Response to comments on NPA-E-37

1 - Justification of the NPA

The "fire" subject was an identified difference between FAR 33 and JAR-E. As part of the FAA / JAA harmonisation effort, a common approach has been attempted by a working group with representatives from FAA, Transport Canada, JAA, AIA and AECMA.

The associated NPA-E-24 covered the then necessary changes to JAR-E Section 1 for achieving the harmonisation.
This NPA-E-37 introduces the advisory material which has been developed in harmonisation with a FAA Advisory Circular.

This NPA proposes only advisory material. Therefore, for compliance with CPR rules of 21.101 (b)(3) of amendment 2 of JAR-21, it has no effect on the level of safety.

2 - Economic impact analysis

This proposal is harmonising the interpretation of JAR-E and FAR 33 rules on fire protection. The corresponding aircraft rules have also been considered for consistency. Basically there is no significant change in the intent of the JAR-E requirements.

Therefore it is assumed that there will be no economic impact.

3 - Comments received during the circulation of the NPA

Comments were received from the following organisations :

- Authorities of Austria, Canada, Denmark, France, United Kingdom and USA
- SAS (Sweden), SBAC (UK), Turboméca (France)

4 - Response to comments

Two commenters provided a « no comment » statement on the proposal and one commenter accepted it.

General comment

One commenter suggested replacing the words "Hazardous Effect(s)" and/or "hazardous effect(s)" by Engine Hazardous Effect(s). This has not been accepted.

Another commenter noted that in many places the wording "hazardous effect" was used in this ACJ and suggested changing it into "hazardous engine effect". This has been accepted and changes made in all places in this ACJ. However, this commenter pointed out the fact that the definition of "hazardous effect" which was proposed in this NPA was not consistent with the definition of "hazardous engine effect" in NPA-E-38. The definition in § (1)(e) has been deleted as superfluous, no adding anything to JAR-E 510. The same commenter also noted that JAR-E 130 final text, attached as appendix to this NPA, contains one occurrence of "hazardous effect" which should be corrected. This will be done by means of NPA-E-46.

One commenter suggested that the advisory material may contain some definitions of words used only in the advisory material. But, if the same wording appears also in the rule, then the definition should be in the newly proposed JAR-E 15 "Terminology" paragraph. Furthermore, if the definition is also used in other codes it should be in JAR-1. This commenter considered that the list of definitions in the ACJ should be reviewed in light of the above-described policy. In particular, the commenter noted that "Hazardous (engine) effects" is used in JAR-E 510 and should be transferred to JAR-E 15. This has been agreed in principle and the list has been reviewed and found adequate with deletion of definition of hazardous effect.

One commenter considered that the validity of JAR-E 130 should be limited to the bare engine with accessories. This comment has not been understood because JAR-E is the code for engine certification and there is no ambiguity.

One commenter noted that the recently published AC33.17-1 contains much of the harmonised material but its text and presentation/layout has been improved to make it an easier document to read. This commenter considered that it could provide a good model for a final version of this ACJ. This has been taken into account in the final version of this ACJ.

One commenter made various editorial comments which were taken into account in the final version of the NPA.

Comment on paragraph (1)(b) of ACJ E 130

One commenter considered that the paragraph should be limited to the external lines limited to the engine in its cowlings. This comment has not been understood because JAR-E is the code for engine certification and there is no ambiguity.

Comment on paragraph (1)(c) of ACJ E 130

One commenter stated that non-self extinguishing fires can be a hazard for re-ignition of a larger fire situation and suggested this be added to the ACJ to read as *:*
(c) Fire Hazard : (1) The unintentional release or collection of a hazardous quantity of flammable fluid, vapour or other materials; or (2) a failure or malfunction which results in

*an unintentional ignition source within a fire zone; or (3) the potential for a hazardous effect as the result of exposure to a fire**, or (4) as sustained or non-self extinguishing fire.*** This has not been accepted because a fire is still a fire and it seems obvious that a fire is to be qualified as a fire hazard. The 3 other elements of the definition are of a different nature.

