68 (c) Requires engine test at specific conditions (33.68 Table 1). 3) 33.68 (c) Requires testing at high power condition in addition to descent.
5	Ignition Systems	33.69	1) 33.69 Requires at least 2 igniters.
6	Hydraulic Systems	33.72	1) Applicable only to non-fuel driven hydraulic systems. For fuel driven hydraulic systems EASA requirements have shown to provide a level of safety equivalent to 33.72.
7	Fuel Burning Thrust Augmentor	33.79	1) Design and construction requirements for engines certified with fuel burning thrust augmentor.
8	Vibration Test	33.83(a)	1) 33.83(a) requires a vibration survey to be conducted on an engine test; i.e. validated analysis is not provided in §33.83.
9	Endurance Test	33.87(a)(8), 33.7(c)(14), (15), and (16)	1) 33.87(a)(8) requires testing of the declared transient rotor shaft overspeed, transient gas overtemperature, and transient engine overtorque. See detail write up for EASA equivalency using special conditions for transients of up to 30 second and transients longer than 30 seconds and up to 2 minutes.
10	Overtemperature Test	33.88	1) 33.88(a) requires running a test at turbine inlet temperature above the maximum permissible value, in combination with the maximum permissible shaft speeds except for 30-second OEI and 2-minute OEI ratings. 2) 33.88(b) prescribes the overtemperature test conditions for engines with 30-second OEI and 2-minute OEI rating.
11	Initial Maintenance Inspection	33.90	1) Requires a test for new type certificates to establish when the initial maintenance inspection is required. Alternately, per 33.90(b) an engine test may be conducted in accordance with § 33.201 (c) through (f).
12	Engine tests in auxiliary power unit (APU) mode.]	33.96	1) Endurance test requirements for turboprop engines designed with a propeller brake.
13	Design & Test Requirements for	33.201	These differences are based on 14 CFR Part 33 Amendment 34 compared to CS-E Amendment 4 and AMC 20-6, revision 2

	Early ETOPS Eligibility		<p>effective October 23, 2010.</p> <p>1) 33.201(c) requires a test for engines to be granted ETOPS eligibility without the service experience specified in part 25, appendix K, K25.2.1 of more than 250,000 engine-hours.</p> <p>2) 33.201(d) and (e)(1) require engine calibration prior and at the conclusion of the test in 33.201(c) for the purpose to demonstrate that any change in power or thrust characteristics is within approved limits.</p> <p>3) Reference detail write up:</p> <p>a) Other differences compensated by compliance with CS-E 1040 and AMC 20-6.</p> <p>b) Guidance on how to run the test.</p> <p>c) Guidance on when to repeat the test for new models and design changes.</p>

Notes:

- 1) In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E to provide a level of safety equivalent to that provided by 14 CFR part 33.
- 2) Reference detail SSD write ups for additional information including guidance material.

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File: SSD_Turbine_Engines_List_14_CFR_33_Amdt_34_and_CS-E_Amdt_4.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 Amend 34 versus CS-E Amendment 4
Instructions for Continued Airworthiness § 33.4 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E 25 to provide a level of safety equivalent to that provided by the Instructions for Continued Airworthiness (ICA) requirement contained in 14 CFR part 33.4 and its appendices as described below.

B. Regulatory Comparison:

1. **33.4** requires ICA instructions to be complete at type certification unless a program exists to ensure their completion prior to delivery of the first aircraft with the engine installed, or upon issuance of a standard certificate of airworthiness for the aircraft with the engine installed, whichever occurs later.
 - a. EASA requires the same for ICAs in Part 21.A.61 with the allowance that the “availability of some manual or portion of the instructions for continued airworthiness, dealing with overhaul or other forms of heavy maintenance, may be delayed until after the product has entered into service, but shall be available before any of the products reaches the relevant age or flight-hours/cycles”.
2. **A33.1(b)** requires that each engine ICA must include ICAs for all engine parts. If ICAs are not supplied by the engine manufacturer for an engine part, the engine ICA must include the information essential to the continued airworthiness of the engine.
3. **A33.3** requires ICAs to be in the English language.
4. **A33.3(b)** requires an Engine Overhaul Manual or Section in the ICAs.
 - a. All approved engines must be capable of being overhauled; i.e. no throw away engines.
5. **A33.4(a)(2)** requires an ICA Airworthiness Limitations FAA approval statement to support FAA regulatory authority. “The Airworthiness Limitations section is FAA approved and specifies maintenance required under Sec. Sec. 43.16 and 91.403 of Title 14 of the Code of Federal Regulations unless an alternative program has been FAA approved.”
6. **A33.3(c)** Requires engine condition monitoring for ETOPS eligibility.
 - a. Compliance with AMC 20-6 revision II, Chapter II, Section 7 Paragraph (15) Engine Condition Monitoring meets this requirement.

