Disposition of Public Comments
PS-ANE-33.89-01, Policy for Turbofan, Turbojet and Turboprop Engine Rotor Lock

Item No:	**Page and Paragraph No:**	**Comment:**	**Reason:**	**Recommendation:**	**Disposition:**
1. Williams International	Page 1, Section 2., Background, paragraph a. Defining Rotor Lock.	First sentence can cause confusion and in-advertently restrict use of rotor locking testing.	Recommend adding a statement clarifying that the rotor lock defined in this document is not to be confused with the Rotor Locking testing discussed in 14 CFR 33.92.	Change "Rotor ... (1) an engine rotor speed falls to zero following an in-flight shutdown or engine flame out and (2) ... attempt" to "Rotor ... (1) an engine rotor speed falls to zero following an in-flight shutdown or engine flame out and not related to a device installed to prevent continued rotation as related to 14 CFR 33.92; and (2) ... attempt."	Nonconcur The policy states that it addresses 33.89 starting requirements.
2. Williams International	Page 4, Section 4., Guidance, paragraph d. <u>Key Elements to Consider</u>., 1st sentence.	Suggest different choice of terms.	None provided	Change "A rotor lock ... maximize the <u>thermodynamic</u> mismatch ... factors" to "A rotor lock ... maximize the <u>thermal</u> mismatch ... factors"	Adopted
3. GE Aviation	Pg 1, 1. Purpose	The reference to turbofan engines appears to appropriately exclude turboprop engines.	For clarity.	Clearly state the Policy is <u>not</u> applicable to turboprop engines	Nonconcur. However, we have added clarification to policy. We intended to include turboprop engines as part of the policy, but did not specifically reference turboprop engines. We revised the policy to specifically state that the policy is applicable to turboprop engines.
4. GE Aviation	Pg 1, 2. Background, a. Defining Rotor Lock	The rotor lock condition of concern is a transient and temporary thermal condition, not the initial rub in at new build addressed by green runs.	For clarity and not to be confused with new or rebuild clearances.	Rotor lock is a transient temporary thermal condition …	Adopted

Disposition of Public Comments
PS-ANE-33.89-01, Policy for Turbofan, Turbojet and Turboprop Engine Rotor Lock

5. GE Aviation	Pg 1, 2. Background, b. Susceptible Features	While the physics may imply modern designs are more susceptible, current requirements maintain wind-milling speeds.	Unfounded conclusion not supported by the record.	Industry work in PPIHWG showed that the left hand boundary of the published windmill start envelope has not trended up with time. (see figure). Issue papers written against airplane certifications since the mid-1990s have maintained the windmill start capability.	Nonconcur The FAA has found that engine designs in the last 20 years are more susceptible. Older low-bypass engines force the core to continue to rotate during windmilling.
6. GE Aviation	Pg 2, 2. Background c. National Transportation Safety Board (NTSB) Recommendations	The first sentence for the accident description is misleading.	Although the later sentence lists rotor lock as contributory, the first sentence should include the prime causes.	In October 2004, a flight crew and airplane perished on a non-revenue flight when the crew crashed while attempting to land after a high altitude aircraft stall, all engines flamed out, they overflew several airports, and were unable to restart the engines.	Nonconcur The second sentence already states the primary causes of the accident as determined by the NTSB.
7. GE Aviation	Pg 4, 4. Guidance d. Key Elements to Consider, para (3)	Crew troubleshooting starts after the crew follows emergency procedures and best glide L/D is not the emergency procedure.	There are some serious flaws in the FAA proposed best L/D glide speed as the pass/fail criteria.	Rotor lock certification analysis or testing should be at a reasonable and rational descent speed consistent with emergency procedures.	Nonconcur Both Transport Airplane Directorate flight test personnel and the actual reaction of the Pinnacle crew support the FAA position that best L/D is a likely flight condition for the crew to set upon initial all-engine power loss.

