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Subject: A350 XWB Airframe Composite guide for firefighters

Objective:

The purpose of this document is to give firemen practices and fire behaviour to fight on CFRP material structure.

For any question, please contact airport operations department
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Airbus A350-XWB Airframe Composite guide for firefighters

Firemen guidelines

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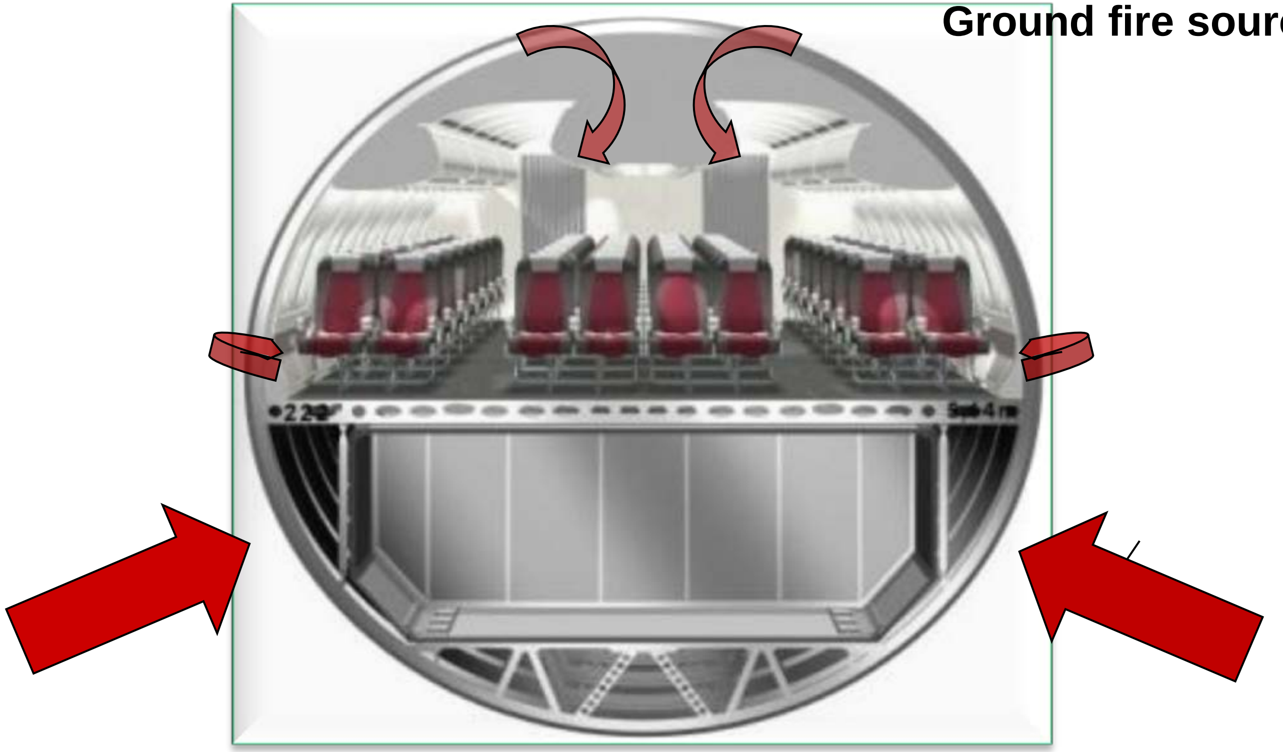
A350 XWB Composite applications

➔***Most of the external structure is made of composite components***

Certification requirements for structure integrity



Ground fire source

Certification requires a structure integrity of **5 minutes** considering external fire.

Burn through requirement applies to the lower half of the shell only.

A350 certification test demonstrates an **equivalent** level of safety in comparison with aluminium fuselage.

What are burning properties of composite material ?

- Composite material are made from organic compounds and as such, they can be thermally converted. Their decomposition depends highly on the conditions of the thermal exposure as well of resin formulation and type.

- Tests have demonstrated that:
  - Flames do not propagate.

- The CFRP composite structures has an increased resistance to penetration compared with aluminium structures.

- There is no spontaneous fire reinitiation

- Tests have demonstrated that the hazards of aircraft with CFRP composite structures is comparable to aluminium fuselage.

- However, specific care should be taken in case of intense and long lasting fires.

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Composite aircraft firefighting recommendations

- **Standard aircraft fire fighting techniques (water/foam) are used to fight a CFRP aircraft.**
- **Composites fires are classified as either Class A or B .**

1- Specific care should be taken as CFRP materials degrade when exposed to intense heat during a long period heat, which results in a loss of mechanical strength :

- ➢ Risk of parts collapsing, risk of falling through surfaces structures in case of loss of stiffness : unlike metallic fuselage that melts due to fuel fire exposure, the CFRP fuselage skin seems to stay in place. The resin burns under the effects of the fuel fire, the fire surface is damaged and carbon fibers become brittle. Although the CFRP skin stays in place, structural strength may be totally lost.

2- Complex chemical degradations can result from composite burning, hence pyrolysis gases can be generated and ejected out of the material. Fiber degradation under extreme fire can result into dust particles contamination.

