

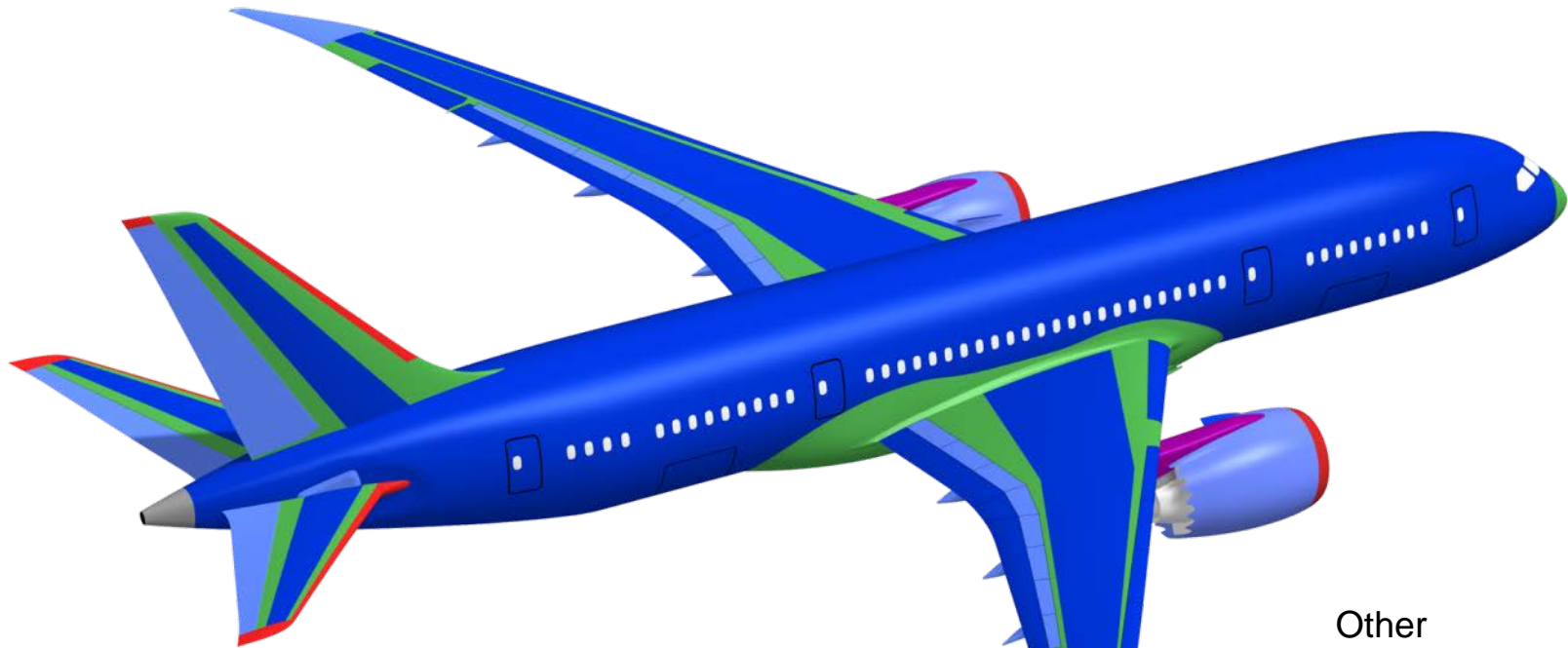


787 Aircraft Rescue & Firefighting Composite Structure April 2013

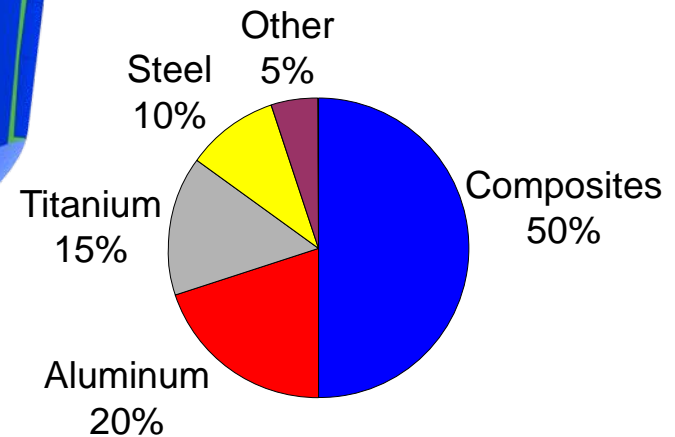
List of Effective Pages

Page	Effective	Remarks
1	Jun 2012	
2	Jun 2012	
3	Jun 2012	
4	Jun 2012	
5	Jun 2012	
6	Jun 2012	
7	Jun 2012	
8	Jun 2012	
9	Jun 2012	
10	Jun 2012	
11	Jun 2012	
12	Jun 2012	
13	Jun 2012	
14	Jun 2012	
15	Jun 2012	
16	Jun 2012	
17	Jun 2012	
18	Jun 2012	
19	Jun 2012	
20	Apr 2013	Updated battery location and enclosure.
21	Jun 2012	
22	Jun 2012	
23	Jun 2012	

