787 Aircraft Rescue & Firefighting
Composite Structure
April 2013
# List of Effective Pages

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Composite Structure Content of the 787

- **Carbon laminate**: 50%
- **Carbon sandwich**: 15%
- **Other composites**: 10%
- **Aluminum**: 20%
- **Titanium**: 5%
- **Steel**: 10%
- **Other**: 5%

Composites make up 50% of the structure content.
Commercial aircraft – Composite structure trends

Materials
- Composites
- Steel
- Titanium
- Aluminum
- Miscellaneous

747
- 81% (1969)
- 1%

757/767
- 79% (1982)
- 3%

777
- 70% (1993)
- 11%

787
- 50%
- 20%

Increased Composite Use Over Time
Increased Titanium Use Over Time
Decreased Aluminum Use Over Time
Questions posed by fire service providers

- Do composites readily burn?
- How do we fight a composite aircraft fire?
- What new hazards do composites pose?
- Can we cut through the fuselage?
- Will penetrating tools work on the fuselage?
- Are there added safety concerns with composites?
Does the composite fuselage readily burn?

Our flame tests indicate that:

- Composite fuselage structures do not sustain combustion and do not aid in the spread of fire.

- Composite fuselage structures exhibit longer burn-through times than aluminum structure.

- Composite fuselage structure does not radiate (transfer) heat to the same degree as aluminum structures.

- Our testing has detected no fire propagation.
How do we fight a composite aircraft fire?

• In the initial attack, composites are classified as either Class A or B fires.

• Our testing has not observed particulates other than typical combustion products.

• Use standard aircraft fire fighting techniques – water/foam upon approach.
  – Foam acts as a fixant and is precautionary when concerned about particulates in the air (like any other fire).
  – Smoldering fires need to be tactically resolved by addressing the seat of the fire (like any other fire).
Are there any new hazards with composites?

• Our evaluations indicate that combustion hazards remain similar.

• In our testing the toxicity levels of fires involving 787 skin panels are similar and no more hazardous than the levels found with an aluminum fuselage. Our testing of representative fuselage sections (with insulation) compared the combustion products of 787 skin panels to those of an aluminum fuselage section (also with insulation). We confirmed an equivalent level of safety for the passengers. There is no reason to think that exposure levels to firefighters are any different.

• There are jagged edges both with aluminum and composite fuselage environments; caution must be taken when moving through the wreckage.
Can we cut through the fuselage?

We have done extensive testing with rotary saws (w/carbide tips and diamond tips) chain saws, air chisels and hand tools.
Do penetrating tools work with composite structure?

• The tip of a standard fire axe bounces back and will not easily penetrate the fuselage.

• We found that some hand tools could be driven through the fuselage with the help of a sledgehammer.
What about penetrating nozzles?

- We have tested penetrating nozzles in a lab environment and have found that they will penetrate the fuselage.
- Both penetration and extraction requires significantly higher force with the composite fuselage.
Interior views of possible cut areas

- Interior Skin w/ Insulation Blankets
- Typical Interior Frames
- Typical Interior Stringer
- Interior View-Fuselage Join Section
Boeing carried out side-by-side penetration tests of 787 and 747 skin panels

The testing observed differences between the two panels in penetration with nozzle devices, cutting tools and human-force tools (axes or halligans).

The tests showed:

(1) penetration nozzles require significantly higher force for the composite fuselage compared to aluminum skins, except along the window belt where the penetration forces are essentially equal;

(2) cutting tools (rescue circular saws and air chisels) were found to require similar forces to cut into either type of panel;

(3) some hand tools (Fyresticks, Vulcans and halligans) were not effective in penetrating composite skin panels, but a Spaat fire drill when applied with a side-to-side or a push-pull motion, was equally effective on the composite as it was on the aluminum panel.

We concluded that by informing ARFF Crews of the outcomes of the tests via notes on the standard ARFF charts for aircraft built with composite skins, crews will be fully able to combat fire events if they occur.
Are there any other safety concerns?

• We are not adding any extra precautions for our firefighters.