One commenter noted that the definition of "Fire Hazard" contains the following : " a hazardous quantity of flammable fluid, vapour or other materials" when the definition of "Hazardous Quantity" refers only to " An amount of flammable fluid". Therefore, the "hazardous quantity of flammable vapour or other materials" is not defined. This should be clarified. This commenter suggested to delete "vapour or other material" and to change definition of Hazardous quantity (see other comment on paragraph (1)(f)). The comment has been accepted and the definition of hazardous quantity has been changed.

Comment on paragraph (1)(e) of ACJ E 130

One commenter noted that the definition suggests that there are more hazards than specified in JAR-E 510 and considered that if there are more hazards they should be included in JAR-E 510 and not in ACJ E 130. The definition has been deleted.

Comment on paragraph (1)(f) of ACJ E 130

One commenter indicated that, through recent certification programme experience attempting to apply the 0.25 litre hazardous quantity concept, the question came out of acceptability of a non-self extinguishing torching flame (after test flame removal) because the total heat energy dissipated could be calculated to be 0.25 litre or less of jet fuel. This commenter considered that this interpretation was totally outside what the harmonisation group intent was, which was to accommodate minor self-extinguishing flickering flames (e.g., one candlepower!) or very minor fluid leakages [without residual fire] so as not to cause such to be automatic failures. It should also be noted that the selection of the 0.25 litre value was very un-scientific and uninformed. This commenter strongly suggested that the ACJ definition be revised to something similar to the FAA AC to read :
(f) Hazardous quantity : An amount of flammable fluid which could sustain a fire for a sufficient period of time ***and severity so as to significantly increase the overall fire hazard or result in a hazardous effect.*** ~~*to create damage potentially leading to a hazardous situation*~~. ~~*In the absence of a more suitable determination of a hazardous quantity, 0.25 litre or more of fuel (or a quantity of flammable material of equivalent heat content) will be considered.*~~
This has not been accepted. The 0.25 litre is also used for aircraft certification as a quantity sufficient to trigger the fire detectors in case of burning puddles and for this reason is not considered "unscientific". Furthermore, the 0.25 litre is only a default value in case of complete absence of better information.

Another commenter suggested changing the paragraph, for improvement, to read:
(f) Hazardous quantity: An amount of flammable fluid which could sustain a ~~*sufficient period of time*~~ *fire* *of sufficient severity and* *time to create damage ... ...hazardous quantity. This can be assumed to be 0.25 litre or more of fuel (...)* ~~*will be considered*~~.
The comment has been partially accepted, in relation to other comments.

One commenter noted that this ACJ was not always consistent in its vocabulary and noted the following references :
(1)(c) Fire Hazard : (1) The unintentional release or collection of **a hazardous quantity of flammable fluid, vapour or other materials**;
(f) Hazardous quantity : An amount of **flammable fluid**

(2)(d) Pass / fail criteria
a **hazardous quantity** for the full 15-minute fireproof test.
Hazardous quantity is defined in paragraph (1)(f) of this ACJ.
is not a **hazardous quantity of flammable fluid, vapour, or material** as defined in this ACJ.
for leakage of a **hazardous quantity of flammable material**.

(5)(b) Drain and Vent Systems
hazardous quantity of flammable fluid during continued rotation
(e) Firewall
a **hazardous quantity of flammable fluid or vapour** pass around the firewall.

The commenter found then the following wording : "flammable fluid", "flammable fluid, vapour or other materials", "flammable fluid, vapour or materials", "flammable material", "flammable fluid or vapour", all in hazardous quantity when only "flammable fluid" was referenced in the definition of hazardous quantity.

This commenter also noted that JAR-E 130 final text, attached as appendix to this NPA, contains twice "hazardous quantity of flammable fluid" (in singular or plural form) and once "hazardous quantity of air, fluid or flame". This last wording is found in JAR-E 130 (d)(2) and is not consistent with the wording used in the corresponding paragraph (5)(e) of ACJ E 130.

