Center Tank Fuel Pumps

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Hydro-Aire Fuel Pumps

**Background**

- Two areas of concern were identified on Hydro-Aire fuel pumps installed on 737-600/-700/-800/-900 airplanes
  - Wire chafing
  - Localized overheating
- Two separate Airworthiness Directives issued
  - Both mandated similar operational restrictions
Background

Wire Chafing

- In August 2002, teardown of several failed Hydro-Aire fuel pumps indicated the potential existed for wires to come in contact with the rotor as a result of installation errors.
- Evidence of arcing due to chafed wires was discovered.
Background

Wire Chafing

Fuel Pump Cross-Section
Background

Wire Chafing
Background

Wire Chafing

• In response, the FAA released AD 2002-19-52 which mandated operational restrictions

• The AD provided terminating action
  – Inspection of pumps per Boeing or Hydro-Aire Service Bulletin required prior to installation
  – Once center tank fuel pumps inspected and found to be in compliance, the operational restrictions could be removed on an airplane-by-airplane basis
Background

Localized Overheating

- In October 2002, evidence of extreme localized overheating in the area of the primer impeller was found on several in-service fuel pumps.
- Further investigations indicated the potential for extreme over-temperature exposure outside the explosion proof chamber of the fuel pump existed.
Background

Localized Overheating
Background

Localized Overheating
Background

Localized Overheating

- The FAA released AD 2002-24-51 which reinstated the requirement to maintain minimum fuel levels to keep center fuel tank pump inlets covered
- No terminating action defined
Background

Alternative Method of Compliance (AMOC)

• In June 2003, the FAA issued Approval Letter 140S-03-189 to allow a “staged shutoff” following approved X-ray inspection of center tank fuel pumps
  – Allows all fuel in the center tank to be used

• A Flight Crew Operations Manual Bulletin was released to provide operating instructions
  – Either the AD procedures or the AMOC procedures to be used at the discretion of the airline
Design Improvements

Master Caution System

• Original Master Caution system logic requires both center tank fuel pumps to indicate low pressure before the Master Caution and FUEL annunciation illuminate.

• With the new system logic, a low pressure condition for either center tank fuel pump will illuminate the Master Caution and FUEL annunciation.
Design Improvements

Automatic Shutoff

• A center tank fuel pump is automatically shut off after approximately 15 seconds of continuous low pressure
  – No indication to the flight crew

• Considered a backup to normal flight crew actions

• If fuel remains in the center tank, the system can be reset by turning the fuel pump switch OFF, then ON
Design Improvements

CONFIG Alert

• In the original design, the alert is displayed if the center fuel tank contains more than 1600 pounds/726 kilograms of fuel and both center tank pumps are producing low or no pressure.

• In the new design, the alert will be displayed if the center tank contains more than 1600 pounds/726 kilograms of fuel and both center tank pumps are OFF.
During climb, position both center tank fuel pump switches OFF when one center tank fuel pump LOW PRESSURE light illuminates.

When established in a level attitude at cruise, if the center tank contains usable fuel and the center tank fuel pump switches are OFF, position the center tank fuel pump switches ON again.

Position both center tank fuel pump switches OFF when the center fuel tank is empty as indicated by the fuel quantity gauge.
FAA Action

- Boeing has proposed the Master Caution system logic change and center tank fuel pump automatic shutoff feature as terminating action for AD 2002-24-51
- Boeing believes the FAA will mandate these changes and propose a 36-month compliance time after release of the Service Bulletin
- FAA decision is imminent
Design Improvements

Availability – 737 NG

- All three design changes will be available in production in May 2004 (Line Number 1494 and on)
- Available via Service Bulletin in 4th Qtr 2004
Design Improvements

Availability – 737-200 through -500

- Master Caution system logic change will be available via Service Bulletin in 4\textsuperscript{th} Qtr 2004
- Automatic shutoff feature will be available via Service Bulletin in 3\textsuperscript{th} Qtr 2005
Design Improvements

Future Design Features

• Wire retention system
  – Prevents wires from contacting rotor due to installation errors
  – Scheduled to be available in 2nd Qtr 2005
  – Boeing is proposing this change as terminating action for AD 2002-19-52

• Replacement fuel pump
  – Scheduled to be available in 24 to 36 months