April 18, 2013
A&C-13-104

Process Support
Rulemaking Directorate
EASA
Postfach 101253
50452 Cologne
Germany

Subject: Gulfstream Aerospace Corporation response to NPA 2013-02 'Protection from Debris Impacts'

Gulfstream appreciates the opportunity to review this Notice of Proposed Amendment concerning protection from debris impacts and wishes to provide the following comments:

General comments

1. The initiative to clarify, correct and harmonize the requirements, assumptions, definitions and methods used to assess the safety of transport aircraft with regard to debris impact damage is very welcome. The broadening of the requirements previously only applicable to fuel tank covers is a long recognized common sense change. The specificity on the applicability of each type of consideration is also a positive aspect of the proposed changes.

2. One issue of significant concern is the creation and entrenchment of overlapping requirements and assessment criteria for uncontained debris from engines or APU. Uncontained engine and APU debris are assessed by detailed and specific methods and criteria. The entrenchment of the "3/8 inch steel cube" impact model as an alternative or additional criterion for fuel tank protection from uncontained debris is an unnecessary complication and may lead to unequal treatment on the subject due to certification authority discretion in applying this model, the existing AC/AMC 20-128A model or both to each application.

   Gulfstream highly recommends that the Fuel Tank Protection guidance refrain from defining its own uncontained engine or APU fragment model and instead reference the existing guidance material on those subjects. The "in the absence of relevant data concerning small engine debris" consideration is not a typical scenario for transport aircraft certification, as detailed fragment models are required for 14CFR/CS 25.901 and 25.903 compliance via the method described in AC/AMC 20-128A.

   Gulfstream highly recommends that the fuel tank protection requirement and guidance simply state that the fuel tank should resist penetration by small debris as defined in AC/AMC 20-128A, if that is the intended requirement. Gulfstream notes, however, that such a requirement applied to aircraft with rear fuselage mounted engines represents no significant improvement in safety and may represent a significant weight penalty. Therefore, Gulfstream suggests this requirement be limited to impact areas where leaking fluid could come into contact with an ignition source.

3. A second issue of significant concern is the expansion of the zone in which uncontained engine debris are considered to be a threat beyond the currently established ± 15 degree area. While it is recognized that a larger zone may be more realistic (as indicated by the reference data), making this change here creates the potential for conflicting or overlapping requirements now and in the future when AC/AMC 20-128A is revised. It also calls into question the suitability of the current AC/AMC 20-128A, creating the temptation for certification authorities to apply the expanded small debris impact zones defined here to the general uncontained engine failure assessment by Issue Paper.

4. Gulfstream highly recommends that no considerations beyond those in AC/AMC 20-128A be added to the assessment of uncontained engine and APU fragments via the Fuel Tank Protection requirements and guidance material. Any perceived deficiency of the existing criteria should be addressed by revising AC/AMC 20-128A.

Specific comments

The following comments apply to the proposed amended text:

Explanatory Note 35. Wheel and tyre failure model, (iv), fourth bullet

Gulfstream requests that 2.5W be changed to $2.5W_{SG}$

CS 25.729 (f) Deletion

No comment.

Creation of CS 25.734

Recommend rewording the first bullet to "tyre *burst* debris".

Recommend the deletion of the word "effect" from the second bullet.

Creation of CS 25.735 (l)

The phrase "possible wheel brake temperatures", though retained from existing regulation, is vague. Specific wording is recommended as to what scenarios should be considered (i.e. worst case operational, probable failure condition etc.).

Amendment of CS 25.963 (e)

Recommend replacing the expression "avoid hazardous fuel leak" with "avoid hazardous fuel leakage".

Recommend replacing the expression in item (1) "small engine and APU debris" with "small debris from uncontained engine and APU failure", to avoid ambiguity (i.e. debris from small engines versus small debris from engines).

Recommend rephrasing item (2) to a simple requirement as opposed to the current comparative requirement with exception. One possible alternative would be: "All fuel tank access covers when installed must have the capacity to withstand the heat associated with fire at least as well as the surrounding fuel tank structure".

AMC 25.729 Deletion

No comment.

Creation of AMC 25.734

Section 3. General, 1st paragraph

The use of the term "corresponding" creates the impression that there is a direct correspondence between the list of gear positions and the list of threats, which is contradicted by the subsequent text. Recommend replacing "corresponding" with "potential".

