DISPOSITION OF INTERDIRECTORATE COMMENTS

AC 25.975-1, *Fuel Tank Fire Protection*

FAA Contact: Mike Dostert, mike.dostert@faa.gov, 425-227-2132

No.	Comment	Requested Change	Disposition
	Commenter: T. Thorson/ANM-100B		
1	In the proposed advisory circular, allowing inerting systems as a method of compliance may not be appropriate to cover all foreseeable external fires. If the rule preamble is revised in response to the comment to address revising the statement of problem to address not only post-crash ground fires, but also other ground fire events such as fires resulting from refuel events, fuel tank leakage events, or refuel overfill/spillage events, then this comment should also be addressed in the advisory circular. There may be foreseeable ground fire events where inerting would not be active and effective in preventing fuel tank explosions due to vent system ignition.	Recommend removing or amending the third bullet of Section 5.2 and the related footnote number 2.	Agree with commenter. Clarification in footnote 2 was added to include normal operating conditions. Similar change was added to footnote 1 for pressurized fuel tanks.
2	If Comment #1 is not adopted, the AC does not provide guidance for fuel tank inerting system requirements for meeting the new 25.975.	Add a new Section 7. to address fuel tank inerting performance requirements to comply with the new standards of 25.975. If beyond the scope of the AC, recommend adding statements to that affect in the AC with guidance that project specific issue paper will be needed to document acceptable methods of compliance.	Agreed, Added section 7 as suggested.
3	Within the definition section of the draft AC for the terms Fire Resistant and Fire Proof, the tolerance of +/- 150 deg F has caused confusion in industry and has been misapplied. The Seattle ACO and BASOO office have clarified that this tolerance is intended to allow individual thermocouple variability when multiple are being used and an avereage is calculated for the 2000 degF minimum flame temperature.	Recommend removing the tolerances from the definitions as they provide no value in the context of the definition. If chosen to remain, the Fire Resistant tolerance is quoted as "(+150 degF)" while the Fire Proof tolerance is quoted as "(+/-150 deg F)." This is presumably a typographical error and should be revised. It may also be beneficial to point out that the definitions were extracted from AC 20-135 instead of 14 CFR section 1.1.	Agreed, Definition deleted

Add additional rows as necessary.

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No.	Comment	Requested Change	Disposition
	Commenter: R. Mohanraj/ANM-106B		
1	p. A-1 Table A-2: The terms "lean" or "rich" are actually used for mixtures whose equivalence ratio is less than one and greater than one, respectively. In the "Condition" column, instead of specifying "lean", the term "lean limit" should be used (similar comments apply for "rich").	Change from (a) Lean, (b) Between lean and stoichiometric, (c) Between stoichiometric and rich, (d) Rich To (a) Lean limit, (b) Between lean limit and stoichiometric, (c) Between stoichiometric and rich limit, (d) Rich limit One might also prefer "Near lean limit" and "Near rich limit" instead of "lean limit" and "rich limit"	Accepted
2	p. A-2 Table A-3: "Limits of Inflammability in Air" While flammable and inflammable mean the same in combustion, while talking about limits, the term flammability limits is preferred.	Use "Flammability limits in Air" instead of "Limits of Inflammability in Air"	Accepted
3	p. 7 "Cut a viewing section into the pipe upstream of the element, and cover it with transparent plastic."	Considering the expectations in terms of thermal properties for the optical window, it might be better to avoid specifying plastic. For example, "Include an optical window in the pipe upstream of the element to provide clear optical access." If there is a preference to specify a type of material or provide an example, a statement such as the following can also be included. "A suitable heat resistant, transparent material (e.g., quartz) can be used for the optical window." (substitute quartz with some less expensive material if preferred)	Accepted
4	p. 3: Definition for Stoichiometric ratio: "The chemically correct ratio…of perfect	Consider a change in the definition: Examples: The ratio of fuel to air corresponding to the	Agreed, modified definition to include example 1.

