A.P. 2068, P.N.

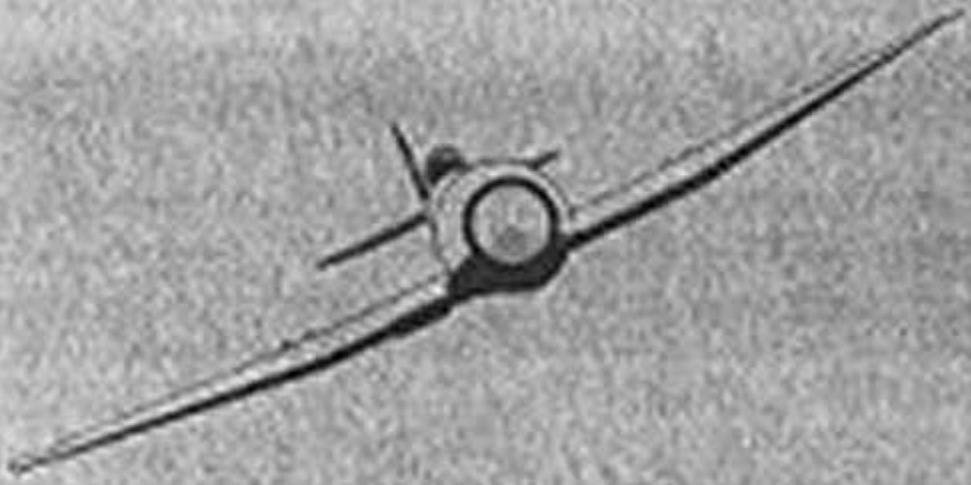
PILOT'S NOTES

FOR

Hawker

TEMPEST II

CENTAURUS V ENGINE



PREPARED BY DIRECTION OF THE MINISTER OF SUPPLY

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PROMULGATED BY ORDER OF THE AIR COUNCIL

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PART I

DESCRIPTIVE

NOTE.—The numbers quoted in brackets after items in the text refer to the illustrations in Part V.

INTRODUCTION

1. The Tempest II is a single-seat low-wing monoplane fighter and fighter-bomber, powered by a Centaurus V engine driving a Rotol four-blade 35° constant speed propeller. The engine is fitted with a Bendix-Stromberg injection carburettor and a two-speed supercharger. There are considerable differences between temperate and tropical versions. These notes cover the tropical version. The appendix on page 39 describes those features peculiar to the temperate version.

FUEL AND OIL SYSTEMS

2. **Fuel system**

(i) Fuel tanks.—Fuel is carried in four self-sealing tanks, one in the fuselage aft of the fireproof bulkhead and three in the wings. The fuel from the main tank is fed to the carburettor by an engine-driven pump. A float-valve in the main tank opens when the contents fall to 66 gallons, to allow the fuel from the wing tanks to be transferred to the main tank by air pressure from the exhaust side of the vacuum pump.

The capacities of the tanks are :

Main (fuselage) tank	76	gal.
2 Interspar (wing) tanks each 28 gal. ...	56	,,
Nose (port wing) tank	28	,,
Total	160	,,

A drop tank of 45 or 90 gallons capacity may be carried under each wing, the fuel from these tanks being transferred to the main tank in the same way that the wing tank fuel is transferred. When necessary, these tanks can be jettisoned by means of the red lever (53) on the right-hand sloping panel above the K-40 priming pump.

~~Note.—The 90 gallon drop tanks are not yet cleared for service use.~~

(ii) Fuel cocks.—There is no provision for isolating separate tanks, the wing tanks, or alternatively the drop tanks, being used as a group. The transfer of fuel from the wing or drop tanks to the main tank is controlled by a single selector lever (54) mounted on the right-hand sloping panel.

When this lever is moved forward to ON, fuel is transferred from the drop tanks, and the wing tanks are turned off and vented to atmosphere. When it is pulled back to OFF, fuel is transferred from the wing tanks, and the drop tanks are turned off and vented to atmosphere. The main tank is not pressurised and the flow of fuel from it is controlled by an ON-OFF cock (55) mounted on the shelf on the right-hand side of the cockpit. An air pressure gauge (18) marked TANK AIR on the right-hand side of the instrument panel shows the pressure available for transferring fuel. The gauge should read between 3½ and 5 lb./sq. in.

(iii) Fuel booster pump.—An electric fuel booster pump is fitted in the sump of the main tank. It is switched on and off by the main tank cock. Should it fail, fuel can still be fed to the carburettor by the engine-driven pump.

NOTE.—On no account must the main fuel cock be ON with the fuel cut-off control at NORMAL unless the engine is running (*see* para. 34 (viii)).

(iv) Fuel contents gauges.—Electrical fuel contents gauges (13) for all the permanent tanks are mounted together on the right-hand side of the instrument panel. They are switched on and off by the electrical master switch (39) which is interlinked with the ignition switches (40). There are no contents gauges for the drop tanks.