Disposition of Public Comments
PS-ANE-33.89-01, Policy for Turbofan, Turbojet and Turboprop Engine Rotor Lock

8. GE Aviation	Pg 4, 4. Guidance g. Reporting Results	Developing an in-flight engine seal grind-in procedure would not address overhaul shop engines.	The rotor lock of concern is a temporary transient thermal condition, not a build issue.	The best alternative is mandating a minimum airspeed airplane operational procedures aimed at mitigating the condition	Nonconcur Section 4.f. of the policy addresses overhauled engines. The commenter is correct in stating that an in-flight grind in procedure would not necessarily address overhaul shop engines, which would still need to be addressed by the applicant. We agree that rotor lock is a temporary transient thermal condition, but it may take a significant amount of time to clear and then allow restart of the engine. It can also be a build standard or design issue since seals can be designed to avert this condition. The commenter suggests replacing the proposed rotor lock screening procedure with a mandated minimum airspeed. We disagree with that approach because it is too restrictive. The policy allows more compliance options to the applicant.

Disposition of Public Comments
PS-ANE-33.89-01, Policy for Turbofan, Turbojet and Turboprop Engine Rotor Lock

9. GE Aviation	Pg 6, 5. Effect of Policy	The policy does constitute a new regulation or creates what the courts refer to as a “binding norm.”	The policy makes significant change to the certification process.	Address with a new rulemaking ARC.	Nonconcur This policy does not constitute a new regulation nor does it create a binding norm. The policy has not made any significant change to the certification process. The current 33.89 rule already requires that the engine must be able to start inflight. The policy addresses a compliance issue to 33.89.
10. Stephen P. Bezman (FRB.gov)	General Comment	An engine experiencing a rotor lock would not “Windmill.”	Clarity	An engine experiencing rotor lock would not "windmill", and perhaps this should be clarified in the policy.	Nonconcur We disagree that an engine experiencing rotor lock would not “windmill”. A wind-milling fan can still have a rotor-locked core. As noted in section 3.a.1 of the policy, it is the core rotor that is of concern for rotor lock and restart capability.

Disposition of Public Comments
PS-ANE-33.89-01, Policy for Turbofan, Turbojet and Turboprop Engine Rotor Lock

11. AIA/ASD/GAMA	General Comment	Various statements regarding "catastrophic consequences" (such as Section1, 2nd sentence) should be removed or reworded in a non-alarmist manner.	The inability to restart an engine in flight is not classified as a hazardous engine effect under 14 CFR 33.75. It is understood that the inability to restart an engine in flight may lead to a forced landing. However, consideration and balance must be given to the likelihood and causes of power loss events for whatever reasons. The policy as written would have the reader believe that "rotor lock" is a condition more disastrous than all other conditions that would lead to engine loss of power.	Remove or reword in a non-alarmist manner, various statements regarding "catastrophic consequences" (such as Section1, 2nd sentence).	Nonconcur The policy addresses an emergency situation where all engines lose power and may possibly lock if not immediately addressed. We believe that not being able to relight engines after an all-engine out event is a potentially hazardous aircraft-level situation. This is why there is a requirement for the applicant to show restart capability. We believe the language is appropriate since this policy is targeting an all engine power loss issue.
12. AIA/ASD/GAMA	Page 3 Section 4 d	Section 4d states that the "screening assessment is intended to maximize the thermodynamic mismatch".	The assessment should not be intending to maximize the mismatch, but instead should be determining the worst case conditions within the declared operating envelope (via the critical point analysis) that effect or hinder rotation of the engine and successful restarting.	The "Key Elements to Consider" appear to be focused on defining the most egregious circumstances for engine operation and restarting, without consideration for what is normal, practical or expected operation of the engine. (It is inferred by the comment that the commenter wants this section reworded to reflect normal or expected operations and not most critical.)	Nonconcur The rotor lock screening policy does address thermal mismatch in a conservative but not the most critical situation. The policy does not address the whole operating envelope or require the worst case stack-up of conditions like the commenter suggests. The policy is intended to address the maximum thermal mismatch for a probable pilot reaction.

