Pratt and Whitney JT15D-4 Engine
Engine Oil System

- **TO BEARINGS 1, 2, 3**
- **RESERVOIR**
- **GRAVITY FEED TO GEAR BOX**
- **PRESSURE ELEMENT**
- **PRESSURE RELIEF VALVE**
- **OIL COOLER**
- **OIL FILTER**
- **SCAVENGE ELEMENTS**
- **BEARING 4**
- **SYSTEM DRAIN**
- **TO BEARINGS 1, 2, 3**
- **TO BEARINGS 3½ AND 4**

**Engine Oil System Diagram**

- **L OIL PRESS LO**
- **OIL PRESS WARN**
- **LH RH**

**Pressure and Temperature Indicators**

- **SUPPLY**
- **PUMP PRESSURE**
- **RETURN**
Fuel Control System

- **Engine Driven Pump**
- **Fuel Control Unit**
- **Fuel Flow**
- **Oil Cooler**
- **Fuel Div.**
- **Fuel Nozzles**
- **Bleed Air**
- **Automatic Fuel Shutoff**
- **Control**
- ** Shut-off**
- **Ignition**
- **Step Modulator**
- **Flow Meter**
- **Motive Flow to Fuel Tank**
- **Motive Flow Valve**
- **From Fuel Tank**

**Diagram Description:**
- Fuel flows from the engine-driven pump to the fuel control unit.
- From the fuel control unit, it goes to the fuel flow meter.
- The fuel then flows to the oil cooler and then to the fuel div.
- From the fuel div., it goes to the fuel nozzles.
- Bleed air is controlled to shut-off the fuel flow.
- The motive flow valve controls the motive flow to the fuel tank.

**Note:**
- This diagram is for training only and is not for public distribution.
- The diagram was last updated in June 1997.

**SimuFlite**

- **Citation I/II/SII**
- For training only
Two Pratt & Whitney of Canada JT15D engines power the Cessna Citation aircraft. The JT15D is a lightweight, two-spool, medium bypass turbofan that produces between 2,200 and 2,550 lbs of static takeoff thrust at sea level (see Table 4K-1).

After air enters the engine inlet, a front fan driven by the low pressure (LP) turbine accelerates air rearward toward the axial (JT15D-4/-4B only) and centrifugal compressors and the full-length, annular bypass duct. Approximately 75% (-1/-1A/-1B) to 66% (-4/-4B) of the total air flows around the engine core through the bypass duct.

After the air passes through the fan, an axial compressor, driven by the low pressure turbine, accelerates the air before passing it to the centrifugal compressor. The compressor, driven by the high-pressure (LP) turbine, slings air outward to accelerate it to a high-velocity, low-pressure flow. The diffuser converts the high-velocity flow into a low-velocity, high-pressure flow before it reaches the combustion section.

<table>
<thead>
<tr>
<th>Engine</th>
<th>Static Thrust</th>
<th>Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Takeoff</td>
<td>Max</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continuous</td>
</tr>
<tr>
<td>JT15D-1</td>
<td>2,200</td>
<td>2,090</td>
</tr>
<tr>
<td>JT15D-1A</td>
<td>2,200</td>
<td>2,090</td>
</tr>
<tr>
<td>JT15D-1B</td>
<td>2,200</td>
<td>2,090</td>
</tr>
<tr>
<td>JT15D-4</td>
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<td>2,375</td>
</tr>
<tr>
<td>JT15D-4B</td>
<td>2,500</td>
<td>2,375</td>
</tr>
</tbody>
</table>

Table 4K-1; Pratt and Whitney JT15D Engines
After entering the annular, reverse-flow combustion section, the airflow makes a 180° turn forward, then mixes with fuel introduced by the fuel nozzles. Initially ignited by two igniter plugs, the air/fuel mixture burns and expands. The hot combustion gases then flow to the exit duct where they make a 180° turn before reaching the HP turbine. As the high velocity gas stream passes through the turbine, the turbine rotates to extract energy to drive the centrifugal compressor. The combustion gases then flow through the two-stage LP turbine to rotate it. The LP turbine, in turn, drives the axial LP compressor (JT15D-4/-4B only) and front fan. After exiting the turbine section, the gas stream enters the exhaust duct where it mixes with bypass air to produce forward thrust.

**Lubrication System**

The engine-driven oil pump draws oil from a tank and provides it under pressure through a fuel/oil cooler and filter to the engine bearings, bevel and spur gears, and accessory gearbox.

After lubricating, cooling, and cleaning the engine, oil drains from the bearings into the accessory gearbox and from the No. 4 engine bearing into a sump. The oil pump’s scavenge elements draw oil from the sump areas to the oil tank.

A breather system relieves excess air pressure from the lubrication system to prevent pump cavitation and excess system pressure.

