T-6B Fuel System
Objectives

• Identify main sections and components of the fuel system
• Understand normal operation of the fuel system
• Identify and understand fuel quantity and balancing system

(Utilize fuel system schematic while reviewing this slideshow)
References

• T-6B NATOPS Manual
  • Section 1
    • Fuel Supply System
  
• Section 5
  • Figure 5-1 Instrument Markings
  • Fuel Limitations
    • Fuel Type
    • Fuel Icing Inhibitor
    • Fuel Quantity Limitations
    • Fuel Imbalance
    • Fuel Pump Suction Feed Limitations
Fuel System Overview

- 3 Fuel Tanks (1 in each wing & collector tank)
- Refueled via single-point or over-wing
- Fuel transferred and moved by jet pumps utilizing motive flow lines
- Fuel pressure increased through use of electric boost pump/engine driven low pressure pump/engine driven high pressure pump
- Fuel tanks are balance through an automatic system
- Fuel indicating and auto-balancing system handled by the Engine Data Manager (EDM) computer
Fuel Tanks

- 3 fuel tanks located in wing (left wing tank/collector tank/right wing tank)
  - Wing tanks only feed to collector tank (not from one wing to other wing)
  - Collector tank feeds to engine
  - Fuel outboard in wing will gravity feed to inboard part of wing for pickup
  - Wing tanks have vents & cross vent line to prevent spillage & vacuum in tank

- Fuel Load
  - Single-point refueling: 1100# total – 530# in each wing/40# in collector
  - Over-wing refueling: 1200# total – 580# in each wing/40# in collector

- Fuel Type
  - Fuel must contain a fuel system icing inhibitor/fungicide

- Refueling Methods
  - Over-Wing
    - Gives 100# more gas
    - Fills individual tanks by gravity feed through filler cap on each wing (wings gravity into collector)
    - Ensure cap is seated with arrow forward and tab folding to back
  - Single-point
    - Primary method of refueling
    - Fills all tanks simultaneously
    - Pre-check valves test shutoff system in tank – lifting simulates full tank and fuel refilling stops

- S.P. – 530#/40#/530#
- O.W. – 580#/40#/580#
- EICAS fuel indicator 150#
Fuel Transfer

- **Motive Flow Line**
  - Taps fuel flow line right after engine driven low-pressure fuel pump
  - Fuel flow/pressure used to drive fuel pick-up & transfer system via primary jet pump & jet transfer pumps

- **Low Pressure Switch**
  - Senses when less than 10 psi in motive flow line
  - Activates FUEL PX CAS warning
  - Activates electric boost pump and illuminates a BOOST PUMP CAS advisory to increase pressure in line

- **Transfer Valves**
  - One valve for each wing tank
  - Shuts off motive flow when closed thus stopping fuel transfer
  - Controlled by auto-balance system or MANUAL FUEL BAL switch on Right Forward Switch Panel

- **Jet Transfer Pumps**
  - 2 per each wing tank
  - Uses Venturi effect (by motive flow lines) to suck fuel from tank and transfer to collector tank
  - Fuel should still gravity feed if motive flow stopped
Fuel Feed to Engine
(Primary Jet Pump)

- Uses same concept as jet transfer pumps
- Powered from motive flow line
- Fuel pickup valve to jet pump has weighted rod that allows fuel pickup from bottom or top of collector tank (flip-flop valve)
- Flip-flop valve provides a minimum of 15 seconds of fuel regardless of orientation
- Manifold Valve
  - Directs fuel from primary jet pump or electric boost pump to main fuel line
Fuel Feed to Engine
(Electric Boost Pump)

- Serves as backup to the engine-driven low pressure fuel pump
- Engine can run if boost pump fails/inoperative
- Merges fuel (with primary jet pump) at manifold valve in collector tank
- A **BOOST PUMP** CAS advisory illuminates any time the electric boost pump is activated
- **BOOST PUMP** Switch on Right Forward Switch Panel (both cockpits)
  - ARM - Boost pump activated by:
    - Starter (regardless of fuel pressure)
    - Low-pressure switch
    - PMU (when pull PCL to idle)
  - ON – Boost pump hard selected on
Fuel Feed to Engine (Refueling Access Bay)