This commenter suggested revising both texts to be consistent and that, may be, the simplest way of doing that was to delete the currently proposed definition of "hazardous quantity", to use everywhere the wording "hazardous quantity of flammable fluid" and to define it as follows :
"hazardous quantity of flammable fluid" : An amount of flammable fluid, *vapour or other material* which could sustain a fire for a sufficient period of time to create damage potentially leading to a Hazardous *Engine Effect*. In the absence of a more suitable determination of a hazardous quantity, 0.25 litre or more of fuel (or a quantity of flammable material of equivalent heat content) will be considered.
The comment has been accepted in principle, and the definition has been changed. Paragraph (5)(e) has been improved.

Comment on paragraph (2)(d) of ACJ E 130

One commenter suggested that the structure and layout of the paragraph could be improved to directly link the five fire test acceptance criteria with their respective explanations, as in FAA AC 33.17-1. This has been accepted.

One commenter suggested an example of a Hazardous Engine Effect. Because engine controls to not cause a Hazardous Engine Effect at any time is implicit in the text, this commenter suggested that the text be changed as follows:
"…Engine controls must not cause a Hazardous Engine Effect (e.g. deployment of the thrust reverser) while…of the Engine ~~at any time~~ within…"
This has been partially accepted with editorial improvements. The addition of the example has been felt as being unnecessary.

One commenter suggested changing the third pass/fail criteria to read :
- no leakage of hazardous quantities of flammable fluids, vapours or other materials,
- no support of **a sustained fire (e.g., rapid self-extinguishing and no re-ignition)** ~~*combustion*~~ by the constituent material of the article being tested **or by flammable fluid leaking from the test article,**

This commenter considered that, similar to another comment above, sustained fires and fluid leakage should not generally occur during these tests, but other minor momentary conditions may be acceptable.
This has not been accepted. This proposal introduced a new concept of "sustained fire" which was not developed enough to be fully understood.

One commenter noted that the 2nd sub-paragraph contains the wording "Engine controls". This wording is not defined. This commenter suggested replacing it by "engine control systems". This would be consistent with the wording of JAR-E 130 (e). This has been agreed.

One commenter noted that the 3rd paragraph suggests that in the event of a shutdown during the fire resistant test, the shutdown must be maintained for 5 minutes. The intent is surely that a safe shutdown is an acceptable consequence at some point during the 5 minutes and which must be maintained until the end of the test. This commenter suggested therefore that the sentence is re-written as follows:
'A safe engine shutdown at any time during the fire resistant test is an acceptable outcome for this type of component, provided the safe shutdown is maintained until the end of the 5 minutes test period.'
This has need accepted with editorial improvements.

One commenter noted that, in the 3rd paragraph, the "at any time" is implicit in the text and suggested to change the text as follows:
"A safe Engine shutdown ~~at any time~~ during…the full 5 minutes of the fire resistant test. "
The comment is covered by the changes made after review of the other comment above.

One commenter noted that the 4th paragraph suggests that after closure, the shut-off valve must stay in the closed position and will not leak a hazardous quantity of fluid for a full 15 minutes. The intent is actually to ensure that after closure, the valve remains closed and does not leak for the remainder of the 15-minute test. As a minimum, this would be 10 minutes.
This commenter suggested that the paragraph is re-written as follows.
'For a flammable fluid tank shut-off valve, the valve must be operable (to close) or should default closed, and be capable of maintaining this position without leakage of a hazardous quantity of fluid until the end of the 15 minute test period.'

This has been agreed with "must" changed into "should" (this change has been made throughout the ACJ where the text did not quote exactly a rule).

One commenter noted that the 6th sub-paragraph "At no time during or at the end of the test should the test article leak a hazardous amount of flammable fluid in any manner. Hazardous quantity is defined in paragraph (1)(f) of this ACJ." contains two different wordings : "hazardous amount" and "Hazardous quantity". Then, the two sentences of this text are not consistent in vocabulary. This commenter suggested using only one wording (Hazardous quantity). In addition, the second sentence could be moved upward (two sub-paragraphs above) after first occurrence of the wording "hazardous quantity". The principle of the comment has been accepted. However, the second sentence has been deleted as unnecessary.