C. Guidance Material:

AC 33.4-1 dated 08/27/1999 and titled “Instructions for Continued Airworthiness”.

AC 33.4-2 dated 03/08/2001 and titled “Instructions for Continued Airworthiness: In-Service Inspection of Safety Critical Turbine Engine Parts at Piece-Part Opportunity”.

AC 33.4-3 dated 09/16/2005 and titled “Instructions for Continued Airworthiness, Aircraft Engine High Intensity Radiated Fields (HIRF) and Lightning Protection Features”.

PS-ANE-2004-33.4-4 dated 03/04/2005 and titled Design Approval Procedures for Parts Manufacturer Approval of Critical Engine and Propeller Parts.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9	X															
	10	X	X														
	11	X	X														
	12	X	X														
CS-E Amendment	0	X	X	X	X	X	X										
	1						X	X	X	X	X	X	X				
	2												X				
	3												X	X	X	X	X
	4																

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 19 contact the Engine and Propeller Standards Branch.

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File: SSD 14 CFR 33.4 ICA Amd 19 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
 14 CFR part 33 versus CS-E
 Durability § 33.19 vs CS-E
 March 15, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E to provide a level of safety equivalent to that provided by the durability (propeller controls) requirements contained in 14 CFR part 33.19 as described below.

B. Regulatory Comparison:

1. 33.19(b) requires each component of the propeller blade pitch control system which is a part of the engine type design to meet the requirements of Sec. 35.21, 35.23, 35.42 and 35.43.

C. Guidance Material:

- Advisory Circular (AC) 35.23-1 - Guidance Material for 14 CFR § 35.23, Propeller Control System, Date Issued October 21, 2011
- AC 35-1 - Certification of Propellers, Date Issued December 29, 2008

D. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9																
	10																
	11																
	12																
CS-E Amendment	0																
	1									X	X	X					
	2												X				
	3												X	X	X	X	X
	4																X

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 28 contact the Engine and Propeller Standards Branch.

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File: SSD 14 CFR 33.19 Durability (Propeller Controls) Amd 28 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Turbine, compressor, fan, and turbosupercharger rotor overspeed § 33.27 vs CS-E
March 20, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E 840 and 850 to provide a level of safety equivalent to that provided by the turbine, compressor, fan, and turbosupercharger rotor overspeed requirements contained in 14 CFR part 33.27 as described below.

B. Regulatory Comparison:

1. 33.27(f) is applicable to fan forward shaft only as discussed in the preamble. The exclusion criterion in 33.27(f) was established for the fan forward shaft where industry experience has shown that it will never fail.
 - a. EASA interprets CS-E 850 to apply to any shaft.
2. 33.27(f)(6) does not allow exclusion of the entire shaft from failure consideration in determining the highest rotor overspeed.
 - a. CS-E 850 does not have a corresponding requirement that prohibits excluding the entire shaft.
3. 33.27(d) requires rotor growth assessment be performed at 105% of the highest rotor speed that results from the failures specified in 33.27(b)(3)(i) and (ii).
 - a. CS-E 840(d) requires evaluation of growth at 100% of the maximum rotor overspeed for the same conditions specified in 840(b)(3).

C. Guidance Material:

Advisory Circular 33.27-1A, Titled, Engine and Turbosupercharger Rotor Overspeed Requirements of 14 CFR § 33.27.

CS-E 840(c) allows exclusion of certain elements of a shaft if it can be shown to be Extremely Remote under the provisions of CS-E 850. EASA clarified that the intent of CS-E 850(a)(3) is that in order for an element to be considered extremely remote, it must meet all of the criteria in CS-E 850(b)(2), and not to allow use of probability for single failures. This interpretation is consistent with 33.75(c) which says that the primary failure of certain single elements cannot be sensibly estimated in numerical terms. Therefore, we conclude that there is no significant standard difference with respect to 33.27(c).

