Part I—Description and Management of Systems

Chapter 18—Aircrew Equipment Assemblies and Oxygen System

List of Contents

	Para.
General	1
Ejection seats	
Ejection seat Type 3K Mk. 1—general	2
Ejection gun and firing handles	3
Drogue gun	4
Ejection seat/canopy time-delay mechanism	5
Barostat time-delay mechanism	6
Leg restraint	7
Manual separation	8
Rear crew safety equipment	
Rear crew safety equipment	9
Clothing	
Air-ventilated suits	10
Mask and helmet	11
Oxygen system	
Normal supply	12
Oxygen regulators—general	13
Emergency oxygen sets	14
Additional emergency oxygen facilities	15
Use of aircrew equipment assemblies	
Strapping-in procedure—pilots	16
Strapping-in procedure—rear crew members	17
Normal exit procedure—pilots	18
Normal exit procedure—rear crew members	19
Abandoning the aircraft in flight	20
Ditching	21
Illustrations	*Fig.*
Ejection seat Type 3K Mk. 1—right-hand view	1
Ejection seat Type 3K Mk. 1—left-hand view	1A
Rear crew member's static seat	1B
Oxygen system	2

WARNING. The aircraft must be rendered *Safe for Parking* whenever the aircraft is on the ground, by ensuring that safety-pins are inserted as follows:

1 In the ejection gun sear
2 In the seat-pan firing handle
3 In the time-delay trip lever
4 In the canopy jettison firing unit sear.

It is emphasised that safety-pins should not be inserted in the fabric strap above the pilot's head.

It is normally the Crew Chief's responsibility to ensure that the ejection seat pins are removed and stowed prior to take off and replaced after flight. In the absence of the Crew Chief, the nav/radar is responsible.

1 General

The aircrew equipment assemblies consist of the seats, the flying and safety clothing and associated equipment, including oxygen

and air-ventilated suit connections. The description of these items and their use is covered in this Chapter. Ejection seats are provided for both pilots, and static seats for the three rear crew members. A spare seat, aft and below the pilots' seats, is provided for an additional crew member.

Ejection Seats

2 Ejection seat Type 3K1 Mk. 1—general

(*a*) Type 3K Mk. 1 ejection seats are fitted, one at each pilot's station, each incorporating a Type ZF harness, headrest, parachute container for the Mk. 9 parachute, a seat-well for the personal survival pack (PSP), an emergency oxygen supply, a downward-pull negative-G resistant strap, and leg restraining cords. Port and starboard seats are handed in certain details, principally in respect of the position of the seat-raising and lowering handles, the lean-forward release handles, and the arrangement of the emergency oxygen sets.

(*b*) The seat height may be adjusted by a lever on the outboard side of each seat. The lean-forward release is on the outboard side of the seat-pan. The arm rests may be adjusted to any one of four positions, or fully retracted, by operation of the trigger controls on the arm rest supports.

(*c*) On ejection, intercomm. and normal oxygen connections are disconnected and the emergency oxygen is turned on.

(*d*) The seat has a ground-level ejection capability, provided that the aircraft's flight path is parallel to the ground and that the speed is at least 90 knots. If the aircraft is descending, or nose-down, additional height will be required for safe ejection.

