

## PART IV — EMERGENCY HANDLING

	<i>Para.</i>
Engine failure on take-off ... ..	84
Engine failure in flight ... ..	85
Double flame-out ... ..	86
Action in the event of fire ... ..	87
Flapless landing ... ..	88
Emergency operation of the undercarriage ... ..	89
Landing with an undercarriage unit not locked down	90
Landing with a defective hydraulic system or wheel brakes ... ..	91
Cabin pressurization failure at altitude ... ..	92
Abandoning the aircraft in flight ... ..	93
Forced landing ... ..	94
Ditching ... ..	95

## PART V — OPERATING DATA

Pressure error corrections ... ..	96
C.G. movement ... ..	97
Take-off distances ... ..	98
Flying for range and endurance ... ..	99
Descent data ... ..	100
Use of different fuels ... ..	101

## PART VI — ILLUSTRATIONS

	<i>Fig.</i>
Electrical control pedestal ... ..	1
Cockpit—port side ... ..	2
Cockpit—forward view ... ..	3

**RESTRICTED**

A.P.4326B—P.N.

*Pilot's Notes*

## CANBERRA B.2

### PART I

## DESCRIPTIVE

NOTE.—Throughout this publication the following conventions apply:—

- (a) Words in capital letters indicate the actual markings on the controls concerned.
- (b) The numbers quoted in brackets after items in the text refer to the illustrations in Part VI.
- (c) Unless otherwise stated all airspeeds and Mach numbers quoted are "Indicated".

## INTRODUCTION

- (a) The Canberra B.2 is a light bomber powered by two Avon Mk. 1 engines, each of 6,500 lb. static thrust. The cabin is pressurized and provides accommodation for a crew of three seated in ejection seats. There is an alternative position in the nose for the air bomber, but no provision is made for his ejection from this station. Bombs are carried in a bay in the belly of the fuselage, and provision is made for carrying a camera in the rear fuselage. A variable incidence tailplane is fitted. There is no auto-pilot.
- (b) The pilot's controls and instruments are grouped as follows:—
  - (i) In front of the pilot on the instrument panel (fig. 3);

## PART I—DESCRIPTIVE

- (ii) To the left of the pilot on the port console panel (fig. 2) and on the port front panel forward of and above the port console panel (fig. 3);
- (iii) To the right of and behind the pilot is a pedestal (fig. 1) containing on its forward face circuit-breakers for all fuel booster-pumps and L.P. cocks. On the rear face are the main electrical control switches.
- (c) The principal dimensions of the aircraft are:—
- |                               |              |
|-------------------------------|--------------|
| Height to top of fin ... ..   | 15 ft. 7 in. |
| Length overall ... ..         | 65 ft. 6 in. |
| Span with tip tanks ... ..    | 65 ft. 6 in. |
| Span without tip tanks ... .. | 64 ft. 0 in. |

## FUEL AND OIL SYSTEMS

### 1. Fuel system description

- (a) Three fuel tanks are fitted in the fuselage above the bomb bay; they are numbered 1, 2 and 3 from front to rear. Jettisonable wing tip tanks may be carried.
- (b) Fuel from the wing tip tanks feeds automatically under air pressure into No. 3 fuselage tank. Fuel from the fuselage tanks is fed to the engines by immersed, electrically-driven pumps, two in each tank, through low-pressure cocks and filters.
- (c) From the L.P. cocks the fuel flows to the dual engine-driven H.P. pumps, through the throttle valves and H.P. fuel cocks to the Duple-type burners.
- (d) A barometric pressure control (B.P.C.) helps to control the delivery pressure of the H.P. pumps and to maintain the correct flow of fuel for a given throttle setting under changes of altitude and airspeed.
- (e) An acceleration control unit (A.C.U.) ensures satisfactory acceleration of the fuel flow for rapid throttle openings and reduces the possibility of engine surge and high jet pipe temperatures.

## PART I—DESCRIPTIVE

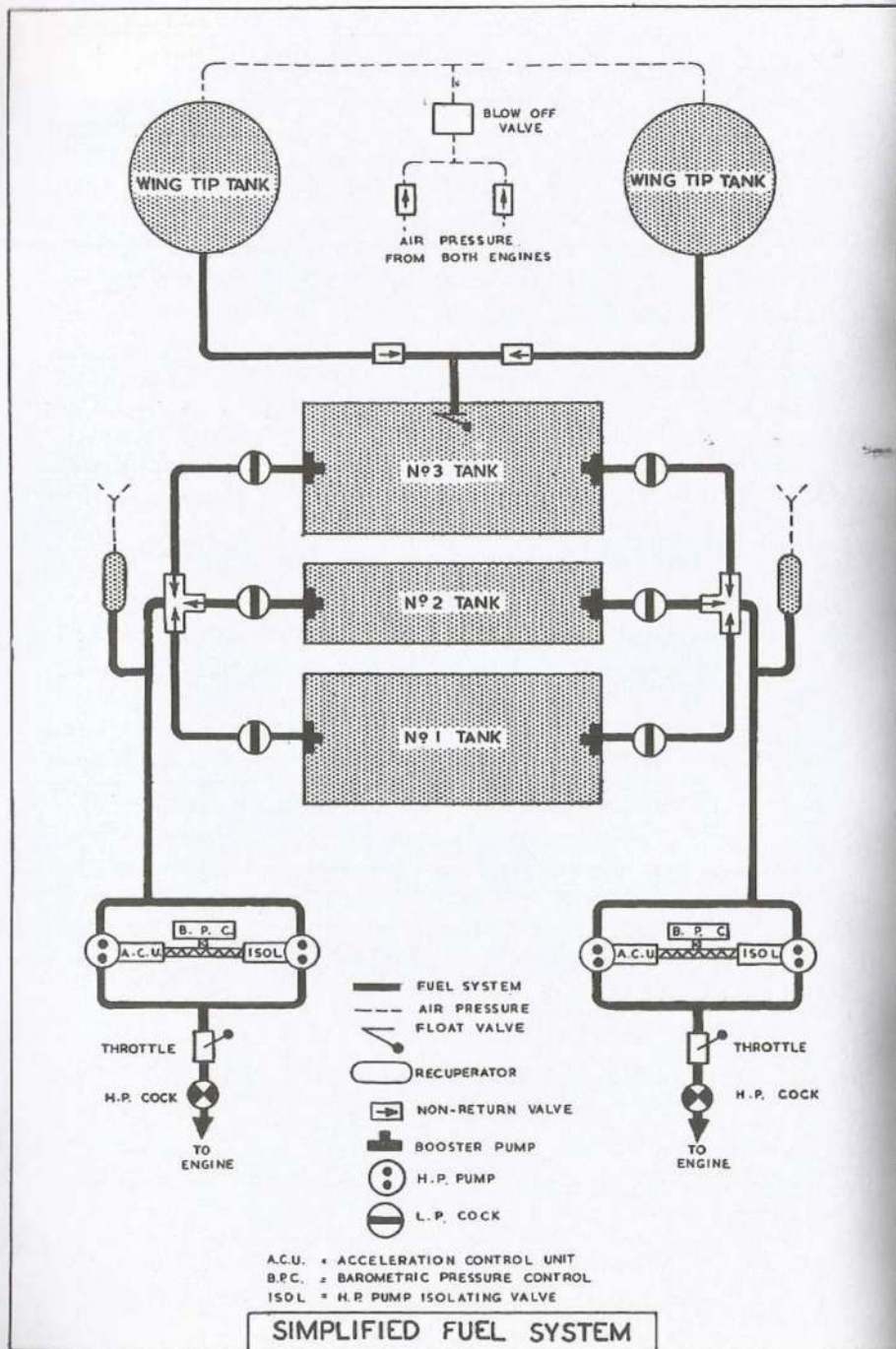
### 2. Fuel tanks

- (a) The three fuselage tanks are of flexible construction; No. 1 and 2 are self-sealing; No. 3 is of the flexible bag type. All tanks are vented to atmosphere. Flush fitting filler caps, one for each tank, are on the port upper surface of the fuselage.
- (b) The wing tip tanks are pressurized from the engine compressors and both feed together and automatically through a float-valve into No. 3 fuselage tank. No cocks or other controls, except the jettison switch (see para. 3) are required for these tanks.
- (c) The effective fuel capacities are approximately:—