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	combustion…" The terms *chemically correct* ratio and *perfect combustion* can mean different things and be interpreted in different ways (e.g., (1) perfectly stirred reactor, also known as well stirred reactor, type of combustion regime refers to a state of combustion in which there is total mixing between fuel and air resulting in a homogeneous fuel air mixture, regardless of equivalence ratio (2) if looked at in terms of nitric oxide emissions, combustion at stoichiometric ratio gives very high levels of emissions and is far from ideal/perfect).	condition in which the available amounts of fuel and oxygen completely react with each other thereby resulting in combustion products containing neither fuel nor oxygen. (or) The ratio between fuel to air (or oxidizer) for the following condition: the minimum amount of air (or oxidizer) that is required to completely burn the amount of fuel used.	
5	p. 5 "…results in a high speed pressure wave that can travel through the flame arrestor without sufficient time for the heat transfer necessary for the flame arrestor to quench the flame front."	If the intent is to refer to a detonation, that can be specified explicitly: "…results in a high speed pressure wave (detonative mode of combustion instead of the typical deflagration mode) that can…"	Not accepted. The lightning strike creates a pressure wave that when combined with ignited vapors can travel through the arrestor.
6	Minor typo in p. A-1: "ration" is used in two places (instead of ratio).	Change to ratio.	Agreed. Correction made.
7	p. 7 "Mount the flame arrestor in the test fixture in the orientation that simulates the actual airplane installation. Mounting of the flame arrestor facing downward so a ground fire impinges on its face has been shown to significantly shorten the time for which the arrestor is effective."	Perhaps some factors that make the orientation critical can also be specified, (e.g., buoyancy... or other phenomena/conditions that play a role).	Not accepted. Good suggestion, however the factors that impact the efficiency of the arrestor at different orientations are not known by the author. This factor was discovered during cert testing and noted by an applicant.
8	p. 10 "The position of the flame front should be determined and the vapor flow rate adjusted such that the flame contacts the arrestor face, resulting in the greatest rate of heating of the arrestor surface." Is there a means to verify that the flame contacts the arrestor face (e.g., appropriate placement of downstream thermocouple)? The schematic in p. A-3 shows the viewing window at a distance from the arrestor element.	Clarify	Not accepted. The viewing window provides a means to view the flame front touching the arrestor face.

Add additional rows as necessary.

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No.	Comment	Requested Change	Disposition
	Commenter: T. Kobayashi/ANM-106B		
1	Section 4.8 provides a definition for "fire resistant." This definition includes "wing skin" although the definition in Part 1, section 1.1 or in AC 20-135 does not include "wing skin." Why it is necessary to include "wing skin" in this AC?	Remove "wing skin" from the definition or explain the intent.	Definition deleted. – comment no longer relevant
2	Section 5.5, second sentence states "… and therefore, the actual effectiveness of the arrestor should exceed the time for wing-skin penetration." It is not clear what is meant by "the time for wing-skin penetration."	Please clarify.	Discussion deleted- comment no longer relevant
3	Section 6.2 states "A separate test is then conducted by … to show that the flame arrestor installation … meet the requirements." However, Section 6.2 is titled as the flame arrestor element test, and the test setup appears to be testing the element, instead of actual installation.	Please clarify the intent of the testing discussed in the AC.	Accepted. Additional clarification added to make it clear the test is intended to address the installation. Title to 6.3 changed from element, installation.
4	Sections 6.3.1 and 6.3.1.1 require the ducting upstream of the flame arrestor to be approximately 40 inches. It is not clear why this 40-inch ducting is needed since it may not represent the actual installation. If the flame arrestor is installed facing downward, what is the required length for the upstream tubing?	Please clarify the intent of the test setup discussed in the AC.	Accepted. Additional clarification added based on this and other comments.
5	Section 6.3.2.2.1 refers to the flow rate of 0.75 ft/sec. Is this measure upstream or downstream of the flame arrestor?	Please clarify.	Mixture velocity is a guide to assist in test set up. The critical case is when the flame front touches the face of the arrestor and the highest temperature at the face is achieved.
6	Section 6.3.2.2.1 states "Determine and establish the location of the flame front by …" What is the requirement of the flame front location. Is it required for the flame front to touch the flame arrestor?	Please clarify.	The AC describes the condition of the flame touching the arrestor face as the critical condition.
7	Section 6.3.2.2.1 requires the flame arrestor to stay below 700 F for 2 minutes and 30 seconds. When does the clock start? Is it started when the flame front touches the flame arrestor?	Please clarify.	The clock starts when the flame front touches the face and the flow has been adjusted to the critical velocity, which is the critical condition.
8	Section 6.2.3.3.3 refers to the flow rate of 0.75 to	Please clarify.	Clarification added- .

