Notification of a Proposal to issue a Certification Memorandum

Required material properties and structural residual strength for Fireproof / Fire-resistance compliance demonstration

EASA Proposed CM No.: CM–S-015 Issue 01 issued 07 July 2021

Regulatory requirements: CS 29.861, 29.1181, 27/29.1183, 29.1191, 29.1193, 27/29.1194

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Log of issues

Issue	Issue date	Change description
01	07 July 2021	First issue

Table of Content

1. Introduction

1.1. Purpose and scope

The purpose of this Certification Memorandum is to provide guidelines and Interpretative Material relating to Fireproof / Fire Resistance compliance demonstration for CS-27 Category A (including specific CS-29 provisions quoted in CS-27 Appendix C) and CS-29 rotorcraft.

1.2. References

It is intended that the following reference materials be used in conjunction with this Certification Memorandum:

Reference	Title	Code	Issue	Date
[1]	CS-Definition of fire resistance / fireproof	CS-Definition	amdt 2	16/12/2010
[2]	Fire protection of structure, controls, and other parts	CS 29.861(a)	All	N/A
[3]	Designated fire zones: regions included	CS 29. 1181(a)	All	N/A
[4]	Lines, fittings, and components	CS 29.1183 CS 27.1183	All	N/A
[5]	Firewalls	CS 29.1191(a)(1)	All	N/A
[6]	Cowling and engine compartment covering	CS 29.1193(e)	All	N/A
[7]	Other surfaces	CS 29.1194 CS 27.1194	All	N/A
[8]	Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards and Criteria with change 1	AC 20-135	Change 1	11/10/2018
[9]	Aircraft – Environmental test procedure for airborne equipment – Resistance to fire in designated fire zones	ISO 2685	-	15/12/1998

1.3. Definitions

Fire Resistance	With respect to materials, components and equipment, means the capability to withstand the application of heat by a flame, as defined for 'Fireproof', **for a period of 5 minutes** without any failure that would create a hazard to the aircraft. For materials this may be considered to be equivalent to the capability of withstanding a fire at least as well as aluminium alloy in dimensions appropriate for the purposes for which they are used. (Source: CS-Definitions, Amdt. 2)

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/m^2 ± 10 KW/m^2 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. (Source: CS-Definitions, Amdt. 2)

Table 1: Fire-resistant & Fireproof Summary table

	Duration	Criteria
Fire-resistant	5’	No failure that would create a hazard to the aircraft
Fireproof	15’	No failure that would create a hazard to the aircraft

2. Background

2.1. Rotorcraft fire protection - General

CS-29 addresses the threats due to fire on the whole rotorcraft with specific certification specifications that are adapted to the particular threat (e.g. engine, APU, cargo load, oxygen, battery, flammable fluids, electrical, etc). With the inherent and likely occurrence of fire due the presence of combustion chambers, CS-29 contains unique fire protection certification specifications for combustion heaters, APU and engine installation.

CS-29 contains, whenever needed, requirements to mitigate the fire threat from combustion heaters, APU and engines, by requiring that structure, panels, piping, equipment and wiring are capable of withstanding a certain level of fire upon being exposed to either direct effect (flame) or indirect effect of fire (heat).

Generally, CS-29 contains criteria for design elements to be either fireproof or fire resistant. Those terms are defined in CS-Definitions (respectively 15 min. and 5 min. capability to perform the function under a 1100°C ± 80° flame having a heat flux of 116KW/m² ± 10KW/m²).

Thermal protection can be installed in the area exposed to fire, but the residual strength conditions should be considered for the structural elements (parts) as described in this Certification Memorandum.

Some of these CS-29 requirements are also referenced in CS-27 Appendix C as applicable to CS-27 Category A rotorcraft.

Notes:

1. This CM addresses the ability of both loaded and non-loaded structure to resist the effects of fire. The loaded or non-loaded structure classification should be made for each project considering the loading condition, the safety assessment and also the criteria given in the existing standard (e.g ISO 2685). When these structural elements are part of systems, additional criteria can be found necessary to demonstrate their performance under fire conditions. These criteria are not addressed in this CM.

2. This CM only addresses the static residual strength characteristics for fireproof and fire resistance of components affected by fire. However, for high cycle loaded parts, additional investigations can

be requested to justify the residual strength of the part during the fire exposure period considering the damage accumulated prior to fire.

3. More generally, the applicant should check if the material characteristics degradation (strength, stiffness…) under fire do not detrimentally affect the flight performances.

4. When repairs or modifications are performed, the effect on the fireproof and fire-resistance characteristics should be checked. This guidance if initially selected for certification should be considered in the compliance demonstration.

