PILOT'S NOTES

GNAT Mk. 1

FOR

THE FINNISH AIR FORCE

PREPARED BY

FOLLAND AIRCRAFT LTD.,
HAMBLE, SOUTHAMPTON,
ENGLAND.

COPY NO 7.

Sqn. Ldr. Tennant.

GNAT MK. I

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AMENDMENT RECORD SHEET

Incorporation of an Amendment List in this publication is to be recorded by signing in the appropriate column and inserting the date of making the amendment.

A.L. No.	Initials	Date	A.L. No.	Initials	Date
1	-- INCORPORATED --		10	VL.	26/11/58
2			11	VL	16/1/59
3			12	VL.	13/3/59
4			13	VL	13/3/59
5			14	VL	25/4/59
6	VL.	15/9/58	15	VL	15/5/59
7	VL.	6/10/58	16	VL	23/6/59
8	VL.	27/10/58	17	VL	31/7/59
9	VL.	7/11/58	18	VL.	4/1/60

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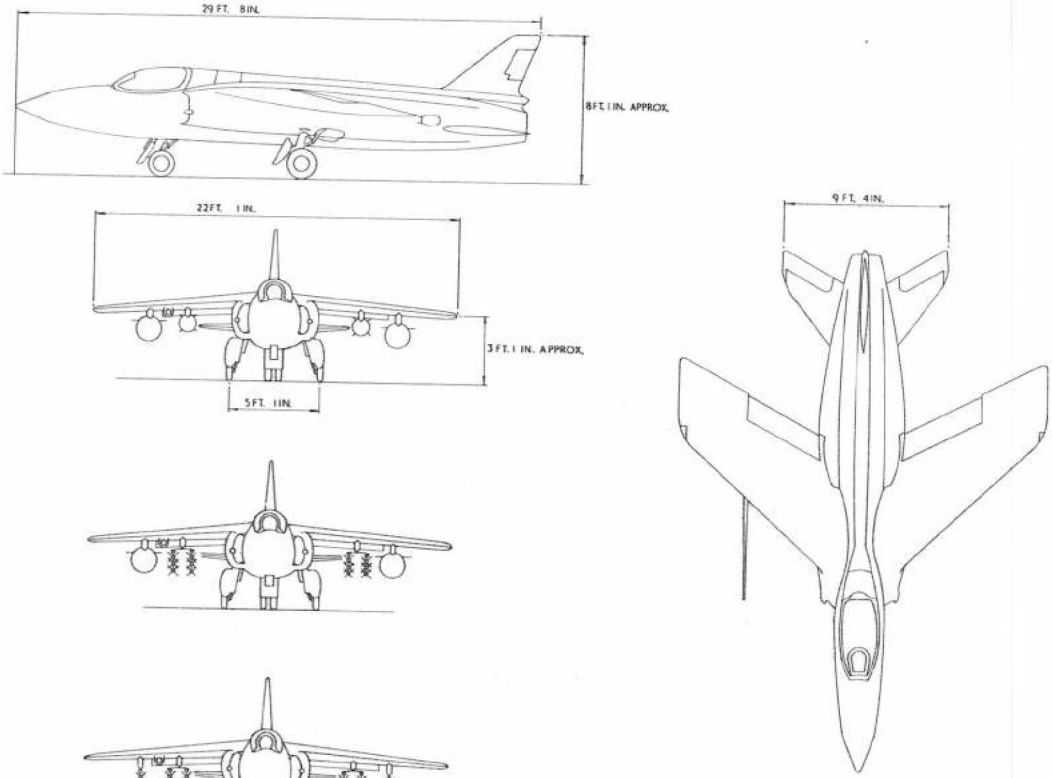

General Arrangement

AL.14.MAR.'59

GNAT MK. I

PILOT'S NOTES

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PART I

DESCRIPTIVE

Introduction

The GNAT Mk.1 is a single seat, swept wing light fighter aircraft powered by a Bristol Orpheus 701 series turbo-jet engine.

Provision is made for the installation of the standard armament of two 30 m.m. Aden guns together with the Mk. 8 gunsight and the G.90 camera.

The cockpit is pressurised and is fitted with a Folland light weight pilot ejection seat, which is interconnected with the canopy.

Powered ailerons and a flying tail are fitted. The rudder is manually operated.

FUEL AND OIL SYSTEMS

1. Fuel Tanks

(i) Seven internal tanks are fitted in the fuselage (nine post Mod. GN.53). The forward tanks, Nos. 1 and 1A and the aft tanks, Nos. 3, 4, 5 and 6, (7 and 8 post Mod. GN.53), feed into No. 2 tank through a flow-proportioning valve, the level being controlled by a float valve. The engine is supplied with fuel from No. 2 tank via a low pressure booster pump located in the tank. Inter-tank fuel transfer is by air pressure from the engine compressor, reduced to 3 p.s.i. through a pressure reducing valve. A relief valve is fitted to prevent excessive pressure in the tanks.

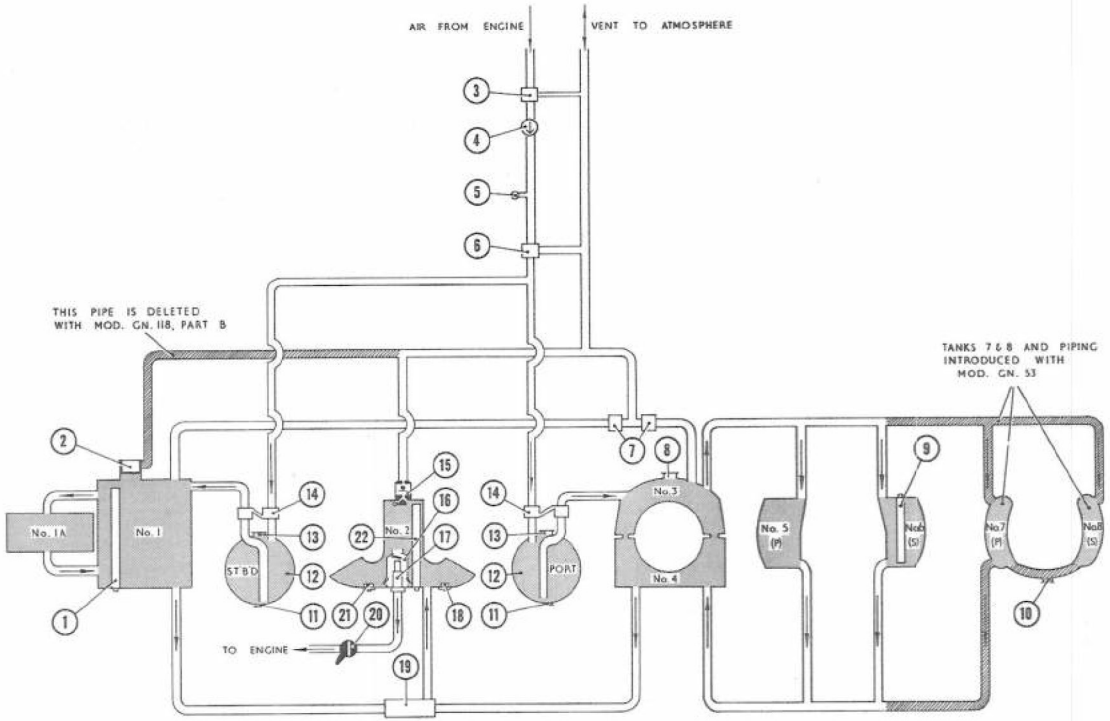
Tank capacities are as follows:-

No. 1A (Forward)	- 19.0 gallons.		
No. 1 (Forward)	- 54.0 gallons.		
No. 2 (Centre)	- 39.0 gallons.		
No. 3 (Aft)	- 18.0 gallons.		
No. 4 (Aft)	- 14.0 gallons.		
No. 5 (Aft)	- 14.5 gallons.		
No. 6 (Aft)	- 14.5 gallons.		
No. 7 (Aft)	- 11.5 gallons.)	Post Mod. GN.53.	
No. 8 (Aft)	- ~~11~~.5 gallons.)		
	173.0 gallons.	786.5 litres (approx.)	
	~~196~~.0 gallons.	~~891~~ litres (approx.) (Post Mod.GN.53)	

Key to Fuel System Diagram

1. Fuel contents gauge unit.
2. Filler.
3. Pressure reducing valve and filter.
4. Non-return valve.
5. Switch unit (air pressure failure warning).
6. Relief valve.
7. Combined vent valves.
8. Filler.
9. Fuel contents gauge unit.
10. Water drain valve.
11. Drain plug.
12. Underwing tank.
13. Filler.
14. Coupling valve.
15. Float valve.
16. Inverted flight valve.
17. Booster pump.
18. Water drain valve.
19. Fuel flow proportioner.
20. Low pressure fuel cock.
21. Fuel drain valve.
22. Fuel contents gauge unit.

A.L. 16. May.59.



Fuel System Diagram

A.L. 16, MAY '59

(ii) In addition to the normal fuel load, provision is made for the installation of an external jettisonable tank on each of the outboard wing pylons. The starboard tank is connected to No.1 tank and the port tank to No. 3 tank. Fuel is transferred by air pressure from the jettisonable tanks to the main tanks. Each jettisonable tank holds 66 gallons, (300 litres), providing a total fuel capacity of 305 gallons. (1390 litres approx.). (Post Mod. GN.53 - 328 gallons. (1491 litres).

A jettison switch similar to the bomb jettison switch and mounted adjacent to it on the port coaming is provided for jettisoning these tanks. The tanks may also be jettisoned together with any other jettisonable stores which are being carried by pressing the clean wing switch situated on the port upper instrument panel.

(iii) The fuel booster pump located in No. 2 tank is fitted with a negative 'g' device which ensures a fuel supply to the engine during negative 'g' conditions.

2. Main Fuel System

(i) A flow proportioning valve controls the flow from the forward and aft tanks into No. 2 tank, such that the two sets of tanks empty together in flight. In the event of a failure of the transfer air pressure, an override device in the valve allows both groups to empty. The proportioner also acts as a non-return valve.

(ii) The booster pump in No. 2 tank delivers fuel via the Low Pressure cock to an engine driven pump. In the event of booster pump failure, fuel will be delivered by air pressure and gravity to the H.P. Cock via a gravity by-pass valve in the booster pump.

(iii) From the engine driven pump, fuel is delivered to the High Pressure cock and throttle valve. A Barometric Pressure control valve regulates the delivery pressure of the pump for change in altitude and forward speed.

(iv) The combined throttle valve and High Pressure cock are interconnected to the throttle lever.

3. Low Pressure Fuel Cock

The Low Pressure Fuel cock is controlled by a lever operating in a quadrant marked 'ON' and 'OFF' situated to the rear of the starboard console. The lever is normally wired 'ON'.

4. High Pressure Fuel Cock

The High Pressure Fuel cock is connected to the throttle lever and initial movement of the throttle to the 'IDLING' position on the quadrant opens the High Pressure cock.

5. Booster Pump

(i) The booster pump is controlled by an ON/OFF switch situated on the top of the control pedestal, below the instrument panel.

(ii) A fuel pressure warning indicator is situated on the starboard upper instrument panel. This indicator will show 'WHITE' when the pump delivery pressure falls below 5 p.s.i.

(iii) A fuel tank pressure failure indicator is situated on the starboard upper instrument panel. This indicator shows 'RED' when the fuel transfer air pressure falls below 0.75 p.s.i., 1.75 p.s.i. Post Mod. GN383 Pt.A., 2.25 p.s.i. Post Mod. GN383 Part B or GN393.

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6. Engine Driven Fuel Pump

One engine driven High Pressure fuel pump satisfies the fuel requirements of the engine.

7. Fuel Contents Gauge

Smiths Waymouth type tank units are fitted in Nos. 1, 2 and 6 tanks and are calibrated to a single fuel contents gauge mounted on the starboard upper instrument panel. The gauge indicates fuel contents in lb. or litres x 100.

With jettisonable tanks fitted, the gauge registers 'FULL' until the jettisonable tanks are empty.

8. Oil System

(i) Oil is carried in a tank mounted on the engine compressor casing. The tank has a capacity of 1¾ gallons (6¾ litres approx.) of oil plus ¼ gallon (1 litre approx.) air space.

(i) A baffle incorporated in the oil tank ensures an adequate supply of oil to the engine up to a maximum of 15 seconds under conditions of negative 'g'.

(ii) An oil pressure warning indicator is situated on the starboard upper instrument panel adjacent to the R.P.M. indicator. The indicator will show 'WHITE' when the oil pressure drops 10 p.s.i. below the normal operating pressure when the engine is hot.

ENGINE CONTROLS

9. Throttle Control

The throttle lever which moves in a quadrant on the port console is marked 'H.P. OFF', 'IDLING' and 'THROTTLE OPEN'.

10. Engine Starting System

Engine starting is carried out by compressed air controlled from the starting trolley.

11. Ignition and Relight Control

The ignition and relight press button switch is mounted above the V.H.F. press-to-transmit button in the hand grip of the throttle control.

12. Engine Instruments

The following engine instruments are provided :-

R.P.M. Indicator.
Jet Pipe Temperature Gauge
Fuel Pressure Warning Indicator
Oil Pressure Warning Indicator

13. Engine Fire Warning

In the event of a fire in the engine bay a 'Firewire' will cause the fire warning light situated on the starboard upper instrument panel to glow 'RED'.

NOTE: No fire extinguisher system is fitted to the aircraft. For action in the event of fire, see Emergency Handling, para.2.

MAIN SERVICES

14. Hydraulic System

(i) An engine driven pump provides hydraulic pressure at 3,000 p.s.i. for the operation of the following controls:-

(a) Undercarriage and dive brake system.
(b) Ailerons.
(c) Flying tail.

NOTE: (a) The undercarriage acts as an airbrake when partially lowered.

(b) When the undercarriage is fully down the ailerons are automatically drooped to an angle of 22 degrees; and act as landing flaps. In this configuration the ailerons retain their differential movement.

(ii) An hydraulic accumulator is provided to ensure smooth operation of the system and to give a limited source of supply when the engine is not running or in the event of pump failure. A pressure maintaining valve assures priority of pump and accumulator delivery for the flying tail. Each aileron Servodyne has an individual accumulator supplied from the non-priority side of the pressure maintaining valve.

(iii) A manually operated cock is provided to enable the pilot to shut off hydraulic pump delivery on the following occasions:-

(a) When wishing to practise manual flying simulating an hydraulic failure.

(b) Prior to the selection of "emergency undercarriage".

(c) In the event of any suspected malfunctioning of the hydraulic system.

NOTE: When selected 'OFF' the cock will not produce immediate manual response from the flying controls. This will only be obtained after the run-down of the accumulator reserves.

(iv) An initial air pressure of 1,500 p.s.i. is applied to the main accumulator and 500 p.s.i. to the aileron accumulators. An hydraulic pressure gauge situated on the port lower instrument panel indicates main accumulator pressure. A warning indicator is fitted on the starboard upper panel and shows 'WHITE' when the accumulator pressure falls below 2,100 p.s.i. Post Mod. GN.352 the warning indicator is replaced by a red light which illuminates at accumulator pressures below 2,100 p.s.i., and at the same time (providing that the V.H.F. set is operating) an audio warning is received in the pilot's earphones. The audio warning, but not the red light, may be cancelled by pressing the cancelling button on the port upper instrument panel. This button illuminates amber when operated. If the hydraulic pressure is subsequently restored to above 2,100 p.s.i., the red light will be extinguished. The audio warning may then be re-set by pulling the cancelling button which will also extinguish its amber light.

(v) The undercarriage can be lowered in the event of an hydraulic failure by accumulator air pressure. To select emergency undercarriage, turn the selector lever handgrip 90° in an anti-clockwise direction, and with the handgrip raised, draw the lever aft to the rear of the gate.

NOTE: (a) No further selection of the undercarriage system can be made after selecting DOWN on the emergency system.

(b) Prior to the selection of "emergency undercarriage" the hydraulic power On-Off cock and the "elevator unlock" lever must be operated. (See Part IV Paragraph 7 Part 1 Note 1).

(vi) A safety lock prevents selection of undercarriage UP when the throttle is in the "H.P. OFF" position, or (post Mod. GN.280) when the throttle is less than three-quarters open. In an emergency this safety lock can be over-ridden by moving the selector handgrip 90° in an anti-clockwise direction, and with the handgrip raised then forward into the undercarriage 'UP' position.

Key to Hydraulic System Diagram

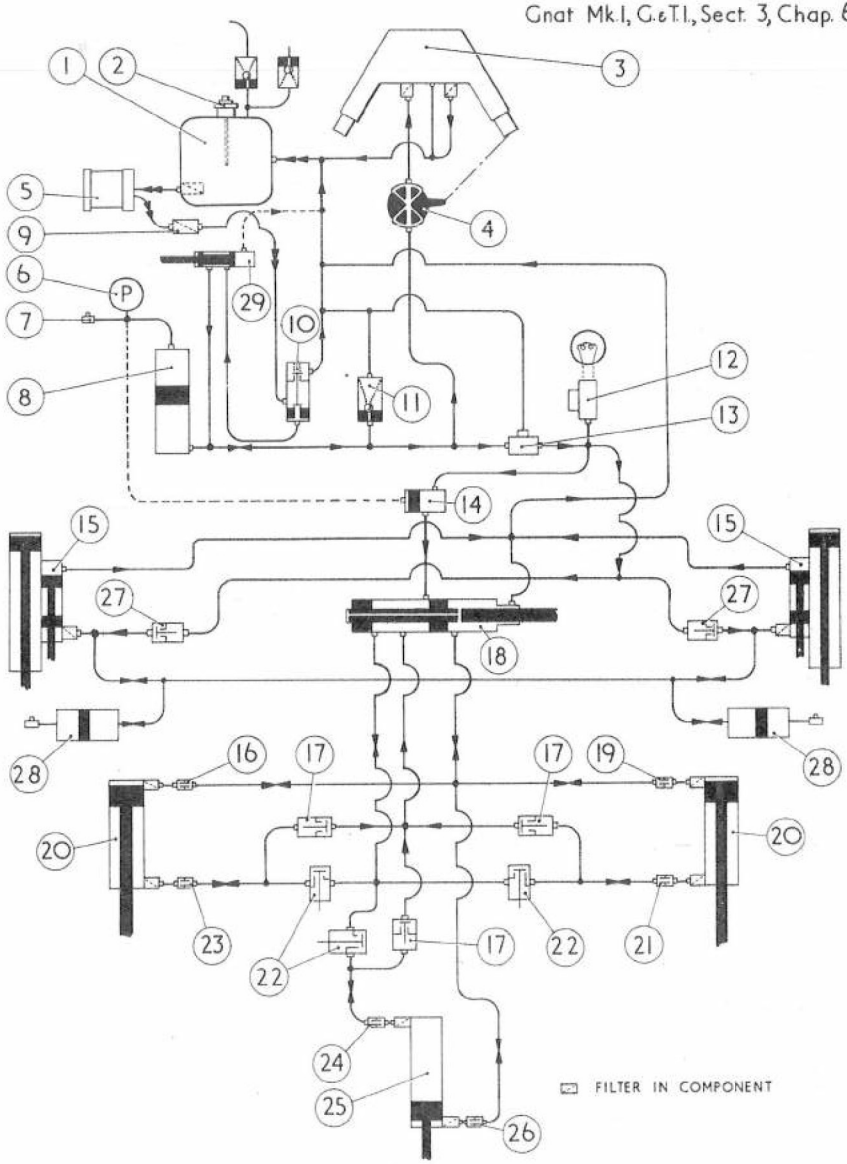
1 Reservoir (with relief valve)
2 Filler cap and dipstick
3 Italiano motor
4 Flow-restrictor valve
5 Engine-driven pump
6 Pressure gauge
7 Main accumulator air-charging valve
8 Main accumulator
9 Filter
10 Cut-out valve
11 Pressure-relief valve
12 Low-pressure warning switch
13 Pressure-maintaining valve
14 Air-release valve
15 Aileron Servodyne units
16 Heat-lator
17 Non-return valves (in selector valve)
18 Selector valve
19 Restrictor
20 Airbuffing gear main-wheel unit jacks
21 Restrictor
22 Air-brake sequence valves
23 Restrictor
24 Restrictor
25 Airbuffing gear nose-wheel unit jack
26 Restrictor
27 Non-return valves
28 Aileron accumulators
29 Shut-off cock

A.L.H. Jan.1939.

Key to Hydraulic System Diagram

1 Reservoir (with relief valve)
2 Filler cap and dipstick
3 Tailplane motor
4 Flow-restrictor valve
5 Engine-driven pump
6 Pressure gauge
7 Main accumulator air-charging valve
8 Main accumulator
9 Filter
10 Cut-out valve
11 Pressure-relief valve
12 Low-pressure warning switch
13 Pressure-maintaining valve
14 Air-release valve
15 Aileron Servodyne units
16 Restrictor
17 Non-return valves (in selector valve)
18 Selector valve
19 Restrictor
20 Alighting gear main-wheel unit jacks
21 Restrictor
22 Air-brakes sequence valves
23 Restrictor
24 Restrictor
25 Alighting gear nose-wheel unit jack
26 Restrictor
27 Non-return valves
28 Aileron accumulators
29 Shut-off cock

A.L.11. Jan.1959.



Hydraulic System Diagram

15. Electrical System

(i) D.C. Supply

A single engine driven generator supplies the whole of the electrical system and gives an output of 28.0 volts when charging the Varley battery. A generator failure warning light is provided on the upper starboard instrument panel to indicate when the generator ceases to supply power.

An emergency battery is installed in the nose equipment bay for operation of the Standby V.H.F. and the Turn and Slip indicator in the event of failure of the main electrical supply.

(ii) A.C. Supply

An electrical inverter supplies A.C. power to the artificial horizon, the G4F compass and the fire warning system. There is no standby inverter. A separate inverter supplies A.C. power for the radar ranging installation in the nose equipment bay. An A.C. supply failure indicator is mounted on the starboard upper instrument panel.

(iii) Battery Control

The Varley battery, housed in the nose wheel bay, is controlled by a switch situated on the top of the control pedestal, immediately below the instrument panel. Provision is made for the connection of an external electrical supply. A series of relays isolates the aircraft battery when the external supply is connected.

(iv) Circuit Breakers

Six circuit breakers, under the control of the pilot, are provided for the following circuits:-

(a) Fuel Pump.
(b) Instrument Inverter.
(c) Tail Trim.
(d) Emergency Tail Trim.
(e) Generator Field.
(f) Gun Firing.

The circuit breakers are mounted under a perspex cover below the coaming on the port side of the cockpit. All circuit breakers should be checked 'MADE' before flight and any which have tripped due to temporary overload etc. should be reset by depressing the perspex cover.

