Slide 1

Fuel Tank Maintenance & Safety

This fuel tank safety course will deal with inspections and preventions required to identify ignition sources of the design.

The reason for concern about Fuel Tank Safety
The proposal stemmed from the July 1995 TWA Flight 800 explosion over the Atlantic. The Boeing 747 broke apart after takeoff from New York, killing all 230 people aboard. Investigators believe a **wiring problem triggered a spark** that ignited fuel vapors in the jet's center tank.

In November 15, 2005 US airlines and aircraft manufacturers would have to equip more than 3,200 passenger jets with safety systems to reduce the potential of fuel tank fire or explosions, according to a Federal Aviation Administration
Maintenance training for the technicians is one of those safety features.

The maintenance of ignition prevention is necessary for the inherent safety and reliability of an aircraft's fuel tank system. The aircraft cannot be operated indefinitely with the failure of an ignition prevention feature. The failure will have a direct adverse effect on operational safety. The Fuel Tank Safety program will prevent catastrophic failure and allow safe flight and landing of the aircraft without serious or fatal injury to the occupants.

This fuel tank safety course will deal with inspections and preventions required to identify ignition sources of the design.

The failure of any of these design sources may not immediately result in an unsafe condition, but it may warrant certain maintenance to support continued airworthiness.

Note: A large percentage of the work involved in properly inspecting and modifying airplane fuel tanks and their systems this must be done in the inside of the tanks. Maintenance performed is the necessary tasks that requires inspection and maintenance personnel to physically enter the tank, where lots of environmental hazards exist. The potential hazards include **fire and explosion**, **toxic, irritating chemicals**, and **oxygen deficiency**, and the confined nature of the fuel tank itself. In order to prevent related injuries, technician and repair station maintenance organizations should have specific procedures for identifying, controlling, or eliminating the hazards associated with fuel-tank entry.

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Concepts of fuel tank safety

Your company should have specific guidelines or use OEM procedures for Fuel Tank Safety and Maintenance practices: The Maintenance technicians responsibilities are to make sure you understand the following:

•Original Aircraft Manufactures procedures for fuel tanks, if any (OEM)
•Conditions required for entry.
•Emergency response plan.
•Fuel tank exit procedures,
•Keeping a Clean working environment, and wearing Personal Protection Equipment (PPT)
•Foreign debris, Trash or objects (FOD)
•Configuration control for part removal and tagging
•Engineering configuration control for safe designs of aircraft fuel systems
•Wire separation rules, and bonding of components etc, minimum requirements should be per FAA AC 43-13 guidelines.

Slide 3

Fuel-Tank Hazards

The potential dangers that fuel-tank personnel may experience present themselves in one of two forms:
Chemical.
Physical.

CHEMICAL

The most commonly recognized hazard of fuel-tank work is the jet fuel itself. Jet fuel is a flammable liquid and can be ignited given certain ambient conditions, primarily temperature and vapor concentration. The temperature at which the vapors of a flammable liquid can ignite is known as the "flash point." A hazardous vapor concentration is present when a fuel vapor reaches a level known as the lower flammability limit (LFL) or lower explosive limit (LEL). These limits are usually expressed as a percentage by volume. Fuels below the LFL/LEL are considered too lean to burn.

If the fuel vapor concentration exceeds the upper flammability limit or upper explosive limit, the fuel is considered too rich to burn. A fuel vapor concentration between these two limits is considered to be in its flammable range and will ignite and burn if exposed to an ignition source. One of the best ways to control unwanted fires and explosions is to keep the fuel vapor concentration below the LFL/LEL, preventing it from reaching its flammable range

Other flammable chemicals may also be present during fuel-tank work. Chemicals with a low flash point (less than 70ºF (21ºC)), such as methyl ethyl ketone (MEK), are even more hazardous than jet fuel, and their use must be strictly controlled. Jet 5

PHYSICAL

The physical characteristics of the tank itself can create hazards and can also exacerbate fire, explosion, and toxicity hazards. Entry into most airplane fuel tanks is through an oblong hole less than (0.6 m) long and (0.3 m) wide. Though the interior dimensions of fuel tanks vary considerably, with the wing center tanks in wide body jets the largest, all fuel tanks have a limited volume. A relatively small amount of a chemical inside one of these enclosed spaces can create significant levels of flammable or toxic vapor.

