

## PART IV EMERGENCY HANDLING

### 88. Action in the event of fire

- (a) If the engine fire warning light comes on, the throttle should be closed immediately. If the light then goes out within 5 seconds, a hot gas leakage as distinct from a fire is indicated. It is safe to use the engine in this condition, but a landing should be made as soon as practicable. Reduced power should be used, but unless the power required is small the light will probably come on again. It is advisable, therefore, to throttle back every 5 minutes to check the light goes out in order to ensure that a fire has not started.
- (b) Should the light remain on after throttling back, a fire is indicated. Should a fire occur; set:—
- |               |     |
|---------------|-----|
| H.P. cock     | OFF |
| L.P. cock     | OFF |
| Booster pumps | OFF |
- and quickly reduce airspeed to a practicable minimum. Then press the extinguisher pushbutton. Should the light remain on and the fire persist, the aircraft should be abandoned.
- (c) If a satisfactory extinction has occurred the warning light should go out as the circuit is broken by the cooling of the flame switches. *The engine must not be restarted*, due to the risk of fire with the fire fighting resources exhausted.
- (d) Carry out forced landing procedure (see para. 93), or abandon.

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### 89. Electrical system failures

#### (a) Single generator failure

If either generator fails, the output of the other is sufficient for non-combat flying provided that all non-essential electrical services are off and that engine r.p.m. are maintained above 4,000.

#### (b) Double generator failure

If both generators fail, all electrical services will be supplied by the batteries. These, *if fully charged*, will last:—

At combat load, including radar ranging    2 mins. max.  
At combat load, excluding radar ranging    8–9 mins. max.

#### (c) Battery failure

Once the batteries are discharged, no electrical services may be operated, e.g. trim tab actuators, tailplane motors, electro-hydraulic selectors, etc. *If the flying controls are in Power selection of Manual will not be possible.* In addition the fuel gauges, Mk. 4F compass and electrically-operated flight instruments will become unserviceable. The fuel booster pumps will cease operation, which may entail reduction in altitude and engine r.p.m. to ensure satisfactory engine running. (See para. 56 (f) (ii).) No relight facilities will be available when the batteries are fully discharged.

#### (d) Action in the event of double generator failure

- (i) If complete generator failure occurs, switch off all non-essential electrical services to conserve the battery for as long as possible.
- (ii) Set the tailplane angle to zero incidence.
- (iii) Provided that the engine is running correctly and hydraulic pressure is normal the flying controls may be left in Power. The magnetic indicators will show white when the batteries are discharged although the controls will remain in Power.

NOTE.—If any doubt as to the serviceability of the hydraulic system exists, select Power OFF before the batteries are discharged.

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### (e) *Emergency operation of the tailplane*

If the normal tailplane motor fails, or "runs away", lift the cover of the standby switch on the port shelf and use that control. Rate of operation of the latter is about one-third that of the normal control. If complete electric failure occurs, control of the tailplane is impossible. It is important therefore to set the tailplane to zero incidence before the batteries are fully discharged.

## 90. **Hydraulic system failures**

### (a) *Complete hydraulic failure*

(i) Periodic checks of the triple pressure gauge should be made in flight and the central needle should normally read  $3,000 \pm 150$  lb./sq. in. If the reading drops substantially below this figure when no service is being operated, then hydraulic failure should be suspected. The red warning light, and the audio warning when mod. 327 is fitted, should come on if the pressure falls below 600 lb./sq. in.

(ii) If the hydraulic supply pressure fails, there may be sufficient reserve in the power controls accumulators for a maximum of  $3\frac{1}{2}$  full reversals of aileron and elevator, the actual reserve depending on the state of charge of the respective accumulators at the time of failure. However, even if no control movement is made, accumulator pressure will not be maintained for a long period, due to normal hydraulic component seepage. When the accumulators are exhausted the controls will revert automatically to Manual.

(iii) A failure in the power controls hydraulic circuit, as distinct from supply failure, may lead to immediate and automatic Manual reversion when the pressure at the locking pawls has fallen well below that at which the warning light becomes illuminated.

(iv) The wheel brakes accumulators provide sufficient pressure for brake operation during landing down to an accumulator pressure reading of 750 lb./sq. in. approximately. (1,500 lb./sq. in. unmodified aircraft.)

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### (b) *Action in the event of complete hydraulic failure*

(i) Complete failure will be indicated by a loss of pressure on the gauge followed by the red light coming on and, when mod. 327 is incorporated, by the audio warning.

(ii) Immediate action should be:—

(1) Reduce speed to 250 knots, or if above 40,000 ft. 0.80M.