AIRCRAFT CONTROLS

16. Flying Controls

The rudder pedals are adjustable for leg length by a star

wheel fitted to the rudder bar. External locks are provided for the elevators and rudder.

Aileron Controls

(i) Power operated ailerons are fitted, their operation being effected by hydraulic Servodynes attached to the aileron operating levers.

(ii) The ailerons are drooped 22° when the undercarriage is lowered from AIRBRAKE position to fully down.

Tail Control

(i) A Hobson screw-jack unit and hydraulic motor powers the flying tail which consists of a tailplane and elevator normally locked together moving as one. An artificial feel spring system is incorporated.

For the purpose of trimming the aircraft, the screw-jack units can be operated by an electric motor controlled by a double pole switch mounted on top of the control column handgrip. This switch is spring loaded to centre and operates in the natural sense, i.e. forward for nose-down trimming and back for nose-up.

(ii) Tailplane incidence is indicated on an instrument mounted on the port panel adjacent to the hydraulic pressure gauge. A green segment indicates the range of settings safe for take-off. The range obtainable on the normal (control column) trimming system is +2° to -12° (+1° to -14° when Mod. GN. 332 is embodied).

(iii) Operation of the normal trimmer switch trims the tailplane to a negative or positive angle within the normal trim limits of +2° to -12° (+1° to -14° post Mod. GN. 332) whilst the control column remains in the neutral position. Movement of the control column will then shift the tailplane hydraulically about the adopted trim datum. For example it is possible to trim the tailplane electrically to -12° with the control column neutral, an angle which would normally correspond to the control column fully aft. If the control column is then pulled fully aft only another approximate 6° of negative tailplane movement will be available before the tailplane stops are reached, and if the control column is pushed fully forward the negative tailplane angle will not be reduced below approximately -7°, a position that normally corresponds to a flying speed of 150 knots. This example shows the very powerful position change that can be superimposed upon the normal hydraulic/control column operation of the tailplane by use of the trimming switch. Any abnormal trim settings would of course

be apparent in flight by an unusual control column position coupled with an out of trim force. This would cause the pilot to trim in the correct sense. This detailed explanation is given in order that it may be clearly appreciated that the tailplane as a whole is trimmed thus altering the tailplane datum without changing the stick datum. Thus there is a unique relationship between the control column and the tailplane for every trim position.

(iv) A double-pole split switch is provided on the same panel for emergency trimming in the event of malfunctioning of the normal system. The switch is spring loaded to centre and operates upwards for nose up and downwards for nose down trimming. Both halves of the switch must be operated together and no additional switching is required to render the emergency system operative.

NOTE: Care must be taken when using the emergency trimming system as the circuit does not include the limit switches for tailplane movement, and damage may be caused when the tailplane reaches its physical stops.

(v) A red warning light labelled "Elevator unlocked" is also situated on the port panel. A T-lever mounted on the port side of the cockpit above the throttle lever unlocks the elevator for manual reversion under emergency conditions. The elevator unlock light indicates on the least withdrawal of the elevator locking pins, such locking being essential at any speeds over 500 knots, I.A.S. When using the unlock lever care should be taken to pull the lever fully back until it locks in the rear position.

Hydraulic Power On-Off Control

(i) A lever mounted on the starboard console shuts off the hydraulic pump delivery when required for the occasion in para. 14(iii).

(ii) The lever is normally in the forward 'ON' position. To select hydraulic power 'OFF' depress the knob of the lever fully and pull fully back. To re-select power 'ON' depress the knob and move the lever fully forward.

(iii) Operation of this control will not affect the reserve hydraulic power provided by the pressure maintaining valve in the case of the tailplane, and the aileron accumulators in the case of the ailerons.

17. Undercarriage Normal Control

(i) The undercarriage selector lever is mounted to the side and inboard of the throttle control. It has four positions:- DOWN, AIRBRAKE and UP, and EMERGENCY UNDERCARRIAGE DOWN at the rear of the gate. (See para. 14, sub para. (iv)). The lever

can be moved from the DOWN to the UP position in one complete forward movement, but it is gated at the airbrake position back from UP to DOWN and has to be lifted to pass the gate.

AL 18 (ii) ~~Interference is provided between the throttle lever and the undercarriage lever to prevent raising the undercarriage on the ground until the throttle lever is in the idling position.~~ For operation of the undercarriage safety lock, See Part I, Para 14 (vi).

18. Undercarriage Position Indicator

A standard undercarriage position indicator is fitted on the port panel below the tailplane indicator, and registers as follows:-

Undercarriage locked UP	- No lights
Undercarriage locked DOWN	- Three green lights
Undercarriage selected UP or DOWN before locks have engaged.	- Three red lights

19. Airbrake Control

Refer to paragraphs 14 (sub para. (i) and (iv) 16 sub para. (ii) and 17 sub para. (i).

20. Wheel Brakes

(i) The toe operated wheel brakes are operated from a separate hydraulic system by pumps fitted on the rudder bar pedals. These can be operated regardless of rudder position. To park the aircraft with brakes 'ON' depress the brake pedals and pull the parking lever situated in the centre of the instrument panel, and turn through 90°.

(ii) A 7'6" diameter ring slot tail parachute is fitted to assist in braking the aircraft during the landing run. It is controlled by a lever on the port console outboard of the throttle box. To stream the parachute the lever is pulled fully to the rear. To jettison the parachute the lever is pushed forward to its original position.

21. Entry to Aircraft

Entry to the aircraft is effected by means of a special ladder designed primarily for use when the guns are loaded. This is a safety precaution to enable the pilot to enter or leave the cockpit without crossing the line of fire of the guns.

COCKPIT EQUIPMENT

22. Combined Canopy and Ejection Seat Operation

(i) A Folland/SAAB ejection seat is fitted. The seat height is adjustable on the ground and secured by a toggle lever positioned at the front of the top beam of the seat pan.

The firing mechanism is operated by a handle attached to the seat blind on the pilot's head rest or by operation of the handle mounted on the seat pan between the pilot's legs. Operation of the seat blind will first jettison the canopy through an interconnecting mechanism. A mechanical stop prevents completion of

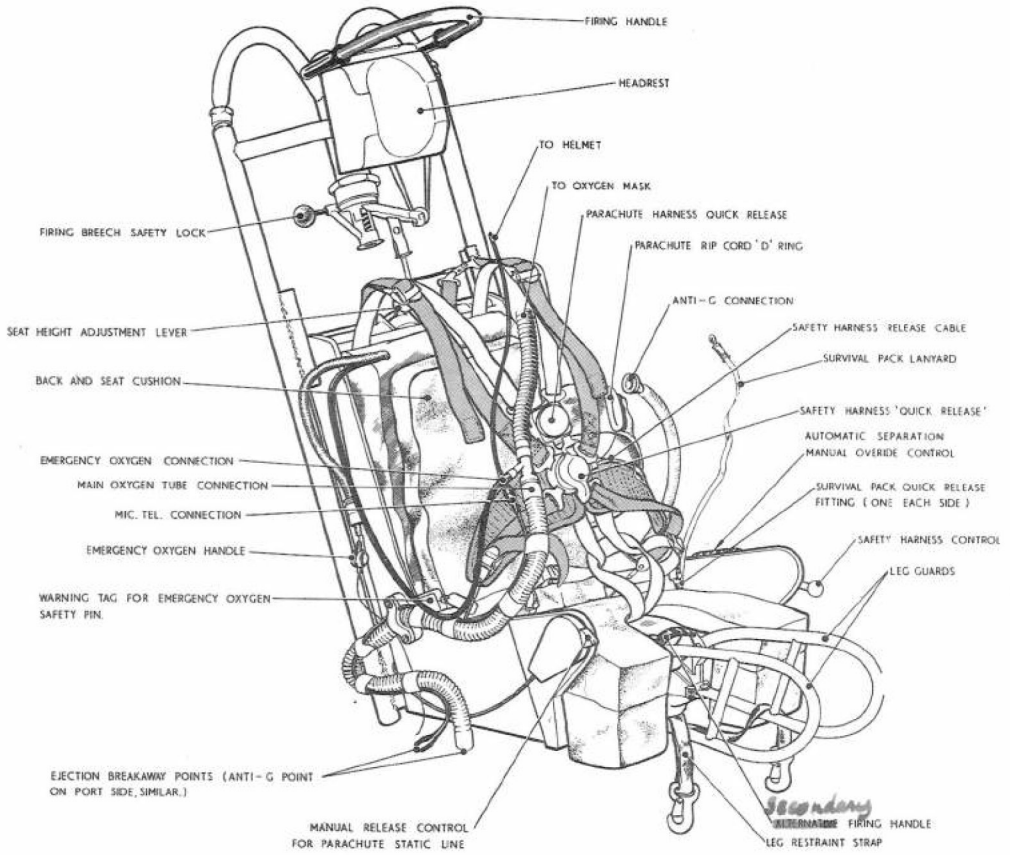
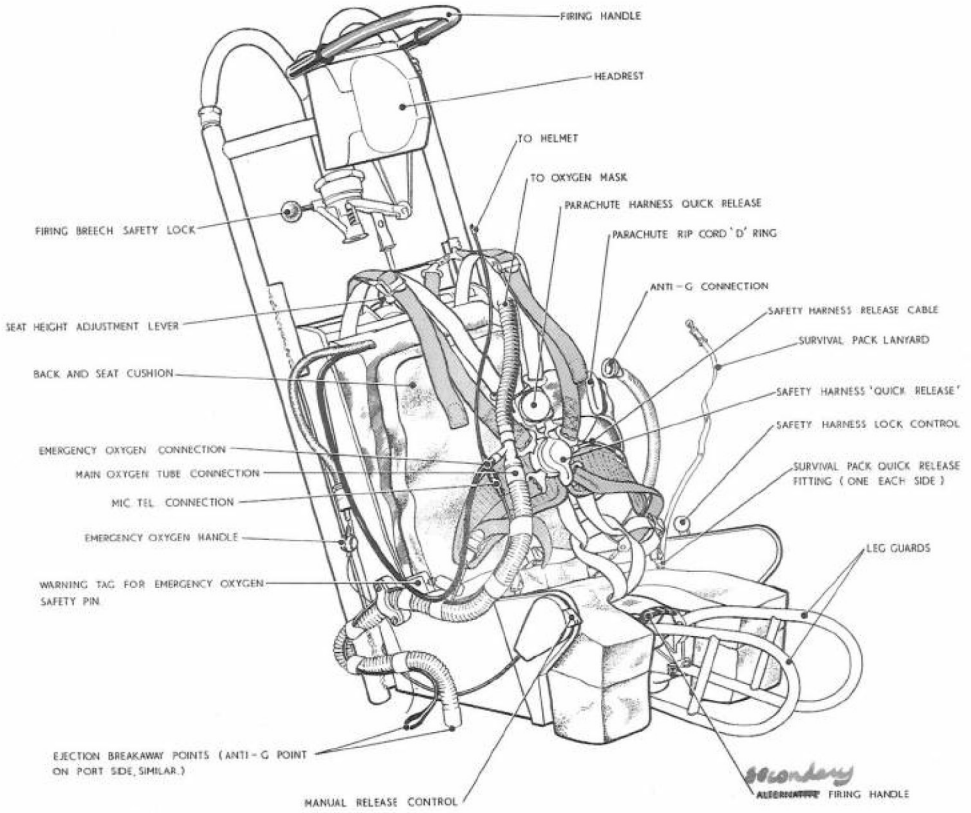


Fig. I. Lightweight Ejection Seat Type I.G. Post Mod G.N. 67

A.L.19



Lightweight Ejection Seat Type I.G.

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the firing movement until the canopy has jettisoned. In the event of this not happening, or the handle between the pilot's legs being used to eject, the canopy must be jettisoned separately beforehand (See sub. para. (vii)).

(ii) The seat safety harness release is manually operated on the ground but is disconnected automatically when the seat is ejected. The shoulder straps are attached to an inertia locking device which is released by a lever mounted on the port side of the seat pan gated to remain locked or unlocked. When the lever is in the unlocked position the pilot is free to move forward in the seat by about 10 inches. In the event of sudden deceleration occurring the inertia lock will restrain the pilot.

(iii) A back type parachute incorporates a barometric controller, and special harness. The harness includes two attachments for a survival pack which is secured by means of two barrel type quick release fasteners.

The lanyard attaches the survival pack to the life jacket.

The emergency oxygen bottle is situated within the parachute pack.

The survival pack is rigid and shaped to fit into the seat pan.

A handle on the starboard side of the seat pan is used to disconnect the pilot's parachute static line in the event of the pilot abandoning the aircraft without using the ejection seat.

(iv) The main oxygen and mic-tel services are positioned on the starboard side of the seat, and the anti-'g' on the port side. The services are automatically disconnected and the emergency oxygen supply valve opened by a static line, when the seat is ejected. This static line incorporates an emergency knob, located to the rear of the starboard console. Pulling the knob downwards will provide emergency oxygen during flight, if required. Post Mod 6W 443 the Knob is repositioned forward on the starboard side of the seat in a more accessible position, and is pulled upwards.

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(v) The seat firing breech mechanism, situated immediately below the pilot's headrest is fitted with a two-position locking lever which extends forward when in its locked position into the back of the pilot's neck. The arm locates in slots in the flange of the firing mechanism, and in the locked position prevents inadvertent firing of the seat when on the ground. A clamp type maintenance lock is also provided for the use of ground personnel, but it is the pilot's responsibility to render the seat firing mechanism operative by moving the safety lever to the unlocked position before flight, and returning it to the locked or "SAFE" position on landing.

(vi) The cockpit canopy is hinged on the rear bulkhead of the pressure cabin. The canopy seal inflation valve is automatically operated by the canopy locking lever, which is situated on the port coaming. The pilot controls the unlocking of the canopy by means of this lever, but it may also be released externally by depressing and turning anti-clockwise the release plunger situated on the port side of the cockpit. Post Mod. GN.336, a button situated on the inboard end of the canopy locking lever spindle facilitates the locking of the canopy from inside the cockpit.

(vii) The canopy is jettisoned by giving a sharp pull on the jettison lever positioned on the port console to the rear of the throttle lever. This method should be used if the combined canopy jettison and ejection mechanism fails (or if the seat pan handle is to be used to eject) and also if it is desired to jettison the canopy for any other reason such as a forced landing.

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(viii) Post Mod. GN.67 leg restraint straps are provided. These straps are adjustable for reach, and are attached to the pilot's garters by clips. An additional manual override lever is positioned on the port side of the seat pan behind the safety harness lock control for use in the event of the automatic separation system failing after an ejection. Pulling this lever upwards releases the safety harness, leg restraint garters, and face blind, thus completely freeing the pilot from the seat.

23. Cockpit Pressurisation and Heating System

(i) A control for regulating the cockpit temperature is situated on the starboard coaming. This control also turns 'OFF' the pressurisation system which is automatically controlled by a valve mounted on the forward bulkhead. Turning the temperature control from the 'OFF' position allows the flow of air from the engine compressor to be fed into the cockpit. The pressure is controlled by a valve which permits a steady build-up above 15,000 ft. until at 43,000 ft. the cockpit differential pressure reaches 3.5 p.s.i.

(ii) The temperature settings of the control are as follows:-

OFF	-	No pressurisation, no ventilation.
HOT	-	Air enters the cockpit from the engine compressor without passing through the heat exchanger.
MEDIUM	-	Hot air from the engine compressor and cold air which has passed through the heat exchanger and cold air unit enters the cockpit.

COLD - Air enters the cockpit from the heat exchanger and cold air unit.

NOTE: A variation in cockpit temperature may be obtained by selecting intermediate positions of the control.

The air distribution into the cockpit is as follows:-

PRE MOD. GN.210

HOT AIR (i) from the spray discharge pipe in the canopy

(ii) from outlets close to each rudder pedal.

COLD AIR (i) from an outlet on the starboard side of the cockpit.

POST MOD. GN.210

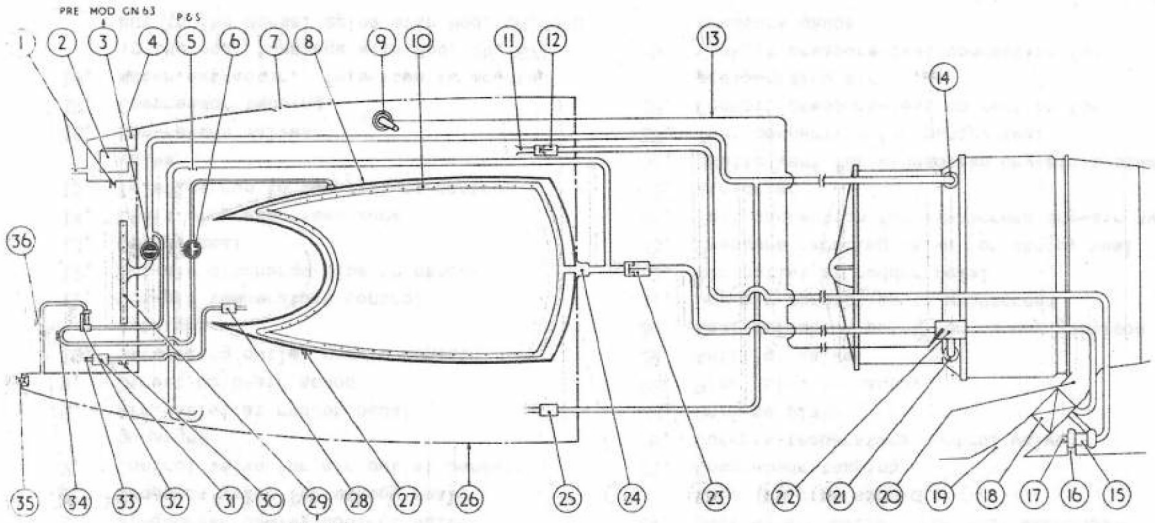
HOT AIR (i) from the spray discharge pipe in the canopy.

(ii) from outlets close to each rudder pedal.

(iii) from an outlet beneath the G.G.S.

COLD AIR (i) from same outlets close to rudder pedals as used for 'HOT' air.

(ii) from outlet beneath the G.G.S. as used for 'HOT' air.



1 AIR OUTLETS, TO RADAR COOLING
2 COCKPIT-PRESSURE CONTROL VALVE
3 WINDSCREEN DE-MIST CONTROL VALVE
4 EXHAUST AIR COLLECTOR-MUFF
5 HOT-AIR OUTLET TO FEET AND LEGS
6 SEQUENCE VALVE (CANOPY SEAL)
7 DIRECT COLD-AIR SCOOP
8 CANOPY SEAL
9 COCKPIT-TEMPERATURE CONTROL
10 HOT AIR DISCHARGE PIPE IN CANOPY
11 COLD AIR OUTLET
12 NON-RETURN VALVE
13 TELEFLEX RUN TO TEMPERATURE-CONTROL VALVE
14 COMPRESSOR TAPPING
15 COLD-AIR UNIT
16 AIR INLET
17 AIR EXHAUST FROM COLD-AIR UNIT
18 HEAT EXCHANGER
19 AIR INLET TO HEAT EXCHANGER
20 AIR EXHAUST INTO JET-PIPE SHROUD
21 COMPRESSOR TAPPING
22 COCKPIT-TEMPERATURE CONTROL VALVE
23 NON-RETURN VALVE
24 PIPE JOINT TO CANOPY.
25 ANTI-G VALVE
26 LIMIT OF PRESSURISED ZONE
27 SEAL DEFLATION FOR CANOPY JETTISON
28 DRY-AIR CONNECTION TO WINDSCREEN
29 GALLERY PIPE FOR DE-MISTING AIR.
30 TEST CONNECTION FOR WINDSCREEN
31 AIR DRIER
32 PRESSURE REDUCING VALVE, CANOPY SEAL
33 STATIC VENT, WINDSCREEN DRY-AIR
34 TEST CONNECTION, CANOPY SEAL
35 COCKPIT PRESSURE-TEST CONNECTION
36 PRESSURE GAUGE CONNECTION, COCKPIT TEST

Diagram of Air Conditioning System

Key to Diagram of Air Conditioning System with Mod. GN.271 and GN.367

1. Air outlets, to radar cooling
2. Cockpit-pressure control valve
3. Exhaust air collector muff
4. Discharge gallery for windscreen demisting
5. Windscreen demist control valve
6. Sequence valve for canopy seal
7. Control valve for air outlet beneath gunsight
8. Air outlet at rudder pedal
9. Direct cold-air scoop
10. Swivelling outlet nozzle beneath gunsight
11. Cockpit temperature control
12. Hot-air discharge pipe in canopy
13. Canopy seal
14. Limit of pressurised zone
15. Teleflex run to temperature control valve
16. Non-return valves
17. Compressor tapping
18. Water extractor. This item is mounted in the rear fuselage with Mod. GN.367A but in the dorsal spine with Mod. GN.367B.
19. Pressure relief valve
20. Air inlet to cold-air unit
21. Air outlet from cold-air unit
22. Heat exchanger
23. Cooling air inlet to heat exchanger
24. Cooling air outlet from heat exchanger into jet-pipe shroud
25. Compressor tapping
26. Cockpit-temperature control valve
27. Orifice plate
28. Pipe joint to canopy
29. Anti 'g' valve
30. Seal deflation point for canopy jettison
31. Dry-air connection to windscreen
32. Air outlet at rudder pedal
33. Pressure reducing valve for canopy seal
34. Test connection for windscreen dry-air system
35. Air-drier
36. Static vent for windscreen dry-air system
37. Test connection for canopy seal
38. Cockpit pressure-test connection for pressurising air
39. Cockpit pressure-test connection for pressure gauge

A.L.18. Nov. 1959.

