RESTRICTED

O/C FLYING

2nd Edition
April, 1958

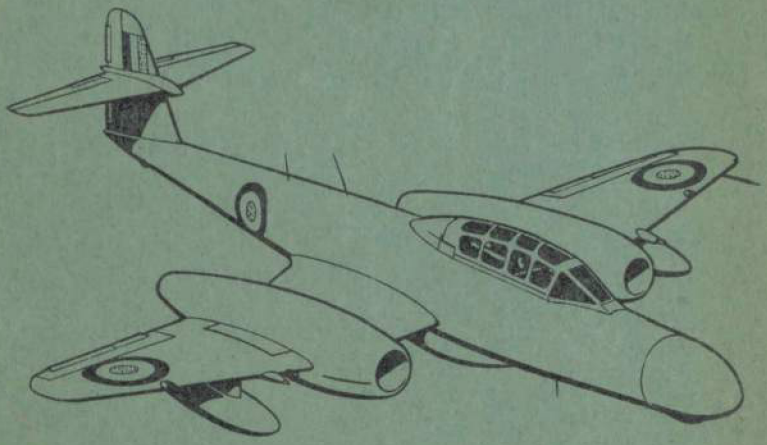
W.D. 790

A.P. 2210L, M, N, P & V—P.N.

PILOT'S NOTES

METEOR NIGHT FIGHTERS

Marks 11, 12, 13 and 14 and TT20, TARGET TOWER



Prepared by Direction of the Minister of Supply

Promulgated by Command of the Air Council

R. Musgrave M. J. Dean.

RESTRICTED

MINISTRY OF DEFENCE
August, 1964

Amendment List No. 3
to AP.2210 L, M, N, P & V-PN
Pilot's Notes

METEOR NIGHT FIGHTERS

NOTE.—1. This Amendment List includes information covering the following Modifications:—

Mods. 5961, 5966, 5967, 5975, NSM.3014, 3019, 3023, 3026.

2. When a manuscript amendment is made, *endorse* the adjacent margin " A.L.3 ".

3. When the amendment List is fully incorporated:—

(a) *Affix* this sheet to the inside front cover of the Notes.

(b) *Certify* its incorporation on Page 1 of the Notes.

PAGE	PARA.	AMENDMENT
7	LIST OF CONTENTS	Below para. 65 *insert* " AALs . . . 65A ".
8	LIST OF CONTENTS	After Para. 98 *insert* " Compressor surge . . . 98A ".
12	—	*Amend* by gummed page.
37, 38	—	*Amend* by two gummed pages.
44	65A	*Insert* new para. 65A by gummed slip, to follow para. 65.
57	91 (c) (contd.)	*Amend* Items 11, 12, 13, by gummed slip.
58	91 (c) (contd.)	Item 10. *Amend* " VHF " to read " VHF/UHF ".
60	93	Item 6. *Amend* " VHF " to read " VHF/UHF ".
63	98	*Amend* by gummed slip to include Para 98A.
68	107, 108	*Amend* by gummed slip.
69	109 (a) (contd.)	Line 4. *Amend* " 110 " to read " 115 ".
72	119	*Amend* by gummed slip.
73	121 (a) (b)	*Amend* by gummed slip.
78	131	*Amend* by gummed slip.
84–87	—	*Amend* by four gummed pages.
90	—	*Amend* by gummed page.
Outside back cover	—	*Amend* by gummed page.

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NOTES TO USERS

The notes are complementary to A.P.129 (6th Edition), Flying, and it is assumed that all concerned have a thorough knowledge of the chapters relevant to the operation of this type of aircraft.

Additional copies may be obtained by the Station Publications Officer by application on R.A.F. Form 294A, in quadruplicate, to Command Headquarters for onward transmission to A.P.F.S. (see A.P.113A). The number and edition of this publication must be quoted in full—AP.2210L, M, N, P and V—P.N. (2nd Edition).

Comments and suggestions should be forwarded to the Officer Commanding Handling Squadron, Royal Air Force, Boscombe Down, Wilts.

AMENDMENTS

Amendment lists will be issued as necessary and will be gummed for affixing to the inside front cover of these notes.

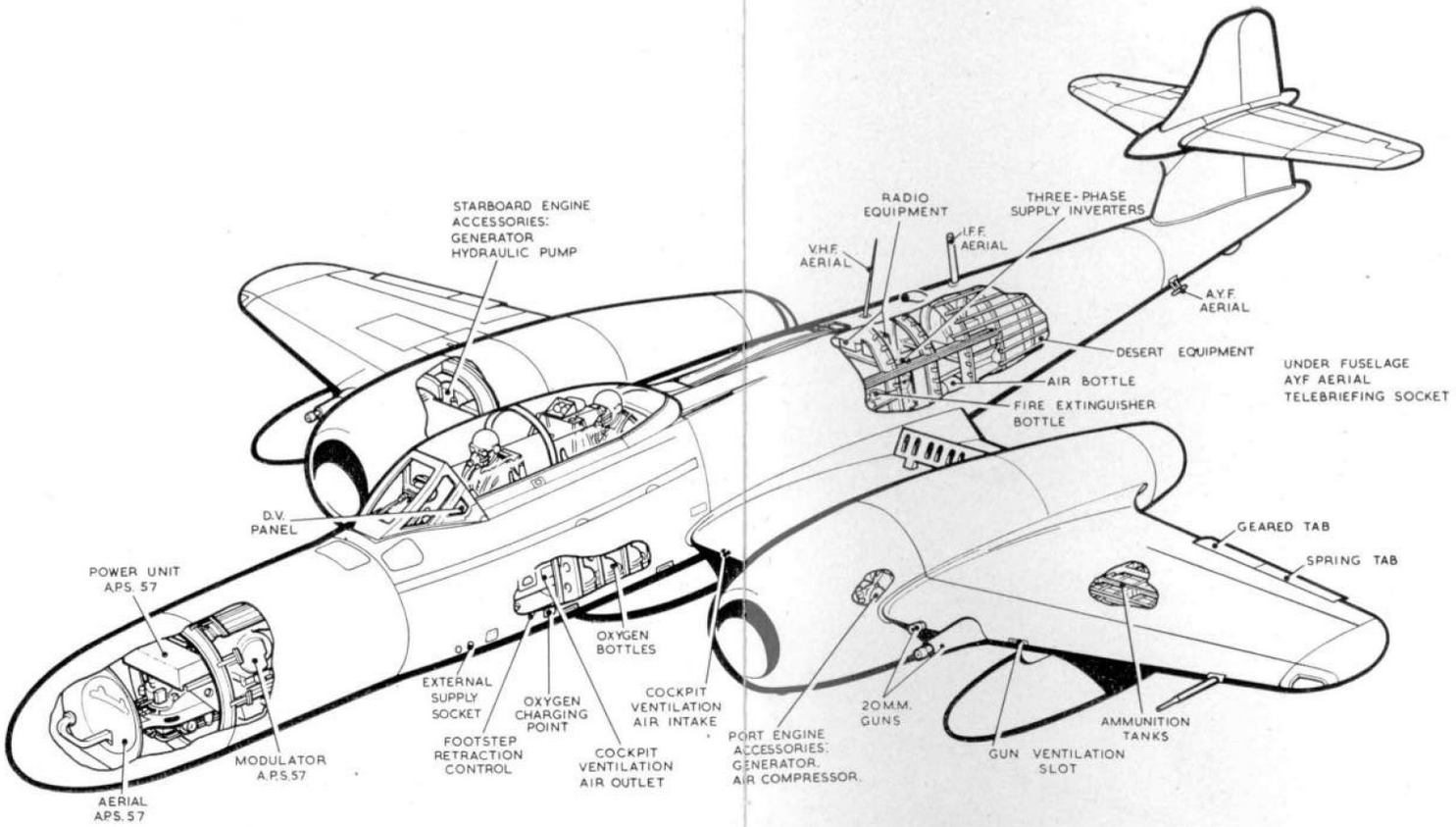
When suitable, each amendment list will be accompanied by gummed slips for sticking in the appropriate places in the text. When the text is amended because of modifications or Special Flying Instructions, a list of such mods./S.F.I. will be given at the beginning of each amendment list.

Incorporation of an amendment list must be certified below.

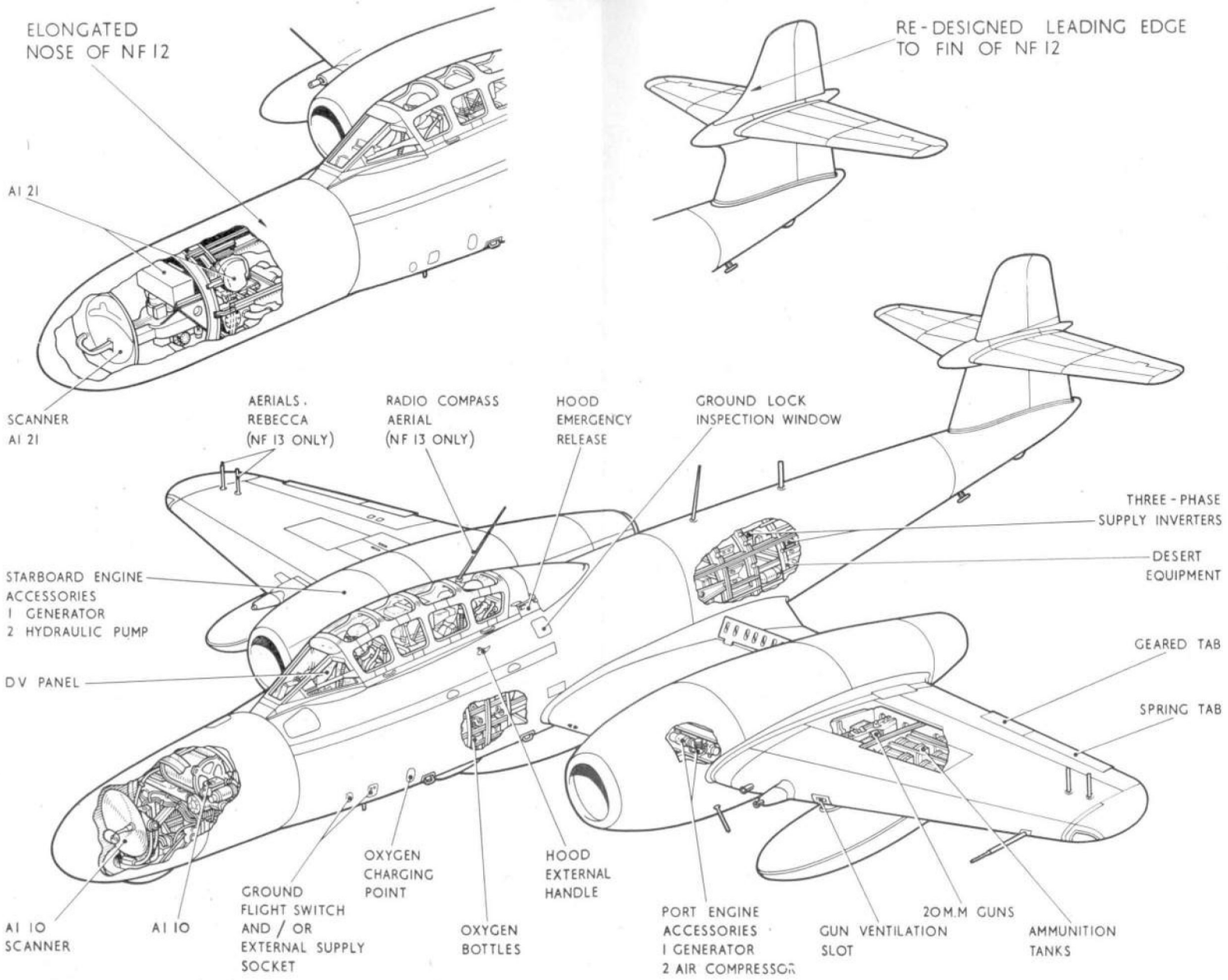
A.L. No.	INITIALS	DATE	A.L. No.	INITIALS	DATE
1	[illegible]	18/9/70	4		
2	[illegible]	21/9/70	5		
3	[illegible]	21/9/70	6		

LIST OF ASSOCIATED PUBLICATIONS

Title	A.P. No.
Meteor NF 11 descriptive handbook	2210L Vol. 1
Meteor NF 12 descriptive handbook	2210M Vol. 1
Meteor NF 13 descriptive handbook	2210N Vol. 1
Meteor NF 14 descriptive handbook	2210P Vol. 1
Meteor TT 20 descriptive handbook	2210V Vol. 1
Derwent 8 and 9 descriptive handbook	4038C and D. Vol. 1
Fuel system components for gas turbine aero-engines	4282 series
Rotol accessory gear boxes and drives	2240A
Electrical equipment manual	4343 series
Hydraulic equipment	1803D and E
Wheels, tyres, and brake systems	2337
Signal manual	1186 series
Instrument manual—general instruments	1275A
Instrument manual—navigation instruments	1275B
Gyro gunsight	1275E
Safety equipment manual	1182 series
Cine-cameras and accessories	1355 series
Guns, Hispano 20 mm.	1641F
Fire-extinguisher equipment	957C
Air pump units	1519
Aircraft operating and servicing under low temperature conditions	1441B
Pressurising and air-conditioning equipment, aircraft	4340
Target towing	1492 Vol. 1
Handbook for ZBX	2565 Vol. 1



METEOR N.F. 14



METEOR N.F. 11, 12 & 13

Air Ministry
April, 1958

A.P.2210 L, M, N, P and V—P.N.
Pilot's Notes
2nd Edition

NOTE.—This edition supersedes and cancels AP 2210 L and N dated August 1953, AP 2210 M dated February 1954, and AP 2210 P dated April 1954, all 1st editions.

METEOR NIGHT FIGHTERS

Marks 11, 12, 13 and 14

also

METEOR TT20

Target Tower

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PART I

DESCRIPTIVE

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

(a) Words in capital letters indicate the actual markings on the controls concerned.

(b) The numbers quoted in brackets refer to the illustrations in Part VIII.

(c) Unless otherwise stated all airspeeds and mach numbers quoted are "Indicated".

1. Introduction

(a) The Meteors NF 11, NF 12, NF 13 and NF 14 are twin-engined, jet-propelled, two-seater, night fighter aircraft. They are basically similar; the NF 13 is an NF 11 adapted for overseas conditions; the NF 12 and NF 14 have a lengthened nose to accommodate a larger radar and the NF 14 has a redesigned windscreen and hood. All are fitted with either Derwent Mk. 8 or Mk. 9 turbo-jet engines. The Meteor TT 20 is an NF 11 specially modified for target towing: it is dealt with separately in Part VI.

(b) Flying controls are conventional, manually operated, and of all-metal construction, the ailerons being internally mass-balanced. Variable trim is provided for rudder and elevator. Later NF 11 and all NF 12, 13, and 14, have enlarged flap area. Non-ejection crew seats are fitted.

(c) The undercarriage, flaps, and airbrakes are hydraulically operated and the wheel brakes pneumatically operated. Electrical power is provided by a normal 28-volt d.c. system with associated a.c. systems.

(d) All marks have AI radar. The NF 13 has Rebecca and Radio Compass; the others have GEE and some a radar interrogator. All have four belt-fed 20-mm. guns mounted in pairs immediately outboard of the engines, a retractable gyro gunsight and a synchronised cine-camera. Most aircraft of all marks may have IFF fitted but inoperative.

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A.L.3.

(e) Other systems include cabin pressurisation and air conditioning, oxygen, and windscreen de-misting and de-icing.

(f) The principal dimensions of the aircraft are as follows:—

	Mk. 11, 12, 13, *TT* 20	*Mk.* 14
Wing span	43 ft. 0 in.	43 ft. 0 in.
Length	48 ft. 6 in.	49 ft. 11¼ in.
Max. height above ground ..	13 ft. 11 in.	13 ft. 11 in.
Wheel track	10 ft. 5 in.	10 ft. 5 in.
Ground to canopy height (unladen)	8 ft. 7 in.	8 ft. 7 in.

FUEL SYSTEM

2. Fuel tanks and gauges

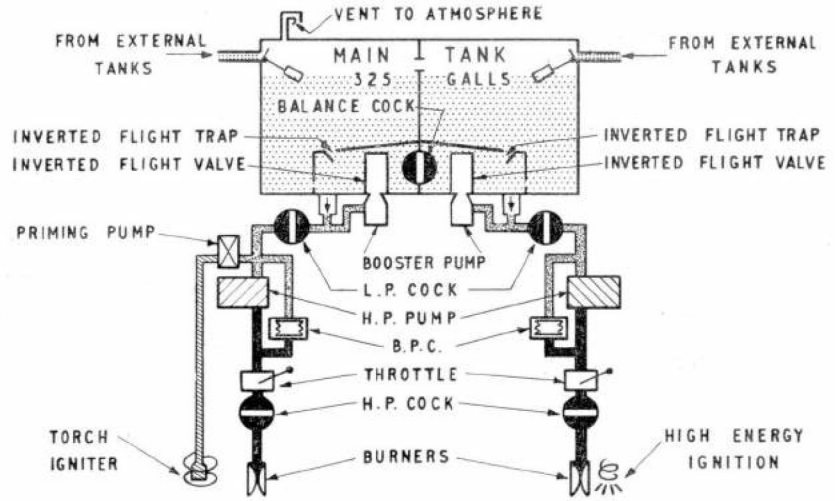
(a) Fuel is carried in a main or fuselage tank (325 gallons), a ventral drop tank (175 gallons) and two underwing drop tanks (100 gallons each). The aircraft may be flown without wing tanks.

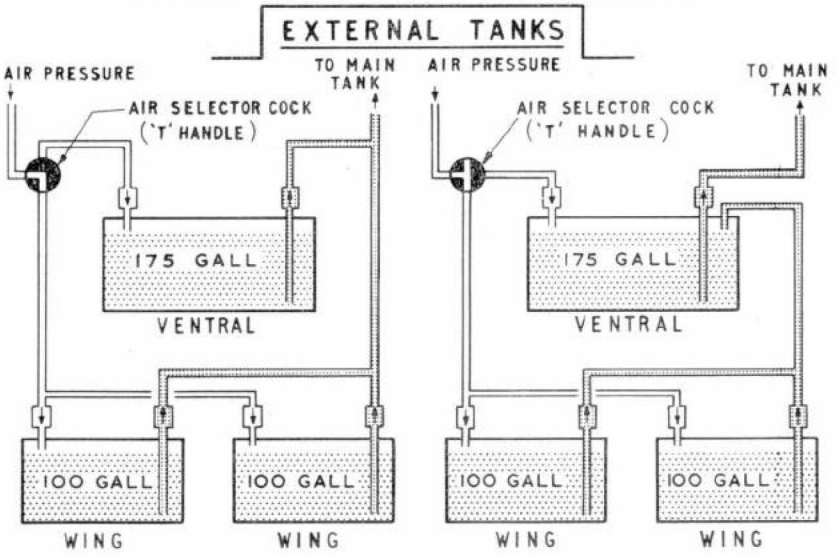
(b) The engines are fed from the main tank which is divided into two compartments. The front compartment normally feeds the port engine and the rear compartment the starboard. The compartments may however be interconnected by a manual balance cock controlled by an up to open/down to close handle (21) to port of the pilot's seat. In each compartment there is an inverted flight trap and valve which ensure a supply of fuel under negative G conditions for a short time.

(c) Two electrical fuel contents gauges (61) (65) below the instrument panel indicate, in gallons, the contents of the main tank compartments. The port gauge indicates front compartment contents and the starboard gauge the rear compartment contents. There are no gauges for the external tanks.

3. Fuel transfer

(a) Fuel is transferred from the external tanks to the main tank by air pressure. A float valve in each main tank compartment prevents overfilling by transfer fuel. The transfer air is controlled by a T-handle (38) at the top left of the instrument panel. Post Fighter Command Modification Meteor/44 (2nd T.A.F. Mod. Meteor/29) the handle has two positions ALL ON (at 12 o'clock) and VENTRAL ON (at 3 o'clock). This modification re-routes both air and fuel lines so that when ALL ON is selected the wing tank fuel transfers first to the ventral tank and thence to the main tank. The T-handle is normally wire-locked to ALL ON and with this selection all external fuel should transfer automatically. VENTRAL ON *must* however be





PRE FIGHTER COMMAND MOD. METEOR/44

POST FIGHTER COMMAND MOD. METEOR/44

SIMPLIFIED FUEL SYSTEM

selected if wing tanks are not being carried, or if they have been jettisoned, otherwise the transfer air will vent to atmosphere and the ventral tank will not feed.

(b) On some early aircraft, pre-mod. 44, the T-handle has three positions, OFF (at 6 o'clock), BELLY ON (at 3 o'clock) and WINGS ON (at 12 o'clock). In this case each external tank must be individually selected.

(c) A red transfer warning light (66) below the contents gauges will go out when fuel is being transferred and, pre-mod. 44, when OFF is selected.

4. **Drop-tanks jettison controls**

The ventral tank may be jettisoned by pulling out the T handle, regardless of which tank is selected. The wing tanks may be jettisoned by pulling back a lever (100) on the cockpit floor to starboard of the pilot's seat.

5. **Low-pressure booster-pumps and cocks**

(a) Two electrically-driven low-pressure booster pumps are fitted, one to each main tank compartment, beneath the inverted flight valves. The pump motors are controlled by two circuit breakers (13) on the shelf to port of the instrument panel. A by-pass to each pump provides gravity feed in case of pump failure. There are no low-pressure failure warning lights.

(b) Fuel flows from the pumps to LP cocks which are mechanically operated by levers (22) (96) located on either side of the pilot's seat at hip height.

6. **High-pressure pumps and cocks**

From the low-pressure side fuel feeds to engine-driven high pressure pumps, one to each engine. HP fuel then passes to the engine burners via HP cocks which are mechanically controlled by levers (1) (95) located outboard of the LP cock levers.

POWER UNITS

7. **Engine type**

Derwent Mk. 8 or Mk. 9 engines are fitted. They have double entry, single stage, centrifugal compressors, nine

equally spaced flame tubes, and a single-stage axial turbine. The Mk. 8 has torch igniters with a separate fuel priming system: the Mk. 9 has high energy ignition and the priming system is inoperative. The Derwent develops 3,470 lb. static thrust at 14,550 r.p.m. at sea-level. Approximate consumption at take-off rate is 8 gallons/minute/engine at sea level.

8. **Oil system**

Engine lubrication is by an integral dry-sump closed circuit, the whole system being self-contained in each engine. A small access door to the oil fillers is on the port side of each nacelle; the tanks hold 22 pints (19½ pints post Derwent Mod. 571) of oil and are filled to within one inch of the filler neck. Oil pressure gauges (62) (64) are below the centre of the instrument panel.

ENGINE CONTROLS

9. **Throttle controls**

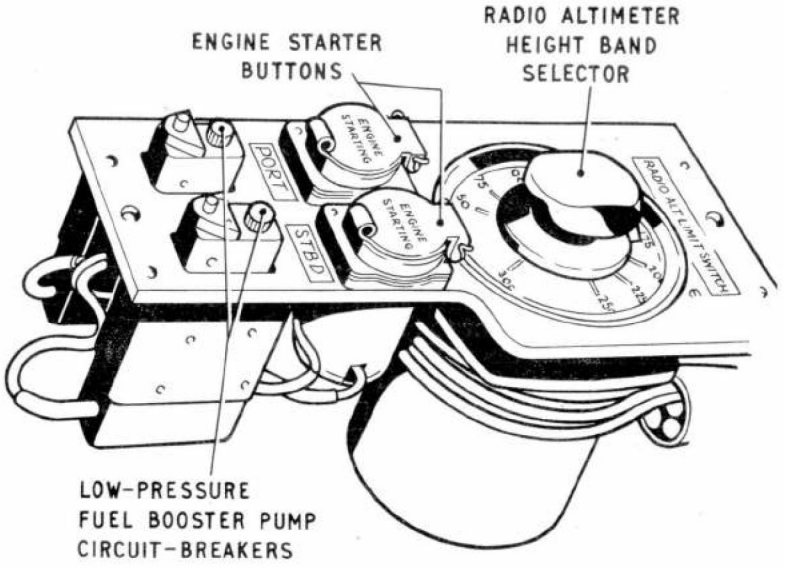
Throttle levers (7) are mounted in slides on the port wall of the cockpit. The levers move forward to open and aft to close. No friction damper is fitted.

10. **Barometric pressure controller**

An automatic barometric pressure controller is fitted on each engine to compensate for the variations of air density with height, and for ram effect at high indicated speed. The BPC controls HP pump delivery and should maintain r.p.m. as set; however when climbing it does not do so and the pilot must throttle back. At height, maximum r.p.m. is obtained at less then full throttle.

11. **Engine starting controls**

To complete the electric starting circuit the throttles must be closed, the booster pump circuit-breakers made, and the battery isolating switch on. Two switches labelled IGNITION ISOLATING and PRIMING PUMP ISOLATING (Derwent Mk. 8) or MAIN SUPPLY and HIGH ENERGY SUPPLY (Derwent Mk. 9) are fitted in each



ENGINE START PANEL – FRONT COCKPIT PORT WALL

undercarriage bay. These switches must be ON before starting and OFF if a dry blow is required. Two starter pushbuttons (11) on the shelf to port of the instrument panel, when depressed for two seconds, wind up the sequence mechanism which then, in stages, operates the starter motor and ignition. All current is automatically cut off after 30 seconds.

12. **Engine relighting controls**

Engine relight buttons (1) (95) are fitted on top of each HP fuel cock lever. These operate the igniters direct. They are used for relighting in flight; the normal starting system must *never* be used in flight.

13. **Engine fire-extinguishers**

(a) Engine fire warning lights (40) and (45), one for each engine, are on the instrument panel coamings; they work from

fusible flame switches in the nacelles. Once operated the lights will remain on.

(b) The engine fire-extinguishers may be operated electrically by two shielded pushbuttons (50) on the top starboard side of the instrument panel.