(2) Release the aileron trim safety lock and check that the trim indicator shows zero.

(3) The controls may be left in Power, providing electrical supply is normal, but when Manual reversion occurs, and in any case at a safe height before joining the circuit switch OFF elevator and aileron Power.

(iii) Lower undercarriage and flaps on the emergency systems.

### (c) *Partial hydraulic failure*

Partial hydraulic failure can occur due to a type of leak which could cause complete loss of pressure during the operation of a service, but which would allow pressure to build up again when the operation is complete. This type of failure can cause the power controls to disengage temporarily and re-engage with the possibility of a false anchorage.

### (d) *Action in the event of partial hydraulic failure*

(i) Reduce speed to 250 knots or 0.80M.

(ii) Release aileron trim safety lock and check that trim indicator shows zero.

(iii) The controls may be left in Power to assist in manoeuvring, providing electrical supply is normal, but should a false anchorage occur and in any case before landing, switch OFF elevator and aileron Power.

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- (iv) If a partial hydraulic failure occurs subsequent to complete electric failure when the controls are still in Power, the landing is likely to be extremely hazardous, and it is recommended that the aircraft be abandoned.

### 91. Engine failure and flame-out

#### (a) Engine seizure

Engine seizure will involve both hydraulic and electric supply failure. If the engine has failed due to obvious mechanical causes do not attempt to relight. Proceed as follows:—

- (i) Close the throttle. Turn off the H.P. and L.P. cocks and switch off the booster pumps.
- (ii) Reduce speed and glide at 210 knots.
- (iii) Switch off all unnecessary electrics.
- (iv) Set tailplane incidence to zero. Release aileron trim safety lock and check that trim indicator is at zero.
- (v) The controls may be left in Power, but manual reversion must be expected.
- (vi) Carry out forced landing procedure (See para. 93), or abandon.

#### (b) Sudden drop in engine speed

- (i) If a sudden inexplicable drop in engine speed occurs, which cannot be identified as engine surge (see para. 57), proceed as follows:—

*Above 20,000 ft.* Close the throttle fully and descend; check engine response to throttle movement during the descent.

*Below 20,000 ft.* If the engine fails to respond to normal throttle movements, close the throttle fully and (when fitted) set the H.P. pump isolating switch to ISOLATE. If the engine still fails to respond to

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throttle movement, leave the switch at ISOLATE and carry out relight action. Once the switch has been set to ISOLATE it must be left there for the remainder of the flight; with it thus set the A.C.U. is ineffective and all throttle movements must be made with care.

- (ii) If this type of failure occurs when no isolating switch is fitted, it is unlikely that relight action will be successful.

#### (c) Flame-out

Should flame-out occur, indicated by engine r.p.m. dropping below 3,000 the immediate action should be:—

Throttle	Closed
H.P. cock	OFF
L.P. cock	Leave ON
Booster pumps	OFF
All non-essential electrical services	OFF

### 92. Relighting

NOTE.—The maximum relight altitude is 35,000 ft. When relighting above 25,000 ft. the airspeed should not exceed 200 knots; below 25,000 ft. the speed should not exceed 0.80M. Relights are obtained more readily at lower altitudes and with lower airspeeds.

#### (a) Check:—

All non-essential electrics	Off
Throttle	Closed
H.P. pump isolating switch	As required (see 91 (b))
Battery master switch	On
Ignition switch	On
Engine master switch	On
Booster-pumps	On

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- (b) Press the relight button and at the same time open the H.P. cock. R.p.m. should commence to rise almost immediately. (If this does not occur after 30 seconds release the relight button, turn the H.P. cock OFF and allow a period of 30 seconds to elapse to dry out the engine before the next attempt). The initial rise in j.p.t. may be small. When the r.p.m. rise to idling release the relight button and open the throttle.
- (c) Every precaution should be taken to ensure a successful first attempt relight due to the heavy loads on the batteries and the possible risk of fire on subsequent attempts. If the engine and its fuel system are serviceable and the drill is followed correctly, a relight should occur at the first attempt.
- (d) *Emergency relighting*

WARNING.—Although use of this method may not cause damage to the starter motor, the risk exists.

- (i) In circumstances where the engine cannot be relit by use of the above drill, *provided that the pilot is reasonably sure that the fault lies in the relight button circuit*, it may be possible as a last resort to obtain a light-up by using the starter push-button in the following way:—

- (ii) Check:—

Height	Below 15,000 ft.
All non-essential electrics	Off
Throttle	Closed
Booster pumps	On
Engine master switch	On
Ignition switch	On

Reduce engine windmilling speed to a minimum to avoid damage to the starter motor drive due to shock engagement. Open the H.P. cock and, with no G applied to the aircraft, press the starter button. The igniters will function irrespective of whether a cartridge is fired or not.