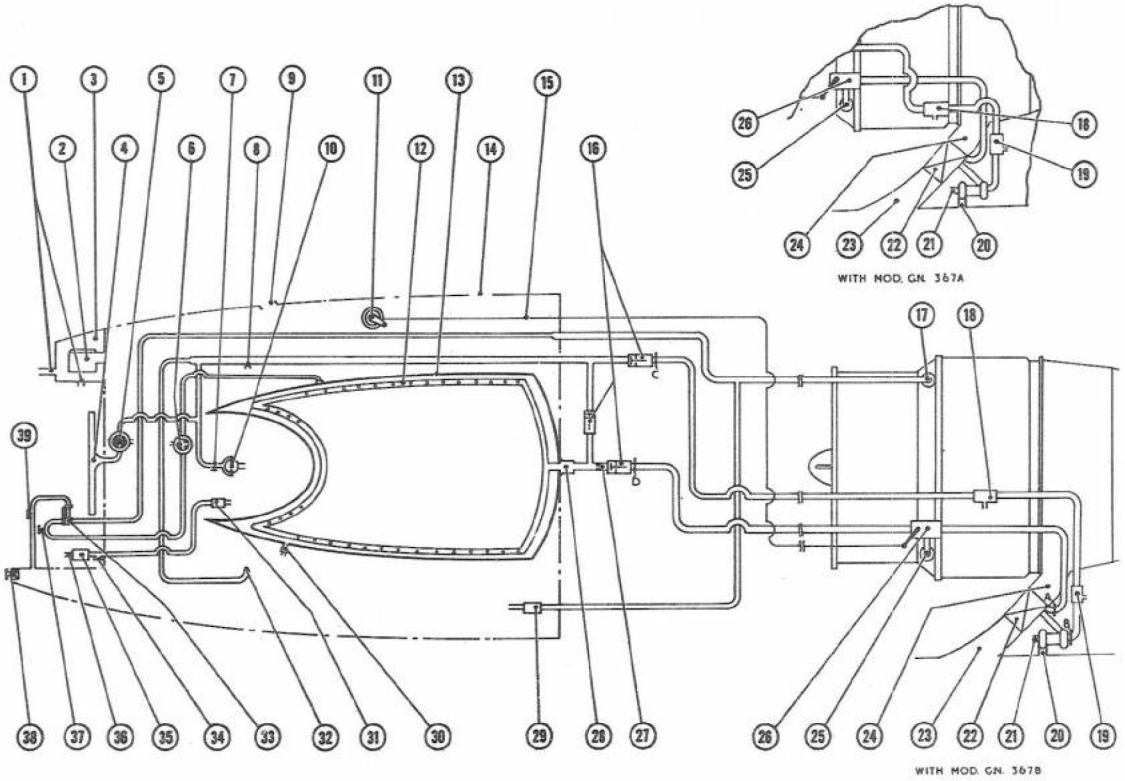


Diagram of Air Conditioning System
with Mod. GN. 271 and GN. 367

It is recommended that if the flight plan consists of a cruise at high altitude, HOT air should be selected from take-off.

(iii) A cockpit altimeter on the control pedestal below the instrument panel indicates the altitude corresponding to cockpit pressure.

(iv) A cockpit pressure warning indicator situated on the starboard upper instrument panel indicates when the cockpit differential pressure falls 1.0 p.s.i. below the design working pressure for a given altitude above 21,000 ft. The indicator is not operative below this altitude.

(v) Pre-Mod. GN.63 a demisting and de-icing system is provided. The system is controlled by a push pull control lever which regulates a flow of hot engine air through external vents at the base of the windscreen. This lever is immediately below the gunsight bracket.

(vi) A scoop on the starboard side of the cockpit controlled by a lever above the starboard console, can be opened to admit ram air to the cockpit when required. This scoop is only to be used with the temperature control at 'COLD' or 'OFF'.

(vii) Post Mod. GN.210 an additional air discharge point into the cabin is positioned beneath the G.G.S. It can be selected 'ON' or 'OFF' at will by operation of the knurled knob below the outlet. The direction of the outlet can be varied by adjusting th outlet nozzle position. This outlet supplies 'HOT' or 'COLD' air dependent on the position of the temperature control on the starboard coaming. However, in order to obtain maximum cooling in the cabin at any time, this outlet must be selected 'ON'.

24. Cockpit Lights

Cockpit lighting is controlled by two dimmer switches on the starboard console. (Post Mod. GN.231 - on the starboard cockpit wall).

25. Navigation Lights

The navigation lights are controlled by an ON/OFF switch situated on top of the control pedestal below the instrument panel.

26. Electrically Operated Flight Instruments

(i) The turn and Slip Indicator is operated by the normal D.C. supply.

If the supply fails, the emergency supply should be selected by the switch marked Turn and Slip "(T & S) SUPPLY", "NORMAL" and "STANDBY". This switch is situated on the starboard lower instrument panel.

(ii) Both the Artificial Horizon and the G.4.F compass are supplied from the instrument inverter. A fast erection button is incorporated in the Artificial Horizon.

In the event of inverter failure the ON/OFF indicator on the face of the Artificial Horizon will show "OFF" and the A.C. power failure indicator will show "WHITE".

(iii) A standby Magnetic Compass is mounted on the port side of the windscreen arch.

NOTE: No standby inverter is fitted. If the inverter fails the artificial horizon, G.4.F compass and the fire warning system, (see para. 13) will become inoperative.

27. Oxygen System and Pressure Breathing Equipment

(i) The Mk.17D oxygen regulator is mounted at the foot of the control pedestal and is supplied from three 400 litre oxygen bottles stowed in the port wing root.

(ii) The regulator is fully automatic in operation, and supplies oxygen according to the demands of the pilot from sea level to a cabin altitude of 45,000 ft. At cabin altitudes above 38,000 ft. the regulator supplies oxygen at a progressively higher pressure than the normal breathing pressure. In the event of cabin pressure failure, the regulator adjusts itself automatically to the new cabin altitude, but above 40,000 ft. an immediate descent to below 40,000 ft. is recommended. (See Emergency Handling para 8).

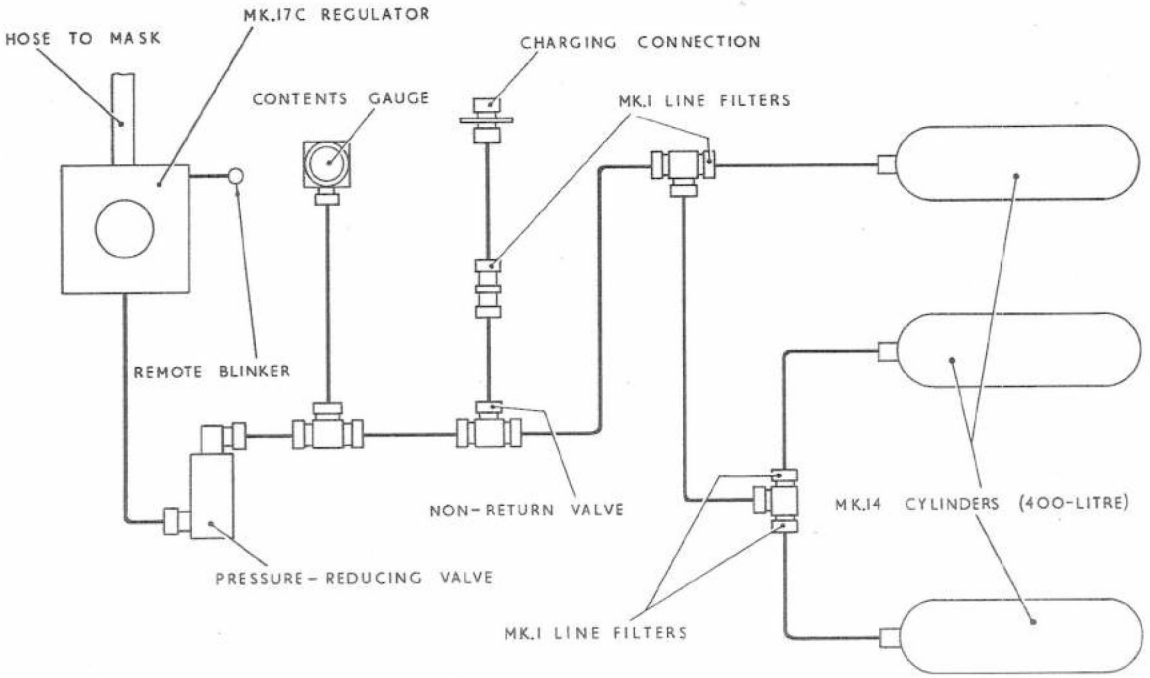
AL 19

(iii) The flow selector lever, which is mounted on the control pedestal immediately below the cockpit altimeter, is marked for selection either to NORMAL or 100% OXYGEN, but due to operational limitations on the use of the regulator the lever is wire locked to the 100% OXYGEN position.

(iv) The cockpit emergency selector button, mounted towards the centre of the regulator and operable through a lever at the top left hand corner of the pedestal can be offset to the left to give additional breathing pressure in an emergency. The selector button on the regulator can be

depressed inwards for testing the pilot's mask for leaks.

(v) A pressure gauge and flow indicator is incorporated on the front face of the regulator. When the system is fully charged the pressure gauge should read between 250 to 300 p.s.i. In addition to the regulator flow indicator (blinker) a remote blinker is situated on the port upper instrument panel.



Main Oxygen System

28. Emergency Oxygen

(i) An emergency oxygen supply is contained within the parachute pack. On ejection, the main services are broken automatically and a static line opens the emergency supply to the pilot's mask.

(ii) Should the main oxygen system fail in flight, emergency oxygen may be selected by pulling the knob located to the rear of the starboard console.

NOTE: When emergency oxygen has been selected the oxygen mask tube must be disconnected from the supply tube to permit the breathing of air when the emergency supply is exhausted.

29. Pressure Head Heater

The pressure head heater control switch is an ON/OFF switch mounted at the top of the control pedestal.

30. Anti-'g' Equipment

A quick release coupling is provided for connection to the anti-'g' system on the port side of the ejection seat. A valve using air from the engine compressor is fitted on the port console and is automatic in operation. A knurled ring at the top of the valve controls the output to the anti-'g' suit and permits the pilot to select either 'H' (High Gradient) or 'L' (Low Gradient) at will. A test button on the top of the valve provides for checking the inflation of the suit on the ground when the engine is running. An accelerometer is mounted on the port upper instrument panel.

31. Armament

(i) Guns

The aircraft is fitted with two 30 m.m. Aden guns and a total ammunition load of 115 rounds per gun is provided.

Firing of the guns is controlled through a trigger switch on the forward face of the control column handle, and a SAFE/FIRE lock is provided on the switch. No provision is made for a gun master switch in the cockpit, but the circuit is broken through a micro-switch when the undercarriage is fully extended. The circuit is not affected with the undercarriage in the dive brake position.

A fuel dipping installation is fitted which reduces engine R.P.M. to avoid engine surge when the guns are fired. Fuel dip is only required at altitudes in excess of 25,000 ft. The master switch

for fuel dipping is situated on the port console and is labelled "Fuel dip - ON-OFF". Pre Mod. GN.269 this switch directly energises the fuel dipping circuit. Post Mod. GN.269 this switch energises the fuel dipping circuit via an altitude switch which closes at altitudes in excess of 25,000 ft.

(ii) Gun Sight

A standard Gyro Gun Sight Mk.8, is fitted, and is harmonised for both rocket and gun firing. A master switch is situated on the coaming on the port side of the cockpit. Ranging is electrically controlled by means of the twist grip throttle handle, and the control for sight illumination and rocket angle of dive setting is positioned at the forward end of the starboard console. The sight is used in conjunction with the radar ranging installation (see Para. 36).

(iii) Bomb Installation

Provision is made for the carriage of bombs on the inboard pylons. The bombs are suspended from Vickers No.1 Mk.1 Electro-Magnetic release slips. Release of the bombs is controlled through a press switch on the top of the control column handle. This switch also controls rocket firing. The circuit is such that both bombs are released simultaneously, and no provision is made for selective separate release.

A two way selector switch on the cockpit port coaming provides alternative selection of either rockets or bombs, and a similar switch provides either tail fusing or nose and tail fusing. A separate sprung switch operates a jettison circuit. This switch does not isolate the fusing circuit, and it is necessary to ensure that the fusing switch is in the 'Off' position before jettisoning if the bombs are to be dropped safely.

The bombs may also be jettisoned together with any other jettisonable stores which are being carried by pressing the 'clean wing' switch situated on the port upper instrument panel.

(iv) Rockets

Using standard 25 lb. heads on Mk.5 rocket motors, a total of 18 rockets may be carried, two tiers of three under each inboard pylon and a single tier of three under the outboard pylon. Alternatively, the inboard pylons may be used for rockets with the outboard pylons carrying wing jettisonable tanks, or bombs may be carried on the inboard pylons with a tier of three rockets on each

outboard pylon.

A two way selector switch on the port cockpit coaming provides selection of either rockets or bombs, but it is not possible to fire both rockets and release bombs simultaneously. Rocket firing is controlled by the press switch on top of the control column handle.

A rocket selector box is provided immediately below the port cockpit coaming forward of the selector switches, and enables bursts of either 2, 4 or 8 rockets to be fired, or provides "ripple" firing. The circuit is such that the rockets are fired equally from port and starboard, and the sequence of firing is from inboard to outboard. A 'Ferranti' rotary selector controls the number of rockets fired, and is so designed that a very short interval elapses between the release of each pair of rockets when the selector in the cockpit is set at either 4, 6 or 8, i.e. any selection or rocket burst above 2 is, in effect, "ripple" firing, and a true salvo is not possible.

No provision is made for the jettisoning of rockets or launchers.

32. Camera

A G.90 camera is fitted and is operated either by the camera switch or the gun firing switch on the control column, provided that the camera master switch on the PORT coaming is switched ON.

33. Radio

(i) A V.H.F. 1 LRU 240A controller for the STR 9X or STR 9X/44 radio is mounted on the port lower instrument panel. Two selector switches marked 'V.H.F.' 'NORMAL' and 'STANDBY' and 'V.H.F. SUPPLY' 'NORMAL' and 'STANDBY' are situated on the starboard lower instrument panel. These are selected UP for normal V.H.F. use. Volume control for V.H.F. and A.D.F. is mixed by rotating the respective knurled knobs on the starboard lower instrument panel.

(ii) A standby V.H.F. set, type TR.2002 is fitted for use in the event of failure of the STR 9X or STR 9X/44 set or failure of the main electrical supply and is operated by

the emergency battery. The two switches on the starboard lower instrument panel should be moved down for 'STANDBY' V.H.F.

34. Radio Compass

(i) Marconi ADF 722 direction finding equipment is fitted. This equipment provides automatic relative bearing indication of a source of radio signals, by a panel-mounted visual indicator with simultaneous aural reception of modulated or unmodulated radio signals. These facilities are provided for homing, position fixing and communication operation and are available throughout the frequency range from 200 kc/s to 1700 kc/s.

(ii) The type 8283 control unit is situated on the starboard console and contains the following controls :-

(a) ON/OFF switch to bring the equipment into operation. This should be placed ON a few minutes before the equipment is required.

(b) Frequency Band Selector. This is a hand operated switch which projects through a slot in the panel immediately in front of the tuning dial. The frequency average of each band is as follows :-

Band 1.	200 to 415 kc/s (Scale marked .200 to .415 Mc/s)
Band 2.	415 to 840 kc/s (Scale marked .415 to .840 Mc/s)
Band 3.	840 to 1700 kc/s (Scale marked .840 to 1.701 Mc/s)

Operation of the switch selects the required frequency and illuminates the appropriate scale on the tuning dial.

(c) ADF/RECEIVE switch. With this switch in the ADF position, the equipment is connected for fully automatic DF operation. For normal reception the ADF facility is made inoperative by setting the switch to REC (Receive), the equipment then functioning as a conventional receiver.

(d) Tuning Control. Tuning to a radio station is accomplished by turning the cranked TUNING handle, the appropriate frequency being given on the scale reading which appears under the hairline in the window.

(e) Gain Control. This regulates the output level of the received signals and should normally be set to give a comfortable earphone signal level.

(f) B.F.O. Switch. Reception of keyed stations is obtained by setting the RT/CW switch to CW. For RT reception, the switch should be kept in the RT position.

(g) Panel Illumination Control. Panel illumination and tuning scale brightness is controlled by operation of the small knob labelled "DIM PUSH". Pushing the knob inwards decreases the brightness. A spare dial lamp is screwed into the dummy holder marked "SPARE".

(iii) Tuning into a Beacon

(a) Set the BFO switch to RT for MCH transmission or to CW for the reception of a keyed CW transmission.

(b) Select the appropriate frequency band.

(c) Rotate the TUNING handle to obtain the required frequency.

(d) Tune for maximum clockwise pointer deflection on the tuning indicator, again using the TUNING handle and adjust the GAIN control to the desired output level.

(iv) Homing

Switch on the equipment and tune to the desired beacon and proceed as follows :-

(a) Set the ADF/REC switch to ADF.

(b) Turn the aircraft in the direction shown by the bearing indicator until the indicator reads zero. The aircraft will then be pointing towards the beacon.

(c) Adjust the gain control to a position of satisfactory headphone volume.

(d) Maintain the bearing indicator at zero until the aircraft arrives over the beacon, indicated by the bearing indicator swinging on to the reciprocal bearing.

35. I.F.F. (If fitted)

An I.F.F. Mk. 3 G.R. receiver (If fitted) is mounted in the rear equipment bay. Selector switches for this equipment are mounted on the starboard lower instrument panel. The equipment is switched on by operation of the right-hand toggle switch. For normal operation, the G/D switch is in the 'G' position but is moved to the 'D' position for the transmission of an automatic distress indication. When operating on G band, A to G "chopping" operation is obtained for a fixed duration by pressing and releasing the push button situated on the left of the G/D switch.

36. Radar Ranging

(i) Radar ranging Mk. I, which operates in conjunction with the G.G.S., is situated in the nose equipment bay. It automatically provides the G.G.S. with target range information from 800 yards to 200 yards. The G.G.S. graticule is varied in size as the target range decreases and at 600 yards range, the small amber light at the top right hand side of the G.G.S. is illuminated. A green light in the same position indicates when the radar is locked on to a target whatever the range may be up to the maximum search range of the radar (1500 yards).

(ii) A radar ON/OFF switch is situated beneath the coaming on the port side of the cockpit. The associated circuit breaker is mounted on the port wall of the cockpit above the throttle quadrant. When switched ON, the radar warms up and will commence ranging. To enable the radar to control the G.G.S., the TARGET PRESENTATION switch, mounted on the port console, is switched on. When the radar locates a target, it automatically locks on and the green light comes on. When the range has decreased to 600 yards, the amber light also illuminates. From 800 yards and below, the range information will control the G.G.S. graticule.

(iii) The TARGET REJECT IN-OUT switch, also on the port console, is used to unlock the radar from an unwanted target or to check

that it is locked on to the correct target. When IN is selected, the radar unlocks from the target and searches inwards to minimum range. If no fresh target is found, the normal search cycle from maximum to minimum range recommences whether the switch is kept at IN or not. When OUT is selected, the radar unlocks from the target and searches outwards to maximum range. It will remain at maximum range if the switch is kept at OUT, but when released the normal search cycle will commence.

(iv) To check that the radar is locked on to the correct target, set the span knob of the G.G.S. to the span of the target type. If the correct target is being ranged, the graticule will just encompass the target span. If the target span extends beyond the graticule (over-ranging), or does not extend to the graticule (under-ranging), the wrong target is being ranged and REJECT IN or OUT should be selected.

NOTE: When the manual twist grip on the throttle is set at a shorter range than that of the target, the radar cannot control the graticule until the target comes within the range set by the twist grip. For normal operation with radar, the twist grip should be set to maximum range unless a violent manoeuvre is being executed, when the usual procedure of ranging back on the twist grip to avoid toppling the G.G.S. should be followed.

PART 11

FLIGHT LIMITATIONS

1. Loading Limitations

Loadings	Maximum Weight for Take-Off	Maximum Weight for Landing
(a) Aircraft without external stores.	~~6400~~ 6450 (6820 Post Mod GN 53)	5500
(b) Aircraft with external stores.	8700 (9070 Post Mod GN 53)	5500 (7000 lb. for overload landing See Note.)

NOTE: The maximum weight for overload landing is defined as the maximum all up weight at which a landing without structural damage can be anticipated under good conditions - i.e. good visibility, no cross wind and hard smooth runway.

2. Speed Limitations

(i) Without external stores

Unrestricted

(ii) With 19" Dia. external tanks only

Maximum speed - 0.85 I.M.N.

(iii) With 16" Dia. external tanks only

Unrestricted

(iv) With 19" Dia. external tanks and 3" rockets Mk.V - 25 lb. heads.

Maximum speed - 0.85 I.M.N.

(v) With 16" Dia. external tanks and 3" rockets Mk.V - 25 lb. heads

Maximum speed - 0.94 I.M.N.

(vi) With 3" rockets Mk.V - 25 lb. heads only

Maximum speed - 0.94 I.M.N.

(vii) With 19" Dia. external tanks and two 500 lb. bombs, Mk.21 fitted with No. 112 tails

Maximum speed - 0.85 I.M.N.

(viii) With 16" Dia. external tanks and two 500 lb. bombs, Mk.21 fitted with No. 112 tails

Maximum speed - 0.90 ~~0.94~~ I.M.N.

(ix) With two 500 lb. bombs Mk.21 fitted with No. 112 tails only

Maximum speed - 0.94 I.M.N.

(x) Maximum speed with undercarriage and flaps down - 300 kts. I.A.S.

(xi) Maximum speed and/or Mach Number with airbrakes extended.

Unrestricted.

(xii) Maximum speed of jettison of 16" diameter external tanks:-

400 kts. below 10,000 ft. altitude.
0.70 I.M.N. between 10,000 ft. and 25,000 ft. altitude.
0.80 I.M.N. above 25,000 ft. altitude.

Maximum speed of jettison of 19" diameter external tanks:-

300 kts. below 10,000 ft. altitude.

(xiii) Manual Control

The following limitations apply when operating the controls manually:-

Maximum speed and/or Mach Number

Up to 9,000 ft.	- 500 kts. I.A.S.
9,000 ft. to 16,000 ft.	- 0.88 I.M.N.
Above 16,000 ft.	- 450 kts. I.A.S. or 1.15 I.M.N. whichever is the lower.

NOTE: These limitations must not be confused with the speeds recommended for deliberate manual reversion (See Parts III and IV).

3. Normal Acceleration Limitations

(i) With or Without External Stores

Maximum positive normal acceleration 7 'g'.

Maximum negative normal acceleration -3 'g'.

(ii) With airbrakes extended

Maximum positive normal acceleration.	7 'g' at Mach Numbers up to M = 1.0. 5 'g' at Mach Numbers greater than M = 1.0.
Maximum negative normal acceleration.	-3 'g' at all altitudes.

4. Angle of Sideslip Limitations

At speeds up to 200 kts. I.A.S. - Unrestricted.

At speeds between 200 and 500 kts. I.A.S. - 5^{o}.

At speeds above 500 kts. I.A.S. - 3^{o}.

5. Maximum Safe Cross Wind Components for Take-off and Landing

(i) Aircraft without external stores

For take-off - 20 knots.

For landing - 20 knots.

(ii) Aircraft with external stores

For take-off - 15 knots.

For landing - 15 knots.

6. Rolling Manoeuvre Limitations

(i) Aircraft without external stores

(a) The rate of roll is not to exceed 300^{o}/sec.

(b) At rates of roll exceeding 200^{o}/sec. the angle of roll is not to exceed 180^{o}.

(c) In rolling pull-out manoeuvres the maximum 'g' is not to exceed 4.0 in rolls through up to 90°, and 3.0 in rolls through up to 180°.

(ii) Aircraft with external stores

(a) The rate of roll is not to exceed 150°/sec.

(b) At the maximum rate of roll there is no limitation on angle of roll.

