

Auxiliary Power Units

Auxiliary power Unit

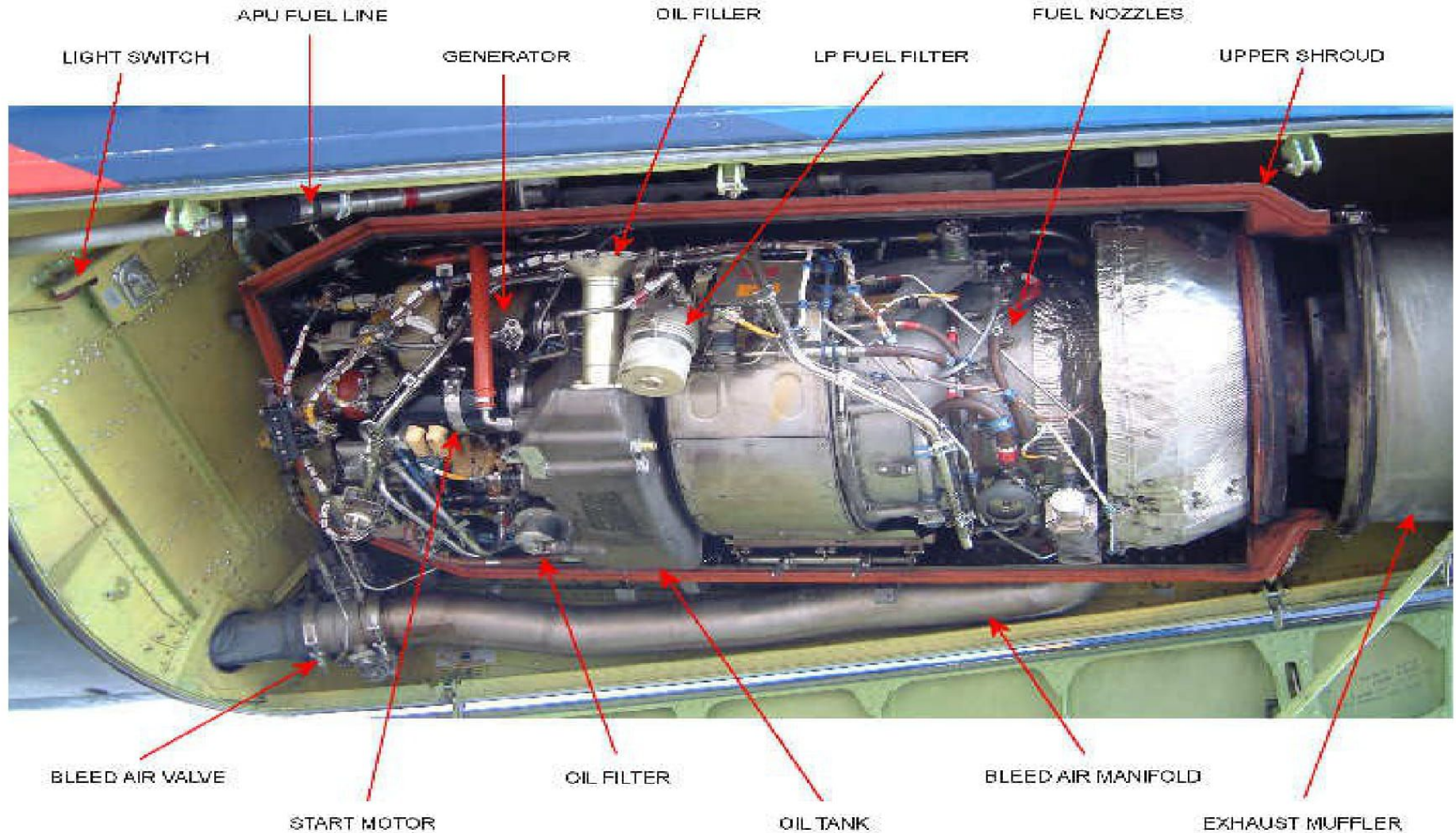
- they are used to provide pneumatic and electrical power to aircraft systems.
- they are primarily **used** during the following scenarios:
 - Main engine starting;
 - Main engines not operating;
 - In-flight emergencies;
 - Ground power support not available;
 - Main engine de-loading of bleed air demands.
- They used GPU (ground power units) carts with a piston engine and a direct drive generator to provide electrical energy to the main engine 's starter motor.
- With larger engines, more torque is required for start rotation and so more electrical energy

- APU is installed in aircraft to provide operating flexibility.
- Passenger comfort was also increased by using the APU provided pneumatic power to operate the air conditioning on the ground with the main engines not operating.
- APU have been used to drive AC and DC generators,hydraulic pump,air compressor as well as provide pressurized air for starting,heating and air conditioning.