Composite Structure Content of the 787



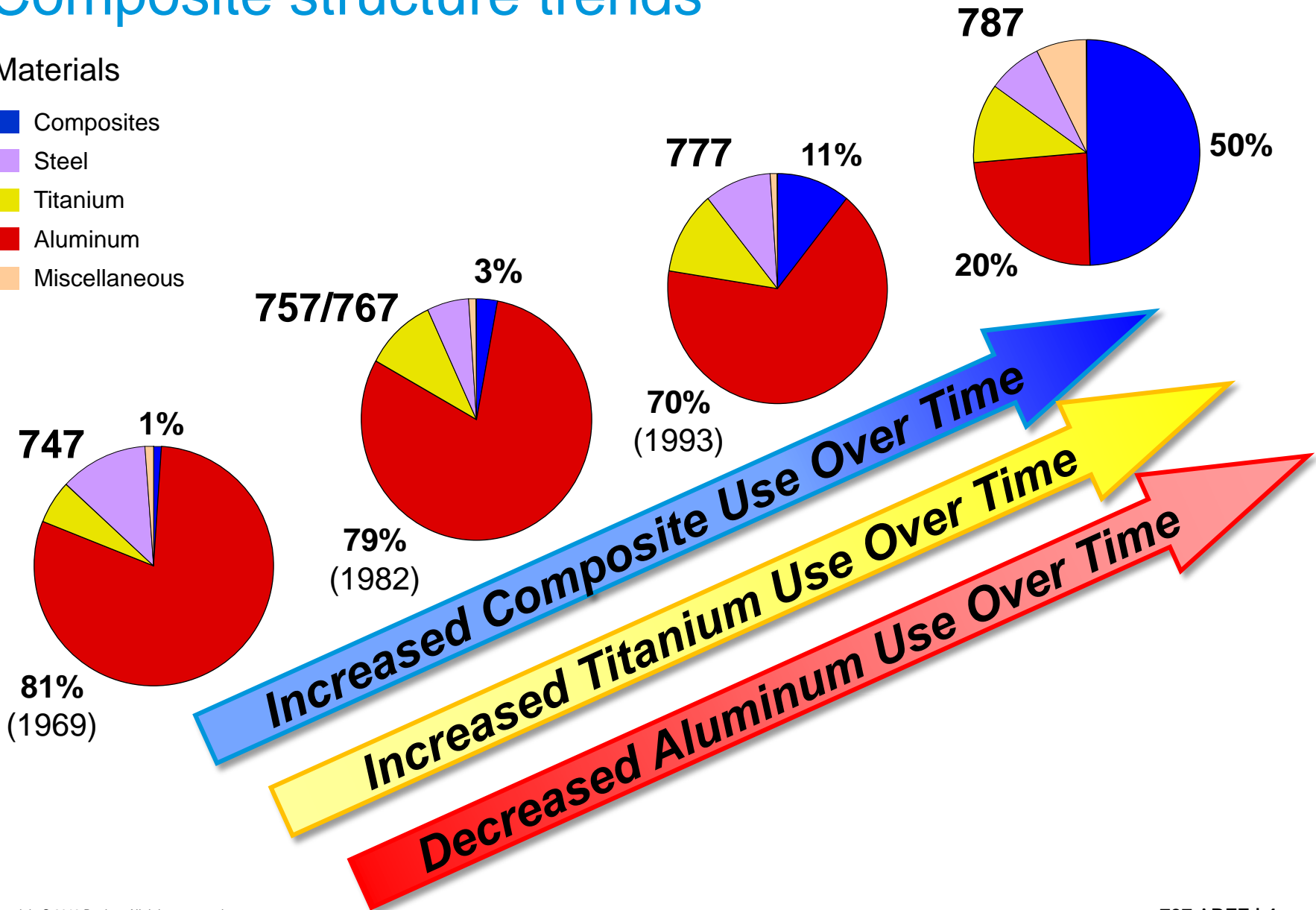
- Carbon laminate
- Carbon sandwich
- Other composites
- Aluminum
- Titanium



Commercial aircraft – Composite structure trends

Materials

- Composites
- Steel
- Titanium
- Aluminum
- Miscellaneous



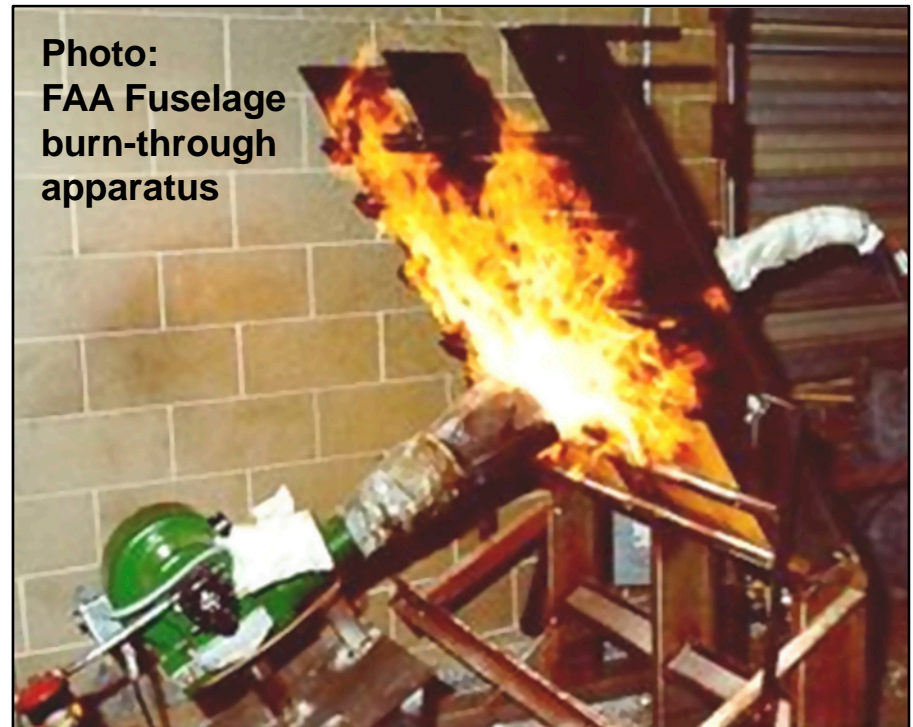
Questions posed by fire service providers

- 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.

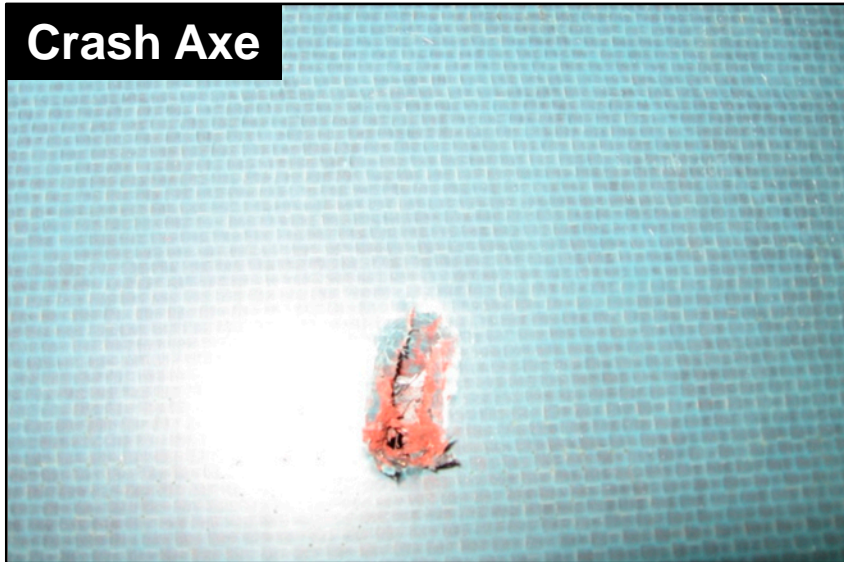
Can we cut through the fuselage?



