DISPOSITION OF PUBLIC COMMENTS
AC 25.362-1, *Engine Failure Loads*
Prepared by Todd Martin, ANM-115

No.	Comment	Requested Change	Disposition
	Commenter: Airbus		
1.	Compared to the AMC 25.362 §4c, §5.3.2 describes additional engine failure conditions: "partial blade loss" and "bird strike." AMC 25.362 refers only to "other failures" in §5c, if they could result in higher loads, without specifying any particular condition. In addition, AC references engine feature "Fused/frangible bearing support" to be considered for loads determination. This is not in line with AMC.	Please delete the references to "partial blade loss," "bird strike" and description of engine feature "Fused/frangible bearing support," and replace by "Other engine structural failures" that could result in higher loads.	We don't agree with the proposed change regarding bird strike. In fact, AMC 25.362 §4c does refer to bird strike events. And bird strike is stipulated in the rule as well. We don't agree with the proposed change regarding partial blade loss. The rule refers to "failure of a blade." The rule does not assume that this means only a full fan blade failure, since partial blade failures may also occur. The intent of the rule is to ensure the airplane is capable of withstanding "the most critical transient dynamic loads and vibrations." As explained in the AC, although loss of a blade is likely to produce the most severe loads, a partial fan blade failure may be more critical. The AC points out that in some unique cases, partial blade failure of a blade may result in higher loads than a full blade failure.

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	Commenter: Boeing		
1.	Section 6.3: Our suggested revision would clarify that other engine failure conditions	We suggest revising the text to read as follows:	We agree. The AC has been revised as follows. Differences between this and the

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	Commenter: Boeing		
	need to be analyzed only if they could result in higher loads than the blade loss condition. As described in proposed paragraph 5.3.1, fan blade loss is likely to produce the most severe engine failure loads. Dynamic loads analysis is only necessary for those other engine failure conditions that could produce higher loads than the fan blade loss condition. Analyzing other engine structural failure conditions that do not produce higher loads than fan blade loss would create additional, unnecessary work. Our suggested change is also consistent with EASA AMC 25.362, paragraph 5.c.	"As identified in paragraph 5.3 of this AC, ~~the~~ if any other engine structural failure conditions specified in § 25.362 could result in higher loads being developed than the blade loss condition, those conditions must ~~also~~ be evaluated by dynamic analysis to a similar standard and using similar considerations to those described in paragraph 6.2 of this AC."	recommended text are underlined. "As identified in paragraph 5.3 of this AC, if any of the other engine structural failure conditions specified in § 25.362, applicable to the specific engine design, could result in higher loads being developed than the blade loss condition, those conditions ~~must~~ should be evaluated by dynamic analysis to a similar standard and using similar considerations to those described in paragraph 6.2 of this AC." While this change is made to harmonize the AC and the corresponding EASA AMC, the rule itself specifies the requirement directly, and the AC cannot change that requirement: "For engine mounts, pylons, and adjacent supporting airframe structure, an ultimate loading condition must be considered that combines 1g flight loads with the most critical transient dynamic loads and vibrations, as determined by dynamic analysis, resulting from failure of a blade, shaft, bearing or bearing support, or bird strike event."
2.	Section 8.1: Our suggested revisions clarify that a full airplane model is not necessary to calculate engine failure loads for the engine	We suggest the text be revised as follows: "8.1 Components of the Integrated Dynamic Model. The applicant should calculate	We agree with adding "adjacent supporting" as recommended. We do not agree with adding the