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9																
	10																
	11																
	12																
CS-E Amendment	0																
	1																
	2																
	3													X	X	X	X
	4																X

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 31 contact the Engine and Propeller Standards Branch.

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Aircraft Certification Service

File: SSD 14 CFR 33.27 Overspeed Amd 31 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Induction System Icing § 33.68 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E 780 to provide a level of safety equivalent to that provided by induction system icing requirements contained in 14 CFR part 33.68 as described below.

B. Regulatory Comparison:

1. 14 CFR 33.68 requires all engines (turbojet, turbofan, turboprop and turboshaft) to meet the icing requirements irrespective of the aircraft on which the engine is to be installed. CS-E 780 tailors the test and demonstration requirements for each engine, depending on the Certification Specifications applicable to the aircraft on which the engine is to be installed, as specified in CS-E 20(b). Specifically:
 - a. 14 CFR 33.68(a) requires each engine to operate throughout its flight power range, including the minimum descent idle rotor speeds achievable in flight, in the icing conditions defined for turbojet, turbofan, and turboprop engines in Appendices C and O of part 25 of this chapter, and Appendix D of part 33, and for turboshaft engines in Appendix C of part 29.
 - b. 14 CFR 33.68(b) requires each engine to operate throughout its flight power range, including minimum descent idle rotor speeds achievable in flight, in the icing conditions defined for turbojet, turbofan, and turboprop engines in Appendices C and O of part 25 of this chapter, and for turboshaft engines in Appendix C of part 29 of this chapter.
 - c. 14 CFR 33.68(e) requires each engine to demonstrate by test, analysis, or combination of the two, acceptable operation for turbojet, turbofan, and turboprop engines in mixed phase and ice crystal icing conditions throughout Appendix D of this part, icing envelope throughout its flight power range, including minimum descent idling speeds.

The FAA requires the engine comply with all appendices required by 14 CFR 33.68. 14 CFR 33 does not contemplate reducing certification requirements based on engine installation. EASA CS-23 does not require compliance with their appendices, equivalent to FAA Part 25 Appendices C and O and Part 33 Appendix D, on engines intended for installation in Part 23 airplanes. See attachment for additional clarification.

2. 14 CFR 33.68(c) (33.68 Table 1) requires demonstration by engine test at specific conditions, including total air temperature (TAT) conditions unless replaced by similar CPA test conditions that are more critical or produce an equivalent level of severity. CS-E 780 (ref AMC E 780 Table 1) does not require demonstration at specific TAT but instead allows test point definition by altitude and ambient temperature. The FAA requires the table points to be run using TAT because that accounts for aircraft speed. An applicant could run the test point under other conditions, if the applicant shows that the proposed CPA test conditions that are more critical or produce an equivalent level of severity.
3. 14 CFR 33.68(c) requires testing at 50%, 75% and 100% maximum continuous power in addition to idle descent unless replaced by similar CPA test conditions that are more critical or produce an equivalent level of severity. These power points are defined within Table 1 of

14 CFR 33.68. CS-E 780 only requires testing at the minimum power/thrust associated with descent in icing conditions. The FAA requires the additional tests at 50%, 75% and 100% maximum continuous power in addition to idle descent because those points expose engine design shortfalls not detected at idle descent power. An applicant could run the test points under other conditions, if for each point the applicant shows that the proposed CPA test conditions are more critical or produce an equivalent level of severity.

C. Guidance Material:

AC 20-147A title, Turbojet, Turboprop, Turboshift, and Turbofan Engine Induction System Icing and Ice Ingestion, provides guidance on how to show compliance with these requirements.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9																
	10																
	11																
	12																
CS-E Amendment	0																
	1																
	2																
	3																X
	4																X

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 34 contact the Engine and Propeller Standards Branch.