3- Further information can be found in the ICAO AN 179 circular 3.15 § 3.5.7 & 3.5.8.

Additional consideration: Backdraft

- CFRP materials may contain the fire longer than an aluminium fuselage and could generate a thermal effect called backdraft .
- This phenomenon can occur during the later stages of the free burning phase but most likely during the smouldering phase of a fire.
  – special care has to be taken when penetrating into a fuselage submitted to extensive fire.

- A common tactic to face a potential backdraft is to ventilate the area by opening doors to evacuate gases and toxic smokes.

Fuselage cutting - possibilities

- Structures made of cured composite (carbon fibre, glass fibre, aramid, etc.) materials based on continuous and non-continuous fibre reinforced thermoset and thermoplastic resins, un-reinforced thermoplastic, etc., as well as “hybrid” structures manufactured by metal and composite materials can by cut by conventional machining processes with hand tools machines, using specific tools
  - Drilling
    - ❑Drills bits / Trepans
  - Sawing / Routing
    - ❑Rotative saws / Chain saws / Routers
  - Hand Tools (“Penetrating nozzles”, “Fire sticks”, “Halligans”, etc.)

Above tools can be used to cut into the fuselage. However “Drilling” and “Sawing” are more effective as chisels and hand tools require higher penetration and extraction forces or might bounce back during force application)

Fuselage cutting - possibilities

- Composite materials (reinforced thermoset and thermoplastic resins, un-reinforced thermoplastic, etc.) can by cut by conventional machining processes with hand machines and specific tooling (drilling, sawing, hand tools, etc.)

Typical tools (as reference, but not limited to)

- Drilling
  - Drill bits, Trepans
- Sawing, "Cutting"
  - Rotative saws, blade saws, etc.
- Hand tools
  - Penetrating nozzles, Fire Sticks, Axes, Hooks, etc.

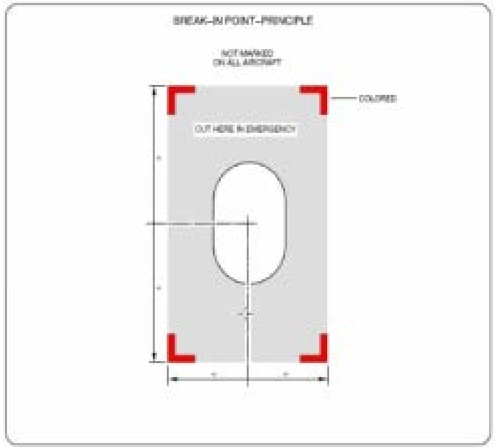
- Typical and conventional tool materials for CFRP structures (as reference):
- HSS (High Speed Steel): High carbon content (0,6% C) alloyed with chromic, wolfram, vanadium. TiN coating increases life tool. i.e. HSSC - High Speed Cobalt Steel
- Carbide or Cement Carbide: Cemented carbides; Longer life-time and advancing speed than the HSS
- PCD: Polycrystalline diamond.
- Integral hard metal K10 quality - ultra micro grain 8% Co

Fuselage cutting - possibilities

- Typical and conventional machining tool materials for CFRP structures (as reference)
- HSS (High Speed Steel): steel with high carbon content (0,6% C) and alloyed with chromic, wolfram, vanadium. Its cutting edges and diameters are rapidly worn: its life-time increases when it has TiN (titanium nitride) coating. i.e. HSSC - High Speed Cobalt Steel
- Carbide or Cement Carbide: cemented carbides; materials obtained by powder metallurgical processes combining carbide and metal powder. Longer life-time and advancing speed than the HSS
- PCD: Polycrystalline diamond. Great wear strength
- Integral hard metal K10 quality - ultra micro grain 8% Co: rapid steel of great hardness, employed in the manufacturing of tools, the manufacturing method of the same being synthetization, in which wolfram carbide alloy is the main component

Specific details (machining parameters) in engineering and Manufacturing documentation (i.e. AIPS/AIPI, AIAH-G-500, etc.

Interior views of possible cut areas



Safety equipment

- The risk for the staff results from the decomposition of the material during and after the fire ; the intense heat on the scene of a crash will decompose resins linking fibers, releasing toxic vapors and increasing the risk during breathing . Besides the respiratory risk these fibers can cause traumatic dermatitis.
- In any situation, when fire brigades have to carry out emergency and response plan intervention it is recommended that clear and stringent rules and procedures including training should be introduced and respected.
- Specific breathing apparatus equipment "Insulating respiratory systems" for composite aircraft as for metallic aircraft should be used.

Safety Equipment

- Firefighters should wear full protective clothing with bunker gear and self-contained breathing apparatus (SCBA) with filtering half masks to protect against particles.
- For information FAA recommends the following equipment Mishap response checklist; however each ARFF team has its own standard operating procedure.

- Personal Protective Equipment (PPE):
- Coated Tyvek suit with hood and booties
- Fixant/Clean-up materials
- Full face respirator
- Leather work gloves
- Nitrile gloves (inner)
- Hard-soled leather work boots

Emergency rescue information

http://www.airbus.com/aircraft/support-services/airport-operations-and-technical-data/aircraft-rescue-firefighting-charts.html

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