(c) In the event of a crash landing an inertia switch automatically operates the extinguishers and isolates the aircraft electrical services from the batteries.

ELECTRICAL SYSTEM

14. **D.C. supply**

(a) Two generators, one on each engine, provide the power for a 28-volt d.c. system and also charge the batteries.

(b) Generator failure warning lights (58) (121) are fitted in both cockpits. Generator field circuit-breakers (120) and reset switches (122) are on the electrical panel on the rear cockpit starboard wall.

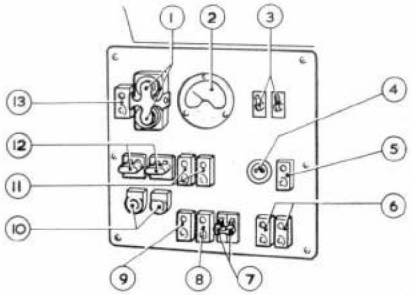
(c) Two 12-volt, 40-amp/hour batteries are connected in series.

(d) A battery isolating switch (90) on the front cockpit starboard wall, when set to OFF, disconnects the batteries from all aircraft services except the engine fire-extinguishers which are permanently on line.

(e) An external battery socket and GROUND/FLIGHT switch are on the port side of the nose. At GROUND the switch connects the external source to the aircraft busbar and disconnects the batteries therefrom. A battery socket incorporating an automatic switch may replace the GROUND/FLIGHT switch.

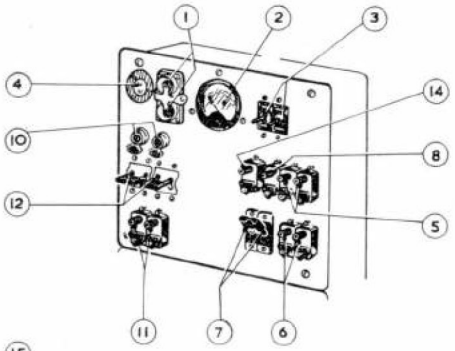
(f) The d.c. supplies for radio and radar are controlled from the rear cockpit electrical panel.

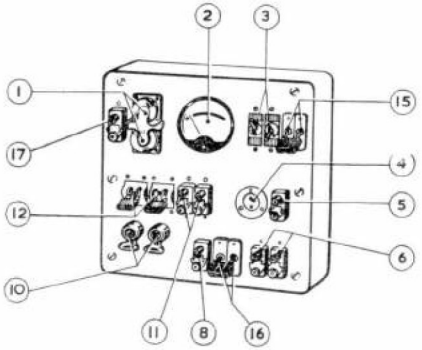
(g) The electrical turn and slip indicator is supplied with d.c. as soon as the busbar is made live. This instrument has no separate switch or circuit-breaker. In most aircraft an alternative supply is automatically provided by a change-over relay, through a separate fuse, should the primary supply fail.



N.F. 11

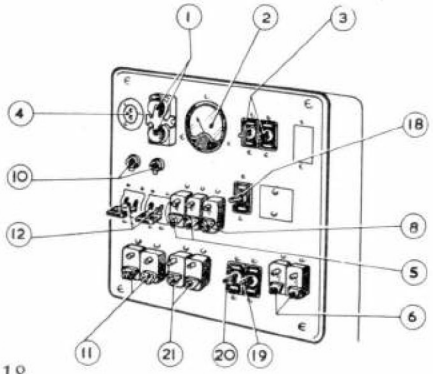
N.F. 12 (Pre-mod. 5777)
N.F. 14 (Pre-mod. 5808)





N.F. 13

N.F. 12 (Post-mod. 5777)
N.F. 14 (Post-mod. 5808)



REAR COCKPIT ELECTRICAL PANELS

KEY TO "REAR COCKPIT ELECTRICAL PANELS"

1. Radar inverter START/STOP buttons.
2. Instrument inverter—failure indicator.
3. Instrument inverter—change-over switches.
4. Supply socket for chart lamp wander-lead.
5. AI—d.c. supply.
6. Nos. 1 and 2 VHF supplies.
7. GEE —a.c. and d.c. supplies.
8. AI—a.c. supply.
9. Radar interrogator—a.c. supply.
10. Generator—failure warning lights.
11. Generator—field circuit-breakers.
12. Generator—re-set switches.
13. } GEE inverter—on/off.
14. }
15. Radio compass supplies.
16. REBECCA—a.c. and d.c. supplies.
17. REBECCA inverter—on/off.
18. GEE/FIS—inverter change-over.
19. FIS—on/off.
20. GEE—on/off.
21. Radar ground test—a.c. and d.c. supplies.

15. A.C. supply—general

All the inverters are driven by d.c. To prevent damage the d.c. circuits are guarded by circuit-breakers which are all in the rear fuselage on either Junction Box 3 or Junction Box 5. In the case of the main instrument inverter the d.c. supply is also routed via micro-switches on the HP fuel cock levers.

16. A.C. supply—flight instruments

(a) The Mk4B compass, the artificial horizon and where fitted the autostabiliser, are driven by 115 volt, 400 cycle, three-phase a.c. which they receive from one of two inverters, main and standby, type 100A or 100B. There are two FLIGHT INSTS switches (113) on the observer's electrical control panel which have two positions, NORMAL and EMERGENCY TEST. When at NORMAL the main inverter is selected; however the d.c. to drive this inverter is first routed via micro-switches actuated by the HP fuel cock levers (one to each lever, connected in parallel). Either HP lever therefore acts as the main inverter on/off switch. When EMERGENCY TEST is selected the d.c. supply to the main inverter is broken and transferred to the standby inverter; the HP lever micro-switches are not included in the standby circuit.

(b) There is an a.c. voltmeter (112) marked PHASE FAILURE on the observer's electrical control panel. This meter has a white sector in a red arc; the meter will indicate white when the instrument supply is satisfactory.

17. **A.C. supply—radar**

(a) Two START/STOP buttons on the observer's electrical panel control an inverter which supplies single-phase a.c. to the AI; in the NF 11 and NF 13 it is an MG4B inverter and in the NF 12 and NF 14 a Royal D 1 inverter. The output from these inverters is switched by a circuit-breaker on the same panel.

(b) The Gee (NF 11, 12 and 14) and Rebecca (NF 13) require 115 volt, 1,600 cycle, single-phase a.c. This is provided in the NF 11 and NF 13 by an MG 7 inverter and in the NF 12 and NF 14 by a type 200 inverter. These inverters are switched on and off by a circuit-breaker on the observer's electrical control panel. The a.c. to the Gee/Rebecca and a complementary d.c. supply are controlled by switches on the same panel.

(c) Some NF 12 and NF 14 aircraft have FIS installed which also requires 115 volt, 1,600 cycle, single-phase a.c. In these aircraft a second inverter type 200 is fitted, the No. 1 normally supplying Gee and the No. 2, FIS. The inverters start automatically when the equipment is selected on at the observer's electrical control panel. In case of failure the two circuits can be transposed by use of an EMERGENCY TRANSFER switch on the same panel. This switch has two positions, NORMAL and CHANGE-OVER. If No. 1 inverter fails the switch should be at NORMAL to obtain Gee: if No. 2 fails, at CHANGE-OVER. If FIS is required the switch should be put to CHANGEOVER if No. 1 fails and to NORMAL if No. 2 fails. In all cases the unwanted equipment should be switched OFF.

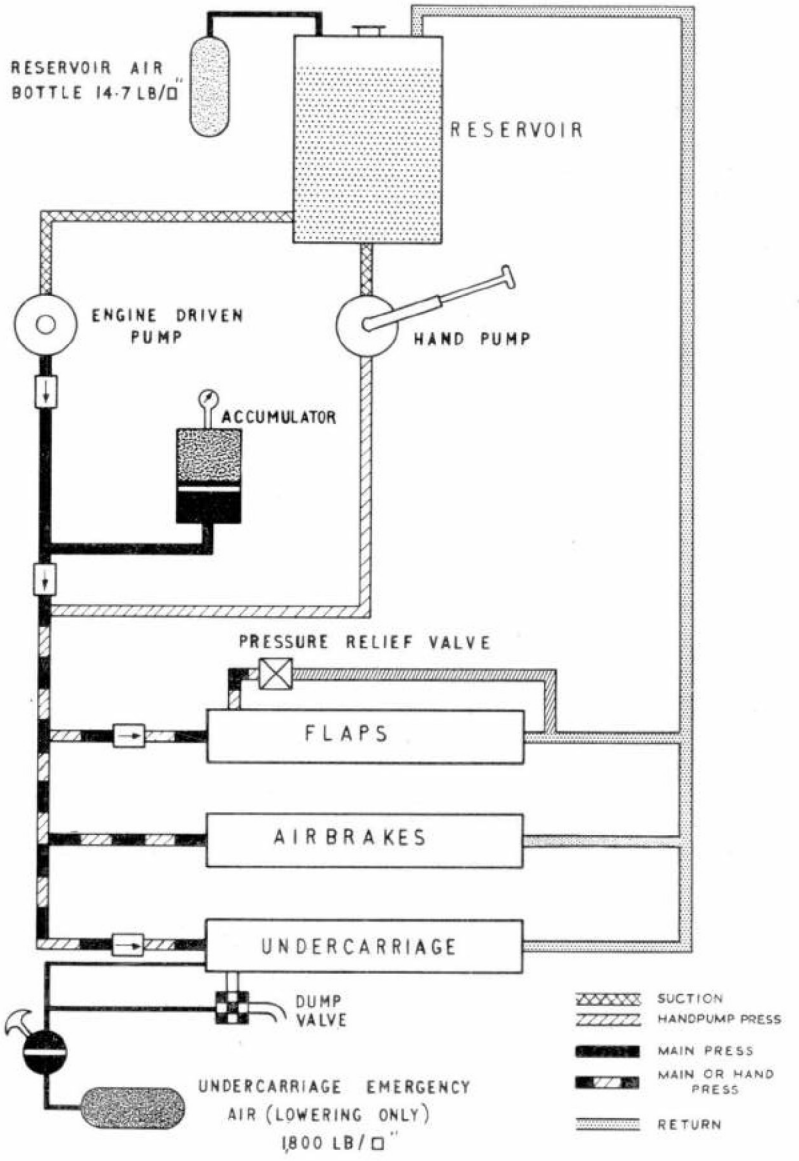
18. **A.C. supply—radio**

The radio compass (NF 13 only) requires a single-phase a.c. supply which is provided from a tapping on one phase of the instrument inverter(s) circuit.

OTHER MAIN SYSTEMS

19. **Hydraulic system**

A hydraulic pump on the starboard engine provides power to operate undercarriage, flaps and airbrakes. The pump also charges an accumulator which in turn provides a reserve source sufficient to operate each service once,



SIMPLIFIED HYDRAULIC SYSTEM

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one way. A handpump (103) with telescopic handle projects to starboard of the pilot's seat: this will operate all services through the normal lines should the main pressure fail and providing there is no mechanical damage.

NOTE.—In tropical temperatures, the efficiency of the hydraulic accumulator may be reduced.

20. Pneumatic system

An air compressor on the port engine charges a storage cylinder in the rear fuselage to 450 lb./sq. in. This air is used to operate the wheel brakes. The pressure available is indicated by a gauge (3) on the front cockpit port wall. An entirely separate compressed air system supplied from a *non-recharging* air bottle is fitted for undercarriage emergency lowering.

AIRCRAFT CONTROLS

21. Flying controls

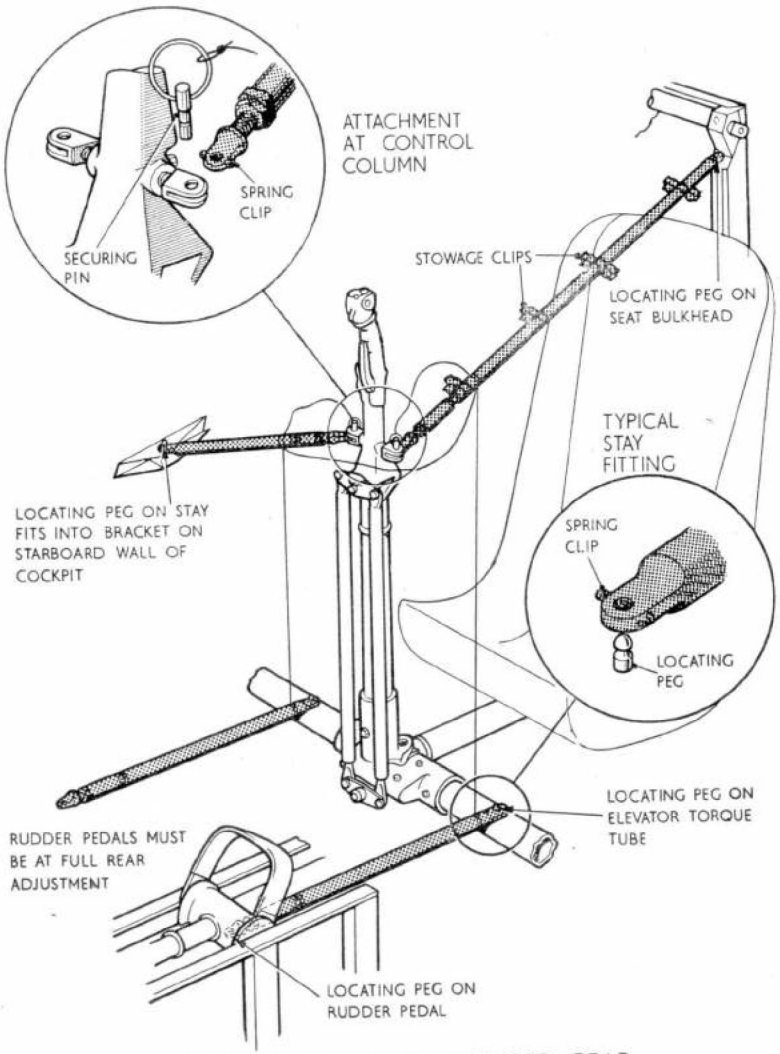
The ailerons and elevators are controlled from a shaped handgrip which forms the moving portion of a split-stick. The rudder is controlled through parallel-movement pedals which are adjustable for reach. A spring-loaded in/out adjustable knob (34) locks/unlocks the pedal mechanism: the pedals are not individually adjustable.

22. Flying control locks

The flying controls can be locked by the use of four rods which are fitted to the control column and rudder pedals. External aileron clamps may also be fitted. When not in use the locking gear is stowed in the rear fuselage or, in a few early NF 11 aircraft, on the starboard side of the cockpit hood.

23. Trimmers

Trim tabs are fitted to all three control surfaces but only elevator and rudder are adjustable in flight. The elevator trims are controlled by a handwheel (17) on the cockpit port wall. The rudder tab is controlled by a smaller wheel (20) aft and to port of the elevator wheel. Trim position indicators (19) are mounted alongside the elevator wheel. The trim controls work in the natural sense. Spring and geared tabs are fitted to the ailerons to reduce stick loads.



FLYING CONTROLS LOCKING GEAR

24. **Autostabiliser**

(a) Some aircraft (post-mod. 5308) have an autostabiliser which reacts to and damps yaw. It consists of a yaw sensitive gyro-unit, a control box and a servo motor which latter is connected to the rudder trim tab mechanism. All three units are supplied from the instrument inverter circuit. Originally the units were directly connected and became live with the instruments: a manual ON/OFF switch connected or interrupted the control signal to the servo. To obviate the risk of a servo runaway a modified switch may be fitted (mod. 5904). This switch has three positions, OFF/STANDBY/ON: when at OFF the power supplies to the units are cut, when at STANDBY power is directed to the gyro-unit only, and when at ON all three units are live and interconnected. The switch is on the port side of the instrument panel below the undercarriage selector. A micro-switch automatically switches the autostabiliser off when the undercarriage is lowered.

(b) During the pre take-off checks the autostabiliser should be switched ON. If the autostabiliser is not required, the switch should be set to STANDBY (three-position switch) or OFF (two-position switch). OFF should only be selected on the three-position switch in the case of malfunctioning of the unit or if it is essential to conserve electrical power.

25. **Flaps**

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(a) Flaps, mechanically interconnected to ensure synchronisation, are fitted inboard and outboard of the engine nacelles (inboard only on some NF 11s). Flap position is infinitely variable and is selected by a lever (36) on the instrument panel extreme port side (see para. 81 (b)). An electrical flap position indicator (35) is mounted inboard of the selector lever.

(b) A pressure-relief valve by-passes fluid from the flap jack at a pre-determined back pressure. This permits the flaps to respond to excessive air loads though only up to a set rate.

(c) Flaps may be raised or lowered in the event of hydraulic pressure failure by use of the handpump after normal selection.

26. **Airbrakes**

Pierced type airbrakes are mounted on the mainplane upper surfaces inboard of the engine nacelles. The brakes, also mechanically interconnected, are two-position only and are selected by a lever (9) on the front cockpit port

wall. When the lever is forward brakes are in and lever aft brakes are out; there is no indication of airbrake position other than the position of the lever. The airbrakes may be operated in the event of failure of the main system by normal selection and use of the handpump.

27. **Wheel brakes**

Pneumatic pressure to the wheel brakes is controlled by a vertical lever on the front of the control column handgrip. A unit actuated by the rudder mechanism proportions the air between the two wheels and provides differential braking. There is a parking catch at the base of the hand-lever.

28. **Undercarriage controls**

(a) The undercarriage is selected UP or DOWN by a two-position lever (33) on the instrument panel extreme port side. On raising there is no particular sequence but on lowering the nose wheel should come down first followed by the port and starboard legs in that order.

(b) The undercarriage emergency down system is operated by pulling a handle (102) on the front cockpit starboard wall. The undercarriage will then lower irrespective of the position of the normal selector lever. However if the lever is UP all hydraulic fluid will be dumped to atmosphere and it will not be possible to use the handpump to operate the other services. The selector lever should therefore be DOWN whenever possible before applying emergency air.

(c) A standard undercarriage position indicator (63) is below the main flight instruments.

(d) A red warning light (60) to the right of the position indicator comes on if any wheel is not fully locked down and either throttle is less than one-third open. At height this light will burn continuously as the throttles are usually less than one-third open for normal cruising.

(e) When the port oleo is compressed the u/c selector lever is locked to prevent UP selection on the ground. However, in emergency, this ground lock may be over-ridden by pulling the selector lever sharply rearwards (outwards from the panel). This breaks a restraining wire and UP can be selected. The lever will remain extended as an indication that the override has been operated: the exposed portion of the lever is painted red.

NOTE.—It is possible for the undercarriage to be locked down but the ground lock not engaged if the

selector lever is not fully down on the stop. A window on the port side of the fuselage just below the rear end of the hood enables the pilot to check that the ground-lock hook is engaged.

HOOD AND COCKPIT EQUIPMENT AND CONTROLS

29. **Access to cockpits**

Retractable footsteps and foot and hand hold recesses are provided on the port side of the aircraft. Each footstep may be pulled down to a locked position and retracted under spring pressure by turning a flush fitting disc above the step; the disc has finger holes.

30. **Cockpit hood (NF 11, 12 and 13)**

(a) *Mounting*

A metal-framed multi-panel hood is fitted to NF 11, 12 and 13. When the hood is closed it is supported and locked by catches on the port and starboard sides and further locked by two hooks at the rear. To open the hood the port catches and the rear hooks are released and the hood swings up on the starboard catches. A spring-operated assister mechanism takes most of the weight of the hood during opening. A folding strut between the two cockpits straightens as the hood opens. The strut is locked open by a sliding sleeve. The assister mechanism also locks the hood handles and port catches at their open position when the hood is fully open.

(b) *Hood controls*

(i) *Hood opening handles—ground use only*

There are two hood opening handles (4) inside the cockpits and one outside, all on the port side and all interconnected. These handles are connected to the port catches and both rear hooks.

(ii) *Hood release toggles—ground use only*

Two triangular toggles (91) painted yellow and black one in each cockpit on the starboard wall are provided in case the rear hooks jam. These toggles permit the application of a greater torque to the operating shaft. An external toggle is located on the port side of the fuselage aft of the hood.

(iii) *Hood jettison handles*

Two yellow and black T-handles (48), one in each cockpit, starboard side, may be used to jettison the

hood on the ground or in the air. When either handle is pulled hard rearwards all hood catches on both sides are released, the rear hooks are locked against any movement and a spring mechanism is wound up. On release of the catches the assistor arm starts to push the hood upwards, pivoting it about the rear hooks. Therefore, when jettisoning on the ground, the handle must be released immediately on reaching full travel to enable the spring to unwind and unlock the rear hooks when the hood may be pushed off to starboard (it is much easier to starboard as that way it is helped by and will pass over the assistor arm). In the air the jettison handle must be held fully rearwards to hold the rear hooks locked. Then, when the assistor arm has moved the hood a few degrees, air pressure continues the pivoting until 40° is reached when the hood will fly off rearwards and upwards. The handle may then be released.

(c) *Hood locking indicator and light*

Immediately below the hood/fuselage joint on the front cockpit starboard wall is an arrow and a small round window (88). When the hood is properly locked a white pointer appears in the window opposite the arrow. In addition, in some aircraft, a red hood warning light is fitted on the top frame of the windscreen.

31. **Cockpit hood (NF 14)**

(a) *Mounting*

On the NF 14 a one-piece clear-vision perspex hood of improved shape replaces the multi-panel hood of earlier Meteor Night Fighters. This new hood is mounted on vertical rollers which are enclosed in clamp-action rails on both sides: the hood moves fore and aft instead of swinging open. To facilitate the aft movement the hood is mounted at the rear on a trolley which in turn can run back on shaped rails over the fuselage centre section. The hood may be operated electrically or manually: either way, it is locked in the shut (fully forward) position by a spring-loaded peg which engages with the hood trolley. This peg is withdrawn by an electrically-controlled pneumatic-locking valve. There is no positive lock for the hood open position.

(b) *Hood electrical system*
A reversible electrical actuator drives the hood via a chain. On the actuator shaft is a timing wheel which, through micro-switches, stops the hood at its fore and aft limits and controls the hood seal. On the locking valve is a micro-switch which breaks the actuator opening circuit until the locking peg is withdrawn. The actuator selector circuit is guarded by a circuit-breaker (93) on the front cockpit starboard wall, and post-mod. 5802 by a HOOD MASTER SWITCH on the outside of the fuselage port side. Selection of hood position is by any one of three switches marked OPEN–OFF–SHUT and spring loaded to OFF. These are located one (30) in each cockpit and one externally on the fuselage port side.

(c) *Manual operation*
Integral with the actuator is a clutch by which the hood may be detached from the electrical drive. This clutch can be released from either cockpit (release handle (24) on port wall) or from an external release on the fuselage port side near the electrical selector switch. There are six handles on the inside of the hood and a grip under a flap on the outside of the hood port side. When the clutch has been released the hood may be moved by use of these handles.

(d) *Hood jettison*
The hood is jettisoned by pulling either of the yellow and black jettison handles (48), one in each cockpit. This action releases the clamp rails and the hood pivots about the trolley; to do this the trolley must be locked to the fuselage by the peg. *The hood must therefore be fully closed for jettisoning.*

(e) *Hood locking indicator and pointers*
A window in the rear pressure bulkhead enables a check to be made on the setting of the trolley lock. When the lock is engaged a magnetic indicator between the oil pressure gauges shows black; when the hood is unlocked it shows white. Pointers (23) on each side of the front cockpit, when lined up, show that the hood rails are locked in the closed position. When the jettison handle is pulled the pointers will come out of line.

32. **Direct-vision panel**

A section of the port windscreen side panel is hinged and forms a direct-vision panel. The DV locking lever will lock the panel open or closed.

NOTE.—On the NF 11, 12 and 13 the DV panel locking lever and the forward hood opening handle will foul when closing the hood if the panel is not closed. When the GGS recorder camera is fitted the movement of the DV panel is restricted and this camera should be removed if a landing in rain is likely. A stowage is provided under the pilot's seat for this camera: the camera *should not* be left in the pilot's lap as this will restrict control column movement.

33. **Cockpit pressurising, air conditioning and de-misting**

(a) *Air supply*
Air is bled from both engine compressors for the pressurisation and heating systems. A duct in the port wing leading edge provides a source of ram air.

(b) *Pressurisation*

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(i) When the hood is closed and locked an automatic controller inflates a rubber gasket which seals the hood. No other selection is required. Similarly the seal deflates when the hood is selected open.

(ii) *Pressure selector* (*NFs* 12, 13, 14)
A pressure air selector (5), marked OFF–PRESSURE–ON, is on the front cockpit port wall. At OFF only ram air is admitted to the cockpits. At ON ram air is cut off and only compressor air may enter. At intermediate positions both supplies are partially open, the ratio between them varying with the position of the selector.