	Gallons	Lb. at .77 S.G.	Lb. at .8 S.G.
No. 1 tank ... ..	512	3,942	4,096
No. 2 tank ... ..	317	2,441	2,536
No. 3 tank ... ..	545	4,197	4,360
<i>Total internal fuel</i> ...	<u>1,374</u>	<u>10,580</u>	<u>10,992</u>
Wing tip tanks (2 × 244 gall.) ... ..	488	3,757	3,904
<i>Total, all tanks</i> ...	<u>1,862</u>	<u>14,337</u>	<u>14,896</u>

NOTE.—The capacity of the No. 3 tank may be somewhat less than quoted until the bag stretches with use.

- (d) *Fuel recuperators.* When Mod. 1480 is embodied, a fuel recuperator is fitted in each wing to deal with negative G conditions. The recuperator casing contains a flexible bag and is fed with air from the engines at a constant pressure. The pressure from the fuel booster pumps is higher than this air pressure, and the flexible bag is consequently charged with fuel. During negative G conditions the booster-pumps will cease to deliver fuel and the air pressure in each recuperator will discharge its bag of fuel to the respective engine. The supply in each bag will feed an engine for about 10 seconds at full power at sea level. The recuperators will re-charge when negative G is relaxed.



## PART I—DESCRIPTIVE

## 3. Wing tip tanks jettisoning

Both wing tip tanks may be jettisoned electrically at any speed, full or empty, by pressing the FUEL TANK JETTISON pushbutton (39) on the port console panel. This jettisons both tanks simultaneously by firing explosive bolts.

## 4. Fuel cocks

## (a) L.P. cocks

NOTE.—Until all aircraft are fully modified the following differences will be found:—

*Unmodified aircraft.* Each L.P. fuel cock is controlled by its associated L.P. fuel pump switch, so that when the fuel pump is switched on the fuel cock is opened and when the pump is switched off the cock is closed.

*Partly modified aircraft.* When the first part of Bomber Command Mod. 32 is incorporated, all fuel cocks are electrically disconnected and permanently locked open. The second part of this Mod. introduces control of the L.P. fuel cocks as described below.

A pair of electrically operated L.P. cocks is fitted for each fuselage tank. Of each pair, one cock serves the port engine and the other the starboard engine. All cocks are controlled by the L.P. fuel pump switches (74, 75, 76, 78, 79 and 80) on the engine instrument panel.

The switches have three positions:—

UP	...	Pump on, cock open
MID	...	Pump off, cock open
DOWN	...	Pump off, cock closed.

The switches have to be pulled out before they can be moved to the down position. All cock circuits are protected by circuit-breakers (10, 11 and 12) on the front face of the electrical control pedestal. The engines

## PART I—DESCRIPTIVE

should not be stopped by turning off the L.P. cocks as this causes the engine-driven pumps to run dry and air to be drawn into the pipe lines. For this reason it is also necessary to leave open at least one cock for each engine whenever it is rotating.

### (b) *H.P. cocks*

Two H.P. cocks, one for each engine, are controlled by levers (28) outboard of the throttles. The levers incorporate relighting push-buttons and may be clamped in either the ON (forward) or OFF position by the smaller of the two knurled knobs (32) labelled UNLOCK, LOCK.

### 5. **L.P. fuel pumps**

- (a) Two electrically-driven pumps are fitted in each fuselage tank, one on each side. Each pump feeds through an electrically actuated L.P. cock. The pumps on the port side of the tanks feed the port engine through a common collector box; those on the starboard side similarly supply the starboard engine. Thus either one, two or three tanks can be used to feed either or both engines together or independently. Each pump is controlled from one of six switches (74, 75, 76, 78, 79 and 80) fitted in two rows, one each side of the fuel tank contents gauges, on the engine instrument panel. Their circuits are protected by circuit-breakers (10, 11 and 12) on the front face of the electrical control pedestal.
- (b) On unmodified aircraft (see para. 4 (a)) the L.P. pump switches also control the L.P. fuel cocks. When the pump is on, the cock is open and when the pump is off, the cock is shut.
- (c) On fully modified aircraft the L.P. pump switches have three positions and control the L.P. cocks and pumps as shown in para. 4 (a).

### 6. **H.P. fuel pumps**

The dual engine-driven H.P. fuel pumps are connected by a common servo system to the B.P.C. and A.C.U.

## PART I—DESCRIPTIVE

which control the output of the pumps. Either pump is capable of supplying sufficient fuel at full stroke to permit 70% of take-off thrust to be obtained at low altitudes.

### 7. **H.P. fuel pump isolating valve**

- (a) A solenoid-operated isolating valve is incorporated in the upper pump and is intended as a means of restoring power in flight in the event of a sudden drop in engine r.p.m. caused by failure of the fuel pumps servo system.
- (b) When the switch (33) on the port console panel is set to ISOL., the upper pump is isolated from the B.P.C. and A.C.U. servo system which then controls only the output of the lower pump. The upper pump moves to full stroke and is controlled only by its overspeed governor.
- (c) The use of these switches is covered in para. 56 (f).

### 8. **Fuel pressure warning lights**

Two fuel pressure warning lights (73 and 81) one for each engine, are on the instrument panel. They come on if the fuel pressure at the suction side of the engine-driven pumps falls appreciably below normal due to the failure of the booster pumps or shortage of fuel in the tank(s) in use. For the effect of fuel booster-pump failure, see para. 53 (d).

### 9. **Fuel contents gauges**

- (a) Three capacitor-type gauges (77) are mounted on the engine instrument panel. The upper gauge indicates the contents of No. 1 tank; the centre gauge indicates the contents of No. 2 tank, and the lower gauge indicates the contents of No. 3 tank. No contents gauges are fitted for the wing tip tanks.
- (b) Mod. 1271 introduces contents gauges reading in pounds instead of gallons.

## PART I—DESCRIPTIVE

### 10. Oil system

- (a) Each engine has its own independent integral oil system of 19 pints capacity from which the main engine bearings and engine-driven accessories are lubricated. There are no oil tanks.
- (b) Oil pressure gauges, one for each engine, are on the instrument panel; these register whenever A.C. electrical supply to the instruments is available.