13. AIA/ASD/GAMA	Pages 4 & 5 Sections d & e	The proposed policy should be revised to remove any indication the screening test include slowing to best glide and remaining at that speed until reaching the restart envelop.	Given FAA's inability to quantify the operational threat that rotor lock would foreseeably occur during normal/typical operations outside a test flight scenario and in consideration of increasing reliability and decreasing in-flight shutdown events.	AIA/ASD/GAMA would endorse having manufacturers verify the associated emergency procedure has appropriate margin and accounts for flight crew trouble-shooting by using a screening approach that incorporates a delayed reaction to a loss of power. After such time has passed, the screening procedure would allow adherence to previously established requirements to ensure restart capability. While it is physically possible for the pilot to select airspeeds that are lower than the operating procedure for an all engine-out event, the minimum airspeed for descent in the aircraft operating instructions is normally governed by other considerations such as maintaining cabin pressurization. The FAA's stated expectation to select 'best glide slope is likely' is incorrect. The expectation is for the flight-crew to follow the aircraft operating procedures for an all engine-out event; with time allowance only for recognition of the all-engine-out condition, and not 'troubleshooting the emergency for several minutes' which implies associated distraction from the primary responsibility of the flight crew to maintain the required aircraft flight path.	Nonconcur The FAA and AIA essentially agree that an effective rotor-lock screening procedure after a power loss includes a reasonable time frame for the pilot to assess the situation before initiating descent, and demonstration of relight capability. The engine level rotor lock policy is not intended to validate the adequacy of airframe level emergency procedures. Rather it is intended to screen engines for a specific condition that can potentially occur in-flight after an all engine power loss event. The commenter's suggestion that the FAA should consider the large number of possible airframe level procedures at the engine level does not address the pilot reaction to an emergency all engine out scenario. As the policy states, applicants may propose other approaches at other flight conditions to demonstrate that the engines can be relit after a reasonable time frame to assess the situation.

14. AIA/ASD/GAMA	Page 4 Section 4 e	Section 4e requires a detailed assessment for "major engine design change programs" without any definition of, or expectation of which "major engine design change programs" necessitate additional screening assessments.	clarity	AIA/ASD/GAMA recommend adding the following edit, or similar, to better define what kind of "major" programs would necessitate rotor lock screening: *"A rotor lock compliance screening assessment for new engine certifications, or major engine design change programs which directly affect the engine characteristics known to alter rotor lock tendency, should include the following procedures in the CPA or…."*	Partially Adopted Although we concur with the comment, we worded the new paragraph (now 4.c) slightly differently.
15. AIA/ASD/GAMA	Page 5 Section 4 f	It is proposed that this paragraph be deleted.	Assuming there is no core lock, the engine will not have zero core speed as referenced in note (1). There is also a reference to starter assistance in note (2), however it is assumed that this is a windmill start.	Delete this paragraph.	Partially Adopted Although the reason we removed the paragraph was due to it no longer being applicable since we decided to remove detailed guidance from the policy.
16. AIA/ASD/GAMA	Page 4 Section h	As written, paragraph 4 h imposes additional requirements on engine manufacturers beyond the requirements of 33.4 (Instructions for Continued Airworthiness) and 33.5 (Installation and Operating Instructions).	Currently, the results of certification tests are not documented in the instructions or manuals defined by 33.4 or 33.5. However, the results of certification tests and analyses, and a variety of other manufacturer data, are used to develop the content of the prescribed manuals and instructions.	It is recommended that the first sentence of paragraph 4 h be changed to *" Applicants should use the results of the rotor lock compliance assessment (as described in this policy) to develop appropriate engine restart procedures to mitigate against rotor lock. Appropriate procedures shall be documented in the engine installation and operating procedures as required under 33.5"*	No longer applicable We removed this section from the policy. Note: It is standard policy to pass on any significant engine installation issues to the installer through the installation manual. A known rotor lock condition would be one of those issues that may be addressed at installation.