3. EASA Certification Policy

3.1. Fireproof / fire-resistance

The conditions for fireproof and fire-resistant are addressed in the CS definition (see paragraph 1.4).
For structural parts/components, material properties can be used to demonstrate fireproof / fire resistance, along with other various compliance means. When the function performed under fire conditions includes loads carrying capability, the reduced material strength which occurs under these conditions should be evaluated.
This CM clarifies when the use of material properties as a means of compliance (MoC Code 1) becomes acceptable or not to demonstrate fireproof / fire resistance for structural parts.

3.1.1. Fire protection of structure, controls, and other parts

Whenever a material with fire withstanding capability is used for a structure, it should be capable of sustaining the appropriate loads with a positive margin of safety under heat/fire conditions. This should be demonstrated over the complete load path where heat/flame conditions exist:

- under direct flame impingement, when structural load paths are running partially and/or totally in a designated fire zone and
- under heat effect, when structural load paths are running partially and/or totally behind a shield (i.e. adjacent zone to a designated fire zone).

The following two structural cases should be considered for fireproof and fire-resistant capability.

3.1.1.1. Loaded structure

1. The following materials that are commonly used on engine and APU mounts and have been previously accepted as fireproof by EASA can be considered fireproof provided that dimensions / loading capability under nominal conditions are substantiated:
    a. AISI 4100 series and 15-5PH CRES steels,
    b. Inconel 718,
    c. Ti-6Al-4V and Ti-6Al-2Sn-4Zr-2Mo alloys.
2. For other steel, nickel-chromium and titanium alloys, material data evidence should be provided to show that these alloys can maintain structural integrity under fire conditions, in order to be accepted as fireproof. Validated analysis may be required to justify the temperature/stress levels.
3. For other materials, such as aluminium, composites and elastomers, compliance should be shown by test, or analysis supported by test, in order to be accepted as fireproof. A similar level of compliance demonstration is required for loaded structure made of aluminium material to be declared fire resistant, including:
    - Compliance demonstration by a combination of thermal analysis and stress analysis might require intensive testing to validate the models. Analysis should include the most conservative operating conditions (i.e. Max. day temperatures, Max. engine/APU torque/power/vibrations).

- Similarly, analysis may not be appropriate for elastomeric material where vibrations have a detrimental effect on elastomeric compound integrity while under fire. If disaggregated under vibration and fire, the introduced effect on the relative freedom should be assessed.
- Alternatively, a loaded fire test with representative thermal and other environmental conditions, including vibrations (with isolation or shielding, if this is part of the TC definition), can be performed.

4. In the absence of a more rational determination of the expected flight loads, the structure, including elastomeric materials, should be able to support limit flight loads (including engine/APU torque for maximum continuous power) without failure for at least 5 minutes to be accepted as fire resistant. For fireproof material, after 5 minutes and until the end of 15 minutes, the engine/APU may be assumed to be shut down and the structure must be able to support the get home loads.
   The 'get-home' loads are based on the maximum loads derived from fatigue spectrum in combination with any limitations given in the Flight Manual.

3.1.1.2. Non-loaded structure

1. Steel and titanium elements that have dimensions appropriate for the intended use can be declared as being fireproof in accordance with the definition in CS-Definition. Examples of acceptable minimum thicknesses are given in AC 29.1191 (flat firewall with uniform heat flux).
2. Aluminium elements that have dimensions appropriate for the intended use can be declared fire resistant in accordance with the definition in CS-Definition. The applicant should substantiate the appropriateness of the thickness of the aluminium element for the function required to be performed under fire conditions.
3. For compliance with CS-29 requirements, Aluminium cannot be directly considered fireproof in accordance with the definition in CS-Definition and would require justification based on tests with representative environmental conditions.

For loaded and non-loaded structure, composite and other material would require justification based on tests with representative environmental conditions. Further guidance can be found in AC 20-135 and ISO 2685.

3.2. Who this Certification Memorandum affects

This Certification Memorandum affects applicants for a CS-27 Category A or CS-29 rotorcraft Type Certificate (or Supplemental Type Certificate), or changes including repairs to an existing Type Certificate (or Supplemental Type Certificate), when proposing the means of compliance, demonstrating and finding compliance with the relevant certification specifications relating to fire protection.

4. Remarks

1. This EASA Proposed Certification Memorandum will be closed for public consultation on the **25th of August 2021**. Comments received after the indicated closing date for consultation might not be taken into account.
2. Suggestions for amendment(s) to this EASA Certification Memorandum should be referred to the Certification Policy and Planning Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu.
3. For any question concerning the technical content of this EASA Proposed Certification Memorandum, please contact:

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