We have done extensive testing with rotary saws (w/carbide tips and diamond tips) chain saws, air chisels and hand tools.



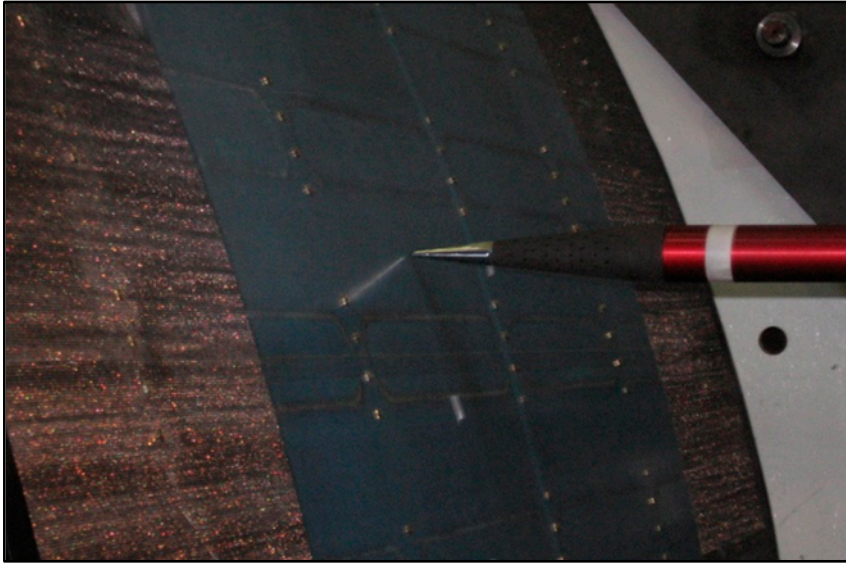
Do penetrating tools work with composite structure?



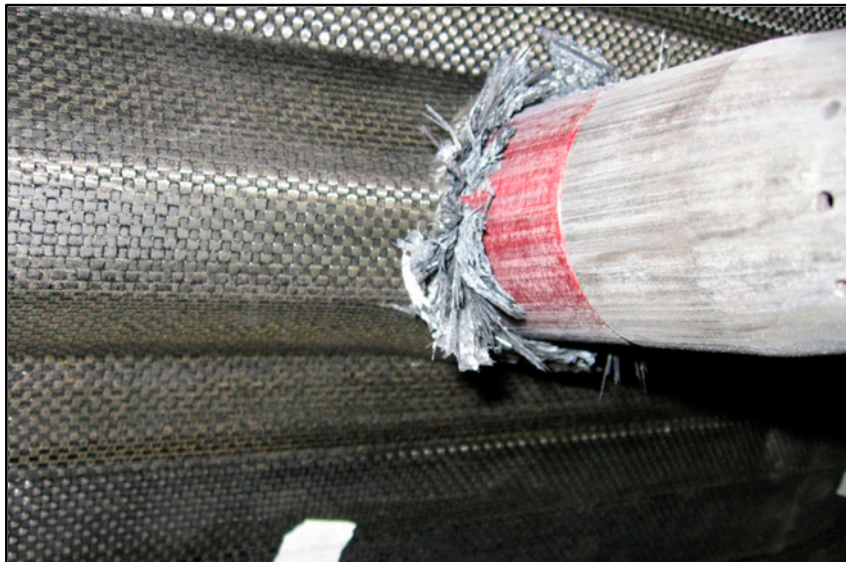
- The tip of a standard fire axe bounces back and will not easily penetrate the fuselage.
- We found that some hand tools could be driven through the fuselage with the help of a sledgehammer.



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.