One commenter suggested changing the 7th sub-paragraph to read :
Consideration should be given to non-self-extinguishing fire test events. ***This type of event could be either combustion of the constituent material of the test article or combustion of flammable fluid leaking from the component (firewalls not considered in either case).*** *In general, these events should continue to be cause for failure of the test, unless it can be shown that the* ***residual fire is not sufficient enough to significantly increase the overall fire hazard.*** ~~*constituent material supporting combustion is not a hazardous quantity of flammable fluid, vapour, or material as defined in this ACJ.*~~ This commenter considered this as clarification of event types, and clarification of what might be an acceptable residual fire based on judgement grounded back to the revised definitions for fire hazard and hazardous quantity he proposed (see above). The first part of the comment has been accepted. The second proposal has not been accepted for similar reasons to rejection of comment on definition of hazardous quantity.

One commenter, considering necessary to move away from the hard definition of hazardous quantity, suggested changing the 8th sub-paragraph to read :
An example of such a situation has been certain electronic components. Current technology electronic components often use circuit board potting compounds internal to the control housings that may support combustion when heated sufficiently or when exposed to fire. These compounds can also flow under high heat and may leak through the control housings. Therefore, such materials may support a ***small intensity*** *fire internal and / or external to the housing for a limited period of time after the test flame is removed.* ~~*If this result occurs during test, then the constituent material supporting combustion should be evaluated against the criteria for leakage of a hazardous quantity of flammable material.*~~ This has been agreed.

One commenter noted that the 8th sub-paragraph contains the wording "control housings". This is not defined and the texts before or after these words do not provide a clue on the definition. The commenter could not suggest any alternate wording by lack of understanding of the intent. This has been agreed and the word "casings" has been proposed.

One commenter, to be consistent with aeroplane policy, suggested changing the 9th sub-paragraph to read :
At no time during or at the end of the test should a firewall component fail to contain the fire within the intended zone or area. Implied with this outcome is the expectation that the

*firewall component will not develop a burn through hole and will not fail in any manner at its attachment or fire seal points around the periphery of the component**, does not cause backside ignition, and does not continue to burn after the test flame is removed.***
This commenter, based on significant experience with firewall testing, considered backside ignition as unacceptable, and also considered residual firewall combustion as unacceptable. This has been agreed with editorial improvement.

Comment on paragraph (4)(a) of ACJ E 130

One commenter considered that it would be helpful if other acceptable references were quoted for burner calibration etc. and suggested that a reference to AC20-135 be made in this paragraph. This has not been accepted. JAA refer to ISO (see NPA 25D-181); however, as this is advisory material, other equivalent means may be proposed by an applicant.

Comment on paragraph (4)(b) of ACJ E 130

One commenter suggested adding mark of plural to "feature" and "location" in first and second sub-paragraphs to read:
*The test flame generally should be applied to the test article feature**(s)** that is determined by analysis or test to be the most critical with respect to surviving the effects of the fire.*

*For this approach, determination of the flame impingement location**(s)** should consider, as a minimum, the following potential factors: materials; geometry; part features; local torching effects; vibration; internal fluid level, pressure and flow rate; surface coatings; fire protection features; etc.*
This commenter considered that more then one location may be critical and therefore multiple flame impingement locations or multiple tests may sometimes be necessary (for example, a main gearbox design with two distinct critical features requiring test; a flange seal and a thin wall section). This has been agreed.

One commenter, considering that multiple features may need to be evaluated, suggested changing 4th sub-paragraph to read:
*The intent is to identify locations or features which cannot be directly impinged by fire, and **evaluating** ~~choosing the most~~ critical **features** ~~from those other locations~~ which can be directly impinged. If the applicant chooses this installation analysis approach, it should be based on the actual intended installation, and should consider, as a minimum, the factors noted above, plus the following potential installation specific factors : cowling and nacelle structure; under cowl airflow; aircraft engine build up hardware; etc.*
This has been agreed.

