EASA European Union Aviation Safety Agency	**Consultation paper** **Deviation**	Doc. No.: DEV-F25.734-01 Issue : 1 Date : 07 Jul 2023 Proposed ☒ Final ☐ Deadline for comments: 28 Jul 2023

SUBJECT	:	**Wheel Flange Debris and Fuel Tank Protection**
REQUIREMENTS incl. Amdt.	:	CS 25.734 and CS 25.963(e)(1) at Amdt. 21
ASSOCIATED IM/MoC[1]	:	Yes☐ / No ☒
ADVISORY MATERIAL	:	AMC 25.734, AMC 25.963(e)

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[1] Associated Interpretative Material and/or Means of Compliance may be published for awareness only and they are not subject to public consultation.

INTRODUCTORY NOTE:

The following Deviation (DEV) shall be subject to public consultation in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) which states:

"*2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.*"

ABBREVIATIONS:

none

IDENTIFICATION OF ISSUE:

CS 25.734 specifies the following:

- CS 25.734 "Protection against wheel and tyre failures"

  The safe operation of the aeroplane must be preserved in case of damaging effects on systems or structures from:
  - *…*
  - *wheel flange debris.*

Additionally, AMC 25.734 clarifies that all fuel tanks must be evaluated against all wheel and tyre failure threat models defined in AMC 25.734, only those located within the torsion box of high aspect ratio wings and manufactured of light metal alloy need only to be evaluated for impact with small tyre debris and are exempted from other threat models including the wheel flange debris. (Para 3.3)

Due the presence of fuel tanks in the proximity of the landing gear area, compliance with 25.734 has an intrinsic impact on CS 25.963 that specifies the following:

(…)

(e) Fuel tanks must comply with the following criteria in order to avoid hazardous fuel leak:

(1) Fuel tanks located in an area where experience or analysis indicates a strike is likely, must be shown by analysis supported by test, or by test to address penetration and deformation by tyre and wheel fragments, small debris from uncontained engine failure or APU failure, or other likely debris (such as runway debris).

(…)

In the frame of the Falcon 6X Type Certification project, analysis and calculations performed by the Applicant, revealed that 2 areas of the lower rear "T34" fuselage tank cannot sustain the wheel flange debris impact without fuel leakage, therefore not showing direct compliance with CS 25.734 and CS 25.963(e)(1) and making some redesign necessary. As these issues were picked up only at a late stage of the Falcon 6X TC project,

schedule and industrial constraints do not allow the finalisation of the redesign, the substantiation against the mentioned requirements and implementation before Type Certification or Entry Into Service (EIS).

The applicant will develop, certify, and ensure full application of the necessary design changes to make all aeroplanes fully compliant with CS 25.734 and 25.963(e)(1) (Amdt 21) after the issuance of the EASA Type Certificate.

For the TC, the Applicant has:

- requested a Deviation (as explained in this paper),
- proposed, per point 21.B.80(a)3(i) of Part 21, mitigating factors until completion of the retrofit activities,
- the mitigating factors are based on the following:
  - Good in-service experience on the Falcon fleet (similar configuration and performances) equipped with similar wheels from same manufacturer.
  - Very few percent of trajectories of wheel debris impacting the fuel tanks in areas not sufficiently protected by structure or system layout.
  - No direct spillage on potential ignition source(s).

As detailed in appendix A to this paper, the proposed mitigating factors provide alternative means to ensure that the safety objective of the requirements are met and compliance with the applicable essential requirements for airworthiness (as defined in appendix A) laid down in Annex II of the regulation (EU) 2018/1139 is demonstrated.

Considering all the above, the Deviation in appendix A is proposed, which is agreed by EASA.

DEV-F25.734-01

Deviation

Wheel Flange Debris and Fuel Tank Protection

1. APPLICABILITY

CS-25 Large Aeroplanes

1.1 AFFECTED CS

The following paragraphs of CS-25 are affected because compliance cannot be demonstrated for a small area of the fuselage fuel tank:

- CS 25.734 "Protection against wheel and tyre failures"

  The safe operation of the aeroplane must be preserved in case of damaging effects on systems or structures from:
  - *…*
  - *wheel flange debris.*

- CS 25.963 "Fuel tanks: general"

  (…)
  (e) Fuel tanks must comply with the following criteria in order to avoid hazardous fuel leak:

  (1) Fuel tanks located in an area where experience or analysis indicates a strike is likely, must be shown by analysis supported by test, or by test to address penetration and deformation by tyre and wheel fragments, small debris from uncontained engine failure or APU failure, or other likely debris (such as runway debris).
  (…)

1.2 Pre-Conditions for Application of the Deviation

Not Applicable

2. APPLICABLE ESSENTIAL REQUIREMENTS FOR AIRWORTHINESS OF REGULATION (EU) 2018/1139 (Annex II)

The following paragraphs of the "Essential Requirements for Airworthiness" as defined in Annex II of Regulation (EU) 2018/1139 are affected by the actual design:

Paragraph 1.3.3:

"The aircraft systems and equipment, considered separately and in relation to each other, must be designed such that any catastrophic failure condition does not result from a single failure not shown to be extremely improbable and an inverse relationship must exist between the probability of a failure condition and the severity of its effect on the aircraft and its occupants"

and

paragraph 1.3.5:

"Design precautions must be taken to minimise the hazards to the aircraft and occupants from reasonably probable threats, including information security threats, both inside and external to the aircraft, including protecting against the possibility of a significant failure in, or disruption of, any non-installed equipment."

3. MITIGATING FACTORS

The following mitigating factors have been identified as alternative means to ensure compliance with the above identified essential requirements.

- It must be demonstrated that only few percent of trajectories of wheel debris impacting the fuel tanks can create a hazardous fuel leak. This may take into account the fact that some of these trajectories are protected by system layout before the debris impact the tanks.
- A zonal analysis must demonstrate that, even in case of fuel leakage, the risk of hazard to the aircraft (and consequently the occupants) is limited taking into account the potential ignition source(s).
- The Deviation has been exceptionally granted with a limited number of flight cycles or calendar time (whichever comes first).

Note: Full CS 25.734 and CS 25.963(e)(1) compliance on the concerned fuel tanks will be restored with a dedicated design change. The design change will be implemented through retrofit on any individual aircraft delivered with a design that is compliant with this deviation only. Therefore, a plan for implementation of the design change and retrofit is to be defined to limit the exposure. This should be determined through an analysis to be agreed by EASA. In-service experience from similar designs wheels from same manufacturer, production and operational constraints can be used to support the analytical considerations.