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File: SSD 14 CFR 33.68 Induction System Icing Amd 34 and later vs CS-E.docx

Attachment for Regulatory Comparison # 1 – Engine Application Matrix

	14 CFR Part 25 Appendix C (Atmospheric Icing)					14 CFR Part 25 Appendix O (SLD)					14 CFR Part 33 Appendix D (Mixed Phase & ICI)				
	EASA specific to engine installation					EASA specific to engine installation					EASA specific to engine installation				
	FAA	Part 25	Part 23	Part 29	Part 27	FAA	Part 25	Part 23	Part 29	Part 27	FAA	Part 25	Part 23	Part 29	Part 27
Turbojet	X	X	X			X	X				X	X			
Turbofan	X	X	X			X	X			X	X				
Turboprop	X	X	X			X	X			X	X				
Turboshaft	X			X	X										

Gray cells are not applicable.

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Ignitions System § 33.69 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E 500 to provide a level of safety equivalent to that provided by the ignitions system requirements contained in 14 CFR part 33.69 as described below.

B. Regulatory Comparison:

1. 33.69 requires at least two igniters.
 - a. CS-E-500 allows a single igniter ignition system.

C. Guidance Material:

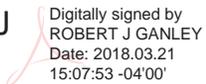
FAA Advisory Circular (AC) 33-2C, titled “General Type Certification Guidelines for turbine engines”, dated June 25, 2013.

Policy Statement ANE-1998-33.69-R1, titled, “Policy for Evaluating Ignitions System Requirements, 14 CFR 33.69”, dated February 26, 2001, provides a detailed review of the intent of the FAA regulation on ignition systems.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9	X															
	10	X	X														
	11	X	X														
	12	X	X														
CS-E Amendment	0	X	X	X	X	X	X										
	1						X	X	X	X	X	X	X				
	2												X				
	3												X	X	X	X	X
	4																

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 6 contact the Engine and Propeller Standards Branch.

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File: SSD 14 CFR 33.69 Ignitions System Amd 6 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Hydraulic Actuating Systems § 33.72 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E to provide a level of safety equivalent to that provided by the hydraulic actuating systems requirements contained in 14 CFR part 33.72 as described below.

B. Regulatory Comparison:

1. The intent of 33.72 is to demonstrate that any hydraulic actuating systems operates as intended throughout the engine operating envelope. Also includes specific design requirements for filters and tanks. These design requirements are intended to provide systems with safe operating characteristics. Hydraulic actuating systems include any source of hydraulic fluid used to power engine type design systems. For example, high pressure fuel can be used for hydraulic actuation of VSV's or various bleed or cooling valves.
2. For hydraulic actuating systems using fuel as the hydraulic fluid, compliance with CS-E has shown to provide a level of safety equivalent to that provided by § 33.72. Therefore, fuel driven hydraulic actuating systems that comply with the following CS-E requirements will also comply with § 33.72:
 - a. CS-E 50(a) Engine Control System,
 - b. CS-E 80 Equipment,
 - c. CS-E 560 Fuel System,
 - d. CS-E 660 Fuel Pressure & Temperature,
 - e. CS-E 670 Contaminated Fuel, and
 - f. Transient Fuel Icing CRI / Fuel System Icing Threats Issue Paper
 - g. Engine hydraulic fluid tanks must meet the design criterial in CS-E 570 Oil System.

C. Guidance Material:

None.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9	X															
	10	X	X														
	11	X	X														
	12	X	X														
CS-E Amendment	0	X	X	X	X	X	X										
	1						X	X	X	X	X	X	X				
	2												X				
	3												X	X	X	X	X
	4																

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 6 contact the Engine and Propeller Standards Branch.

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Aircraft Certification Service

File: SSD 14 CFR 33.72 Hydraulic System Amd 6 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Fuel burning thrust augmentor § 33.79 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E to provide a level of safety equivalent to that provided by the fuel burning thrust augmentor requirements contained in 14 CFR part 33.79 as described below.

B. Regulatory Comparison:

1. Section 33.79 provides design and construction requirements for engines certified with fuel burning thrust augmentor.
 - a. CS-E does not specifically address thrust augmentation/afterburner systems.

C. Guidance Material:

There are no current advisory circulars or policy for this rule.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9	X															
	10	X	X														
	11	X	X														
	12	X	X														
CS-E Amendment	0	X	X	X	X	X	X										
	1						X	X	X	X	X	X	X				
	2												X				
	3												X	X	X	X	X
	4																

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 6 contact the Engine and Propeller Standards Branch.