(c) Rolling pull-out manoeuvres

Tanks full

In rolling pull-out manoeuvres the maximum 'g' at the maximum rate of roll of 150°/sec. is not to exceed 3.0 in rolls through up to 180°. In rolls up to 100°/sec. the maximum 'g' is not to exceed 4.0 in rolls through up to 90° and 3.0 in rolls through up to 180°.

Tanks less than half full

In rolling pull-out manoeuvres the maximum 'g' is not to exceed 4.0 in rolls through up to 90° and 3.0 in rolls through up to 180°.

7. Engine Operation Limitations and Conditions

(i) General Limitations

Condition	R.P.M.	J.P.T. °C Pilot's Instrument	Time Limit (per flight)
Take-off and operational necessity.	10,000	720 below 35000 ft.)) 725 above 35000 ft.)	10 mins.
Intermediate.	9,750	675	15 mins.
Maximum Continuous.	9,500	640	Unrestricted.
Approach.	4,000(Min.)	640 (200 minimum)	Unrestricted.
Ground Idling.	3,250 (Sea Level I.C.A.N. conditions)	640 (675 for 15 mins.)	Unrestricted.

The ground idling setting should vary with airfield height above sea level according to the following tabulation:-

Airfield Height (Ft.)	Ground Idle R.P.M. (I.C.A.N. Conditions)
Sea level	3250
1,000	3380
2,000	3500
3,000	3620
4,000	3740
5,000	3860

The tolerance is $^{+100}_{-0}$ R.P.M.

The A.F.R.C. should be set to give the following acceleration times from 4000 R.P.M. to 200 less than the available maximum, without stall, in response to throttle slam to OPEN on the ground.

Ambient Temperature ^{o}C	Acceleration Time (secs.)
4 and below	Not less than 5
4 to 34	5 to 8
34 and above	Not more than 8

It should be possible to retard the throttle quickly from OPEN to FLIGHT IDLE and then as the R.P.M. fall through 6000, to re-slam it to OPEN without surge or stall.

Note 1

Slam throttle openings from below 4,000 R.P.M. must not be made, but the engine should accelerate without stall from 4000 R.P.M. to maximum available, in response to throttle slam to OPEN.

Note 2

At I.C.A.N. conditions the limited fuel pump capacity will restrict maximum R.P.M. to around 9800 at approximately 200 ft. as air intake ram pressure develops during take-off.
This restriction diminishes in hot weather and with increasing height and 10,000 R.P.M. will be attainable at 10,000 ft. if 710°C J.P.T. has not occurred first. In very cold weather the maximum R.P.M. (static) on the ground at sea level will also become restricted below 10,000 R.P.M.

Icing Conditions and Foggy Weather

The engine has no anti-icing and should not be operated in icing conditions. On the ground this includes foggy weather with ambient temperature plus 3°C or below.

(ii) Fuel and Oil

Fuel

Aviation Turbine Fuel - D. Eng. R.D. 2482 (AVTUR).

or

Aviation Aviation Turbine Fuel - D. Eng. R.D. 2486 (AVTAG).

or N.A.T.O. symbol F-40 (J.P.-4)
American Specification MIL-F-5624C.

NOTE: When changing from AVTUR to AVTAG or J.P.4 fuels, the following limitations apply before flight:-

(i) The fuel pump governor setting must be checked and re-adjusted if found necessary.

(ii) Trial slam accelerations between idling and full throttle must be carried out and the A.F.R.C. re-adjusted if necessary to give stall-free accelerations.

Oil

Specification	Interservice	N.A.T.O. Code	Supply and Reference
D. Eng. R.D. 2487	OX.38	O.149	ESSO (British) EATO 35
			ESSO (U.S.A.) ETO 35
American MIL/L/7808C		O.148	ESSO Turbo Oil 15
			Caltex/Texaco Synthetic Aircraft Turbine Oil 15.
WARNING:- "35 grade" and "15 grade" oils must NOT be mixed.			

8. General Limitations

(i) Minimum engine and oil temperature for starting, minus 10°C (minus 26°C if Orpheus Mod. No. ORP 54 is embodied).

NOTE: If ambient temperature is below these limits, ensure that the engine and oil are sufficiently warm.

(ii) Inverted and sustained negative 'g' flying is prohibited with indicated fuel contents less than 250 lb. With indicated fuel contents of more than 250 lb. negative 'g' can be maintained for not longer than 15 seconds.

(iii) Intentional spinning is prohibited.

(iv) Ejection Seat

(a) Minimum ejection height and speed

Recommended minimum height for ejection in straight and level flight -

300 ft. at a minimum speed of 130 knots I.A.S. (See Pt. IV Para. 3 Note 2).

(b) Maximum ejection speed

500 knots I.A.S. should be considered the maximum speed for ejection unless otherwise forced by circumstances. Ejection speed should preferably be below 400 knots I.A.S. as above this speed injury to the limbs is possible.

(c) The combined canopy and seat ejection control is not to be used at speeds below 130 knots I.A.S.

(v) The limiting conditions for a cold engine relight are 30,000 ft. at a speed less than 150 knots I.A.S.

(vi) If the fuel transfer air pressure falls below the normal working range the fuel transfer pressure failure warning light will show RED. If the aircraft is using external tank fuel at the time of failure, dependent upon the degree of failure and rate of fuel demand the fuel remaining in the external tanks may become unusable. Fuel will then be used from the main system. After failure maximum R.P.M. at sea level will be obtainable down to an indicated fuel content of approximately 500 lb. Below an indicated fuel content of 500 lb. the maximum R.P.M. at sea level will be progressively reduced.

(vii) Flight with asymmetric external stores

(a)	One 500 lb. bomb	- minm. control speed 140 kts. IAS
(b)	One full ext. tank	- minm. control speed 200 kts. IAS
(c)	One half full ext. tank	- minm. control speed 145 kts. IAS
(d)	One empty ext. tank	- minm. control speed, unrestricted.

(viii) Radar Ranging Mk.1. Installation

Limited to 30 minutes operation per flight. This limitation is lifted with the introduction of Mod. GN. 152.

(ix) Aden Gun Installation

(i) Minimum speed for gun firing ..... 160 knots I.A.S.

(ii) At altitudes above 25,000 ft. throttle opening from below 8500 R.P.M. immediately before and during gun firing is prohibited.

(iii) The fuel dip master switch must be 'ON' prior to gun firing above 25,000 ft. altitude.

(x) Cabin Conditioning

The ram air scoop is only to be used with the cockpit temperature control at 'COLD' or 'OFF'. (See Pt. 1, para. 23 (vi)).

PART III

HANDLING

1. Management of the Fuel System

(i) The High Pressure Fuel Cock lever is connected to the throttle and is opened when the throttle is moved to the IDLING gate. This is also the starting and ground idling position for the throttle.

(ii) The Low Pressure Fuel Cock lever is on the rear of the starboard console and is wire locked 'ON'.

(iii) The fuel booster pump must be switched 'ON' at all times when the engine is running. If the pump fails or is not switched ON the fuel pressure warning indicator will show WHITE. Engine fuel will then be supplied by tank pressurisation and gravity.

(iv) If the pressure warning indicator shows WHITE indicating a fuel pump failure, the fuel pump circuit breaker should be checked.

NOTE: The fuel pressure warning indicator may flicker at take-off R.P.M. but this is not an indication of pump failure.

(v) If the fuel transfer air pressure fails, the tank pressure failure warning light, on the starboard upper instrument panel will show RED. In this event it will not be possible to use fuel from the jettisonable tanks, and the main fuel tank contents will start to fall. The flight plan should be amended as necessary. (See Section IV, Para.9).

STARTING, TAXYING AND TAKING OFF

2. External Checks

(i) The outside of the aircraft should be systematically checked for obvious signs of damage, security of panels, doors and wheel fairings. The engine air intakes and boundary layer bleeds must be free from obstruction. Oleos should be checked for equal extension; the tyres for creep, excessive wear or cuts, and the brake leads for damage.

(ii) The pressure head cover should be removed. Ensure that the ground locks have been removed from the flying controls and undercarriage.

3. Cockpit Checks

(i) On entering the cockpit ensure that the ejector seat firing breech locking lever is set to SAFE (pointing fore and aft) and check that the seat is adjusted to the correct height. Ensure that the emergency oxygen safety pin has been removed.

(ii) Strap in and make the necessary oxygen, emergency oxygen, anti-'g' suit and V.H.F. connections.

(iii) Check that the harness straps are secure and that the harness lock functions.

(iv) Check the oxygen mask fit by depressing the emergency toggle switch on the centre of the oxygen regulator and tightening the face strap to stop any leaks.

(v) After closing the canopy move the canopy locking lever forwards and upwards, and post Mod. GN.336 depress the canopy locking button. (When the locking button is properly depressed the white mark on the shank of the button will not be visible). Check that the red lines painted on the canopy frame windows each side of the cockpit are parallel with the grooves in the face of the canopy locking catches.

(vi) Move the ejection seat firing breech lock to the firing position and check the following :-

Parking brake	-	ON
Canopy release lever	-	LOCKED (Both locks engaged)
External power supply	-	CONNECTED and OFF
Accumulator master switch	-	OFF
Instrument master switch	-	OFF
Canopy jettison handle	-	SAFE (Down and wire locked)
Undercarriage selector	-	DOWN (Aft) check that blanking plate for 'Emergency Down' selection is removed.
Throttle	-	CLOSED (H.P. 'OFF').
Braking parachute selector	-	SET (Forward).
V.H.F. Selector	-	OFF

Turn and slip normal/ standby switch	- NORMAL
Windscreen demist control	- OFF (Pre Mod. GN.63)
Fuel pump switch	- OFF
Pressure head heater switch	- OFF
V.H.F. Normal/standby switch	- NORMAL
V.H.F. Supply Normal/ standby switch	- NORMAL
Navigation light switch	- OFF
Oxygen supply	- On 100% and wired
Oxygen contents	- FULL (or as required for flight)
Cockpit heating control	- As required
L.P. fuel cock control	- ON and wired
Emergency oxygen control	- 'PULL OFF' knob secure

(vii) With external power supply and Instrument Master Switch ON check the following :-

Main aircraft circuit breakers.	- MADE
Undercarriage position indicator	- 3 green lights - check bulb change over and Day/Night switch
Turn and Slip Indicator	- Functioning
Cabin pressure warning indicator	- BLACK
Hydraulic pressure warning indicator	- WHITE RED LIGHT ON post Mod GN 252 or 371
Generator failure warning light	- ON (red)
Fuel Pressure warning indicator	- WHITE
Oil pressure warning indicator	- WHITE
Fuel contents gauge	- Indicating contents - Full.
Tank pressure warning	- ON (red)

4. Checks before starting the Engine

Battery master switch	- ON
Fuel pump switch	- ON (Fuel pressure failure indicator - BLACK)
Instrument master switch	- ON
V.H.F. selector	- Select channel as required.

5. Starting the Engine

(a) With the throttle in the IDLING position (H.P. Cock ON), signal 'AIR ON' to the ground crew. As air is turned on depress the re-light switch and release when J.P.T. reaches 200°C.

(b) The engine should light up (J.P.T. begins to rise) at approximately 1400 R.P.M. in three seconds and accelerate to idling R.P.M. (3,000 R.P.M.) in approximately twelve seconds.

(c) If, during engine starting, the jet pipe temperature rises too quickly and exceeds 675°C, immediately close the throttle to "H.P. OFF".

6. Failure to Start

If the engine fails to light up normally, close the throttle to 'H.P. Off' and release the re-light switch. Allow the engine to run down and check for cause. Ensure that excess fuel is drained from the jet pipe and if necessary tilt down the tail of the aircraft. With throttle at 'H.P. Off', fuel pump switch 'ON' and re-light switch 'OFF' carry out a dry motoring cycle giving 8 to 10 seconds of air to the starter. Avoid risk of fire from fuel on ground under the tail before making the next attempt to start.

7. Checks after starting the Engine

Relight switch	- Release
External power supply	- Disconnected
Air starter	- Disconnected
R.P.M.	- 3250 ±50
J.P.T.	- 540 - 600°C
Fuel dip	- OFF (Pre Mod. GN.269)
	- ON (Post Mod. GN.269)

Turn and slip normal/ standby switch	- NORMAL
Windscreen demist control	- OFF (Pre. Mod GN.63)
Fuel pump switch	- OFF
Pressure head heater switch	- OFF
V.H.F. Normal/standby switch	- NORMAL
V.H.F. Supply Normal/ standby switch	- NORMAL
Navigation light switch	- OFF
Oxygen supply	- On 100% and wired.
Oxygen contents	- FULL (or as required for flight)
Cockpit heating control	As required
L.P. fuel cock control	ON and wired
Emergency oxygen control.	'PULL OFF' knob, secure.

(vii) With external power supply and Instrument Master Switch ON check the following :-

Main aircraft circuit breakers.	- MADE
Undercarriage position indicator	- 3 green lights - check bulb change over and Day/Night switch.
Turn and slip indicator	- Functioning
Cabin pressure warning indicator.	- BLACK
Hydraulic pressure warning indicator.	- WHITE
Generator failure warning light.	- ON (red)
Fuel Pressure warning indicator.	- WHITE
Oil pressure warning indicator.	- WHITE
Fuel contents gauge	- Indicating contents - Full.
Tank pressure warning	- ON (Red).

4. Checks before starting the Engine

Battery master switch	- ON
Fuel pump switch	- ON (Fuel pressure failure indicator - BLACK)
Instrument master switch	ON
V.H.F. selector	- Select channel as required.

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5. Starting the Engine

(a) With the throttle in the IDLING position (H.P. Cock ON), signal 'AIR ON' to the ground crew. As air is turned on depress the re-light switch and release when J.P.T. reaches 200°C.

(b) The engine should light up (J.P.T. begins to rise) at approximately 1400 R.P.M. in three seconds and accelerate to Idling R.P.M. (3,000 R.P.M.) in approximately twelve seconds.

(c) If, during engine starting, the jet pipe temperature rises too quickly and exceeds 675°C, immediately close the throttle to "H.P. OFF".

6. Failure to Start

If the engine fails to light up normally, close the throttle to 'H.P. Off' and release the re-light switch. Allow the engine to run down and check for cause. Ensure that excess fuel is drained from the jet pipe and if necessary tilt down the tail of the aircraft. With throttle at 'H.P. Off', fuel pump switch 'ON' and re-light switch 'OFF' carry out a dry motoring cycle giving 8 to 10 seconds of air to the starter. Avoid risk of fire from fuel on ground under the tail before making the next attempt to start."

7. Checks after Starting the Engine

Relight switch	- Release
External power supply	- Disconnected
Air starter	- Disconnected
R.P.M.	- ~~3000 ± 50~~ 3250 ± 50.
J.P.T.	- 540 - 600°C.
Fuel Dip	- OFF

PART III - HANDLING

Increase R.P.M. to ~~4500~~ 5000 and check the following:-

Generator failure warning light.	- Red light out.
Anti 'g' suit.	- ON and test.
Tailplane trim.	- Function.
Tailplane position indicator.	- Functioning.
Emergency tailplane trim.	- Function.
Cabin pressure warning indicator.	- BLACK (see 'heating control').
Fire warning light.	- OUT.
Hydraulic shut-off cock.	- ON.
Hydraulic pressure warning indicator.	- BLACK (RED light 'OUT' Post Mod. GN. 352 or 371).
Audio warning cancel button.	- AMBER light 'OUT' (Post Mod. GN. 352 or 371).
Operate hydraulic tail and check tailplane position indicator for full travel.	
Operate ailerons through full travel six times to ensure dampers are full of fluid.	- Check fluctuations of hydraulic pressure gauge between approximately 3000 p.s.i. and approx. 2400 p.s.i.
A.C. supply failure indicator.	- BLACK.
Fuel pressure failure indicator.	- BLACK.
Tank pressure failure.	- RED light OUT.
Oil pressure failure indicator.	- BLACK. *
Instruments	- Check functioning, set G4F compass and altimeter, press fast erection button on artificial horizon.
Heating control.	- Heating and pressurisation as required.

* In very cold weather retard the throttle until BLACK shows, then increase R.P.M. gradually, keeping the warning BLACK.

8. Taxying

Taxi forward and check for equal braking effect. Sharp turns at speed should be avoided. For taxying, the idling throttle position is adequate, but R.P.M. should be kept to ~~4500~~ 5000 whenever possible to avoid excessive loads on the aircraft battery.

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9. Checks before Take-off

Fuel	-	TANK pressure failure light - OUT. CONTENTS - Fuel pressure failure indicator - BLACK.
Instruments	-	CHECK - set compass - press fast erection button on Artificial Horizon. Pitot Head Heater - ON.
Oxygen	-	CONTENTS - Adequate for flight. ON 100% - Reaching mask. Remote blinker in phase with regulator blinker and breathing.
Flying Controls	-	FULL, FREE and CORRECT movement. TAILPLANE set to -6°.
Canopy	-	CLOSED and LOCKED.
Harness	-	TIGHT and LOCKED.
Pressurisation	-	As required.
Brake Parachute	-	SET.

10. Take-off

(i) Align the aircraft with the runway, apply the brakes and open the throttle. When the brakes begin to slip release them and increase the R.P.M. to the maximum. A maximum of 10,000 R.P.M. will be obtained at the beginning of the take-off run, but a maximum of 9,700 R.P.M. will be obtainable at approximately 200 ft. due to engine fuel pump limitation.

(ii) The aircraft accelerates rapidly, with no tendency to swing. The rudder becomes effective at between 60 and 70 knots. Up to this speed directional control should be obtained from the brakes.

(iii) The flying tail is a very powerful longitudinal control. All movements of the stick should be smooth and not jerky. At 120 knots, raise the nosewheel and fly off with stick almost fully back. Apply the brakes, select wheels up and, as the undercarriage retracts, allow the stick slowly to return to the neutral position to counteract the nose-up trim change. When the stick is in the neutral position, retrim the aircraft to climb away, approximately -2° of tailplane trim.

HANDLING IN FLIGHT

11. Engine Handling

(i) An air fuel ratio control is fitted to control engine response with varying rates of throttle movements. Movements of the throttle from flight idling to full power in less than 3 seconds should be avoided.

(ii) A maximum J.P.T. limiter is fitted. It will limit J.P.T. to 700°C near the ground, but increases with altitude. Above 35,000 ft. the J.P.T. must not exceed 725°C. Jet pipe temperature limits are critical. Avoid exceeding them when starting, or when re-lighting, when taking off in high ambient temperature and when climbing at higher power at high altitudes.

NOTE: The correct functioning of the limiter should be checked frequently against the pilot's J.P.T. gauge. It will not control during rapid throttle opening or during high N/$\sqrt{\theta}$ surge.

(iii) An anti-surge control is fitted to limit the R.P.M. to below the values for high N/$\sqrt{\theta}$ surge to occur. This normally will become active above 30,000 ft. but in very cold weather it will do so at a lower height.

NOTE: The setting requires to be checked in flight above 30,000 ft. and the engine should run without surge at full throttle in climb at low I.A.S. It is necessary to know the R.P.M., height, Mach No. and the ambient air temperature for making a correcting adjustment.

(iv) A fuel dipping installation is fitted which reduces engine R.P.M. to a value below that for surge to occur when the guns are fired. The fuel dip master switch must be 'ON' prior to gun firing above 25,000 ft. altitude. Post Mod. GN.269 the switch can for convenience be placed 'ON' prior to take-off and remain 'ON' for all of the flight. With the switch in the 'ON' position the R.P.M. will be reduced if necessary when the gun trigger is depressed, and will be restored when the gun trigger is released. If the R.P.M. fail to recover on release of the trigger the fuel dip master switch should immediately be selected 'OFF'. This will isolate the fuel dipping circuit and enable the engine R.P.M. to be restored.

12. General Flying

(a) Climbing

The recommended climbing speeds are given in Part V. The speed should be increased to the value given for 5,000 ft. (1500 m.) immediately after take-off since no appreciable gain is obtained by holding the aircraft down. The best climbing speed should not be exceeded, particularly at high altitudes, as this will give rise to large losses in the rate of climb. In all cases, the Mach No. should be between 0.8 and 0.9.

(b) Longitudinal Stability and Control

(i) Stability

The aircraft is statically stable throughout the speed range.

(ii) Longitudinal Handling with Flying Tail

Response of the slab tail in flight is quite normal, but transonically larger stick movement will be required for a given 'g'. The transonic trim change occurs at approximately 0.92 I.M.N. and is accompanied by a nose down trim change which should be trimmed out if continued flying above 0.92 I.M.N. is intended.

(c) Lateral Control

(i) The ailerons are light and powerful and remain very effective at high Mach numbers.

(ii) If any coupling develops during rolling manoeuvres, i.e. if large angles of yaw or pitch develop during rolling the ailerons should be centralised slowly and the aircraft allowed to recover.
Reference should be made to Part II, Flight Limitations, for limitations applicable to rates of roll.

(d) Directional Control

The rudder is fairly light and effective at all speeds. In common with all swept wing aircraft, the use of rudder at low speeds induces rolling.

(e) Airbrakes

The nose and main undercarriage doors are used as airbrakes. There is very little trim change up to 0.95 M. Above this speed there is a marked nose down trim change with airbrake operation.

13. Practice Flying in Simulated Emergency Conditions

(a) Simulating an Hydraulic Failure

It is assumed that the pilot is thoroughly conversant with the hydraulic and flying control systems, and that he realises that operating the shut-off cock will isolate all the hydraulic services, i.e. undercarriage and dive brakes.

NOTE: In manual slight asymmetry of the ailerons may occur at speeds of 300 knots and more. The force to hold this will, however, not be great and will disappear at 250 to 300 knots.

(i) At speeds not exceeding 250 knots I.A.S. to simulate an hydraulic failure select 'OFF' with the hydraulic shut-off cock operating lever in the cockpit. The tailplane will then be operated using the hydraulic pressure retained in the main accumulator. With the aircraft in trim pull the 'elevator unlock' lever to full travel.

NOTE: After selection of elevator 'unlock' re-selection is impossible and should never be attempted.

For a short period the pilot will be flying with a combined tailplane and elevator system. (See Part IV para. 6 (iii) which describes flying with the combined tailplane and elevator). Now exhaust the main accumulator by small and gentle fore and aft movements of the control column. The aircraft is then flown using the elevator and the electrically trimmed V.I. tailplane.

(ii) In the meantime power for the ailerons will be provided by the aileron accumulators. These will last approximately 5 to 10 minutes depending on the rate of aileron operation. As these become almost exhausted the ailerons will become progressively heavier until full manual reversion occurs. With undercarriage and flaps up the force will be moderately heavy at airspeeds above 350 knots I.A.S.

Procedure in Circuit Prior to Landing

It is reiterated here that with the hydraulic shut-off cock selected 'OFF' undercarriage and dive brakes are inoperable using normal selection, and to avoid unnecessary use of the emergency undercarriage lowering system the following procedure is to be adopted.