## ENGINE CONTROLS

### 11. Throttle controls

The two throttle levers (27), marked SHUT, OPEN, are on the engine controls quadrant on the port side of the cockpit. The friction is adjusted by the larger (31) of the two knurled knobs on the side of the throttle box; the knob must be turned clockwise to increase the friction.

### 12. Variable-pitch guide vanes and air bleed valves (Post-Mod. Avon 175)

- (a) The first row of stator blades in the engine compressor consists of variable pitch inlet guide vanes which assist in imparting swirl to the incoming air. At low r.p.m. the first stages of the compressor deliver more air than is acceptable to the later stages. To prevent instability of flow, i.e., surge, the surplus air is bled off through air bleed valves, and the guide vanes are held closed to give an angle of flow acceptable to the first stage blades at low r.p.m. As the normal flight range of r.p.m. is reached, the air bleed valves close and the guide vanes move progressively to the minimum swirl position.
- (b) As the engine accelerates, the bleed valves close at 5,900 r.p.m. and the guide vanes start opening at 6,500 r.p.m. reaching the fully open (or minimum swirl) position at 7,250 r.p.m. As the engine decelerates, the guide vanes operate at the same r.p.m. and the bleed valves open at

## PART I—DESCRIPTIVE

5,850 r.p.m. These are the nominal settings for standard conditions; there is a tolerance of  $\pm 50$  r.p.m., and r.p.m. may also be expected to vary somewhat with fuel and temperature.

- (c) No noticeable change in r.p.m. or thrust occurs when the bleed valves change over nor do the guide vanes have any noticeable effect on engine operation. However, until the guide vanes reach the fully open position at about 7,250 r.p.m. the compressor is not operating at maximum efficiency. Better specific fuel consumption will therefore be obtained by operating above 7,250 r.p.m.

### 13. Variable-pitch guide vanes and air bleed valves (Pre-Mod. Avon 175)

Surging in the lower r.p.m. range is minimized by the incorporation in the engine compressor of automatic bleed valves and variable angle swirl vanes. As the engine accelerates, the closing of the bleed valves and change in angle of the swirl vanes cause, at about 6,500 r.p.m., a sudden decrease of approximately 300 r.p.m. with an increase in thrust. The r.p.m. then increase steadily as the throttle is further opened. As power is reduced, when r.p.m. fall to about 6,200, there is a sudden increase of about 300 r.p.m. with a decrease in thrust as the bleed valves open and the swirl vane angle changes. With the bleed valves open the engine operates less efficiently, with a consequent increase in specific fuel consumption.

### 14. Engine starting and stopping controls

- (a) A single-breech cartridge starter is fitted for each engine. They are operated by the starter pushbuttons (83 and 89) below the instrument flying panel. Two MASTER STARTING switches (90) and two IGNITION switches (84 and 88) are fitted below the instrument panel. These switches must be set up for ON.
- (b) The cartridge starter firing pushbuttons and ignition switches are operative only when the master starting

## PART I—DESCRIPTIVE

switch is ON. When the pushbuttons are pressed the starter time sequence switches come into operation to energize the igniters and fire the cartridges. If it is necessary to turn the engines without starting them, the ignition switches should be turned off (down) to ensure that the igniters do not operate when the starter push-buttons are pressed.

- (c) To stop the engines the H.P. cocks should be closed by pulling the levers (28) back.

### 15. Engine relighting system

The igniters may be used to relight an engine in flight, by pressing the relighting pushbutton on the appropriate H.P. cock lever. The ignition switch and the master starting switch must be on.

### 16. Engine instruments

The fuel contents gauges (77) fuel pressure warning lights (73 and 81), r.p.m. indicators, oil pressure gauges, and a dual jet pipe temperature gauge (62), are on the engine instruments panel.

### 17. Engine and fuel tank fire-extinguishers and warning lights

- (a) Three fire-extinguisher bottles are fitted, one for the fuel tank bay and one for each engine. The engine bottles have twin heads and can be discharged into the fuel tank bay.
- (b) Fire warning lights (at 64) on the instrument panel come on when an engine fire trips one or more of the flame switches in the engine bays. The fire-extinguisher should then be operated by pressing the pushbutton (at 64) on the instrument panel. When the fire is extinguished the warning light will go out.
- (c) If fire occurs in the fuel tank bay, the warning light (66) beside the fire-extinguisher pushbuttons will come on

## PART I—DESCRIPTIVE

and all three bottles are automatically fired into the bay. When the fire is extinguished the light will remain on.

- (d) In the event of a crash all three bottles are fired automatically, the engine fire-extinguishers discharging into the engine bays and the fuel tank fire-extinguisher discharging into the fuel tank bay.

## MAIN SERVICES

### 18. Hydraulic system

- (a) A hydraulic pump on each engine draws fluid from a reservoir which contains 16 pints of fluid and is fitted on the starboard side above the equipment bay. A stack-pipe in the reservoir ensures a reserve of fluid for use with the handpump. From the engine-driven pumps fluid is delivered to the system for operating the:—

Undercarriage

Flaps

Wheel brakes

Airbrakes

Bomb doors.

- (b) A handpump to the right of the pilot's seat, works in conjunction with the hydraulic GROUND/FLIGHT cock situated near the front of the bomb bay roof on the starboard side. When the cock is at FLIGHT the handpump can be used to operate only the undercarriage and bomb doors and to charge the brake accumulator. With the cock at GROUND the handpump can be used to test all services. The cock is normally wire-locked in the FLIGHT position. When not in use the handpump handle is stowed in clips above and aft of the entrance door. The handle must be fitted, ready for use, before taxiing and left in position at all times in flight except when the folding seat is occupied.

NOTE.—Until Mod. 710 is fitted, there is no ground/flight cock and the handpump will operate all services in flight as well as on the ground.

## PART I—DESCRIPTIVE

- (c) There are two hydraulic accumulators in the system; the one for the wheel brakes is fitted in the equipment bay, and that for the undercarriage, flaps, airbrakes and bomb doors is in the starboard wing. Each accumulator has an air pressure gauge, the one for the brake accumulator is in the bomb bay on the front bulkhead and the one for the wing-mounted accumulator is in the starboard wheel well. The air pressure in each accumulator should be 1,350 lb./sq. in. when there is no pressure in the hydraulic system. A brake hydraulic pressure gauge (71) is on the starboard control panel. On aircraft incorporating Mod. 887 a gauge (70) is fitted in the cockpit, adjacent to the brake pressure gauge, to show the pressure in the wing-mounted accumulator; if this gauge does not read more than 1,500 lb./sq. in. during flight, a hydraulic failure must be assumed and it is probable that the handpump will have to be used to lower the undercarriage prior to landing.
- (d) A cut-out in the hydraulic pump delivery circuit maintains the working pressure in the accumulators and system at 2,000 to 2,500 lb./sq. in.
- (e) The selector valves for all services except the wheel brakes, are electrically actuated from switches in the cockpit. The wheel brake control valve is mechanically operated and there is provision for mechanical actuation of the selector valves for lowering the undercarriage and opening the bomb doors in the event of electric failure.

### 19. Electrical system—24-volt

#### (a) D.C. supply

A 6kW generator on each engine charges a battery and supplies power for the operation of the electrical services. On aircraft incorporating Mod. 714, the generators are driven through automatically controlled 2-speed gearboxes (see (b) (iii) and (iv) below).