APU LOCATION

- APU engine is located in section 48 of the fuselage.
- Completely enclosed
- APU is provided with two shrouds upper and lower shroud attach together with ten latches.
- Upper shroud is attached to aeroplane structure by struts.
- The lower shroud contains cooling air, exhaust and two drains which mate with fuselage mounted access doors.

APU NOMENCLATURE



CONSTRUCTION

Divided into three main categories

1. intake/compression.
2. combustion/ turbine
3. gear box

The inlet or plenum consists of ducting from an intake door or scoop located on the top or side of the aircraft fuselage.

APU is primarily a ground operating engine, it could be very prone to FOD damage by ramp debris if the screen wasn't in place to protect the intake.

construction

- Most APUs use a centrifugal impeller/radial diffuser combination in either one or two stages to compress the intake air for engine operation and airframe system use.
 - Centrifugal compressor having several advantages
- creates a larger pressure rise per stage
- creates a smaller engine area
- more FOD and surge/stall resistant
- APUs use either a can or annular style combustor, depending on the type of turbine used.
- can-annular combustors are not typically used due to maintenance and inspection concerns.

construction

- A single turbine configuration provides horse power to rotate both the compressor and the gear box section.
- The APU exhaust is carried overboard through the use of stainless steel ducting located in the tail cone or the side of the empennage.
- Cooling for the APU can also be accomplished by a device known as an educator. The educator is a convergent duct located around the APU exhaust .
- The educator creates a low pressure pulling airflow in and around the APU.

construction

- The APU gearbox is normally located opposite the combustion section with the intake and compressor section in the middle.
- The gearbox not only provides the drive input for the APU's electric starter motor, but it also uses shaft horse power from the turbine to provide rotational energy at a correctly geared RPM.
- This drives the engine's fuel pump, oil pump, and the APU's generator.
- The generators used on the APU are varied in size and output, depending on the electrical requirements of the aircraft on which it is installed