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	Commenter: Boeing		
	mounts, pylon, and adjacent supporting airframe structure, as stated in the last sentence of paragraph 8.2.1. of the proposed AC. Additionally, our suggested change to "adjacent supporting airframe structure" is consistent with EASA AMC 25.362, paragraph 7.a.	airframe dynamic responses with an integrated model of the engine, engine mounts, pylon, and <u>adjacent supporting</u> airframe structure <u>(i.e. wing model for wing-mounted engines)</u>.	parenthetical phrase "<u>(i.e. wing model for wing-mounted engines),</u>" because the AC already clarifies in the subsequent section that "A full airplane model is not usually necessary for the engine failure analysis …."
3.	Section 8.1: The frequency requirement for the dynamic model is applicable to all components of the integrated dynamic model that are described in the third sentence of paragraph 8.1. The text in the proposed AC could be misinterpreted to indicate that the frequency requirement is only applicable to the airframe structural model. Our suggested revision would clarify this.	We suggest revising the text as follows: "… The integrated dynamic model used for engine structural failure analyses should be representative ~~of the airplane~~ to the highest frequency needed to accurately represent the transient response. …"	We agree. The recommended change has been made.
4.	Section 8.2.1: Our suggested revision clarifies that a full airplane model is not necessary to calculate engine failure loads for the engine mounts, pylon, and adjacent supporting airframe structure, as stated in the last sentence of paragraph 8.2.1.	We suggest revising the text as follows: "8.2.1. An analytical model of the <u>adjacent supporting</u> airframe <u>structure</u> is necessary in order to calculate the airframe responses due to the transient forces produced by the engine failure event. …"	We don't agree with the proposed change. This change would make our AC inconsistent with the EASA AMC. Furthermore, later in the same paragraph, the AC says, "A full airplane model is not usually necessary for the engine failure analysis, and it is normally not necessary to consider the whole aircraft response, the effects of automatic flight control systems, or unsteady aerodynamics."

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No.	Comment	Requested Change	Disposition
	Commenter: Cessna		
1.	The following statement from Section 6.2.2 is prejudicial: "The loads to be applied to the pylon and airframe are normally determined by the applicant based on the integrated model, which includes the validated engine model supplied by the engine manufacturer." And in Section 8.1, it is assumed that an that an integrated model including considerable engine dynamics detail is to be used. This claim of normalcy is not accurate for smaller Part 25 designers. Many applicants have been successful without such a model.	The implied requirement of an integrated dynamic model should remain in the realm of the "special condition" for those few applicants for which it is intended. Alternatively, better articulated exceptions should be part of the AC language.	Section 6.2.2 - We agree the use of "normally" should be changed as follows: "The loads to be applied to the pylon and airframe ~~are normally~~ should be determined by the applicant based on the integrated model …" Section 8.1 - The commenter did not propose any specific changes. The material presented in this section provides basic and generic guidance on modeling and validation. Since this is an AC, the applicant may propose a different method than what is presented.
2.	Section 8.3 is explicit in its requirements to include a model designed for engine certification. This description, coupled with Section 6.2.2 virtually requires use of a model designed for one purpose (engine certification) to be incorporated into another purpose (airframe certification). A host of technical and contractual issues arise from this forced integration that is not technically justified for most applicants. This makes it difficult for the applicant to maintain ownership of, and take full responsibility for, his own demonstration of compliance. Compelling justification seems	None specified.	We do not agree that Section 8.3 or Section 6.2.2 requires that the model used for engine certification also be used for airframe certification. The AC does not require any contractual arrangement between the airframe and engine manufacturer, nor does it suggest that an engine manufacturer surrender control of its processes or data. To comply with 25.362, it will be necessary to perform some level of analysis and modelling of both the engine and airframe. The AC recommends that the airframe and engine manufacturers "should mutually agree upon the definition of the model." However,

