

PART 1

Chapter 2 — ENGINE CONTROLS AND INSTRUMENTS

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Description

1 Avon 122 engine

(a) General

The engine is a 12-stage axial-flow gas turbine developing 7575 lb static thrust at sea level. The main engine systems include:

- Variable incidence guide vanes (see para 2)
- A cartridge starting system (see para 3)
- Relighting facilities (see para 8)
- An anti-icing system (see para 13)
- A high-pressure fuel system controlled by a flow control unit
- A self-contained oil system

(b) High-pressure fuel pumps

The twin engine-driven HP pumps share a common housing. A servo-control system controls the total pump output and a governor prevents over-speeding of the engine.

(c) Flow control unit

The servo-control system is operated by the barometric pressure control (BPC) and acceleration control unit (ACU), and varies fuel flow to the engine according to throttle position, altitude, forward speed and RPM.

(d) Oil system

Oil is carried in the engine sump, the capacity of which is approximately 17 pints. One pressure and two scavenge pumps maintain a continuous circulation through a cooler and filter to the engine bearings and gears. An oil pressure gauge is below the port instrument panel.

2 Variable incidence guide vanes and air bleed valves

(a) The first row of stator blades in the engine consists of variable incidence guide vanes which impart swirl to the incoming air. At low RPM the first stages of the compressor deliver more air than is acceptable to the later stages. To prevent surge, the surplus air is bled off through air bleed valves and the guide vanes are held in the maximum swirl position. The air bleed valves are controlled by compressor delivery air pressure and the swirl vanes ram by HP pump delivery fuel pressure.

(b) The guide vanes start to move from the maximum swirl position at about 6400 RPM and reach the minimum swirl position at about 7550 RPM. The bleed valves close at about 6500 RPM.

(c) The positions of the guide vanes and bleed valves have no noticeable effect on RPM, but until the guide vanes are in the minimum swirl position and the bleed valves are closed the engine is not operating at maximum efficiency; thrust is reduced and fuel consumption is increased.

3 Starting system

(a) Starting is by means of a triple breech cartridge starter system, which accelerates the engine until it becomes self sustaining.

(b) When the starting cycle is initiated, a cartridge is indexed and fired and burns for about 3 seconds to turn the engine compressor. At the same time the high energy igniter units operate to ignite the fuel spray in the combustion chambers. After approximately 30 seconds the engine becomes self sustaining and a switch operates to shut down the starting system and to release the starter button, which has been held in during this time.

4 Engine fire-extinguisher

(a) A fire-extinguisher bottle, stowed between the air intakes just forward of the engine, is connected to two spray rings in the engine bay. Operation of the system is either by:

- (i) A manually-operated button in the cockpit on the centre panel, or
- (ii) Automatically-operated inertia switches in the radio bay, which operate if a crash landing occurs. Operation of the switches also cause the batteries and generators to be isolated irrespective of the position of the battery master switch.

(b) Fire detection is provided by a Triple-FD firewire system. Two firewire detector loops surround the engine and forward part of the jet pipe. If the temperature in the engine bay exceeds a pre-determined level the loops complete a circuit to the engine fire warning light in the button. When the button is pressed the extinguisher discharges its contents through two spray rings, one round the engine compressor and the other round the turbine nozzle box. If the fire is extinguished, the light goes out as the firewire cools.

(c) The firewire circuit may be tested by using the test button which is adjacent to the fire warning light. If the circuit is serviceable the light appears. Unserviceability of the system is indicated either by the warning light not illuminating or failing to extinguish when the test button is released. Testing should be done before engine start and immediately after flight, when optimum conditions for moisture contamination of the firewire have been experienced. Testing of the Triple-FD system should not normally be done in the air.

(d) When the battery master switch is off the fire extinguisher can be operated only by the inertia switches. The battery master switch must be on, or an external DC supply connected, to test the warning circuit or to operate the system by button.

Controls and Indicators

5 HP fuel cock

The HP fuel cock control is in a quadrant on the cockpit port shelf, and is moved forward from OFF to ON. A safety gate is provided to ensure that the HP cock cannot be moved unless it is first pressed downwards.

6 Throttle controls

Two throttle control levers are provided, one in a quadrant on the port shelf, and the other on the centre pedestal; the throttles are interconnected. The handle of each lever incorporates a twist-grip for GGS manual ranging, a press-to-transmit switch and an airbrake control. A throttle damper is provided aft of the lever on the port shelf.

7 Starting controls

The main control switches below the port instrument panel are:

- (a) *The battery master switch*
- (b) *The ignition switch* which controls the current to the igniter plugs. It should normally be locked in the on position.
- (c) *The engine master switch and circuit breaker (centre pedestal)* which complete the circuit through the starter button, ignition switch and relight button in its normal out position. The engine master switch also controls the electrical supply to the engine instruments, and completes the circuits to the standby inverters and the booster pumps. The switch should be on and the circuit breaker made when the engine is running.
- (d) *The starter button* which initiates the starting sequence.