Section 3. General and subsequent

Recommend renumbering or changing the designation of the models such that there is a direct sequence applicable to each position of the landing gear. The current "1, 3a, 4, 2, 3b" sequence is not intuitive. One possible alternative would be:

With the landing gear in the extended position, the following models are applicable:

Model **1** — Tyre **Burst** Debris Threat Model

Model **2** — Wheel Flange Debris Threat Model

Model **3E** — Flailing Tyre Strip Threat Model

With the landing gear retracting or in the retracted position, the following models are applicable:

Model **3R** — Flailing Tyre Strip Threat Model

Model **4** — Tyre Burst Pressure Effect Threat Model

Section 4. Threat models, all models

Each model provides an applicability (gear extended/retracted, braked wheels etc.) and the rationale for it. A recommended improvement is to separate this content under an "Applicability" sub topic at the beginning of each model.

Section 4, Threat models, Model 1

Gulfstream recommends that the tire debris released from the tread area be clearly defined, i.e., what comprises tread and ply, and how the total tread area is defined.

In Figure 1, Section A-A, Gulfstream recommends adding clarification that the angle for zone of vulnerability should originate from the tire centerline, as it may appear to originate from the rim diameter.

Section 4, Threat models, Model 1, Protection of the structure and pass-fail criteria on effects of penetration, item (1)

As currently written, a fuel leakage must be assumed to occur as a result of large debris impact (locally or remotely due to pressure wave propagation). The brakes installed on main landing gear are intrinsically an ignition source. This guidance can, therefore, be difficult to impossible to comply with other than by creating a dry bay covering the entire exposed area or destructive ballistic testing of the fuel tank (as gaining acceptance for modeling of pressure wave behavior is likely to be a challenge). The impact and cost of this should be considered. If this is not the intended application of the guidance, the text should be clarified.

Section 4, Threat models, Model 1, Protection of the structure and pass-fail criteria on effects of penetration, item (2)

The only practical means to comply with this section is a full extent dry bay or destructive ballistic testing (given the specific leakage rate criteria and the difficulty in gaining acceptance for modeling of pressure wave behavior). The impact and cost of this should be considered. If this is not the intended application of the guidance, the text should be clarified.

Section 4, Threat models, Model 1, Protection of systems and pass-fail criteria

The dual fragment impact criterion for cascading tire failures is new. Typical landing gear and trailing edge installations cannot be shown to resist two independent fragment impacts (for example, damaging the two hydraulic supplies typically used for the redundant brake systems). The probability based approach described in item (4) will likely be invoked in every application. The impact and cost of this should be considered.

Section 4, Threat models, Model 2, third paragraph

Gulfstream recommends changing the wording of "*maximum unloaded rated tyre pressure"* to *"maximum unloaded service tyre pressure".*

Focus should be on the tire pressure chosen for the specific application, not on the tire rated pressure which could be significantly higher. This would penalize the applicant with possibly excessive conservatism.

Section 4, Model 3, section (b)

In recent applications credit for in flight braking of wheels as a mitigating factor for retracted tire strip flailing has required demonstrating that the in flight braking system is reliable and that its failure is not latent. These considerations should be added to the guidance.

With regard to sub item (ii), a quantitative rate for flailing strip is necessary to allow the required calculation. The guidance should provide an accepted rate to be used in the absence of specific data on the application specific tire. Gulfstream requests a clarification be made, as it is unclear if the probability of a flailing strip should be taken as 1 or some other probability.

Section 4, Model 3, Figure 3: Flailing Tyre Strip Threat

Gulfstream recommends the Figure 3 be updated to show each flailing strip originating from the edge of the grown shoulder width and from the grown tire radius.

Creation of paragraph 4.l in AMC 25.735

The text mentions damage due to tire burst but then requires a Brake Temperature Monitoring System (BTMS) only if the heating itself could be damaging to the items in the wheel well. The current text is a non sequitur. Recommend deletion of the tire burst language, retaining the requirement for BTMS where overheating could damage items in the wheel well. This is consistent with the fact that simply installing a BTMS does not remove the requirement to perform tire burst safety analysis of the installation.

Amendment of AMC 25.963(e)

Gulfstream recommends deletion of the specific debris model ("steel cube") and replacement with a reference to appropriate uncontained engine and APU failure guidance, similar to the reference provided for wheel and tire failure models.

Additionally, Gulfstream recommends deletion of the "beyond ± 15 degrees area" criterion. Changes to the accepted modeling of engine and APU debris should occur within the context of AC/AMC 20-128A.

If there are any questions please do not hesitate to contact Steve Cottrell at (912) 965-6469 or GAC.Cert@Gulfstream.com.

Sincerely,

For
Richard J. Trusis, Director, Airworthiness & Certification