Wing tanks usually have a single access hole between each rib section. The inboard portion of the wing tank offers just enough clearance inside of the tank for a maintenance person's head, shoulders, and trunk, leaving the legs outside of the access hole.

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Inspection of Wire and Components

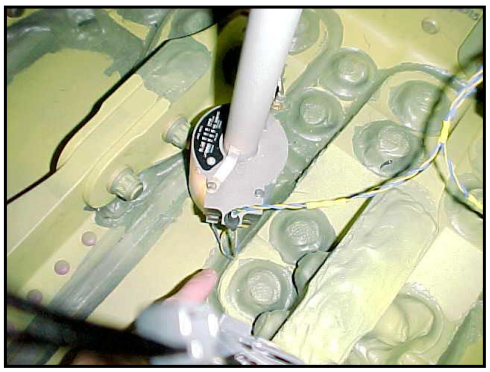
Why we inspect wiring for condition
A short circuit of the fuel-quantity-indication system wiring for fuel tank No. 7 on a Concorde.
Main-tenance personnel also found fire damage to an associated wire bundle in the wing/fuselage fairing area behind the main landing gear and below fuel tank.

Wire Inspection
Failures of the pump and its associated wiring that results in arcing within the fuel tank system were identified as one of the higher priority issues
The mechanics can recognize, interpret and handle by using the following guide lines:

Wiring should be inspected for:
•Cracks in the insulation
•To tight of bend raduis –raduis should be 10 times the wire diameter
•Kinks
•Broken wires
•Loose connections
•Bundle is to loose
•Chaffing, wire is rubbing the floor or brackets in the tanks
•Corrosion of bonds or connections

Slide 5

Wiring Installation Rules



GENERAL.

Wires and cables should be inspected for adequacy of support, protection, and general condition throughout. The desirable and undesirable features in aircraft wiring installations are listed below and indicate conditions that may or may not exist. Accordingly, aircraft wiring must be visually inspected for the following requirements:

CAUTION: For personal safety, and to avoid the possibility of fire, turn off all electrical power prior to starting an inspection of the aircraft electrical system in the fuel tanks or while performing maintenance inside the fuel tanks.

a. Wires and cables are supported by suitable clamps, grommets, or other devices at intervals of not more than 24 inches, except when contained in troughs, ducts, or conduits. The supporting devices should be of a suitable size and type, with the wires and cables held securely in place without damage to the insulation.
b. Metal stand-offs must be used to maintain clearance between wires and structure. Employing tape or tubing is not acceptable as an alternative to stand-offs for maintaining clearance.
c.. Wires and cables in junction boxes, panels, and bundles are properly supported and laced to provide proper grouping and routing.
d. Clamp retaining screws are properly secured so that the movement of wires and cables is restricted to the span between the points of support and not on soldered or mechanical connections at terminal posts or connectors.
e. Wire and cables are properly supported and bound so that there is no interference with other wires, cables, and equipment.
f. Wires and cables are adequately supported to prevent excessive movement in areas of high vibration..

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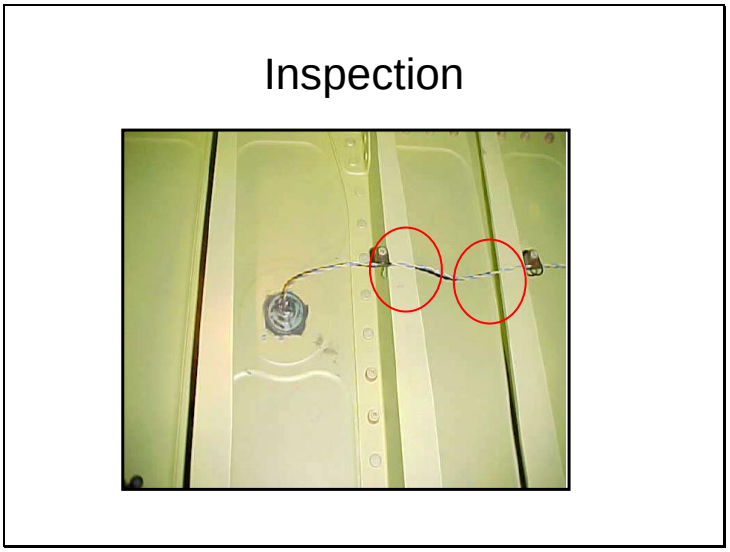
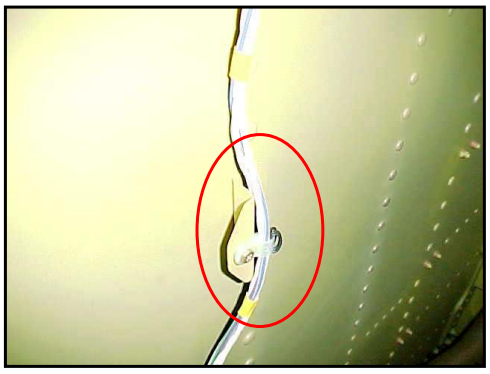