17. AIA/ASD/GAMA	Page 5 Section 4 g	AIA/ASD/GAMA feel the FAA has not adequately addressed what actions will be required if a rotor lock condition is experienced during the proposed screening test.	Given broad types of engines certified under Part 33, the potential to experience rotor lock under the proposed testing scenario is reasonably high. Yet, as has been the primary focus of AIA/ASD/GAMA comments, there is no substantive safety benefit to be gained by complying with the proposed policy statement. As such, the proposed in-flight grind-in option, while effective, is not an acceptable alternative to all aircraft/engine types in Part 25 and cannot be conducted on production or overhauled engines sent directly to the field. Furthermore, the option of applying a "mandatory minimum airspeed airplane operational procedures" is the equivalent of existing windmill restart envelopes and therefore removes any value, perceived or otherwise, of the proposed policy.	At a minimum, AIA/ASD/GAMA request the referenced paragraph be edited as follows: *"If rotor lock, rotor drag, hung start, or any condition adversely affecting restart capability is encountered during the applicant's engineering or certification testing, the FAA certification office should report this to the Engine & Propeller Directorate Standards Staff. It is up to the applicant is encouraged to determine if incorporate engine design changes are an appropriate solution that would mitigate those adverse conditions. Other mitigating actions to address these adverse conditions may include developing an in-flight engine seal grind-in procedure, procedures to reduce drag from gearbox accessories or mandatory minimum airspeed airplane operational procedures aimed at mitigating the condition, potentially in combination with other mitigating actions, such as the use of starter-assist."*	Partially adopted We accepted the commenter's phrase, "report this to the EPD" and revised the policy. Section 4.f. does define some possible alternatives if a rotor lock condition is discovered. The policy allows the applicant to propose an action from the list of alternatives or they may propose another method to address the rotor lock condition if it is discovered during screening. We disagree that there is no safety benefit by complying with the policy. We believe it will identify, through screening, those engine designs that tend to lock and not restart.

18. AIA/ASD/GAMA	Page 6 Section 5., 1ST sentence	The 1st sentence, *"The general policy stated in this document does not constitute a new regulation or create what the courts refer to as a "binding norm."* should be deleted. As noted in the attached response letter, rotor lock, as described in the draft policy statement is outside the scope of 14CFR Part 25.903(e). This is clearly articulated in the preamble language and by FAA's repeated acceptance of compliance demonstrations.	Technical	Delete the 1st sentence of Section 5. The FAA should review Order IR 8100.16 2-2 (a), (b) and (c) and revise the draft policy statements accordingly.	Nonconcur 14 CFR 25.903(e) is not applicable to part 33 TC programs, only part 25 aircraft. The policy is in compliance with Order IR8100.16 since it is not adding requirements to the existing rule. The policy provides guidance in showing compliance to the 33.89 in-flight starting compliance demonstration. As the policy states, other methods are also acceptable. The policy provides guidance as to how the FAA would evaluate alternate proposals.

19. NTSB	General Comment	The NTSB is pleased to note that publication of the proposed policy statement will ensure that engine rotor lock will be included in future 14 CFR Part 33 engine certification tests. The NTSB believes that the proposed policy will provide sufficient means for identifying rotor lock and will offer instructions for mitigating actions to address the rotor lock condition.	The NTSB is satisfied that the proposed rotor lock screening procedures and proposed actions to alleviate the rotor lock condition, as well as the reporting and documentation procedures, address the NTSB's concerns regarding this issue, and the NTSB supports the proposed policy.	No changes recommended	Not applicable NTSB concurs and accepts policy as written (Note: policy wording and elements have changed since the NTSB reviewed it and commented on it. So this NTSB endorsement may or may not still be valid).
20. NTSB	General Comment	The NTSB notes that the instructions to report negative results of the rotor lock screening test to the installing aircraft certification office will ensure consideration during aircraft certification, and documenting negative rotor lock screening results in the engine's installation and operating manuals will ensure that the condition is considered during future aircraft certification processes.	The NTSB is satisfied that the proposed rotor lock screening procedures and proposed actions to alleviate the rotor lock condition, as well as the reporting and documentation procedures, address the NTSB's concerns regarding this issue, and the NTSB supports the proposed policy.	No changes recommended	Not applicable NTSB concurs and accepts policy as written (Note: policy wording and elements have changed since the NTSB reviewed it and commented on it. So this NTSB endorsement may or may not still be valid).