(v) No-transfer warning light.—The warning light (11), mounted on the top right-hand side of the instrument panel comes on when the contents of the main tank have fallen to 65 gallons, thus indicating that fuel has ceased to transfer from the wing or drop tanks.
As the float valve in the main tank opens at approximately 66 gallons, the warning light may flicker at times before the wing tanks are empty. The incorporation of Mod. 369 prevents this happening, and the warning light then comes on when the contents of the main tank have fallen to 63 gallons, *but the light will probably come on also when the main tank is completely full, that is, when it contains 76 gallons*. However, when the contents fall to 74 gallons the light will go out and stay out until the wing tanks are empty and the contents of the main tank have fallen to 63 gallons. If the main tank is full (and the light is on) when the engine is started, the fuel level will fall to 74 gallons and the light will go out during the warming up and run up. The pilot should not take-off with the light showing, since this indication may mean a fault in the fuel transfer system.

(vi) Fuel pressure warning light.—The warning light (19) on the right-hand side of the instrument panel comes on when fuel pressure drops appreciably below normal.

(vii) Priming system.—A single K.40 priming pump (69) mounted at the bottom of the right-hand sloping panel draws fuel from a separate tank on the right-hand side of the main tank for priming the engine.

3. **Oil system**

(i) Oil is supplied from a tank mounted aft of the main fuel tank, having a capacity of 14 gallons of oil and 4 gallons air space.

(ii) The oil cooler in the starboard wing root is by-passed at low oil temperatures.

(iii) The oil cooler shutter is thermostatically operated and no control lever is fitted. The operation of the shutter can be verified by pressing and releasing the push-button in the starboard wheel-well, marked OIL COOLER FLAP TEST SWITCH. The electrical master switch must be on and hydraulic pressure available.

MAIN SERVICES

4. **Hydraulic system**

An engine-driven pump which maintains a pressure of 1,800 lb./sq. in. in the system operates the

Flaps
Oil cooler shutter
Undercarriage and
Wheel doors.

In the event of failure of the engine-driven pump a handpump (26) on the left of the pilot's seat can be used to operate all the services.

5. **Pneumatic system**

An engine-driven compressor charges an air bottle at 450 lb./sq. in. for the operation of the

Brakes
Gun firing mechanism and
Undercarriage assister

A triple pressure gauge (24) is mounted at the bottom left-hand side of the instrument panel.

6. **Electrical system**

A 24-volt engine-driven generator supplies two 12-volt batteries in series for the operation of the whole electrical system. A power failure warning light (21) on the lower right-hand side of the instrument panel comes on when the generator is not charging the batteries. Most of the electrical switches are grouped on a panel on the right-hand side of the cockpit.

AIRCRAFT CONTROLS

7. **Flying controls**

(i) The control column is of the spade-grip pattern and incorporates the brake-lever, the gun and camera gun firing control and the gun-sight gyro-caging pushbutton.

(ii) The rudder bar is fitted with two-position rudder pedals and can be adjusted for reach by a foot-operated wheel in the centre of the bar.

ENGINE CONTROLS

16. Throttle and mixture control

(i) The throttle quadrant in the engine control box is gated at the climbing and economical cruising boost positions. A friction damping control is fitted.

(ii) Mixture control is entirely automatic and is governed by the setting of the throttle lever (31); an economical mixture strength is obtained only when this is at or behind the rearmost gate in the quadrant.

17. Propeller speed control

(i) The lever (41) on the engine control box moves forward to OVERRIDE and back to AUTO.
With the lever at AUTO, r.p.m. are controlled automatically by the setting of the throttle lever, but with it at OVERRIDE the interconnection device is overridden and r.p.m. are then governed at 2,700.
With the lever at AUTO the corresponding r.p.m. for a given throttle setting are:

Throttle set to give Boost lb./sq. in.	r.p.m.
−4 to 0	1,600
+2 (economical cruising gate)	2,100–2,200
+6 (climbing gate)	2,380–2,460
Full throttle	2,700

The lever can be used in the same way as the conventional propeller speed control lever to enable the pilot to select higher r.p.m. than those given by "interconnection." Automatic control of r.p.m. is only effected when the lever is at AUTO and indiscriminate use of it in any other position will increase fuel consumption considerably.

(ii) At certain r.p.m. (1,650–1,950) the engine runs very roughly. Throttle settings which give these r.p.m. should, therefore, be avoided whenever possible. Where this is found to be difficult, as when climbing in formation, the propeller speed control lever should be advanced to give not less than 2,050 r.p.m. This will incur a slight loss in range.

(iii) The friction damping control for the throttle also serves the propeller speed control lever.