(i) At pilot's convenience trim for level flight at a speed of 200 to 250 knots I.A.S. and ensure zero stick force.

(ii) Reselect hydraulic power 'ON'.

Power will return to the tailplane and ailerons almost simultaneously.

NOTE: The tailplane will then become a combined control as in Part IV para. 6 (iii).

(iii) Check that the hydraulic pressure gauge is reading 2400 p.s.i. or more and then select dive brakes and undercarriage as required.

(iv) Reselect hydraulic power 'OFF' after checking that the undercarriage is locked down. Exhaust the accumulators by gentle movements until full manual reversion is established before making the final approach. If the pilot does not wish to land using full manual control hydraulic power 'OFF' should not be selected after lowering the undercarriage. The landing is then made using the combined tailplane and elevator.

(b) Simulating an Electric Trimmer Motor Failure

(i) This failure can be practised in any trim position within the normal trimmed flight range. Reduce speed to 250 knots I.A.S. or less by normal methods without retrimming. As far as is practical (i.e. consider height, weather etc.) allow the control column to go to the zero load position, and immediately pull the 'elevator unlock' lever to full travel.

If the elevator unlock lever is pulled with the control column not in the neutral position a slight nose up or nose down movement will result due to the out of trim position which the elevator will momentarily take up.

(ii) Procedure in Circuit Prior to Landing

The trim change caused by the lowering of the undercarriage may be easily held by use of the control column only. Regardless of the 'failed' position of the trimmer motor there will always be adequate longitudinal control to 'round out' although if the 'emergency' has been simulated trimmed at $+1^{0}$ the final approach speed should be around 145 knots I.A.S. at the normal landing weight. This speed may vary slightly depending on the amount of control available for the round out.

NOTE: All practice emergency conditions should first be tried out at a safe altitude, i.e. not less than 15,000 ft., including a simulated approach at the correct R.P.M. and rate of descent.

14. Stalling

The following are speeds and characteristics of a flaps and undercarriage down stall. Figures in parenthesis give equivalent speeds with flaps and undercarriage retracted.

Aircraft without external stores

Speed (Knots)	Characteristics
130-120 (135-125)	Slight buffet.
120-110 (125-115)	Buffet increases slightly. Possible yawing and wing dropping.
Below 110 (115)	Rate of sink increases.

Aircraft with external stores

Stalling characteristics and stall warning are similar to those for the aircraft without external stores. Rate of sink at the stall is somewhat greater than that for the aircraft without external stores.

15. High Speed Stalling

Stalling at Mach Number greater than 0.7 will be preceded by :-

(i) High frequency 'vibration' buffet.

(ii) Mild and erratic wing dropping.

(iii) Violent wing dropping followed by 'flicking' in either direction.

16. Aerobatics

The following are the recommended minimum speeds for aerobatics.

Roll	-	300 knots.
Loop	-	350 knots.
Roll off	-	350 knots.
Vertical roll	-	450 knots.

17. Spinning (with or without external stores)

(i) Intentional spinning is prohibited

(ii) Should the aircraft inadvertently enter a spin, recovery should be made by centralising all controls. The aircraft will recover in a dive within half a turn. Use of anti-spin rudder is not recommended as there is a danger of entering a spin in the opposite direction.

(iii) If a spin is inadvertently entered whilst carrying external stores the recovery action should be as for the clean aircraft. If this is not effective within one turn all external stores should be jettisoned.

(iv) The aircraft is usually reluctant to spin, and full pro-spin rudder is required to keep the aircraft spinning. The spin is oscillatory about all three axes with an average rotation of 70°/sec.

18. Handling with Jettisonable Tanks

With jettisonable tanks installed, the following differences in handling qualities from the clean aircraft should be noted.

(i) Lateral control is less effective with fuel in the jettisonable tanks.

Lateral control improves as fuel is used from the tanks.

(ii) An increase of 5 knots over the approach speed for the clean aircraft is recommended when landing with empty jettisonable tanks.

NOTE: Reference should be made to Part 11, Flight Limitations, for special limitations applicable when flying with external stores.

Jettison of Jettisonable Tanks

(i) There is a transient nose up pitch followed quickly by a residual nose down pitch when tanks are jettisoned. This nose down pitch increases with both speed and Mach number, and can be corrected by a small aft movement of the control column and subsequent re-trimming. A small height loss should be taken into consideration when jettisoning tanks at very low altitude.

NOTE: Reference should be made to Part 11, Flight Limitations, for speed limitations applicable to the jsttison of tanks.

19. Rocket Firing

When carrying out a ROCKET attack and in a suitable position to commence sighting the pilot will:-

(i) Select the Bomb/R.P. master switch to R.P. and switch on camera master switch.

(ii) Press the camera push switch on the control column, which will allow the camera to expose film and also uncage the moving graticule in the gunsight.

(iii) When the R.P. firing switch on the column is pressed this will cause the rockets to be fired, the camera to stop and the sight to be caged.

If the pilot does not fire the rockets the camera can be stopped and the sight re-caged by switching the R.P. Master Switch OFF and then back to the ON position, ready for the next attack.

20. Bombing

A pronounced nose up pitch occurs when bombs are dropped in level flight, the severity of which increases rapidly with increase of speed above 400 knots I.A.S. It is therefore recommended that bombing be performed at speeds below 400 knots I.A.S. At dive angles above 20° no nose up pitch occurs on release of bombs and the above remarks do not apply.

21. Handling with Jettisonable Tanks and Bombs

A tendency to starboard wing heaviness occurs at 0.88 I.M.N. in dives at any altitude. This can be easily corrected, and corrective action should be taken as soon as the wing heaviness becomes apparent.

CIRCUIT PROCEDURE AND LANDING

22. Circuit Procedure

NOTE: 300 lb. of fuel should be allowed for the circuit and landing. (This will allow for one baulked landing)

(a) Entering Circuit

Reduce speed in circuit to 200 knots. A comfortable speed for the downwind leg is 170/180 knots. Lower the undercarriage at this speed and retrim the tailplane to -8°. This will give rise to a push force until the speed has dropped to 140 knots.

(b) Checks before Landing

Undercarriage	DOWN.	Three green lights on.
Tailplane	-8°.	
Brakes	OFF.	
Fuel	Contents minimum of 300 lb.	
Harness	Tight and locked.	

(c) Approach

(i) Turn on finals at 150 knots at approximately 6,000 R.P.M. (In rough conditions it may be desirable to make this figure 160 knots). Steep approaches are not recommended for early flights, as these necessitate throttling back to flight idling R.P.M. This will increase engine response time in event of a baulked landing.

(ii) To ensure rapid engine response a fairly flat approach should be made with the engine R.P.M. about 6,000 on the turn to the final approach.

(iii) The recommended minimum speeds at which to cross the runway threshold are:-

At normal landing weight	125 - 130 knots
Landing with jettisonable tanks empty to ½ full and/or bombs and rockets.	130 - 135 knots

NOTE: If it is necessary to land immediately after take-off:-

(i) With bombs and tanks - then jettison the bombs.

(ii) With rockets and tanks - then jettison the tanks.

These restrictions are imposed pending further overload landing tests.

For handling with asymmetric stores, see Emergency Handling, Para. 11.

(d) Landing

(i) The shortest landing run is obtained by putting the nose-wheel onto the runway as soon as possible after touchdown, and braking hard. This also applies when a brake parachute is deployed at touchdown.

(ii) When application of brake is required above 115 knots, the tail braking parachute should also be deployed.

23. Baulked Landing

(i) Jettison the brake parachute, if deployed.

(ii) Open the throttle smoothly to approximately 8,500 R.P.M.

(iii) Climb away as for normal take-off. The circuit can be continued with flaps and undercarriage down or retracted.

24. Stopping the Engine

Throttle	-	Move back to H.P. OFF
Fuel booster pump	-	OFF
All other switches	-	OFF

After Stopping the Engine

Parking brake	-	ON
Ejection seat	-	Firing Breech Lock set to SAFE

PART IV

EMERGENCY HANDLING

1. Power Failure and Re-lighting in Flight

(a) Flame-out and hot re-light (J.P.T. falling below 200°C)

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(i) If a flame-out occurs immediately depress the Relight button and throttle back to the IDLING gate. A successful HOT relight will be indicated by a rise of J.P.T. and R.P.M. If the J.P.T. reaches the limit of 675°C or if no relight occurs after 10 seconds, release the Relight switch and take the following action :-

Throttle	- Closed to "H.P. OFF" position
All non-essential electrics.	- OFF
If at 30,000 ft. or below reduce speed to 150 knots.	- Attempt relight after about 20 seconds, as per (b) below.
If above 30,000 ft.	- Booster pump OFF. Descend to 30,000 ft. and relight as per (b) below.

(b) Relighting.

1. The likelihood of obtaining a successful relight increases with decrease in altitude. The re-light ceiling with the engine cold is about 34,000 feet, but it is recommended that a descent be made to 30,000 feet or lower before a re-light is attempted.

2. At the best gliding speed, 200 knots, the aircraft will cover approximately 2 nautical miles per 1,000 ft. height loss.

3. With all services running, the electrical battery cannot be relied upon for more than 10 minutes. All non-essential electrics such as instrumentation, booster

pump, etc. should be switched OFF to conserve power.

4. During descents at the best gliding speed of 200 knots with the engine out, the engine windmilling speed is sufficient to provide hydraulic pressure for operating the ailerons and flying tail. The air brakes and undercarriage may also be lowered at the best gliding speed or above, but operating times will be higher than with the engine running. Providing that rapid large angle movements of the tailplane are avoided, the pressure-maintaining valve will ensure that sufficient fluid is available for tail plane operation.

5. After an unsuccessful re-light attempt, before attempting another re-light, fly the aircraft in a nose-up attitude for as long as is convenient to ensure that best conditions for draining unburnt fuel.

6. To re-light, proceed as follows :-

(i) Maximum Altitude - 30,000 ft.

Maximum Airspeed - 150 knots down to 25,000 ft.
200 knots below 25,000 ft.

All non-essential electrics - OFF

Throttle - H.P. OFF

Fuel Booster Pump - ON

(ii) Depress relight switch for 2 seconds.

(iii) Keeping the relight switch depressed, slowly move the throttle to the IDLING gate. The engine should light up smoothly indicated by rising J.P.T. before or as the throttle reaches the IDLING gate.

(iv) Release the relight switch when the engine speed is increasing smoothly above 4,000 R.P.M.

(v) Do not open the throttle beyond the IDLING gate until the engine has lit up and is running smoothly. Observe the precautions in (a).

(c) Engine Failure

If flame extinction occurs due to mechanical failure of the engine, take the following action immediately:-

Throttle	-	Closed to H.P. OFF position.
All non-essential electrics	-	OFF

DO NOT ATTEMPT TO RELIGHT.

2. Action in the Event of Fire

(i) Should fire break out in the engine bay, indicated by the fire warning light, the following action should be taken immediately:-

Throttle	-	Closed to H.P. OFF position.
L.P. Cock	-	OFF
Fuel Booster Pump	-	OFF
Airspeed	-	Reduce as much as possible by use of airbrakes above 250 knots, by use of undercarriage if below 250 knots.
All non-essential electrics	-	OFF

(ii) No attempt should be made to relight as this may result in a further outbreak of fire.

(iii) If the fire persists the aircraft should be abandoned, (See Para. 3).

(iv) Depending on prevailing conditions, it may be necessary to abandon the aircraft even if the warning light shows the fire to have been extinguished. If a forced landing without power is possible the recommendations of para. 11 should be adhered to.

3. Abandoning the Aircraft

Note 1

The maximum speed for ejection should be taken as 500 knots unless otherwise forced by circumstances. Ejection speed should preferably be below 400 knots as above this speed injury to the limbs is possible.

Note 2

The minimum combination of height and speed for successful ejection is 300 ft. and 130 knots I.A.S. in straight and level flight. It must be clearly understood that should the aircraft be losing height at the instant of ejection its rate of descent has an adverse effect upon the height safety margin, and the minimum safe height becomes unsafe. An approximate allowance for rates of descent can be made as follows:-

$$300 + \frac{\text{rate of descent in ft./min.}}{10} = \text{minimum safe height for that rate of descent}$$

e.g. at a rate of descent of 2500 ft./min. the minimum safe height for ejection = $300 + \frac{2500}{10}$

$= 550$ ft.

Conversely if there is speed to spare it is advantageous to translate it into rate of climb at the instant of ejection. Height gained in this manner can always be used to organise the parachute descent and landing, and to cater for the remote cases where it may be necessary to override the automatics and operate the parachute manually.

Note 3

The aircraft is fitted with a seat/canopy interconnection mechanism which provides for the jettisoning of the canopy on the initial movement of the seat firing handle. This system is cleared for use down to speeds of 130 knots I.A.S. but below this speed and prior to abandoning the aircraft in a spin the canopy must first be jettisoned manually as in para. 4 before ejection.

(i) Normal Ejection (i.e. using the combined canopy/seat mechanism)

(a) Grasp the blind handle in both hands and draw the blind firmly down over the face, keeping head well back and elbows tucked in close to the sides.

(b) If it is not possible to reach the blind, or the blind fails to operate, proceed as per para. (ii).

(ii) Ejection using Secondary Firing Handle

(a) Reduce speed as much as possible.
(b) Jettison the canopy as per para. 4.
(c) Keeping the head firmly on the headrest, press the 'pip' pin in the centre of the firing handle and pull the handle upwards.

(iii) Automatic Separation and Parachute Deployment Sequence

(a) After clearing the aircraft, automatic separation from the seat will take place after approximately 1 second.

(b) The parachute will be automatically ~~deployed~~ commence to deploy 2 seconds after separation if abandoning the aircraft below 10,000 ft. If above this height a free fall will be made to 10,000 ft. before the parachute is deployed. AL 24

(iv) Action during Free Fall and Prior to Touchdown

During the free fall following ejection at altitudes in excess of 10,000 ft. it is possible that the body might commence spinning in an unpleasant and even dangerous manner. To avoid this, and to achieve a stabilised position during free fall (after separation from the seat) the following action is recommended.

(a) After separation from the seat the pilot should retain a compact position with his legs together and fully stretched and his arms folded across the chest for approximately three seconds.

(b) He should then adopt a "Spreadeagle" position (illustrated in Part VI Fig. 6) by vigorously stretching his arms and legs to adopt the position as illustrated. It is essential that the limbs are displaced symmetrically and the back extended; palms of the hands should be in the same plane as the body, fingers and thumbs together, feet pointed.

(c) This position will stabilise the falling body. It should be noted that more definite control of stability can be achieved once terminal velocity has been reached, e.g. involuntary turns are sometimes more difficult to prevent during the first few seconds of fall.

(d) Parachutist can see the ground below. (Movement of the head above will not destroy stability).

NOTE: As forward velocity decreases and vertical velocity increases the body will assume a more horizontal position in relation to the ground, and with arms in this position will probably be slightly head-down within 8 seconds.

Prior to landing release the survival pack by unfastening the quick release fasteners attaching the survival pack to the parachute harness. The survival pack will then hang on the lanyard which is connected to the life jacket. Disconnect the emergency oxygen supply hose at the face mask hose.

AL 24

On touchdown turn and press the parachute harness quick release.

(v) Action Following Failure of Automatic Separation and Parachute Deployment Systems

AL 24

(a) When forward speed is sufficiently low, let go of the ~~firing handle or emergency~~ primary or secondary firing handle.

(b) Pre-Mod. GN.67. Operate the seat harness quick release and push clear of the seat.

Post Mod. GN.67. Pull outwards and upwards on the manual override lever on the port side of the seat pan to obtain separation from the seat.

AL 24

(c) After manual separation the parachute will be automatically deployed but if below 10,000 ft. and the parachute is not automatically ~~developed~~ deploying after 2 to 3 seconds, pull the parachute rip cord 'D' ring.

(vi) Action should the Ejection Seat Fail to Eject

(a) Reduce speed to a safe minimum.

(b) If possible disconnect leg restraint garters at quick release clips (Post Mod. GN.67).

(c) If above 10,000 ft. initiate emergency oxygen supply.

(d) Break the oxygen, mic-tel and anti-'g' connections.

(e) Pre Mod. GN.67. Operate the seat harness quick release.

Post Mod. GN.67. Operate the manual override lever on the port side of the seat pan to release the seat harness.

(f) Jettison the canopy as in para. 4.

(g) Trim nose heavy and invert the aircraft.

(vii) Action when committed to a Forced Landing

In general it is recommended that a forced landing remote from an airfield be made with wheels down but air brakes may be selected to advantage at the pilot's discretion: if, for example, the landing area is restricted. To facilitate a rapid exit from the aircraft the following action should be taken prior to touchdown:-

(a) Adjust harness as tight as possible.

(b) Disconnect leg restraint garters at quick release clips, (Post Mod. GN.67.). This action does not prejudice ejection at a later stage.

(c) Disconnect oxygen mask tube at quick release fitting, mic-tel and anti-'g' connectors.

(d) Jettison the canopy as in para. 4.

After touchdown:-

(a) Release the seat harness.

(b) Operate the parachute harness quick release.

(c) Vacate the aircraft.

(viii) Action when committed to Ditching

Ditching should not be attempted and the aircraft should be abandoned as detailed previously.

4. Jettisoning the Canopy

(i) The canopy must be jettisoned manually in the following circumstances:-

(a) If the combined canopy/seat system has failed. This may necessitate use of the ~~seat pan ejection~~ secondary firing handle (See para. 3(ii)).

(b) If the airspeed is below 130 knots I.A.S. and it is intended to eject.

(c) Prior to forced landing or ditching when ejection is not contemplated.

(ii) To jettison the canopy manually give a sharp rearwards pull of the jettison 'D' handle situated on the port console behind the throttle. Keep the head well down whilst jettisoning but replace it firmly against the headrest before ejection.

5. Electrical System Failure

(a) Generator Failure

(i) If the generator fails the generator failure warning light will illuminate. Check that the generator field circuit breaker is 'IN' and also increase the R.P.M. to see if the warning light goes OUT.

(ii) If the failure warning persists switch 'OFF' the Radar Ranging.

(iii) With the Radar Ranging switched 'OFF' the main aircraft battery can be relied upon for approximately 20 minutes, providing that the failure has not occurred within approximately 5 minutes of take-off, in which case the battery may only cater for an immediate return to base.

(iv) If all other services except the V.H.F. transmitter/ receiver and the instrument supplies inverter are switched OFF at the time of failure the main battery can be relied upon for approximately 50 minutes. Decreasing voltage as the battery discharges and reaches these time limits will result in:-

(a) Failure of the tail trim motor to operate.
(b) Failure of the instrument supplies inverter which will render the G4F compass, the artificial horizon and the fire warning system inoperative.
(c) The fuel contents indication becoming inaccurate by rapidly falling off to indicate zero contents.
(d) Deterioration in the operation of the normal V.H.F.

(v) The standby battery should be selected when required for operation of the turn and slip indicator and the standby V.H.F. It may also be necessary to unlock the elevator prior to landing as in para. 6(iii).

(b) Inverter Failure

If the instrument inverter fails, the A.C. power failure indicator will show 'WHITE'. Inverter failure will be accompanied by the loss of the Artificial Horizon, the G4F Compass and the Fire Warning system.

6. Tailplane Emergency Trimming

(i) If the normal tailplane trimming system becomes unserviceable in flight, trimming may be carried out using the emergency trimming switch on the port lower instrument panel.

Emergency trim must not be used when normal trim is serviceabl

On emergency the full tailplane travel of $+3^{\circ}$ to -18° is available. On normal trimming only $+2^{\circ}$ to -12° is available. ($+1^{\circ}$ to -14° when Mod. GN. 332 is embodied).
The emergency circuit must not be used outside these normal trim limits on the ground.

(ii) Tailplane runaway is most unlikely as the action of trimming makes two switches so that a double failure is required to give a runaway If runaway should occur the tail-trim circuit breaker should be tripped immediately.

(iii) If the tailplane becomes untrimmable using normal or emergency trimming the following action should be taken:-

(a) Reduce speed to below 250 knots I.A.S.

(b) Pull the elevator unlock lever to full travel, preferably with no load on the control column and the airspeed below 250 knots I.A.S. to avoid any slight pitching motions. If the elevator is unlocked with a pull or push force on the control column a slight nose up or nose down movement will result due to the ou of trim position which the elevator will momentarily take up.

The control will then become a combined tail and elevator whic will be lighter and more sensitive than the normal control.

(c) Rapid movements of the control should be avoided whilst using this emergency system. Pilots should remember that the effectiveness of the control will increase with increasing deflections of the stick and with increasing airspeeds. Trim changes due to undercarriage lowering can be easily held on th stick.

Approach and landing should be made at the normal speeds excep where trimmer failure has occurred at positive values of tail-plane setting. In this case the approach speed should be 145 knots I.A.S. at normal landing weight (See Part III, para. 13 (b) (ii)).

7. Hydraulic System Failure

Part 1 Flying Controls

(a) If the hydraulic pressure warning indicator shows "WHITE" (Post Mod GN. 352 or 371 red light 'ON' plus audio warning) and the hydraulic pressure gauge approaches to 1500 p.s.i. a failure can be assumed,

Speed should be reduced as soon as convenient to 250 knots I.A.S. or less at all altitudes by use of the power remaining in the hydraulic system provided by the pressure maintaining valve, or if necessary by use of the electric trimmer. If hydraulic failure is confirmed by the pressure gauge remaining at 1500 p.s.i., select 'OFF' with the hydraulic shut-off cock and revert to manual by pulling the elevator unlock lever to full travel as in para. 6(iii)(b).

Note 1

Elevator unlock and selecting 'OFF' with the hydraulic shut-off cock must always precede undercarriage "emergency down" operation.

Note 2

If the hydraulic tail motor seizes the rest of the hydraulic system will of course remain normal, but control column movement will not produce longitudinal response. In these circumstances the elevator should be unlocked when speed is below 250 knots I.A.S. at all altitudes and the hydraulic 'ON/OFF' lever should be selected 'OFF'. This will commit the pilot to use of emergency undercarriage selection prior to landing.

Note 3

If the elevator unlock lever is used inadvertently with hydraulic power still available, see para. 6 (iii).

Note 4

Maximum speed in manual aileron and elevator is as laid down in Part II - Flight Limitations. It should be clearly understood that these speeds are the limiting speeds for flying with manual controls. They should not be confused with the recommended speed of 250 knots I.A.S. for actual reversion to manual.

The ailerons will automatically revert to manual when the aileron accumulators are exhausted, when possibly a slight asymmetry of the ailerons may occur at speeds of 300 knots or more. The forces involved, however, will not be great and will disappear at 300 to 250 knots. If economical use is made of ailerons, the period of time elapsing before reverting to manual will be extended to approximately 10 minutes. A gradual increase of stick force will be encountered as the accumulators exhaust. Finally, in manual, aileron forces will be very heavy with the undercarriage down which may require approaching at a speed above the normal value, and even two handed forces.