Inspection

In this picture we see chaffing and to loose of a wire

Slide 7

In-tank wiring problems



In this picture we see the wiring is rubbing against the bracket and wall of the tank

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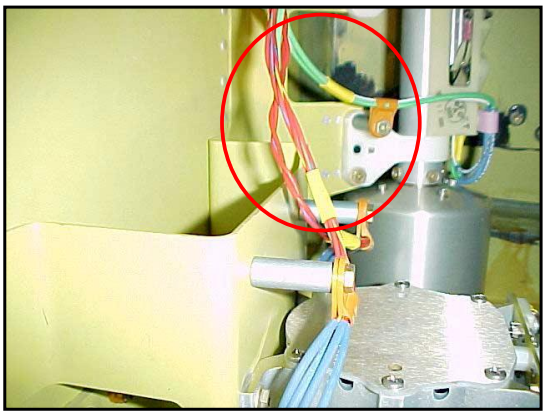
Fuel Tank Inspections - What to look for



Fuel Quantity Indicating System and fuel pump in-tank wiring problems discussed herein

- Missing, or loose sealant
- Debris, trash, tools (FOD)
- Damage to components
- Missing components, such as fuel pump inlet screens
- Missing or poorly installed bonding wire on tank plumbing
- Inappropriate faying surfaces (Consider spot-checking brackets for
•appropriate faying surfaces. Note bracket location, check drawing
•requirements later).

If you are inexperienced in what to look for, consider going in with someone more experienced in fuel tank inspections

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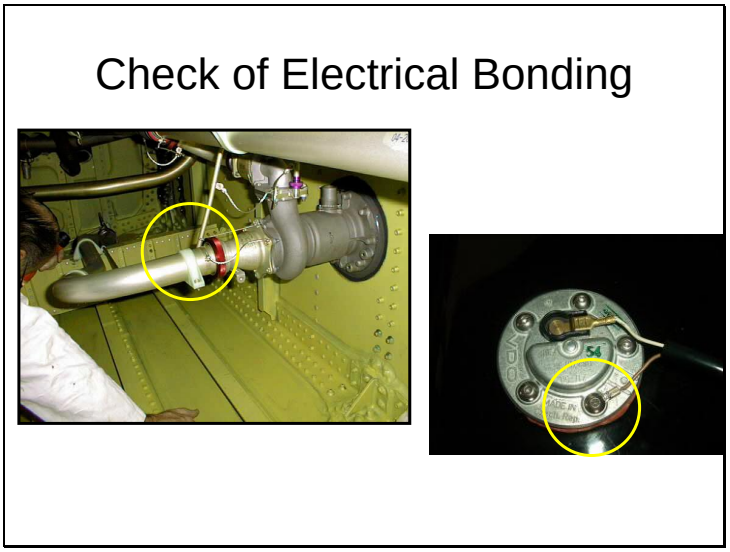


Check Electrical Bonding Straps or bonding points
Check straps for breaks and tightness of clamps
In the tank Small metallic objects within an aircraft fuel tank, that are not part of the tank structure, should be electrically bonded to the structure so as to dissipate static charges that may otherwise accumulate on these objects.

A practical bonding design would use a flexible braided jumper wire or riveted bracket. In such situations, a DC resistance of 1 ohm or less should indicate an adequate connection, your engineering department will have specified resistance values for each bonding

Slide 10

Entry and Exiting a Fuel Tank

Entry and Exiting a Fuel Tank

Never enter a tank without a portable gas detectors are used to monitor the oxygen and flammable vapor concentrations within the fuel tanks. Oxygen concentrations should be between 19.5 and 23.5 percent. Levels below 19.5 percent (PPM) are considered oxygen deficient, while levels above 23.5 percent will significantly increase the risk of fire and/or explosion. Monitoring these numbers is critical to the safety of the maintenancetechnican.