18. Fuel cut-off control

The red-topped lever (46) at the rear of the engine control box cuts off the supply of fuel to the carburettor when it is in the down (CUT-OFF) position. It is connected with the throttle lever and cannot be moved to CUT-OFF until the throttle is nearly closed. Similarly the throttle cannot be opened beyond the correct position for starting until the lever is set to NORMAL.

19. Supercharger control

The black-topped lever (30) on the engine control box is moved down for high and up for low gear.

Note.—The lever must always be moved smartly and without pause.

20. Carburettor air-intake filter control

A combined air-intake filter and heat control is fitted and is electrically controlled by a switch (10) on the right-hand side of the instrument panel. It has three positions: FILTER, COLD and HOT. The filter is automatically brought into operation when the undercarriage is lowered, irrespective of the position of the switch; and unless the switch is at FILTER, the filter will be withdrawn from operation when the undercarriage is retracted. This is undesirable because the aircraft may still be in a dust-laden atmosphere and also because faulty operation of the filter may cause engine cutting, so the switch should always be placed in the FILTER position before take-off and also before landing (in case of a mislanding, when the undercarriage will be retracted).

The micro-switch (in the starboard wheel well), which is normally operated by the movement of the undercarriage leg, can be depressed (when Mod. 381 is incorporated) by a small strip of metal, hinged at one end, so that it is then possible to take off in ram air.

21. **Cowling gills control**

(i) On early aircraft the cowling gills are controlled by a three-position switch (33) on the left-hand cockpit wall above the engine control box. When the electrical master switch is turned on the gills take up the position selected on the three-position switch, but will open irrespective of the setting when the master switch is turned off.

(ii) On later aircraft the gills are thermostatically controlled and the three-position switch is deleted. The gills will, therefore, close fully when the electrical master switch is turned on, if the engine is cold.

(iii) No gill position indicator is fitted.

22. **Coffman starter re-indexing control**

The toggle (43) at the top of the left-hand sloping panel is pulled out and returned gently to re-index the Coffman starter breech.

COCKPIT EQUIPMENT

23. **Sliding hood controls**

(i) *Operation.*—To operate the winding gear the spring-loaded knob on the crank lever (32) should be pulled out while the crank lever is rotated in the required direction. When the knob is released the hood is automatically locked in position.

Before leaving the cockpit, the knob on the crank lever should be pulled out as far as possible and turned until a projection on the knob engages in a small recess in the crank lever; this permits the hood to be moved from the outside by hand.

(ii) *Locking from outside.* If it is desired to lock the hood shut from the outside, the knob should first be set as in sub-para. (i), and the hood closed by hand. A hand grip is fitted at the back of the sliding hood to help in closing it. The spring-loaded locking bolt in the side of

the fuselage should then be engaged with the slot in the starboard side of the hood framing.

NOTE.—One end of this spring-loaded locking bolt engages in the sliding hood, and the other end, incorporating a pin, lies in a deep slot when in the hood-locking position, and in a shallow slot when not in use. Before flight, the bolt must be positioned so that the pin is properly home in the shallow slot. With the pin in any intermediate position, vibration may cause it to rotate and fall into the deep slot, locking the hood, or preventing it shutting fully, if it is open when this occurs. Accidental locking of this nature in flight with the hood closed will prevent its normal opening, and may prevent its emergency release.

(iii) *Opening the hood from outside.* If the hood has been locked in the closed position, the spring-loaded locking bolt must first be pushed in and rotated a quarter turn. The hood may then be pushed back by hand.

(iv) In emergency, the hood may be jettisoned from both inside and outside the aircraft (*see* para. 57).

24. **Cockpit lighting**

Two lights are fitted just beneath the coaming and are controlled by two rheostat switches mounted on the top centre of the instrument panel.

A third light above the trimming tab control box is controlled by a rheostat switch at the top of the left-hand sloping panel, and a fourth light above the electrical panel on the right-hand side of the cockpit is controlled by a rheostat switch at the forward end of the panel. The compass light is controlled by the lower right-hand rheostat switch on the top centre of the instrument panel.

25. **Cockpit heating and ventilation**

The cockpit heating control (7) is on the top centre of the instrument panel. Cold air is supplied through four ventilators, one on each side of the instrument panel (17) and (25), and two under the coaming.

26. **Retracting footstep.** A retracting footstep in the starboard side of the fuselage behind the wing is connected by an elastic cord to a hand-hold behind the cockpit. When the footstep is pulled down, the cover over the hand-hold opens and sets a trigger so that, by closing the hand-hold cover, the footstep automatically retracts. Care must be taken to ensure that the footstep is correctly retracted before flight ; otherwise, engine fumes may be drawn into the cockpit.

OPERATIONAL CONTROLS

27. **Guns**

The guns are fired electro-pneumatically by the push-button on the control column spade-grip. The compressed air supply is taken from the same source as the brake supply and the available pressure is shown on the triple pressure gauge (24).