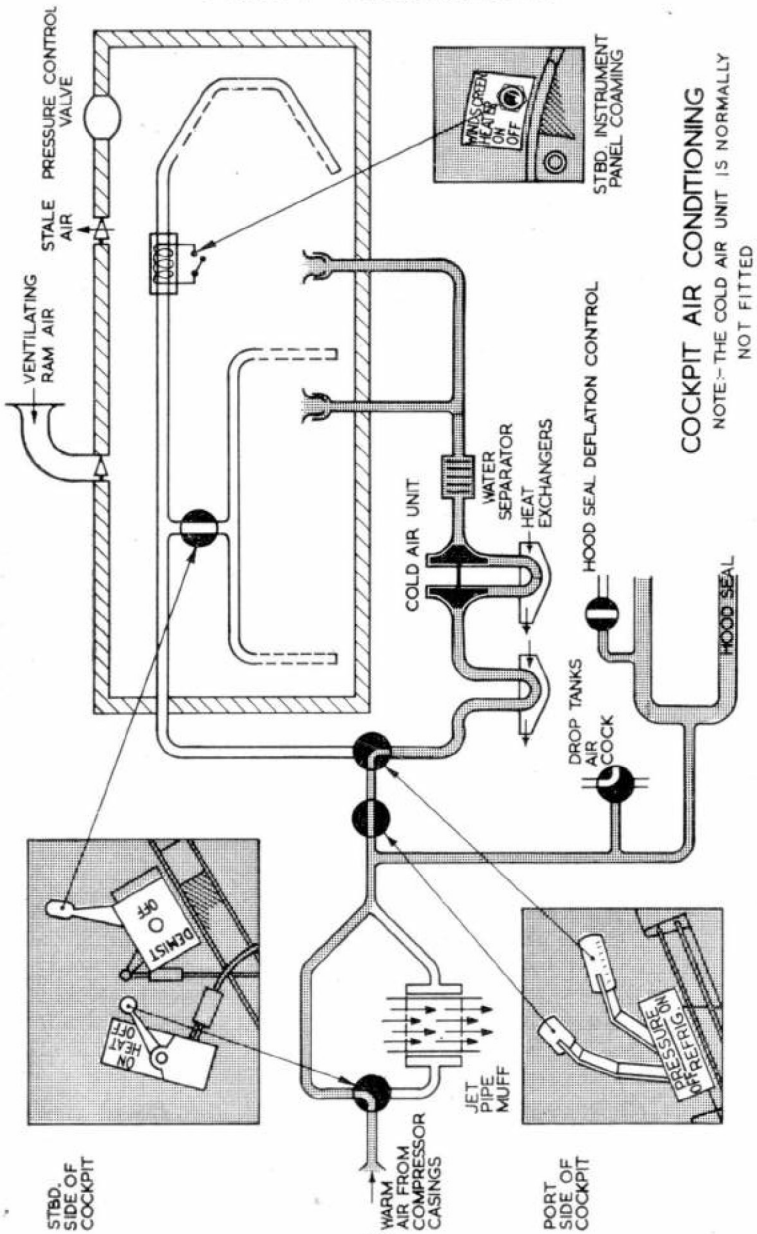
(iii) *Pressure selector* (*NF* 11, *TT* 20)
A pressure air selector, marked COLD-PRESS, is on the front cockpit port wall. When set to COLD, the air intake and extractor valves are open. As the control is moved forward to the PRESS position, the air intake and extractor valves are closed and compressor air enters the cockpit to pressurise it.

(iv) Should pressurising air be selected prior to take-off, fumes may occasionally appear in the cockpit. These should soon clear.

(v) An automatic pressure controller will, above 10,000 feet, regulate cockpit pressurisation when the pressure selector is at fully ON.

(vi) A horn fitted behind the front seat gives warning of any serious fall in cockpit pressure. A horn master switch (89) is fitted on the front cockpit starboard wall.

(vi) A PRESSURE CABIN ALTIMETER (51) is fitted on the starboard side of the front instrument panel. The table overleaf gives the readings applicable to various actual heights.



Actual altitude	Equivalent cockpit altitude	Cockpit altitude at which warning horn sounds
feet	feet	feet
10,000	10,000	—
15,000	12,000	14,000
20,000	14,500	17,000
25,000	16,000	19,000
30,000	18,000	21,500
35,000	21,000	25,000
40,000	24,000	28,000

(c) *Heating and cooling*

(i) The pressure selector controls the entry of ram air, engine air, or a mixture of the two. At low altitudes this selector may therefore be used to regulate cockpit temperature.

(ii) Additional heat for altitude is provided by diverting the engine air before it enters the fuselage through muffs around the jet-pipes. This extra heat is controlled by a two-position hot air lever (71) marked OFF–HEAT–ON which is on the starboard wall of the front cockpit. The degree of heating is automatically maintained at the engine.

(iii) The only method of cooling in the NF 11 and most NF 12, NF 14 is by ram air. In the NF 13, and in some NF 12, NF 14, the engine air can be directed through a separate cold air unit (heat exchanger) under the front cockpit. This cold air is selected by a lever (6) marked OFF–REFRIG–ON mounted co-axially with the pressure selector. If a lesser degree of cooling is desired it may be obtained by selecting the hot air control to ON at the same time as REFRIG is ON.

NOTE.—The cold air unit will not function properly unless the pressure selector is fully ON. The cold air unit *must* not be used on the ground as it will then overheat.

(d) *De-misting*

The windscreen and front panels of the hood are de-misted internally by warm air via a separate branch of pipes. The air used is engine air and the pressure selector must therefore be ON. An electric element, controlled by a switch

(46) on the front coaming, can be used to give extra heat to the air. A thermal switch prevents the element from overheating. The electric load on the element can be eased by having the hot air control ON. At low engine speeds the air supply may be so reduced as to impair de-misting. To restore the air supply the de-mist control (70) on the front cockpit starboard wall should be moved to DEMIST. This concentrates all available engine air into the de-mist pipes.

34. **Windscreen de-icing**

A hand-operated windscreen de-icing pump (99) is on the cockpit floor to starboard of the pilot. The de-icing fluid is fed to a spray-pipe at the base of the windscreen and thence over the centre panel. The handpump plunger is locked down by a catch. When the plunger is pulled up the pump body fills with fluid. When the plunger is pushed down an internal spring is compressed which, when released, forces the fluid to the delivery pipe. The delivery is metered by adjusting the knurled knob (98) aft of the plunger. The duration of the delivery stroke may be varied from 40 seconds to 5 minutes but normally a period of 1 minute is recommended.

35. **Crew seats and harness**

The non-ejection crew seats are adjustable for height by levers on their starboard sides. Safety harness lean-forward to release levers (101) are on the starboard wall and harness stowage hooks (87) on either side of each cockpit.

36. **Flight instruments**

(a) *Pressure head*

The single pressure head, mounted on the port outer wing is electrically heated, its control switch (105) being on the pilot's switch panel, starboard wall.

(b) *Pressure-operated instruments*

Standard pressure-operated altimeter, air speed indicator, machmeter, and vertical speed indicator are fitted. In a few early aircraft the turn and slip indicator may be air operated.

(c) *Electrically-operated instruments*

(i) *Mk. 4 B compass*

The Mk. 4 compass master indicator is in the rear cockpit to starboard of and slightly below the map

table. The control unit (94) is on the front cockpit starboard wall: this should be wire-locked to GYRO. Course setting and synchronising controls are on the front cockpit indicator (67). The compass is driven by the instrument inverter.

(ii) *Artificial horizon*

An electrically-driven artificial horizon is fitted. In most aircraft the horizon has a fast-erecting button and an OFF flag to indicate power failure. The horizon is driven by the instrument inverter.

NOTE.—If the roll pointer is more than 10° from vertical 20 seconds after switching on, the fast erect button must be used.

(iii) *Turn and slip indicator*

An electric d.c. turn and slip indicator is fitted. The electrical supply to this instrument is on immediately the busbar is live.

(d) *Radio altimeter*

A radio altimeter indicator (69) with integral ON/OFF switch is at the bottom left corner of the pilot's instrument panel, with its three associated limit lights (32) above it. A limit switch (10) is on the front cockpit port shelf ahead of the starter buttons.

(e) *Standby compass*

An E.2 compass (47) is fitted under the front cockpit starboard coaming.

(f) *Clocks*

An eight-day clock is on the pilot's instrument panel. Mod. 5571 introduces a time-of-flight clock (81) on the front cockpit starboard wall.

37. **Oxygen system**

(a) Oxygen is carried in three 750-litre bottles; an external charging connection is on the fuselage port side, level with the pilot. Contents are indicated on the pilot's regulator.

(b) Mk. 16 regulators (52), one for each crew member, are fitted on the starboard side of the front instrument panel and on the port wall of the rear cockpit; the rear regulator is fed from the front one. On some older aircraft Mk. 11 regulators may be fitted and HIGH flow must then be manually selected at 25,000 feet.

(c) Oxygen is routed from the regulators to selector valves (2) marked PB–ECON. These valves, which should be wirelocked to the position appropriate to the oxygen equipment worn by the crew, are to port of the two seats at shoulder height.

(d) With ECON selected the oxygen passes through an economiser to the mask. With PB selected the economiser is by-passed and the oxygen flows directly to the mask.

NOTE.—If pressure breathing equipment is used with ECON selected, the economiser will be damaged and a serious leak may occur.

(e) Emergency oxygen flow can be selected on the regulators.

38. **Interior lighting**

(a) *Front cockpit*
The instruments can be illuminated by two red lamps and/or by two ultra-violet lamps, each set being controlled by ON/OFF/dimmer switches (59) (68) on the centre of the instrument panel. The red lamp dimmer switch also controls a lamp over the pilot's switch panel on the cockpit starboard wall and, post-mod. 5571, a lamp over the time-of-flight clock. Two auxiliary red lamps over the brake pressure gauge and the trim wheels are controlled by an ON/OFF/dimmer switch (37) on the port wall outboard of the pressure control lever. Emergency lamps (41) under the port anti-glare shield are controlled by an ON/OFF switch (92) on the starboard wall. They obtain their supply from a small dry battery.

(b) *Rear cockpit*
An ON/OFF/dimmer switch (110) on the starboard wall controls a red lamp over the compass indicator. A chart board lamp on a free lead is supplied direct without switching, when plugged into a socket (115) in the electrical control panel. Post-mod. 5103 a separate dimmer switch (111) is provided for the chart lamp. Post-mod. 5381 two additional red lamps are fitted, one over the altimeter and the other over the airspeed indicator. These two lamps are controlled by an ON/OFF/dimmer switch on the port side of the rear cockpit.

(c) *Rear fuselage bay*
Lighting for the interior of the rear fuselage bay is by a single white light on the roof. This is controlled by a switch on Junction Box 5 which is on the starboard wall.

39. **Exterior lighting**

(a) *Navigation lights*
Normal wing-tip and rear cone steady burning navigation lights are controlled by a two-position switch (72) on the front cockpit starboard wall. To facilitate night training whilst retaining maximum safety, it is possible in most operational aircraft to switch out the rear navigational light only. A switch to do this is above the pilot's electrical and radio panel on the front cockpit starboard wall. This switch is not shown in Part VIII.

(b) *Identification lights*
Three coloured identification lights in the NF 11 and NF 13 (one only in NF 12 and NF 14) under the rear fuselage are controlled by either an ON/OFF switch (75) or a morse pushbutton (77), both on the front cockpit starboard wall. In the NF 11 and NF 13 a colour selector switch (76) is alongside the ON/OFF switch.

(c) *Taxy lamps*
Two taxy lamps are fitted on the nosewheel door and are controlled by a switch (104) on the front cockpit switch panel, starboard wall. On some early NF 11 aircraft the lamps may be one in each outer wing leading edge.

40. **Map stowage**

A map stowage is provided in the front cockpit immediately ahead of the trim wheels.

ARMAMENT AND CAMERA EQUIPMENT AND CONTROLS

41. **Guns and gun firing**

(a) Four 20-mm. guns are mounted in pairs outboard of the engine nacelles. They are fired electrically by a trigger (57) in front of the top of the control column: a safety catch (54) on the top of the column has first to be moved to FIRE. In those aircraft modified for target towing the switch TARGET TOWING (see para. 136) must be at OFF.

(b) To prevent inadvertent firing of the guns on the ground the firing circuit is broken when the wheels are locked down. However, to enable the guns to be ground tested there is a butt-test switch in the starboard wheel bay marked SAFE and FIRE.

(c) The guns are automatically heated by air bled from the engines the temperature being thermostatically controlled.

The gun bays are automatically ventilated by ram air when the guns are firing.

42. **Gunsight**

(a) A retractable gyro-gunsight Mk. 4E is fitted above the instrument panel. The sight can be raised or lowered by an ON (raise) OFF (lower) switch (43) alongside the sight provided that the gunsight circuit-breaker (44) outboard of the switch is made. If this electrical system fails the sight can be lowered manually by pushing in the red handle (42) which is at the lower right-hand corner of the sight. This control should be used only in emergency, since after its use the sight will need servicing.

NOTE.—If electrical supply is available the sight is lowered automatically when the hood jettison is operated.

(b) The gunsight range control is operated by a twist-grip incorporated in the port throttle lever.

(c) A gunsight dimmer selector (14) (29) is on the cockpit port wall.

(d) Radar ranging in NF 12 and NF 14 is normally under the control of the observer. When radar ranging is switched on, the pilot's twistgrip control must initially be kept at the minimum (200 yards) position and also when executing any manœuvres involving sharp turns. When tracking smoothly the grip should be moved clockwise to the maximum position thus enabling the sight to be radar-controlled whenever the target range drops below 800 yards. A strobe-disconnect switch is introduced by mod. 5900 and is positioned just aft of the selector-dimmer control. This switch is marked RADAR–MANUAL and allows manual ranging to be selected by the pilot if the strobe unit fails.

43. **Gun-isolation switch**

A gun-isolation switch is fitted to some aircraft on the front cockpit port coaming. If a gun jams the switch marked STOP PORT GUN–NORMAL–STOP STARBOARD GUN may be used to prevent yaw.

44. **Camera and gunsight camera recorder**

(a) A camera type G 45 is mounted in the leading edge of the starboard wing inboard of the engine. When the camera master switch (74) on the pilot's switch panel is ON the camera may be operated by pressing the button (56)

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marked C on the top of the control column. The camera will also operate when the guns are being fired provided the camera master switch is ON.

(b) A SUNNY-CLOUDY switch (73) is situated alongside the camera master switch.

(c) A recorder camera may be fitted on top of the gyro gunsight. This camera is also controlled by the camera master switch, and the camera button or gun-switch.

RADAR AND RADIO

45. **Radar and radar interrogator**

(a) Both NF 11 and NF 13 have AI 10 radar: the NF 12 and NF 14 have AI 21 radar. Some NF 12s and NF 14s may also have a radar interrogator (FIS).

(b) The controls and indicator units are all in the rear cockpit:—

(i) ON/OFF switches and circuit-breakers are on the electrical control panel, starboard wall.

(ii) A control box (NF 11 and NF 13) is mounted centrally below the chart table.

(iii) An indicator unit (NF 11 and NF 13) is mounted centrally at eye height.

(iv) A comprehensive console in the NF 12 and NF 14 replaces items (ii) and (iii).

(v) A visor for the indicator screen is stowed in a case on the port wall (all marks).

46. **IFF**

Post-Mods. 5855, 5856, IFF Mk. 10 is installed in Mks. 12 and 14 aircraft. The controls are on the port side of the rear cockpit; the control unit is in the place occupied by item 109 in Fig. 5, Part VIII and the master switch is on the forward face of the bracket supporting the control unit.

47. **Gee Mk. 3 (NF 11, 12 and 14)**

The Gee on/off control(s) are on the electrical panel and the indicator is on the port side of the centre panel, both in the rear cockpit.

48. **Rebecca (NF 13, 14)**

(a) The Rebecca Mk. 4 in the NF 13 is controlled by two switches (118) on the rear cockpit electrical panel. The control and indicator units are alongside each other on the port side, above and behind the chart table.

(b) Mod. 5960 introduces Rebecca Mk. 8 for the NF 14. The pilot's range and heading indicator is to the left of the artificial horizon. The navigator's indicator is above the A.I. console and his controller is on the port side of the cockpit, to the rear of the IFF controller.

49. **Radio compass (NF 13, 14)**

(a) *NF 13*

The radio compass is controlled from the rear cockpit electrical

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panel; the instruments inverter must be running. The indicators are on the port side of the front cockpit (15) and above the Rebecca indicator in the rear cockpit.

(b) *NF* 14

Mod. 5960 introduces a radio compass for the NF 14. The indicators are on the lower starboard side of the instruments panel in the front cockpit and to the left of the Rebecca in the rear cockpit. The controls are in the rear cockpit, below the A.I. console. If the aircraft is flown with the canopy open, the accuracy of the instrument may be affected.

50. VHF, UHF and intercomm.

(a) (i) *VHF*

Two 10-channel VHF sets, either TR1934/35 or 1985/86 are fitted. Two channel selectors (82, 86) are on the front cockpit starboard wall. The set in use is selected by a CHANGEOVER switch (84) marked NO. 1 SET-NO. 2 SET, which is the uppermost of three switches between the VHF controllers.

(ii) *UHF* (*NF* 14)

Some NF 14 aircraft may have UHF and standby fitted. The controller is in the position previously occupied by the gun-sight. A UHF/standby/power switch is on the cockpit starboard wall. In the up position, the normal UHF is selected; in the centre position the standby set, operating from normal electrical supplies, is selected; in the down position the standby set operates from the emergency battery. The existing camera button on the control column is used to provide tone facility. The navigator's tone switch is on the port side of the Rebecca indicator.

(iii) *UHF and VHF* (*NF*14)

SRIM2725 allows both VHF and UHF to be carried together in NF 14 aircraft. The controllers are located as in (i) and (ii) above and a VHF/UHF changeover switch, UHF tone switch are provided on the starboard wall of the front cockpit.

(b) The press-to-transmit button (8) is on the starboard throttle lever. Post-mod. 5835 a press-to-transmit button is fitted in the rear cockpit of the NF 12 and NF 14.

(c) Press-to-mute switches are fitted in both cockpits: in the front a button (55) is mounted on the control column and marked M and in the rear cockpit a foot-operated stud is placed handy to the right foot.

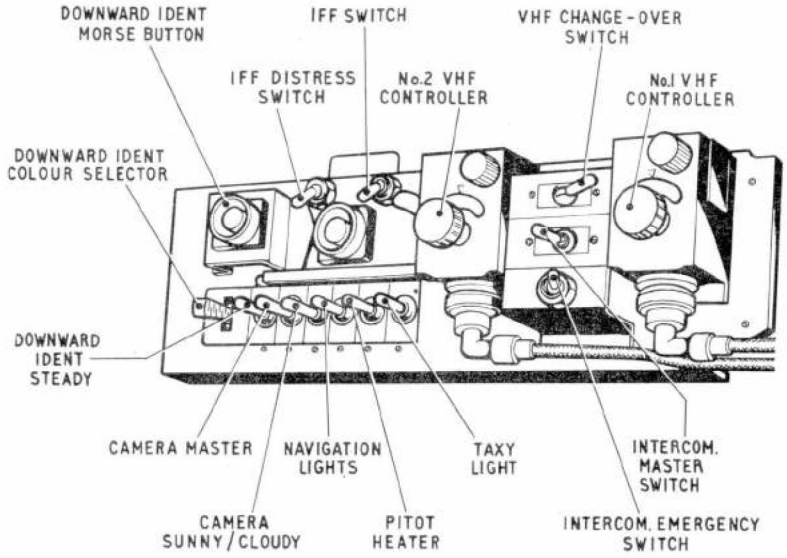
(d) The two channel selectors have OFF positions. In addition, there are two circuit-breakers (117) on the rear cockpit electrical panel marked VHF 1 and VHF 2 which control the main supply to the sets.

(e) Normal intercomm is by use of either:—

(i) A type 1134A amplifier (pre-Mod. 5890);
(ii) an A3713 amplifier (post-Mod. 5890); or
(iii) an A1961 amplifier (post-Mod. 5966).

In emergency, intercomm is through the amplification stage of the VHF or UHF set in use.

(f) An I/C MASTER switch (83) between the channel selectors controls the intercomm amplifier. If the amplifier fails intercomm can be restored by moving the I/C EMERGENCY switch (85), the lowest of the switches between the channel selectors, to EMERGENCY (to ON in early NF 11 aircraft) or by operating a similar switch on the rear cockpit starboard wall. In all NF 14, in most



PILOTS SWITCH PANEL—
COCKPIT STARBOARD WALL

NF 12 and in some later NF 11 and NF 13 aircraft the I/C MASTER switch and the I/C EMERGENCY switch are replaced by a rotary three-position switch marked OFF–NORMAL–EMERGENCY.

(g) When the navigator in the NF 13 is using the radio compass he is normally cut off from the intercomm. The pilot may call him by pressing a switch (39) on the port coaming. The navigator can put the radio compass on to the intercomm by a switch alongside his i/c emergency switch.

51. Telebriefing

A telebriefing socket is fitted behind a spring-loaded flap under the rear fuselage. On connecting up, the mic./tel. lines are disconnected from the VHF and intercomm circuits and connected to the land line. A light (49) under the front cockpit coaming indicates when the telebrief circuit is live. Both crew members can then receive from control on telebrief until the pilot presses a transmit

switch (49) alongside the light, when he can speak to control. The transmit function is not duplicated in the rear cockpit. Normal intercomm and VHF are restored when the telebrief plug pulls out as the aircraft taxies away.

EMERGENCY EQUIPMENT

52. **Hand fire-extinguisher**

A hand fire-extinguisher is carried in the rear cockpit.

53. **Crowbars**

Light crowbars are clipped to the port side of both crew seats. In the NF 13 the front cockpit crowbar may be replaced by a screwdriver.

54. **Aircraft destructor**

Provision is made in the front fuselage for the stowage of an aircraft destructor.

55. **First-aid**

A first-aid outfit is fitted either above the radar equipment between the two cockpits or to starboard of the observer's seat.

56. **Dinghies**

In each cockpit, provision is made for carrying a Type A parachute pack including a Type K dinghy and an emergency oxygen set.

57. **Desert equipment**

Provision is made to carry desert equipment in the rear fuselage. A screwdriver for removing the access panels is clipped to the front seat in the NF 13.

58. **Asbestos gloves**

Asbestos gloves are fitted on the rear cockpit starboard wall.

PART II

LIMITATIONS

59. **Engine limitations**

The principal engine limitations are as follows:—

Engine setting	R.p.m.	J.p.t. °C.
Maximum throttle for take-off, climb and operational necessity (15 mins.)	14,700±100*	680†
Maximum continuous ..	14,100	630
Idling on ground .. .. (throttle closed)	3,300–3,700	500

*R.p.m. governed to 14,550 at sea level.

†700°C. above 20,000 feet for 10 minutes.

Oil pressures

Minimum for idling (5 minute limit)	5 lb./sq. in.
Minimum at 14,100 r.p.m. and above	30 lb./sq. in.
Normal at 14,100 r.p.m.	35 lb./sq. in.

60. **Flying limitations**

(a) Intentional spinning is prohibited.

(b) Aerobatics are permitted with the ventral tank fitted, full or empty. Aerobatics are however prohibited when carrying wing drop tanks, even if empty.

(c) The angle of dive in air-to-ground attacks must not exceed 45°.

(d) If the aircraft is out of trim (nose-up) at high speed e.g. during ground-attack dives, and a heavy pull force is applied for the pull-up, excessive G may be induced resulting in structural damage. For this reason stick forces must be trimmed out right up to the maximum speed attained and care must be exercised when pulling up.

61. Speed limitations

(a)

Aircraft state	Height	Maximum speed
Clean or with ventral tank	(a) Sea Level–10,000 ft.	430 Kts. (up to 10° of dive) 400 Kts. (at greater than 10° dive)
	(b) 10,000 ft.–20,000 ft.	0.78 M
	(c) Above 20,000 ft.	No limit for structural reasons: only limited by controllability.
With wing drop tanks full or empty	(a) Sea level–7,000 ft.	430 Kts. (up to 10° of dive) 400 Kts. (at greater than 10° dive)
	(b) At 7,000 ft.	0.73 M
	(c) At 30,000 ft. and above	0.76 M

(b) For jettisoning external tanks, at any altitude, but, unless in emergency, *only* in straight and level flight.

Ventral tank .. .. .. 345 knots

Wing tanks .. .. .. 350 knots

(c) For raising or lowering undercarriage .. 175 knots

With undercarriage locked down .. .. 190 knots

(d) For lowering flaps .. .. relief valve guards system

When flaps fully down .. .. .. 150 knots

(e) For opening airbrakes .. .. .. No limit

(f) For opening D.V. panel .. .. .. 250 knots

NOTE.—Noise will be excessive above 200 knots.

(g) For jettisoning hood (NF 11, 12 and 13) .. 250 knots

(NF 14) .. .. 220 knots

(h) Gun firing—clean or with ventral tank ~~400 knots~~ unlimited ACI

—with wing tanks (full or empty) 350 knots

62. Weight and manœuvre limitations

Max. Weight in lb.	Permitted manœuvres and maximum accelerations	Total fuel (galls.)	Total ammo. (rounds)
20,500	Take-off from prepared runways. Gentle manœuvres only, to avoid over-stressing wing-tank attachments. Guns may be tested in straight and level flight but no gun-firing exercises.	700	520
18,700	Clean or with ventral only, all permitted forms of flying up to 6G. With wing tanks, full or empty, aerobatics are prohibited and the following acceleration limits must be observed. Straight pull-out .. .. 4.5G Rolling pull-out Up to half aileron .. 3.5G Half to full aileron .. 2.5G	500	520
16,000	Landing (see NOTES)	170 or 160 or 125	NIL 120 520

NOTES.—(1) The above fuel totals are based on AVTAG.

(2) If flown solo an additional 25 gallons may be allowed for landing.

(3) If wing tanks have been removed an additional 20 gallons may be allowed for landing.

63. Gun-firing limitation

When wing tanks are carried, full or empty, gun firing is permitted only if mods. 5167 and 5537 are embodied.

64. Descent limitation

Unless mod. 5537, or mod. 5263, has been incorporated, the rate of descent when carrying wing drop tanks should be restricted to 5,000 feet per min., otherwise due to the insufficient equalising of pressures there is a risk of tank collapse. Slight damage to the tank nose increases the risk of collapse, though even if collapse should occur there is no danger or change of trim.

65. **Anti-G equipment**

Some aircraft may be fitted with anti-G equipment (mods. 5590 and 5811). With this equipment in use it is easy to impose high accelerations. The G limitations given in para. 62 must not however be exceeded.

