G650

Auxiliary Power Unit
The purpose of the APU is to supply an auxiliary source of:

1. Electrical AC power > On Ground
2. Pneumatic Bleed Air

1. Backup Electrical AC power
2. Pneumatic Bleed Air for engine air start > In flight

- APU is powered by a dedicated single shaft, constant speed gas turbine
- APU is controlled by an Electronic Control Unit (ECU)
- APU is self monitoring and will protect itself against faults with an automatic shutdown
- APU is enclosed in a fireproof titanium case
- Minimum Ambient Temperature for ground start is **-40°C (-40°F)**

- APU has a fully automatic start sequence

- The APU can be started with **power**

- Minimum main batteries voltage for APU start: **22 volts**

  (APU STARTER uses **MAIN BATT** only but both MAIN BATTERIES switches must be selected ON)

- APU starter limits:

  - Three (3) consecutive start attempts followed by a one (1) hour cooling period

  - Six (6) successful and consecutive starts with a ten (10) minute interval between starts

  - Use of **EXT DC** to start the APU is **prohibited**
- APU EGT Limits:
  - Start = 1050°C
  - Running = 732°C

- Maximum APU RPM (Rotor Speed): 106%

- Unattended Ground operation is prohibited

- APU fuel burn is 264 pounds/hour

- APU cannot be used for pressurization

- Maximum Operating Altitude is 45,000'

- APU oil check: 15-30 minutes after shutdown
**APU Master Switch**

1. **Master switch illuminates** when pressed in

- The Electronic Control Unit (ECU) is powered
  - Pre-start Build-in-Test (BIT) is performed
  - APU oil temperature is sensed
  - APU fuel shut-off valve opens
  - APU air inlet door (left side) opens

- If all parameters **OK**, the APU **READY** illuminates

It is still possible to start the APU in the absence of an APU **READY** light provided the APU air inlet door is visually confirmed as open.
- The ECU, the brains of the APU, is a microprocessor with embedded software.
- It automatically controls the APU and interfaces with subsystems.
- It is located in the Baggage Electronic Equipment Rack (BEER).
- It is powered through the ON switch.

The ECU selects one of the two power sources if both are available.
1. **Maintains** required RPM and safe EGT during:
   - Start
   - Acceleration
   - Idle
   - Full load operation
2. **Monitors** operational limits
3. **Controls** air inlet door
4. **Controls** protective shutdowns

[Diagram showing on speed, non-essential on ground, and essential in flight]
- Six (6) Operational Modes:

- AUTO PROTECTIVE SHUTDOWN:

  The ECU provides operational protection for the APU by shutting it down if operating parameters are exceeded or if a FIRE is detected within the APU housing.
The ECU uses two sets of operating limits:

1. **Non-Essential (On Ground):**
   - The APU will automatically shutdown in order to protect itself in the event of any discrepancies.
   - Cool-down mode is bypassed
   - APU’s fuel shutoff valve is closed
   - APU shuts down

2. **Essential (In flight):**
   - In Essential mode the APU will not automatically shutdown for certain failures. The safe condition of the aircraft takes precedence over any possible damage to the APU.
• APU operating **In flight**
• Fault detected
• Crew notified via CAS message

If the APU is **not needed**:

• Shut it down with the Stop switch

If the APU is **needed**:

• Allow APU to continue running
• After landing the APU remains in Essential Mode for fifteen (15) minutes before the ECU shuts it down. If not needed shut it down.
APU exhaust is exhausted overboard on the aft lower right side of the fuselage under the engine pylon.

To prevent damage to the engine cowl when opened during ground maintenance the APU starter is inhibited.