28. **R.P. controls**

A master ON-OFF switch (36) and a switch (35) for selecting PAIRS or SALVO are mounted on the left-hand side of the cockpit. The bomb release push-button in the throttle lever is used for firing the rockets.

29. **Gyro gunsight**

A gyro gunsight is mounted above the instrument panel, the master switch (29) being mounted on the left-hand side of the cockpit together with a dimmer and selector control (27). The ranging control is incorporated in the top of the throttle lever, and the control (8) to enable the sight to be used in conjunction with R.P. is at the top right-hand of the instrument panel. A switch for caging the gyro during violent manoeuvres is on the control column.

30. **Camera gun**

The camera gun is mounted in the leading edge of the starboard wing, outboard of the oil cooler, and is operated by the gun-firing pushbutton on the control column spade-grip. A footage indicator and an aperture switch

are on the shelf on the right-hand side of the cockpit : the camera master switch (62) is on the electrical panel. A separate pushbutton on the control column operates the camera gun independently of the guns. When not in use, the plug to the footage indicator should be put in the dummy socket on the shelf.

31. **Bomb controls**

The bomb selector and fuzing switches are mounted together on a panel on the right-hand cockpit wall above the main fuel cock. The bomb release pushbutton is in the top of the throttle lever and there is an emergency release (48) outboard of the left-hand sloping panel.

PART II
HANDLING

NOTE.—The use of oxygen is advised at all times when the engine is running.

32. **Management of the fuel system**

(i) Without drop tanks.—The locking plate provided should be fitted so that it is not possible to select DROP TANKS ON as this would prevent fuel from being transferred from the wing tanks to the main tank.

(ii) With drop tanks.—Start the engine, warm up, taxy out and take off with the drop tanks selector lever at ON and with the main tank cock ON. Continue to fly until the no-transfer warning light comes on, indicating that the transfer of fuel from the drop tanks has ceased, then select drop tanks OFF and continue the flight on wing tanks.

NOTE.—The drop tanks should not be jettisoned unless operationally necessary. Their drag is small and the gain in range when they are jettisoned is very slight.

33. **Preliminaries**

(i) On entering the cockpit check :

Ignition switches	OFF
Undercarriage lever locking catch	LOCK
Hood spring-loaded locking bolt	Correctly positioned (*see* para. 23 (ii)).

Then switch on the electrical master switch and check :

Undercarriage indicator... ...	all lights green.

NOTE.—The cowling gills will be open until the electrical master switch is turned on, when (on early aircraft) they will take up the position selected by the control switch, and (on later aircraft) will close completely unless the engine is hot.

(ii) Check that the footstep is retracted (*see* para. 26).

(iii) Check the operation of the hydraulic handpump by partially lowering, and then raising, the flaps.

(iv) Check that power failure warning light is on.

34. **Starting the engine and warming up**

NOTE.—Where a full run-up is intended, the tail of the aircraft must be securely lashed down.

(i) Set :

Gills (on early aircraft)	OPEN
Throttle	CLOSED
Fuel cut-off control	CUT-OFF
Flaps	UP (selector at VALVE SHUT)
Propeller speed control	OVERRIDE
Carburettor air intake filter control	FILTER (*see* para. 20)
Supercharger control	M (low gear)

(ii) Have the engine turned by hand through at least two revolutions of the propeller in order to avoid the possibility of hydraulic shock damage.

(iii) Turn on the main tank cock (checking the booster pump audibly), and open the throttle to the stop.

(iv) Load the cartridge starter.

(v) Prime the engine with the following number of strokes if cold :

Air Temperature °C.	+ 30	+ 20	+ 10	0
Number of strokes	1	1	2	3

(vi) Switch ON the ignition.

(vii) Press the starter and booster-coil pushbuttons, keeping the latter depressed until the engine is running smoothly. Move the fuel cut-off control to NORMAL as soon as the engine fires and continue to prime, if necessary, until the engine is running smoothly.

(viii) Should the engine fail to start, the fuel cut-off control must be returned immediately to CUT-OFF ; otherwise, fuel will be injected into the engine under pressure and there will be in consequence a serious risk of fire.

(ix) Should a cartridge fail to fire, a wait of one minute should be allowed before the Coffman starter breech is re-indexed.

(x) Screw down the priming pump.

(xi) Run the engine at its lowest steady speed for about one minute, then gradually open up to 1,000 r.p.m. and warm up at this speed.

35. **Testing the engine and services**

While warming up :

(i) Check all temperatures and pressures and test the operation of the hydraulic system by lowering and raising the flaps.

(ii) Test each magneto as a precautionary check before increasing power further.

After warming up to 120°C. (cylinder) and 15°C. (oil) .

(iii) Open up to 0 lb./sq. in. boost and check :

(*a*) That r.p.m. are within 50 of those normally obtained, thus verifying that all cylinders are operating.