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File: SSD 14 CFR 33.79 Thrust Agumentor Amd 6 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Vibration Test § 33.83 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E 650 to provide a level of safety equivalent to that provided by the vibration test requirements contained in 14 CFR part 33.83 as described below.

B. Regulatory Comparison:

1. Section 33.83(a) requires a vibration test and does not provide for use of validated analysis.
 - a. CS-E 650(a) allows for a combination of test and validated analysis to be used for establishing the engine vibration characteristics are acceptable.

C. Guidance Material:

1. FAA AC33.83A provides guidance for use of analysis when, during a 33.83 vibration test, the loss of instrumentation is minimal and data from the surviving instrumentation is used to fill-in the gaps.
2. When instrumentation does not survive during testing, use of analysis may be accepted as a method for direct compliance providing it falls within the guidance in AC33.83A paragraph 12(b) page 8. The guidance specifies that the loss of instrumentation should be minimal and the associated analysis should be primarily based on the surviving instrumentation data. This is not a SSD.
3. Beyond the bounds in AC33.83A, FAA approved the use of validated analysis by equivalent level of safety (ELOS) finding. A recent validation example is the ELOS AT03491EN-E-P-2 for the Rolls-Royce Trent XWB-97 engine model.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9																
	10																
	11																
	12																
CS-E Amendment	0																
	1																
	2																
	3																
	4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 17 contact the Engine and Propeller Standards Branch.

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Manager, Engine and Propeller Standards Branch, (AIR-6A0)
Policy and Innovation Division
Aircraft Certification Service

File: SSD 14 CFR 33.83 Vibration Test Amd 17 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Endurance Test § 33.87 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA prescribes additional requirements relative to CS-E 740 to provide a level of safety equivalent to that provided by the Endurance Test requirements contained in 14 CFR part 33.87 as described below.

B. Regulatory Comparison:

1. Section 33.87(a)(8) requires testing of the declared transient rotor shaft overspeed, transient gas overtemperature, and transient engine overtorque. The transients are intended for speed, temperature, or torque overshoots above the limits associated with steady state ratings in § 33.7(c)(1), usually occurring during engine acceleration and prior to reaching the steady state limit value. The transients are declared in accordance with § 33.7(c)((14), (15), and (16).
 - a. EASA Special Condition “Transient over-temperature, over-speed and over-torque limit approval” dated 05.09.2014 provides an equivalent to the intent of § 33.87(a)(8) for over-temperature, over-speed, and over-torque transients up to 30 seconds. The SC must be included in the certification basis.
 - b. For over-temperature transients longer than 30 seconds and up to 2 minutes, EASA’s SC and CS-E 740(f)(4)(iii) and (iv) provide an equivalent to § 33.87(a)(8) and AC 33.87-1A, Appendix 7.

C. Guidance Material:

FAA Advisory Circular (AC) 33.87-1A, titled “Engine Over-torque Test, Calibration Test, Endurance Test, and Teardown Inspection for Turbine Engine”, dated March 19, 2015, provides guidance for compliance with 33.87(a)(8).

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9	X															
	10	X	X														
	11	X	X														
	12	X	X														
CS-E Amendment	0	X	X	X	X	X	X										
	1						X	X	X	X	X	X	X				
	2												X				
	3												X	X	X	X	X
	4																

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part 33 amendment 6 contact the Engine and Propeller Standards Branch.

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Policy and Innovation Division
Aircraft Certification Service

File: SSD 14 CFR 33.87 Endurance Test Transients Amd 6 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Engine overtemperature test § 33.88 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E to provide a level of safety equivalent to that provided by the engine overtemperature test requirements contained in 14 CFR part 33.88 as described below.