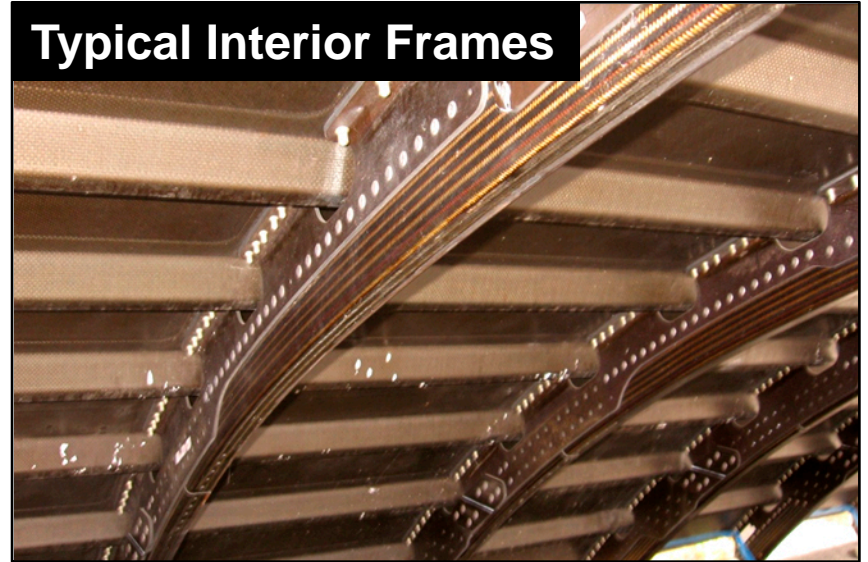


Interior views of possible cut areas

Interior Skin w/ Insulation Blankets



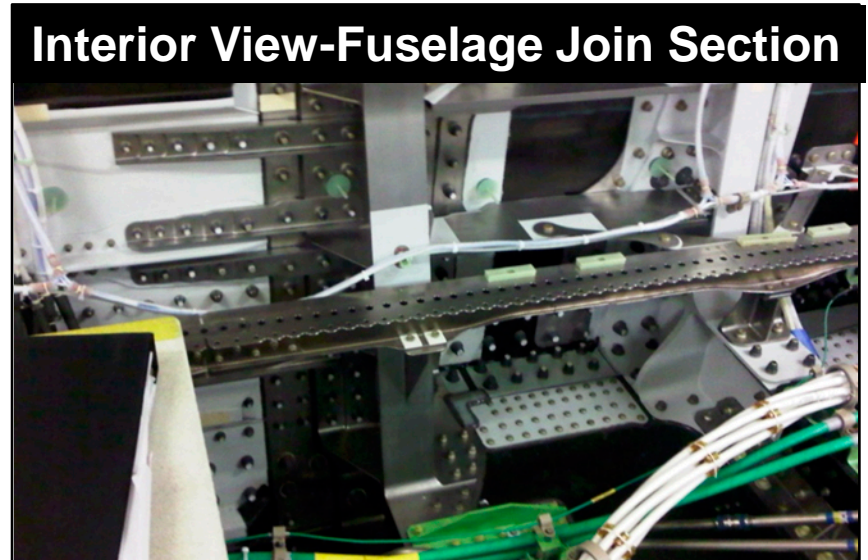
Typical Interior Frames



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.

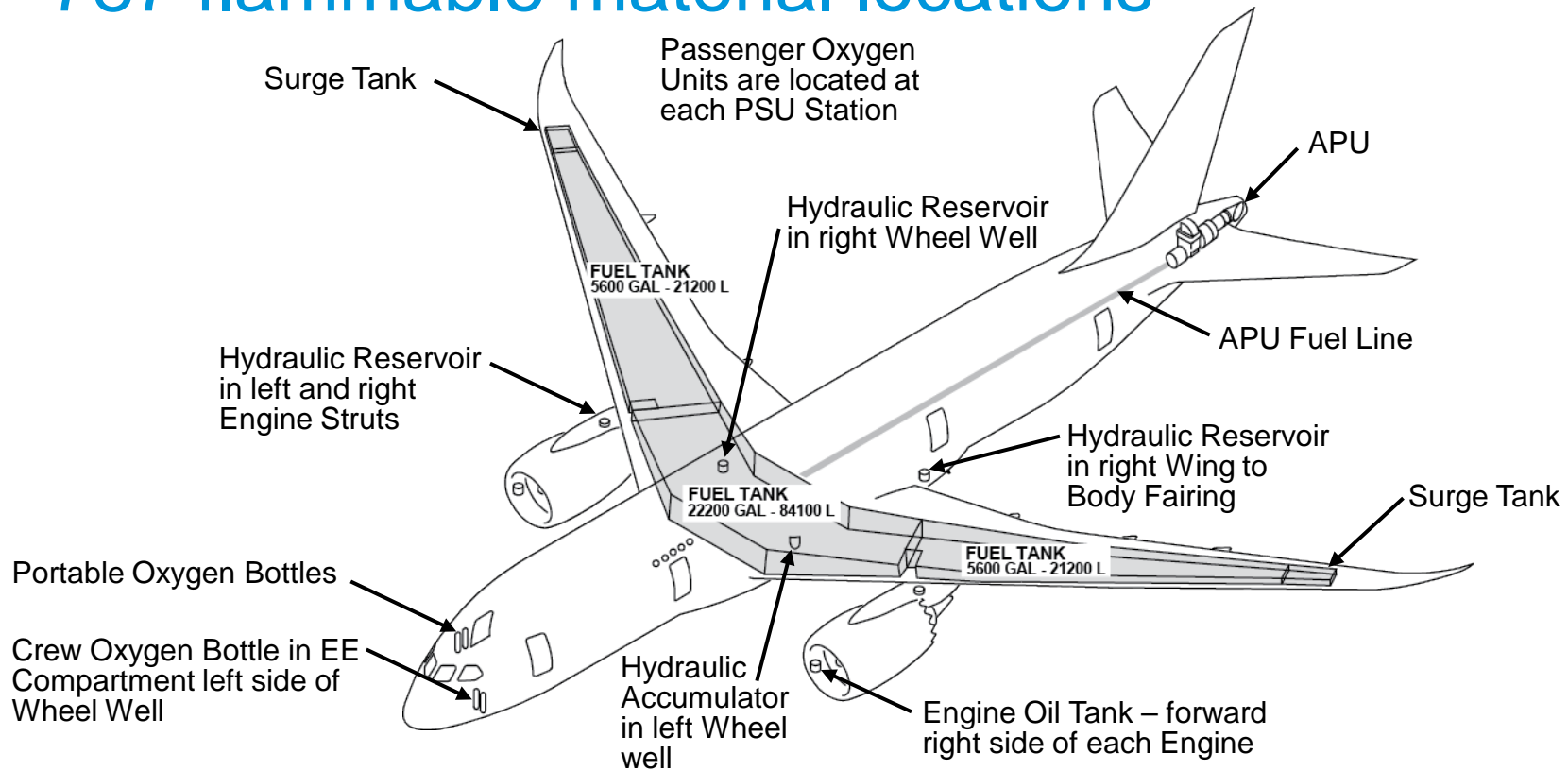
We concluded that by informing ARFF Crews of the outcomes of the tests via notes on the standard ARFF charts for aircraft built with composite skins, crews will be fully able to combat fire events if they occur.

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.

(None 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

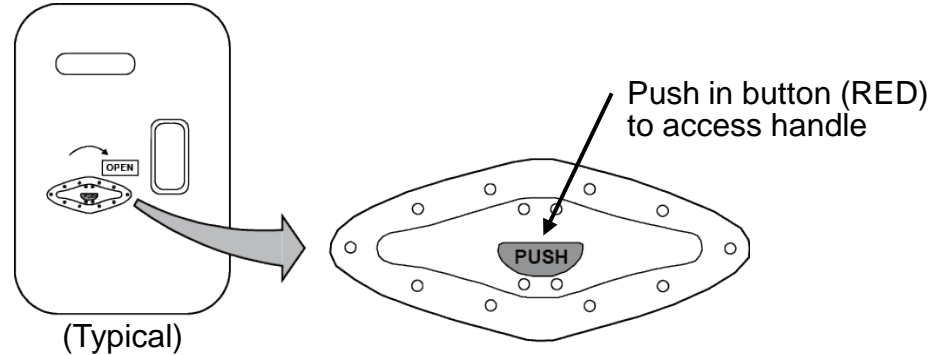
- Normal Cooling (move aircraft to suitable location and allow to cool on their own)
- Water Mist (can be deployed from turret or handline)
- Fans (placement of fans may place firefighters very close to the hazard zone)

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

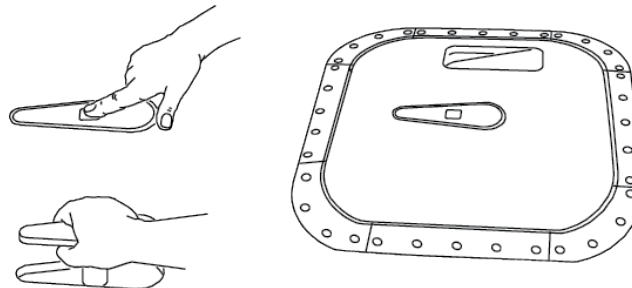
1. Entry/Service Door/Overwing Exit External Handle



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.

