PART IV
EMERGENCY HANDLING

72. Engine failure and relighting in flight

(i) *Mechanical*

If the engine fails due to obvious mechanical causes, immediately turn off the H.P. and L.P. cocks, switch off the booster pumps, and all non-essential electrical services. (See paras. 74 and 79.) *Do not attempt to relight.*

(ii) *Flame-out* (See also para. 79 (ii) (b))

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

Throttle	Close
H.P. cock	OFF
L.P. cock	Leave ON
Booster pumps	Leave ON
A11 non-essential electrical services	OFF

(iii) *Relighting*

(a) Reduce height rapidly to 30,000 ft. or below and maintain a speed to give approximately 1,200 r.p.m. (windmilling speed).

(b) Check:—

All non-essential electrics	Off
Throttle	Closed
Ignition switch	On

(c) Press the relight button and open the H.P. cock, keeping the button pressed until the engine lights up and r.p.m. begin to rise by about 200. R.p.m. should commence to rise almost immediately. (If this does not occur after 15 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.) When the r.p.m. rise to idling, release the relight button and open the throttle.

(d) 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.

73. Action in the event of fire

(i) If the fire warning light comes on, the throttle should be closed immediately. Should further symptoms of a fire then 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.

(ii) 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. (See paras. 74 and 79.)

74. Electrical system failures

(i) *Generator failures*

(a) 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) 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.

If conservation of battery power is essential and flight conditions permit, switch off *all* electrics, including instruments and booster pumps. Nevertheless it is recommended that in all cases preparation for landing, e.g. tailplane selection, etc., is carried out immediately. No service can be expected to operate after the VHF fails to receive.

(ii) *Battery failure*

Once the batteries are dead, no electrical services may be operated, e.g. trim tab actuators, tailplane motors, electro-hydraulic selectors, etc. 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.

(iii) *Inverter failure*

(a) If No. 1 inverter fails, automatic changeover to No. 2 inverter occurs and continuous operation of the

electrical flight instruments is ensured. At the same time the radar ranging becomes inoperative.

(b) If No. 2 inverter fails, operation of radar ranging will be impossible.

(c) The radar ranging magnetic indicator shows white whenever No. 2 inverter is in operation either through auto-changeover, or when radar ranging is in use.

75. **Hydraulic system failure**

(i) Periodic checks should be made of the triple pressure gauge, the central needle of which should normally read 3,000 ± 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 should come on when the pressure has fallen to below 600 lb./sq. in.

(ii) The emergency handling of the undercarriage, flaps, wheel brakes and flying controls is dealt with under those respective headings.

76. **Undercarriage and flaps emergency operation**

NOTE.—(1) 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 (but see NOTE 2).

(2) If either system is used for any reason (e.g. incorrect undercarriage position indication because of a micro-switch failure, or failure of an undercarriage lock to engage) when both electrical and hydraulic power are available, all hydraulic fluid will be dumped overboard, *causing complete hydraulic failure*. With the normal selectors UP, dumping will occur via the pressure line, and

with them DOWN, by the return line. In the former case hydraulic failure will be immediate, but in the latter the failure will be more gradual, occurring as the fluid is used by the power control jacks. No dumping should occur if electrical supply to the service to be operated has failed.

(3) Unless complete electrical failure has occurred, it should be assumed that use of either emergency system will result in loss of powered controls. Select POWER OFF before landing and be prepared for possible brake failure if the accumulator pressure drops below 1,550 lb./sq. in.

(i) *Undercarriage*

(a) If the undercarriage fails to lock down by normal operation when the hydraulic system appears to be serviceable, repeated raising and lowering and the application of sideslip or G should be attempted. If this is unsuccessful (see NOTE 2), or in cases of electrical or hydraulic failure, pull the emergency lowering control after first pushing in central knob. The system takes about 10 seconds to operate.

(b) Emergency raising of the undercarriage *on the ground only* is achieved by rotating and then pressing the UP selector button. This is not possible if the undercarriage has been lowered on the emergency system.

(ii) *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.

77. **Landing with an undercarriage unit not locked down**

(i) *Both main wheels only locked down*

In cases where it has been impossible to lower the nosewheel, or to re-raise the main wheels, little damage on landing has been caused to the aircraft and none to the pilot. In such circumstances a normal landing should be made, taking care to hold the nose up for as long as

possible after touchdown, avoiding an excessive nose-up attitude.