B. Regulatory Comparison:

1. Section 33.88(a) for engine ratings other than the 30-second OEI and 2-minute OEI ratings, requires an overtemperature test of 5 minutes at maximum permissible rotational speed (rpm) with the gas temperature at least 75 °F (42 °C) higher than the maximum rating's steady-state operating limit. Section 33.88(a) also requires that following the test, the turbine assembly must be within serviceable limits.
 - a. The governing temperature location from which to base the test temperature increase is the turbine inlet temperature (TIT), refer to FAA policy PS-ANE100-1997-00004 dated October 7, 1997.
 - b. CS-E 870 requires a 15-minute test at the Maximum Exhaust Gas Over-temperature limit elected by the applicant. The base for the overtemperature test in the CS-E 870 is the exhaust gas temperature (EGT) and the temperature increment over the maximum EGT is elected by the applicant. A direct compliance with § 33.88 is achieved when the following conditions are met:
 - i. The test required by CS-E 870 is run to the gas temperature equal to or higher than that required by § 33.88(a),
 - ii. The governing temperature location from which to base the test temperature increase is the turbine inlet temperature (TIT) in accordance with the referenced FAA policy.
 - iii. The CS-E 870(c) requirement that “the stripped condition of the Engine must be satisfactory for continued running” must be applied to ensure that the turbine assembly is within serviceable limits.
2. Section 33.88(b) applies to engines with 30-second OEI and 2-minute OEI ratings.
 - a. CS-E does not have an equivalent requirement.

C. Guidance Material:

1. FAA policy PS-ANE100-1997-00004, titled “Engine Overtemperature Test; Governing Temperature Location” dated October 7, 1997. The policy identifies the TIT as the location in the turbine for measuring the delta gas temperature.
 - a. For engine models in which TIT is not directly measured, analytical means may be used to extrapolate this temperature from the measured temperature.
2. FAA Advisory Circular (AC) 33-2C, titled “General Type Certification Guidelines for turbine engines”, dated June 25, 2013.

3. FAA Advisory Circular (AC) 33.87-1A, titled “Engine Overtorque Test, Calibration Test, Endurance Test, and Teardown Inspection for Turbine Engine Certification”, Appendix 7, dated March 9, 2015.
 - a. The AC states that for the purpose of running the overtemperature test, transients greater than 30 seconds and less than 2 minutes are considered steady state.

D. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9																
	10																
	11																
	12																
CS-E Amendment	0																
	1							X	X	X	X	X					
	2											X					
	3											X	X	X	X	X	
	4																X

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part 33 amendment 25 contact the Engine and Propeller Standards Branch.

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Manager, Engine and Propeller Standards Branch, (AIR-6A0)
Policy and Innovation Division
Aircraft Certification Service

File: SSD 14 CFR 33.88 Overtemperature Amd 25 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Initial Maintenance Inspection Test § 33.90 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E to provide a level of safety equivalent to that provided by the initial maintenance inspection test requirements contained in 14 CFR part 33.90 as described below.

B. Regulatory Comparison:

1. Requires a test for new type certificates to establish when the initial maintenance inspection is required. Alternately, per 33.90(b) an engine test may be conducted in accordance with § 33.201 (c) through (f).
 - a. CS-E currently has no requirements for an Initial Maintenance Inspection (IMI) test.

C. Guidance Material:

FAA Advisory Circular (AC) 33.90-1A, titled Initial Maintenance Inspection, 14 CFR 33.90, Test for Turbine Engines, dated 04/13/2016, provides guidance for 33.90.

FAA Advisory Circular (AC) 33.201-1, titled Extended Operations (ETOPS) Eligibility for Turbine Engines, dated 1/21/10, Chapter 6 Initial Maintenance Inspection Test – §33.90(b), which describes a method for utilizing the Early ETOPS § 33.201 test to show compliance with § 33.90.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9																
	10																
	11																
	12																
CS-E Amendment	0			X	X	X	X										
	1						X	X	X	X	X	X	X				
	2												X				
	3												X	X	X	X	X
	4																X

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part 33 amendment 21 contact the Engine and Propeller Standards Branch.

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Policy and Innovation Division
Aircraft Certification Service

File: SSD 14 CFR 33.90 IMI Amd 21 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Engine tests in auxiliary power unit (APU) mode § 33.96 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E to provide a level of safety equivalent to that provided by the engine tests in auxiliary power unit (APU) mode requirements contained in 14 CFR part 33.96 as described below.

B. Regulatory Comparison:

1. Section 33.96 requires an endurance test for turboprop engines that include a propeller brake to keep the propeller from rotating during engine ground runs. The rule is structured the same as any endurance test. It includes engine run cycles with the brake engaged followed by disassembly to examine for wear.
 - a. EASA does not have a comparable requirement.