construction

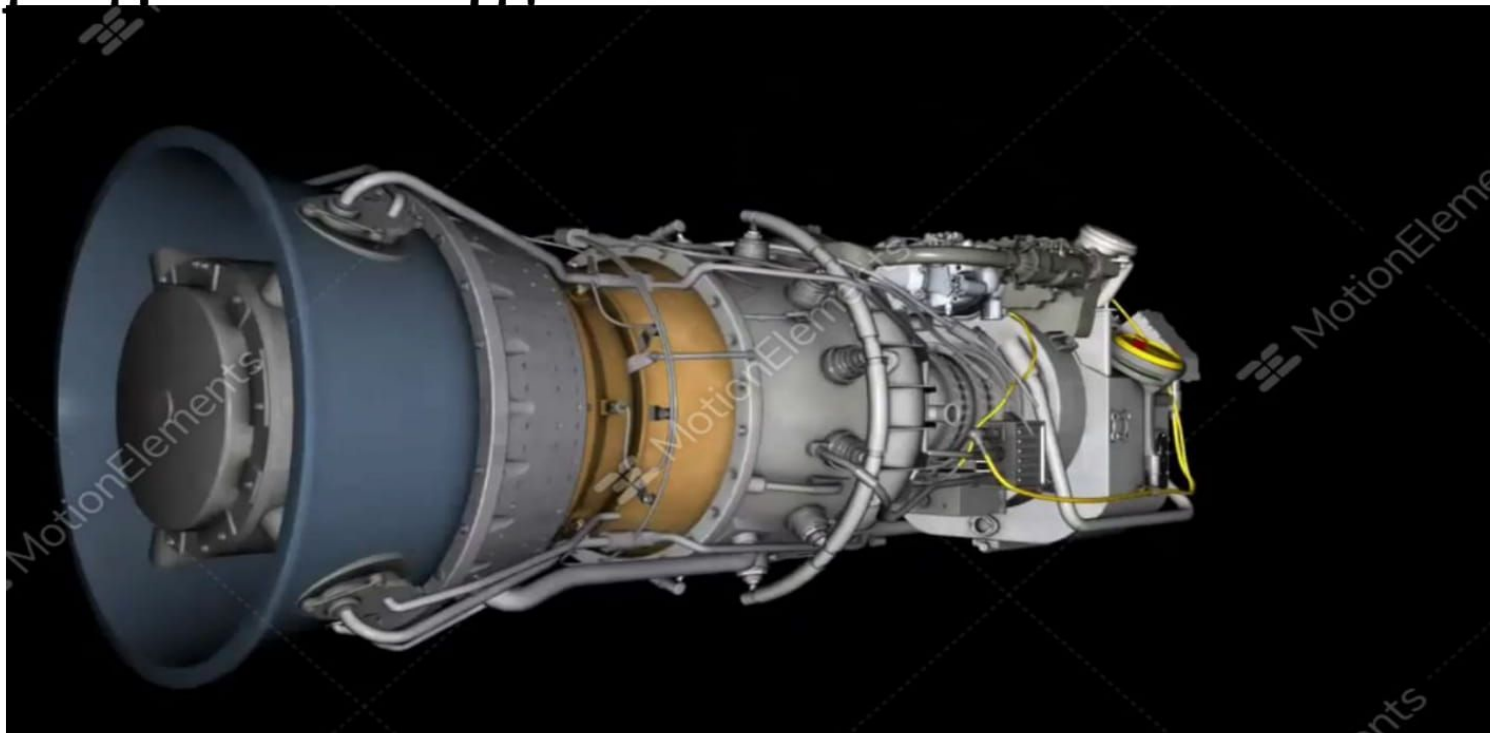
- In large rotor wing aircraft, the APU often provides a third power output in the form of hydraulic pressure from a multi piston hydraulic pump located on the gearbox.
- The fluid pressure is used to power a multi-piston hydraulic motor to deliver start RPM to the main engine, transmission, and rotor head assembly.
- A power density only hydraulics can apply is required to provide the shaft horse power