Starter is not inhibited in flight.
The APU provides an auxiliary source of:

1. Electrical AC power - On ground
2. Backup Electrical AC power - In flight

The APU GEN runs at a constant speed.
- When the APU reaches 99% RPM plus two (2) seconds the APU generator comes online and can power all AC and DC buses.
- The APU provides:
  - **On ground**: bleed air for air conditioning and engine start
  - **In flight**: bleed air for assisted engine starts

- The APU's Load Control Valve (LCV) allows high pressure/temperature air into the left and right pneumatic manifolds.
- APU bleed air plumbing connects directly to the R manifold

- After the APU is started on the ground the LCV will not open for sixty (60) seconds to allow the APU to operate in a lightly loaded condition (low EGT)

- Selection of APU bleed air automatically opens the isolation valve to allow bleed air to enter the L manifold

- If the EGT is warm (>149°C) the sixty (60) second time delay is removed and APU pneumatic air will be available immediately

- APU bleed air is available immediately to restart an engine inflight
- APU bleed air is available to start the engines on the
  on ground or in flight from S.L. to 30,000'
APU Fire Detection System

- The APU is enclosed in a titanium case capable of sustaining a fire for fifteen (15) minutes. Beyond this period damage to other systems will occur.

- The APU Overheat/Fire Detection System consists of a hermetically sealed Helium-filled tube secured to the top of the APU enclosure.

- As the temperature inside the enclosure increases, the gas in the tube expands and the pressure increases.

![Graph showing pressure vs. temperature with a pressure sensor trigger point]
- A large temperature increase on a small length of tube indicates a Fire

![APU FIRE]

- Fire Bell (On ground only)

- APU ECU
  - Closes APU fuel supply valve
  - Closes load control valve
  - Shuts off APU generator
  - Closes APU inlet door
APU Fire Extinguishing System

- The APU Fire Extinguishing System is powered by the bus (down to main batteries)

- Fire extinguishing discharge switch (guarded) is located on the APU control panel

- Discharges left fire bottle Halon into APU compartment. Only one shot is available

- Discharge generates the following CAS message:

L/HPU Fire Bottle Discharged
APU Fire Test

- Proper Test - Eight (8) indications

APU

TEST

If on the ground a Fire Bell (located in the nose wheel well) will sound
Fuel is normally supplied from the left fuel manifold but can also be supplied from the right manifold by temporarily opening the crossflow valve.
In flight operation of the APU is prohibited except:

- **Single IDG failure**

- **Dual IDG failure**
• **Single Engine Failure**

• **Dual Engine Failure**

Refer to AFM OIS G650ER-2016-03 APU Sealant

**Aircraft Service Change (ASC) 095:**

This ASC provides an **Alternate Method of Compliance (AMOC)** with FAA **Airworthiness Directive 2017-20-08**
Maximum Altitude for Start

Non ASC 123:

Starts are possible from
30,000' to 39,000'

Guaranteed start ≤ 30,000'
Maximum Altitude for Start

ASC 123:

 Starts are possible from

37,000' to 39,000'

Guaranteed Start ≤ 37,000'
APU Surge Control Valve

The surge control valve opens whenever the APU is started in flight ≥ 16,500 ft. Its purpose is to prevent a compressor stall.
APU Shutdown

- When the STOP switch is pressed the legend illuminates and the shutdown sequence commences.

A. Unloads electrics and bleed air

B. APU enters cool-down mode
   - RPM remains at 100% for 60 seconds

C. After cool-down the ECU signals an overspeed condition to shut down the APU

D. Any faults detected - CMC and/or CAS

E. APU air inlet door closes

- When altitude is > 20,000 feet

- When altitude is ≤ 20,000 feet

- When altitude is ≤ 45,000 feet
- When the APU Master switchlight is pressed in (RPM less than 70%) the following occurs:

A. Master switch legend extinguishes
B. APU fuel shut off valve closes
C. APU immediately shuts down
D. Inlet door begins to close

If the APU is operating pressing the APU switchlight will shutdown the APU immediately.

This is NOT recommended.
APU Oil Servicing

Fifteen (15) to Thirty (30) minutes after shutdown

- 1/6 Ground Service Synoptic window
- Fluid Quantity Indicator (Tail Compartment)
- Standby Multifunction Controller (SMC)
Questions, comments or errors...please send me an email: ivan@code7700.com

Thank you!