NOTE.—Check that the generator is charging the accumulators by noting that the power failure warning light is out.

(*b*) The operation of the supercharger gear change by changing to high gear, noting the momentary drop in oil pressure and the flicker of the r.p.m. indicator.

(*c*) The correct engagement of the high gear clutches by noting that 0 lb./sq. in. boost is maintained and that r.p.m. are 80–100 below those obtained on the power check.

Then change back to low gear and

(*d*) Exercise and check the operation of the constant speed propeller by moving the speed control lever over its full range at least twice. Return it to OVERRIDE.

(*e*) Test each magneto in turn. If the single ignition drop exceeds 50 r.p.m. but there is no undue rough running the ignition should be checked at climbing power (*see* sub-para. (v) below).

NOTE. The following checks should be carried out after repair, inspection other than daily, or at any time at the discretion of the pilot. When these checks are performed the tail must be securely lashed down.

(iv) Open the throttle fully and check take-off boost and static r.p.m.

(v) Throttle back to the climbing gate and, if r.p.m. have fallen below 2,700, test each magneto in turn. If the single ignition drop exceeds 50 the aircraft must not be flown.

36. **Taxying**

(i) Before taxying check :

Brake pressure ... 100–110 lb./sq. in.

Pneumatic supply pressure ... ... 450 lb./sq. in. (if lower, ensure that it has built up during warming up and running up of the engine).

(ii) The brakes are very powerful and must be used with care.

37. **Check list before take-off**

T-Trimming tabs	At full normal load (11,800 lb.)	At overload (12,600 lb.) 2 × 45 gal. drop tanks	At overload (13,750 lb.) 2 × 1,000 lb. bombs
Elevator ...	1 div. nose down	2 divs. nose down	2 divs. nose down
Rudder ...	Fully left	Fully left	Fully left

P —Propeller speed control lever — OVERRIDE

F —Fuel ... ... — Check contents and cock settings. No-transfer warning light out (*see* para. 2 (v)).

F —Flaps ... — UP (Selector at VALVE SHUT)

Gills ... ... — ½ open (if manually operated) Check visually.

Supercharger — M (low gear).

Carburettor air intake filter control — FILTER

38. **Take-off**

(i) Always use full throttle for take-off.

(ii) The tendency to swing to the right can be controlled easily by the rudder.

(iii) Retract the undercarriage as early as possible after take-off. Should the undercarriage red lights fail to go out, throttle back and reduce speed to about 145–150 m.p.h. (125–130 knots) I.A.S. when the deceleration will allow the wheels to lock up.

(iv) Move the propeller speed control lever smoothly back to AUTO when comfortably airborne before reducing boost.

39. **Climbing**

(i) Unless operating in dusty or sandy conditions the carburettor air intake filter control should be set to COLD at a height of 2,000 ft.

(ii) The speed for maximum rate of climb is 190 m.p.h. (164 knots) I.A.S. from sea level to 20,000 ft., but there is little loss in rate of climb if speed is increased to 210 m.p.h. (180 knots) I.A.S.

40. **General flying**

(i) *Stability* :

The aircraft is stable laterally and directionally but is unstable longitudinally except on the glide. There is a slight tendency to tighten in turns at medium and high altitudes.

(ii) *Change of trim* :

Undercarriage up	Nose up.
Flaps up	Initially nose down, finally nose up.
Flaps down ...	Nose down (during the first 20° of flap movement the change of trim is marked).
Cockpit hood open	Nose down.

There is a marked change of directional trim with changes in speed and power, moreover, changes in directional trim induce changes in longitudinal trim, left yaw tending to make the nose drop and right yaw tending to make it rise.

These tendencies should be countered by accurate use of the rudder trimming tab. This control is powerful and sensitive and must be used with care.

Operation of the cowling gills produces a marked change of trim and in aircraft fitted with manually operated gills, no attempt should be made to open or close them when in a high speed dive.

(iii) *Flying at reduced airspeed in conditions of poor visibility.* Reduce speed to 200 m.p.h. (172 knots) I.A.S., open the cockpit hood and lower the flaps to 20°, set the propeller speed control lever to give 2,400 r.p.m. and fly at about 170 m.p.h. (146 knots) I.A.S. .

41. **Stalling**

(i) The stalling speeds, engine "off," gills closed, in m.p.h. (knots) I.A.S. are :

	At Overload (2×1,000 lb. bombs) 13,750 lb.	At Overload (2×45 gal. drop tanks) 12,600 lb.	At full Normal load (less drop tanks) 11,820 lb.	At light load (All ammunition expended and half fuel remaining). 10,570 lb.
Undercarriage and flaps UP	118 (102)	112 (96)	110 (94)	105 (90)
Undercarriage and flaps DOWN ...	106 (92)	103 (89)	100 (86)	95 (82)

NOTE.—With the gills open the above speeds are increased by approximately 5 m.p.h. or knots in all cases.