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- (e) *Failure to relight*

- (i) If the engine fails to relight turn off the H.P. and L.P. cocks and switch off all non-essential electrical services (including the booster pumps).
- (ii) Set the tailplane incidence to zero and reduce speed to the trimmed condition.
- (iii) Release the aileron trim safety lock and check that the trim indicator is at zero.
- (iv) Carry out forced landing procedure (see para. 93) or abandon.

93. **Forced landing procedure**

NOTE.—All the circumstances prevailing at the time of engine, hydraulic, or electrical failure cannot be predicted. Each system and the effects of failure of each system must thoroughly understood. The following information is intended to help the pilot reach the best decision.

- (a) In all cases of engine failure when a relight is not possible or practicable glide at 210 knots. If a deceleration is required to obtain the correct gliding speed climb rather than use the airbrake. If used, the airbrake requires considerable hydraulic power and constitutes a hazard on landing should it remain out.
- (b) Check and/or set the following:—
- |                             |                                       |
|-----------------------------|---------------------------------------|
| H.P. and L.P. cocks         | OFF                                   |
| Booster pumps               | OFF                                   |
| Tailplane incidence         | Zero                                  |
| All non-essential electrics | OFF                                   |
| Aileron trim                | Safety lock off<br>Indicator zero     |
| Elevator and aileron power  | Leave on temporarily, but select OFF. |
- (1) Before electric power fails.
- (2) If a false anchorage occurs.

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- (c) (i) Engine failure may lead to either or both electrical and hydraulic failure. Experience shows that at 200 knots windmilling r.p.m. will create sufficient hydraulic pressure for limited use of the power controls, but large or frequent use of the controls or selection of any of the services may cause Manual reversion. If pressure then rebuilds false anchorages may occur.
- (ii) Selecting Power off can only be accomplished whilst electrical power is available. *To avoid the danger of obtaining a false anchorage with no electrical power available and to prevent inadvertent Manual reversion at an inconvenient stage of the approach, select Power off before electrical failure occurs.*
- (iii) If electrical failure occurs before Manual can be selected, to keep in Power, windmilling r.p.m. should be maintained as high as possible and control movements kept to a minimum; if a reversion to Manual then follows, reduce airspeed (not below 170 knots) to decrease windmilling r.p.m. and use the controls excessively to avoid a rebuild of pressure. In these circumstances the landing is likely to be extremely hazardous and it is recommended that the aircraft be abandoned.
- (iv) If a false anchorage occurs with no electric power available it can only be cleared as described in para. 87. If for any reason this is not possible the aircraft must be abandoned.
- (d) If electrical power is still available, the undercarriage and flaps may be lowered by means of the normal systems, but the services will take longer than usual to lower. If electrical power is not available, the emergency systems can be used, but the undercarriage, once locked down, cannot be retracted either in the air or on the ground in the event of overshooting, and the flaps can only be lowered to the fully-down position.
- (e) (i) If a forced landing on an aerodrome is being made attempt to arrive overhead at approx. 6,000 ft. (7,000 ft. in Manual) or above.

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- (ii) Plan a Manual approach and aim to be downwind opposite the caravan at 4,000 ft. A.G.L. at 175 knots.
- (iii) Turn across wind maintaining speed at 175 knots and when it is certain the touch-down point can be reached select full flap.
- (iv) Commence the round-out at approximately 150 knots.

- NOTE.—1. Experience suggests that it is preferable to lower the undercarriage when making a forced landing on an aerodrome or in open country. In the down position it absorbs much if not all of the initial impact, assists in retarding the aircraft, and, provided that electrical power is available and that the emergency lowering system has not been operated, it may be retracted after touch-down if necessary. With the undercarriage up, the aircraft must be lowered gently on to the ground *at the normal speed*; if the speed is too low a wing drop is likely to occur and if the speed is too high the aircraft is prone to bounce, the initial impact having a damaging effect on the cockpit.
2. With the undercarriage down the rate of descent is high and it increases rapidly as speed is reduced below 180 knots.
3. For practice forced landings, a flap setting of 30° and 4,500 r.p.m. (min.) will give a rate of descent comparable with an engine-off glide.

#### 94. Undercarriage and flaps emergency operation

NOTE.—The emergency systems are designed to lower the undercarriage and flaps in the event of hydraulic failure or electrical failure or both. Both systems operate independently of their respective normal selectors. If either system is used for any reason when both electric and hydraulic power is available, all hydraulic fluid will be dumped overboard.