(ii) *Nosewheel and one main wheel locked down*

Again, in such circumstances, little damage should be caused if a normal landing is made, taking care to hold the wings level by use of aileron for as long as possible after touchdown. When the wing finally drops, the aircraft will swing in that direction. Such a landing should therefore be carried out only if an area of about 800 yards width is available at the side of the landing path in the direction of the anticipated swing.

78. **Practice flying in manual control**

NOTE.—Attempts to re-engage power may not always succeed. Remember, before selecting power OFF, that the landing may have to be made in manual and that return to the airfield in poor visibility will be arduous, even when landing conditions are otherwise good.

(i) In manual control, the elevator forces are high but tolerable and no difficulty with the longitudinal control of the aircraft should be experienced at low and moderate airspeeds and mach numbers. At airspeeds below 150 knots with the undercarriage and full flap lowered as for the approach, aileron buffet can be felt on the control column. The ailerons are very heavy; reasonable angles of bank can be applied but at low airspeeds, in conditions in which poorly damped lateral and directional oscillations develop, e.g. in gusty air or after coarse use of rudder, it is difficult to apply repeated small corrections without getting out of phase and thereby aggravating the disturbance. Practice landings must not be made in gusty or cross wind conditions until pilots have gained considerable experience of the control of the aircraft with ailerons manual.

(ii) Manual control should normally only be selected in straight and level flight at altitudes above 10,000 ft. and at speeds below 250 knots and 0.80M. Before selecting, trim the aircraft accurately longitudinally and check that

the aileron trim tab indicator is at neutral, at the same time disengaging the aileron trim tab guard. The aileron trimmer is effective in manual under all conditions, but the response is slow.

(iii) Because any asymmetric lowering of the undercarriage is liable to cause lateral control difficulties near the ground, the undercarriage must be lowered at a safe height and left down in an overshoot until a safe height is reached. Because of the longitudinal trim changes, flaps must only be selected up to a mid-position on initiating the overshoot, full retraction being deferred to a safe height.

(iv) Before selecting re-engagement of aileron and/or elevator power, the aircraft must be trimmed, laterally and longitudinally, in straight and level flight at the same airspeed and approximate altitude as when manual was selected. Immediate re-engagement is more likely on the elevator than on the ailerons; it is therefore preferable to re-select elevator before ailerons.

(v) If the appropriate indicator remains white, exercise the control column over the available range, using a maximum two-handed force if necessary. It is possible that a false anchorage may occur, which, although giving the feel of power control, may move under other conditions of flight and unacceptably restrict the maximum stick movement; it is therefore essential to check engagement by the indicator. If engagement is not indicated re-select manual and try again as many times as possible.

(vi) If having failed to re-engage correctly, a failure of the electrical system prevents re-selection of manual (this possibly resulting in control jamming), no attempt should be made to land the aircraft, which should be abandoned.

79. **Emergency operation of the flying controls**

(i) (a) If the hydraulic supply fails there may be sufficient accumulator reserve for a maximum of 3½ 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.

(b) A failure in the 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.

(c) In all cases of possible hydraulic failure or of low hydraulic pressure, it is preferable to select manual at the earliest opportunity, rather than wait for automatic reversion.

(ii) *Actions in event of engine, electric or hydraulic failure*

(*a*) *Engine under power—electrics serviceable—hydraulics failed*

Power will be automatically disengaged when the pressure drops sufficiently at the locking pawls. Speed should be reduced to below 250 knots or 0.80M immediately and manual selected before landing.

(*b*) *Engine windmilling—electrics serviceable—hydraulics serviceable*

If engine r.p.m. fall below 3,700 the electrical supply will fail (see para. 74 (i) (b)); if this occurs the electrically-operated flying controls selectors will fail in their set position. The windmilling engine may create sufficient hydraulic pressure for limited use of the power controls. Any subsequent drop in pressure will result in immediate manual reversion. If pressure is then rebuilt, false anchorages may be created.

Manual should be selected as soon as possible, and in any case before electrical failure occurs.

(*c*) *Engine windmilling — electrics failed — hydraulics serviceable*

If the electrics have failed, manual cannot be selected. The magnetic indicators will become unserviceable and their indications should be ignored.