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65A. **A.A.Ls**

The aircraft approach limitations, subject to the standard conditions of pilot proficiency, airfield approach lighting, minimum visibility and accurate height information, are as follows:—

GCA	200 ft. above runway level
PPI (no glide path) ..	400 ft. „ „ „

PART III

MANAGEMENT OF SYSTEMS AND USE OF EQUIPMENT

MANAGEMENT OF THE FUEL SYSTEM

66. **Grades of fuel**

Derwent engines may be operated on either AVTAG or AVTUR jet fuel. The engine maximum r.p.m. governor is ground-adjusted to the fuel in use. When using AVTAG with r.p.m. set for AVTUR there will be a tendency to overspeed at full throttle and r.p.m. and j.p.t. must be manually controlled within limits. For "get you home" purposes only, AVGAS of any grade may be used but the overspeeding tendency will be greater. The AVGAS may be mixed with the fuel already in the tanks but only the amount necessary for the ferry should be uplifted. As AVGAS has a high evaporation factor the ferry should be made below 15,000 feet, and it should be noted that consumption will be approximately 11% greater than with AVTUR and 7% greater than with AVTAG.

67. **Fuel: starting and closing down**

(a) To provide the normal supply of fuel the booster-pumps, LP cocks and HP cocks must be ON.

(b) If the booster-pump circuit-breakers trip they should be re-selected: electrical failure should not be assumed unless the button will not stay in. If a booster-pump does fail maximum power will not be available on the engine concerned at low altitude.

(c) The LP cocks control the fuel to the HP pumps which are fuel lubricated. These cocks must not normally therefore be used to stop the engines in flight or on the ground as such use will damage the HP pumps. The HP cocks control the fuel supply to the burners and should always be used for voluntary closing down. In case of engine mechanical failure or fire however both cocks must be closed.

68. **Use of external tanks**

(a) In aircraft post-mod. 44, the T-handle should normally be wire-locked to ALL ON; it should only be set to VENTRAL ON if wing tanks are not fitted or if they are jettisoned. The transfer light should remain out and the contents reading remain constant until all fuel has fed from the external tanks. The light will then come on and remain on.

NOTE.—Post-mod. 44 the flow rate from the wing tanks is somewhat reduced. A careful check of the fuel gauges should therefore be maintained during periods of prolonged use of high power at low altitude.

(b) In aircraft pre-mod. 44, the fuel should be used from the wing tanks first. The fuel transfer light will go out when fuel is being transferred. As soon as this light comes on again (it may flicker for a while first), or when the fuel contents readings start to fall, the ventral tank should be selected. When the light indicates that fuel has stopped feeding, or the readings again fall, the total available fuel may be read from the contents gauges.

(c) Pre-mod. 44, freezing of the ventral tank inward vent valve may occur when flying at altitude with wing tanks selected. This would prevent the ventral tank from feeding when ultimately selected. Freezing may be avoided by making frequent selections of the ventral tank.

69. **Use of the balance cock**

(a) When flying on two engines any out-of-balance between the main tank compartments can be quickly corrected by use of the balance cock and the correction speeded by altering the attitude of the aircraft. Out-of-balance will occur during prolonged climbs or descents and this will be aggravated if the balance cock is open. If at this time the fuel level is low the outlet of the uppermost tank may become uncovered and cause a flame-out. The balance cock should therefore normally be closed.

(b) If it is decided to close one engine to conserve fuel the starboard engine should be kept running for the following reasons.

(i) In level flight at range speed the main fuel tank is in a slightly nose-up attitude. With the balance cock open the fuel will tend to flow into the rear compartment from which the starboard engine is supplied.

(ii) The hydraulic pump is driven by the starboard engine.

(c) The following table gives a guide to the use of the balance cock during single-engined flying:—

Condition of flight	Engine in use	Position of balance cock
Climb	Port	Closed
	Starboard	Open
Descent	Port	Open
	Starboard	Closed
Level	Port	Closed only if speed is below approx. 250 knots
	Starboard	Open

NOTE.—When the head of fuel in the main tank compartments is low the fuel demand of one engine at or near full power at low altitudes will be greater than the flow through the balance cock. It is possible to empty the compartment feeding the engine if the fuel in the non-feeding compartment is less than 35 gallons.

70. **Inverted-flight fuel-traps**

The inverted-flight fuel-traps ensure a supply of fuel for 15 seconds at full throttle at sea-level. Care must however be taken as after 15 seconds the engines may become starved of oil. Furthermore should these traps be emptied, aeration of the HP fuel pumps may occur, particularly above 15,000 feet, and it may not then be possible to relight.

ENGINE HANDLING

71. **On the ground**

In the lower r.p.m. range, i.e. below 7,000, rapid throttle opening will cause over-fuelling and should be avoided. The condition can be recognised by a muffled roaring.

72. **Take-off, climb and descent**

At sea-level the engines are governed to 14,550 r.p.m. However during a full throttle climb r.p.m. will progressively rise owing to governor creep to 14,700. A close watch should therefore be kept on j.p.t. which must not be allowed to exceed limits (680° C. normally but 700° C. for 10 minutes maximum above 20,000 ft.). If climbing at less than full power the throttles will need frequent adjustment to maintain selected r.p.m. Similarly adjustment will be needed during a descent.

73. **General flying**

(a) There is little or no risk of flame extinction at altitude and throttles may be fully closed at any height. Throttle movements should however be smooth and not too rapid. Coarse throttle opening will cause surging and excessive j.p.t. particularly at altitude.

(b) False indication of oil pressure failure may be given whilst at height. A descent to a lower altitude should return the indication to normal.

(c) After periods at height the HP cock may freeze in the ON position. It will free during the descent.

MANAGEMENT OF ELECTRICAL SYSTEM

74. **Batteries**

The internal batteries are not normally sufficient for starting and an external source should therefore be used. Before starting, move the GROUND/FLIGHT switch to GROUND and the battery isolation switch to ON. After starting, the GROUND/FLIGHT switch must be set to FLIGHT *before* the external source is removed otherwise the j.p.t. gauge may be damaged. When the aircraft is parked the GROUND/FLIGHT switch must be at GROUND or the battery isolation switch at OFF otherwise certain aircraft services (e.g. turn and slip) which have no on/off switch of their own will drain the batteries.

75. **Generators**

(a) When an engine has reached idling r.p.m. its generator may be switched on. To prevent damage the field circuit-breaker must be made live before the reset switch. Similarly on closing down the reset switch must be switched off first.

(b) Providing r.p.m. is sufficient (above 6,000 r.p.m.) the generator power is available whether batteries are in circuit or not: if the battery isolation switch is OFF, however, the batteries will not be charging.

(c) Generator failure may be due to:—

(i) A fault in the field circuit.

(ii) Overloading which causes overheating and the operation of the thermal trip-switch.

(iii) Severe brushwear at extreme altitudes at loads below normal safe maximum.

(iv) Overvolting of one generator which causes the other to come off line.

(d) The procedure for re-setting is:—

(i) Switch off all non-essential loads.

(ii) Check appropriate field circuit-breaker made. If the circuit-breaker trips (*do not attempt to hold it in*) leave the generator off.

(iii) If the field-circuit makes satisfactorily put the generator test switch to TEST and then to IN. If the warning light remains on wait for 30 seconds before repeating the procedure.

(iv) If the field-circuit is satisfactory but the generator refuses to reset the fault may be due to overvolting by the other generator. To check this, the second generator (the one still on line) should be switched off and a further attempt be made to re-set the first generator. If this is successful it indicates that the second generator was overvolting. The offending generator should be left off otherwise the accumulators will boil and acid spillage will occur.

76. **Loading and generator output**

(a) As a general guide the following list of loads may prove helpful:—

Service	*Amps*
Instruments including inverter	14
Fuel pumps	14
Windscreen heating	19
VHF (receiver plus transmitter)	17

Service	Amps
Pressure head heater	5
Internal lights	8
External lights	5
Gauges, indicators and warning lights	4
AI (NF 11 or NF 13)	83
AI (NF 12 or NF 14)	135
FIS	14
GEE	15
IFF	10
Radio altimeter	4
Gunsight, gunfiring and gas dilution	22
Engine relight	19

(b) Below 35,000 feet each generator will produce up to 250 amps. In the NF 11 and NF 13 this will satisfy full electrical load; in the NF 12 and NF 14 it is recommended that some load be shed if a generator fails.

(c) Above 35,000 feet the generator output which may be absorbed without incurring severe brushwear falls rapidly to 185 amps. If a generator fails above 35,000 feet it is recommended that, in particular on the NF 12 and NF 14, the whole AI and associated inverter loads be immediately shed. On the NF 11 and NF 13 it is recommended that loads be kept down by using equipments alternately.

(d) The batteries on their own will give:—

200 amps for 4 minutes
100 amps for 11 minutes
50 amps for 27 minutes

77. **Instrument supply**

(a) The normal a.c. supply for the electrical flight instruments (compass and horizon) is obtained by switching both FLIGHT INSTS switches to NORMAL and one or other HP fuel cock to ON. Should the PHASE FAILURE indicator fall into the red sector, or the instruments appear to be malfunctioning, both switches should be moved to EMERGENCY to bring in the stand-by inverter. After starting up, the stand-by inverter should be tested before taxying (switches to EMERGENCY, indication in white

sector). If either inverter fails to start i.e. no indication at all on the meter, the circuit-breakers in the rear fuselage should be checked.

(b) A d.c. supply to the electrical turn and slip indicator is provided as soon as battery and/or generator power is connected. In most aircraft, a relay automatically provides an alternative supply if the normal supply fails.

78. **Radio supply**

(a) The two circuit-breakers marked VHF FEED on the rear cockpit electrical panel must be made before flight.

(b) An a.c. supply for the radio compass where fitted is automatically available when the instrument inverter is running.

MANAGEMENT OF THE HYDRAULIC SYSTEM

79. **Hydraulic pressure—normal**

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(a) Hydraulic pressure is normally available from the pump driven by the starboard engine, backed by a reserve from the accumulator. However there is no gauge or other indication of pressure. As a check therefore the system should be exhausted of all pressure before starting up by operation of flaps or airbrakes. Selection of flaps or airbrakes after starting will then prove the system.

(b) If the starboard engine is windmilling, there should be sufficient pressure to operate each service once, one way only. However, if the starboard engine has seized or if the pump has failed, the reserve of pressure may not always effect all these operations. It should be noted that there will be no indication of pump failure while the starboard engine is running and, in this case, the accumulator reserve will be used without the pilot being aware of it.

(c) In tropical conditions, the effective capacity of the accumulator may be reduced, in which case it is advisable to avoid the use of airbrakes and to select undercarriage down before any flap is selected, in order to avoid losing available pressure through the flap relief valve.

80. **Hydraulic pressure—stand-by**

(a) If the pump fails all services may be operated by use of the handpump after normal selection. If however the normal pressure has failed through a broken pipe it may not be possible to operate one or more of the services by handpump pressure.

(b) At speeds above 150 knots it will not be possible to lock the nosewheel down by use of the handpump because of air pressure on the nosewheel door.

81. **Hydraulic services—normal selection**

(a) Selection of the hydraulic services is by levers which work in the normal sense. The undercarriage and airbrake levers have two positions only.

(b) The flap selector has three positions UP–NEUTRAL–DOWN. To obtain intermediate flap settings the lever should be moved to UP or DOWN as appropriate and when the required flap position is indicated the lever should be returned to NEUTRAL. If the lever is not returned precisely to the mid-position the flaps may creep.

(c) When excessive air loads are imposed on the flaps by too high an airspeed a relief valve opens and the flaps will retract until the load is within limits. However, the rate of retraction may not be sufficient to prevent damage if maximum accelerations are made with flaps at or near fully down. When the relief valve has allowed the flaps to retract under overload, re-selection will be necessary if the original flap position is still required: similarly if selected at too high a speed the flaps will not lower.

82. **Undercarriage selection—abnormal cases**

(a) The undercarriage may fail to operate normally even though hydraulic pressure is available:—

(i) If the selector lever has jammed it is probably due to back pressure causing the rotary valve to stick. To relieve this condition the starboard engine should be throttled back and the flaps and airbrakes operated until the selector lever is freed.

(ii) If on selecting DOWN the port leg is slow to move, the ground lock may engage on the compressed oleo. The selector lever will then be locked down with the port leg locked up. To overcome this operate the ground lock override, select UP, then reselect DOWN.

(b) If all else fails the undercarriage can be lowered by emergency air; see para. 134.

MANAGEMENT OF THE HOOD MECHANISM—(NF 11, 12 AND 13)

83. **Hood opening**

(a) Before the hood is unlocked, from inside or outside, the arrow and pointer of the hood lock indicators must be

in line. If they are not in line it may mean that the starboard catches on which the hood is to swing are not properly secure.

(b) If the handle is moved whilst the hood is being opened serious damage will be done to the catches and locking hooks when the hood is next closed. If a handle is so moved it *must* be returned to its original position before the hood is closed.

(c) When the hood has been unlocked it should swing freely and easily to the open position and automatically lock there. If, after operating the locking handle, the hood will not open it may be due to the rear hooks jamming. In this case the triangular toggle should be pulled.

84. **Hood closing**

To close the hood slide the sleeve on the locking strut down until the strut can fold. The hood can then be pulled down and should bed firmly on the fuselage decking. The hood must be locked by one of the internal handles: *the external handle must be not relied upon* as its action is insufficiently positive. When the hood is secured the front handle should be fully back against the stop and the rear handle retracted in a slot. In a few earlier aircraft both cockpits have similar handles which should be one-quarter of an inch from the stop when in the locked position. Where a red warning light is fitted check that it goes out when the hood is closed. AC

85. **Hood jettisoning**

(a) In the air the hood may be jettisoned by pulling either of the jettison handles. The assistor mechanism will then push up the front of the hood pivoting it on the rear hooks. Air pressure will continue the movement and the hood will disengage from the hooks when it has moved through some 40 degrees.

(b) The hood can also be jettisoned on the ground by use of the same handles. In this case however, to allow the rear hooks to be disengaged by the spring mechanism without the hood moving, the jettison handle must be pulled and then released immediately.

MANAGEMENT OF THE HOOD MECHANISM—(NF 14)

86. **Circuit-breaker, master switch and clutches**

Before the hood can be operated electrically the circuit-breaker (85) in the front cockpit must be made, the external HOOD MASTER SWITCH (post-mod. 5802) must be ON and the internal and external clutches must be engaged.

87. **Electrical operation**

The hood can be opened or closed electrically by use of any of the three switches (one in each cockpit and one externally). The observer's switch over-rides the external switch and the pilot's switch over-rides both. The switches work in the natural sense and, being spring-loaded to OFF, must be held forward or aft to operate. The hood may be stopped in any intermediate position. When opening the hood there is a 10 second delay before the hood moves to allow the hood seal to deflate.

88. **Manual operation**

The hood may be opened or closed manually when any one clutch lever is disengaged.

89. **Hood jettisoning**

The hood may be jettisoned by pulling out either of the jettison handles (one in each cockpit). The hood *must* be fully closed before jettisoning.

PART IV

HANDLING

STARTING, TAXYING AND TAKE-OFF

90. **External checks**

(a) Before starting the external checks, look inside the front cockpit and ensure that the undercarriage selector lever is fully DOWN, and that there is sufficient brake pressure and oxygen. Ensure also that the control locks are removed.

(b) The outside of the aircraft should be checked systematically for obvious signs of damage and for security of panels, doors and mudguards. The main wheel oleo extensions should be checked for equality, the tyres for cuts and creep, and the brake leads for damage.

(c) The following specific checks should also be made:—

Starboard undercarriage bay	Ignition isolating switches on
Starboard wing	Engine intake free from obstruction Jet pipe for wrinkling and turbine for damage
Port wing	As for starboard wing Pressure head cover off
Port undercarriage bay	As for starboard undercarriage bay
Fuselage tank panels	Secure
Hood external release ring	Flap secure (not Mk. 14)
Undercarriage ground lock hook (behind window)	Engaged with pin

91. **Internal checks**

(a) Before entering the cockpit, check that a ground starter battery is plugged in and switched on.

(b) If the aircraft is being flown solo check the following items in the rear cockpit:

Crowbar	Secure
Chartboard	Secure
Oxygen supply	~~Turned~~ Supply off A.C.1
VHF supplies	ON
Mk. 4B compass	Variation ~~set~~ zero
Check all other essential circuit breakers	Made
GEE switches	OFF
REBECCA & RADIO COMPASS	OFF (~~Mk. 13 only~~) A.C.2
Generator field circuit-breakers	Made
Generator reset switches	ON (up)
Flight instrument switches	Normal (up)
Hood jettison handle	In
Asbestos gloves	Stowed
Hood rear hooks release toggle (not Mk. 14)	In correct position
Fire-extinguisher	Secure
Seat straps	Secure
First-aid kit	Stowed

(c) *Front cockpit checks*
(Start at the left and work round to the right).

Hood and windscreen	Absence of cracks Check hood warning light before closing hood (post-mod. 5861)
Hood	NF 14—As required NF 11, 12 and 13—Closed and locked Handle in correct position Warning light out (post-mod. 5861)
Oxygen selector valve	ECON. (Type H mask) P.B. (Type J mask)

Crowbar/Screwdriver	Secure
Brake supply pressure	Sufficient
Port hood lock indicator (Mk. 14)	Pointers in line
Port LP cock	ON
Port HP cock	OFF
Balance cock	Closed
Elevator and rudder trimmers	Full and correct movement
Throttles	Closed
Cockpit pressure control	As required
Refrigeration control (if fitted)	Off
Airbrake selector lever	Select OUT and IN
LP booster pump circuit breakers	On individually. Check aurally
Flap selector lever	Check operation. Exhaust accumulator and test hand-pump. Select UP
Undercarriage selecter lever	Fully DOWN
Fuel transfer lever	Pre-mod. 44— Turn to WINGS ON Post-mod. 44— Confirm wire-locked at ALL ON, or VENTRAL ON if wing tanks not fitted.
Fuel transfer warning light	On
Fire warning lights	Out
Fuel	Check contents
Undercarriage indicator	Three green lights Check bulb changeover Red warning light out
Hood magnetic indicator (Mk. 14)	White
Hood jettison handle	In

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Generator failure lights	On
De-mister booster switch	OFF
Oxygen	ON Contents
Heat control	OFF
De-mist control	OFF
Pressure head heater switch	ON
Internal and external lights	Test and set as required Rear navigation light switch (if fitted) ON
Cockpit emergency lamp	Test
Undercarriage emergency air control	Handle in
VHF and intercomm. switches	As required
Cockpit pressure warning switch	ON
Battery isolating switch	ON
Harness release	Test
Wing drop tanks jettison lever	Forward
Windscreen de-icer control	Plunger in
Starboard hood lock indicator (Mk. 14)	Pointers in line
Hood lock indicator (not Mk. 14)	Corresponding to hood position
Hood rear hooks release toggle (not Mk. 14)	In correct position
Starboard HP cock	OFF
Starboard LP cock	ON
Mk 4B compass control	Wire-locked on
Footsteps	Retracted (check with ground-crew)

92. **Starting the engines**

(a) *Pre-starting checks*

Confirm the following:—

LP cocks	ON
HP cocks	OFF
Throttles	Closed
Booster-pumps circuit-breakers	Made

(b) *Starting*

NOTE.—1. The aircraft batteries may be used for starting an engine but this imposes an undesirably severe load on them and is *not* recommended as normal practice.

2. If an engine fails to start after two attempts the cause should be investigated before making further attempts.

(i) Press the starter pushbutton of the selected engine and release it after two seconds.

(ii) When the undercarriage lights dim, move the HP cock to the half-open position. When r.p.m. increase, the cock should be moved slowly to the fully-open position. The engine should accelerate to idling r.p.m. with the throttle closed. The exhaust temperature may momentarily exceed the idling limit but it should settle down to not more than 500° C. The throttle must not be opened before idling r.p.m. are attained.

(iii) If the HP cock is moved too quickly from the half to the fully-open position, resonance and overheating may occur. If excessive exhaust temperatures and resonance persist, close the HP cock to stop the engine. Excess fuel must have drained off before another start is attempted.

(iv) If an engine fails to light-up, proceed as follows:—

1. Turn off the HP cock.
2. Have the appropriate isolating switches set to off.
3. Ensure that the impeller has stopped turning. Wait until the fuel has stopped draining from the nacelle and then dry out the engine by carrying out the starting cycle with the HP cock in the OFF position.

4. When the impeller has again stopped turning have the ground crew remove any surplus fuel from the jet pipes.
5. Have the isolating switches set on.
6. Carry out the normal engine start procedure.

WARNING.—*Derwent 9 engines.* When charged, the capacitor in the high energy ignition unit possesses a lethal voltage. The unit must be isolated and at least one minute allowed to elapse, before the ground crew make adjustments in the vicinity of the unit.

(v) Simultaneous starting of both engines is not permissible but, when for operational purposes it is necessary to start the engines with minimum delay, the starter pushbutton of the second engine may be pressed not less than 5 seconds after the starter pushbutton for the first engine has been released.

(vi) Air in the hydraulic system may cause a severe hammering noise when the starboard engine winds up. This should disappear when one of the hydraulic services is operated.

(vii) When both engines are running at idling r.p.m. and not before, have the ground/flight switch placed to FLIGHT and the ground starter battery disconnected in that order.

93. **Checks after starting**

Engine fire-warning lights	Out
Idling r.p.m.	3,300 to 3,700
J.p.t.	Max. 500° C.
Oil pressure	5 lb./sq. in. (min.)
Air pressure	200 lb./sq. in. (minimum for taxying)
VHF/UHF	Set and channel selected Changeover switch as required Intercomm. switch NORMAL
Generator warning lights	Out at approx. 6,000 r.p.m.

Airbrakes	Operate and check visually
Flaps	Check flap has come up Return lever to neutral
Instruments	Check and set Synchronise Mk. 4B compass and compare with E2A

94. **Taxying**

(a) Considerable power is necessary to move forward initially. At normal taxying speeds gentle turns can be made by using the engines but a combination of engine and brake is required to make small-radius turns.

(b) The throttles should not be opened rapidly as this may cause over-fuelling and excessive j.p.t.

(c) When taxying, fuel consumption is about 1 gallon per minute per engine at idling r.p.m.

(d) The hood magnetic indicator (Mk. 14) may remain white whilst taxying but should go black when the generators cut in.

95. **Checks before take-off**

Trims	Neutral
Airbrakes	IN. Check visually
Fuel	Contents. Balance cock closed. HP and LP cocks fully ON Booster-pumps on.
Fuel transfer	Pre-mod. 44—WINGS ON Post-mod. 44—ALL ON or VENTRAL ON if wing tanks not fitted
Flaps	As required
Instruments	Check and set
Oxygen	On and reaching mask
Hood	Closed and locked Warning light out (post-mod. 5861) Magnetic indicator black (Mk. 14)

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Harnesses	Tight and locked
Controls	Full and correct movement
Yaw damper (if fitted)	STANDBY or OFF

96. Take-off

(a) It is recommended that one-quarter flap be used when wing tanks are fitted.

(b) Align the aircraft on the runway with the nosewheel straight, release the brakes and open the throttle smoothly to take-off r.p.m. At full throttle check r.p.m. 14,550, j.p.t. not exceeding 680°C. and oil pressure above 30 lb./sq. in. (Mk. 14 aircraft check hood magnetic indicator is black). Normally there is no tendency to swing but if the take-off is out of wind it may be necessary to use brake to keep straight initially. The rudder becomes effective at about 70 knots. A shorter take-off run is obtained by running up to 13,500 r.p.m. before releasing the brakes.

(c) The nosewheel should be raised at about 100 knots. At moderate loads the aircraft may be flown off at 120–125 knots.

(d) Safety speed is 160 knots.

97. Checks after take-off

(a) When comfortably airborne, brake the wheels and then retract the undercarriage. To avoid risk of damaging the undercarriage, ensure that retraction is completed before reaching 175 knots.

(b) When safety speed has been attained, raise the flaps (if used), returning the selector to NEUTRAL. If drop tanks are fitted, check that the fuel transfer warning light is out.

(c) Ensure that the cabin pressure control is selected to PRESS; heating or refrigeration as required. Select demister control ON if required.

(d) Unless it is necessary to clear obstacles allow the speed to reach 285 knots before starting the climb. As the aircraft accelerates to climbing speed there is a progressive nose-up change of trim.

(e) Once settled on the climb, switch on the yaw damper and check its serviceability by moving the rudder. If serviceable, the yaw damper should cause the aircraft to regain its previous flight path within three cycles. If uncontrolled directional oscillations are noticed, at any stage of the flight, the yaw damper must be switched OFF and left OFF for the remainder of the flight.

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HANDLING IN FLIGHT

98. Climbing

(a) Climb at full power within the j.p.t. limitations. The following climbing speeds are recommended, with or without drop tanks fitted:—

285 knots at sea level, progressively reducing by 15 knots per 10,000 feet, until 0.63M is reached. Thereafter maintain 0.63M.

(b) If maximum rate of climb is not essential climb at 14,100 r.p.m. using the same airspeeds. Throttle adjustments will be necessary to maintain this power setting.

(c) Particular care must be taken to maintain the correct climbing speed at altitude or a considerable increase in time to height will result.

(d) For cruise climb information, see Part VII Operating Data.

98A. Compressor surge

Compressor surge can occur at high altitude and low IAS. The indications of surge are a muffled " thumping ", fluctuating r.p.m., and a rise in j.p.t. If surging occurs, throttle back the affected engine and increase speed.

99. General flying characteristics

(a) *Flying controls*

(i) *Ailerons*. The control forces increase from light at low speeds to heavy at high speeds. Large control column movements are required for effective control at low airspeed.

(ii) *Elevators*. At medium and high speeds the elevators are sensitive and effective. At low airspeeds they become less sensitive but are effective down to the stall. The control forces are moderate at low speeds becoming heavy as speed is increased.

(iii) *Rudder*. Control forces on the rudder become very heavy at high speed and also with large deflections at low speeds. Sustained asymmetric flight at low airspeed can therefore be very tiring.

(b) *Trimming controls*

NOTE.—The elevator and rudder trimmers may ice up at height. Exercising the trimmers at regular intervals will help to prevent this happening. If necessary reduce height until they can be freed.

(i) *Elevator trimmer*. The elevator trimmer is spongy in operation but very effective and the aircraft is easy to trim under most conditions of flight.