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### (a) Undercarriage

- (i) If the undercarriage fails to lock down by normal operation when both the electric and hydraulic systems are serviceable, repeated raising and lowering and the application of side-slip or G may have the desired effect.

If it is suspected that a sequence valve is at fault (and this is indicated by a door remaining closed with the wheel partially down—a check by the control tower or a forming aircraft will confirm or deny this), the emergency system should be operated. If the hydraulic pressure is normal and the sequence valve does not appear to be at fault the emergency system, which operates at a lower pressure, is not likely to lock the undercarriage down and the implications of the NOTE should be borne in mind.

- (ii) In case of electric or hydraulic failure or both, first push in the knob of the emergency lowering control, then pull the handle. The system takes about 10 seconds to lock the undercarriage down. When fully lowered it is not possible to retract it again either in the air or on the ground.
- (iii) To raise the undercarriage on the ground in an emergency following normal selection, rotate and press the normal UP selector button. It must not be used in this way to retract the undercarriage in the air as there is a risk of the legs being retracted when not fully extended and the leg fairings may be damaged. If the UP button cannot be pressed in normally after take-off, the wheels must be left down and the aircraft landed.

### (b) Flaps

If electrical or hydraulic supply failure has occurred the flaps may be lowered, fully down only, by pulling out the emergency lowering control after first pushing in the central knob.

## 95. Effect of undercarriage and flaps emergency operation on powered controls

- (a) If the emergency undercarriage selector is used when either of the normal selector buttons is in, or if flap is

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lowered by the emergency system, providing electrical and hydraulic power is available, all the hydraulic fluid will be dumped overboard. The reason for this is that with either of the undercarriage push buttons in, or with flap fully down, the respective ports in the selector valves are open, allowing all fluid to pass through. When all fluid is jettisoned, Manual reversion will occur.

- (b) With the normal undercarriage and flap controls UP dumping will be rapid via the pressure line and Manual reversion will occur when the accumulators are exhausted.
- (c) With the normal selectors DOWN, dumping will occur at a reduced rate via the return line and Manual reversion will occur when all hydraulic fluid has been passed through the power control jacks.
- (d) If complete electrical failure occurs, the solenoids in the selector valves will be de-energized, enabling the slide valves to adopt a neutral position thus blanking off both the up and down ports. In this case only the fluid in the lower end of the jacks will be jettisoned.
- (e) If, while electrical power is still available, it is necessary to use the undercarriage emergency lowering system because of sequence valve failure, dumping of all the hydraulic fluid can be avoided by simulating the situation in (d) above as follows:—
  - (i) Select “up” normally to ensure that the down selector button is out.
  - (ii) Pull out the “up” button, this requires little effort.
  - (iii) Operate emergency air selector.

With both buttons out, both solenoids are de-energized and only the fluid in the lower end of the jacks will be jettisoned. The flying controls will remain in power and the flaps may be operated by the normal system.

## 96. Landing with an undercarriage unit not locked down

NOTE.—Experience has shown that these techniques cause minimum damage to the aircraft and none to the pilot.

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### (a) *Both main wheels only locked down*

- (i) Use up as much fuel as is safe in order to move the C. of G. as far aft as possible. Unless circumstances dictate otherwise land on a runway.
- (ii) Check harness tight and locked.
- (iii) Select hood open when crossing the threshold.
- (iv) Make a powered approach, touch down at the normal speed, and maintain a moderate nose-up attitude.
- (v) Close the throttle, turn off the H.P. cock.
- (vi) Trim the tailplane to give full nose-up trim and as the speed falls below 100 knots maintain a high nose-up attitude without actually touching the tail cone on the ground.
- (vii) When the nose drops on to the runway at approximately 80 knots use the brakes gently to keep straight.

### (b) *Nose wheel and one main wheel locked down*

If all attempts to lower the undercarriage satisfactorily fail and only the nose wheel and one main wheel come down, make a normal approach and landing; after touch down hold the wings level for as long as possible by use of the ailerons. When aileron is applied and when the wing finally drops, the aircraft will swing in the direction of the unlocked wheel; this should be counteracted as much as possible by opposite brake. A runway should be chosen which has an area about 800 yards wide available in the direction of the anticipated swing.

### (c) *Belly landing*

If it is necessary to land with the undercarriage retracted, make a normal approach and fly the aircraft gently on to the runway at the normal speed.

## 97. **Landing with a burst tyre**

No special difficulty is encountered when landing with a burst tyre(s), directional control and braking being adequate.

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## 98. **Flapless landing**

A longer than usual powered approach should be made and the boundary crossed at the normal speed. The landing run is very much increased.