(b) If the hydraulic pressure gauge falls below 1200 p.s.i. a loss of air pressure from the main accumulator has occurred, but unless the warning indicator shows WHITE (or red light plus audio warning is received) it can be assumed that normal hydraulic pressure is still available. Select OFF with the hydraulic shut-off cock and reduce speed to 250 knots I.A.S. or below as

in the previous paragraph, again unlocking the elevator at 250 knots or less. When it is required to lower the undercarriage for landing proceed as follows:-

(i) Trim for level flight at between 200 and 250 knots I.A.S. and ensure zero stick force.

(ii) Re-select hydraulic power ON. The tailplane will then become a combined control as in para. 6(iii)(b).

(iii) Lower the undercarriage by a normal selection (DO NOT USE THE EMERGENCY UNDERCARRIAGE SELECTION).

(iv) When the undercarriage is down and locked and the aircraft re-trimmed, re-select hydraulic power 'OFF', and exhaust ~~the~~ both aileron & main ~~reservoirs of~~ accumulators ~~power~~ before making the landing in manual conditions. A.L.23

Part 2. Undercarriage

Following hydraulic failure the undercarriage may be lowered at speeds below 170 knots I.A.S. by selecting "Emergency Down", providing that the elevator has been previously unlocked and the hydraulic shut-off cock selected 'OFF'. No further undercarriage selections are then possible. Following air pressure failure as in Part 1 (b) of this para. the emergency selection is not to be used.

8. Cabin Pressurisation System Failure

(a) When the cabin pressure falls to 1 p.s.i. below the design value the cabin pressure warning indicator will show "WHITE". This will be accompanied by an increase of cabin altitude as shown on the cabin altimeter.

(b) If a failure in cabin pressure occurs above 42,000 ft., a rapid descent to below 40,000 ft. should be made.

NOTE: The maximum permissible cabin altitude for continuous use of the pressure demand oxygen system is 42,000 ft. but it is recommended that the descent following cabin failure be made to below 40,000 ft. to protect the pilot from any anoxia which may occur after exposure to cabin altitudes in excess of 42,000 ft.

(c) As an additional protection emergency flow oxygen should be selected by movement of the lever mounted at the top of the central control pedestal to the left.

(d) If any cracks appear in the canopy or windscreen, the speed should be reduced to 200 knots with return to base at an altitude less than 40,000 ft.

9. Fuel Transfer Air Pressure Failure

(i) If the fuel transfer air pressure falls below the normal working range the fuel transfer pressure failure warning light will show

RED. If practicable, an attempt to restore transfer pressure should be made by increasing the engine R.P.M. If this is unsuccessful, and external tank fuel is being used at the time of the failure, dependant upon the degree of failure and rate of fuel demand the fuel remaining in the external tanks may become unusable. Should this happen fuel will begin to be consumed from the internal tanks, resulting in a decrease of the indicated contents on the fuel gauge.

(ii) Dependant upon the time of failure the maximum obtainable engine R.P.M. may be restricted at low indicated fuel states. However, under the most adverse conditions of failure maximum R.P.M. will always be obtainable down to an indicated contents of 500 lb., at which stage there will begin a progressive reduction to approximately 8500 R.P.M. at 400 lb. indicated and 6000 R.P.M. at 200 lb. indicated.

(iii) Should at any time asymmetry of external tank transfer be indicated by a serious change of lateral trim, the tanks must be jettisoned as soon as possible.

NOTE: The tank pressure warning light will show RED under certain combinations of low fuel state, idling R.P.M. and high rates of descent. Provided that the failure indication ceases shortly after the end of the descent or after re-opening the throttle, it is to be disregarded.

10. Booster Pump Failure

If the booster pump fails, the fuel pressure warning indicator will show "WHITE".
Sufficient fuel will still be supplied by tank pressurisation and gravity for all normal engine demands, except when flying in tropical conditions with "AVTAG" fuel. In this case it will be necessary to descend to 25,000 ft., if above that altitude, and to restrict engine R.P.M. to a maximum of 9000.

11. Forced Landing

NOTE: The minimum combination of height/airspeed for safe ejection in straight level flight is 300 ft./130 knots.

(a) The engine will not windmill at sufficiently high R.P.M. at the best gliding speed to provide electric power for continuous use of the services. These will function off the main and standy batteries. All non-essential electrics should be switched OFF and operation of the tailplane trimmer kept to a minimum.

(b) If committed to a forced landing with the engine windmilling proceed as follows:-

(i) Clear the wings. Pull the elevator unlock lever to full travel, preferably with no load on the control column and with the speed at or below 250 knots I.A.S.

(ii) If the elevator is unlocked with the stick off neutral a slight nose up or nose down pitching will ensue due to the small out of trim position the elevator will momentarily take up. The control will then become a combined tail and elevator which will be lighter and more sensitive than normal. Trim to the largest negative tailplane angle that can be comfortably held (-8° to -10° at 180 to 200 knots I.A.S.).

Wherever possible rapid use of the controls should be avoided because this will tend to speed up the discharge rate of the main hydraulic accumulator, which depends on the low windmilling R.P.M. of the engine for re-charging.

If the tailplane ceases to function momentarily the elevator will give adequate control irrespective of the tailplane position. Where a "wheels down" landing is intended proceed as follows:-

(iii) Using the combined tailplane and elevator fly to a position above the landing field and at a height not less than 5,000 ft. select hydraulic power 'OFF'. Immediately after this select "emergency undercarriage down". (Note: 5,000 ft. should be the downwind altitude). It will take 10 to 15 seconds more than normal for the wheels to lock 'down' after the selection of 'emergency down'. A rough guide for a forced landing into a 10 knot wind with wheels down is to have 1,000 ft. in hand for every mile from the touchdown point. Maintain not less than 170 knots until the turn onto the final approach has been completed. At normal landing weights the final approach speed should be not less than 140 knots I.A.S. With more than 700 lb. of fuel remaining it should be not less than 150 knots I.A.S.

(c) If the engine seizes proceed as follows:-

(i) Unlock the elevator and select hydraulic power 'OFF'. Trim to the largest tailplane angle that can be comfortably held (-8° to -10° at 180 to 200 knots I.A.S.). When the main accumulator eventually becomes exhausted tailplane movement will cease but the elevator will give adequate longitudinal control.

(ii) Fly to a position above the landing field and at a height not less than 5,000 ft. select 'emergency undercarriage down'. Proceed as in previous para. (b) (iii).

(d) The best range gliding speed for the clean aircraft is 200 knots. At this speed with undercarriage up the distance covered in 1,000 ft. height loss is about 2 n.m. over the

full altitude band. If the descent is made at speeds in excess of 200 knots the aircraft may yaw accompanied with engine intake 'duct banging'. This can be overcome by reducing speed and continuing the descent at 200 knots.

(e) If flight speeds of 180 to 200 knots I.A.S. are maintained with the engine windmilling then the ailerons will not revert to manual providing the main hydraulic cock is 'ON'. When the hydraulic cock is finally selected 'OFF' on the downwind leg there will be adequate pressure retained in the aileron accumulators to land in power.

12. Handling with Asymmetric Stores

(a) Jettisonable tanks empty plus 1 x 500 lb. bomb - minimum control speed 140 knots I.A.S.

(b) 2 x 500 lb. bombs plus 1 empty jettisonable tank - unrestricted.

(c) 1 x ½ full jettisonable tank with or without symmetric stores - minimum control speed 145 knots I.A.S.

NOTE: During landing with the above cases, extreme caution must be exercised, taking into consideration runway length, cross wind factor etc.

13. Cockpit Air Contamination

In the event of the air supply to the cockpit becoming contaminated the following action should be taken:-

(a) Cabin air control	-	OFF.
(b) Oxygen supply	-	Select 'emergency flow' by movement of lever at top left of regulator to LEFT ~~or RIGHT~~.
(c) If above 40,000 ft.	-	Descend immediately to BELOW 40,000 ft.
(d) Ram air scoop *	-	OPEN.
(e) Canopy seal *	-	DEFLATE by removing plug from flexible pipe under coaming on port cockpit wall.

* When below 40,000 ft.

14. Action in the Event of Main Oxygen Supply Failure

(a) Initiate emergency oxygen supply by pulling the control knob situated to the rear of the starboard console.

(b) Disconnect oxygen mask tube from supply pipe to permit breathing of air when emergency oxygen supply becomes exhausted.

(c) Descend immediately to below 10,000 ft.

15. Action in the Event of Oxygen Regulator Jamming

If the oxygen regulator jams open causing streaming of oxygen, proceed as follows:-

(a) Initiate emergency oxygen supply by pulling the control knob situated to the rear of the starboard console.

(b) Disconnect oxygen mask tube from supply pipe.

(c) Descend immediately to below 10,000 ft.

PART V

OPERATING DATA

1. Pressure error corrections

(a) A.S.I. sea level total pressure error corrections.

Fig.1 shows the variation of speed and height corrections with indicated airspeed for flaps and undercarriage DOWN and flaps and undercarriage UP.

(b) Machmeter pressure error corrections.

Mach number	0.70	0.75	0.80	0.85	0.90	0.95
Sea level	+.01	+.01	+.01	+.01	+.015	+.02
3,000 m	+.005	+.005	+.005	+.01	+.01	+.02
6,000 m	0	0	+.005	+.005	+.01	+.02
9,000 m	-.01	0	0	0	+.01	+.02
12,000 m	-.01	-.01	-.01	0	+.01	+.025
13,500 m	-.01	-.01	-.01	-.01	+.005	+.025

(c) Altimeter pressure error corrections (metres)

Mach No.	0.70	0.75	0.80	0.85	0.90	0.95
Sea level	+47	+58	+67	+82	+122	+213
3,000 m	+41	+52	+67	+91	+119	+170
6,000 m	+32	+40	+53	+87	+104	+152
9,000 m	-4	+2	+13	+33	+77	+142
12,000 m	-28	-27	-30	-2	+59	+138
13,500 m	-57	-60	-55	-24	+37	+129

2. Take-off distances

Fig.2 shows the variation of take-off distance in metres with aircraft weight.

3. Landing distances

Fig.3 shows the variation of landing distance in metres with aircraft weight.

4. Flight planning data

(a) The tables and graphs on the following pages show the flight planning data for :-

(i) Climb

The tables give the data for climbs in standard I.C.A.N. conditions, using the speeds recommended therein.

(ii) Cruise

Fig. 5 and 6 show litres of fuel used per kilometre plotted against true Mach Number for various altitudes in standard I.C.A.N. conditions. Also shown is sortie endurance for various altitudes (Fig.7.).

(iii) Descent

The tables give the data for descending from one height to another.

PART V - OPERATING DATA

CLEAN AIRCRAFT

Take-off and taxi allowance ..... 50 litres
Landing allowance .....170 litres (minimum)

Climb Data

FROM	TO	FUEL (litres)	DIST (km.)	MIN.
Sea level (740 Km/hr.)	1,500m	72	10	1
	3,000m	95	18	1½
	6,000m	128	28	2¼
	9,000m	155	36	3
	12,000m	180	55	4
	13,500m	194	71	5
1500m (740 Km/hr.)	3,000m	23	8	½
	6,000m	56	18	1¼
	9,000m	83	26	2
	12,000m	108	45	3
	13,500m	122	61	4
3000m (740 Km/hr.)	6,000m	33	10	¾
	9,000m	60	18	1½
	12,000m	85	37	2½
	13,500m	99	53	3½
6000m (0.85M)	9,000m	27	8	¾
	12,000m	52	27	1¾
	13,500m	66	43	2¾
9,000m (0.85M)	12,000m	25	19	1
	13,500m	39	35	2
12,000m (0.85M)	13,500m	14	16	1

In this table block times are from wheels rolling. Fuel used includes the taxi and take-off allowance, Climb at full throttle from take-off to desired altitude.

PART V - OPERATING DATA

CLEAN AIRCRAFT

Descent Data
(Excluding landing allowance)

FROM	TO	FUEL (Litres)	DIST (Km.)	MIN.
13,500m	12,000m	3	8	¾
	9,000m	9	17	1½
	6,000m	14	26	2
	3,000m	19	34	2¾
	Sea level	25	44	3½
12,000m	9,000m	6	9	¾
	6,000m	11	18	1¼
	3,000m	16	26	2
	Sea level	22	36	2¾
9,000m	6,000m	5	9	½
	3,000m	10	17	1¼
	Sea level	16	27	2
6,000m	3,000m	5	8	¾
	Sea level	11	18	1½
3,000m	Sea level	6	10	¾

R.P.M. Flight Idling.
Airbrakes - OUT
Speeds - 0.8M or 560 Km/hr.

PART V - OPERATING DATA

AIRCRAFT WITH 2 x 300 LITRE DROP TANKS

Take-off and Taxi allowance ..... 57 litres.
Landing allowance .....170 litres.
(minimum)

FROM	TO	FUEL (Litres)	DIST. (Km.)	MIN.
Sea	1,500m	100	10	1¼
Level	3,000m	120	27	1¾
(700 Km/	6,000m	146	37	2½
hr.)	9,000m	172	45	3½
	12,000m	206	71	5
	13,500m	232	97	7
1500m	3,000m	20	17	½
(700 Km/	6,000m	46	27	1¼
hr.)	9,000m	72	35	2¼
	12,000m	106	61	3¾
	13,500m	132	87	5¾
3000m	6,000m	26	10	¾
(700 Km/	9,000m	52	18	1¾
hr.)	12,000m	86	44	3¼
	13,500m	112	70	5¼
6000m	9,000m	26	8	1
(0.80M)	12,000m	60	34	2½
	13,500m	86	60	4½
9000m	12,000m	34	26	1½
(0.80M)	13,500m	60	52	3½
12,000m	13,500m	26	26	2
(0.80M)				

In this table block times are from wheels rolling. Fuel used includes the taxi and take-off allowance. Climb at full throttle from take-off to the desired altitude.

PART V - OPERATING DATA

AIRCRAFT WITH 2 x 300 LITRE DROP TANKS

Descent Data

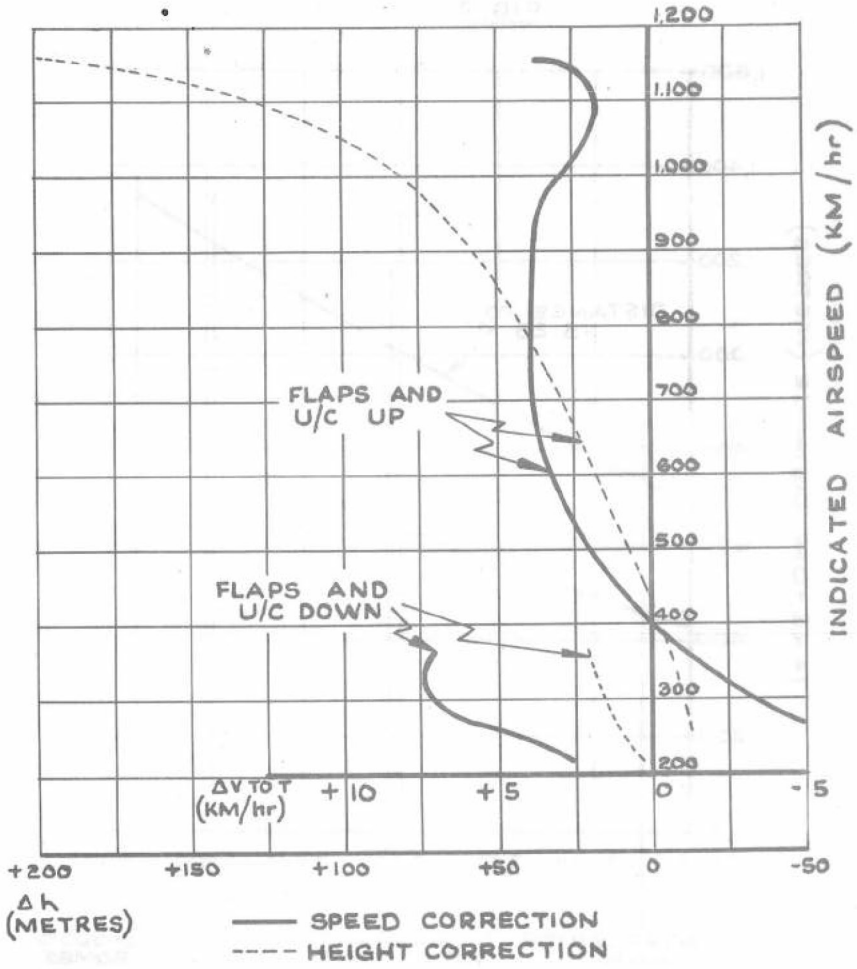
(Excluding landing allowance)

FROM	TO	FUEL (Litres)	DIST. (Km.)	MIN.
13,500m	12,000m	3	8	½
	9,000m	8	20	1½
	6,000m	15	32	2½
	3,000m	23	44	3¾
	Sea level	37	56	5
12,000m	9,000m	5	12	1
	6,000m	12	24	2
	3,000m	20	36	3½
	Sea level	34	48	4½
9,000m	6,000m	7	12	1
	3,000m	15	24	2¼
	Sea level	29	36	3½
6,000m	3,000m	8	12	1¼
	Sea level	22	24	2½
3,000m	Sea level	14	12	1¼

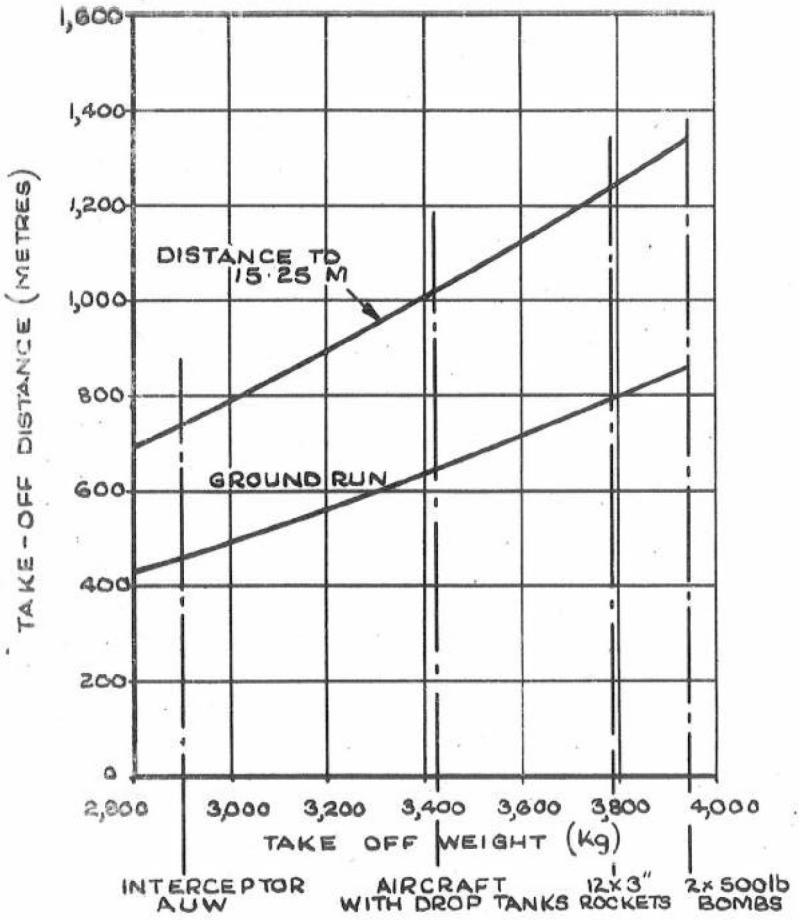
R.P.M. - Flight Idling.
Airbrakes - OUT
Speeds - 0.8M or 560 Km/hr.