- **Maintenance Shutoff Valve**
  - Isolates the fuel system for engine or fuel filter maintenance

- **Fuel Filter**
  - Filters fuel prior to going to engine driven pumps and engine
  - Bypass indicator “pops” out to indicate filter is being bypassed
Fuel Feed to Engine (Refueling Access Bay)

- **Firewall Shutoff Valve**
  - Controlled by Firewall Shutoff Handle (front cockpit only)
  - Handle lifts vertically and has clip to hold down in place
  - Used during emergency to cut off fuel from going fwd of firewall
  - Valve in left side, single point refueling bay

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**Motive Flow Line**

- <10 psi
- Turns on Boost Pump

**Transfer Jet Pump**

**Primary Jet Pump & Flip Flop Valve (15 sec inverted)**

**Manifold Valve**

**Electric Boost Pump**

**Transfer Valve**

**Firewall Shutoff Valve**

- Controlled by Firewall Shutoff Handle (front cockpit only)
- Handle lifts vertically and has clip to hold down in place
- Used during emergency to cut off fuel from going fwd of firewall
- Valve in left side, single point refueling bay
Fuel Feed to Engine (Engine-Driven Low Pressure Pump)

- Increases fuel pressure in line to feed engine-driven high pressure pump
- Engine can continue to operate without low pressure pump
- Shares a common shaft in accessory compartment with external oil scavenge pump
- Motive flow line pulls fuel immediately after pump (can indicate problems with low pressure pump)
• Increases fuel pressure in line to feed Fuel Management Unit (FMU)

• Engine will not operate without high pressure pump

• Purge line returns unused fuel to collector tank

• Operation using only the high pressure pump (without both the electric boost pump and low pressure pump) is limited to 10 hours
- **FMU**
  - Receives inputs from PCL via cable or via PMU
  - Schedules fuel into engine fuel manifold

- **Fuel Flow Transmitter**
  - Senses fuel flow in line to engine
  - Sends indications to EICAS display
  - Reading in pounds per hour (PPH)

**Fuel Feed to Engine**

- **Lt Wing Tank**
- **Collector Tank**
- **Rt Wing Tank**

**Fuel Management Unit (FMU)**

**Fuel Flow Display**

- **Firewall**
- **Generator**
- **PCL Cable**

**Fuel Flow Display**

- **Oil Tank**

**Fuel Management Unit (FMU)**

- **Firewall Shutoff Valve**
- **Fuel Filter**
- **Mx Shutoff Valve**

**Motive Flow Line**

- **<10 psi**
- **Turns on Boost Pump**

**Purge Line**

**Low Press Switch**

- **FUEL PX**
- **<15 psi**
- **Pumps on Boost Pump**

**Electric Boost Pump**

**Transfer Valve**

**FUEL PX**

**Manifold Valve**

**Transfer Jet Pump**

**Fuel Filter**

- **Mx Shutoff Valve**

**Engine Driven Lo-Press Pump**

**Fuel Feed to Engine**

- **FF Transmitter**
- **EICAS**

**EICAS fuel indicator**

- **150#**

**Primary Jet Pump & Flip Flap Valve**

- **(15 sec Inverted)**

**Mx Shutoff Valve**

**To Engine**

**FMU**

- **Via cable**
- **Via PMU**

**FMU**

- **PCL**

**Fuel Flow Display**

- **TOTAL 10391.85**
- **FF 165 PPH**
- **IOAT 24 °C**
- **+9 AMPS**
- **28.2 VOLTS**
- **CPALT 1500 FT**
- **Δ P 0.0 PSI**

**Fuel Management Unit** (FMU)
- **Fuel Manifold**
  - Receives fuel and distributes to all the fuel nozzles

- **Fuel Nozzles**
  - Deliver fuel into combustion section
  - Two spray patterns from nozzles: start fuel (mist) / sustainment (stream)
Fuel Quantity Indicating System

- Fuel quantity and balancing systems handled through Engine Data Manager (EDM) computer which sends info to EICAS

- Fuel quantity measured by 7 Fuel Probes (FP)
  - 3 probes in each tank (Outer/Middle/Inner)
  - 1 probe in collector