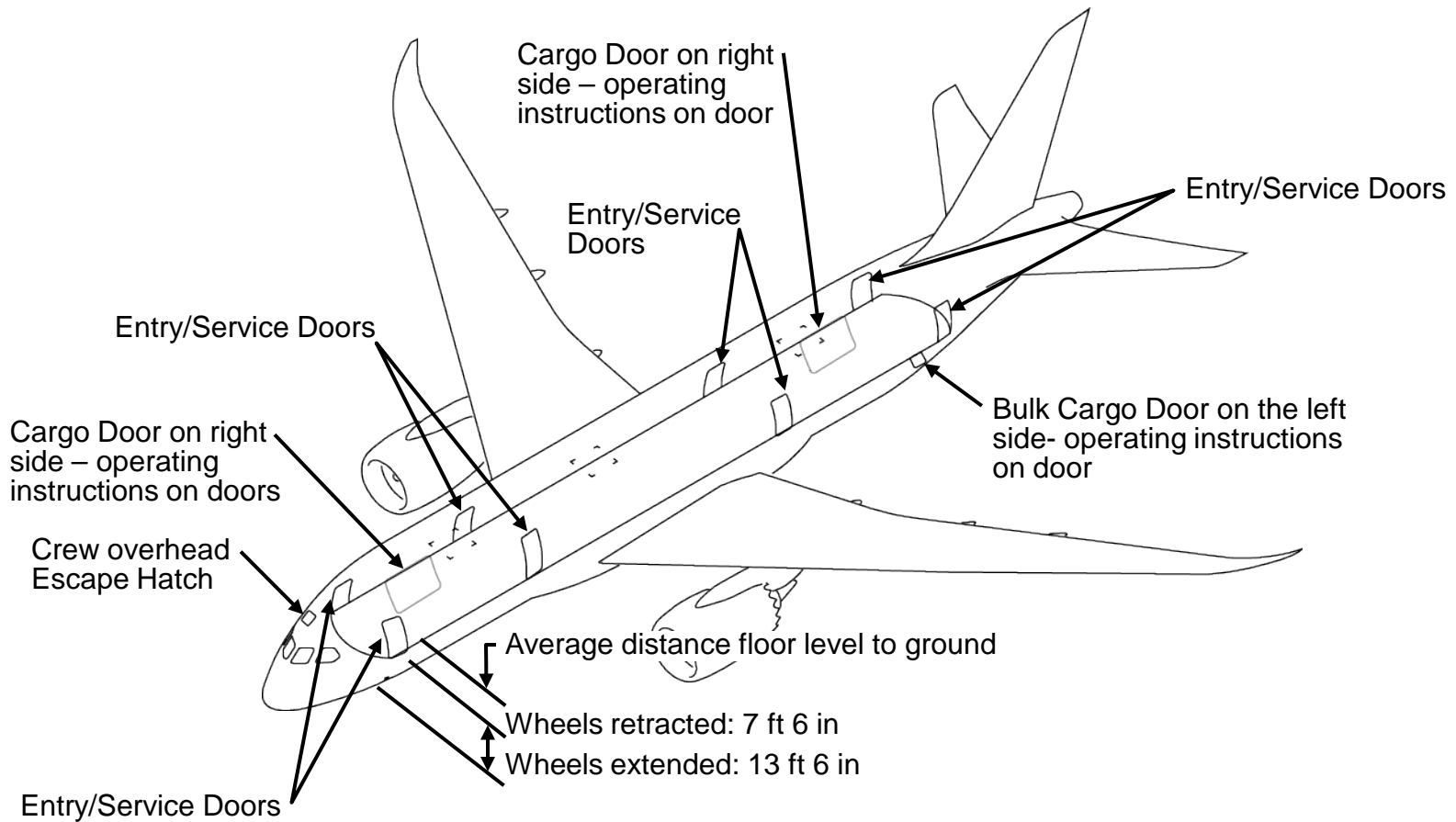
2. Crew Overhead Escape Hatch External Handle