(ii) *Rudder trimmer*. The rudder trimmer is awkward to operate but is effective at high airspeeds. At full power rudder forces can be trimmed out at approximately 280 knots and above.

(c) *Airbrakes*

The airbrakes may be used at any speed, and at high speeds they are very effective. Their use induces general airframe buffeting which increases with speed; at high airspeeds slight rudder kicking may be felt. When descending with airbrakes out and throttles closed, the rate of descent is high and altimeter errors will be considerable. Before closing the airbrakes the angle of dive should be reduced.

(d) *Changes of trim*

Increase in power	Strong nose-up
Increase in speed	Strong nose-up
Flaps down	Nose down (large area flaps) Slight nose up (small area flaps)
Undercarriage down	Slight nose-down
Airbrakes out	No change

100. Flying at reduced speeds

(a) Reduce speed to 160 knots and lower one-quarter flap.

(b) It is recommended that the DV panel should not be opened above 200 knots as the noise level is high.

101. Flying in severe turbulence

The recommended speed for flying in conditions of severe turbulence is 240 knots up to the height at which this corresponds to a mach number of 0.5. Above this height 0.5M should be maintained provided that this does not require an airspeed of less than 175 knots.

102. Stalling and spinning

(a) The approximate stalling speeds, in knots, power off, are:—

Weight	Undercarriage and flaps up	Undercarriage and flaps down
Maximum landing weight (16,000 lb.)	115	100
Typical service load (18,700 lb.)	120	105
Maximum A.U.W. (20,500 lb.)	125	110

(b) Warning of the approach of the stall is given by:—

(i) Slight elevator buffeting some 10 knots before the stall, becoming more pronounced as the stall approaches.

(ii) Slight fore and aft pitching accompanied by vibration before the aircraft stalls.

Immediately before the stall pronounced aileron snatching occurs. As the aircraft stalls the nose falls gently and either wing may drop. Recovery is straightforward, but considerable height may be lost.

(c) Use of airbrakes causes general airframe buffeting, but otherwise does not affect the stall.

(d) Warning of the approach to the stall when G is applied, is given by general airframe buffeting which increases as the control column is moved back and is accompanied by a large loss of speed. At the stall either wing may drop fairly quickly. Recovery is immediate when the back-pressure is released.

(e) Should an accidental spin occur, normal recovery action is effective. Behaviour in the spin is unpleasant; severe oscillation in yaw and pitch must be expected and heavy forces may develop.

103. High speed flying

(a) *General*

The high mach number characteristics vary between individual aircraft and, generally speaking, become worse with age and deterioration of the external finish. The investigation of an aircraft's performance should be carried out

progressively until its high-speed characteristics are established and the limitations quoted in para. 61 must not be exceeded intentionally.

(b) *Sea level–10,000 ft.*

With or without wing drop tanks the aircraft can be flown up to the maximum permissible airspeed without encountering any compressibility effects.

(c) *Above 10,000 ft.*

(i) *With ventral tank only.* As speed is increased there is a slight nose-up change of trim. At 0.78M the flying controls become very heavy and general airframe buffeting commences. At about 0.79M either wing may drop slowly necessitating a very strong restraining force. Moderate rudder buffeting commences at 0.81M and porpoising may occur. At this stage the control forces are so heavy that 0.81M is the practical limit to which the aircraft can be flown.

(ii) *Wing drop tanks fitted.* Buffeting commences at about 0.73M and increases up to the maximum permissible mach number. Wing dropping begins at about 0.74M, but can be held with aileron until at 0.76M marked aileron snatching makes control more difficult.

(d) *Recovery from high speed dives*

Deceleration should be initiated by first selecting airbrakes out and then throttling back. There is a slight nose-down trim change as the airbrakes are extended. Application of high positive G may delay the recovery.

(e) *Pull ups at high speed*

If the aircraft is out of trim (nose-up) and a heavy pull force is applied for pull-up at high speeds, excessive G may be induced resulting in structural damage. For this reason stick forces must be trimmed out up to the maximum speed attained and great care exercised when applying pull-forces at high speeds.

104. **Aerobatics**

(a) Aerobatics are prohibited if wing drop tanks are fitted, full or empty.

(b) Until experience is gained the following speeds, in knots, are recommended:—

Roll	250
Loop	350
Roll off	350
Climbing roll	400

(c) In manœuvres in the looping plane much height may be gained or lost and an ample margin must always be allowed for regaining normal flight. With experience entry speeds can be reduced considerably.

NOTE.—The negative G traps in the main tanks ensure a supply of fuel for 15 seconds inverted flight: this should not be exceeded owing to the possibility of oil starvation.

105. **Descent**

(a) *Gliding descent*

Glide at 180–190 knots at all heights for maximum range. The distance covered in the glide will be approximately 2 miles per 1,000 feet of height lost.

(b) *Normal rate*

Set 11,000 r.p.m. (12,500 asymmetric), airbrakes out, 0.7M into 250 knots and maintain 250 knots. The rate of descent will be 4,500–5,000 ft. per minute.

(c) *Maximum rate*

Set throttles closed, airbrakes out, and maintain 0.7M into 300 knots. The rate of descent will be approximately 15,000–20,000 ft. per minute and altimeter errors will be considerable. This descent is normally only used in cases of operational necessity and misting may be considerable at lower altitudes largely owing to the low windscreen-demisting air flow. An additional reserve of fuel should be kept to give time to clear the misting.

(d) For further descent information see Part VII Operating Data.

106. **Endurance**

If it becomes necessary to fly for best endurance, the following broad rules should be applied:—

(a) If at 25,000 feet or above, maintain height.

(b) Below 25,000 feet, with 300 gallons or more remaining, climb to 25,000 feet.

(c) Below 25,000 feet, with less than 300 gallons, use only one engine and do not climb.

CIRCUIT PROCEDURE AND LANDING

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107. Joining circuit

(a) 30 gallons of fuel per engine should be allowed for the circuit and landing.

(b) Reduce speed to 200 knots, select one quarter flap and set 10,500 r.p.m. to give a speed of 170 knots downwind.

108. Checks before landing

WARNING.—If the aircraft is yawed at speeds below 170 knots with the airbrakes out, the nose may drop suddenly and the elevators become ineffective until the yaw is removed, or the airbrakes retracted. The tendency is aggravated if a ventral tank is fitted. Airbrakes should not be used at airspeeds below 170 knots at circuit height and should be in before the undercarriage is lowered.

Airbrakes	IN
Undercarriage	Down below 175 knots Lever fully down
Flaps	One quarter down
Fuel	Contents. Balance cock as required
Harnesses	Locked and tight
Undercarriage indicator	Three green lights
Brakes	Pressure. Operation. OFF. Exhausted.

109. Approach and landing

(a) Turn across wind at 150 knots with approximately 9,000 r.p.m. selected. Lower full flap when required and start the final approach at 125 knots. To ensure

immediate engine response maintain at least 7,000 r.p.m. until the runway threshold is within reach. Reduce the speed progressively and cross the runway threshold at A.L.3 110 knots at maximum landing weight (see para. 62 for loads to give max. landing weight).

(b) The landing is straightforward and presents little difficulty.

(c) To achieve aerodynamic braking, hold the nosewheel off the runway but avoid an excessive nose-up attitude as the elevator remains effective down to about 80–90 knots and it is possible to strike the tail on the ground. When the nosewheel is on the ground, apply brake progressively and continuously. If it is essential to obtain the shortest landing run, lower the nosewheel on to the runway shortly after touch down and apply full brake holding it on continuously. If landing on a wet runway intermittent braking is more effective as there is less likelihood of the wheels locking when using this method.

110. Instrument approach

(a) The following speeds, flap settings and approximate power settings are recommended for use during instrument approaches with the undercarriage lowered.

	R.p.m.	Flaps	Airspeed
Downwind	11,500	One-quarter	150–155
Base leg	11,500	One-half	140–145
Glide path	11,500	Full flap	130–135

(b) When making an asymmetric approach, the above r.p.m. should be increased by about 1,500. It is recommended that the undercarriage is left up until approaching the glide path but it should be down and locked before starting the descent.

111. Crosswind landing

The "crab" technique should be used for crosswind landings. Use the normal threshold speeds. Kick off the drift and place the aircraft firmly on the ground. Some differential braking may be required to keep straight.

112. **Flapless landing**

Maintain 150 knots crosswind with throttles set to 7,000 r.p.m. On turning into wind, allow the speed to fall to 130 knots, maintaining this speed until near the runway threshold. Close the throttles and cross the threshold at 120–125 knots. Speed drops off slowly and the aircraft requires a long landing run. If necessary, the landing run may be reduced by turning off the HP cocks immediately after touchdown.

113. **Going round again**

(a) The power required and the fuel used depends on when the decision to go round again is taken. If the decision is made on the approach at approximately 300 feet and it is essential to conserve fuel, the use of 12,000 to 13,000 r.p.m. will be sufficient. Going round again under these conditions requires approximately 15 gallons of fuel. Going round again after touchdown is straightforward: use full power initially. The fuel consumption in this case is higher and approximately 30 gallons of fuel should be allowed for the complete circuit.

(b) In all cases:—

(i) Open up smoothly to the required r.p.m.

(ii) At a safe height raise the undercarriage and flaps.

(iii) After reaching 160 knots start climbing and adjust power as required.

114. **Night flying**

Cockpit lighting is good, and night flying presents no difficulties.

115. **Checks after landing**

Brakes	Pressure sufficient for taxying (200 lb./sq. in. min.)
Flaps	UP
Refrigeration	OFF
Pressurisation	OFF
Heating and demister	OFF
Pressure head heater	OFF
Oxygen	OFF
Yaw Damper	STANDBY or OFF

116. **Stopping the engines**

(a) Stop the engines by turning off the HP cocks.

(b) After the engines have stopped, check:—

Booster-pumps circuit-breakers	Tripped
Balance cock	Up
VHF	OFF
~~Generator reset switches and field circuit-breakers~~	~~Trip~~
Chocks	In position
Brakes	Off
Ground/flight switch	GROUND

NOTE.—It is important to ensure that the engines have stopped turning before putting the ground/flight switch to GROUND: if this is not done the j.p.t. gauges may be damaged.

ASYMMETRIC FLYING

NOTE.—It must be remembered that the hydraulic pump is on the starboard engine and all the hydraulic services may be operated normally if the starboard engine is running. If it is stopped the hydraulic accumulator will only provide sufficient pressure to lower the undercarriage and flaps fully and to operate the airbrakes open and closed once.

117. **Stopping an engine in flight**

To stop an engine in flight set:—

Throttle	Closed
HP cock	OFF
Booster-pump circuit-breaker	Trip
Balance cock	As required
LP cock	Leave ON
Electrical loads	Within safe limits

118. Single-engined flying

Single-engine performance is very good and after the rudder force has been trimmed out the aircraft handles easily. The maximum speed attainable at sea level with ventral drop tank fitted is approximately 330 knots. When using full power the rudder force can be trimmed out at 270 knots and above. The minimum speed at which the aircraft can be kept straight at sea level with wings level using full power is 150 knots; control can be maintained down to 140 knots if 5°–10° of bank is applied towards the live engine. Small angles of bank may be used to relieve foot loads at any speed below 270 knots.

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119. Single-engined circuit and landing

(a) A single-engined landing presents little difficulty. Make a normal circuit, lowering the undercarriage and one-quarter flap in the normal position. Maintain 150 knots across wind until on the final approach with approximately 11,000 r.p.m. set. Do not lower full flap until a decision to land has been made. Reduce speed on the final approach and use the normal threshold speeds.

(b) *Single-engined overshoot*

(i) 1. *Starboard engine failed.* Leave the undercarriage down but raise the flaps. Climb away initially at 165 knots.

2. *Port engine failed.* Raise both the undercarriage and flaps. Climb away initially at 185 knots.

(ii) Lower the nose to gain speed, at the same time increasing power. Going round again from 150 knots in the above configuration involves no loss of height. The foot loads in the overshoot are very heavy.

120. Landing with asymmetric load

(a) If a wing drop tank fails to jettison, ample aileron control will be available even at the stalling speed. The force necessary to maintain wings level increases with speed and above 260 knots is heavy. This applies whether the tank is full or empty, and whether flying on one or two engines.

(b) Make a normal circuit and landing. If the tank is full the landing run will be longer since a degree of differential braking will be necessary to keep the aircraft straight.

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121. Restarting an engine in flight

(a) *Recommended heights and speeds*

(i) Derwent Mk. 8:—

Height: Below 20,000 feet

Speed: To give 1,000–1,200 r.p.m.

NOTE 1.—If Derwent Mods. 395, 477, 528 are not embodied, the maximum height for relighting is 15,000 feet.

2.—An abortive attempt to relight above these limits will jeopardise subsequent attempts.

3.—Booster coil life is prolonged if frequent practice relighting is restricted to below 15,000 feet.

(ii) Derwent Mk. 9:—

Height: Up to 25,000 feet.

Speed: No airspeed limit up to 20,000 feet.
230 kts. maximum between 20,000–25,000 feet.

NOTE.—Abortive attempts to relight above these limits should not affect subsequent attempts.

(b) *Cockpit checks*

Booster-pump circuit-breaker	Made
LP cock	ON
HP cock	OFF
Throttle (Derwent Mk. 8)	One-third open
Throttle (Derwent Mk. 9)	Closed

(c) *Procedure*

NOTE.—The normal engine starting system must *never* be used in flight.

Press the relight button and (after five seconds with the Derwent Mk. 8 / immediately with the Derwent Mk. 9) open the HP cock keeping the button depressed. When 2,000 r.p.m. is indicated release the relight button and, Mk. 8, close the throttle fully. If the engine fails to relight within 30 seconds release the button, close the HP cock and wait at least one minute before any further attempt. The next attempt should be at a lower height and airspeed and, with the Derwent Mk. 8, a wider throttle opening.

PART V

EMERGENCY HANDLING

122. **Engine failure during take-off**

NOTE.—The safety speed is 160 knots.

(a) *Engine failure below 140 knots*

If an engine cuts below 140 knots the aircraft will yaw violently and roll rapidly towards the dead engine. Close both throttles and regain control by coarse use of rudder and aileron. Jettison the drop tanks, if fitted. It is recommended that the aircraft be landed straight ahead.

(b) *Engine failure between 140 and 160 knots*

If an engine fails between 140 and 160 knots reduce the throttle setting and use coarse rudder and aileron to regain level flight. Once level flight has been regained, open up the live engine to full power. The aircraft will climb slowly at 145 knots using full power. The rudder forces are extremely heavy and the use of 5°–10° of bank will help lighten the foot loads; the use of greater angles of bank will adversely affect the climb. Allow the speed to increase to 200 knots as soon as possible.

(c) *Engine failure above safety speed*

Use rudder and aileron as required to maintain level flight. Allow the speed to increase to 200 knots and climb.

123. **Engine failure in flight**

(a) If an engine fails in flight because of an obvious mechanical defect do not attempt to relight but carry out the following drill:—

HP cock	OFF
LP cock	OFF
Booster-pump circuit-breaker	Tripped
Balance cock	As required

(b) When engine failure has occurred due to flame extinction, do not turn off the LP cock, as this will cause damage to the fuel pump and BPC. Reduce electrical loads to within safe limits and carry out relighting drill as in para 121.

124. **Action in the event of engine fire**

If an engine fire warning light comes on close the throttle immediately and set:—

HP cock	OFF
LP cock	OFF
Booster-pump circuit-breaker	Tripped

Reduce speed to a safe minimum. Then press the extinguisher button. The engine must not be restarted owing to the risk of a further fire with the extinguisher exhausted. Should the fire persist abandon the aircraft.

125. **Action in the event of double generator failure**

In the unlikely event of both generators failing all electrical services will be supplied by the batteries. All non-essential loads, including the LP booster-pumps must be switched off and, depending on circumstances, an early landing is recommended.

126. **Action in the event of pressurisation failure**

(a) If the aircraft is fitted with a Mk. 11 regulator check HIGH selected on both regulators if above 25,000 feet.

(b) If the aircraft is above 35,000, whatever regulator, select EMERGENCY oxygen and descend as rapidly as possible to below 35,000 ft. Whilst above 35,000 ft., if wearing P.B.-type masks, select the mask exhale valve to H to inflate the pressure breathing waistcoat.

(c) If the failure is due to loss of air supply all heating and demisting will be lost and an early return is advisable.

127. **Action in the event of hood opening in flight (NF 11, 12 and 13)**

If the hood opens inadvertently in flight do not jettison it as the control surfaces would be damaged. Correct the strong yaw to starboard by rudder and differential use of the engines. Reduce speed to at least 200 knots as quickly as possible. Below this speed, adequate control can be maintained and a normal landing made.

128. **Hood jettisoning**

(a) *NF. 11, 12 and 13*

(i) *In the air.* Reduce speed as much as possible. Then check:—

Seats	Fully lowered
Gunsight	Lowered
Harnesses	Tight and locked
Helmets	Strap fastened and tight

Before jettisoning the hood assume a position with head well forward and down. Pull the jettison handle in either cockpit to the full extent.

NOTE.—Unless the aircraft is being flown solo reduce speed to 150 knots before jettisoning the hood; above 250 knots there is a risk of the observer being injured by the sudden air buffeting. When flown solo the hood can be safely jettisoned up to 250 knots

(ii) *On the ground.* If the hood has jammed and it cannot be opened either normally or by use of the toggles, pull the jettison handle to its fullest extent and release it immediately. Push the hood off to starboard.

(iii) *General.* If time permits the hood should be jettisoned in the air before a crash landing or ditching.

(b) *NF. 14*

(i) *In the air*

1. Tests indicate that the hood should jettison satisfactorily at speeds between 135 and 220 knots. At speeds of 135 knots and above the hood will probably jettison satisfactorily in straight flight but may pass rather near to the tail in yawed flight. At speeds between 180 and 220 knots the hood will probably break up on jettisoning.
2. Before jettisoning, helmets should be adjusted and harnesses tightened, seats lowered fully and heads kept well down and forward. *The hood must only be jettisoned from the fully closed position.*

(ii) *On the ground.* The jettison handle should not be used on the ground unless the normal method of

opening the hood fails. If the jettison handle is used the hood can be lifted by pivoting it about the rear trolley.

129. **External fuel tanks jettisoning**

(a) *Wing drop tanks*

Reduce speed to below 350 knots, post-mod. 5259 (260 knots pre-mod. 5259), and pull back the jettison lever. A strong control force will be required to keep the wings level at the moment of release, should one tank hang up. If Fighter Command mod. 44 is embodied, the drop tank control must be moved to VENTRAL ON after jettisoning the wing tanks.

(b) *Ventral drop tank*

Reduce speed to below 345 knots and pull the jettison handle on the left-hand side of the instrument panel.

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130. **Abandoning aircraft in flight**

(a) *General*

Reduce speed as much as possible, jettison the hood and abandon the aircraft by diving over the inboard trailing edge of the wing. The airbrakes must be in before the aircraft is abandoned and, if on asymmetric power, the live engine should be closed down and the aircraft retrimmed, if possible.

(b) *NF. 11, 12, and 13*

The hood opening strut remains on the aircraft after the hood has been jettisoned and forms a considerable obstruction on the starboard side for the occupant of the front seat. Therefore, unless the aircraft is in a spin to the left, the pilot should leave the aircraft on the port side. Do not attempt to abandon the aircraft by dropping out from the inverted position.

(c) *NF. 14*

There is a vent on the port side of the rear fuselage which could prove a hazard when abandoning the aircraft. The aircraft should therefore always be abandoned, if possible, by diving over the inboard trailing edge of the starboard wing unless in a spin to the right. Do not attempt to abandon the aircraft by dropping out from an inverted position.

(d) *TT 20*

The TT20 has a winch on the inboard end of the starboard wing and, therefore, *both* crew members should abandon the aircraft on the port side.

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131. Forced landing without power

(a) Experience suggests that it is preferable to lower the undercarriage when making a forced landing. In the down position, it absorbs much if not all of the initial impact, assists in retarding the aircraft and it may be retracted after touchdown if necessary. Ventral and wing drop tanks should be jettisoned at an early stage.

(b) The best gliding speed is 180–190 knots. The rate of descent with undercarriage down flaps up, at this speed, is approximately 2,500 ft./min.

(c) If forced landing on an airfield aim to be at 2,000 ft. at the end of the downwind leg opposite the caravan.

(d) Maintain 150 knots crosswind; lower full flap when required (be prepared to pump the flaps down). Cross the threshold at 120 knots.

(e) Carry out the following actions during the circuit:—

Airbrakes	IN
Undercarriage	Down below 175 knots Lever fully down
Fuel	HP and LP cocks OFF
Flaps	As required
Harnesses	Seat harnesses tight and locked Parachute harness and dinghy released
Undercarriage indicator	Three green lights
Brakes	Pressure. Off
Hood	Jettison (at pilot's discretion)

132. Ditching

Tests indicate that in calm weather the aircraft should ditch well.

(a) Jettison the wing and ventral tanks.

(b) Tighten the seat harness, fasten and tighten the helmet strap and release the parachute harness.

(c) Jettison the hood.

(d) Make a normal powered approach with the undercarriage up and full flap selected. Flatten out the approach just before touchdown to keep the rate of descent to a minimum. Ditch along the swell or, if the swell is not steep, into wind.

133. Controlled descent through cloud with an unserviceable ASI

A guide to making a safe descent without an ASI is given below:—

Condition of flight	Settings	Speed attained (knots)
Fast rate of descent	11,000 r.p.m. Airbrakes OUT 3,500 ft/min on VSI	230±10
Slow rate of descent	11,000 r.p.m. Airbrakes OUT One-quarter flap 1,000 ft/min on VSI	170±10
Level flight at 1,500 ft.	11,000 r.p.m. Airbrakes IN One-quarter flap	170±10
Final descent	11,000 r.p.m. Undercarriage down Three-quarters flap 700 ft/min on VSI	135±10

134. Undercarriage—emergency lowering

The undercarriage system may not operate normally owing to temporary malfunctioning, see para. 82. It may also not operate owing to mechanical failure. In any event, if all else fails, the undercarriage can be lowered by emergency air which is released by pulling the handle on the front cockpit starboard wall.

PART VI

TARGET TOWING & METEOR TT20

METEOR NF 11, 12, 13 AND 14

135. **Introduction**

Some standard Meteor NF aircraft are modified for target towing. The towing gear itself consists of a hook and release unit installed in the aft end of the ventral tank. The clearance permits towing of 30 feet banner targets with cable lengths up to 1,000 feet. Either drag or snatch take-off techniques may be used.

136. **Controls**

(a) The target release unit is operated from the camera button on the control column after first setting the gun safety catch to FIRE. As the gun firing circuit would otherwise then be live, an additional isolating switch is introduced. This switch, marked TARGET TOWING, ON/OFF, is immediately forward of the downward ident. light switch on the front cockpit starboard wall. The switch has two positions and when ON (up) breaks the gun circuit and makes the target release circuit.

(b) If the normal release unit fails, the target and cable may be dropped by jettisoning the ventral tank (by pulling out the external tanks T-handle).

137. **Limitations**

(a) Maximum towing speed is 260 knots (target limitation).

(b) Maximum turn when towing is Rate 1.

138. **Normal handling**

With trim set to neutral and one-quarter flap, the throttles should be opened to 13,000 r.p.m. before releasing the brakes. The stick must be pulled hard back to raise the

nose, which comes off the ground at 115 knots with wing-tanks fitted and 105 knots without. The unstick speeds are 125–130 knots with wing-tanks fitted and 115 knots without and climb-away speeds are 140 knots and 135 knots respectively.

NOTE.—The climb is below full power critical and safety speeds. The ventral must therefore be jettisoned immediately should there be any engine failure.

(b) *Climb*

The recommended climbing speed is 200 knots at sea level, reducing by 1 knot per 1,000 feet.

(c) *Cruising*

With the target in tow, handling characteristics are normal in straight and level flight and in turns but, to ensure adequate clearance between the cable and the aircraft, turns must not exceed Rate 1. The behaviour of the target is unreliable above 250 knots and this is therefore the limiting speed. Target oscillation is indicated by a gentle tugging motion and if this is felt at any time speed should be reduced until the instability ceases.

(d) *Descent*

Descents with the target on tow are best made at 200 knots, using 11,000 r.p.m. and with air brakes out.

(e) *Approaching and dropping*

Start the approach for target dropping at a height of 1,000 feet and a speed of 150 knots using one-quarter flap, dropping the target at 500 feet and 140 knots. At low speeds the nose of the aircraft obscures the forward and downward view and care has to be exercised while releasing the target.

139. **Performance**

(a) *Take-off distances*

The following tables give the calculated take-off distances, in yards, from a level runway at sea level in conditions of nil wind.

NOTE.—1. For the drag take-off case the distances apply from the initial target position.

2. For the snatch take-off case the distances apply from the initial aircraft position.

140. **Emergency handling**—see also Part V

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(a) If the target breaks away in flight speed should be kept below 200 knots. When dropping the broken cable do so from a rather greater height than usual.

(b) If the target fails to release normally the ventral tank must be jettisoned.

(c) The target and tow cable *must* be jettisoned before abandoning the aircraft, forced landing or ditching.

(d) Should an engine fail, or even partial loss of thrust be experienced, during the initial low-speed climb the ventral tank, i.e. the tow, *must* be jettisoned as quickly as possible after regaining control, see para. 122.

METEOR TT20

NOTE.—The following paras., 141–150, are supplementary to and should be read in conjunction with those paras. dealing with the Meteor NF 11.

141. **Introduction**

The Meteor TT20 is basically a modified NF 11, adapted to carry four sleeve targets which can be air launched successively. When Mods. 5944 and 5945 are embodied, the aircraft is also equipped to carry Dart targets.

142. **Main systems**

(a) The fuel system is identical with that in the NF 11, without F.C. Mod. 44 embodied. The TT 20 is cleared to use AVCAT as well as AVTAG and AVTUR.

(b) The hydraulic system is identical with that in the NF 11.