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	Commenter: Cessna		
	required to ask an applicant to surrender some of his control over his own application process.		in the end, the airplane manufacturer is responsible for compliance with 25.362.
3.	Section 5.3.1 begins with the sentence, "*Of all the applicable engine structural failure conditions, design and test experience have shown that the loss of a blade is likely to produce the most severe loads on the engine and airframe.*" This appears to be good justification for limiting the analysis to this one severe condition as in the successful past, but the AC goes on to add several other failure types not likely to be critical.	This commenter is not aware of any relevant field failure that could have been averted by these more diverse load cases or this more elaborate integrated dynamic model. Therefore, these (additional failure conditions) should not be required or "strongly compelled", but should remain in the realm of the "special condition" for those few cases where the more detailed analysis of more diverse cases is appropriate.	The commenter concludes that the AC requires additional failure conditions be evaluated beyond fan blade failure. In fact, the rule specifies that these additional failure conditions be evaluated: "shaft, bearing or bearing support, or bird strike event." The AC simply restates the requirements. We believe these additional failure conditions should be maintained in the rule. As noted in the AC, following the sentence referenced in the comment: "However, service history shows examples of other severe engine structural failures where the engine thrust-producing capability was lost, and the engine experienced extensive internal damage."
4.	The proposed regulation, §25.362 contains the words "*…with the most critical transient dynamic loads and vibrations, as determined by dynamic analysis, resulting from failure of a blade, shaft, bearing or bearing support, or bird strike event.*" This wording appears to offer latitude to make the case that a dynamic analysis of limited integration and	The AC wording is much more restrictive but this might be remedied with some discussion of the broad spectrum of Part 25 configurations and the commensurate range of dynamic analysis approaches that might be adequate for compliance.	We believe the commenter is referring to Section 6.3, which has been revised to be in line with AMC 25.362. While Section 6.3 is revised to harmonize the AC and the corresponding EASA AMC, the rule itself specifies the requirement directly, and the AC cannot change that requirement: "For engine mounts, pylons, and adjacent

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	Commenter: Cessna		
	for limited conditions might be sufficient to demonstrate compliance.		supporting airframe structure, an ultimate loading condition must be considered that combines 1g flight loads with the most critical transient dynamic loads and vibrations, as determined by dynamic analysis, resulting from failure of a blade, shaft, bearing or bearing support, or bird strike event."

No.	Comment	Requested Change	Disposition
	Commenter: Dassault Aviation		
1.	Paragraph 5.3.2 is new compared to AMC 25.362.	Revise the new paragraph as follows: "5.3.2 Other engine failure conditions may include partial blade loss and bird strike in which the engine continues to rotate at high speed with significant imbalance before being shut down. <u>Depending on system modal characteristics, the run-on loads in some parts of the system may exceed the transient loads during a design full blade loss.</u> If an engine contains fused or frangible bearing supports, …. ~~Depending on system modal characteristics, the run-on loads in some parts of the system may exceed the transient loads during a design full blade~~	We don't agree that highlighted sentence should be moved. That particular sentence would only apply to engines that contain fused or frangible bearing supports, so it should follow that sentence as originally proposed. We have revised the paragraph by deleting the last sentence, as follows: "Other engine failure conditions <u>that should be considered</u> include partial blade loss and bird strike in which the engine continues to rotate at high speed with significant imbalance before being shut down. If an engine contains fused or frangible bearing

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		~~loss.~~ Therefore, even if an engine contains fused or frangible bearing supports, the applicant should assess the condition of engine run-on with a partial blade loss just below the fuse release threshold."	supports, and if the engine can run on with a partial blade loss just below the fuse release threshold, significant loads can develop before the engine is shut down. Depending on system modal characteristics, the run-on loads in some parts of the system may exceed the transient loads during a design full blade loss. ~~Therefore, if an engine contains fused or frangible bearing supports, the applicant should assess the condition of engine run-on with a partial blade loss just below the fuse release threshold.~~"
2.	Paragraph 8.3 is not fully harmonized with AMC 25.362.	None specified.	Paragraph 8.3, Propulsion Structural Model and Validation, is not contained in the corresponding AMC 25.362. EASA decided to put this information in AMC 25-24, Sustained Engine Imbalance, rather than in AMC 25.362. By doing so, much of the material was revised to account for the change in scope to cover sustained engine imbalance as well as sudden engine failure events. The corresponding AC 25-24 has already been in place since 2000, and the FAA does not wish to revise that AC. Therefore, AC 25.362 will include the information related to Propulsion Structural Model and Validation. While there are differences in wording and

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	Commenter: Dassault Aviation		
			scope between AC 25.362 and AMC 25-24, the intent is generally the same.