One commenter, considering that installation assessments are for that installation only, suggested changing 5th sub-paragraph to read:
*Such installation analyses should avoid simple generalities, such as "the most likely flame direction is vertical assuming fuel collects at the bottom of the cowl," and most properly should be co-ordinated with the installer. **If this approach is utilised, each new***

installation will need to be re-evaluated against the original fire protection substantiation to confirm its applicability to the new installation. *Lastly, due consideration should be given to fire protection features such as fire shields, fire protective coatings or other methods so as not to discourage or invalidate their use with respect to compliance with JAR-E 130.*
This has been agreed.

One commenter suggested changing the text to reflect the intent, to read :
such installation analyses…of the cowl' and should generally ~~most properly~~ be coordinated with the installer. If this approach is used, each new installation will need to be re-evaluated against the original fire protection substantiation to confirm its applicability to the new application. Lastly, due considerations…
This has been agreed.

Comment on paragraph (5)(a) of ACJ E 130

One commenter, considering that all critical features should be addressed, suggested changing 5th sub-paragraph to read:
*In the absence of an acceptable installation assessment, the fire test flame should be applied to the tank location**(s)** or feature**(s)** that has been determined by analysis or test to be the most critical with respect to fire susceptibility (i.e. the location or feature least likely to survive the test conditions or meet the test pass / fail criteria).*
This has been agreed.

One commenter considered that this paragraph should be limited to the direct engine installation and not concerns the fuselage and wings. Those parts must be included in JAR23/25 as flammability item with special concern. This comment has not been understood because JAR-E is the code for engine certification and there is no ambiguity.

Comment on paragraph (5)(b) of ACJ E 130

In paragraph 2, one commenter considered that the example of the combustor drain system is equally applicable to an engine shutdown as an aborted start and therefore suggested the text should be amended to read:
"…after an aborted engine start and after an engine shutdown."
This has not been accepted : the fuel is burnt after shut-off valve is closed and therefore should not be "drained".

Comment on paragraph (5)(c) of ACJ E 130

With regard to electrical Bonding, one commenter noted that in some cases electrical components are isolated from the engine in order to avoid fault currents flowing through the engine. This in itself can be a fire hazard, if the engine case is magnesium for example. Also, some engine sensors are isolated from the engine case to reduce the threat from lightning induced transients. Comment noted. The ESG has a separate open action to address the subject of electrical bonding.

One commenter suggested that this section should also address wire harness and electrical connector requirements with respect to fireproofness. This commenter suggested that the text should include reference to the following (but noted that this comment may better be made against the appended JAR-E 130(e) of NPA E-24):

"Electrical Systems components:
The applicant should evaluate the effects of fire on components of the electrical system. Electrical cables, connectors, terminals and equipment, installed in or on the engine, in designated fire zones, that are used during emergency procedures, must be at least fire resistant."
This comment has been incorporated in a new § (4)(d) with editorial improvements.

Proposal for a new paragraph (5)(f) of ACJ E 130

One commenter suggested adding a paragraph (f) providing reference to documents for information on hot surface ignition. There is no JAA document to be referenced. The proposal has not been accepted.

Proposal for a new paragraph (5)(g) of ACJ E 130

One commenter suggested adding a paragraph (g) to read :
(g) Shielding: The overall intent of JAR-E 130(b) requirement concerning the shielding and location of components is to minimise the possibility of liquid flammable fluids contacting ignition sources and igniting. Ignition sources include hot surfaces with temperatures at or above typical flash points for aviation fuels, oils, and hydraulic fluids, or any component that produces an electrical discharge. Compliance with this requirement has been shown by installation of drainage shrouds around flammable fluid lines or fittings; installation of spray shields to deflect leaking fuel away from ignition sources, and general component location on the engine which minimises the possibility of starting and supporting a fire. Therefore, the overall substantiation should show that leaked flammable fluid will not likely impinge on an ignition source to the extent of starting and supporting a fire. For kerosene type fuels, an auto-ignition temperature of 450 ° F has been accepted.
This commenter considered that the proposal did not address a common requirement for shielding (see JAR-E 130(b)) and that there was confusion as to what this requirement truly asks for.
This has been accepted as paragraph (f) with editorial improvements.