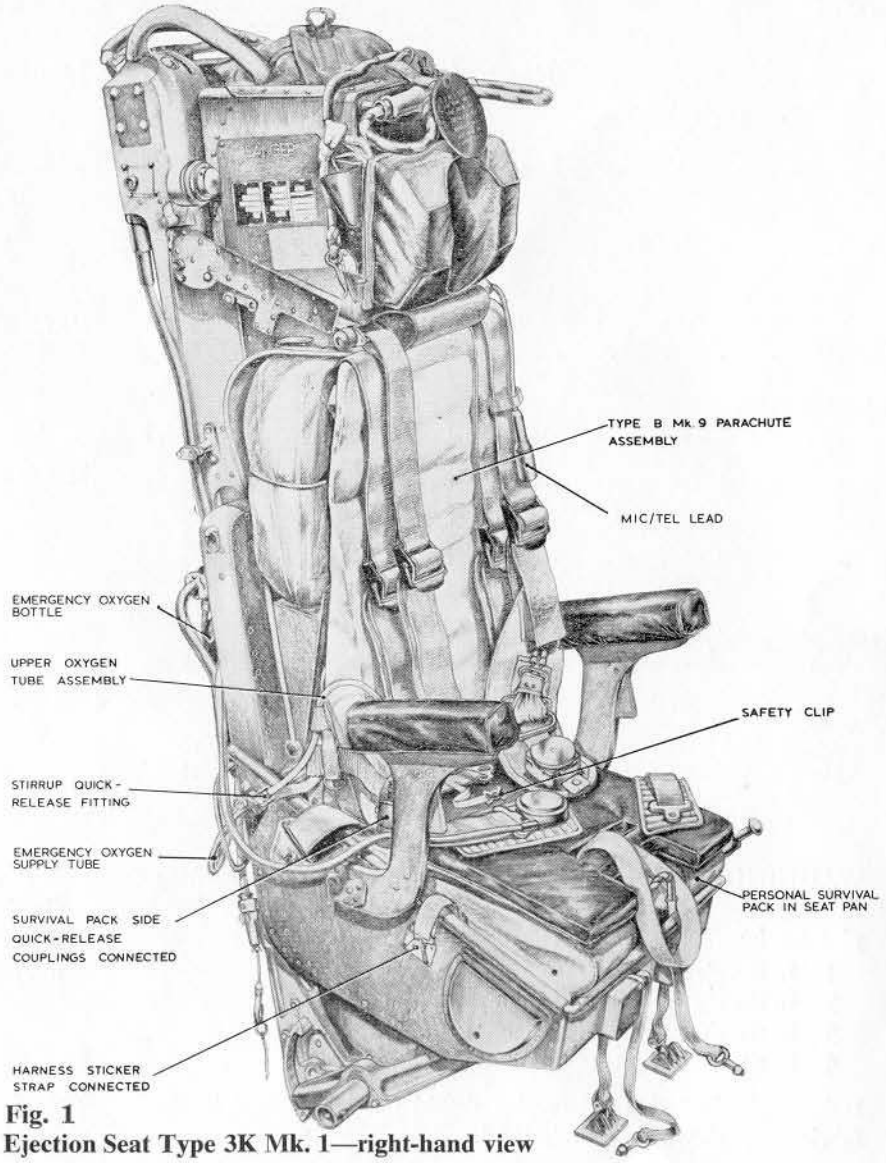

Fig. 1
Ejection Seat Type 3K Mk. 1—right-hand view

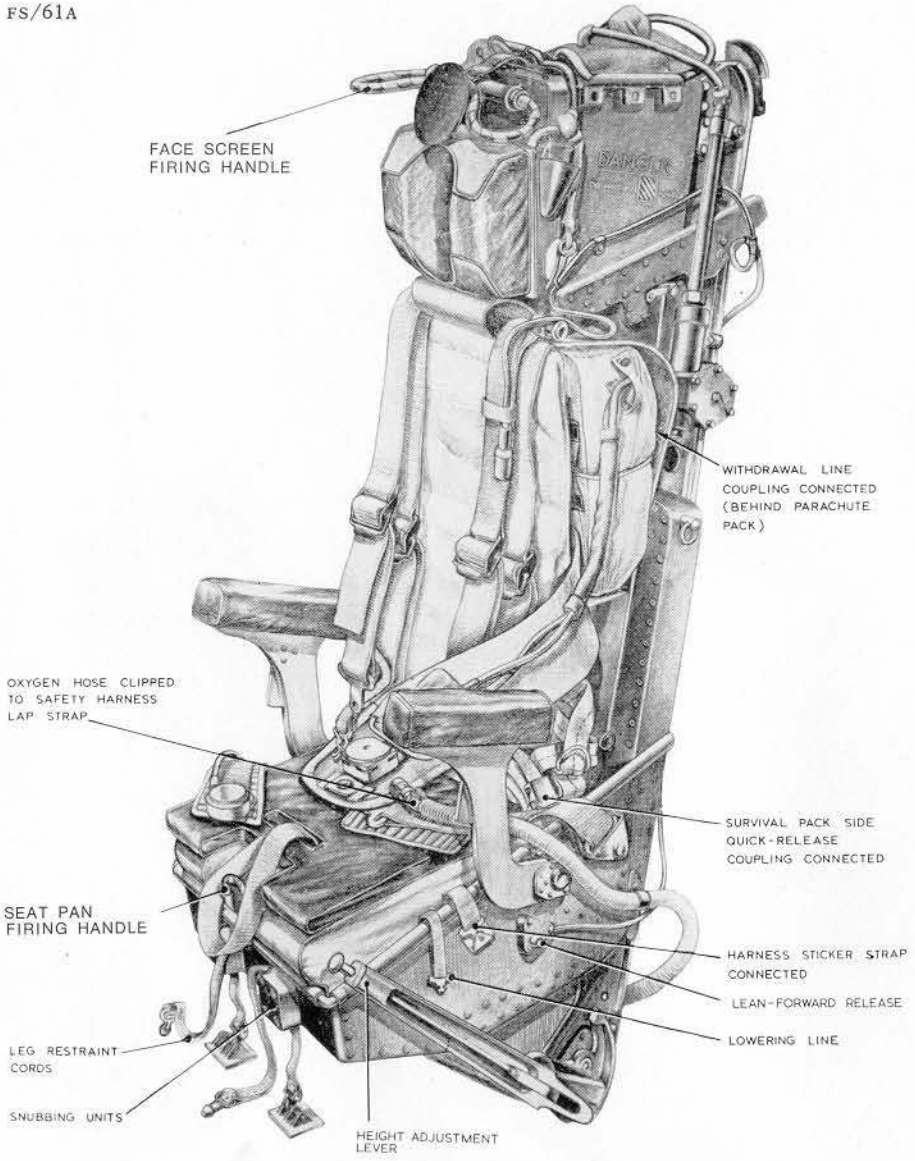

Fig. 1A Ejection Seat Type 3K Mk. 1—left-hand view

3 Ejection gun and firing handles

Each seat is fitted with an 80ft./sec. telescopic ejection gun fired from the handle immediately above the head-rest, to which is attached a flexible blind to protect the face. The seat-pan firing handle (Mod. MB881) is for use in conditions when it is impossible to reach the face-screen handle, and is fitted at the front of the seat-pan. Either firing handle