A.S.I. SEA LEVEL TOTAL PRESSURE ERROR CORRECTION

FIG. 1



TAKE-OFF PERFORMANCE
I.C.A.N. CONDITIONS
SEA LEVEL
FIG. 2

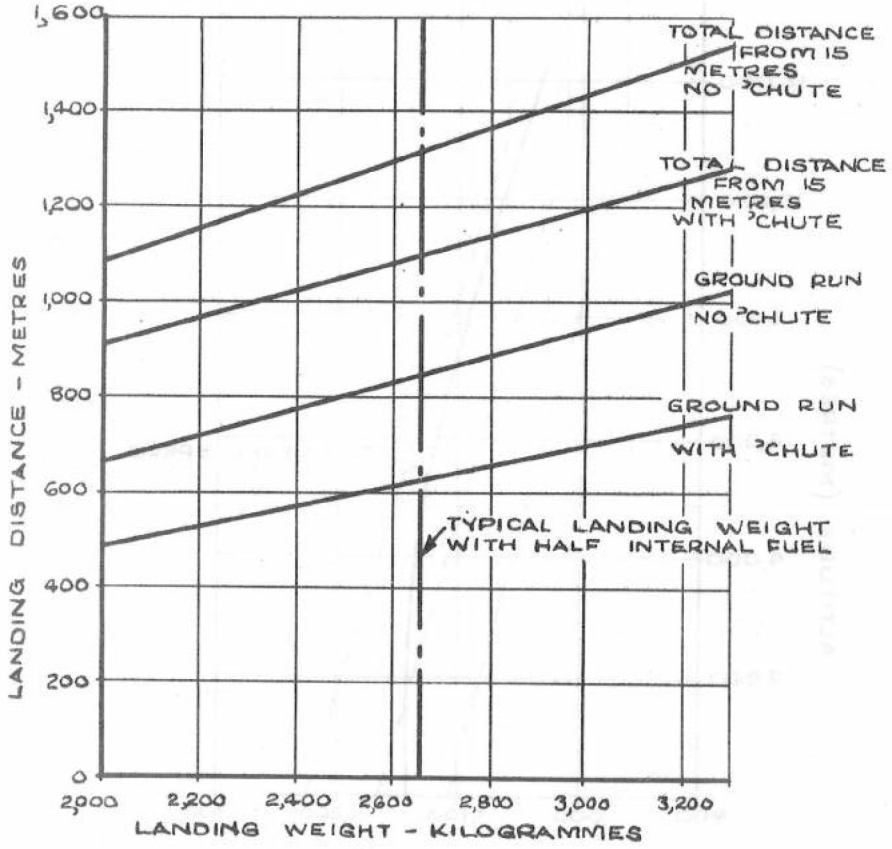


LANDING DISTANCES

I.C.A.N. CONDITIONS

SEA LEVEL

FIG. 3

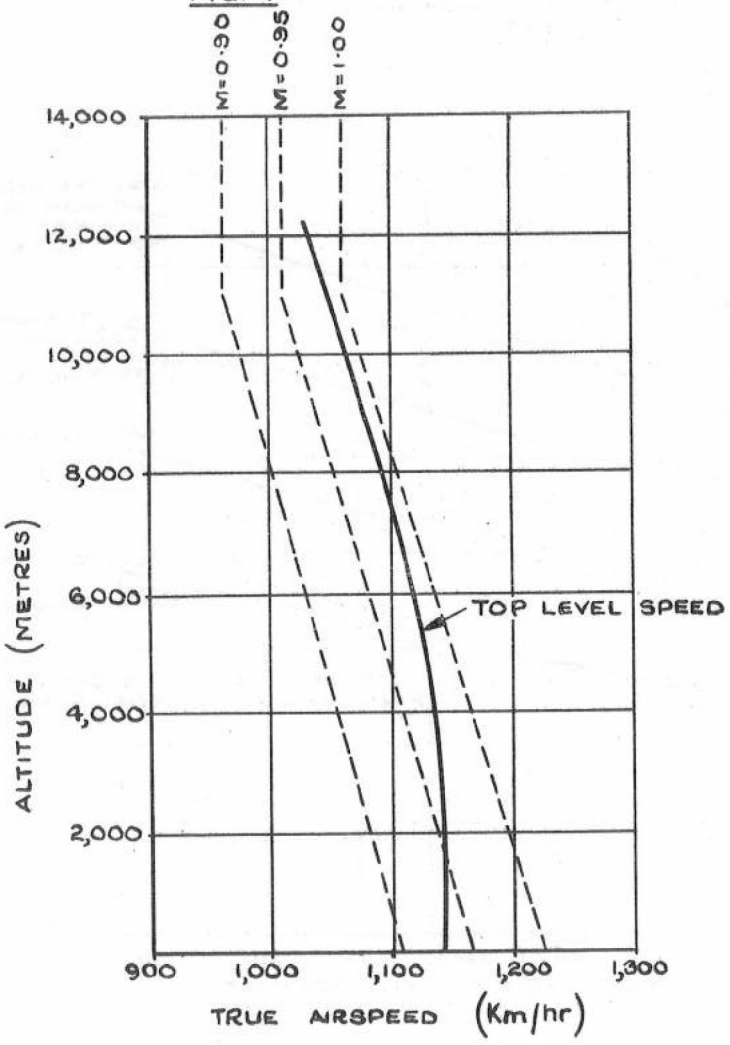


MAX SPEED PERFORMANCE

I.C.A.N. CONDITIONS

CLEAN AIRCRAFT

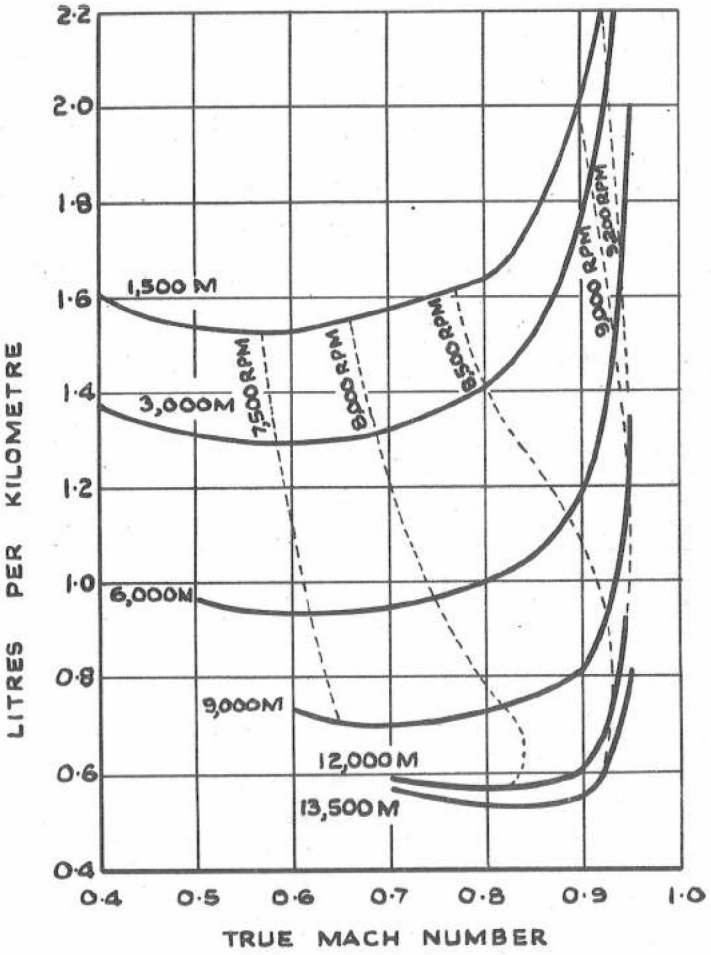
FIG. 4



FUEL CONSUMPTION

CLEAN AIRCRAFT

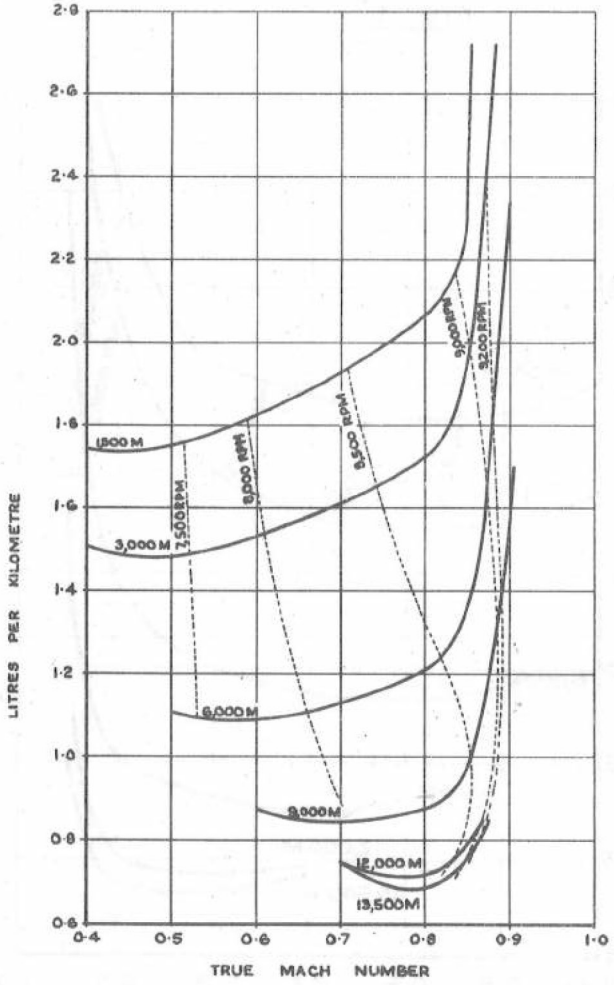
FIG 5



FUEL CONSUMPTION

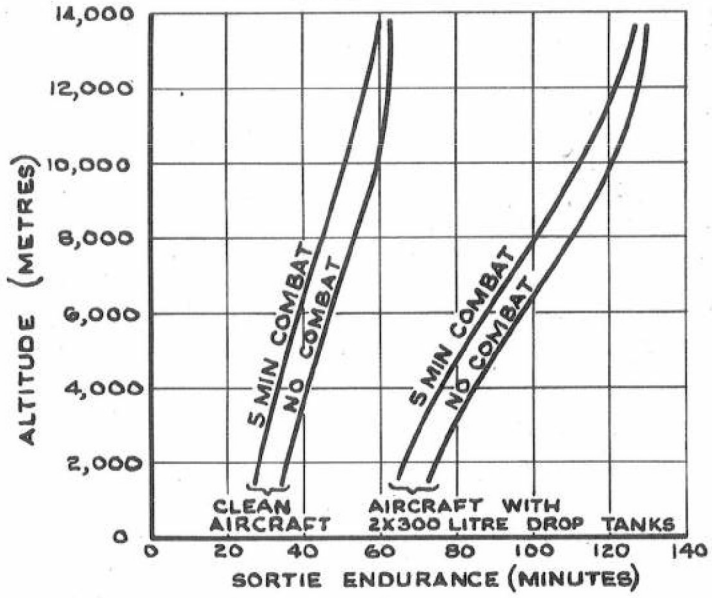
AIRCRAFT WITH DROP TANKS

FIG. 6



SORTIE ENDURANCE
I.C.A.N. CONDITIONS

FIG 7



THIS ASSUMES THE FOLLOWING OPERATIONAL PATTERN:-

TAXI AND TAKE OFF

CLIMB TO ALTITUDE

CRUISE (JETTISON TANKS WHEN EMPTY, IF FITTED)

FIRE GUNS

CRUISE

DESCENT AND LANDING

N.B. LANDING ALLOWANCE 170 LITRES

TAXI TIME INCLUDED IN ENDURANCE

PART VI

ILLUSTRATIONS

A.L.21. May 1960.

KEY

Cockpit - Port side.

1. Canopy jettison 'D' handle.
2. Anti 'g' valve.
3. Undercarriage control lever.
4. Press-to transmit switch.
5. Throttle lever (incorporating G.G.S. range control and H.P. Cock control).
6. Engine start/relight switch.
7. Radar circuit breaker.
8. Fuse blocks.
9. Circuit breakers.
10. G.G.S. master switch.
11. Camera master switch.
12. Camera Iris control switch.
13. Bombs/R.P. master switch.
14. Bomb-fusing switch. (or bomb jettison, POST MOD. GN.199).
15. Bomb jettison switch. (or bomb fusing, POST MOD. GN.199).
16. Outboard pylon stores jettison switch.
17. Radar ranging switch.
18. Seat firing breech locking lever.
19. Seat firing handle (blind handle).
20. R.P. selector switch.
21. Canopy lock control handle.
22. Canopy locking button.
23. Elevator unlock lever.
24. Undercarriage position indicator.
25. Brake parachute stream/jettison control.
26. Tailplane position indicator.
27. Emergency tail trim switches.
28. "Elevator Unlocked" warning lamp.
29. V.H.F. channel selector.
30. Hydraulic pressure gauge.
31. Radar presentation switch.
32. Target reject switch.
33. Fuel dip master switch.
34. Seat harness release lever.
35. Anti 'g' hose connection.
36. Anti 'g' pull-off connection.

A.L.14.April,1959.

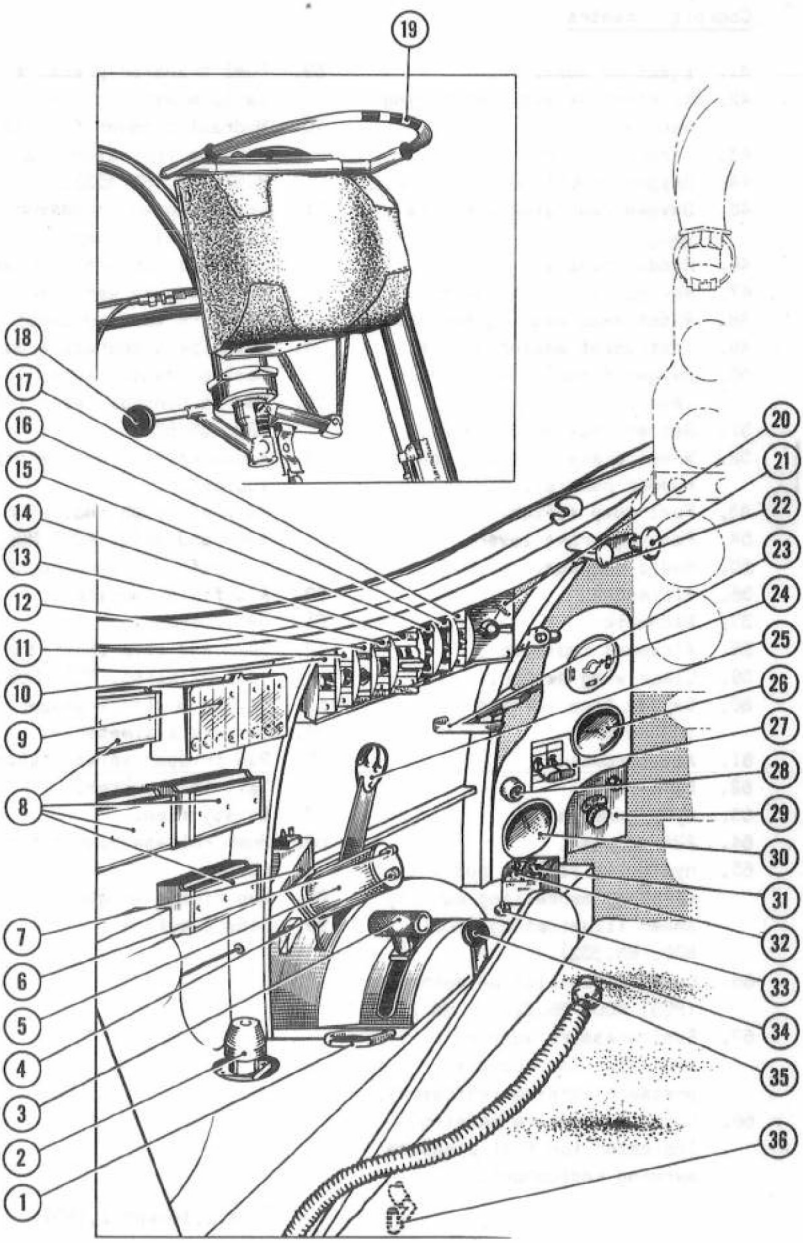


Fig.l. Cockpit—Port Side

A.L.14,MAR.'59

KEY

Cockpit - centre

41. Ejection seat.
42. Alternative seat pan firing handle.
43. Control column.
44. Oxygen on/off control knob.
45. Oxygen regulator pressure gauge.
46. Rudder pedals.
47. Navigation lights switch.
48. Pitot head heating switch.
49. Instrument master switch.
50. Oxygen flood-flow control lever.
51. Battery master switch.
52. Wheel brake controls (on rudder pedals).
53. Fuel pump switch.
54. Parking brake lever.
55. Radio compass.
56. Altimeter.
57. Machmeter.
58. Airspeed indicator.
59. Clear wing switch.
60. Oxygen flow warning indicator.
61. Accelerometer.
62. Clock.
63. Gyro gunsight.
64. E2A compass.
65. Hydraulic failure audio warning, cancelling button, amber illuminating (POST MOD. GN.352).
66. Cockpit ventilation control (POST MOD. GN.210 or GN.271).
67. Fuel pressure warning indicator (or cockpit pressure warning indicator).
68. Cockpit pressure warning indicator (or fuel pressure warning indicator).
69. Fuel transfer pressure-failure warning lamp.
70. Hydraulic power-failure warning indicator. (or lamp, POST MOD. GN.352).
71. Engine speed indicator.
72. Fire warning lamp (or oil pressure warning indicator).
73. Oil pressure warning indicator (or fire warning lamp).
74. Jet pipe temperature gauge.
75. Fuel contents gauge.
76. Demist control lever (PRE MOD. GN.63).
77. A.C.power failure warning indicator.
78. Rate of climb indicator (or turn and slip, POST MOD. GN.174).
79. Generator failure warning lamp.
80. Artificial horizon.
81. G4F compass.
82. Turn and slip indicator (or rate of climb, POST MOD. GN.174).
83. Oxygen contents gauge.
84. Cockpit altimeter.
85. Gun trigger safety catch.
86. Tail trim switch.
87. Safety flap.
88. Bomb release/rocket firing switch.
89. Gun firing trigger.
90. Camera switch.

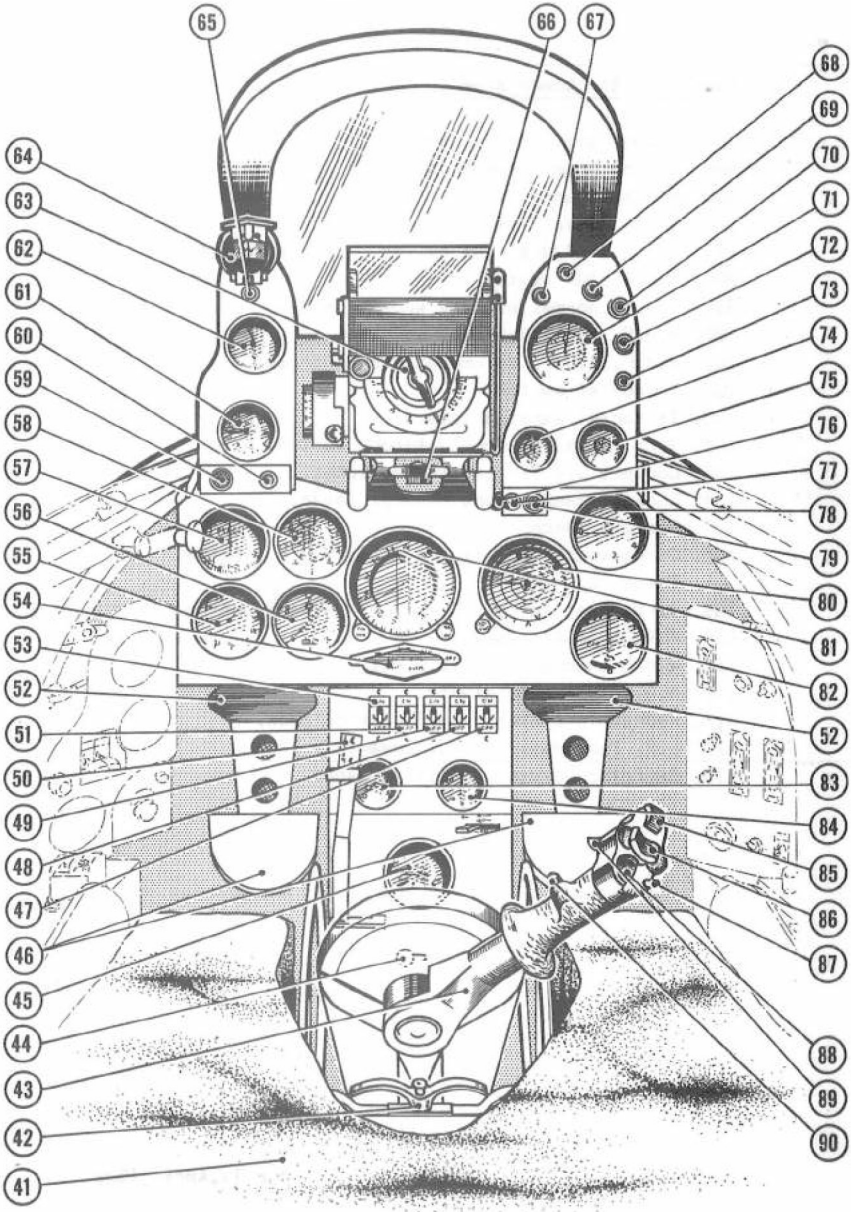


Fig.2. Cockpit—Forward View

A.L.14, MAR. '59

KEY

Cockpit - Starboard side

93. Oxygen pull-off connection.
94. Oxygen hose connection.
95. Mic/tel connection.
96. I.F.F. on/off switch.)
97. I.F.F. "G"/distress switch.) when fitted.
98. I.F.F. "G" switch.)
99. V.H.F. normal/standby supply switch.
100. V.H.F. normal/standby switch.
101. V.H.F./A.D.F. volume mixing controls.
102. Telebrief switch.
103. Telebrief warning lamp.
104. Turn and slip normal/standby switch.
105. Cockpit lighting dimmer switches.
106. Cockpit temperature control lever.
107. Ram air scoop.
108. Correction card holders (also V.H.F. channel frequency cards).
109. Parachute static line manual release control.
110. G.G.S. control panel.
111. Radio compass control panel.
112. G.G.S. spare filaments.
113. Hydraulic system on/off control cock.
114. L.P. fuel cock control lever.
115. Emergency oxygen supply lanyard.

A.L.14.April,1959.

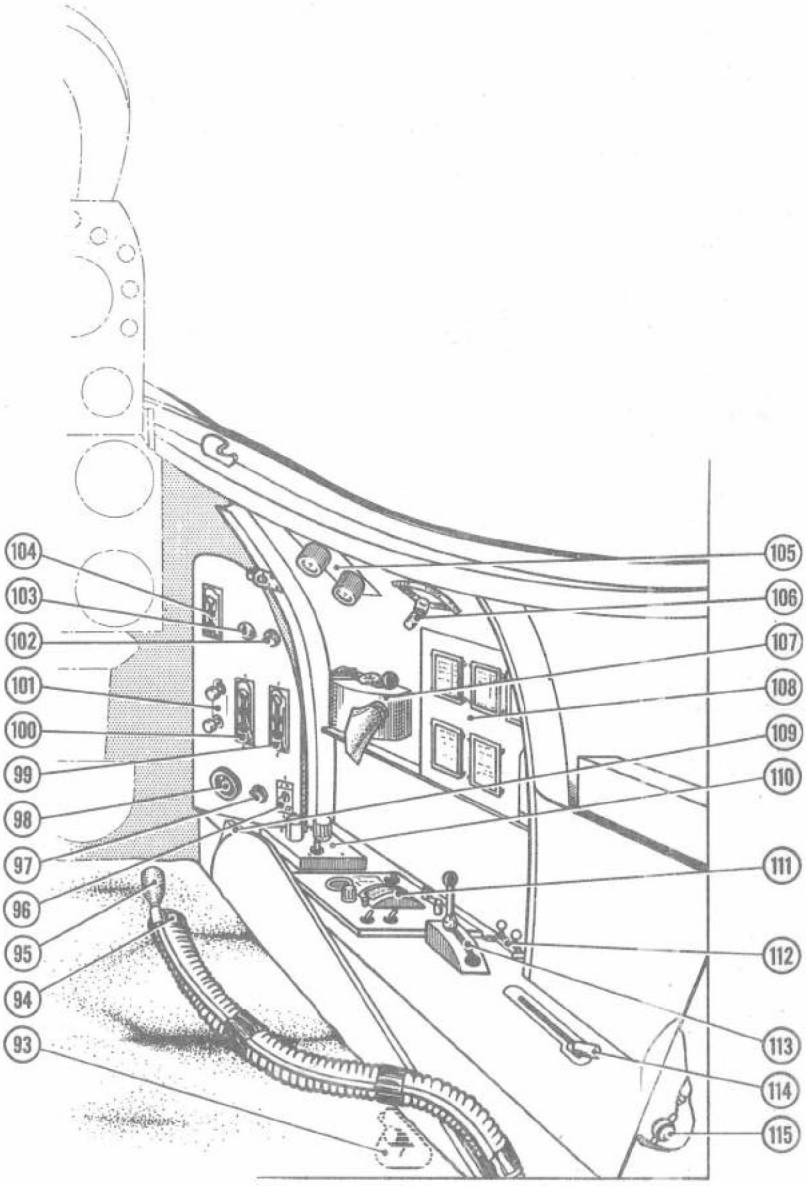


Fig. 3. Cockpit—Starboard Side

FIG. 4

CANCELLED

FIG. 5

CANCELLED

Fig. 6 Stabilised position during free fall after separation from ejection seat

APPENDIX NO.1.