(ii) Warning of the approach of the stall is given by tail buffeting, which is more marked with the undercarriage and flaps up than with them down, and by aileron snatching which can be felt just before the stall itself. The right wing drops at the stall and the wing drop is more marked with the undercarriage and flaps up than with them down.

NOTE.—When carrying 2 × 1,000 lb. bombs the pre-stall buffeting is more pronounced.

(iii) Ample warning of the approach of a stall in a steep turn is given by tail bufleting. Further backward movement of the control column then induces aileron snatching and a tendency for the aircraft to flick out of the turn.

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42. **Spinning**

Intentional spinning is not permitted. Should an accidental spin occur, normal recovery action should be applied immediately and care must be taken in the recovery dive to prevent the aircraft pulling out too violently, causing a stall and probably another spin. This tendency is more noticeable if the aircraft is spun when flying at an aft C.G. loading. Spinning is accompanied by fore and aft pitching and considerable bufleting.

43. **Diving**

(i) The aircraft becomes increasingly nose heavy as speed is gained and should not, therefore, be trimmed into the dive.

(ii) Closing the throttle in the dive induces a further nose-down change of trim, and this should be borne in mind during combat.

(iii) Speed is gained very rapidly and care must be taken to avoid exceeding the limiting speeds.

(iv) The tendency to yaw to the left should be countered by accurate use of the rudder trimming tab. This control, like the elevator trimming tab control, becomes extremely sensitive at high speed.

NOTE.—On aircraft with the manual cowling gills control, the gills should be closed before the dive is commenced.

44. **Aerobatics**

(i) All normal aerobatics are easy to perform but a large amount of height may be gained or lost during some manoeuvres and an ample margin must be allowed.

(ii) The minimum speeds recommended, in m.p.h. (knots) I.A.S., are :

Loop	380 (324)
Roll	260 (223)
Half roll off the top of a loop	400 (344)
Climbing roll	400 (344)
Upward roll	450 (387)

45. **Check list before landing**

Reduce speed to 200 m.p.h. (172 knots) I.A.S. and check :

Brake pressure	
U—Undercarriage ...	DOWN (check by indicators and warning light)
P—Propeller speed control lever	Set for 2,400 r.p.m. (fully forward on the final approach)
F—Flaps	20° DOWN
Gills	SHUT (if manually operated)
Supercharger ...	M (low gear)
Carburettor air intake filter control	FILTER

Reduce speed to 150 m.p.h. (128 knots) I.A.S. and lower flaps fully. Then return the selector to VALVE SHUT.

46. **Approach and landing**

(i) The recommended final approach speeds in m.p.h. (knots) I.A.S. are :

	At full normal load (less drop tanks)	At light load (all ammunition expended and half fuel remaining)
Flaps fully down		
Engine assisted	115 (99)	110 (95)
Glide	130 (112)	125 (107)
Flaps up		
Engine assisted	130 (112)	125 (107)

(ii) The initial straight approach should be made at a speed some 10–15 m.p.h. or knots above these figures.

(iii) (*a*) Should it be necessary in emergency to land at overload weights the recommended final approach speeds in m.p.h. (knots) I.A.S. are as follows :

	At overload (12,600 lb.) 2 × 45 gal. drop tanks full	At overload (13,750 lb.) 2 × 1,000 lb. bombs
Flaps fully down		
Engine assisted	120 (102)	125 (107)

(*b*) Should it be necessary in emergency to land with one bomb only, speed on the circuit and final approach should not be allowed to fall below 130 m.p.h. (112knots) I.A.S. Below this speed full aileron is insufficient to hold the wings level. The recommended approach speed is 150 m.p.h. (130 knots) I.A.S., and only 40° flap should be used to maintain adequate lateral control. All turns should be made with the single bomb on the outside of the turn.

(iv) The pilot must be prepared for a tendency to swing to port after landing.

NOTE.—The brakes are very powerful and must be used carefully as it is easy to overcorrect a swing if they are applied coarsely.

47. Mislanding

(i) The aircraft will climb away easily with the flaps and undercarriage down with the throttle at the climbing gate.

(ii) Before the undercarriage is raised the flaps selector lever must be at VALVE SHUT, otherwise the undercarriage will not retract fully.

(iii) Raise the undercarriage and climb at 140–145 m.p.h. (120–125 knots) I.A.S.

(iv) Raise the flaps in stages above 300 ft. retrimming as required.