INSTALLATION

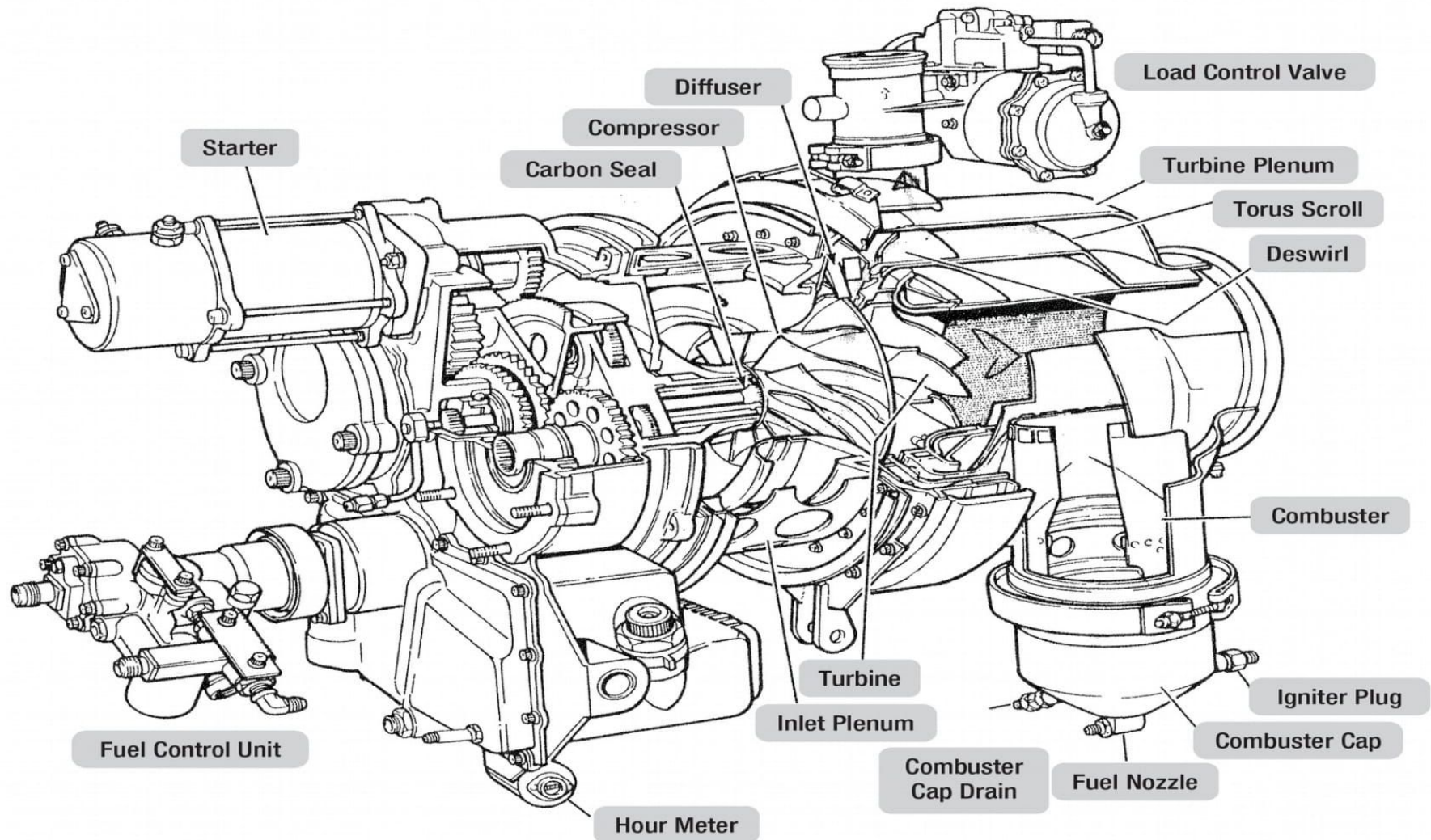
- APU units are normally located in the empennage of the aircraft, either imbedded in an accessory bay or suspended within the tail cone structure.
- APU enclosures are commonly fabricated from high temperature stainless steel and perform several functions 1) to provide a sealed space for engine fire suppression 2) cooling air flow 3) to reduce noise through the use of sound absorbing materials 4) to provide ballistic containment in case of catastrophic engine

Installation

- the APU is suspended within the structure, using a steel mount assembly to a forward firewall with vibrational shock mounts similar



Pic of APU



Operation of APU

- Fuel is supplied from the main tank No.1 through fuel shut off valve which open when the master switch is in the 'ON' position.
- The fuel solenoid valve opens and the fuel is supplied to the combustion chamber.
- If high EGT occurs the thermostat opens, venting the control pressure, bypass increases and fuel flow to the combustion chamber decreases.
- During normal operation governor senses APU speed and regulates the fuel flow bypassing some of it to maintain constant

APU Schematic

- single shaft gas turbine utilizing two centrifugal compressor stage and one centrifugal at turbine
- Air inlet door with door open switch on the right side of the fuselage
- Accessory cooling duct with cooling air shut off valve
- Fuel control unit consisting of fuel pump, acceleration control, and governor
- **It having oil system**

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APU Shut Down

- Due to the fuel solenoid valve de-energizes and APU shuts down.
- APU normally shuts down by placing the master switch to off position
- If pulling either APU fire handle will close both the No.1 tank shut off valve and the fuel solenoid valve and close the air inlet door

Power plant installation

nacelle

- the engines are mounted in streamlined housings called nacelles that extend from the wings.
- These nacelles are divided into two main sections: wing nacelle and engine nacelle.
- The wing nacelle is that portion of the nacelle that is attached to the wing structure.

nacelle

- The engine nacelle is that portion of the nacelle that is constructed separately from the wing.
- the wing nacelles normally contain lines and units of the oil, fuel, and hydraulic systems,