Pressure and temperature transmitters in the lubrication system drive the vertical tape OIL PRESS and OIL TEMP gages. Below approximately 35 PSI, the respective OIL PRESS LO or OIL PRESS WARN annunciator illuminates.
Fuel and Fuel Control

Under pressure from the wing fuel system, fuel flows through the firewall shutoff valve to the engine-driven fuel pump at approximately 20 to 30 PSI. A pressure switch between the firewall shutoff valve and engine pump illuminates the FUEL PRESS LO or FUEL LOW PRESS annunciator if fuel pressure drops below approximately 5 PSI. Low fuel pressure automatically turns the electric fuel boost pump on. The engine-driven fuel pump then delivers fuel at approximately 500 to 700 PSI through a filter to the fuel control unit (FCU).

Movement of a throttle lever controls the FCU through direct linkage. Each throttle lever has a mechanical stop that prevents inadvertent selection of CUTOFF and a latch that must be released to advance the throttle from CUTOFF to IDLE. In response to throttle movement, the FCU meters fuel to provide efficient engine operation based on engine N2 speed, ambient and compressor discharge pressure, compressor inlet temperature, and throttle position during starting, acceleration, and shutdown.

Metered fuel from the FCU flows through the fuel/oil cooler to the flow divider valve and motive flow valve. A fuel flow transmitter between the FCU and cooler drives the vertical tape FUEL FLOW gage. The gage shows fuel flow from 0 to 2,000 pounds-per-hour (PPH).

In the flow divider valve, the fuel flow splits to supply the primary and secondary manifolds. The divider valve also controls fuel pressure to the primary manifold during engine start and ensures that fuel does not enter the manifolds until it reaches a minimum pressure.

The motive flow valve supplies low pressure high-flow motive flow fuel to the fuel system’s primary ejector pump.

From the flow divider valve, fuel flows to the fuel manifold assembly. The assembly then distributes fuel to the fuel nozzle primary and secondary passages. The fuel nozzles deliver a finely atomized spray of fuel into the engine’s combustion chamber.
An emergency fuel shutoff system prevents engine overspeed should a catastrophic failure occur by cutting fuel flow to the engine. Axial displacement of the low pressure turbine shaft activates a plunger in the shutoff valve piston. The piston assembly, in turn, activates the fuel inlet and emergency shutoff valve. Fuel flow stops and the engine shuts down.

**Ignition**

During the engine start cycle, advancing a throttle out of the cutoff position supplies power from the Hot Battery bus to the ignition exciters. The exciters provide high-voltage electrical pulses to the two ignition plugs. The plugs, extending into the combustion chamber, fire to ignite the fuel/air mixture. When the engine start cycle terminates, the ignition system deactivates.

Placing an IGNITION switch in ON supplies power for continuous ignition system operation. During ignition system operation a green light above each switch illuminates. Placing an ENGINE ANTI-ICE switch to ON also provides engine ignition.

**Control**

Each throttle lever mechanically connects with its engine FCU through cables and bellcranks and controls the FCU from cutoff to full thrust. A mechanical stop prevents inadvertent selection of the CUTOFF position. A latch must be raised before the throttle can be moved from CUTOFF to the IDLE position. In response to throttle movement, the FCU then meters fuel to the engine based on N₂ RPM.

During intentional and unintentional thrust reverser operation, a feedback cable between the thrust reverser actuating mechanism, FCU, and throttle lever ensures that the FCU is in the idle thrust position during thrust reverser deployment and stowing. This mechanism also drives the associated throttle lever to the idle position should an inadvertent deployment occur.
Engine Synchronizer

When operating, the engine synchronizer provides automatic $N_1$ or $N_2$ synchronization between the left (master) and right (slave) engines. With the ENGINE SYNC switch in FAN or TURB, the system compares the right engine’s $N_1$ or $N_2$ speed (whichever is selected) to the left engine. If there is a speed mismatch, the system trims the right engine’s FCU through an actuator to either increase or decrease engine speed. The system has a 1.5% $N_1$ or 1.0% $N_2$ RPM authority range. The system does not operate if the slave engine speed, when compared to the master, is out of this range. This prevents the right engine from synchronizing with a failing left engine.
Thrust Reversers

- LH MAIN EXT BUS
- RH CROSSOVER BUS

**HYD PRESS ON**

**SPRING**

**ISOLATION VALVE**

**200 PSI PRESSURE SWITCH**

**STOW SOLENOID**

**DEPLOY SOLENOID**

**DEPLOY LIMIT SWITCH**

**STOWED LIMIT SWITCH**

**WARN LITE 1**

**STOW LIMIT SWITCH**

**DEPLOYED POSITION SHOWN**

**DEPLOY**

**SQUAT SWITCH**

**RESTRICTOR**

**RETRACT**

**HYD PRESS ON**

**7.5 A**

**THROTTLE LOCK SOLENOID**

**STOWED OR IN TRANSIT**

**DEPLOYED**

**DEPLOY LIMIT SWITCH**

**DEPLOY**

**SQUAT SWITCH**

**GND**

**PRESSURE**

**RETURN**

**STATIC**