48. Beam approach

	Preliminary Approach	Inner Marker on Q.D.R.	Outer Marker on Q.D.M.	Inner Marker on Q.D.M.
Indicated height (feet) ...	Down to 1,500	1,000	700–800	150
Action ...	Lower the flaps 20°	Lower the undercarriage	Lower the flaps fully	Throttle back slowly
Resultant change of trim	Strongly nose down	Nose down	Nose down	Slightly nose down
I.A.S.	170 m.p.h. (146 knots)	160–170 m.p.h. (137–146 knots)	130 m.p.h. (112 knots)	115 m.p.h. (99 knots)
R.P.M. ...	2,400	2,400	2,400	2,700
Boost (level flight)	4	2	1½	
Boost (500 ft. min.) ...	–6	–3	–2½	—
Boost (overshoot ...	—			+6

Remarks : (i) Set the carburettor air intake filter control to FILTER before commencing the preliminary approach.
(ii) Before lowering the flaps 20° reduce speed to 200 m.p.h. (172 knots) I.A.S.

Overshoot
Raise the undercarriage and retrim. Climb at 150 m.p.h. (128 knots) I.A.S. and raise the flaps in stages above 300 ft. retrimming as required.

Altimeter error at take-off + 20 feet
Altimeter error at touch down + 60 feet
Subtract 2 millibars from QFE to give zero reading at touchdown.

49. After landing

(i) Before taxying raise the flaps and open the gills (if manually operated).

On reaching dispersal :

(ii) Open up to not more than 0 lb./sq. in. boost and exercise the two-speed supercharger by changing to high gear, running in that gear for 30 seconds, and then changing back to low gear.

(iii) Idle the engine at 800-1,000 r.p.m. for a short period, and then stop it by closing the throttle and setting the fuel cut-off control to CUT-OFF.

(iv) Turn off the fuel and switch off all the electrical services, including the electrical master switch.

NOTE.—Starter cartridges should be removed overnight to avoid deterioration.

(iii) *Fuel consumptions*

The approximate rich mixture consumptions are as follows :

Supercharger gear	Boost lb./sq. in.	R.p.m.	gals./hr.
M (low)	+8½	2,700	240
S (high)	+8½	2,500	260
M (low)	+6½	2,400	210
S (high)	+6	2,400	300

The approximate weak mixture consumptions in gals./hr. at 5,000 ft. in M (low) gear and at 15,000 ft. in S (high) gear are as follows :

Boost lb./sq. in.	R.p.m.				
	2,400	2,200	2,000	1,800	1,600
−2	96	90	83	—	—
−1	90	84	78	69	—
0	84	78	72	63	56
+1	78	73	66	58	54

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(contd.)

speeds are 60 m.p.h. (52 knots) less than those for a "clean" aircraft.

NOTE.—The drag of the drop tanks is small and they should not be jettisoned unless necessary operationally. While jettisoning, the aircraft should be flown straight and level. 45-gallon drop tanks may be jettisoned at any speed between 230 m.p.h. (200 knots) I.A.S. and 400 m.p.h. (348 knots) I.A.S. and 90-gallon drop tanks may be jettisoned at any speed between 210 m.p.h. (183 knots) I.A.S. and 300 m.p.h. (260 knots) I.A.S.

(d) Other limitations

	I.A.S. m.p.h.	I.A.S. knots
Undercarriage down	210	183
Flaps down to 20°	210	183
Flaps fully down	160	140
Sliding hood	300	260

(iii) *Maximum permissible all-up weights*

Take-off, straight flying and gentle manoeuvres	13,750 lb.
All forms of flying and landing	12,000 lb.

NOTE.—Landings above this weight should only be made in an emergency.

52. **Position error corrections**

(i) The air speed indicator corrections are as follows :—

From ...	130	160	200	300	m.p.h. I.A.S.
To ...	160	200	300	400	
Deduct ...	2				m.p.h.
Add ...		2	4	6	

From ...	111	137	172	258	knots I.A.S.
To ...	137	172	258	344	
Deduct ...	2				knots
Add ...		2	4	6	

(ii) The corrections for altimeter are :

From ...	150	200	300	350	m.p.h. I.A.S.
To ...	200	300	350	400	
Add ...	20	60	120	200	feet

From ...	128	172	258	301	knots I.A.S.
To ...	172	258	301	344	
Add ...	20	60	120	200	feet

53. **Maximum performance**

(i) Climbing.—The speed for maximum rate of climb is 190 m.p.h. (164 knots) I.A.S. from sea level to 20,000 feet, thereafter decreasing speed by 3 m.p.h. or knots per 1,000 ft. Change to high gear when, with the throttle at the climbing gate, the boost in low gear has fallen to + 3 lb./sq. in.

(ii) Combat.—Change to high gear when the maximum obtainable boost in low gear is + 4½ lb./sq. in.

54. **Economical flying**

(i) Climbing.—With the propeller speed control lever at AUTO set the throttle to the economical cruising gate and climb at the speed for maximum rate of climb given in para. 53. Change to high gear when, with the throttle in this position, the boost in low gear has fallen to 0 lb./sq. in.