(c) The pneumatic and emergency air systems are identical with those in the NF 11.

(d) The engine services are identical with those in the NF 11.

(e) The electrical services are as follows:—

(i) The generation, control and distribution of d.c. power are the same as those in the NF 11.

(ii) The three-phase a.c. power supplies are the same as those in the NF 11 but, post Mod. 5951, the controls are moved to the front cockpit.

140. **Emergency handling**—see also Part V

(a) If the target breaks away in flight speed should be kept below 200 knots. When dropping the broken cable do so from a rather greater height than usual.

(b) If the target fails to release normally the ventral tank must be jettisoned.

(c) The target and tow cable *must* be jettisoned before abandoning the aircraft, forced landing or ditching.

(d) Should an engine fail, or even partial loss of thrust be experienced, during the initial low-speed climb the ventral tank, i.e. the tow, *must* be jettisoned as quickly as possible after regaining control, see para. 122.

METEOR TT20

NOTE.—The following paras., 141–149, are supplementary to and should be read in conjunction with those paras. dealing with the Meteor NF 11.

141. **Introduction**

The Meteor TT 20 is basically a modified NF 11 adapted to carry four sleeve targets which can be air launched successively. Later versions of the TT 20 may also be equipped for towing a dart target.

142. **Main systems**

(a) The fuel system is identical with that in the NF 11, pre-mod. 44. The TT 20 is cleared to use AVCAT as well as AVTAG and AVTUR.

(b) The hydraulic system is identical with that in the NF 11.

(c) The pneumatic and emergency air systems are identical with those in the NF 11.

(d) The engine services are identical with those in the NF 11.

(e) The electrical services are as follows:—

(i) The generation, control and distribution of d.c. power are the same as those in the NF 11.

(ii) The three-phase a.c. power supplies are the same as those in the NF 11.

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(iii) No single-phase a.c. power is provided in the TT 20.

(iv) Apart from a revised layout of the red floodlighting in the rear cockpit and the addition of electrically actuated aileron trimming, the airframe electrical services are the same as for the NF 11. The switches controlling certain items of equipment (e.g. camera) not fitted to the TT 20, and the associated cables, have not been removed but have been made inoperative.

143. Flying controls

The flying controls are similar to the NF 11 except that power operated aileron trimming has been added. A two-way electrical actuator is fitted in the port mainplane forward of the rear spar and coupled by mechanical linkage to the port geared trim tab mechanism. The actuator is controlled by a three-position switch (131) located on the top of the control column which is spring-loaded to the mid, OFF position. The switch works in the natural sense. The actuator does not directly control the trim tab but biases the tab datum. In this way the tab continues to act as a geared tab as well as an in-flight adjustable trimmer. An aileron trim master circuit-breaker (130) is on the front cockpit starboard coaming and a desynn aileron trim indicator (124) is fitted alongside the normal trim-wheels.

144. NF equipment not fitted to TT 20

The following standard Meteor NF equipment is not fitted to the TT 20:—

A.I. radar: Radar interrogator: IFF*: GEE.
Guns: Gunsight: Gun magazines: Gun feeds.
Camera and camera recorder.
AYF (the indicator may be in some aircraft but will be inoperative).

* On RAF aircraft, IFF and SIF are introduced by Mod. 5967. The controllers, master switch and I/P switch are on the port wall of the front cockpit.

145. Radio

(a) Pre-Mod. 5934, the VHF and intercomm. systems are the same as in the NF 11, except that the VHF will be TR 1934/35 instead of TR 1985/86 on Naval aircraft.

(b) (i) Mod. 5934 introduces UHF and standby instead of VHF. The control unit for the main set is in the position previously occupied by the G.G.S., while the aerial change-over switch is on the UHF panel, on the front cockpit starboard wall, above the external lights switches. The position of the pilot's normal press-to-transmit button is unchanged; the observer has a foot-operated button.

(ii) The standby UHF is controlled by a NORMAL-STANDBY change-over switch, a NORMAL-EMERGENCY power switch, a channel change-over switch and an EMERGENCY STANDBY press-to-transmit switch, all on the UHF panel. The standby emergency power is supplied by a 7 amp./hr. battery in the rear fuselage radio bay. An additional mic-tel socket, working from the standby set only, is supplied in the front cockpit. The endurance of the standby battery is approximately 20 minutes.

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(c) Naval Service Modification 3014 makes provision for VHF to be carried in addition to UHF. The UHF controls are as described in sub. para. (b). The two VHF control units are on the cockpit port wall, aft of the booster pump circuit breakers. A three-position UHF/VHF 1/VHF 2 changeover switch is on the starboard wall.

(d) Mod. 5975 introduces a VHF ferry kit for RAF aircraft. The UHF control unit is replaced by two VHF units and all but one of the UHF switches are made inoperative, the remaining switch being used as a VHF changeover switch. The UHF equipment is stowed in the nose section.

(e) (i) Pre-Naval Service Mod. 3019, ZBX homing is provided. The control unit and mixer switch are on the front cockpit port wall and a BEACON/RT switch is on the rear cockpit starboard wall. The control unit carries an OFF/NAV/VOICE switch, an OUTPUT volume control, a BEAT NOTE control and a channel selector. The RT/MIX/BEAC switch enables the pilot to select RT, RT and ZBX mixed or ZBX only. The BEACON/RT switch in the rear cockpit has no mixing facility.

(ii) Naval Service Mod. 3019 deletes ZBX and introduces ADF radio compass. The indicator is above the instrument panel in the front cockpit, to port of the UHF control unit. The control unit is on the starboard wall and an RT/MIX/ADF switch is on the port wall, forward of the booster pump circuit breakers.

146. Towing system

(a) A fully-feathering, electrically-controlled, variable-pitch, windmill-type winch is mounted on a faired pylon on the starboard mainplane between fuselage and engine nacelle. The winch contains a drum on which is wound some 6,100 feet of cable. The drum has an electro-magnetic braking system controlled automatically at either tow limit or by selection from the rear cockpit. From the rear of the winch a cable is routed via pulleys at the trailing edge and under the centre of the fuselage to a mechanical cable cutter. This cutter, which is for emergency use, is operated by T handles (129) (140) one in either cockpit. The cutter cable has some six inches of slack so that, when pulled, the handle hangs down to indicate cutter operated. From the cutter the cable goes to a spring-loaded shock absorber or buffer unit and thence to a releaser/exchanger unit. The four targets are carried in canisters fitted into the fuselage. The targets may be streamed singly and successively whilst airborne.

(b) Control of the winch and of the streaming and release of the targets is exercised from a control panel in the rear cockpit. From this panel the operator can select cable to be winched out or in and, subject to certain limitations, the speed of winching which is indicated on an r.p.m. meter (144). A veeder counter (144) records length of cable paid out. Three pairs of colour lights (143) inform the operator when the target is at, or is between, certain pre-set distances from the aircraft: these are normally:—

No lights:— target more than 200 feet
Amber lights:—target between 25 feet and 200 feet
Red lights:— target less than 25 feet
Green lights:— target fully in and the electro-magnetic brake on.

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The winch drum brake comes on automatically when the target is fully wound in: it may also be applied in emergency, regardless of target position, by a separate switch (147) on the panel.

(c) The targets are streamed from the control panel by mechanically interlocked switches (134) which ensure selection of 1–2–3–4 sequence. Magnetic indicators (138), normally showing white, show black when their corresponding targets are released.

(d) A SAAB hit/near-miss recording system may be installed in the TT20. This consists of a detector (a sensitive microphone attached to the target which will detect projectile shock waves), a transmitter also located at the target end of the cable, a special conductive towing cable, and a recorder unit (142) which is above the winch control panel.

(e) When the SAAB system is not in use, towing will be by standard 15-cwt. cable up to a maximum length of 6,000 feet.

(f) A streamlined fairing is provided to fit on the pylon when the winch is removed.

(g) (i) Mods. 5944, 5945 make provision for towing a Dart target. The target is carried below the fuselage, aft of the belly tank, with its lower fin folded to give adequate ground clearance for taxying and take-off.

(ii) An additional control panel is provided in the rear cockpit, to the left of the main panel. The panel carries LAUNCH and EMERGENCY LAUNCH (not all aircraft) switches, a FIN UNFOLD magnetic indicator (which shows white when the fin is folded) and a TARGET LAUNCHED magnetic indicator (which shows black when the target is launched).

(iii) Post-Mod. 5961, the emergency launch switch becomes the standby launch switch and the target launched magnetic indicator is deleted.

(iv) The target is launched by holding on the launch switch until both magnetic indicators show black. Operation of the switch first unfolds the fin and then releases the target.

(h) Mod. 5953 introduces mirrors on the engine nacelles which enable the operator to see if the target has been launched.

147. Limitations

(a) *Pylon only*

The TT 20 *must not* be flown unless either the winch or the fairing is fitted.

(b) *Winch fitted*

(i) The Meteor NF limitations, paras. 60, 61, 62, 64 and 65 apply to the TT20, except as follows:—

(ii) With the winch fitted, *with or without a target*, aerobatics and rolling pull-ups are prohibited and the aircraft is restricted to gentle manoeuvres only.

(iii) To prevent overheating of the engine bay, slow climbs at high r.p.m. should be avoided.

(iv) The maximum tow length is 6,000 feet.

(v) Winching in or out during the climb is prohibited.

(vi) The target release height is 600 feet above ground level.

(vii) The aircraft is cleared to operate in ambient temperatures of up to 1SA + 20°C.

(viii) *Speed limitations*

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Condition of flight	Sleeve target		Dart target	
	IAS (Kts)	IMN	IAS (Kts)	IMN
No target carried	390	0·65	390	0·65
Target carried but stowed ..	390	0·65	300	0·65
Launching target	130 ($\frac{1}{4}$ flap)	—	135 ($\frac{1}{3}$ flap)	—
Winching in or out	180	—	180	—
Target on tow (any length) ..	260	—	300	—
Releasing target	130	—	135	—

(c) *Fairing fitted*

(i) When the fairing is fitted the TT 20 is cleared to fly up to full Meteor NF limits as given in Part II except for maximum speeds

(ii) Maximum speeds, fairing fitted, are:—

390 knots	up to 10,000 feet
0.72M	10,000 to 20,000 feet
0.73M	20,000 to 30,000 feet
0.75M	above 30,000 feet

(d) *UHF limitations*

The main UHF set is cleared for operation up to an OAT of 40°C. The standby UHF has the following limitations:—

(i) No restriction on use at normal speeds at low altitude in temperate climates or above 10,000 feet in tropical climates.

(ii) Restricted to 8 minutes use when operating at high speeds at low altitudes in temperate climates.

(iii) Restricted to 8 minutes for all flight conditions below 10,000 feet in tropical climates.

148. Normal handling

(a) *Cockpit checks*

To the normal Meteor NF checks, see Part IV, add:—

(i) Internal—see para. 91.

Aileron trim circuit-breaker	Made
Aileron trim	Operate
ZBX control unit	On VOICE
ZBX junction box	On R/T
Cable cutter handles (both cockpits)	Fully in
Dart target magnetic indicators (rear cockpit)	Both white

(ii) Pre-take-off—see para. 95.

Aileron trim	Neutral
Winch master circuit-breaker (in rear cockpit)	Tripped

(b) *Climbing*

Climb at 280 knots, using 14,100 r.p.m. In order to prevent overheating by climbing at low speed and high r.p.m., targets must not be launched or winched during the climb.

(c) *Aileron trimmer*

The aileron trimmer is fast in operation but normally there is no need to use it. In the event of a runaway the forces are moderate and can be held easily up to the limiting speeds.

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(d) *Airbrakes*
Extension of airbrakes up to 300 knots causes a slight yaw to port and slight buffet. Above 300 knots the yaw becomes more severe and is accompanied by considerable buffet and lurching.

(e) *Changes of trim*
As speed is increased port rudder trim is required to maintain directional trim; at the limiting speeds some 3 divisions port rudder trim is required.

(f) *Stalling*
The stalling characteristics are generally similar to those of the NF 11; stalling speeds are comparable.

(g) *High-speed flying (with or without wing tanks)*
The installation makes no appreciable difference to the handling characteristics up to 0.5M or 300 knots. Above 0.5M general vibration develops into buffeting and an increased tendency to yaw to starboard. Buffeting becomes more severe as Mach number is increased.

(h) *Descents*
Descents with the target on tow should be made at 180 knots, using 10,000 r.p.m. and with the air-brakes IN. The rate of descent is approximately 1,000 ft./min. Winching in is permitted.

(j) *Towing a sleeve target*

(i) *Target streaming and winching*
Reduce speed to 130 knots with ¼ flap selected before streaming the target. When the target is streamed, increase speed to 180 knots and select flaps up. All winching should be done at 180 knots. Approximately 6½ minutes are required to winch 6,000 feet of cable out or in.

(ii) *Target on tow*
With the target on tow, speed must not exceed 260 knots. With 6,000 feet of cable streamed, the vertical separation, in feet, between target and towing aircraft is:—

Speed	Vertical separation
180	1,000
200	900
220	800
240	750
260	700

(iii) *Target dropping*
The target should be winched in to 200 feet (i.e. until amber lights come on), en route back to base. When approaching the dropping area, winch the target in to 25 feet, i.e. immediately the amber lights have changed to red lights. Reduce speed to 130 knots and reduce height to 600 feet. Approximately five seconds before the dropping point, start winching in. The target will automatically be released by the exchanger unit.

WARNING.—When towing with the target close-hauled, turns with flaps lowered must be avoided. Only select flaps down during the final stages of the run-in.

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(k) *Towing a dart target*

(i) When a dart target is carried or towed, no significant handling differences are apparent. Alterations to the technique are given below.

(ii) *Launching the target*
Reduce speed to 135 knots after lowering ¼ flap. When the operator has launched the target (confirmed by the magnetic indicators and in the nacelle mirror), speed may be increased to a maximum of 180 knots until the required amount of cable has been paid out.

(iii) *Target on tow*
With the target on tow, turns are limited to Rate 1 and 30° bank. The maximum speed is 300 knots. With 6,000 feet of cable paid out, the target flies 1,000 feet below the aircraft at 180 knots and 400 feet below at 300 knots.

(iv) *Releasing the target*
During the approach to the dropping area, the target should be hauled in to 200 feet. While in the dropping circuit, the target should be further hauled in to 25 feet and, when settled on a straight approach, ¼ flap should be lowered. Speed at this stage should be 135 knots and the height 600 feet above ground. At 5 seconds (350 yards) before the dropping point, start the winch so that the automatic release occurs as near as possible to the dropping point.

NOTE.—It is important that the aircraft speed should have exceeded 180 knots at some point of the sortie, otherwise the parachute will not deploy when the target is released.

149. Performance

(a) *Climb*
With the target stowed, and climbing at 280 knots, 14,100 r.p.m., the time from 2,000 feet to 10,000 feet is approximately 5 minutes.

(b) *Cruise*

(i) *Sleeve target*
The level speed performance at 5,000 feet with a sleeve target on a 6,000-foot tow length in I.S.A. conditions, is as follows:—

Speed (kts)	R.p.m.
180	12,000
200	12,200
220	12,700
240	13,200
260	13,600

(ii) *Dart target*
With a dart target on a tow length of 6,000 feet, the maximum continuous power setting (14,100 r.p.m.) gives a speed of just below 300 knots.

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(c) *Endurance*
The endurance figures shown below represent the estimated maximum safe time in the target area. The following assumptions are made:—
(i) Wing tanks are fitted and full.
(ii) Distance from base to target area is 30 nautical miles.
(iii) The target is launched and reeled in whilst en route to and from the target area.
(iv) The tow length is 6,000 feet, i.e. maximum.
(v) The reserve of fuel on return to base is 75/75 gallons.

Target	Towing speed (knots)	Maximum safe time (minutes)
Sleeve	180	55
	200	52
	210	50
	220	47
	230	43
	240	39
	250	36
	260	34
Dart	180	50
	290	30

NOTE.—If the target is paid out and reeled in over the target area, the above times will be reduced by at least 10 minutes.

150. Emergency handling

(a) *Engine failure during take-off*
Because of the asymmetric drag of the winch, safety speed with the starboard engine failed is 170 knots.

(b) *Loss of target in flight*
(i) If the first target, or part of it, is lost in flight, leaving the exchanger unit intact at the end of the main cable, the cable may be winched in and the second target launched.
(ii) If the main cable is severed, it should normally be cut immediately and not winched in. If, however, the greater part of the cable is intact, it can be winched in carefully until the remaining cable is seen in the sighting mirrors to become unstable; the cable must then be cut and no attempt may be made to winch in the free end.

(c) *Engine failure (dart target stowed)*
If either engine fails with the dart target stowed, speed should be reduced to 180 knots and the aircraft landed with the target stowed.

(d) *Engine failure (dart target on tow)*
If either engine fails with the dart target on tow, at a speed above 180 knots, speed should be reduced to this figure, the target should be winched in and then released over a safe area. If failure occurs when the speed is below 180 knots, the cable should be cut immediately.

(e) *Fin unfolding*
If the fin of a dart target unfolds while the target is stowed, the aircraft may be landed with the fin unfolded.

(f) *Emergency launch*
The EMERGENCY LAUNCH switch must not be used unless it is essential to jettison the target from the stowed position, in which case the cable cutter must be operated first.

PART VII

OPERATING DATA

NOTE.—Fuel calculations throughout are based on AVTAG.

151. Pressure error corrections

The corrections (in knots) shown in the table below should be applied to the ASI reading to obtain RAS. A Mk. IV computor should be used to convert RAS to TAS, as this computor allows for calibration compressibility error.

From To	130 170	170 220	220 300	300 430
Subtract	1	0	—	—
Add	—	0	2	4

152. Fuel consumptions

(a) Static fuel flow, i.e. ground run, is 950 galls/hour at 14,550 r.p.m.

(b) The following are the approximate fuel consumptions in gallons per hour for various altitudes and power settings.

Aircraft Configuration	Height feet	At max. continuous r.p.m.	At best range speed	At best endurance speed
With ventral tank	Sea Level	*	500	380
	10,000	760	340	280
	20,000	590	265	250
	30,000	450	230	220
	40,000	300	240	235
With ventral tank and wing tanks	Sea Level	**	550	450
	10,000	750	360	315
	20,000	580	285	270
	30,000	435	255	240
	40,000	295	260	250

NOTE.— (1) *With ventral tank, approximately 13,600 r.p.m. will produce limiting speed of 430 knots and consumption will then be approximately 1,000 galls./hour.

(2) **With ventral and wing tanks, approximately 14,000 r.p.m. will produce limiting speed of 430 knots and consumption will then be approximately 1,100 galls./hour.

(3) Consumptions will be 4% lower when using AVTUR.

153. **Take-off distances**

The following table gives approximate take-off distances, in yards, at sea level for various ambient air temperatures and windspeeds using normal techniques as in para. 92. The figures in brackets are approximate corrections, in yards, to be added per 500 feet of airfield altitude.

NOTE.—Distances (a) are to unstick.
Distances (b) are to 50 feet.

Wind	Temp.	Ventral	Wing and Ventral
NO WIND	+15°C.	(a) 765 (25) (b) 1425 (45)	995 (30) 1855 (55)
	+30°C.	(a) 915 (30) (b) 1700 (55)	1190 (38) 2200 (65)
	+45°C.	(a) 1095 (35) (b) 2030 (65)	1435 (45) 2650 (75)
30 KTS.	+15°C.	(a) 430 (15) (b) 1070 (35)	580 (20) 1430 (45)
	+30°C.	(a) 515 (18) (b) 1280 (43)	695 (23) 1710 (55)
	+45°C.	(a) 615 (20) (b) 1535 (50)	840 (25) 2050 (65)

154. **Flight planning data (ISA conditions)**

(a) *Allowances*

(i) For taxying and take-off allow 40 gallons.

(ii) For one circuit, one overshoot at moderate power and one landing allow at least 60 gallons.

(b) *Climb data*

(i) The maximum rate climb tables give the data for climbs, using the speeds quoted in para. 98 and maximum r.p.m.; the range obtainable for any given quantity of fuel is slightly decreased if 14,100 r.p.m. are used. Since the climb performance is dependent on temperature, corrections are given.

(ii) An alternative method of operating the aircraft is to make a maximum rate climb to 30,000 ft. and then to cruise-climb up to 40,000 feet using 13,600 r.p.m. and .70M. The data for that portion of the flight spent between 30,000 feet and 40,000 feet are given in the cruise-climb tables.

(iii) Under operational conditions it may be necessary to do a cruise-climb at heights and/or speeds above optimum. Data has been computed for .72M and cruise-climb from 38,000 feet these being taken as typical operational figures. These also are given in the cruise-climb tables.

(c) *Cruise data*

Each separate altitude block in the cruise tables shows:—

1. The speed for maximum range, the approximate air nautical miles per gallon and the approximate fuel consumption for the particular height, at the best range speed. In addition, a speed band is given within which the reduction in range should not be more than 5%.

2. The range available for various amounts of available fuel, when flying at the best range speed for the height. The range is given to the point of let-down, allowance being made for the amount of fuel required.

3. The range obtainable for various amounts of available fuel, including the distance covered on the climb, if a climb is made to another altitude. In this case, the climb must be made at the speeds quoted in para. 94 and the flight continued at the new altitude at the best range speed for that height.

NOTE.—The range at any altitude is independent of ambient temperature but is dependent on the *weight* of fuel carried.

(c) *Descent data*
The descent tables give the data for descents at normal and maximum rates.

(d) *Cruise data graphs*
The cruise data graphs show air nautical miles per gallon for various altitudes; approximate r.p.m. lines are given.

155. **Flight planning**

(a) *Pre-flight*
For short-range flights, inspect the sea-level block and select the height at which the distance to be covered requires the least amount of fuel. This is the best altitude for the flight.
When range is the primary factor, enter the cruise data table in the sea-level block at the fuel state applying immediately after take-off. Select the height at which maximum range is available at that fuel state. The distance available includes distance covered on the climb but not on the descent. Absolute maximum range is obtained by adding on the descent distance, provided that the let-down is commenced at that distance from the destination.

(b) *In-flight*
At any stage of a flight, the available range may be found by applying the current fuel state to the level flight range in the particular altitude blocks. If an increase in range is required, or if a climb has to be made, the new available range may be obtained by entering the existing altitude block at the particular fuel state and moving vertically downwards within the block until the new altitude is reached. Figures in heavy type indicate the best altitude for the maximum increase in range. Above these heights, no further range increase is possible. If forced to descend, the new range may be found by moving direct from the existing altitude level flight range for the particular fuel state to the new altitude level flight range.

(c) *Flying on one engine*
Range obtainable below 20,000 feet may be slightly increased by flying on one engine and cruising at a speed some 30 knots lower than the speed for maximum range on two engines at that altitude.

(d) *Endurance*
At any altitude, maximum endurance will be obtained by flying at the IAS which requires the lowest r.p.m. to maintain height. This speed is 180–190 knots. Increase in altitude gives increase in level flight endurance; however, the overall endurance may not be improved by climbing above 20,000 feet, owing to the proportion of fuel used on the climb and descent. All climbs should be made at full power and the descent made as quickly as practicable. The approximate fuel consumption at the best endurance speed is shown on the cruise data graphs.

MAX.—RATE CLIMB

Climb at full power or at the maximum without surge.
Climb at 285 Knots into .63M then maintain .63M.
Figures given in brackets are corrections to be added per 10° C. rise in air temperature above ISA.

VENTRAL TANK

(Fuel at T.O. .. .. .. 500 gallons)

Height band	Minutes	Mls.	Galls.
Sea level to 10,000 feet	2(0)	12 (1)	30(2)
10,000 feet to 20,000 feet	3(½)	18 (2)	34(2)
20,000 feet to 30,000 feet	4(½)	20 (4)	35(7)
30,000 feet to 40,000 feet	5½(2½)	30 (7)	41(9)

VENTRAL AND WING TANKS

(Fuel at T.O. .. .. .. 700 gallons)

Height band	Minutes	Mls.	Galls.
Sea level to 10,000 feet	2½(0)	13 (1)	38(2)
10,000 feet to 20,000 feet	3½(½)	20 (2)	42(5)
20,000 feet to 30,000 feet	5¼(1½)	33 (7)	50(11)
30,000 feet to 40,000 feet	9½(4)	80 (33)	75(22)

CRUISE CLIMB

Climb at max. rate up to 30,000 feet then set and maintain 13,600 r.p.m. and .70M.

VENTRAL TANK

(Fuel at T.O. .. .. .. 500 gallons)

Height band	Minutes	Galls.
30,000 feet to 35,000 feet	10½	57
35,000 feet to 38,000 feet	20	100
38,000 feet to 40,000 feet	22	110

VENTRAL AND WING TANKS

(Fuel at T.O. .. .. .. 700 gallons)

Height band	Minutes	Galls.
30,000 feet to 35,000 feet	20	100
35,000 feet to 38,000 feet	20	100

OPERATIONAL CRUISE CLIMB

Climb at max. rate up to 38,000 feet then set and maintain .72M.

VENTRAL TANK ONLY

(Fuel at T.O. .. .. .. 500 gallons)

Approximately 13,750 r.p.m. required.
Rate of climb small at first.
Fuel consumption approximately 270 gallons/hour.

VENTRAL AND WING TANKS

(Fuel at T.O. .. .. .. 700 gallons)

Approximately maximum continuous r.p.m. required.
Rate of climb very small at first.
Fuel consumption approximately 300 gallons/hour.