C. Guidance Material:

FAA Advisory Circular (AC) 33-2C, titled “General Type Certification Guidelines for turbine engines”, dated June 25, 2013. AC 33-2C, para. 9.m. explains that the testing may be done in conjunction with § 33.87 and that the rotor brake system features, including operating instructions and limitations, should be described in the installation and operating manual as required under § 33.5.

Note: For rotorcraft the FAA issued a special condition to demonstrate engine durability with the rotor blades brake while the engine is operating.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9	X															
	10	X	X														
	11	X	X														
	12	X	X														
CS-E Amendment	0	X	X	X	X	X	X										
	1						X	X	X	X	X	X	X				
	2												X				
	3												X	X	X	X	X
	4																

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part amendment 11 contact the Engine and Propeller Standards Branch.

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Policy and Innovation Division
Aircraft Certification Service

File: SSD 14 CFR 33.96 APU Amd 11 and later vs CS-E.docx

Significant Standards Differences (SSD) Detail Description
14 CFR part 33 versus CS-E
Design and test requirements for ETOPS approvals §33.201 vs CS-E
March 21, 2018

A. Summary:

In accordance with Title 14 Code of Federal regulations (14 CFR) 21.29 and the Technical Implementation Procedures for Airworthiness and Environmental Certification between the Federal Aviation Administration of the United States of America and the European Aviation Safety Agency of the European Union, Revision 6, dated September 22, 2017, (TIP Rev 6), the FAA here prescribes additional requirements relative to CS-E 1040 to provide a level of safety equivalent to that provided by the Design and test requirements for Early ETOPS eligibility contained in 14 CFR part 33 section 33.201, as described below.

B. Regulatory Comparison:

Section 33.201 Design and test requirements for Early ETOPS eligibility applies to engines to be installed on a two-engine airplane approved for ETOPS without the service experience specified in part 25, appendix K, K25.2.1.

The CS-E 1040 counterpart regulation contains a single requirement for the in-flight shutdown (IFSD) rate. It includes by reference the advisory material found in AMC 20-6 applicable to “Extended Range Operation with Two-Engine Aeroplanes ETOPS Certification and Operation”.

For the purpose of this SSD, we compared the §33.201 regulation with the CS-E 1040 requirements and the guidance in AMC 20-6, revision 2 effective October 23, 2010.

1. Section 33.201(a) specifies requirements for the applicant’s design quality system. AMC20-6 prescribes equivalent guidance. Specifically:
 - a. Appendix 1 section 7 requires the TC holder must hold an EASA approval in accordance with Part 21 Subpart J Design Organisation Approval requirements, including 21A.239 on “Design assurance system” to require adequate design control and supervision to comply with the certification basis (which would include CS-E 1040).
 - b. Chapter II section 3 requirements which are then more prescriptively demanded in Appendix 1 section 2 b.(1) the ETOPS Certification Plan that must be agreed by the Agency. The processes to be included in the plan are also defined in Appendix 1 and include in section 4 b. through e. the process by which reliability related design features are identified, assessed and incorporated into the type design standard for ETOPS.
 - c. **The regulatory difference is compensated if the applicant follows the AMC 20-6 sections specified above.**
2. Section 33.201(b) specifies requirements to mitigate problems shown to result in an IFSD, loss of thrust control, or other power loss in the applicant's other relevant type designs. The AMC20-6 prescribes equivalent guidance. Specifically:
 - a. AMC20-6 Appendix 1 section 2 b.(1) requires engineering assessment based on in-service experience, to show that the propulsion system will minimize failures and malfunctions, and will achieve an IFSD rate that is compatible with the specified safety target associated with catastrophic loss of thrust.
 - b. AMC20-6 Appendix 1 section 4 prescribes the engineering assessment criteria for acceptable reliability validation methods, which are also applicable to early ETOPS engines.