(ii) Cruising. With the propeller speed control lever at AUTO adjust the throttle to maintain a speed of 230 m.p.h. (198 knots) I.A.S. but do not advance the throttle beyond the economical cruising gate. Low gear should always be used if the recommended speed can be obtained with the throttle lever at or behind the cruising gate and the propeller speed control lever at AUTO.

55. **Fuel capacity and consumption**

(i) *Capacities :*

	gallons
Main tank	76
2 Interspar tanks (each 28 gal.)	56
Nose tank	28
Total (permanent tanks)	160
2 Drop tanks (each 45 gal.)	90
Total all tanks	250

(ii) *Fuel consumptions*

The approximate rich mixture consumptions are as follows :

Supercharger gear	Boost lb./sq. in.	R.p.m.	gals./hr.
M (low)	+8½	2,700	270
S (high)	+8½	2,700	260
M (low)	+6	2,400	210
S (high)	+6	2,400	200

The approximate weak mixture consumptions in gals./hr. at 5,000 ft. in M (low) gear and at 15,000 ft. in S (high) gear are as follows :

Boost lb./sq. in.	R.p.m.				
	2,400	2,200	2,000	1,800	1,600
+2	96	90	83	—	—
+1	90	84	78	69	—
0	84	78	72	63	56
−1	78	73	66	58	54

PART IV

EMERGENCIES

56. **Undercarriage emergency operation**

If after selecting DOWN the undercarriage does not lower normally or the correct sequence of lights does not appear, proceed as follows :

(i) Return the undercarriage selector lever to UP.

(ii) Lower the flaps 30° by means of the handpump, then reduce speed to 130 m.p.h. (112 knots) I.A.S.

NOTE.—If the undercarriage red lights are on, up to 80 double strokes of the pump may be required to lower the flaps.

(iii) Return the flaps selector lever to VALVE SHUT, select undercarriage DOWN and operate the handpump until the green lights come on. This may require up to 120 double strokes of the pump (resistance will at first be very light) but if the red lights do not come on after the first 12 strokes, this method of lowering the undercarriage should be abandoned and the following procedure adopted :

(iv) Leave the undercarriage selector lever at DOWN, ensure that the aircraft is flying straight and then press the emergency release pedals one at a time. This may require a considerable force.

(v) After the red lights come on, allow a few seconds for the wheels to drop, and then operate the pneumatic assister at the same time yawing the aircraft from side to side.

NOTE.—If the wheels do not lock down, close the throttle fully and, still maintaining a speed of 130 m.p.h. (112 knots) I.A.S., yaw the aircraft again. The lower attitude of the nose should ensure that the wheels lock down.

(vi) If, in the first instance, it is not possible to lower the flaps 30°, speed should be reduced only to 150 m.p.h. (128 knots) I.A.S. before the procedure outlined in (iv) and (v) above is followed.
In this case more drastic yawing of the aircraft will probably be necessary before the wheels lock down ; this (due to the lower attitude of the nose, engine " off ") will be more effective if the throttle is first closed.

(vii) Check the visual indicators before landing.

(viii) The tailwheel lowers automatically on failure of the hydraulic system and locks on touching down.

57. **Hood jettisoning**

(i) The sliding hood (together with the right side-panel of the cockpit) may be jettisoned by pulling the yellow T-handle on the lower right-hand side of the instrument panel.

NOTE.—(*a*) A vigorous pull is required to operate the handle.
(*b*) Before jettisoning the hood the pilot should lower his seat fully and should keep his head well down.

(ii) The hood may be jettisoned from outside by pulling a cable (fitted in the footstep for climbing from the wing into the cockpit). The cable is clearly marked with yellow paint.

58. **Ditching**

(i) Wherever possible the pilot should abandon the aircraft by parachute rather than attempt to ditch it.

(ii) If ditching is unavoidable
(*a*) Jettison bombs, R/P or drop tanks if carried.
(*b*) Jettison the cockpit hood and disconnect the R/T plug.
(*c*) If the engine is still available lower the flaps fully and use the engine to help make the touchdown in a tail-down attitude at as low a forward speed as possible. If the engine has failed do not lower the flaps more than 30° ; otherwise, the rate of sink will be very high and judgment of the hold-off will in consequence be rendered more difficult.

(*d*) Ditching should be along the swell or into wind if the swell is not steep.

59. **Tyre bursting**

If it is known that a tyre has burst, no attempt should be made to land with the undercarriage lowered. Greater safety to the pilot and less damage to the aircraft will result from a belly landing.

60. **Emergency equipment**

A crowbar is stowed on the outboard side of the right heelboard. Mod. 363 re-positions the stowage behind the pilot's head.

61. **Emergency lighting**

There is an emergency lamp on the cockpit decking for use should the normal lighting fail. It is supplied with current from a small battery (59) mounted on the electrical panel and is controlled by a switch (61) also mounted on the electrical panel.