(Applicable to GNAT F.R. Aircraft Serial Nos. GN 112 and GN 113 only)

1. The embodiment of Mod. No. GN 449 on the above two aircraft replaces the existing Radar Ranging Installation and associated cockpit controls with a triple camera installation.

This Appendix

(a) Describes this camera installation and its associated controls.

(b) Gives special Flight Limitations and checks prior to take-off peculiar to the camera installation.

(c) Describes the method of operation of the camera demisting system.

This Appendix must be read in conjunction with the preceding text of these Pilot's Notes.

APPENDIX 1

2. Reconnaisance Camera Installation

2.1. Camera Installation

(i) Three Vinten G.95 cameras are mounted in the fuselage forward of the cockpit and face forwards, vertically downwards and abeam (Port or Starboard). The three cameras are operated singly or simultaneously by depressing the camera switch on the control column. No camera sight is provided.

(ii) The camera circuit is controlled by a circuit breaker mounted on the port cockpit wall adjacent to and aft of the throttle box. The circuit breaker should be checked 'MADE' before take-off.

(iii) A camera master switch is situated beneath the coaming on the port side of the cockpit. This switch should be selected ON before the cameras are operated.

(iv) A camera heater switch is situated beneath the coaming on the port side of the cockpit. This switch operates thermostatically controlled heaters in each camera and should be selected on take-off if the cameras are to be used. The camera heater switch operates independently of the camera master switch.

(v) Three combined camera selector/picture speed switches are mounted on the forward port console. Operation of these switches enables each camera to be selected individually with a picture speed of either 4 or 8 pictures per second.

(vi) The camera aperture control switch is situated on the forward starboard console. The switch which has three positions alters the apertures of all three cameras. In general, the switch positions 'OREN' '2' and '3' should be selected for Dull, Bright and Cloudy, and Bright conditions respectively.

(vii) Film footage indicators are provided for each camera and are situated on the starboard lower instrument panel. The indicators record the use of film and show the film footage remaining in each magazine.

A.L.22 Sept.1960.

(viii) The choice of camera speed depends upon the height and speed of the aircraft and on the requirements for stereoscopic cover. A rough guide for oblique photography at 400 knots ground speed is as follows:-

For Stereo cover -

4 P.P.S. above 400 ft.
8 P.P.S. between 200 and 400 ft.

Without Stereo cover -

4 P.P.S. above 200 ft.
8 P.P.S. between 100 and 200 ft.

(ix) The total running time of each camera at 8 P.P.S. is approximately 1 minute and at 4 P.P.S. 2 minutes. Wherever possible a picture speed of 4 P.P.S. should be used to conserve film. At altitudes less than 200 ft. however, slight blurring of near objects may be apparent if this camera speed is used.

2.2. Camera De-mist System

(i) During all flight conditions camera de-misting is automatically provided by the ducting of the cabin discharge air into the area of the camera windows and lenses. This air supply has to be augmented for effective de-misting during descents from high altitudes by diverting the hot air usually supplied to the foot warming and G.G.S. inlets in the cockpit direct to the camera air ducting in the nose bay. This diversion system is controlled by a push-pull lever (formerly the windscreen de-misting lever) mounted below and to the right of the G.G.S. bracket, and an additional ON-OFF control situated on the starboard console inboard of the L.P. fuel cock control.

NOTE The push-pull lever is ON when in the forward position.
The ON-OFF control is ON when pointing fore and aft.

3. Special Limitations

3.1. In order to maintain normal cabin pressurisation the two camera de-mist controls must always be selected 'OFF' for flight at

altitudes in excess of 15,000 ft.

4. Additional Checks before Take-off

4.1. If it is intended to use the cameras during the flight the following additional checks are to be made after starting the engine:-

Camera circuit breaker	-	MADE.
" master switch	-	ON.
" heater "	-	ON.
Both camera de-mist controls	-	OFF.

5. Operation of the Camera De-mist System

5.1. If the flight plan has entailed a cruise at altitudes in excess of 15,000 ft. prior to photography the following action is to be taken at 15,000 ft. during the descent to the photographic altitude:-

(1) Select both camera de-mist controlsON.
(2) Select full 'hot' with the cockpit temperature control lever.

NOTE It will be appreciated that the higher the engine R.P.M. that can be maintained during both the descent below 15,000 ft. and the run-in to the Target area the more effective will be the camera de-misting.

5.2. If the aircraft is to climb above 15,000 ft. following the operation of the cameras, both of the de-mist controls are to be re-selected 'OFF' before 15,000 ft. is attained.

6. Additional Emergency Handling Procedures

6.1. Should a generator failure warning be received, switch OFF the camera master switch and camera heater switch.

6.2. Should a cabin pressurisation system failure warning be received take the normal action specified in PART IV, Para.8. of the Notes and also check that the two camera demist controls are at 'OFF'.

APPENDIX 1

ILLUSTRATIONS

KEY

Cockpit - Port Side

1. Canopy jettison 'D' handle.
2. Anti-'g' valve.
3. Undercarriage control lever.
4. Press-to-transmit switch.
5. Throttle lever (incorporating G.G.S. range control and H.P. cock control).
6. Engine start/relight switch.
7. Camera circuit breaker.
8. Fuse blocks.
9. Circuit breakers.
10. G.G.S. master switch.
11. Camera master switch.
12. Inoperative switch.
13. Bombs/R.P. master switch.
14. Bomb-fusing switch.
15. Bomb jettison switch.
16. Outboard pylon stores jettison switch.
17. Camera heater switch.
18. Seat firing breech locking lever.
19. Seat firing handle (blind handle).
20. R.P. selector switch.
21. Canopy lock control handle.
22. Canopy locking button.
23. Elevator unlock lever.
24. Undercarriage position indicator.
25. Brake parachute stream/jettison control.
26. Tailplane position indicator.
27. Emergency tail trim switches.
28. "Elevator Unlocked" warning lamp.
29. V.H.F. channel selector.
30. Hydraulic pressure gauge.
31. Camera selector switches.
32. Fuel dip master switch.
33. Seat harness release lever.
34. Anti-'g' hose connection.
35. Anti-'g' pull off connection.

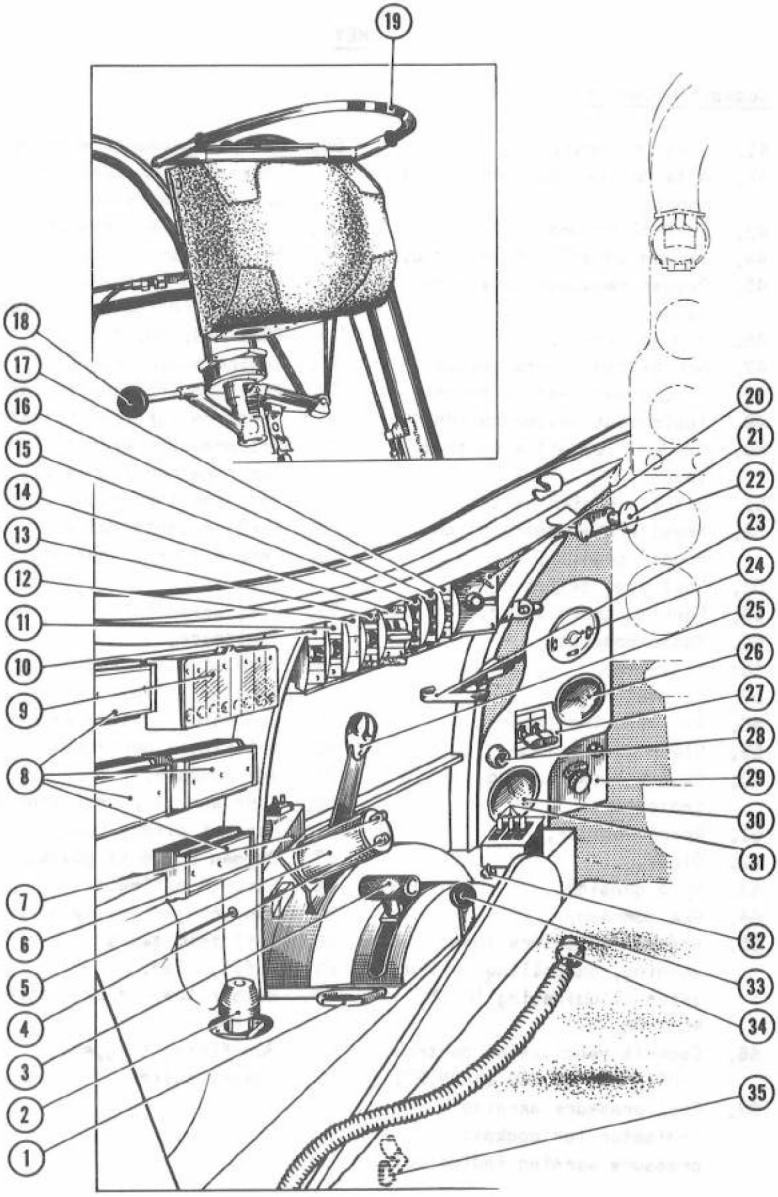
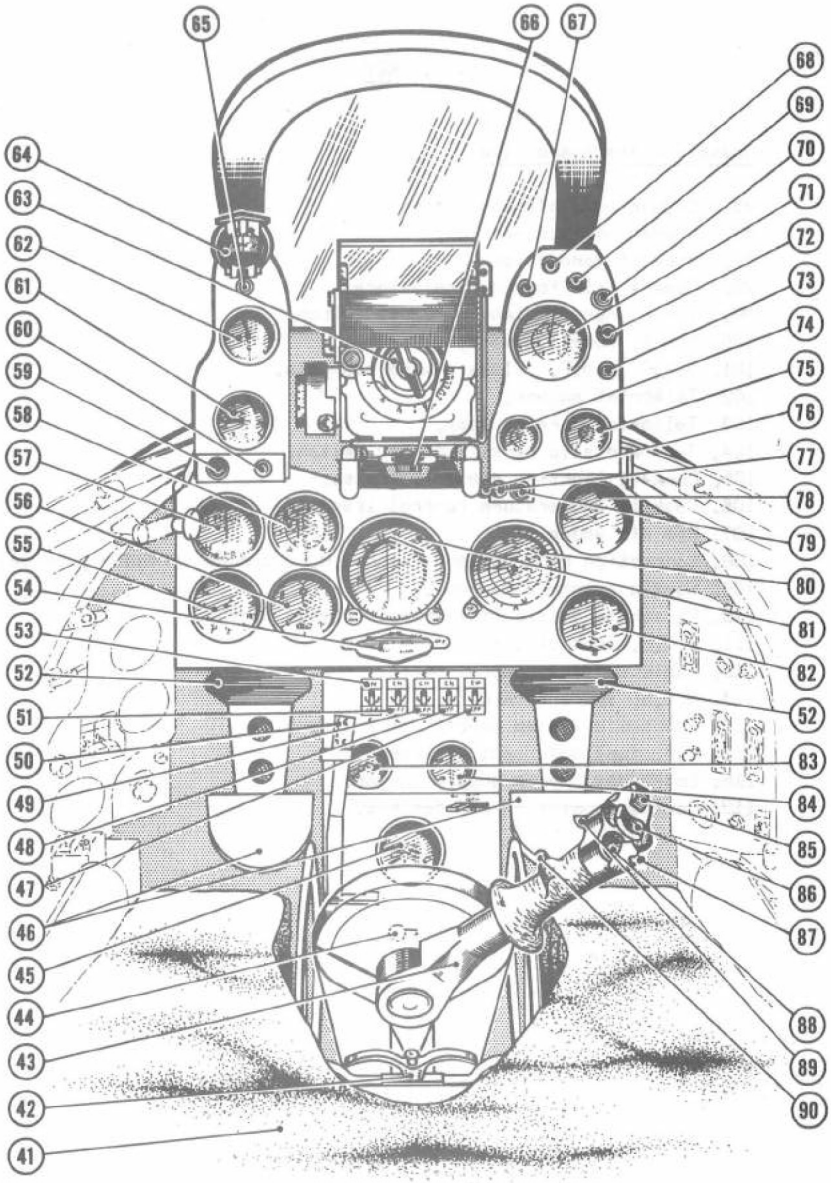


Fig.I. Cockpit—Port Side

KEY

Cockpit - Centre

41. Ejection seat.
42. Alternative seat pan firing handle.
43. Control column.
44. Oxygen on/off control knob.
45. Oxygen regulator pressure gauge.
46. Rudder pedals.
47. Navigation lights switch.
48. Pitot head heating switch.
49. Instrument master switch.
50. Oxygen flood-flow control lever.
51. Battery master switch.
52. Wheel brake controls (on rudder pedals).
53. Fuel pump switch.
54. Parking brake lever.
55. Radio compass.
56. Altimeter.
57. Machmeter.
58. Airspeed indicator.
59. Clear wing switch.
60. Oxygen flow warning indicator.
61. Accelerometer.
62. Clock.
63. Gyro gunsight.
64. E2A compass.
65. Hydraulic failure audio warning, cancelling button, amber illuminating (POST MOD. GN.352).
66. Cockpit ventilation control (POST MOD. GN.210 or GN.271).
67. Fuel pressure warning indicator (or cockpit pressure warning indicator).
68. Cockpit pressure warning indicator (or fuel pressure warning indicator).
69. Fuel transfer pressure-failure warning lamp.
70. Hydraulic power-failure warning indicator (or lamp, POST MOD. GN.352).
71. Engine speed indicator.
72. Fire warning lamp (or oil pressure warning indicator).
73. Oil pressure warning indicator (or fire warning lamp).
74. Jet pipe temperature gauge.
75. Fuel contents gauge.
76. Camera de-mist push-pull lever.
77. A.C. power failure warning indicator.
78. Rate of climb indicator (or turn and slip, POST MOD. GN.174).
79. Generator failure warning lamp.
80. Artificial horizon.
81. G4F compass.
82. Turn and slip indicator (or rate of climb, POST MOD. GN.174).
83. Oxygen contents gauge.
84. Cockpit altimeter.
85. Gun trigger safety catch.
86. Tail trim switch.
87. Safety flap.
88. Bomb release/rocket firing switch.
89. Gun firing trigger.
90. Camera switch.



APPENDIX I. Fig. 2. Cockpit—Forward View A.L. 22, SEPT. '60

KEY

Cockpit - Starboard Side

95. Oxygen pull-off connection.
96. Oxygen hose connection.
97. Mic-tel connection.
98. Camera film footage indicators.
99. V.H.F. normal/standby supply switch.
100. V.H.F. normal/standby switch.
101. V.H.F./A.D.F. volume mixing controls.
102. Telebrief switch.
103. Telebrief warning lamp.
104. Turn and slip normal/standby switch.
105. Cockpit lighting dimmer switches.
106. Cockpit temperature control lever.
107. Ram air scoop.
108. Correction card holders (also V.H.F. channel frequency cards).
109. Camera aperture control.
110. Parachute static line manual release control.
111. G.G.S. control panel.
112. Radio compass control panel.
113. G.G.S. spare filaments.
114. Hydraulic system on/off control cock.
115. L.P. fuel cock control lever.
116. Emergency oxygen supply lanyard.
117. Camera de-mist on-off control.

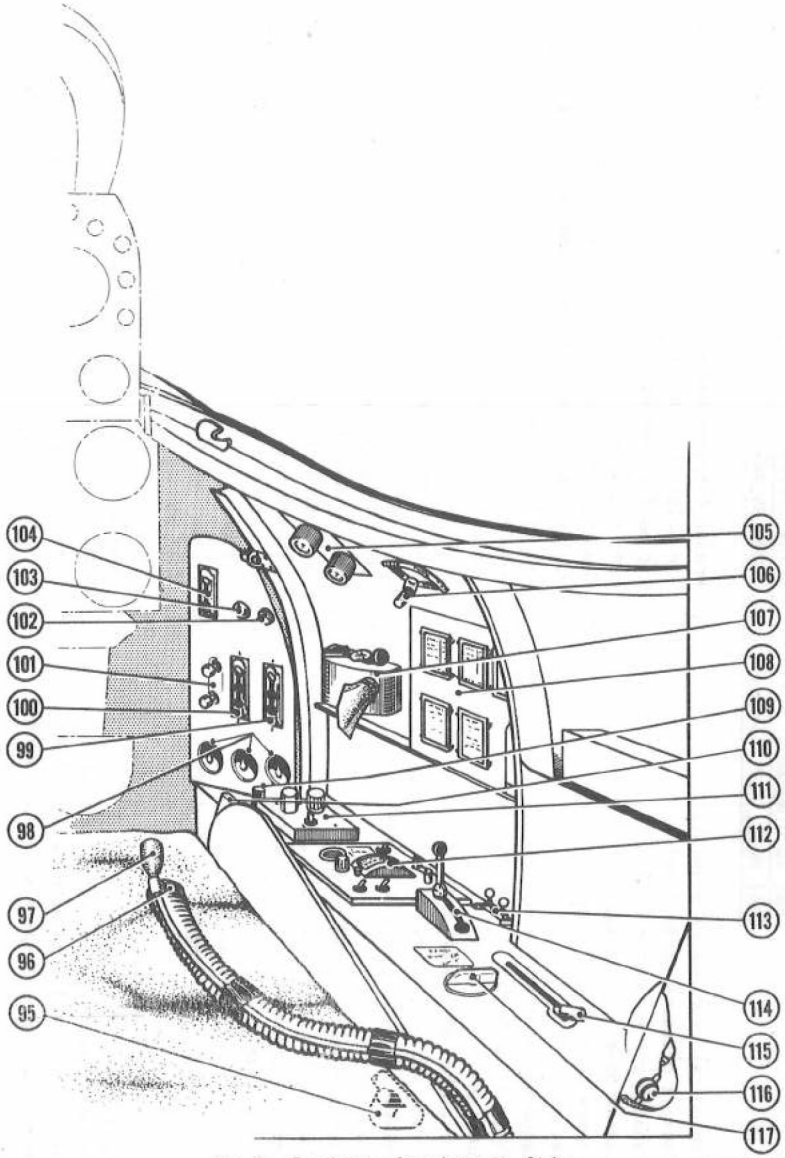


Fig. 3. Cockpit—Starboard Side

Key to Diagram of Air Conditioning System
GNAT Mk.1. F.R. Aircraft only (MOD. GN.449)

1. Air outlet for camera de-mist.
2. Cockpit pressure control valve.
3. Exhaust air collector muff.
4. Camera de-mist outlets.
5. Camera de-mist ON/OFF push-pull lever.
6. Sequence valve for canopy seal.
7. Control valve for air outlet beneath gunsight.
8. Air outlet at rudder pedal.
9. Direct cold air scoop.
10. Swivelling outlet nozzle beneath gunsight.

10a. Camera de-mist ON/OFF cock.

11. Cockpit temperature control.
12. Hot air discharge pipe in canopy.
13. Canopy seal.
14. Limit of pressurised zone.
15. Teleflex run to temperature control valve.
16. Non-return valves.
17. Compressor tapping.
18. Water extractor. This item is mounted in the rear fuselage with Mod. GN.367A but in the dorsal spine with Mod. GN.367B.
19. Pressure relief valve.
20. Air inlet to cold air unit.
21. Air outlet from cold air unit.
22. Heat exchanger.
23. Cooling air inlet to heat exchanger.
24. Cooling air outlet from heat exchanger into jet pipe shroud.
25. Compressor tapping.
26. Cockpit temperature control valve.
27. Orifice plate.
28. Pipe joint to canopy.
29. Anti-'g' valve.
30. Seal deflation point for canopy jettison.
31. Dry air connection to windscreen.
32. Air outlet at rudder pedal.
33. Pressure reducing valve for canopy seal.
34. Test connection for windscreen dry air system.
35. Air drier.
36. Static vent for windscreen dry air system.
37. Test connection for canopy seal.
38. Cockpit pressure test connection for pressurising air.
39. Cockpit pressure test connection for pressure gauge.

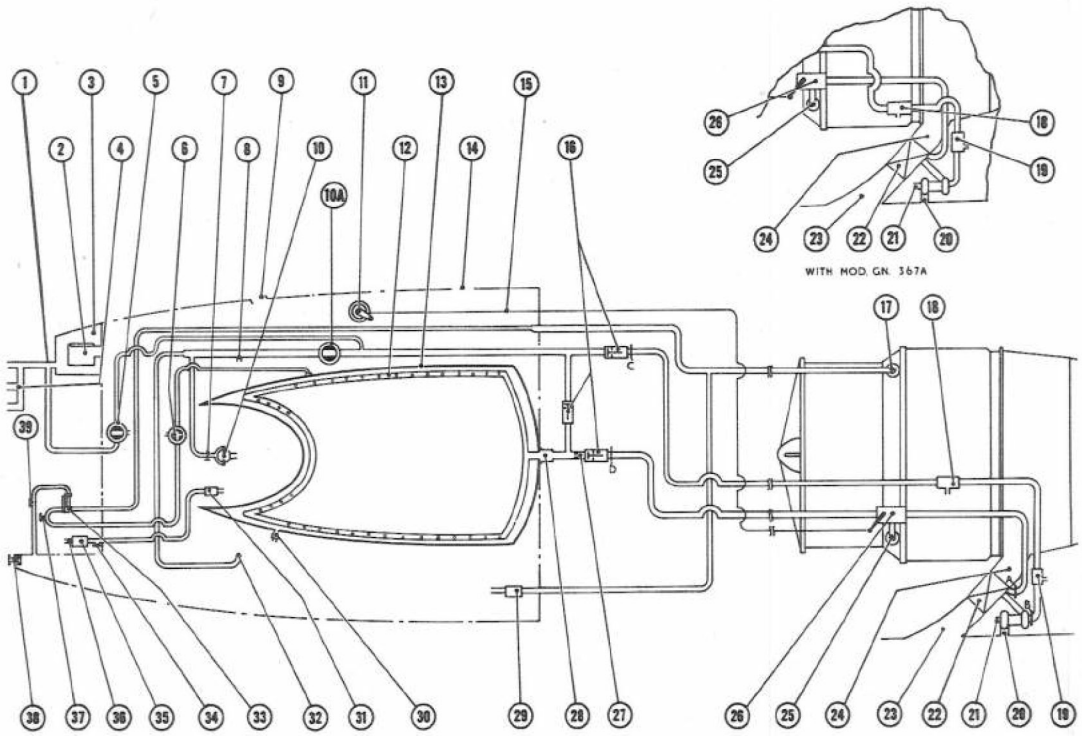


Diagram of Air Conditioning System
Gnat Mk.I, (F.R.) Aircraft Only