#### (b) Generator control

- (i) Each generator has an ON/OFF switch (3 and 6), a field circuit-breaker (at 1) and a generator failure

## PART I—DESCRIPTIVE

warning light (2 and 7) situated on the electrical control panel. On some aircraft additional warning lights (61 and 63) are at the top of the engine instruments panel. Should a generator fail in flight as indicated by its warning light, its control switch should be set to OFF and after a short pause ON again; this will reset the main generator circuit-breaker if this has tripped. If the warning light does not go out, check and if necessary reset the field circuit-breaker. If the warning light still remains on, the generator should be switched OFF. A voltmeter (5) on the electrical panel indicates the voltage of the d.c. electrical system. When the generators are charging, the normal reading is 28 volts; when they are not charging the normal reading is 24 volts.

- (ii) Should a generator failure warning light remain on, or when flying on one engine, all non-essential electrical load, and in any case No. 5 inverter, should be switched off.

#### (iii) Pre-Mod. 714

The generator cut-in speed is between 3,500 and 3,800 r.p.m. and the cut-out speed is between 3,100 and 2,900 r.p.m. Full output is maintained at r.p.m. in excess of 5,000. Should at any time the voltmeter reading fall below 22 volts when low r.p.m. are being used, r.p.m. should be increased and maintained above 5,000 for as long as practicable and all non-essential electrical load switched off.

#### (iv) Post-Mod. 714

The generators cut in at an engine speed of approx. 1,700 r.p.m. and cut out at slightly below this figure. Full output is maintained at r.p.m. in excess of 3,000. Should at any time the voltmeter reading fall below 22 volts when the engines are idling, r.p.m. should be increased and maintained above 3,000 for as long as practicable and all non-essential electrical load, and in any case No. 5 inverter switched off.

PART I—DESCRIPTIVE

(c) *Battery control*

- (i) An external battery socket is behind an access door on the starboard side of the fuselage aft of the entrance door. When an external battery is plugged in, the aircraft batteries are automatically isolated. Until removed by Mod. 258 a ground/flight switch is fitted beside the external battery socket on some early aircraft. When the switch is set to ground, the aircraft batteries are isolated from the system; all services can, however, be operated from a ground battery or by current supplied by the generators if the engines are running above the generator charge r.p.m.
- (ii) A battery isolating switch (4) on the electrical control panel, when set to OFF, isolates the battery from the electrical system with the exception of the crash switches, the canopy, escape hatch and bomb jettison circuits. A similar isolation of the electrical services is effected automatically by the crash switches which also operate the engine fire-extinguishers.
- (iii) The fire-extinguisher, canopy, hatch and elevator control detonator circuits are connected directly to the battery so that they remain operative when the battery has been isolated by operation of the crash switches, or if the battery isolating switch has been put OFF prior to a crash landing. They are also directly connected to the emergency battery (see below), so remain operative if the main battery is disconnected.

(d) *Emergency battery — Mod. 450*

An additional 24-volt battery, completely independent of the normal electrical system, is directly connected to the canopy and elevator control detonator circuits. It is also used for the emergency lighting and for the emergency supply to the turn-and-slip indicator.

(e) *Emergency battery — Pre-Mod. 450*

A separate 2.4-volt battery is provided for operating the emergency panel lamps.

PART I—DESCRIPTIVE

(f) *Circuit-breakers*

- (i) Twelve circuit-breakers (10, 11 and 12), one for each L.P. cock and each L.P. pump, are situated on the forward face of the electrical control panel. Any circuit-breaker which has tripped due to temporary overload may be reset by pressing its ON push-button. A circuit-breaker marked PILOT'S SERVICES (at 1), mounted on the electrical control panel, protects the supply to:—
  - External lights and landing lamp
  - D/V panel de-misting heater
  - Pressure head heater.
- (ii) The d.c. supply to No. 2, 3 and 4 inverters is protected by three circuit-breakers below the electrical control panel, and to No. 5 inverter by a circuit-breaker in the equipment bay. The supply to the inverter relays is protected by two circuit-breakers below the electrical control panel.

(g) *Inverters*

A.C. is supplied by four inverters.

**Distribution of power from inverters**

Inverter No.	Supply to:—	Emergency changeover to:—
2. 115V-400 c/s	Artificial horizon Mk. 4B compass Oil pressure indicators	No. 3 inverter
3. 115V-400 c/s	Bomb sight head and computer Radar cooling motors No. 5 inverter regulator cooling motor Stand-by for No. 2 inverter	No stand-by
4. 115V-1600 c/s	Emergency stand-by for No. 5 inverter (operates at reduced output)	No stand-by
5. 115V-1600 c/s	Radar equipment (Rebecca—Gee H—tail warning device)	No. 4 inverter

## PART I—DESCRIPTIVE

### (h) Control of inverters

- (i) No. 2 inverter starts running when the starboard master starting switch is set to ON. No. 3 inverter starts running when the port master starting switch is ON, or when No. 5 inverter starts up, but only supplies power to the flight instruments if No. 2 inverter fails or if only the port master starting switch is ON. In the event of failure of No. 2 inverter the flight instruments are automatically supplied by No. 3 inverter. At the same time, an indicator (49) on the instrument flying panel shows white.
- (ii) Failure of both No. 2 and 3 inverters will be indicated by the failure of the flight instruments (except the turn and slip indicator) and of the oil pressure indicators.
- (iii) No. 5 inverter is controlled by two switches (at 8) on the electrical control panel, marked START and STOP, and a changeover switch (at 8) marked No. 4/No. 5 inverter. In the event of failure of No. 5 inverter the a.c. supply can be maintained by switching the changeover switch to No. 4, and switching on No. 4 inverter switch (at 8). No. 4 inverter operates at a reduced output and automatic isolation of the tail warning device and the transmitter of the Gee H equipment is provided. Both Rebecca and the Gee receiver remain operative, but only one of these aids should be used at a time to prevent over-loading No. 4 inverter.

NOTE.—No. 5 inverter must not be started unless at least one generator is charging at 28 volts. When starting No. 5 or No. 4 inverters the individual services supply switches must be OFF.

- (iv) Three ON-OFF switches (at 9), labelled for their respective services, distribute the output of No. 5 inverter in addition to the d.c. supply to the individual equipment. On some aircraft an a.c. volt-

## PART I—DESCRIPTIVE

meter (86), showing the output of No. 5 inverter, is below the instrument panel.

## AIRCRAFT CONTROLS

### 20. Flying controls

The flying controls are conventional and the rudder pedals are adjustable for reach by a central star wheel. The control column handwheel carries:—

Wheel brake lever (54)

Brake parking catch

Tailplane incidence control switch (57) and cut-in pushbutton

V.H.F. press-to-transmit pushbutton (56)

Airbrake control switch (50)

Bomb release pushbutton (48).

### 21. Flying controls locking gear and picketing points

#### (a) External locks

All control surfaces are locked by external clamps with red flags attached. When not in use the clamps are stowed in a valise in the rear fuselage reached through the camera hatch. Operation of the flap selector switch when the external clamps are fitted can damage the flaps; this is prevented by inserting a locking pin in the flap selector switch guard. The pin is stowed with the locking clamps in the valise.