Several steps must be completed before a maintenance person enters an airplane fuel tank. These include electrically grounding and defueling the airplane according to standard practices, making adequate fire protection equipment readily available, and deactivating associated airplane systems, including fueling/defueling and fuel transfer systems.

Three final steps must be performed to ensure a safe atmosphere for maintenance personnel:

- Ensure adequate ventilation.
- Follow recommended ventilation techniques.
- Properly monitor air in fuel tanks.

They must be able to recognize potential hazards and evacuate the tank if working conditions deteriorate. Individually and together, the members of the fuel-tank entry crew must be aware of the following requirements for safe working conditions:

- Communication.
- Respiratory protection.
- Ventilation and air monitoring.
- Electrically powered equipment.
- Airplane damage considerations.

COMMUNICATION

Continuous voice communication should be maintained between entry personnel and the standby attendant throughout the entry process. Voice communication can be assisted by radio or electronic equipment, but these devices must be rated for use in potentially flammable (classified) atmospheres.

CONDITIONS

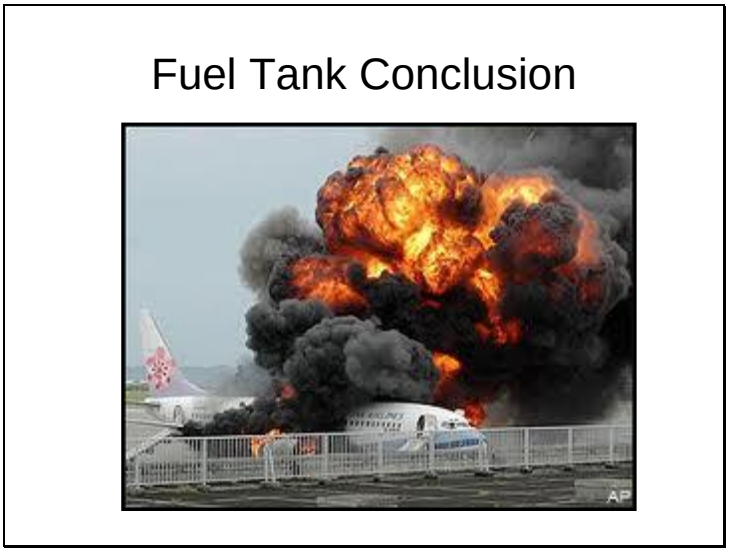
Fans and ducts can be used to purge the tank of fumes and keep fresh air moving in the tank. Always check the air concentration before entering a tank.

PPE is required:

- Tennis shoes are preferred when going into a tank, good grip and no nails in the heels for sparking
- An outer overalls cover made offering similar light weight protection suit.
- Safety Glasses or goggles
- Respirator - never wear one without proper training.
- Cameras, lights and flashlights used in the tanks should be explosion proof type rated.
- **Note: RESPIRATORY PROTECTION**
  Depending on the atmospheric hazards present, entry personnel may be required to wear respiratory protection. Air-purifying respirators can be used if the oxygen concentration is at least 19.5 percent. If the potential exists for oxygen depletion, or if chemical exposure levels are above the permissible exposure level (PEL), supplied-air respiratory protection may be required. In any situation, safety or industrial hygiene professionals should be consulted for specific recommendations.
- Tanks that are being accessed by standing on a ladder should have the area blowing fresh air into the openings and air quality PPM checks done.
- Same PPE is required.
- **Note: REMEMBER FLASH POINT**
  The minimum temperature at which the vapors of a flammable liquid will ignite

- When exiting a fuel tank remember to check for FOD!! And make sure no one else is left behind!!!

Slide 11



Fuel Tank Safety Conclusion
Make sure you are recording maintenance actions, removals, recording measures and results of inspections.
In this course we learned the following:
•The reason for Fuel Tank Safety – Airworthiness
•Maintenance technicians responsibilities –Follow the guidelines defined by your company or AC 43-13 for minimums
•PPE – Remember top use it
•Wiring Inspection
•Chaffing Inspections
•Bonding Inspections
•FOD Checks
•Component Inspections
•Entry and Exiting procedures