No.	Comment	Requested Change	Disposition
	Commenter: GE Aviation		
1.	We believe that the intent of the rule has been changed compared to that of the EASA rule, by some different phrases used in the Advisory Circular. We are concerned that the proposed rule and interpretation will greatly increase the resources devoted to transient dynamic analyses which do not present the most critical case, and therefore provide no safety benefit. The intent expressed by EASA's preamble and advisory material and that expressed by the FAA, appear very different. The FAA regulation with the new advisory material and interpretation it introduces will add a significant incremental cost, without a clear safety benefit. (Specific examples provided in Comments 2 - 6.)	We suggest that the cost benefit assessment be reconsidered, and the benefits of remaining harmonized with EASA's AC wording be reviewed.	An advisory circular cannot increase the cost of a rule. As noted in this AC, "The material in this AC is neither mandatory nor regulatory in nature and does not constitute a regulation. … The material in this AC does not change or create any additional regulatory requirements, nor does it authorize changes in, or permit deviations from, existing regulatory requirements." GE identified certain areas where they believe the proposed AC wording changes the interpretation of the requirement compared to EASA CS 25.362 and AMC 25.362. We believe the most significant of these is addressed in comment 2 below. As discussed in the disposition to comment 2, the final AC has been revised to be more closely harmonized with AMC 25.362.
2.	Section 6.3: The AMC states: " … if any	Harmonize to the AMC.	We agree. The recommended change has

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	Commenter: GE Aviation		
	other engine structural failure conditions … could result in higher loads being developed than the blade loss condition, they should be evaluated by dynamic analysis to a similar standard and using similar considerations ….” The draft AC states: “the other engine structural failure conditions specified in § 25.362 must also be evaluated by dynamic analysis to a similar standard and using similar considerations ….” Where AMC 25.362 says that other structural failures (besides fan blade off) should be evaluated if they could result in higher loads, the FAA AC says they must be evaluated by dynamic analysis, regardless if they could result in higher loads or not.		been made as shown below. A reference to the conditions “specified in § 25.362” is included to ensure that the scope of evaluation is appropriately limited to the conditions specified in the rule. “… if any of the other engine structural failure conditions <u>specified in § 25.362</u> … could result in higher loads being developed than the blade loss condition, those conditions should be evaluated by dynamic analysis to a similar standard and using similar considerations ….” While this change is made to harmonize the AC and the corresponding EASA AMC, the rule itself specifies the requirement directly, and the AC cannot change that requirement: “For engine mounts, pylons, and adjacent supporting airframe structure, an ultimate loading condition must be considered that combines 1g flight loads with the most critical transient dynamic loads and vibrations, as determined by dynamic analysis, resulting from failure of a blade, shaft, bearing or bearing support, or bird strike event.”
3.	The section titled “Propulsion structural model and validation” describes an analytical scope outside our experience. It is not clear	None specified.	The commenter did not propose any specific changes. The material presented in this section provides basic and generic guidance