Hydraulic pressure at windmilling r.p.m. may be sufficient for landing if the airspeed is kept as high as possible until committed to the landing and control surface movements are kept to a minimum. Lower the undercarriage and flaps on the emergency systems.

The hydraulic supply warning light must be watched carefully; if it comes on, the locking pawls may disengage and the controls subsequently jam, as at (b) overleaf. In this case it may be necessary to abandon the aircraft.

(d) *Engine seized—electrics failed—hydraulics failed*

In this case the indicators will show white, although power is still engaged due to hydraulic accumulator reserve. It will not be possible to select manual.

Reduce speed to below 250 knots or 0.80M. To remove the risk of unexpected reversion to manual during the landing, operate the controls to empty the accumulators and obtain automatic manual reversion before landing.

80. **Emergency trimming**

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 of 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.

81. **Wheel brakes emergency operation**

(i) The wheel brakes accumulator provides sufficient pressure for brake operation during landing, down to a pressure of 1,550 lb./sq. in. approx. When landing without main hydraulic pressure, the brakes should be applied gently as soon as possible after touchdown and a continuous pressure maintained. If care is taken to avoid locking the wheels, a landing should be achieved on one brake application.

(ii) If, after landing, it is suspected that the accumulator is nearly exhausted of fluid, the aircraft must be brought to rest and the engine stopped.

82. **Flapless landing**

A normal circuit and approach should be made and the runway threshold approached at a speed 5 - 10 knots in

excess of the normal final approach speed. The landing run is very much increased.

83. **Forced landing**

NOTE.—Unless the proposed landing area is known to be suitable in all respects, it is recommended that the aircraft be abandoned. If a wheels-up landing is to be made it is important to check that the airbrake is in before touchdown.

(i) Unless the engine is damaged, it should windmill at sufficient r.p.m. to provide power to maintain pressure in the accumulators. Excessive and coarse use of the flying controls should be avoided to prevent using hydraulic pressure faster than the pump can replace it.

(ii) Switch off all non-essential electrical services.

(iii) Set the tailplane to zero.

(iv) Turn off H.P. and L.P. cocks.

(v) The best gliding speed is 210 knots, which should be achieved with minimum control column movement. Maintain this speed until the selected landing area is within reach.

(vi) When on the final approach, lower the flaps by the emergency system and aim to cross the boundary at 150 knots.

84. **Landing with a burst tyre**

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

85. **Hood jettisoning**

The hood is jettisoned by pulling the handle on the port panel (early aircraft) or on the port shelf (later aircraft).

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.

86. **Abandoning the aircraft**

(i) Reduce speed as much as possible, and set parachute container fully back.

(ii) Jettison the hood and retract the G.G.S. If electrical power is available, the G.G.S. should automatically lower on jettisoning the hood.

(iii) 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.

(iv) 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.

(v) After ejection, the drogue gun will fire automatically.

(vi) 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 be immediate.

(vii) If the automatic system fails after ejection:—

(a) When forward speed is sufficiently low, discard the face screen and disconnect the main oxygen tube.

(b) Pull the override D-ring to isolate the parachute auto device.

(c) Operate the harness quick release.

(d) Disengage the seat restraining straps.

(e) Lift the flap over the rip-cord D-ring and grasp the handle.

(f) Fall clear of the seat and pull the rip-cord handle.

87. **Ditching**

(i) Model tests of a clean aircraft indicate that a ditching in any but ideal conditions would be very hazardous.

(ii) 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.

(iii) If ditching is inevitable:—

(a) Jettison the hood, select 100% oxygen and deflect the emergency toggle sideways.

(b) Lower full flap and make the approach at the lowest forward speed and rate of descent compatible with good control.

(c) Ditch along the swell, or, if the swell is not steep, into wind.

88. **Toxic fumes**

100% oxygen should be selected whenever the cockpit air becomes contaminated. The emergency toggle switch should also be deflected as the extra pressure in the mask will prevent inward leaks.

89. **Oxygen failure**

If the blinker mechanism ceases to operate, check the supply pressure. If this reads between 200 and 400 lb./sq. in. push down the emergency toggle switch to check the regulator. A supply of oxygen under pressure indicates that the regulator is serviceable and the blinker mechanism is defective. If no pressurized oxygen is received descend to a safe altitude, at the same time pulling up the emergency oxygen toggle.