- c. **The regulatory difference is compensated if the applicant follows the AMC 20-6 sections specified above.**
- 3. Section 33.201(c) requires a test for engines to be granted ETOPS eligibility without the service experience specified in part 25, appendix K, K25.2.1 of more than 250,000 engine-hours.
 - a. AMC section 2(b) test applies to “first entry in service” engines. However, AMC 20-6 Appendix 1 section 2(a) does not require early ETOPS testing for engines with more than 100,000 engine hours for new types and 50,000 engine hours for derivatives. CS-E and AMC 20-6 allows these engines to be approved for ETOPS based on the service experience.
 - b. **The regulatory difference is compensated if the applicant follows the AMC 20-6 Early ETOPS guidance for an engine with service experience less than 250,000 engine-hours, or as permitted under part 25, appendix K, K25.2.1.**
- 4. Sections 33.201(d) and (e)(1) require engine calibration prior and at the conclusion of the test in 33.201(c) for the purpose to demonstrate that any change in power or thrust characteristics is within approved limits.
 - a. The CS-Es or AMC 20-6 don’t prescribe the calibration requirements.
 - b. **The regulatory difference remains applicable and the applicant must comply with §33.201(d) and §33.201(e)(1).**
- 5. Sections 33.201(e)(2) and (e)(3) require engine visual and teardown inspections at the conclusion of the test.
 - a. AMC 20-6 Appendix 1 Sections 2(b)(2)(i) and (ii) provide the same inspections.
 - b. **The regulatory difference is compensated if the applicant follows the guidance in AMC 20-6 Appendix 1 Sections 2(b)(2)(i) and (ii).**
- 6. Section 33.201(e)(4) specifies the criteria for acceptable wear or distress observed during post-test inspections, and prescribes corrective actions when necessary.
 - a. The AMC 20-6 Appendix 1, section 2(b)(2)(ii) states that potential sources of in-flight shutdown, loss of thrust control, or other power loss encountered during inspection must be tracked and resolved in accordance with paragraph 5 of AMC 20-6 Appendix 1.
 - b. **The regulatory difference is compensated if the applicant follows the guidance in AMC 20-6 Appendix 1 paragraph 5 for the test engine.**

C. Guidance Material:

FAA Advisory Circular AC33.201-1, titled “Extended Operations (ETOPS) Eligibility For Turbine Engines”, dated January 21, 2010. The AC33.201-1 guidance has no comparative equivalent in AMC 20-6 revision 2 effective October 23, 2010. **The applicant should follow these AC33.201-1 sections:**

- 1. Section 33.201(c)(1) requires a minimum of 3,000 representative cycles. AC 33.201-1 Section 5.e defines the required "representative" service start-stop cycle, including the cold starts.
 - a. Below are some areas that require special attention based on past experience
 - i. AC 33.201-1 Section 5.e.(1)(a) defines “representative” as a mix of full rated and de-rated takeoff thrust mission that represent typical operations expected in the first two years of service for the specific model. i.e. not model/family/series. The test must cover all models to be certified for early ETOPS eligibility.
 - ii. AC 33.201-1 Section 5.e.(1)(a) states that the “a minimum of 50 cold starts should be included in the test, where cold is defined as the engine being shutdown for a minimum of 3 hours”.

- iii. AC 33.201-1 Section 5.e.(1)(b) states that “the takeoff rating used for this test must be the highest takeoff rating for which ETOPS eligibility is sought for a family/series of engines. Any applicable thrust de-rates should be evaluated similarly”.
 - iv. AC 33.201-1 Section 5.e.(1)(d) states that “the MCT rating used for this test must be the highest MCT rating for which ETOPS eligibility is sought for a family/series of engines”.
2. AC 33.201-1 Section 5.f. provides guidance for §33.201(c)(2) requirements for unbalance and vibration endurance.
 3. AC 33.201-1 Sections 5.g. and 5.h.(1) provides guidance for calibration test requirements for §§33.201(d) and (e)(1).
 4. Section 33.201(c) test may need to be repeated for derivative models, or design changes. AC 33.201-1 Section 5.d.(2) provides criteria for when a new test is required.

E. Applicable Amendment Pair Matrix:

		14 CFR Part 33 Amendment															
		19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
JAR-E Change	9																
	10																
	11																
	12																
CS-E Amendment	0			X	X	X	X										
	1						X	X	X	X	X	X					
	2												X				
	3												X	X	X	X	X
	4																X

The actual amendment pair will be based on the bilateral agreement. Per TIP Rev 6 the validating authority certification basis is established based on the application date to the certifying authority. This SSD may be applicable to later amendment pairs which will be reflected in the SSD list summary. For amendment pairs prior to 14 CFR Part 33 amendment 21, contact the Engine and Propeller Standards Branch.

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