EASA European Union Aviation Safety Agency	**Consultation paper** **Equivalent Safety Finding**	Doc. No.: **ESF E-31** Issue : 1 Date : 04/03/2020 Proposed ☐ Final ☒ Deadline for comments: 25/03/2020 Final with CRD ☐ without CRD ☒

SUBJECT	:	**Equivalent Safety Finding to CS 29.1193(e) (3) - Engine and Exhaust Cowlings Fire Testing**
REQUIREMENTS incl. Amdt.	:	**CS 29.1193(e) (3) Amdt. 3**
ASSOCIATED IM/AMC[1]	:	Yes☐ / No ☒
ADVISORY MATERIAL	:	**N/A**

INTRODUCTORY NOTE:

The following Equivalent Safety Finding (ESF) has been classified as important and as such 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.*"

IDENTIFICATION OF ISSUE:

CS 29.1193(e) (3) requires that:

> (e) Each rotorcraft must:
> ….
> (3) Have fireproof skin in areas subject to flame if a fire starts in or burns out of any designated fire zone.

CS-Definitions specifies what the "*fireproof*" requirement of CS 29.1193(e) (3) means:

> **'Fireproof.'** With respect to materials, components and equipment, means the capability to withstand the application of heat by a flame, for a period of 15 minutes without any failure that would create a hazard to the aircraft. The flame will have the following characteristics:
>
> Temperature 1100°C ± 80°C
>
> Heat Flux Density 116 KW/m2 ± 10 KW/m2
>
> For materials this is considered to be equivalent to the capability of withstanding a fire at least as well as steel or titanium in dimensions appropriate for the purposes for which they are used.

The Means of Compliance with CS 29.1193(e) (3) have been selected with reference to the AC 20-135, agreeing on fire testing pass/fail criteria that should result in withstanding a flame, as specified above in CS-Definitions for "*fireproof*" demonstration, without any burn through the test specimen during 15 minutes in the following conditions on ground and in flight:

- 5 min in simulated ENGINE ON condition, i.e. with induced air flow in air inlet
- 10 min in simulated ENGINE OFF condition, i.e. with no induced air flow

[1] In case of SC, the associated Interpretative Material and/or Acceptable Means of Compliance may be published for awareness only and they are not subject to public consultation.

The outcome of the fire tests performed on the engine and exhaust composite cowlings showed marginal results for the simulated ground condition, with a burn through of the test specimen after 12 min with no air flow instead of the expected 15 min.

Such fire testing results do not bring straightforward compliance finding to CS 29.1193(e) (3) for the engine and exhaust cowlings and therefore, an ESF to this requirement is claimed for the two composite cowlings at stake.

JUSTIFICATION OF AN ESF

With reference to the fire testing results obtained (i.e. 12 min achieved vs. 15 min required), the safety intent of the requirement CS 29.1193 (e) (3) can be met by demonstrating that the cowlings fire withstanding capability on ground ensures a safe evacuation of the crew and the passengers and do not endanger ground personal.

Considering the above, the following ESF is proposed:

Equivalent Safety Finding to CS 29.1193(e) (3) Amdt. 3

Engine and Exhaust Cowlings Fire Testing

Applicable to Airbus Helicopters H160

COMPENSATING FACTORS

- **Cowlings design vs. the portion of test specimen subject to fire testing**:

  The cowlings are made of composite material with an arrangement of monolithic carbon fiber plies in some areas and sandwich layup in others. All areas have been succesfully demsontrated fireproof by testing at the exception of the monolithic layup of 5 structural carbon fiber plies. These cowling portions (of monolithic layup of 5 structural carbon fiber plies) are very reduced for the design of the engine cowling while they constitute the majority of the composite structure of the engine exhaust cowling.

  As fire occurrence is more likely to occur in the engine compartment (Designated Fire Zone) rather than in the exhaust area (separated by firewall from the engine compartment), the risk exposure is reduced.

- **Aircraft egress scenario if a cowling fire emergency occurs on ground**:

  In the case of a fire emergency declared on ground, the time between fire ignition and effective evacuation of the rotorcraft will last less than 5 minutes with a conservative approach.

  This maximum evacuation time (around 3min 35s) is within the requirements for a fire resistant material behaviour. The claimed cowlings design is offerening an additional margin of 7min on ground until first flame penetration.

  Moreover, the possible scenario of a cowling fire occurring on ground while taxiing has also been assessed. It is concluded that the rotor air flow during taxiing is providing additional cooling and because of this, it is beneficial to the overall time until flame penetration could occur.

  The fire withstanding capability demonstrated (5min + 7min) is providing margins to ensure a safe evacuation of the crew and the passengers

- **Further assessment of possible cowlings fire vs. other risk hazards at aircraft level**:

  After 12min fire development, the flame may no longer be contained and pass through the portions of monolithic layup of 5 structural carbon fiber plies.

  The H160 powerplant installation architecture is such that the cowlings are above the engine compartment, which is located on top of the helicopter, above the cargo compartment, with the MGB compartment in front, and the rear transmission compartment behind.

  The engine compartment itself is separated from the other compartments by titanium firewalls as required by CS 29.1191. It means in case of fire on ground and burn through of the cowlings, that the flames are not expected to reach the passenger compartment nor other compartments where flammable fluid are stored, such as:
  - hydraulic tank in the MGB compartment (is protected by a fireproof firewall in front of the engine)
  - oil cooler and lubricating system in the MGB area (is protected by the same fire wall)
  - fuel tanks that are located on the lower part of the helicopter.

Therefore, risk of injuries to crew/passengers or ground person during and after evacuation is very unlikely

- **Firefighting means available on ground**

  Another compensating factor is the improved possibility to fight fires when on the ground, because not only the two on-board extinguishing systems are useful against engine fires, but also any other available fire extinguishing device (such as cabin extinguishers or handheld extinguishers from the airfield or helipad or firemen presence) can be used as additional firefighting means on ground.

EASA position

The cowling fireproofness (subject to 15min standard flame exposure) to be demonstrated for ground and flight conditions, has not been fully achieved for the ground condition (agreed as 5min in simulated ENGINE ON condition, i.e. with induced air flow in air inlet, then followed by 10min in simulated ENGINE OFF condition, i.e. with no induced air flow).
A flame burn through has been experienced at 12min during the fire testing for some portion of the composite engine and exhaust cowlings, hence not achieving marginaly the 15min fireproof required.

To compensate the non-compliance with CS 29.1193(e) (3) for cowlings fireproofness, the above listed factors are considered adequate and acceptable for justification of ESF granting.