DESCENT DATA

With ventral tanks or with ventral and wing tanks

		Descent 1			Descent 2		
From	To	Mins.	Mls.	Galls.	Mins.	Mls.	Galls.
40,000 feet	30,000 feet	3	23	5	¼	4½	2
30,000 feet	20,000 feet	2	12	4	½	4½	2
20,000 feet	10,000 feet	2	12	4	¼	4½	2
10,000 feet	Sea level	2	11	4	¼	4	4

Descent 1:—11,000 r.p.m.
Airbrakes OUT
0.7M into
250 knots

Descent 2:—Throttles closed
Airbrakes OUT
0.7M into
300 knots

CRUISE DATA

VENTRAL TANK ONLY

FUEL AVAILABLE	Galls (AVTAG)	460	400	340	280	220	160	100
	Pounds	3,540	3,080	2,620	2,160	1,695	1,232	770
Sea Level	Range	228	194	160	125	91	57	**23**
ANM/Gall=0.57 Gall/Hr =500 Best Range IAS= 283 Kts. 95% Range IAS= 234–384 Kts.	10,000 ft.	323	272	221	170	119	**68**	17
	20,000 ft.	401	333	265	197	**130**	62	—
	30,000 ft.	449	366	**283**	**200**	118	—	—
	40,000 ft.	**464**	**369**	275	180	87	—	—
10,000 feet	Range	—	286	235	184	133	82	**31**
ANM/Gall=0.85 Gall/Hr =340 Best Range IAS= 249 Kts. 95% Range IAS= 203–295 Kts.	20,000 ft.	—	354	287	219	**151**	**84**	—
	30,000 ft.	—	396	**313**	**230**	147	64	—
	40,000 ft.	—	**404**	310	215	120	—	—
20,000 feet	Range	—	—	307	240	172	**104**	**36**
ANM/Gall=1.13 Gall/Hr =265 Best Range IAS= 222 Kts. 95% Range IAS= 183–258 Kts.	30,000 ft.	—	—	342	**259**	**176**	93	—
	40,000 ft.	—	—	**345**	251	156	61	—
30,000 feet	Range	—	—	370	**287**	**204**	**121**	**39**
ANM/Gall=1.38 Gall/Hr =230 Best Range IAS = 198 Kts. 95% Range IAS= 168–237 Kts.	40,000 ft.	—	—	**381**	286	191	96	—
40,000 ft.	Range	—	—	—	**321**	**226**	**131**	**36**
AMN/Gall=1.58 Gall/Hr =240 Best Range IAS = 197 Kts. 95% Range IAS= 161–222 Kts.								
FUEL AVAILABLE	**Galls (AVTUR)**	443	385	327	269	212	154	96

NOTE. 98 The above range figures and by 18% with the

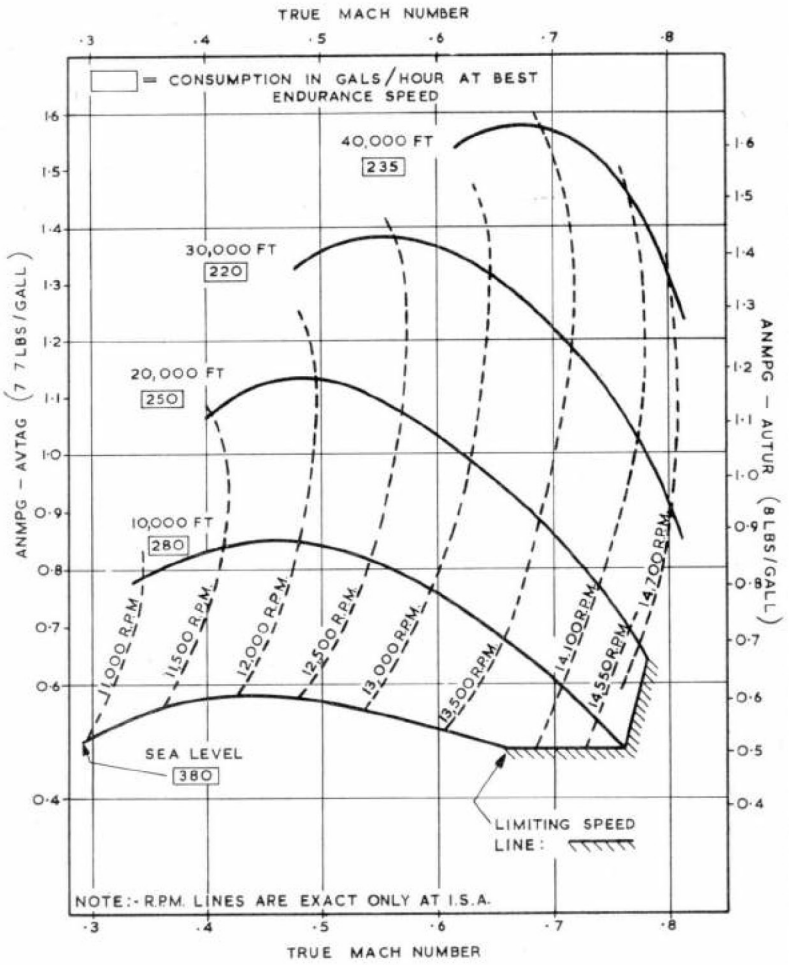
CRUISE DATA

VENTRAL TANK AND WING TANKS

FUEL AVAILABLE	Galls (AVTAG)	660	600	500	400	300	200	100
	Pounds	5,080	4,620	3,850	3,080	2,310	1,540	770
Sea Level	Range	288	259	211	163	115	67	**19**
ANM/Gall=0.48 Gall/Hr =550 Best Range IAS= 263 Kts. 95% Range IAS= 215–321 Kts.	10,000 ft.	425	381	306	232	159	**85**	—
	20,000 ft.	544	484	384	284	184	84	—
	30,000 ft.	637	562	438	313	**188**	—	—
	40,000 ft.	**700**	**613**	**465**	**319**	172	—	—
10,000 feet	Range	—	397	323	249	175	101	**27**
ANM/Gall=0.74 Gall/Hr =360 Best Range IAS= 227 Kts. 95% Range IAS= 199–276 Kts.	20,000 ft.	—	510	410	310	210	**110**	—
	30,000 ft.	—	598	473	348	**223**	98	—
	40,000 ft.	—	**657**	**510**	**362**	215	—	—
20,000 feet	Range	—	—	432	332	232	**132**	**32**
ANM/Gall=1.0 Gall/Hr =285 Best Range IAS= 212 Kts. 95% Range IAS= 179–249 Kts.	30,000 ft.	—	—	505	381	256	131	—
	40,000 ft.	—	—	**569**	**421**	**275**	128	—
30,000 feet	Range	—	—	535	410	285	**160**	**35**
ANM/Gall =1.25 Gall/Hr =255 Best Range IAS = 200 Kts. 95% Range IAS= 169–229 Kts.	40,000 ft.	—	—	**591**	**444**	**298**	151	—
40,000 feet	Range	—	—	—	**475**	**328**	**181**	**34**
ANM/Gall=1.47 Gall/Hr =260 Best Range IAS = 198 Kts. 95% Range IAS= 166–227 Kts.								
FUEL AVAILABLE	**Galls (AVTUR)**	635	577	481	385	289	193	96

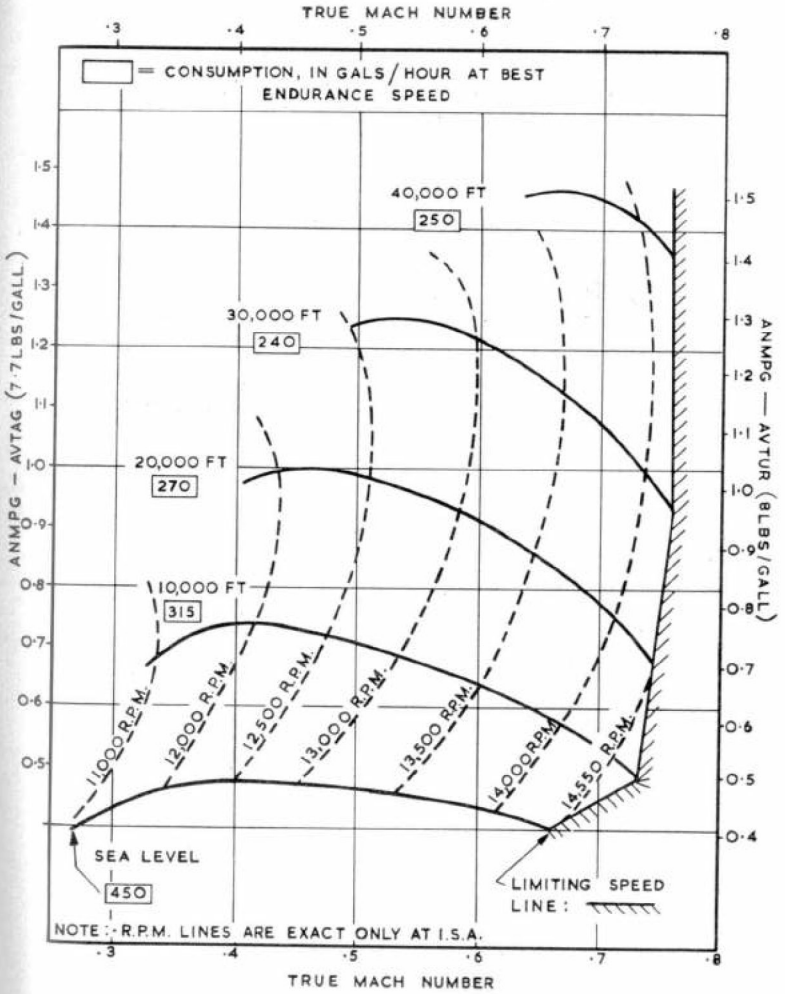
are reduced by 10% with a forward winch pylon 99 wind fitted + target stowed. Ac 2

CRUISE DATA



VENTRAL TANK ONLY (18,700 LB)

CRUISE DATA



VENTRAL AND WING TANKS (20,500 LB)

PART VIII

ILLUSTRATIONS

KEY TO FIGURE 1

1. HP fuel cock lever and relight button (port)
2. PB/ECON oxygen selector
3. Brake air pressure gauge
4. Hood lock/unlock handle
5. Pressure air selector
6. Cold air selector (only fitted when heat exchanger installed)
7. Throttle levers (two)
8. Press-to-transmit button
9. Airbrake selector
10. Radio altimeter limit switch
11. Engine starter buttons (two)
12. Cold air inlet (when item 6 fitted)
13. Booster-pump circuit-breakers (two)
14. GGS selector dimmer switch (or as at item 29)
15. Position for radio compass indicator (NF 13)
16. Booster-pumps test buttons
17. Elevator trim handwheel
18. Booster-pumps test socket
19. Trim position indicators (two)
20. Rudder trim handwheel
21. Fuel balance cock control
22. LP fuel cock lever

KEY TO FIGURE 2

23. Hood lock indicator
24. Hood clutch release
25. DV panel locking lever
26. DV panel
27. Booster-pumps test socket
28. LP fuel pumps test buttons
29. GGS selector/dimmer control
30. Hood operating switch

KEY TO FIGURE 3

31. Clock
32. Radio altimeter limit lights
33. Undercarriage selector lever
34. Rudder pedal adjustment knob
35. Flap position indicator
36. Flap selector
37. Brake pressure gauge and trim indicator light ON/OFF switch
38. External tanks selector and ventral jettison T handle
39. Press-to-call-navigator switch (NF 13 only)
40. Port engine fire warning light
41. Emergency lamps
42. GGS emergency retraction handle
43. GGS normal raise/lower switch
44. GGS master circuit-breaker
45. Starboard engine fire warning light
46. Windscreen de-mist switch
47. E2A stand-by compass
48. Hood jettison handle
49. Telebriefing press-to-speak switch and light
50. Engine fire-extinguisher buttons (two)
51. Cabin altimeter
52. Oxygen regulator
53. J.p.t. gauges
54. Gun firing safety catch
55. Press-to-mute button
56. Press-to-start camera button
57. Gun firing trigger
58. Generator failure warning lights (two)
59. Red lamps ON/OFF/dimmer switch
60. Undercarriage red warning light
61. Rear compartment, main tank, fuel gauge
62. Starboard engine oil pressure gauge
63. Undercarriage indicator
64. Port engine oil pressure gauge
65. Front compartment, main tank, fuel gauge
66. Fuel transfer warning light
67. Mk. 4B compass
68. U/V lamps ON/OFF/dimmer switch
69. Radio altimeter altitude indicator

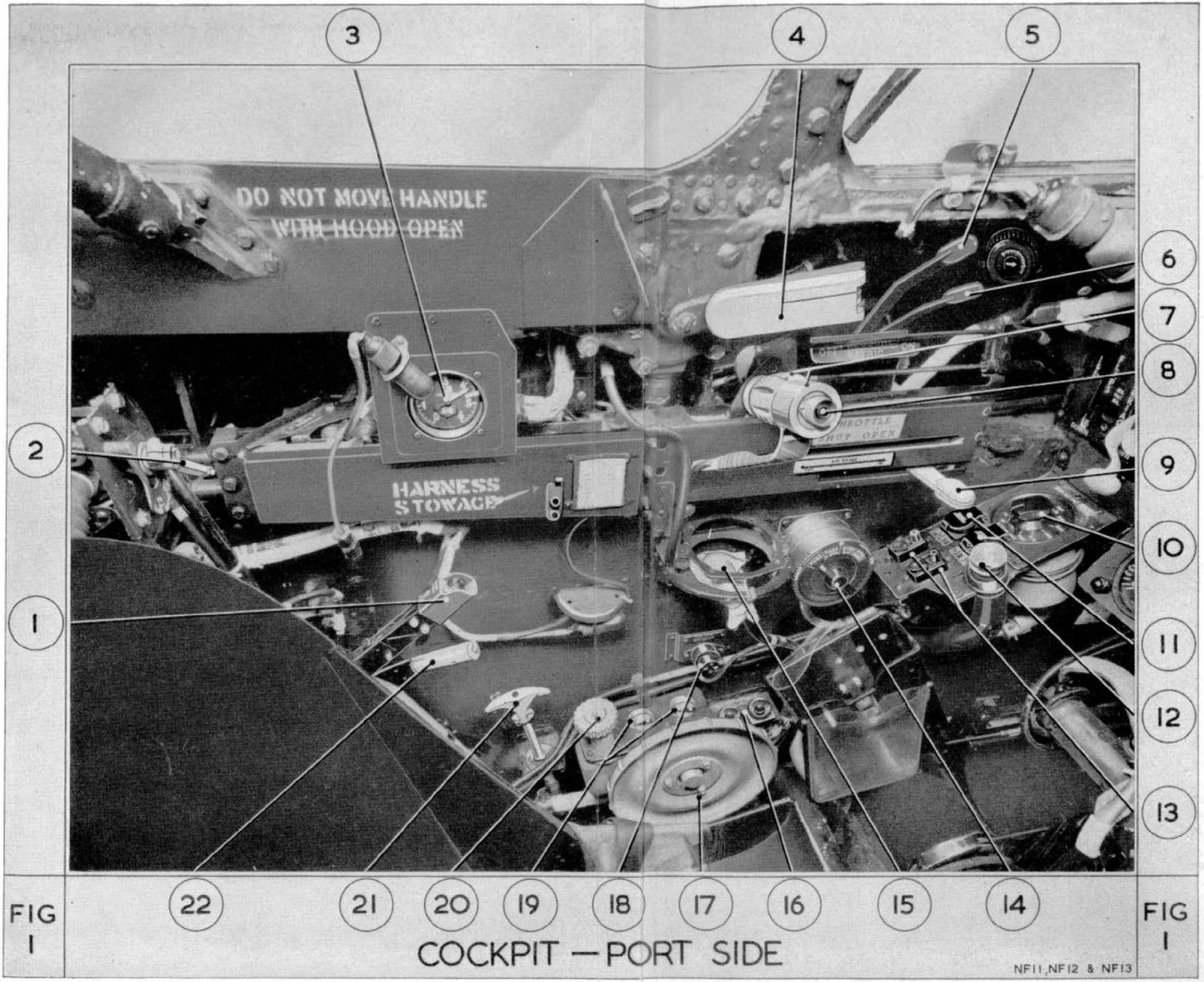


FIG 1

COCKPIT — PORT SIDE

NF11, NF12 & NF13

FIG 1

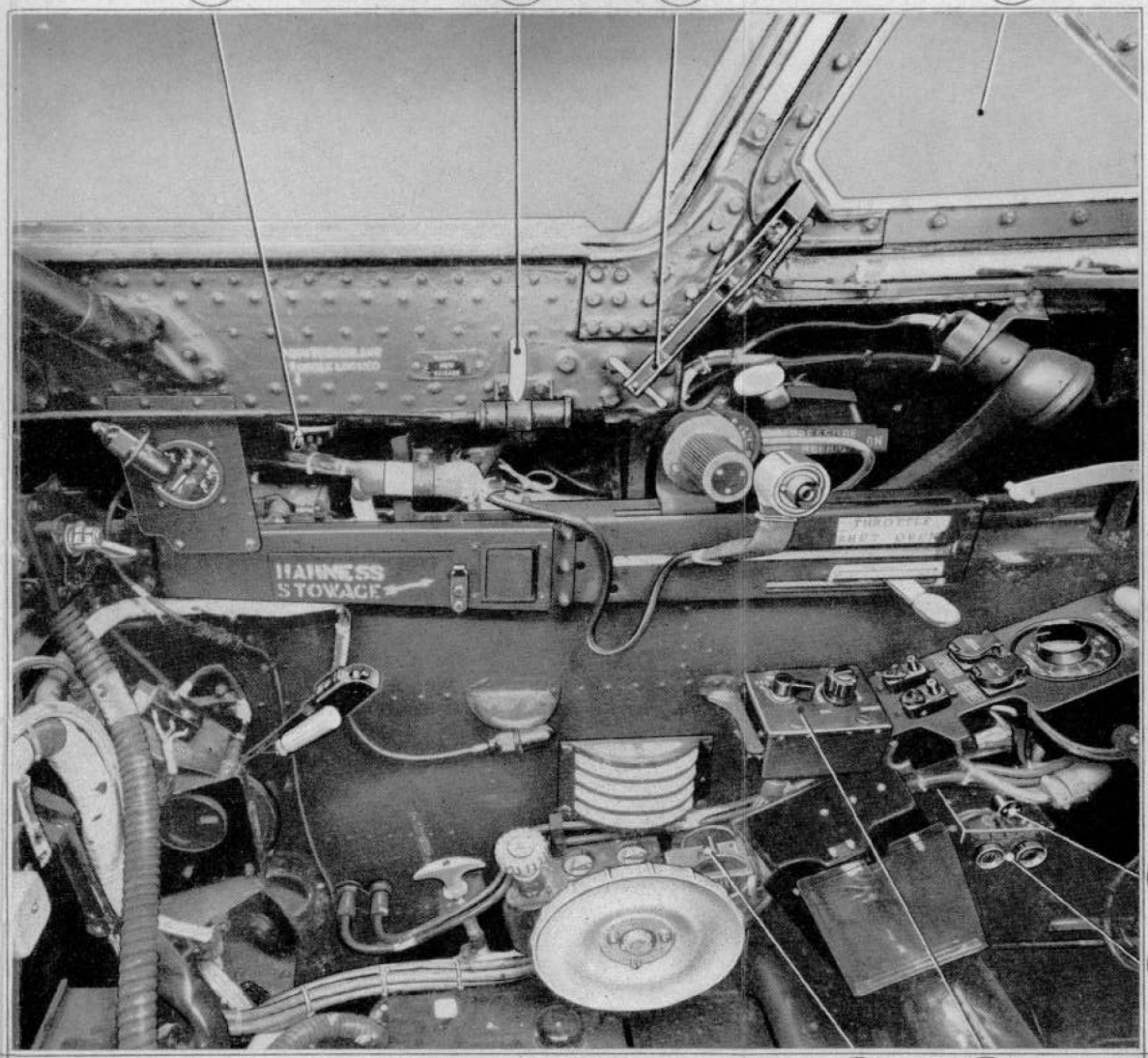


FIG 2

COCKPIT–PORT SIDE

NF14 ONLY

FIG 2

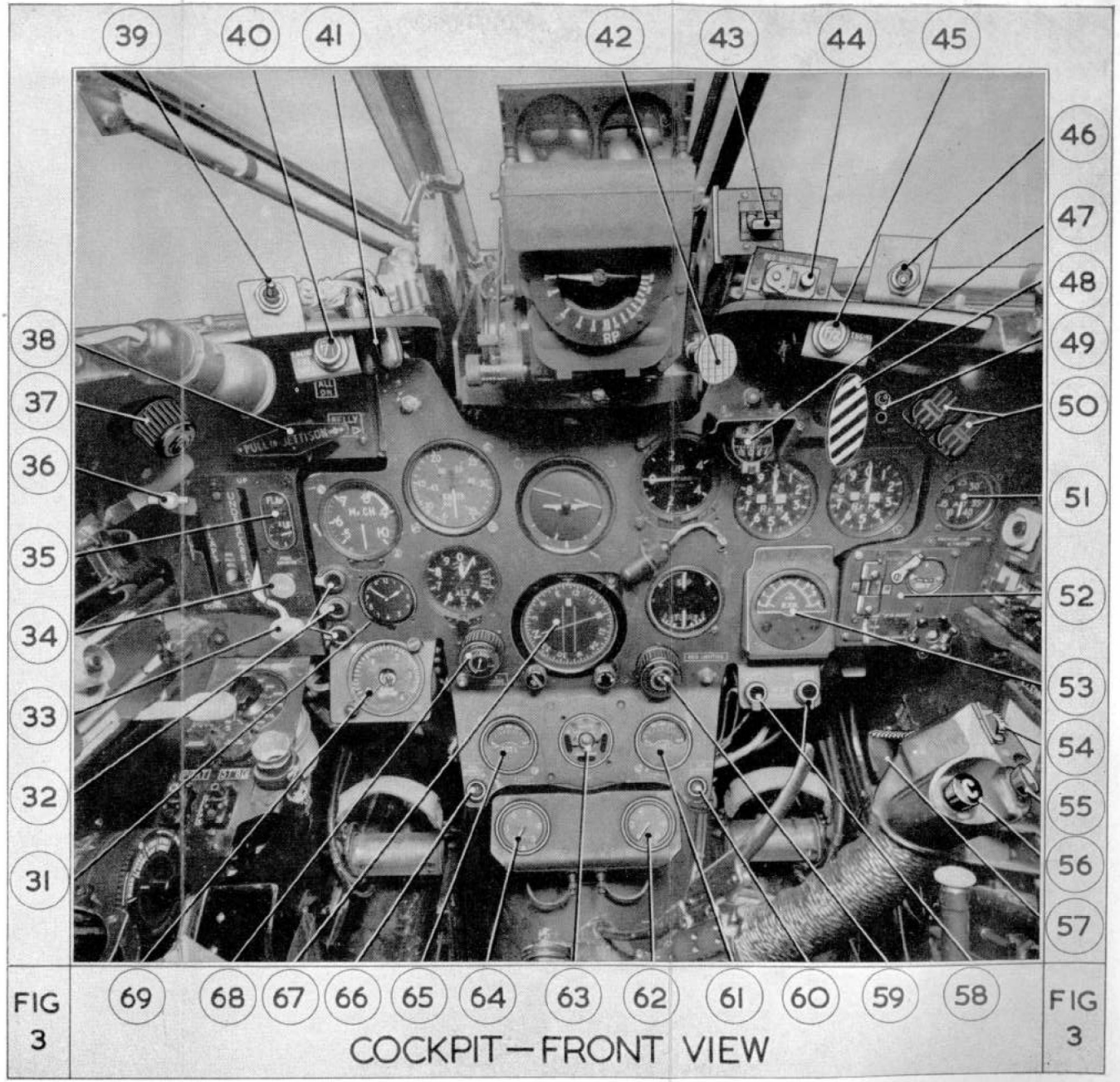


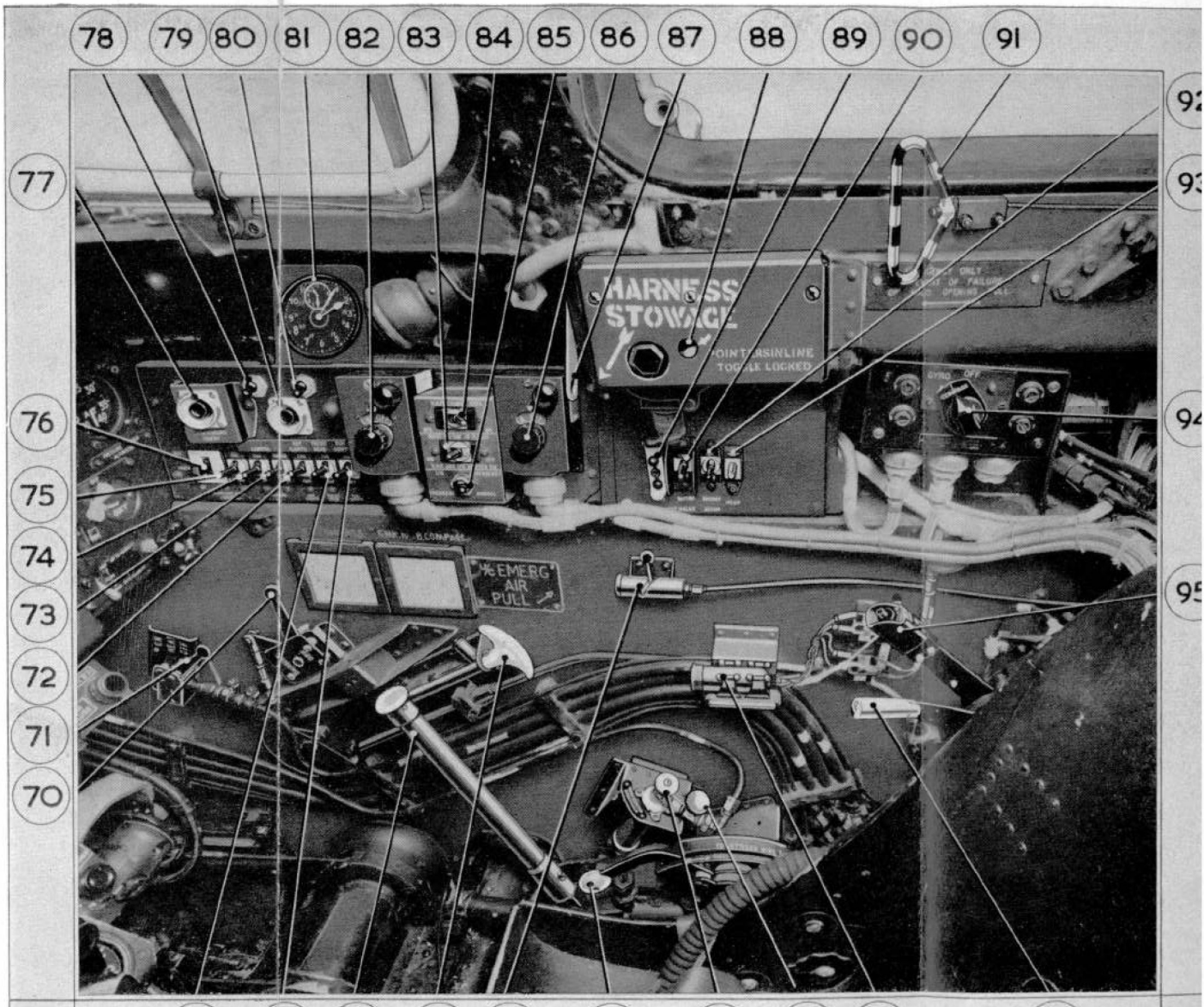
FIG 3

COCKPIT — FRONT VIEW

FIG 3

KEY TO FIGURE 4

70. Demist ON/OFF lever
71. Hot air ON/OFF lever
72. Navigation lights switch
73. Camera Sunny/Cloudy switch
74. Camera master ON/OFF switch
75. Downward identification lights ON/OFF switch
76. Downward ident. colour selector (NF 11 and 13 only)
77. Downward ident. morsing button
78. IFF controls: these may not be fitted as IFF inoperative
79. IFF controls: these may not be fitted as IFF inoperative
80. IFF controls: these may not be fitted as IFF inoperative
81. Time-of-flight clock
82. No. 2 VHF selector box
83. Intercomm. master switch
84. VHF changeover switch
85. Intercomm. emergency switch
86. No. 1 VHF selector box
87. Harness stowage hook
88. Hood locked indicator (hood shown locked)
89. Cockpit pressure horn master switch
90. Battery isolation switch
91. Hood release toggle—ground use only
92. Emergency lighting ON/OFF switch
93. Hood master circuit-breaker (NF 14 only)
94. Mk. 4B compass controller
95. HP fuel cock lever and relight button (starboard)
96. LP fuel cock lever
97. Mic/tel plug
98. Windscreen de-icing rate-of-flow control
99. Windscreen de-icer handpump
100. Wing tank jettison lever
101. Lean-forward, harness control
102. Undercarriage emergency control
103. Hydraulic handpump
104. Taxy lamp switch
105. Pressure head heater switch



