15 Airborne Auxiliary Power (ATA 49)

15.1 Definition

> *Those airborne power plants (engines) which are installed on the aircraft for the purpose of generating and supplying a single type or combination of auxiliary electric, hydraulic, pneumatic or other power. Includes power and drive section, fuel, ignition and control systems; also wiring, indicators, plumbing, valves, and ducts up to the power unit. Does not include generators, alternators, hydraulic pumps, etc. or their connecting systems which supply and deliver power to their respective aircraft systems.* (**ATA 100**)

15.2 Fundamentals

An **auxiliary power unit** (APU) is a compact, self-contained gas turbine-powered unit delivering rotating shaft power, compressed air, or both. Rotating shaft power can be used to drive a generator, a hydraulic pump, and/or a load compressor. An APU comprises the air intake and exhaust, the fuel and oil system, engine controls and indications, as well as ignition and starting equipment.

An APU may be used on the ground and in the air, or only on the ground. For the overall aircraft system safety concept it makes a difference if the APU is dependable or not. If overall safety depends on the APU, then the APU is essential; otherwise it is non-essential.

> *"Essential APU" means an APU which produces bleed air and/or power to drive accessories necessary for the dispatch of the aircraft to maintain safe aircraft operation.* (**JAR-1**)

> *"Non-essential APU" means an APU which may be used on the aircraft as a matter of convenience, either on the ground or in flight, and may be shut down without jeopardising safe aircraft operations.* (**JAR-1**)

An essential APU is necessary for dispatch. For the pilot this will be indicated on the *minimum equipment list* (MEL).

The APU is installed in the tail cone of most airplanes, isolated form flight critical structure and control surfaces by a firewall. The APU is started by battery. When running, the APU is able to start the main engines with its pneumatic power supply.

The significance of APU power within the concept of the secondary power systems is explained in Subsection 1.8.

15.3 Example: Airbus A321

The A321 is equipped with an APU (Figure 15.1) to permit aircraft *ground operation* independent from external power supply, allowing the operator to service airports without adequate ground power facilities. The APU is also available in flight. This is of importance for flights under *extended-range twin-engine operations* (ETOPS) rules, where the aircraft flies on remote routes with no alternative airfield available within a flight time of up to 180 minutes.

The APU essentially generates shaft power. A load compressor is flanged to the shaft to generate *pneumatic power*. With APU pneumatic power it is possible to start the aircraft main engines and operate the air conditioning system.

The APU shaft also drives a 90 kVA generator via a gearbox to generate *electrical power*. The APU is regulated to a constant speed, so that the generator is able to produce 110 V AC at a constant frequency of 400 Hz. If an increase in demand to the aircraft systems is necessary, the supply of the electrical power has priority over the supply of bleed air.

The APU is fitted with a DC *starter motor*, which draws its power from the electrical system battery bus. The APU starts in flight up to an altitude of 7620 m (25000 ft) with the use of the aircraft batteries alone. The starter motor turns the engine to such speed that self-sustained engine operation becomes possible. The *electronic control box* (ECB) automatically controls and monitors the APU. Manual control of the APU is possible through the crew interfaces in the cockpit. The APU is supplied with *fuel* from the aircraft tanks. The APU compartment is equipped with a *fire detection and extinguishing* system.

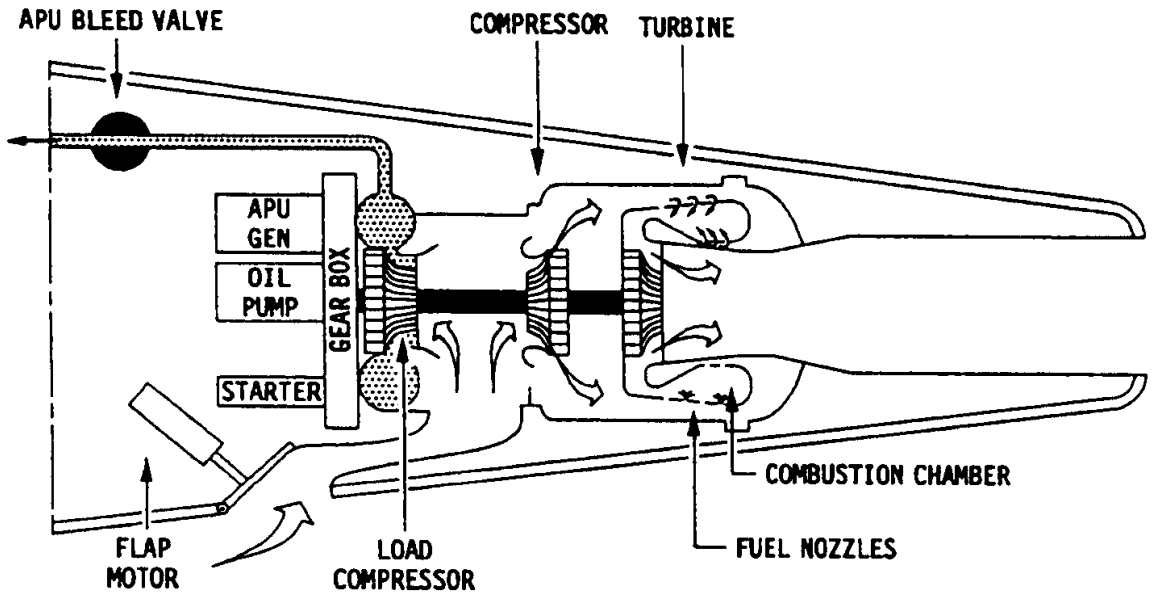

Figure 15.1 A321 auxiliary power unit (APU)