No.	Comment	Requested Change	Disposition
	1.0 fps. Is this measured upstream or downstream of the flame arrestor?		
9	Section 6.3.3.1 refers to earlier sections for test criteria. Test criteria should be defined in this section.	Please provide test criteria in this section.	Not accepted. Existing AC provides acceptable guidance.

Add additional rows as necessary.

No.	Comment	Requested Change	Disposition
	Commenter: Jon Regimbal, ANM-140S		
1	On page 3, paragraph 4.6, the definition of "flame holding" is inconsistent with the common definition of a "flame holder." A flame holder is a device or feature that provides a stable location for continuous combustion in an environment where gases are flowing at significant velocity relative to location where stable combustion is desired, and the flame holder is primarily intended to prevent the extinguishment or oscillation of the flame. While a flame holder may also, as part of its flame stabilization function, serve to arrest flame propagation upstream in a combustor, its "flame holding" ability is broader than the flame arresting capability it has. Unless the "flame holding" definition in the draft AC is an already established industry or scientific community definition, we should use a different term for a flame arrestor's performance in preventing flame propagation.	I suggest using the term "flame propagation prevention" in the three locations where "flame holding" is used, and delete the definition since "flame propagation prevention" is self-explanatory.	Agreed. Changes made as suggested.
2	On page 3, paragraph 4.7, the definition of "fireproof" is significantly different from the definition of fireproof in 14 CFR part 1. It also introduces the 15 minute burner test MOC in AC 20-135 that clearly does not show equivalence to steel as required under the part 1 definition. (I have previously commented on this AC 20-135 issue.) In addition, this definition is unnecessary in the draft AC because the term "fireproof" is not used anywhere in the draft AC.	Delete the definition of "fireproof." Alternatively, revise the definition to quote or refer to the definition in part 1, and do not mention the erroneous AC material.	Agreed. Definition deleted.

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No.	Comment	Requested Change	Disposition
3	On page 4, paragraph 4.8, the definition of "fire resistant" is significantly different from the definition of fire resistant 14 CFR part 1. It also introduces the 5 minute burner test MOC in AC 20-135 that does not necessarily show equivalence to aluminum as required under the part 1 definition. (I have previously commented on this AC 20-135 issue.) In addition, this definition is unnecessary in the draft AC because the term "fire resistant" is not used anywhere in the draft AC.	Delete the definition of "fire resistant." Alternatively, revise the definition to quote or refer to the definition in part 1, and do not mention the questionable AC material.	Agreed. Definition deleted.
4	(Style) The definitions are presented in apparently random order.	Consider presenting the definitions in alphabetical order.	Agreed. Definitions reordered.

No.	Comment	Requested Change	Disposition
	Commenter: Jeff Englert, ACE-116W		
1	Test setup uses lead in to flame arrestor of 40 inches. Some business jet vent lines don't total 40 inches in length.	Require installation with less lead in to use actual length.	Agreed. Added qualifying statement allowing shorter distances.
2			
3			

No.	Comment	Requested Change	Disposition
	Commenter: Jeff Pretz, ACE-116W 316-946-4153		
1	Paragraph 6.3.1, second sentence from the end states "Also install thermocouples on the surface of the center of the arrestor element face and…". Sentence does not clearly indicate which face, upstream or downstream, to install thermocouple.	Add "upstream" to clarify which face thermocouple should be installed. Revise as follows: "Also install thermocouples on the surface of the center of the arrestor element **upstream** face and…"	Accepted
2	Paragraph 6.3.1.2.3, the reference to 390 °F is a bit confusing as the range of permissible maximum fuel tank surface temperatures is not discussed until later in paragraph 6.3.2.2.1	Replace "limit of 390 °F" with "maximum permitted fuel tank surface temperature (reference 6.3.2.2.1)" in second sentence.	Accepted