#### (b) Picketing

Ring bolts are provided for picketing; they are stowed with the control locking clamps and screw into sockets

## PART I—DESCRIPTIVE

covered by flaps labelled PICKETING POINT on each main undercarriage fairing and below the fuselage aft of the rear skid. A fourth picketing attachment is provided by the radius rod lugs on the nosewheel strut.

### 22. Variable incidence tailplane and trimming controls

- (a) The tailplane incidence is electrically controlled by a tail trim switch (57) labelled NOSE DOWN, NOSE UP, on the control column right-hand grip. The limits of the tailplane travel are controlled by electrical limit switches; if these switches fail, the actuator will run on slightly until stopped by positive mechanical stops.
- (b) A master cut-in pushbutton (Mod. 1925) is positioned just forward of the tail trim switch. This pushbutton, which is spring-loaded to the off position, controls a master relay in the power circuit to the tailplane actuator. Until it is pressed, therefore, no current can reach the actuator, and when it is released the power supply to the actuator is cut off irrespective of any selection of the tail trim switch. When trimming is required, the tail trim switch and cut-in pushbutton must be operated and released simultaneously (see para. 67(d)).
- (c) The rudder combined trimming tab and spring tab, and aileron bias gear are also electrically operated by switches (36 and 37) on the port console panel.
- (d) Position indicators (41, 46 and 92) for all three trimming controls are on the instrument panel.

### 23. Undercarriage controls and indicator

- (a) Two pushbuttons (42) to the left of the instrument panel control the electrical actuators for the undercarriage selector valve. The top button is pressed for UP and the bottom button for DOWN. An electrically operated lock prevents normal operation of the UP button when the weight of the aircraft is on the wheels. The lock can be overridden by turning the up button until the knobs

## PART I—DESCRIPTIVE

on the button are up and down; undercarriage UP can then be selected by pressing the button. This override must not be used in flight. The electrically operated lock may not function when the aircraft weight is very low.

- (b) A standard undercarriage position indicator (40) is fitted below the pushbuttons. The red nosewheel light comes on at any time if either throttle is less than one-third open when any wheel is not locked down.

### 24. Undercarriage emergency lowering

- (a) If the undercarriage selector valve fails to operate electrically, it may be operated mechanically by pulling the toggle handle (44) fitted above the selector pushbuttons. It must first be established that failure of the undercarriage to lower is due to failure of the selector and not to hydraulic failure (see para. 89).
- (b) After the emergency toggle handle has been pulled it is not possible to retract or unlock the undercarriage.

### 25. Flap control

- (a) The flap selector is controlled electrically by a switch lever (43) marked UP and DOWN, on the port front panel. The flaps have only two positions, fully up or fully down. In the event of hydraulic failure the flaps cannot be operated by the handpump, and in the event of electric failure it is not possible to operate the selector.
- (b) The flap position indicator (91) is on the instrument panel.

### 26. Airbrakes control

Either two-position or three-position airbrakes are fitted. They are controlled by a switch (50) on the control column, which is marked IN, OUT or IN, MID, OUT. The MID position is equivalent to the OUT position in the two-position system.

### 27. Wheel brakes control

- (a) The hydraulic wheel brakes are operated by the lever (54) on the control column. A parking catch is provided.

## PART I—DESCRIPTIVE

Differential braking is obtained by movement of the rudder bar.

- (b) The gauge (71) on the right of the instrument panel shows the available brake pressure in the brake accumulator. Normally 2,500 lb./sq. in., this pressure allows several full applications of the brakes if the main system has failed, and in this event the pressure will fall to 1,350 lb./sq. in. as the brakes are used. At this point the accumulator is discharged of hydraulic fluid and pressure will drop rapidly to zero. Thus, as the pressure falls towards 1,350 lb./sq. in., reliance should not be placed on the continued availability of the brakes. Pressure may, however, be restored by means of the handpump, provided that fluid is available.

### 28. Flight instruments

(a) *A.S.I. system*

The pressure head is at the bottom left of the nose and the heater is controlled by a switch (17) on the port console panel. On later aircraft the pressure head is in the centre of the nose. Two static vents are fitted, one each side of the nose of the aircraft.

(b) *Mk. 4B compass*

A Mk. 4B gyro compass is installed. The master indicator and control panel are at the navigator's station. The pilot's repeater, which can also be used as a directional gyro, is fitted centrally on the instrument flying panel. The repeater embodies caging and setting knobs and an annunciator. A changeover switch (82) marked COMP.-D. GYRO is below the instrument flying panel.

(c) *Magnetic stand-by compass*

An E2A stand-by compass is fitted centrally below the coaming. A few early aircraft have a P.12 compass instead, fitted below the coaming on the starboard side.

(d) *Artificial horizon*

On some aircraft the artificial horizon has a fast erection pushbutton below and to the left of it. The instrument

## PART I—DESCRIPTIVE

is not self-erecting when first switched on, unless the horizon bar is within 10° of horizontal in the roll sense. After the engines have been started the fast erection button must, therefore, be pushed in and held until the horizon bar falls well within these limits. This may take some 10 seconds. Self-erection within the 10° limits is slow; about 5° per minute. If the gyro is toppled in flight, the aircraft must be flown level by reference to the other instruments before the fast erection button is pressed. The gyro will not topple in roll, but only if 80° of climb or dive is exceeded.

(e) *Turn and slip indicator*

The turn and slip indicator is operated from duplicated 24-volt d.c. supplies having automatic changeover. Both supplies are primarily controlled by the MASTER START switches. When Mod. 450 is embodied, an additional stand-by supply, taken from the emergency battery, is controlled by a switch beside the indicator. This should normally be set to OFF, but if both supplies fail, the switch should be set to ON, when the indicator will be supplied by the emergency battery.

(f) *Altimeter*

The altimeter is subject to error during rapid descents from high altitude. Tests indicate that these errors may be up to 200 feet, the altimeter reading high.

## COCKPIT EQUIPMENT

### 29. Access

Entrance to the pressure cabin is through the door on the starboard side of the fuselage below the canopy. It is opened from outside by pressing the button to release the handle which is then pulled out and turned anti-clockwise. From inside, the door is locked by rotating the handle near the lower edge anti-clockwise and then pulling the handle inboard. To open the door the button forward of the handle is pressed, the handle pushed outboard and rotated clockwise.

**30. Emergency operation of the entrance door**

The entrance door can be jettisoned by turning the crank fitted centrally above it. This releases the hinge pins allowing the door to fall outwards. The crank may be stiff to operate and four and a half full turns are required. The normal handle should not be used to open the door in flight.

**31. Canopy and hatch jettisoning and control column snatch unit**

NOTE.—These circuits are connected through the master switch direct to the battery bus-bar and also, when Mod. 450 is embodied, to the separate emergency battery. If the master switch (29) is on, they will function if the battery isolation switch is off, or if the crash switches have tripped, or when Mod. 450 is embodied, even if the main battery has become damaged or disconnected.