KEY TO FIGURE 5

106. Rebecca—inverter on/off circuit-breaker
107. Radar inverter STOP/START buttons
108. Mk. 4B compass indicator
109. IFF controller—not now fitted
110. Compass light switch
111. Chart lamp switch
112. Instrument inverter failure indicator
113. Instrument inverter changeover/test switches
114. Radio compass a.c./d.c. ON/OFF switches
115. Chart lamp wander-lead socket
116. Radar-d.c. circuit-breaker
117. VHF master circuit-breakers (two)
118. Rebecca—a.c./d.c. ON/OFF switches
119. Radar—a.c. circuit-breakers
120. Generator field circuit-breakers (two)
121. Generator failure warning lights (two)
122. Generator reset switches (two)
123. Generator trimming panel

NOTE:—THIS PHOTOGRAPH IS OF AN NF13
SEE DIAGRAMS IN TEXT FOR NF11, NF12 & NF14

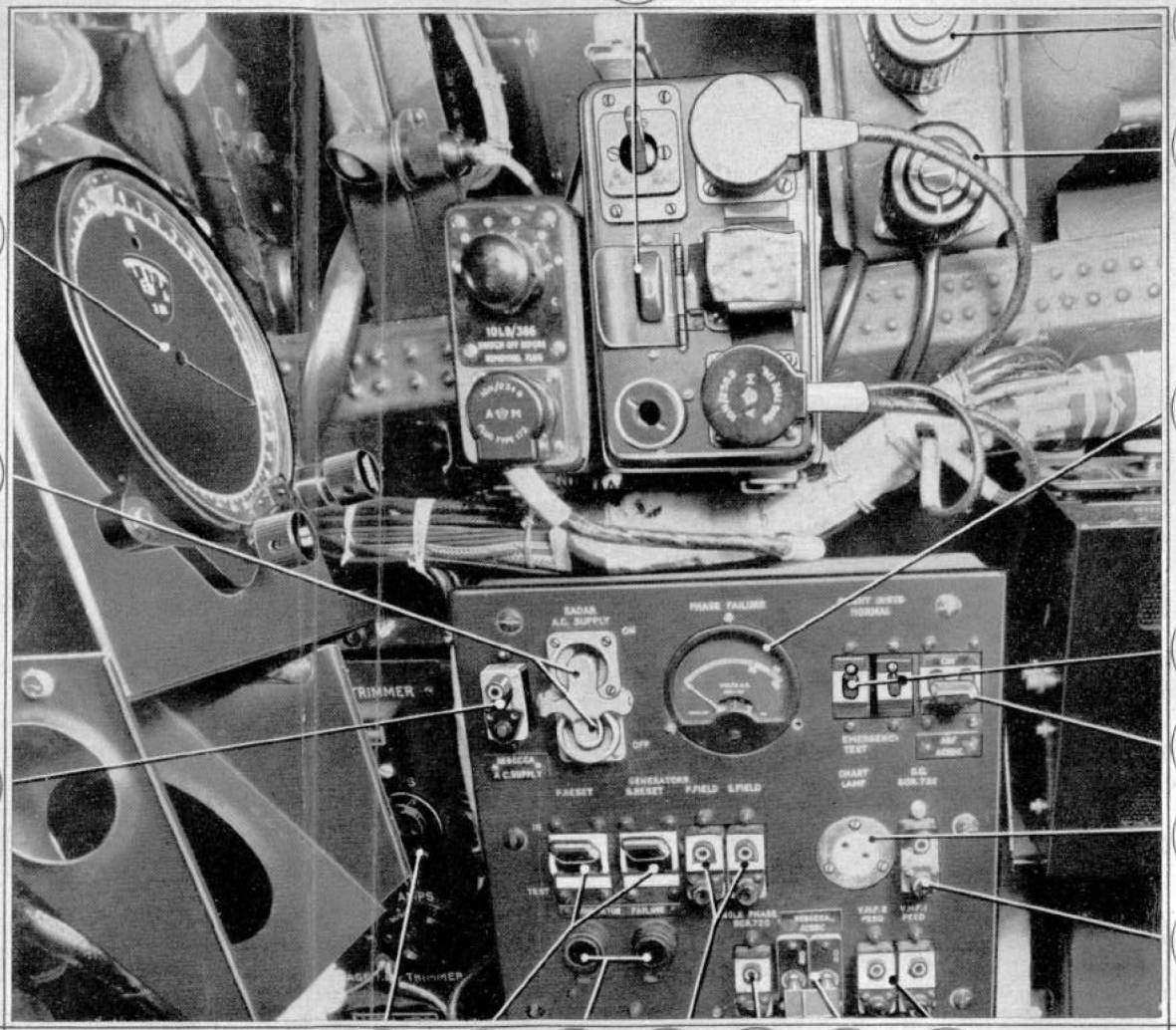


FIG 5

ELECTRICAL PANEL—OBSERVERS COCKPIT

FIG 5

KEY TO FIGURE 6

124. Aileron trim indicator
125. Port hood lock-light micro-switch
126. R/T / MIX / BEACON switch
127. Control unit type 345
128. Outside air temperature gauge—may not be fitted
129. Emergency cable cutter control handle
130. Aileron trimmer master circuit-breaker
131. Aileron trimmer operating switch
132. Starboard hood lock-light micro-switch

KEY TO FIGURE 7

133. SAAB cable test unit
134. Target release switches, mechanically interlocked
135. Press-to-transmit
136. Target release interlock—re-set knob
137. Hood lock/unlock handle
138. Target release indicators, black when released
139. Pay-out override switch
140. Emergency cable cutter control handle
141. Windmill speed indicator
142. SAAB recorder panel
143. Cable position indicator
144. Cable paid out footage indicator
145. Haul-in override switch
146. Footage indicator re-set switch
147. Emergency cable brake switch
148. Cable inching switch
149. Hood jettison handle
150. Haul-in / pay-out selector switch
151. Winch master circuit-breaker

KEY TO FIGURE 8

152. Generator—failure warning lights
153. Generator—field circuit-breakers
154. Generator—re-set switches
155. Instrument inverter failure indicator
156. Lean-forward, harness release
157. Compass light switch
158. Chart lamp dimmer switch
159. BEACON/RT switch
160. Intercomm EMERGENCY/NORMAL switch
161. Hood opening override toggle
162. Instrument inverter change-over switches
163. Chart lamp supply socket
164. Nos. 1 and 2 VHF supplies

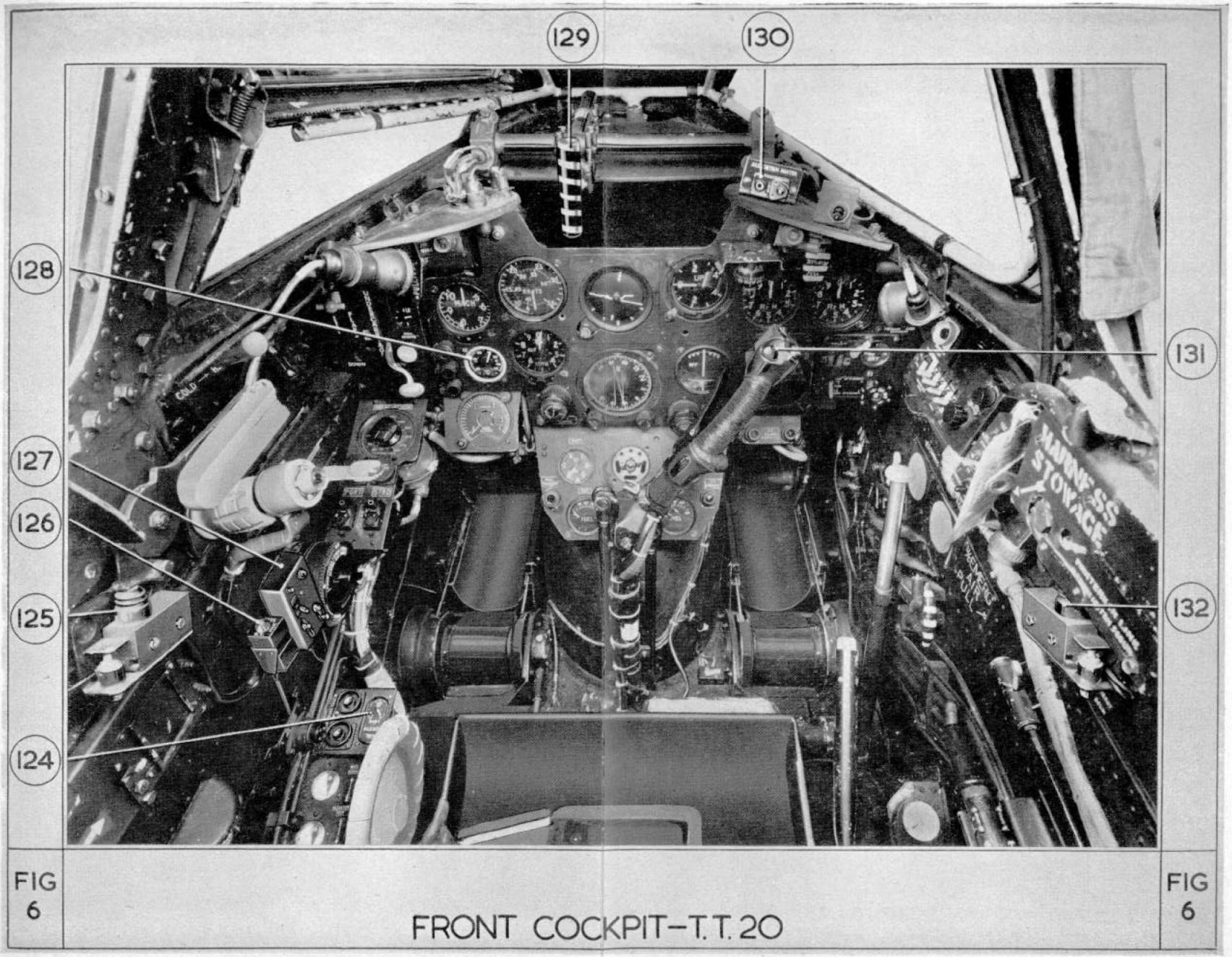


FIG 6

FRONT COCKPIT–T.T. 20

FIG 6

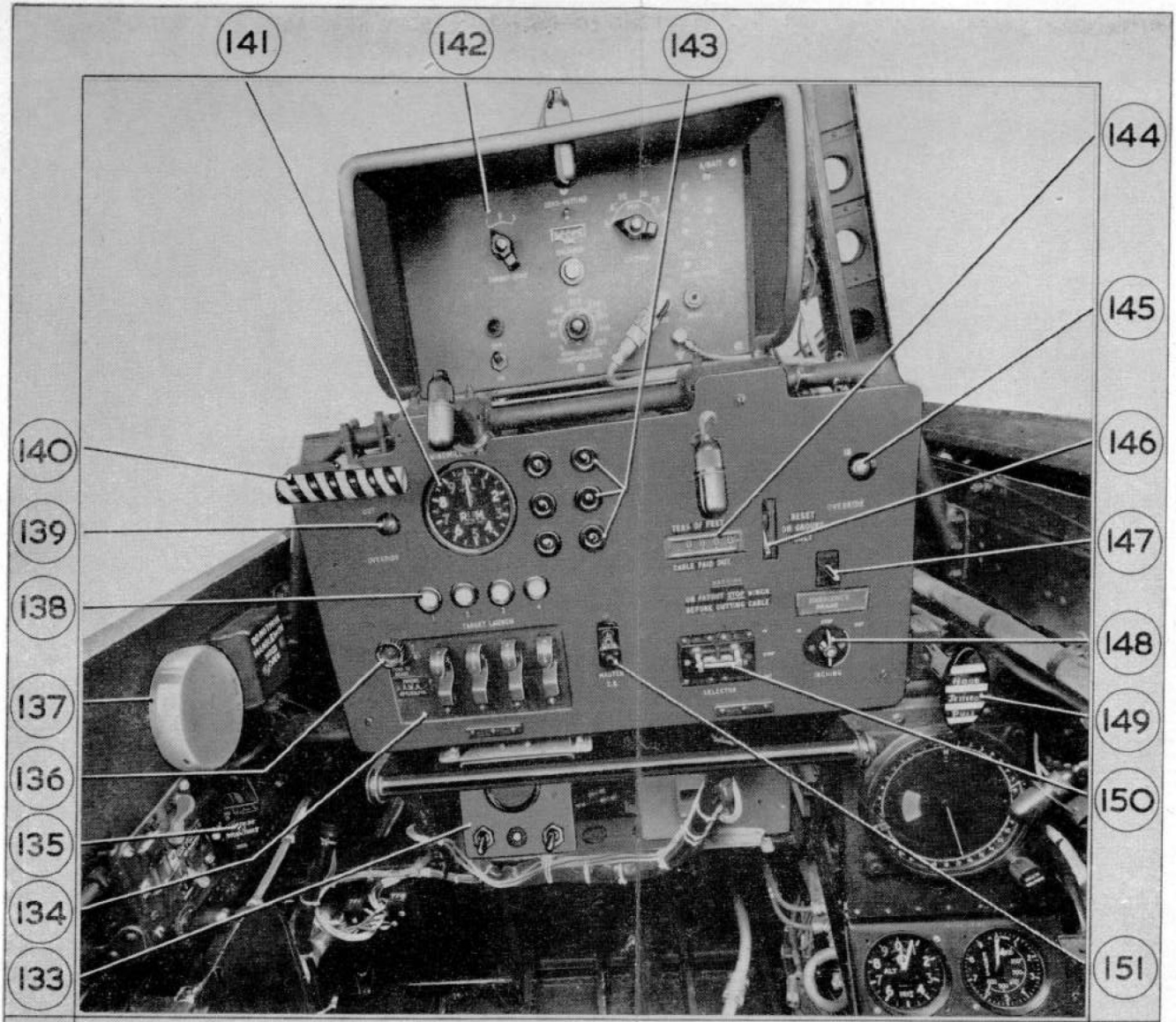


FIG 7

REAR COCKPIT – TOWING CONTROLS – T.T. 20

FIG 7

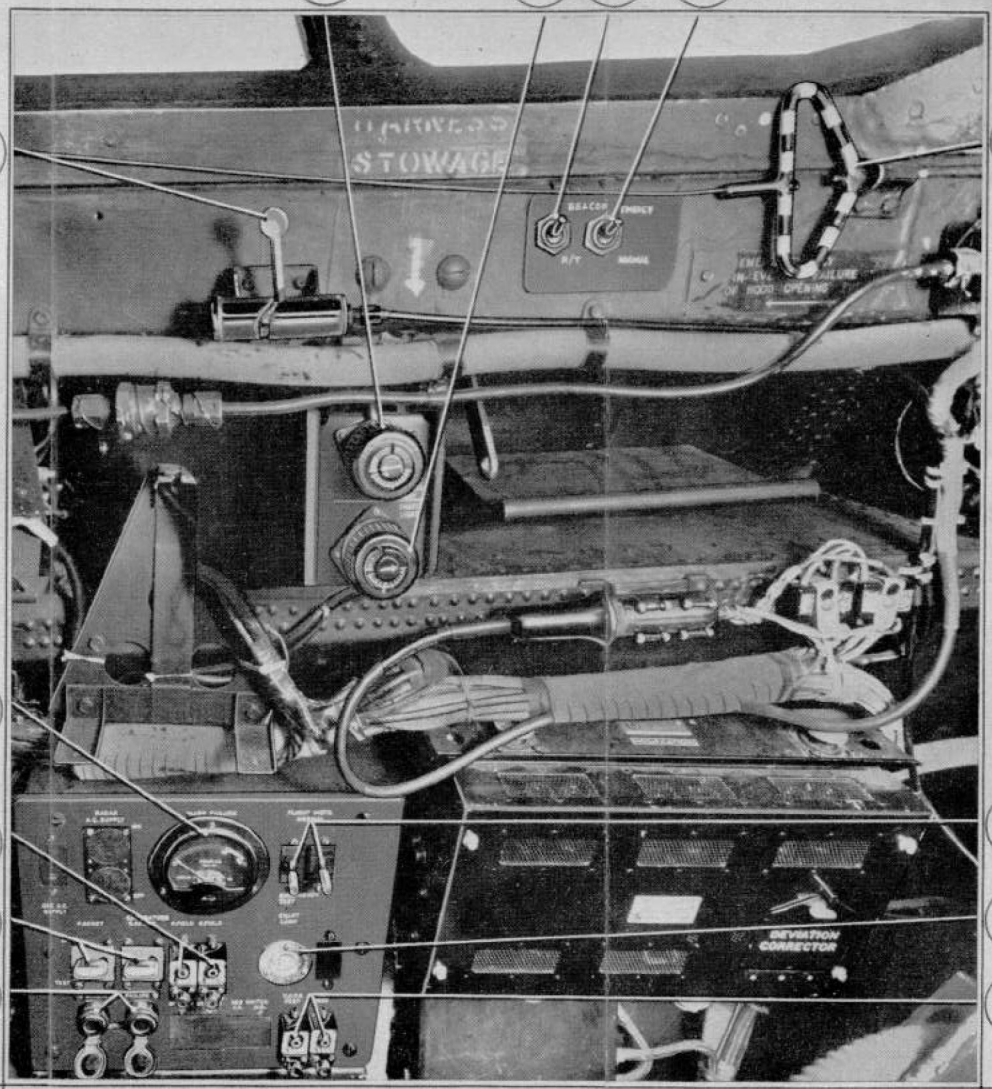


FIG. 8

REAR COCKPIT—STARBOARD—T.T. 20

FIG. 8

ENGINE FAILURE IN FLIGHT

(a) *Mechanical failure*

HP cock	OFF
LP cock	OFF
Booster-pump circuit-breaker	Trip
Balance cock	As required
Electrical load	Within safe limit

Do not attempt to relight

(b) *Flame out*

HP cock	OFF
Electrical load	Within safe limit

Relight as below

RELIGHTING

Note.—*Do not attempt to relight using normal starter button*

(i) *Derwent Mk. 8*

Altitude	Below 15,000 feet
Airspeed	To give 1,000–1,200 r.p.m.
LP cock	ON
HP cock	OFF
Throttle	One-third open
Booster pump circuit-breaker	Made

Press relight button and after 5 secs. set HP cock on. When r.p.m. reach 2,000 release relight button and close throttle fully. If engine fails to relight within 30 seconds close HP cock. After 1 minute, attempt to relight at lower altitude and wider throttle opening.

(ii) *Derwent Mk. 9*

Altitude	Below 25,000 ft.
Airspeed	Below 230 knots if above 20,000 ft.
LP cock	ON
HP cock	OFF
Throttle	Closed
Booster pump circuit-breaker	Made
R.p.m.	Steady

Open HP cock, press and hold in relight button until r.p.m. rise (or for up to 30 seconds). If engine fails to relight allow 1 minute to elapse before making next attempt at lower altitude and/or airspeed.

ENGINE FIRE

Close throttle immediately, then:—

HP cock	OFF
LP cock	OFF
Booster pump circuit-breaker	Trip
Airspeed	Minimum safe

Press extinguisher button. If fire persists, abandon aircraft. Do not relight. Check electrical load within limits.

HOOD OPENING IN FLIGHT

Do not jettison (N.F. 11, 12 & 13)
Reduce airspeed below 200 knots

HOOD JETTISONING

Airspeed	Below 220 K and hood fully closed –N.F. 14. Below 250 K – N.F. 11, 12 and 13
Seats	Fully lowered
Gunsight	Lowered
Helmets	Strap fastened and tight
Harnesses	Tight and locked
Heads	Forward and down

Pull jettison handle in either cockpit.

UNDERCARRIAGE FAILURES

(a) *Hydraulic pump failure*
Select DOWN and use handpump. Keep airspeed below 150 knots.

(b) *Selector lever jammed*
Throttle back starboard engine, reduce speed and operate airbrakes until selector is free.

(c) *Ground-locking with U/C up*
Operate ground-lock override, then select DOWN normally.

(d) *Emergency lowering*
Check before pulling handle that u/c is selected DOWN.

FLAPS/AIRBRAKE FAILURE

Make normal selection and use handpump.

GENERATOR FAILURE

Electrical load	Reduce to safe
Field circuit-breaker	Make

(If it will not stay in do *not* hold in)

Reset switch	To TEST then IN

If this fails check for other generator overvolting

VITAL DRILLS—contd.

FORCED LANDING

Best gliding speed	180 knots
Ventral & wing tanks	Jettison
Airbrakes	IN
Undercarriage	Down below 175 knots. Lever fully down
Fuel	HP and LP cocks OFF
Flaps	As required
Harnesses	Tight and locked (seat). Parachute released
U/C indicator	Three greens
Brakes	Pressure. Off
Hood	Jettison (pilot's discretion)

DITCHING

Best gliding speed	180 knots
Airbrakes	IN
Ventral & wing tanks	Jettison
Hood	Jettison
Harnesses	Tight & locked Release seat parachute
Undercarriage	UP
Flaps	As required

ABANDONING

Airspeed	Minimum
Throttles	Close
Seats	Fully lowered
Gunsight	Lower
Harnesses	Tight and locked
Helmets	Strap fastened and tight
Hood	Jettison
Leads	Disconnect and stow
Harnesses	Release seat harnesses
Airbrakes	In

Do NOT invert. Abandon aircraft by diving over inboard trailing edge of wing. NF 11, 12 and 13—Port side from front seat unless in a spin to left. NF 14—Starboard side unless in spin to right. TT20—Both crew from port side.

CHECK LISTS

CHECKS BEFORE TAKE-OFF

Trims	Neutral
Airbrakes	IN
Fuel	Contents. Balance cock closed. HP and LP cocks fully ON Booster-pumps on
Fuel transfer	Pre-mod. 44 WINGS ON Post-mod. 44 ALL ON or VENTRAL ON (if wing tanks not fitted)
Flaps	As required
Instruments	Check and set
Oxygen	On and reaching mask
Hood	Closed and locked Warning light out (post-mod. 5861) Magnetic indicator black (Mk. 14)
Harnesses	Tight and locked
Controls	Full and correct movement
Yaw damper (if fitted)	STANDBY or OFF

CHECKS BEFORE LANDING

Airbrakes	IN
Undercarriage	Down below 175 knots. Lever fully down
Flaps	¼ down
Fuel	Contents. Balance cock as required
Harnesses	Locked and tight
U/C Indicator	Three greens
Brakes	Pressure. Operation. Off. Exhausted.

INSTRUMENT APPROACH

DOWNWIND
11,500 r.p.m. One-quarter flap, 150–155 knots
BASE LEG
11,500 r.p.m. One-half flap, 140–145 knots
GLIDE PATH
11,500 r.p.m. Full flap, 130–135 knots.
Note:—If asymmetric—increase r.p.m. by 1,500.
A.A.Ls:
GCA—200 ft. PPI—400 ft.

ENGINE LIMITATIONS

Engine Setting	r.p.m.	j.p.t. °C.
Take-off, climb and operational necessity (15 mins.)	14,700±100*	680†
Maximum continuous	14,100	630
Idling on ground (throttles closed)	3,500±200	500

*R.p.m. at sea level governed to 14,550. †700°C. above 20,000 ft. for 10 minutes