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	Commenter: GE Aviation		
	why the existing analysis methodology is not considered sufficient – greater accuracy in load prediction may not be needed to assure safety.		on modeling and validation. Since this is an AC, the applicant may propose a different method than what is presented. Paragraph 8.3, Propulsion Structural Model and Validation, is not contained in the corresponding AMC 25.362. EASA decided to put this information in AMC 25-24, Sustained Engine Imbalance, rather than in AMC 25.362. By doing so, much of the material was revised to account for the change in scope to cover sustained engine imbalance as well as sudden engine failure events. The corresponding AC 25-24 has already been in place since 2000, and the FAA does not wish to revise that AC. Therefore, AC 25.362 will include the information related to Propulsion Structural Model and Validation. While there are differences in wording and scope between AC 25.362 and AMC 25-24, the intent is generally the same.
4.	The AMC includes the following, not included in the AC: "These means are intended to provide guidance to supplement the engineering and operational judgement that must form the basis of any compliance findings relative to the design of engine mounts, pylons and adjacent supporting	Harmonize to the AMC.	We don't see this as a significant difference between the AMC and AC. The AC has similar generic guidance, such as, "This advisory circular (AC) describes an acceptable means for showing compliance with the requirements of Title 14, Code of Federal Regulations (14 CFR) 25.362,

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	airframe structure, for loads developed from the engine failure conditions described in CS 25.362.”		*Engine failure loads*.”
5.	The Background section of the AC differs from the AMC as follows: “Consequently, ~~it is considered necessary that the applicant performs~~ the applicant must perform a dynamic analysis to ensure that representative loads are determined during and immediately following an engine failure event. A dynamic model of the aircraft and engine configuration ~~should~~ must be sufficiently detailed to characterize the transient loads for the engine mounts, pylons, and adjacent supporting airframe structure during the failure event and subsequent run-down.”	Harmonize to the AMC.	The AC was revised to more plainly state the requirement. We believe that the phrases “it is considered necessary that the applicant performs” and “the applicant must perform” are synonymous. However, we have revised the “must” to “should” in this sentence and in the subsequent sentence.
6.	The Background section of the AC differs from the AMC as follows: “However, service history shows examples of other severe engine structural failures where the engine thrust producing capability was lost, and the engine experienced extensive internal damage. ~~For each specific engine design, the applicant should consider whether these types of f#6ailures are applicable, and if they present a more critical~~	Harmonize to the AMC.	We agree and the recommended change has been made. However, we did not include the reference to whether the noted failure conditions are “applicable.” These failure conditions should be considered “applicable”; the only question is whether they are more critical. We also add specific criteria in terms of bird ingestion.

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	Commenter: GE Aviation		
	~~load condition than blade loss. In accordance with CSE~~ ~~520(c)(2), other structural failure conditions that should be considered in this respect are:~~ ~~· failure of a shaft, or~~ ~~· failure or loss of any bearing/bearing support, or~~ ~~· a bird ingestion.~~ Examples are failure of a shaft, failure or loss of any bearing or bearing support, and bird ingestion. Therefore, § 25.362 requires that these failure conditions be considered. When evaluating bird ingestion, the bird weight and quantity requirements specified in § 33.76 should be used.		

No.	Comment	Requested Change	Disposition
	Commenter: Rolls Royce		
1.	Section 5.3: There is no definition of a "structural failure." Fan Blades and Main Shafts are not normally considered to be "structures."	Define what is meant by "structural failure" within the AC.	We don’t believe that defining “structural failure” is necessary, because the relevant failure conditions are specified in the rule and also discussed in the AC. These conditions are: “failure of a blade, shaft, bearing or bearing support, or bird strike

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			event.”
2.	Section 8.3.4: Another key parameter that should be highlighted is the rate of change of rotor speeds after the failure event, as this will affect the level of loading that can be induced within the Aircraft structures.	Include "Rotor Deceleration Rates" within 8.3.4.	We agree and the recommended change has been made.
3.	Section 8.3.7: Implication is that a Blade Loss Test will be performed, but this is not normally the case, especially for Core Blade release events.	The words "if such a test has been performed" needs to be included within this paragraph.	We don’t believe this change is needed. In order to correlate a model as specified in the AC, there must be some testing to which the model will be correlated. We believe this is already addressed in the Section 8.3.5 of the AC, which says, “In cases where compliance with § 33.94 is granted by similarity instead of test, the model should be correlated to prior experience.”