- (a) A panel marked DANGER DETONATORS on the port console carries:—
- (i) A MASTER SAFETY SWITCH (29) which must be set to ON before the canopy jettisoning or control column snatch unit can be operated. It should be set to ON before take-off and switched OFF after landing.
  - (ii) A guarded CANOPY JETTISON SWITCH (30) which, when set to ON, fires the detonators to explode the canopy bolts thus allowing the canopy to blow off. It does not operate the control column snatch unit.
- (b) A lever on the port console panel, shielded by a flap (38) marked DANGER CONTROL COLUMN RELEASE, controls an explosive charge which, when fired, severs the elevator control rod. The same lever operates a snatch device which pulls the control column fully forward. It is for use before abandoning the aircraft. It should only be operated immediately before abandoning as control

of the elevators is lost as soon as the explosive collar fires, though the variable incidence tailplane remains operative for longitudinal control.

NOTE.—Although the snatch unit spring is strong enough to pull the control column forward when the elevator tube is severed, its accidental release in flight (without operating the lever and severing the elevator tube) will have very little noticeable effect. It will be indicated by the need for about half a degree nose up trim in flight, and an increased pull force necessary to unstick on take-off.

- (c) The navigator's roof hatch is jettisoned independently of the canopy by setting the SAFETY switch to ON and then operating the associated guarded switch marked JETTISON. These switches are on the cabin port wall at the navigator's station and are duplicated on the starboard side.

**32. Ejection seats—Mk. 1C**

WARNING.—Whenever the aircraft is on the ground the firing handle must always be locked against the possibility of accidental withdrawal. A fabric safety strap attached to the drogue container should be passed through the blind handle and secured by means of the safety pin to which is attached a metal disc. It is the occupant's responsibility to do this after landing, and to remove and stow the pin in the stowage provided on the starboard side of the drogue container prior to take-off. Immediately on entering the cockpit, personnel must ensure that the firing handles are locked.

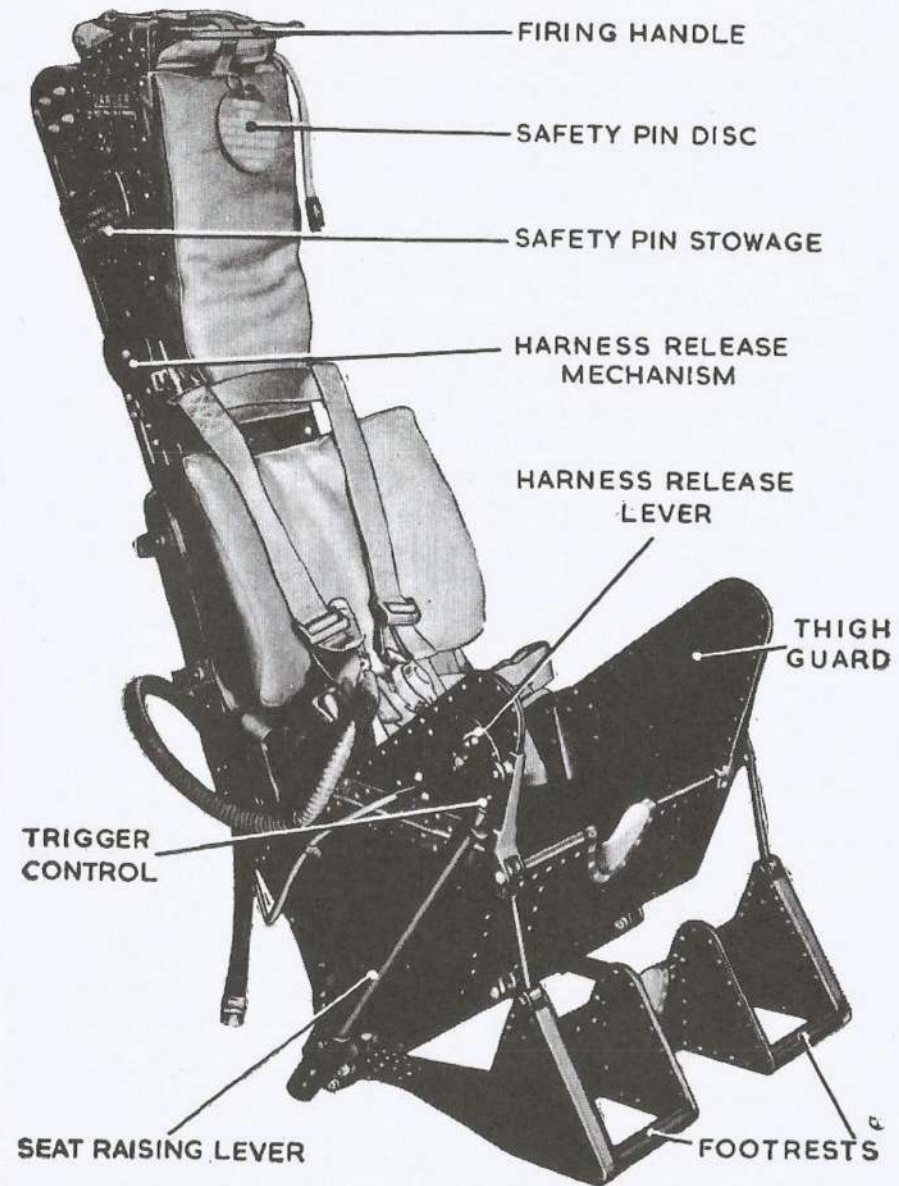
- (a) The ejection seat incorporates a headrest, footrests, and two thigh guards. The right thigh guard can be folded down to make access easier by releasing the clamp at the forward edge. Adjustment for height is effected by a lever, incorporating a thumb-operated spring-loaded catch, on the starboard side of the seat. At the rear of

## PART I—DESCRIPTIVE

the seat is the ejection gun and on the port side the drogue gun. The ejection gun is fired by a handle immediately above the headrest, to which is attached a flexible blind to protect the face. When the handle is pulled down to the full extent of its travel it fires the seat. The drogue gun, which releases a drogue parachute stowed in the container behind the headrest, is fired by a static line attached to the aircraft and does not operate until the seat is well clear.

- (b) The Z-type harness lock may be released by a spring-loaded lever on the starboard thigh guard, to allow the wearer to lean forward. When the lever is released the harness is locked by a ratchet mechanism from going further forward; as the wearer leans back, however, the harness is locked in any position, and to lean forward again he must operate the spring-loaded lever. If in the first instance the wearer leans forward more than six inches before releasing the lever, the harness locks will be beyond the ratchet mechanism and the wearer can lean forward or back as desired until he leans back to the six-inch position, where the ratchet mechanism again comes into play.
- (c) The drogue parachute slows down and stabilizes the seat. On modified seats an automatic harness release operates in conjunction with a barometric parachute release; no provision is made for forcibly separating the pilot from the seat, as in fully automatic seats, and the seat must be kicked away after the automatic harness release has operated. The ejection of the seat starts a delay mechanism which operates the harness release after  $1\frac{1}{2}$  seconds. The barometric control is then set to operate the parachute rip cord at a height of 13,000 ft. If the ejection height is below 13,000 ft. the parachute will be released two seconds after the separation of the seat and its occupant. Manual operation of the parachute and harness is normal, though the harness quick-release can only be operated one way, i.e., to the left. A manual override for operating the parachute is also provided, but this should only be used when ejection is at a very low altitude as it provides instant operation of the parachute. With unmodified seats, the harness should be released after ejection and a normal parachute descent made.

## PART I—DESCRIPTIVE



Ejection seat—Mk. 1C

**33. Folding seat**

A folding seat is provided on the cockpit starboard wall beside and aft of the pilot. When not in use it folds up against the starboard wall where it is secured by a strap. A pair of lap straps is fastened to the seat.