NOTE: The engine starting procedure is covered in Part 3, Chapter 1.

8 Relighting control

A relight button is in the top of the HP cock control lever and when held in completes the circuit to the high energy ignition units. The button is spring-loaded to return to the out position.

NOTE: The relighting procedure is covered in Part 4, Chapter 1.

9 HP pump isolating valve and warning light

(a) The isolating valve is intended as a means of restoring power in flight in the event of failure of the HP pumps servo system causing a sudden loss of power.

(b) The valve is controlled by an ENGINE FUEL PUMPS—NORMAL/ISOLATE switch on the port shelf. When the switch is set to ISOLATE, one HP pump is isolated from the servo system which continues to control only the other HP pump. The isolated pump moves to full stroke and is controlled only by its over-speed governor.

(c) An adjacent warning light indicates when the isolating switch is at ISOLATE.

10 Top temperature control

(a) A top temperature control system prevents the jet pipe temperature from rising above the permissible maximum (690°C) by partially closing the throttle when this temperature is reached. Further throttle opening is restricted until the jet pipe temperature drops below this maximum. When the temperature drops, the throttle is automatically returned to its original setting and its full range of movement is restored. The system requires both AC and DC supplies; AC is supplied by No 1 group inverters immediately the AC supplies circuit is operating. The DC supply is controlled by a JET PIPE TEMPERATURE CONTROLLER—ON/OFF switch on the port shelf, which should normally be selected ON, and an override microswitch operated by the closing of the nosewheel door.

(b) When the nosewheel door is up and locked, the microswitch closes and starts a time switch; after approximately 30 seconds the time switch operates to allow DC to the ON/OFF switch. Provided that ON is selected, the top temperature control system is operative.

(c) Malfunctioning of the system is indicated by a JPT reading above 690°C or by a sudden drop in RPM of up to 1000. In either case the switch should be set to OFF and the JPT and RPM controlled by throttle movement.

11 Engine instruments

The engine instruments comprise a jet pipe temperature gauge, an oil pressure gauge and an RPM indicator. The JPT gauge and RPM indicator are on the port instrument panel; the oil pressure gauge is below the port instrument panel.

12 Engine fuel and air dipping system

(a) An engine fuel and air dipping system automatically decreases RPM to minimise the risk of surge during gun-firing.

(b) When either gun-firing trigger is pressed, solenoid-operated fuel and air dip valves operate to restrict fuel flow to the engine and to bleed air from the compressor, thus causing a drop in RPM.

(c) The amount of fuel bled in a given time is constant and independent of throttle position. At part throttle settings this can result in RPM dropping below flight idling; throttle response is then uncertain, particularly at low altitude and low airspeed. RPM drop is further aggravated if the gun-firing trigger is held for lengthy periods; for this reason it is important that the camera button and not the gun-firing trigger is used during cine gun practice.

(d) If the RPM should drop below flight idling, they may be restored, provided that the engine is not in a surge condition, by setting the HP pump isolating switch to ISOLATED (see para 9).

NOTE: If the throttle is opened when firing in buffet conditions, the throttle opening time must not be less than 2 seconds.

13 Engine anti-icing

An engine anti-icing OPEN/SHUT switch and indicator are forward on the centre pedestal. The indicator shows red when open and green when shut. When the valve is motoring between open and shut or if the system is de-energised the indicator shows amber. Hot air is tapped from the engine compressor and with the switch OPEN is ducted to the inlet guide vanes. The system is *not* intended for de-icing, but to prevent ice formation.

14 Management of the engine anti-icing system

(a) With the system in use, all throttle movements must be made smoothly. There is a loss of thrust (about 7%), increased fuel consumption and JPT usually rises by about 20°C. At full throttle, RPM may then fall if the top temperature control comes into operation.

(b) *Ground running*

In conditions of fog or mist at OATS below +5°C switch anti-icing OPEN immediately after starting. Taxi and, if runway length permits, take-off with the system OPEN; otherwise run the engine at about 7000 RPM for one minute immediately before take-off and then switch the system SHUT. Switch the system OPEN again as soon as possible after take-off and leave it OPEN until 2 minutes clear of icing conditions.

NOTE: Do not carry out any engine acceleration checks with the system in use.

(c) *Level flight*

If icing conditions are met in level flight, climb or descend out of the icing level (see (d) and (e) below).

(d) *Climbing*

Open up to not less than 7200 RPM and set the switch to OPEN. Climb at the maximum practicable rate.

(e) *Descending*

Throttle back to not less than 5500 RPM and set the switch to OPEN. Descend at the maximum practicable rate; maximum anti-icing protection is obtained at the highest practicable RPM.

(f) When clear of icing conditions, set the switch to SHUT and wait for about 10 seconds before making any rapid throttle movements. If icing conditions persist down to airfield level keep the switch at OPEN and maintain engine speed above 5500 RPM until finally committed to a landing.



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