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No.	Comment	Requested Change	Disposition
3	Paragraph 6.3.2.2.2, last sentence states "The position of the flame front should be determined and the vapor flow rate adjusted such that the flame contacts the arrestor face, resulting in the greatest rate of heating of the arrestor surface." Suggest clarification of which arrestor face is being referenced.	Revise last sentence of paragraph 6.3.2.2.2 as follows: "The position of the flame front should be determined and the vapor flow rate adjusted such that the flame contacts the **downstream** arrestor face, resulting in the greatest rate of heating of the arrestor surface."	Accepted
4	Paragraph 6.3.2.2.3, first sentence states "Data from developmental testing shows that the temperature of the center of the arrestor face at which failure (propagation of the flame) occurred was typically above 700 F, which is well above the AIT of JP-4 fuel vapor of 445 °F as established during no flow conditions." Suggest clarification of which arrestor face is being referenced.	Revise first sentence of paragraph 6.3.2.2.3 as follows: "Data from developmental testing shows that the temperature of the center of the **upstream** arrestor face at which failure (propagation of the flame) occurred was typically above 700 F, which is well above the AIT of JP-4 fuel vapor of 445 °F as established during no flow conditions."	Accepted
5	Appendix A: the discussion section under Table A-1 and A-3 which calculate the stoichiometric ratios are inconsistent. The stoichiometric ratio for air to hexane is listed as 15.24 (air/fuel), then the 1.15 fraction is inverted to hexane to air (fuel/air vs air/fuel) and becomes 0.07567. In the next paragraph stoichiometric ratio for air to propane is 15.7 (air/fuel) and the 1.15 fraction remains consistent as air to propane and results in 13.7 (air/fuel). All number should be in the either air/fuel ratio or fuel/air ratio not a mix of both.	Revise discussion on calculation for stoichiometric mixture of air and hexane as an **air to fuel** (not a fuel to air) weight ration of: **13.2** instead of 0.07567 to be consistent with all other calculations. Invert the calculation to **2627.48/1.15 x 172.34 = 13.2** to be consistent.	Not accepted. The existing AC presentation is acceptable.

No.	Comment	Requested Change	Disposition
	Commenter: James Galstad, ACE-116Wp, 316-946-4135		
1	¶5.3.1 There are four basic scenarios included in this paragraph. They are: flame arresting for a fast moving flame front, flame arresting for a slow moving flame front, flame arresting for a lightning induced flame front, and flame holding capacity for the 2 minute and 30 second time requirement.	Insert the following after the first sentence: Performance standards for slow moving flame fronts, fast moving flame fronts, and flame holding capacity are addressed within this AC.	Not accepted. This clarification is not needed for the reader to understand the intent of the AC.

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No.	Comment	Requested Change	Disposition
2	¶6.1 The last sentence, "Alternatively, separate tests … used to show compliance." opens the door to non-compliant installations being certified. This is because a flame arrestor capable of a bench test flame arrest for a slow moving flame may not arrest the flame when the installation transitions the flame front to a fast moving flame front. Should non-test analysis be acceptable, those analysis known to be acceptable need to be identified. Are there any non-test solutions known and accepted by the FAA? Experience to date dictates the need to use a conformed type design installation in order to get valid pass / fail results.	Replace the last sentence with: Flame arrestor performance is a function of the installation configuration. Consequently conformed type design installation configuration is necessary to obtain valid flame arrestor performance results affected by the speed of the flame front. The flame arrestor's thermal holding characteristics use for the 2 minute and 30 flame holding performance requirement may be met by a conformed type design configuration test. Alternatively, a combination of tests, i.e. separate bench and installation testes may be used, or a combination of bench test arrestor flame holding performance may be combined with a validated FAA accepted analysis of the installation.	Agreed. Partially incorporated comment
3	¶6.3.1 As established in the previous comments, approximation of the installation does not establish that the results are valid. Installation approximations would be valid ONLY after establishing that the flame front speed of the test is correct or conservative for the installation. An FAA accepted means other than test to do this is not known. If it is known, it must be included so that an FAA accepted means is used.	Delete the sentences: "The test setup involves … approximately … About 40 inches… should simulate, as closely … that simulates the actual airplane installation. If a way other than test is known, it must be included so that an FAA accepted means is used. Replace the deleted sentences with: The test setup must use a conformed type design flame arrester installation unless an FAA prior approved means to establish the flame front for assessing the arrestor performance is used.	Agree with intent of comment. Deleted reference to specific length of tubing and added reference "representative production flame arrestor installation"
4	The validity of a 40 inch length of ducting establishing the accurate or conservative flame front speed has not been established.	¶6.3.1.1 Delete the sentence: "A section of ducting approximately 40 inches (102) long upstream of the test article. –or- provide the FAA accepted means of showing compliance that makes the 40 inch length accurate or conservative.	Accepted.
5	An acceptable basis to not accurately replicate the flame front speed has not been established.	¶6.3.2.1 Start this para. with "The flame front speed at the flame arrester is determined by the installation of the flame arrestor. Move the content of ¶6.3.4.3 into ¶6.3.2.1. to follow "The flame front … installation of the flame arrestor."	Accepted, modified the text to clarify the need to provide a representative installation, with emphasis on impact of the distance of the arrestor to the fuel tank vent inlet and impact on flame front speed.