**34. Cabin heating and ventilating (Pre-Mod. 5)**

- (a) The cabin is heated with a controllable mixture of hot air from the engine compressors and cold air from an inlet in the wing leading edge. The mixing valve is controlled by adjusting the switch (69) on the right of the instrument panel, which is marked COLD-HOT and is spring-loaded to the mid (off) position. The setting of the mixing valve is shown on an indicator (65) on the right of the instrument panel. The upper half of the indicator is divided in two; the left-hand sector is coloured blue and is marked COLD, and the right-hand sector is red and is marked HOT.
- (b) When the indicator needle is right over to the left in the blue sector, the mixing valve is in the fully cold position and only cold air from the duct in the wing leading edge is admitted to the cabin. When the switch is moved to HOT the mixing valve progressively reduces the amount of cold air and increases the amount of hot air, the indicator needle turning clockwise across the blue sector. The valve is stopped in any desired position by releasing the switch. When the needle reaches the vertical position the cold air inlet is shut off and only hot air from the engine compressors reaches the cabin, though at this setting most of the hot air is being passed through coolers in the wing roots. As the needle moves further into the red segment, hot air is coming in at its maximum temperature. The mixing valve should be returned to the fully cold position after landing.
- (c) At low altitudes, cold air can be admitted to the cabin through three vents below the instrument panel. These shut off automatically when pressurizing commences but should always be closed when cold air is not required.

**35. Cabin heating and ventilating (Post-Mod. 5)**

- (a) The cabin is heated with hot air from the engine compressors. The temperature is controlled by a mixing valve by means of which any desired proportion of the hot air may be passed through coolers in the inner plane leading edges and a cold air unit in the port inner plane. An isolating cock is fitted in the air supply line from each engine. These are operated by two cabin air switches (72) on the right of the instrument panel, which must be set ON before heating or pressurizing can be obtained. The mixing valve is controlled by adjusting the switch (69) on the right of the instrument panel, which is marked COLD-HOT and is spring-loaded to the mid (off) position. The setting of the mixing valve is shown on an indicator (65) on the right of the instrument panel.
- (b) When the indicator needle is fully over to the left, the mixing valve is in the fully cold position and all the hot air from the engines is passed through the coolers and the cold air unit. When the switch is moved to HOT the mixing valve progressively reduces the amount of air passed through the cold air unit and increases the amount of hot air passed direct to the cabin, the indicator needle turning clockwise across the dial. When the needle reaches the right of the scale all the hot air from the engines is fed straight to the cabin. The mixing valve is stopped in any desired position by releasing the switch. It should be returned to the fully hot position after landing, and the cabin air switches should be put off.
- (c) Air from the system is passed into the cabin at various points to supply the pilot and navigators. A separate duct directs air on to the bombing window.
- 36. Cabin pressurizing**
- (a) At about 10,000 ft. a pressure control valve, operated from a static vent on each side of the nose, comes into operation to control the outlet of air from the cabin, thus allowing the heating and ventilating system to build up pressure until the full differential of 3.5 lb./sq. in. is reached at about 26,000 ft. Above this height the differential pressure is constant, and the cabin altitude is shown on an altimeter (68) on the right of the instrument panel.

## PART I—DESCRIPTIVE

Aircraft altitude (ft.)	Cabin altitude (ft.)
10,000	10,000
25,000	13,000
40,000	22,000
50,000	26,000

- (b) On aircraft not incorporating Mod. 5, as the cold air for ventilation is only at ram pressure, full pressurizing will not be obtained while the mixing valve is admitting cold air. When pressurizing and ventilation is required, therefore, the valve must be adjusted until the indicator needle is vertical or in the red sector. (See para. 35(b)). On aircraft embodying Mod. 5, the cabin air switches must be ON before pressurizing or ventilation can be obtained.
- (c) A warning horn sounds if the cabin pressure falls excessively. A horn override switch (67) is on the starboard instrument panel.

### 37. Canopy, D.V. panel and de-misting

- (a) The jettisonable canopy cannot be opened on the ground or in flight. A direct vision window is fitted. The window is electrically heated, the switch (16) being on the port console panel. At low altitudes, at which the cabin is not pressurized, the window can be opened by unscrewing the knurled clamping knob and hinging the frame downwards ensuring that it engages in the retaining clip. The window must always be closed and tightly secured before the aircraft is taken to altitudes at which pressurizing becomes effective.
- (b) The entire canopy, the navigator's window, and the plastic nose are of the "dry air" sandwich type. Cartridges containing the drying agent for the canopy and the navigator's window are fitted, one on the coaming behind the pilot's right shoulder, and one on the shelf behind the seat. Another cartridge is mounted just aft of the plastic nose. Small indicator windows in the casings enable the crystals to be seen; they will appear pink when the cartridges are unserviceable. Dry

## PART I—DESCRIPTIVE

air is circulated through the canopy by a small electrically-driven fan controlled by a switch (13) marked CANOPY DE-MISTER on the port console panel.

- (c) On aircraft incorporating Mod. 739 a perforated tube along the coaming in front of the pilot, is fed with hot air from the cabin heating system and directs this hot air on to the front of the canopy. A control valve (45) on the tube below the coaming on the left side enables the pilot to regulate the flow of hot air. The de-mister must not be on during a climb. It should be turned on when starting a descent from altitude and turned off again immediately de-misting is complete.

### 38. Oxygen system and pressure-breathing

- (a) The oxygen cylinders are stowed on the port side, aft of the pressure bulkhead.
- (b) A Mk. 11C regulator (24) is fitted on the port wall of the cockpit for the pilot. A Mk. 11D regulator on the port wall at the navigator's station supplies oxygen to the navigator as well as to two Mk. 11E regulators fitted one on the starboard side of the cabin at the air bomber's station, and the other at the air bomber's forward station. Three economizers are fitted, one for the pilot, one for the navigator and one for the air bomber. At the forward station only pressure-breathing is provided.
- (c) The supply from the regulators is taken to selector valves marked P.B. and ECON. The valve for the pilot is to the right of his seat at the bottom of the electrical control pedestal, that for the navigator is on the port wall at his station and that for the air bomber is on the starboard wall. The selector valve enables oxygen to be used with or without pressure-breathing equipment and should be set as follows:—
- (i) *With pressure-breathing equipment*  
Turn on the oxygen and set the selector to P.B. The oxygen then by-passes the economizer and flows to the pressure-breathing waistcoat and the type "J" oxygen mask. The flow selector lever on the regulator is used in the normal way to vary the flow according to the cockpit altitude.

## PART I—DESCRIPTIVE

### (ii) *Without pressure-breathing equipment*

After turning the oxygen on and setting the selector to ECON., the oxygen flows through the economizer and thence to the mask.

NOTE.—Damage will result to the economizer if pressure-breathing equipment is used with the selector at ECON.

### (d) *Audio-warning*

When Bomber Command Mod. 36 is embodied an audible warning is given in the earphones if any mask tube is not properly connected. An ON/OFF override switch (85), normally wired ON, is below the instrument panel.