21. Embraer	General Comment	Embraer believes that the proposal to define a post-flameout operating envelope down to the speed for maximum lift-over-drag (L/Dmax) minus 10 knots will have a negligible effect on protection against rotor lock events in service, and may unintentionally result in an overall lower level of safety and possibly cause adverse environrnental effects.	First of all, L/Dmax airspeed is not typically published nor is it part of the training program for Part 25 jets. In addition, there are other considerations like the pressurization loss the also result from all-engine flameout that cal1 for a more expedited descent. To characterize a deceleration to L/Dmax speed as "representative of an expected pilot's response" is not reflective of an optimal response considering all risks, not part of training, and as far as Embraer is aware, is not shown in service history as a normal or expected pilot response for all-engine flameouts that happen at altitude.	(Embraer does not propose alternate language or a different proposal.)	Partially Adopted The commenter disagrees with our statement that max L/D is an expected pilot's target speed in reaction to an emergency all engine out condition. The commenter does not propose alternate language or a different proposal. Although we disagree philosophically with the commenter, we have revised the policy such that this explicit criterion that they object to has been removed.
22. Embraer	General Comment	The policy does not recognize that some engines, typically turboprop and smaller turbofans with electric starter-generators, do not have a windmill start envelope and rely on assisted starts throughout the restart envelope.		The policies for Part 25 and Part 33should be revised to address these designs.	Partially adopted We have removed the methods of compliance from the policy. Although the policy does not explicitly allow or disallow starter assist, the policy does not prohibit it. There are two references to its use in the policy.
23. Embraer	General Comment	In addition, the Part 33 policy would presumably be applicable to turbine engines intended for installation on smaller Part 23 aircraft.		The installation considerations for these aircraft should be addressed somewhere.	Nonconcur The part 33 policy can not impose installation requirements for small airplanes.

24. Embraer	General Comment	The FAA policy encourages engine design changes in response to installations that do not successfully pass the new Max L/D speed demonstration, but does not address the adverse economic and environmental effects due to the resulting increase in fuel consumption and emissions, nor the significant economic impact that would result.	Embraer believes that the proposed policy should not be implemented as written without a full accounting of these effects with the opportunity for public review and comment.	Embraer would support a proposal to evaluate the time available to the flight crew to detect and respond to an all-engine flameout by pitching the airplane nose-down to achieve the required airspeed.	Nonconcur We have afforded the public an opportunity to comment on the policy, including any economic concerns or issues that could result from the policy. Additionally, during the AIA rotor lock meetings, there were no specific adverse economic or environmental effects of either Airbus or Bombardier in-flight rotor lock screening tests. AIA never identified any specific adverse economic or environmental impacts. Based on our AIA discussions, we are not aware of any specific significant environmental or economic impacts. Embraer's alternate proposal appears nonspecific and incomplete, was not discussed in the open forum AIA meetings. Also see response to related comment #17.
25. Cessna	General Comment	Cessna has no comment on this policy at this time.	No comment	No comment	Not applicable

26. Bombardier	General Comment	General: Bombardier Aerospace supports the position of AIA and GAMA: 1. The proposed flight test for rotor lock susceptibility is unrealistic and unwarranted given current high-altitude engine restart instructions. 2. The engine restart requirements of 14 CFR Part 25 are not consistent with the proposed rotor lock testing conditions. As written, the proposed policy creates new certification requirements.		Withdrawal of proposed policy statement.	Nonconcur See response to similar comment # 9 The rotor lock screening policy is not intended to address realistic high altitude starting, but it is intended to screen for potential designs that are more susceptible to rotor lock. The proposed screening procedure does identify rotor lock for designs like the engine involved in the Pinnacle Airlines accident. The part 33 and part 25 rotor lock policies are consistent in their approach in screening. Compliance to this part 33 policy on rotor lock does not require flight test. Analysis is also acceptable to meet this part 33 policy.
27. Bombardier	Page 5, Point 3 of the rotor lock screening test	The described procedure does not allow full use of the restart envelope	Significant altitude is lost during the acceleration from the target airspeed to the minimum windmill restart speed. By anticipating the top of the envelope and accelerating to minimum windmill restart speed before it is entered, the full height of the envelope can be used.	Change to “Acceleration to minimum windmill restart airspeed should begin *prior* to reaching the top of the restart envelope, with the intent of attaining minimum windmill restart speed at the top of the envelope.”	Not applicable We have removed this element from the policy so the comment is no longer relevant.