• EMERGENCY RESPONSE
  – Every aircraft incident involving fires should be treated as a hazardous material incident with full decontamination procedures in place.
    – Full PPE, SCBA, ALWAYS establish HOT, COLD, & WARM Hazard Zones
    – Establish and maintain control over the accident scene

• POST ACCIDENT INVESTIGATION
  – Post accident investigations must have PPE, Respiratory Protection, Tyvek, and gloves making sure all skin is covered.

(No one of these provisions are unique for composite fire events.)
787 flammable material locations

**ACTIONS:**
- **WHEELS ARE EQUIPPED WITH FUSIBLE PLUGS DESIGNED TO MELT AND DEFLATE THE TIRE WHEN THE TEMPERATURE IS EXCESSIVE.**

**HOT BRAKES**
- Normal Cooling (move aircraft to suitable location and allow to cool on their own)
- Water Mist (can be deployed from turret or handline)
- Fans (placement of fans may place firefighters very close to the hazard zone)

**WHEEL FIRE**
- Large amounts of water initially with Turrets.
- Transition to handline application to continue and maintain a cooling effect.
- **WARNING:** APPROACH THE LANDING GEAR TRUCK FROM FORWARD OR AFT WHEN FIGHTING A WHEEL FIRE AS WHEELS AND TIRES MAY EXPLODE.
787 Emergency Rescue Access-1

1. Entry/Service Door/Overwing Exit External Handle

To open door:
1. Push in RED button.
2. Pull handle from recess.
3. Rotate handle 180° degrees in the direction of the “OPEN” arrow.

2. Crew Overhead Escape Hatch External Handle

To open hatch:
1. Push release trigger on handle (handle will spring out from recess approximately 3 inches).
2. Rotate handle 180°.
787 Emergency Rescue Access-2

Cargo Door on right side – operating instructions on door

Entry/Service Doors

Entry/Service Doors

Cargo Door on right side – operating instructions on doors

Entry/Service Doors

Crew overhead Escape Hatch

Average distance floor level to ground

Wheels retracted: 7 ft 6 in

Wheels extended: 13 ft 6 in

Bulk Cargo Door on the left side - operating instructions on door
Door 4L – Also allows access to the Overhead Crew Rest Area. Overhead Crew Rest Areas are optional but if they are installed they MAY BE OCCUPIED and must be checked for trapped and/or injured people.

Door 1L – Also allows access to the Overhead Crew Rest Area. Overhead Crew Rest Areas are optional but if they are installed they MAY BE OCCUPIED and must be checked for trapped and/or injured people.
787 Emergency Rescue Access-4

Note: Single seat configuration shown.
Two seat configuration also available.

Seat Module

Entrance Enclosure

Forward Overhead Flight Crew Rest Area (Optional)

Bunk Module
787 Battery locations

Lithium-ion Batteries

NOTE: The box containing the lithium-ion battery cells is secured inside a reinforced stainless steel enclosure capable of containing a lithium-ion battery event. Venting of vapor during a battery failure event may be visible from an exterior vent on the bottom of the aircraft under the forward or aft E&E bay. During active venting, there is no reason to make access to the E&E bay.

NOTE: If vapor is visible or odors are noticed, advise ground personnel to stay clear of vapor if battery is still venting.

CAUTION: MAKE NO ATTEMPT TO DISCONNECT BATTERY PACK FROM THE AIRCRAFT’S ELECTRICAL SYSTEM USING QUICK DISCONNECT OR BY CUTTING THE BATTERY CABLES.

For additional information on recommended fire fighting procedures related to the lithium-ion batteries on the 787, please see data posted in the “Fire & Rescue” section at the following website: www.boeing.com/airports.
787 Flight Deck Control Switch locations

Critical switch locations and their operation are shown with the expanded views of the Control Modules.

- **Battery Switch** - Press
  - Note: ON symbol is removed

- **Thrust Levers** - Retarded

- **Fuel Control Switches** - Cutoff

- **APU Fire Switches** - Pull
  - (If not illuminated, push and hold the button under the switch to release)

- **Engine Fire Switches** - Pull
  - (If not illuminated, push and hold the button under the switch to release)
Recommended Cut Zones (outlined in green)

Areas not indicated contain structural elements that may include titanium which inhibits access.

Note: Body frames are a nominal 24” (61 cm) apart.
Contact Information

Additional questions regarding issues related to Aircraft Rescue and Fire Fighting (ARFF) and Boeing aircraft can be directed to the following:

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