## 39. Oxygen emergency supply

Each crew member has an emergency supply of oxygen for use when abandoning the aircraft. The bottles are carried in the parachute packs and are connected to the main oxygen supply tubes at the quick release socket. This reserve supply can be made available in the event of failure of the main system by pulling up the ball on the operating cable at the right-hand side of the seat pan. The supply is operated automatically when the ejection seat is fired. A further reserve bottle is mounted in the nose for the use of the air bomber when at his forward station.

## 40. Cabin lighting

- (a) The cabin is illuminated by two dome lamps, one on each side of the roof in the navigator's compartment. The lamp-holders incorporate switches. Small floodlamps are fitted near the dome lamps. They are controlled by dimmer switches adjacent to them.
- (b) The cockpit instrument panels are illuminated by 4 U.V. and 4 red floodlamps. Four dimmer switches (51, 53, 58 and 60), each controlling two lamps, are fitted centrally on the coaming.

## PART I—DESCRIPTIVE

- (c) Emergency panel lamps are on either side below the coaming. The ON-OFF switch (55) for these is on the coaming; it has a luminous spot for identification in the dark. These emergency lamps are operated from a separate battery (see para. 19 (d) and (e)).
- (d) In addition to the main lamps and floodlamps in the navigator's compartment there is a portable chartboard lamp with an integral dimmer switch, which can be plugged into either of two sockets, one embodied in each of the main dome lamps.
- (e) A dome lamp with an integral switch is fitted at the air bomber's nose station.

## 41. External lighting

- (a) An EXTERNAL LIGHTS MASTER switch (at 34) is on the port console panel; it must be set ON before any of the external lights will function. All external lighting circuits are protected by the PILOT'S SERVICES circuit-breaker (at 1) on the rear face of the electrical control panel.
- (b) The navigation lights are controlled by a switch (at 34) near the master switch. Duplicate lights, controlled by the same switch are in the nose of the wing tip tanks.
- (c) An identification lights selector switch and colour switch (at 34) and a MORSE pushbutton (35) are on the same panel.
- (d) The landing lamp under the port wing is controlled by a three-position switch (at 34) marked OFF, LOW, HIGH, on the port console panel.
- (e) A switch (at 34) on the port console panel controls the taxiing lamps in the wing tips.

## 42. Emergency equipment

### (a) *Signal pistol*

There is a pressure-tight mounting for a signal pistol in the escape hatch in the roof of the navigator's compartment. The pistol can be removed from its mounting when the cabin is not pressurized.

## PART I—DESCRIPTIVE

### (b) *Hand fire-extinguisher*

A hand fire-extinguisher is stowed on the starboard wall of the fuselage aft of the entrance hatch.

### (c) *Crash axe*

A crash axe is stowed on the cockpit starboard wall.

### (d) *Asbestos gloves*

A pair of asbestos gloves is stowed on the cockpit starboard wall.

### (e) *First-aid kit*

A first-aid kit is stowed on the starboard side of the cockpit.

## RADIO AND RADAR EQUIPMENT

### 43. **V.H.F. installation**

The V.H.F. incorporates two transmitter-receivers, T.R.1934-T.R.1935. The channel selectors, volume control and changeover switch (87) are at the bottom of the instrument flying panel. On a few early aircraft they are on the cockpit port wall. A press-to-transmit push-button (56) is on the control column handwheel.

### 44. **Intercomm.**

(a) Intercommunication is by amplifier A.1961 or A.3713 with the V.H.F. T.R.1934/35 as an emergency stand-by. The **ON-OFF** and **NORMAL-EMERGENCY** change-over switches (25) are on a panel on the cockpit port wall. The pilot's Mic/Tel. socket is on the left of his seat back.

(b) Later aircraft have an external intercomm. socket fitted on the starboard side of the fuselage, just below the wing.

## PART I—DESCRIPTIVE

### 45. **Radar equipment**

#### (a) *Gee-H—A.R.I. 5829*

This equipment is under the control of the navigator. The pilot's indicator (52) which consists of three small lamps is on the top left of the instrument panel.

#### (b) *Rebecca—A.R.I. 5610*

This equipment is under the control of the navigator.

#### (c) *I.F.F.—A.R.I. 5131*

The control is at the navigator's station. The receiver control switch and G/D switch (26) are on a panel above the pilot's port console.

#### (d) *Rear warning—A.R.I. 5800*

The control unit is on the port console panel and the equipment gives audible warning in the crew's headphones. The visual indicator (59) is on the pilot's instrument panel.

## OPERATIONAL CONTROLS

### 46. **Bomb doors**

The bomb doors are operated by the pilot by means of a switch (19) marked **OPEN**, **CLOSE**, mounted on the port console panel; a red light (20) alongside the switch comes on when the doors are fully open. On later aircraft two indicators are fitted alongside the switch and indicate white when the doors have reached the selected position.

### 47. **Bomb control installation**

(a) The main bomb controller and distributor are on the starboard side of the fuselage at the air bomber's station.

- (b) The bomb release pushbutton is on the starboard side in the nose compartment, and is duplicated on the control column (48).
- (c) A bomb safety switch (14) on the port console panel must be set ON before any bombing circuits can be operated.

#### 48. Emergency operation of bomb doors and jettisoning bombs

- (a) In emergency the bomb doors can be opened and all bombs jettisoned by the pilot by the shielded EMERGENCY BOMB JETTISON switch (21) on the port console panel.
- (b) Should the doors fail to open when the emergency jettison switch is operated, the door selector valve can be operated mechanically by means of the lever (23) on the port side of the cockpit. The lever should be pulled down after releasing the gate. If the defect is electrical the doors should then open and the bombs automatically jettison as soon as the doors reach the fully open position, provided the jettison switch is still on. If the indicator light does not come on, however, indicating that the doors have not opened, a hydraulic fault is the probable cause and an attempt may be made to open them by means of the handpump.
- (c) If the emergency lever is operated it is impossible to close the doors subsequently in flight. The doors should, therefore, not be opened by this means if it is of vital importance to reclose them after jettisoning the bombs. If time permits an attempt should be made by selecting air brakes or flaps to ascertain whether the defect is electrical or hydraulic. If these fail to operate, a hydraulic failure may be assumed and the handpump used to open the doors, and, after resetting the bomb door selector switch to CLOSED, to close them. Subsequent lowering of the undercarriage by the handpump may not prove possible.

#### 49. Camera controls

The camera is controlled by the air bomber, the control unit and switch box being mounted on the cabin starboard wall at his station.

## PART II

## LIMITATIONS

#### 50. Engine limitations—Avon Mk. 1

	R.P.M.	J.P.T.
<b>Max. take-off and operational necessity</b>	7,800 ± 50	600
<i>30 Mins. limit</i>		
<b>Max. continuous</b>	7,600	565
<b>Idling on the ground</b>	2,750 ± 100	500
<b>Oil pressures</b>		
Minimum idling ... ..		3 lb./sq. in.
Minimum at 7,400 r.p.m. and above		15 lb./sq. in.
Normal at 7,400 r.p.m. ... ..		20 lb./sq. in.

#### 51. Flying limitations

- (a) The aircraft is designed as a light bomber. Intentional spinning and aerobatics are not permitted.

This file was downloaded  
from the RTFM Library.

Link: [www.scottbouch.com/rtfm](http://www.scottbouch.com/rtfm)

Please see site for usage terms,  
and more aircraft documents.