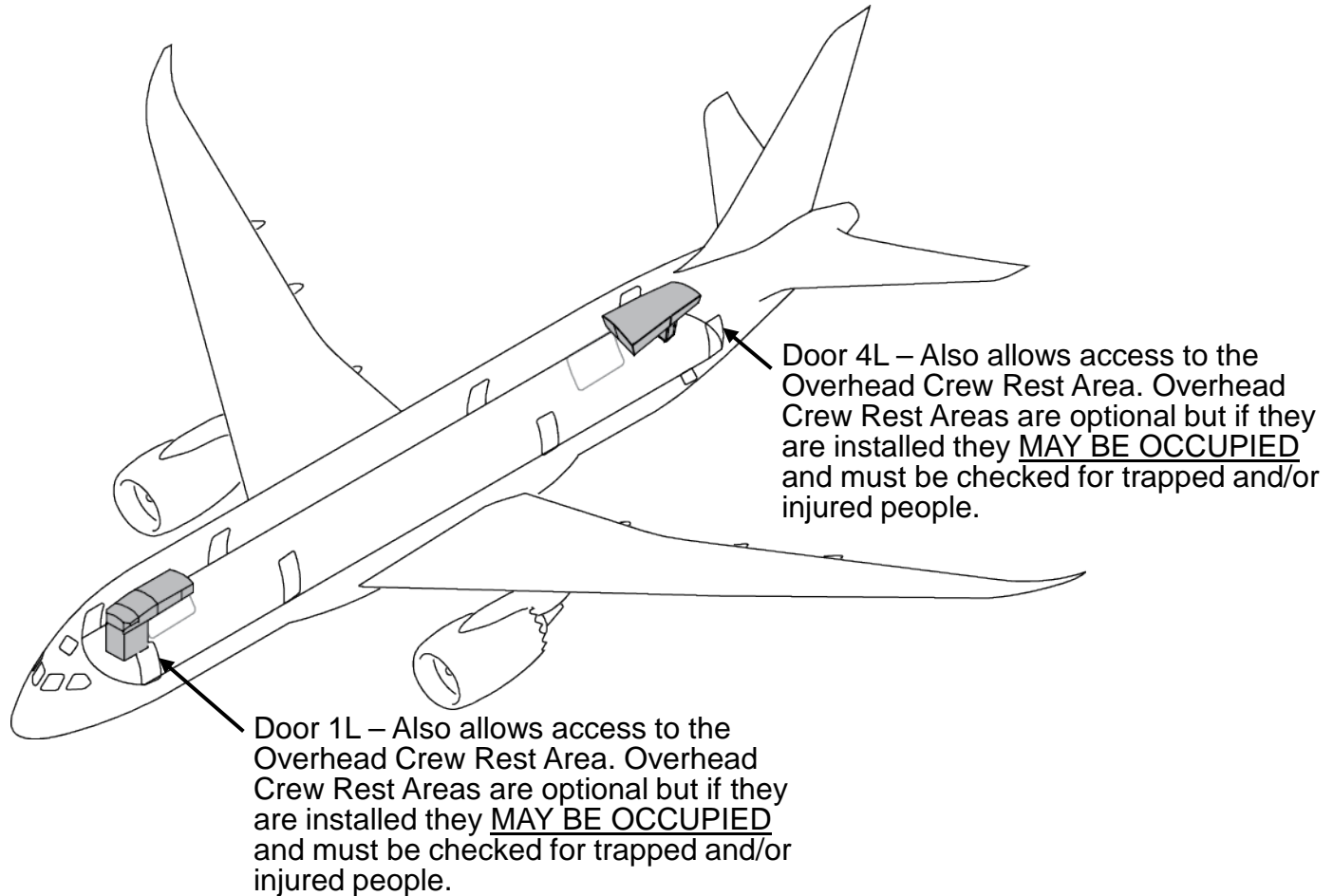
To open hatch:

1. Push release trigger on handle (handle will spring out from recess approximately 3 inches).
2. Rotate handle 180°.
3. Push hatch inward.

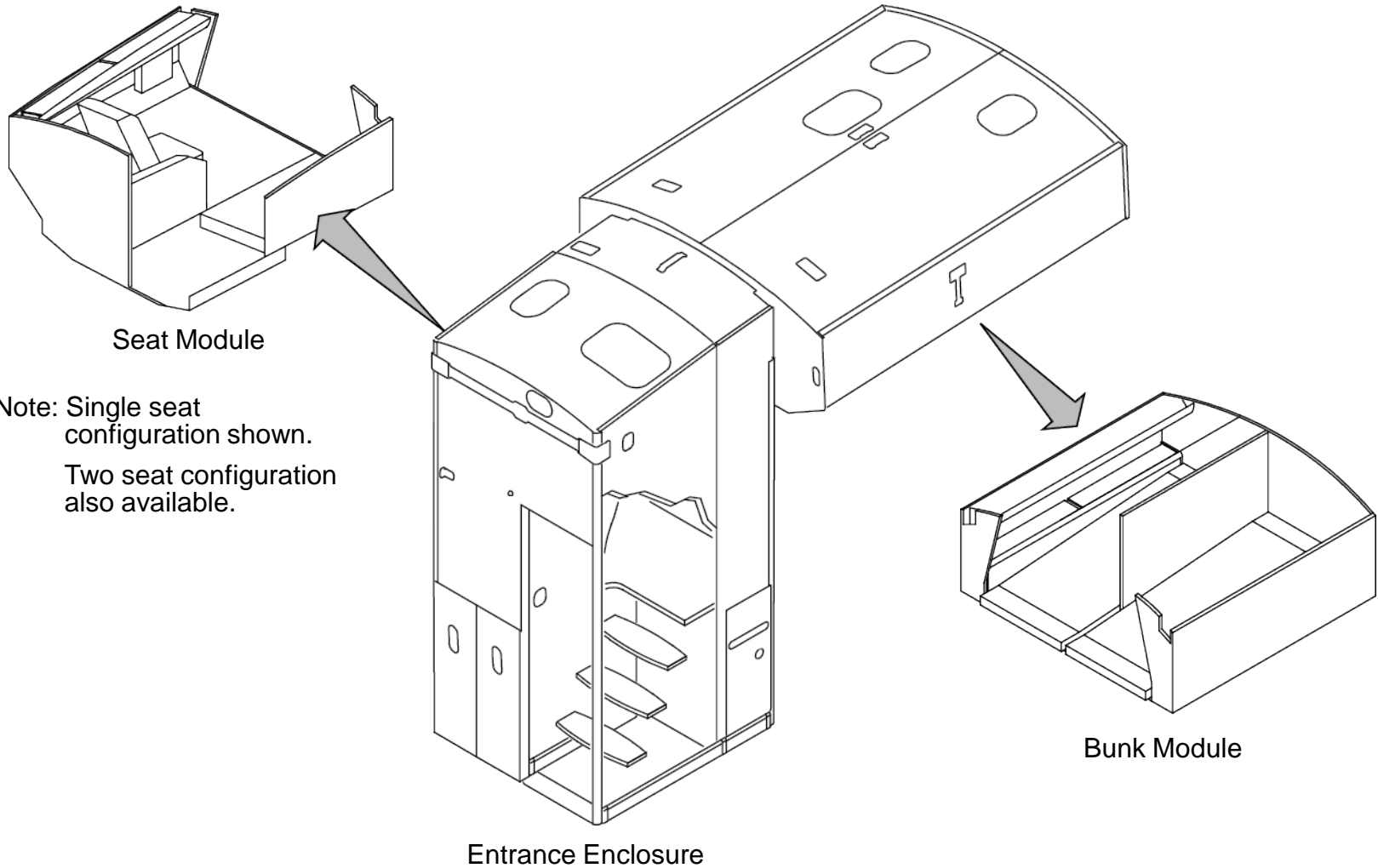
787 Emergency Rescue Access-2



787 Emergency Rescue Access-3



787 Emergency Rescue Access-4



Seat Module

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

Bunk Module

Entrance Enclosure

Forward Overhead Flight Crew Rest Area (Optional)