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No.	Comment	Requested Change	Disposition
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	Commenter: Don. O Young, ACE-118A		
1	This Advisory Circular guidance should also apply to part 23 commuter and Very Light Jet (VLJ) categories. Part 23 VLJ design(s) presently in certification are installing flame arrestors to comply with part 23.954 based on vendor flame holding qualification testing.	Include part 23 commuter and VLJ category airplanes.	Good recommendation but outside the scope of this rulemaking. Part 23 standards staff can adopt this as an acceptable standard, or AIR could make this a 20 series AC if acceptable to Rotorcraft.

No.	Comment	Requested Change	Disposition
	Commenter: Ansel James, ACE-118A		
1	4.7 Fireproof definition for materials and parts used to confine fires does not specify a minimum time for performing this function. Only a minimum time for withstanding the 2000°F flame is specified.	4.7 Fireproof. …The term "fireproof," when applied to materials and parts used to confine fires within designated fire zones, means that the material or part will perform this function under conditions likely to occur in such zones for a minimum of 15 minutes and will withstand a 2000° flame (±150°F) for 15 minutes minimum.	Comment not relevant, this definition deleted per other comments.
2	5.1 & 5.4 AC only refers to the safe evacuation of passengers with no mention of crew safety or evacuation. Part 25 freighters do not carry passengers.	5.1 …which would provide additional time for safe evacuation of passengers and crew. 5.4 …the effects of a fuel tank explosion on the ability of passengers and crew to leave the crash site. …allows additional time for passengers and crew to exit the crash scene.	Accepted- Added crew to the discussion.
3	6.2 There is no mention of where the flame propagation requirements can be found.	6.2 In many cases the flame arrestor is vendor-furnished and, therefore, qualified to meet the flame propagation requirements by the vendor with only a partial arrestor installation. The flame propagation requirements can be found in ***.	Not accepted. The performance of the arrestor can be obtained from the vendor.

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No.	Comment	Requested Change	Disposition
	Commenter: James Blyn, ASW-111		
1	Pg. 7 Para 6.3.1 The sentence "Mounting of the flame arrestor facing downward…which the arrestor is effective," is good information but does not belong in the test setup paragraph.	Remove this sentence and possibly incorporate into the background section of the document.	*Agreed, text added to AC and modified note on figure. .*
2	Pg 9 and 10 Para 6.3.2.2.1 and 6.3.2.2.2 Various locations referring to the "flow rate" of the mixture is measured in ft/sec (fps) however flow rate is traditionally a measurement of unit volume per unit time. Later, in Para 6.3.2.2.3 the term "velocity" is used to describe the mixture flow.	Either describe the movement of the mixture through the flame arrestor as a 'velocity' in terms unit length per unit time or modify the requirement to prescribe a volumetric flow rate.	*Agreed, change made to clarify intent. .*
3	Pg A-1 Table A-1 description and Table A-2 JP-4 Header Ratio is misspelled as "ration" in the two locations noted above.	Correct spelling.	Corrections made.

No.	Comment	Requested Change	Disposition
	Commenter: Richard Beckwith, ANE-171		
1	On page 13 of the NPRM, there is discussion about the hazards that can result from the use of flame arrestors in the vent lines. Flame arrestors are presently the common method of compliance to the proposed regulation (which is currently enforced through issue papers). The discussion further points out that these hazards are mitigated by applicants through the introduction of positive and negative pressure relief provisions. The proposed rule, however, does not have any language to require the mitigation of the hazards that are potentially introduced by the rule itself. Do we want to require the mitigation of the noted hazards, when the method of compliance is the use of flame arrestors?		Partially accepted. The intent of the AC is to address MOC for the flame arrestor. Fuel system MOC, including potential failure and environmental factors are addressed in other regulations. A statement referring to these compliance issues was added to section 5.3.1.

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