- Operation
  - Collector tank divides capacity equally between left/right fuel tank readings
  - Each probe senses fuel for given range as fuel quantity decreases
    * Outer probe reads fuel until approx. 445 ± 50#
    * Middle probe reads fuel until approx. 308 ± 50#
    * Inner probe reads fuel until approx. 20#
  - FP failure
    * Illuminates an FP FAIL caution message on CAS
    * Kicks off the auto-balance system illuminating a FUEL BAL caution
    * Low level optical sensors (110#) still work

Probes
- 7 fuel quantity probes (3/1/3)
  - 445 ± 50# (outer probe)
  - 308 ± 50# (middle probe)
  - Until approx. 20# (inner probe)
- Collector divides capacity equally between lt/rt
- FP FAIL if a probe fails and shuts off auto-balance
- 2 Low level sensors (1 per wing tank)
- Optical sensors - separate from fuel quantity probes
- L/R FUEL LO on CAS indicates <100 lbs in tank
**Fuel Quantity Indicating System**

- **Fuel Low Level Sensor**
  - Optical sensor in each tank
  - Independent of FP & quantity gauge
  - Illuminates an L FUEL LO or R FUEL LO caution message on CAS
  - Indicates fuel quantity below 110# in tank

- **Fuel Quantity Indicator**
  - On EICAS environmental area
  - Fuel bar for each tank & totalizer
  - Fuel bar and total turns yellow at 150#
  - Aerobatics are prohibited with indications below 150# per side

- **BINGO**
  - Pilot-selectable “BINGO, BINGO” audio alert
  - Set value through UFCP (0 to 1200)
  - Audio alert activates when totalizer reaches set value
  - Must reset value to less than total fuel onboard to silence audio alert
  - Default value is 400#

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**Probes**
- 7 fuel quantity probes (3/1/3)
- -45 ± 50# (outer probe)
- -30± ± 50# (middle probe)
- -Until approx. 20# (inner probe)
- -Collector divides capacity equally between lt/rt
- -FP FAIL if a probe fails and shuts off auto-balance
- -2 Low level sensors (1 per wing tank)
- -Optical sensors - separate from fuel quantity probes
- -L/R FUEL LO on CAS indicates <100 lbs in tank

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**Fuel Probes**
- Transfer Valve
- Middle FP
- Vent Line
- Inner FP
- Lt Wing Tank
- Collector Tank
- Fuel Quantity Indicating System
- • Fuel Low Level Sensor
  - Optical sensor in each tank
  - Independent of FP & quantity gauge
  - Illuminates an L FUEL LO or R FUEL LO caution message on CAS
  - Indicates fuel quantity below 110# in tank
- • Fuel Quantity Indicator
  - On EICAS environmental area
  - Fuel bar for each tank & totalizer
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  - Audio alert activates when totalizer reaches set value
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  - Default value is 400#
Fuel Balancing System

• Fuel quantity and balancing systems handled through Engine Data Manager (EDM) computer which sends info to EICAS

• Operation
  • Keeps fuel level in tanks within 20# of each other
  • Maximum lateral fuel imbalance is 50#
  • EDM begins auto-balance when senses imbalance of 20# (or more) for 30 seconds
  • Transfer valve closes to lighter tank shutting off transfer jet pumps
  • If fuel imbalance is not reduced to less than 30# in 2 minutes:
    • Auto-balance system will shut off
    • A FUEL BAL caution message on CAS illuminates
  • Reset auto-balance system by selecting RESET then back to AUTO on FUEL BAL switch

• Controls
  • Located on Right Forward Switch Panel (front cockpit only)
  • FUEL BAL Switch:
    • AUTO – Auto-balance system selected
    • MAN/RESET – Reset auto-balance system/select manual balancing of system
    • Selecting MAN will illuminate a M FUEL BAL CAS advisory light
  • MANUAL FUEL BAL Switch:
    • L/R – Turns off respective transfer valve (stops transfer)
    • OFF – Both transfer valves open
    • Switch active when MAN selected on FUEL BAL switch
Conclusion

- Identified main sections & components of fuel system
- Discussed operation of fuel system
- Discussed operation of fuel quantity and indicating system
- Discussed operation of fuel balancing system

Abnormal Fuel Scenarios located in Procedures Section/EPs