787 Battery Locations

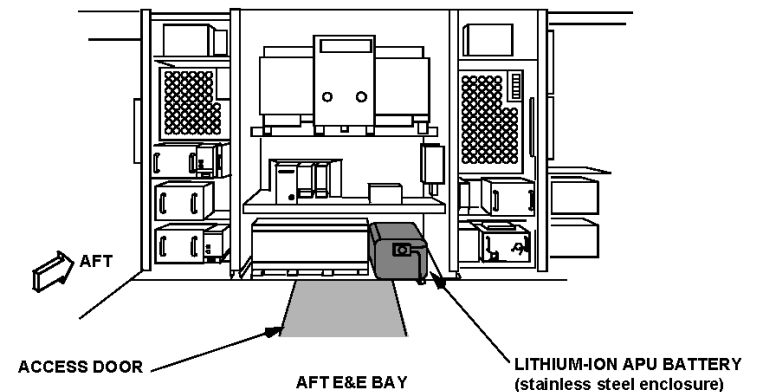
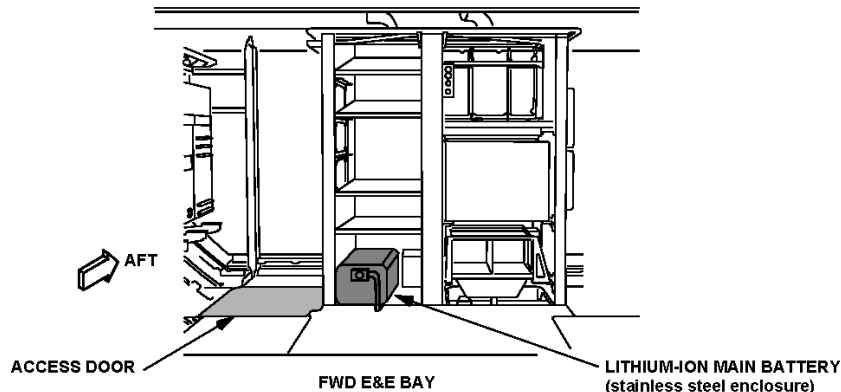
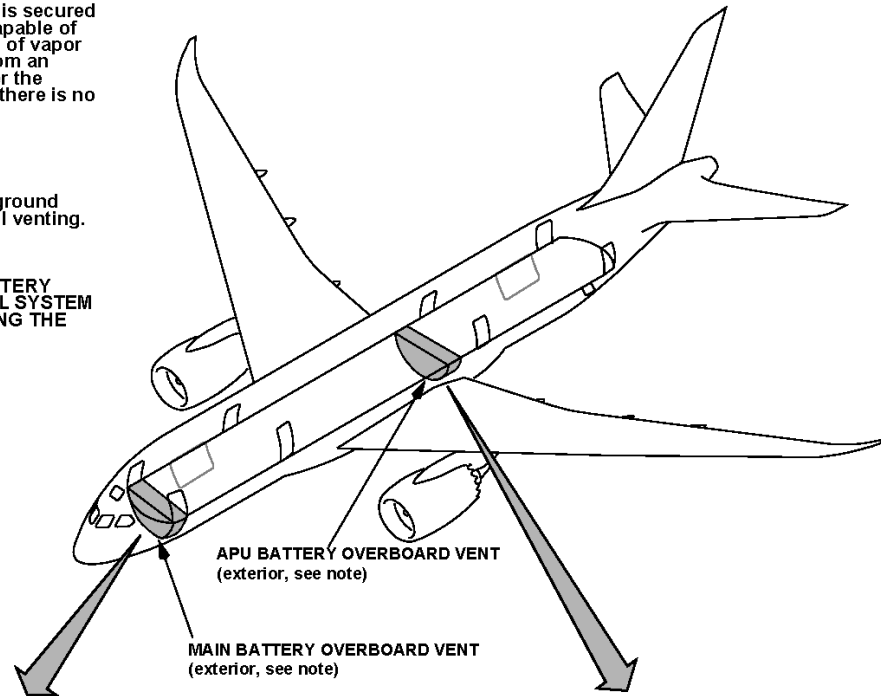
Lithium-ion Batteries

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.