## 99. **Wheel brakes emergency operation**

- (a)
  - (i) Should the hydraulic system fail, the wheel brake accumulators provide sufficient pressure for brake operation during landing, down to a gauge reading of 750 lb./sq. in. approximately (1,500 lb./sq. in. unmodified aircraft). To conserve pressure when landing without main hydraulic pressure do not operate the lever during the down-wind checks.
  - (ii) If maxaret units are fitted apply brake pressure in such a way that maxaretting does not occur (little pressure at high speed but increasing with decrease in speed) and avoid differential braking as much as possible. The brake lever should not be released after brakes have once been applied as this will result in a large loss of fluid.
  - (iii) If maxaret units are not fitted the brakes should be applied gently as soon as possible after touch-down and continuous pressure maintained. If care is taken to avoid locking the wheels, a landing should be achieved on one brake application.
- (b) The H.P. cock should be put OFF on touch-down, if the brakes accumulator pressure is low and the runway short.
- (c) Check the accumulator pressure after landing. If it is almost exhausted i.e. nearly down to 750 lb./sq. in. (1,500 lb./sq. in. unmodified aircraft) the aircraft must not be taxied.

## 100. **Emergency use of oxygen**

### (a) *Toxic fumes*

If the cockpit becomes contaminated with toxic fumes, set the air-dilution switch on the regulator to 100% OXYGEN and deflect the EMERGENCY switch to either side, to prevent inward leaks on the mask.

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### (b) *Blinker failure*

- (i) If the blinker mechanism ceases to operate check that the main tube is correctly connected, that the pressure on the regulator gauge is normal and that the main oxygen contents gauge is indicating that oxygen is still available.
- (ii) If the above indications are satisfactory depress the regulator EMERGENCY switch when in the central position. A supply of oxygen under increased pressure indicates that the regulator is serviceable but that the blinker mechanism is defective. If the regulator is unserviceable, as indicated by no flow, descend immediately to a safe altitude and check all oxygen tube connections.

### (c) *Use of emergency bottle*

- (i) If it is necessary to use the emergency oxygen bottle through failure of the regulator or because of exhaustion of the main supply, pull up the emergency control on the right of the seat, and disconnect the mask tube from the main supply point.
- (ii) The main supply tube is automatically released and the emergency bottle brought into use on ejection.
- (iii) The duration of supply from the emergency bottle is 10 minutes only.

### 101. **Hood jettisoning**

The hood is jettisoned by pulling the handle on the port shelf. To ensure a clean jettison, the hood must be closed and the speed should be in excess of 140 knots. The aircraft may be flown at speeds up to 420 knots with the hood jettisoned, but above this speed suction on the pilot's helmet may be disconcerting.

### 102. **Abandoning the aircraft**

- (a) Reduce speed as much as possible, set parachute container fully back, and lower the seat fully.
- (b) Jettison the hood and retract the GGS. If electrical power is available, the GGS should automatically lower on jettisoning the hood.

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- (c) Place the feet in the footrests, at the same time grasping the firing handle. The elbows must be drawn in close to the body and both hands must grasp the handle firmly, the backs of the hands facing forward.
- (d) Draw the handle and face screen firmly over the face, keeping the head pressed hard against the headrest. It is not necessary to jerk the handle and in no circumstances should the blind be pulled outwards away from the face, as it may not then be possible to fire the cartridge.
- (e) After ejection, the drogue gun will fire automatically.
- (f) If ejection takes place above 10,000 ft. automatic separation will not occur until that height is reached. If ejection takes place at or below 10,000 ft. automatic separation will occur within 3 seconds.
- (g) If the automatic system fails after ejection:—
  - (i) When forward speed is sufficiently low, discard the face screen and disconnect the main oxygen tube from the seat.
  - (ii) Pull the override D-ring to isolate the parachute auto device.
  - (iii) Operate the harness quick release.
  - (iv) Disengage the seat restraining straps.
  - (v) Lift the flap over the rip-cord D-ring and grasp the handle.
  - (vi) Push clear of the seat and pull the rip-cord handle.

### 103. **Ditching**

- (a) Model tests of a clean aircraft indicate that a ditching in any but ideal conditions would be very hazardous.
- (b) It is recommended, therefore, that except in calm sea and air conditions combined with good visibility, the pilot should bale out rather than attempt a ditching.

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(c) If ditching is inevitable:—

- (i) Jettison the hood, select 100 per cent oxygen and deflect the emergency toggle sideways.
- (ii) Lower full flap and make the approach at the lowest forward speed and rate of descent compatible with good control.
- (iii) Ditch along the swell, or, if the swell is not steep, into wind.

NOTE.—The airbrake must be retracted.



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