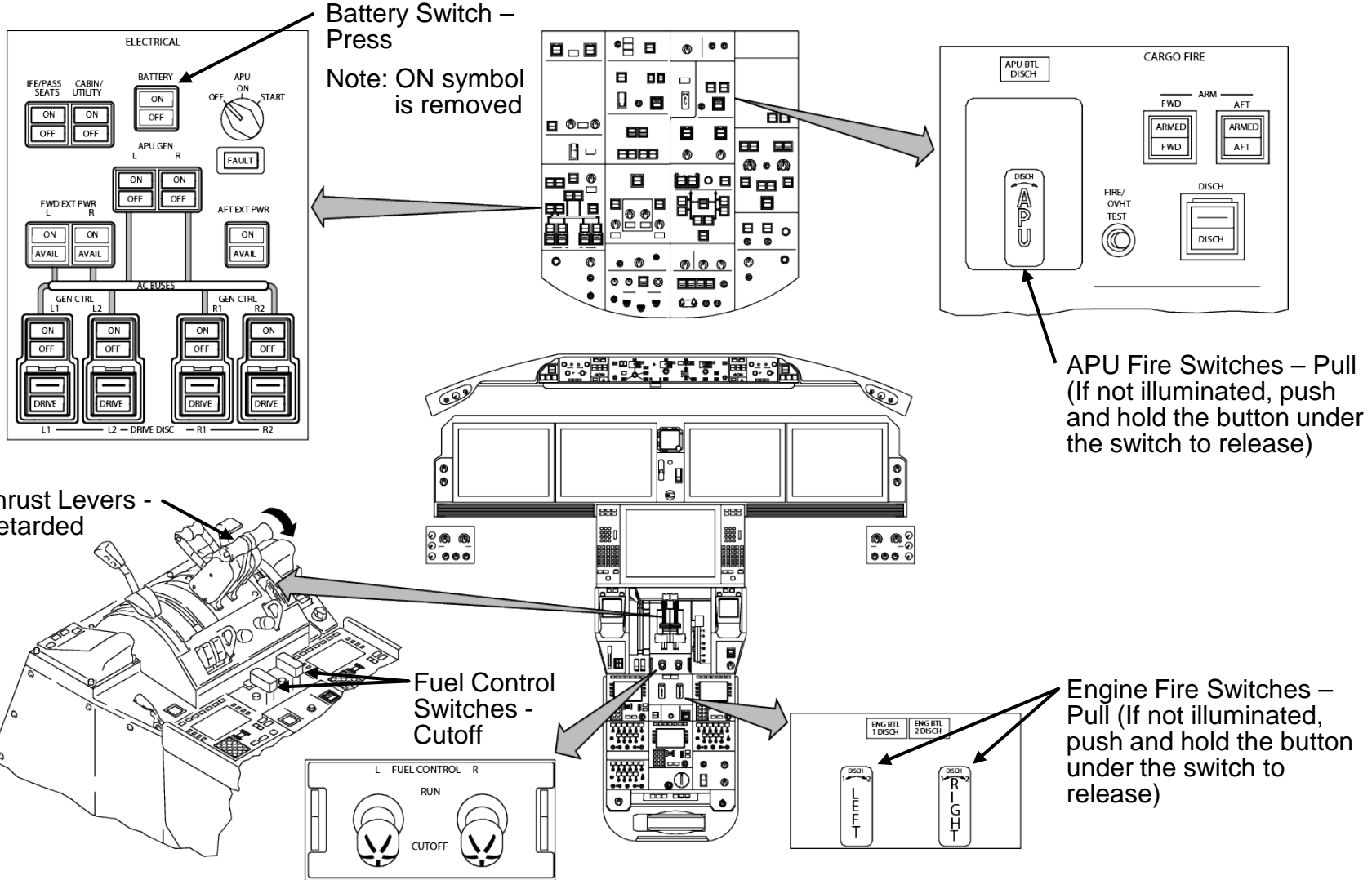
NOTE: The box containing the lithium-ion battery cells is secured inside a reinforced stainless steel enclosure capable of containing a lithium-ion battery event. Venting of vapor during a battery failure event may be visible from an exterior vent on the bottom of the aircraft under the forward or aft 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.

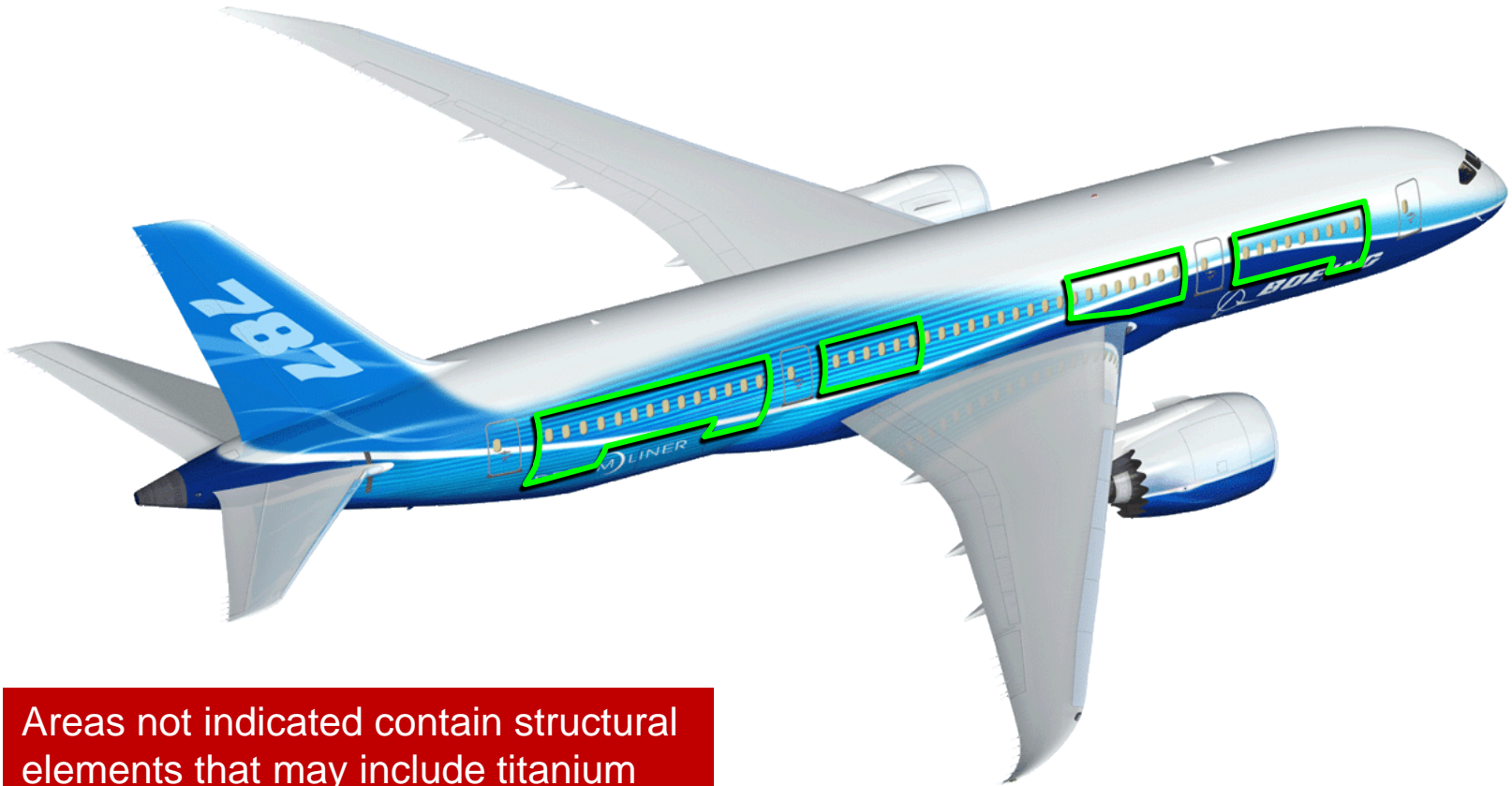


787 Flight Deck Control Switch locations



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

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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