must be pulled to its fullest extent to fire the gun. Safety-pins are provided, one for each firing handle, and when not in use are stowed on the inboard side of the seat-pan.

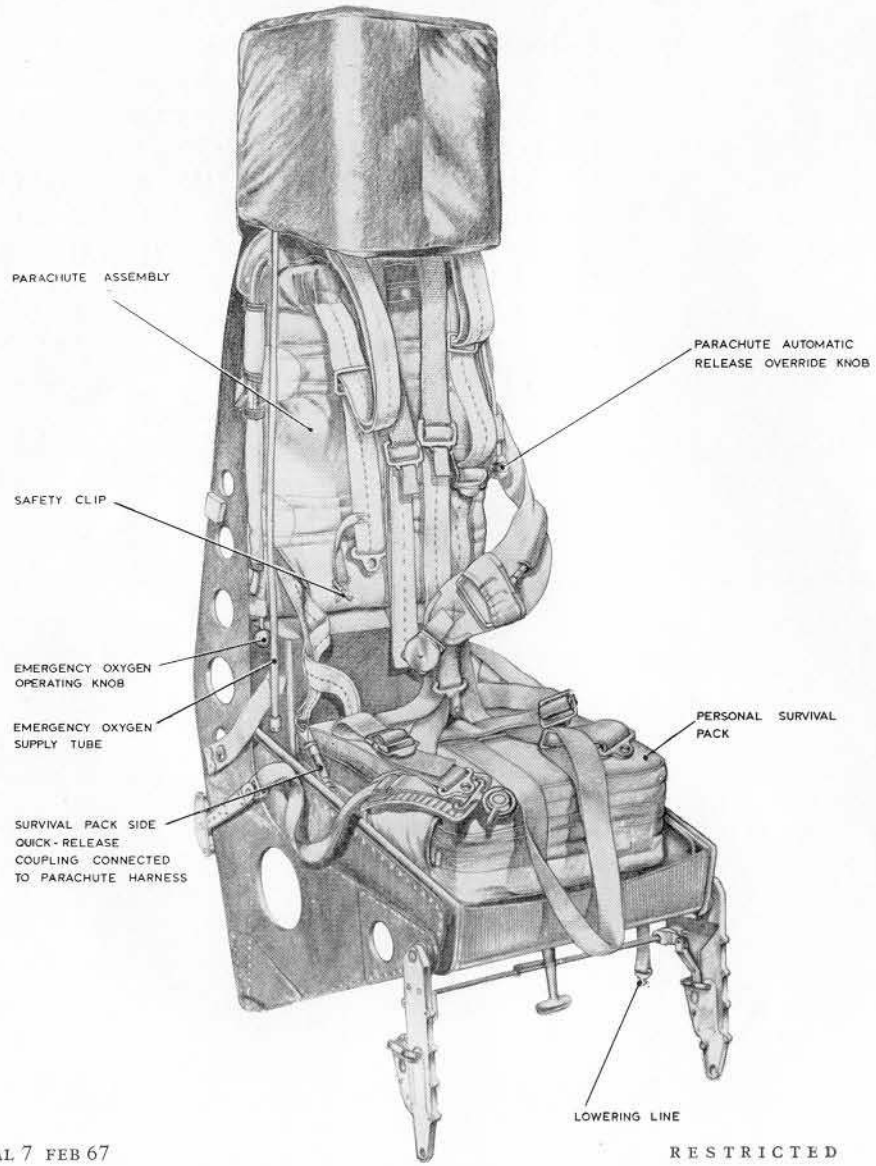

Fig. 1B Rear Crew Member's Static Seat

4 Drogue gun

On the port side of each seat is fitted the drogue gun, which fires one-half second after the ejection gun has fired, withdrawing the duplex drogues to stabilise the seat. The time-delay mechanism is operated by a static rod, which withdraws a sear from the gun as the seat rises up the rails.

5 Ejection seat/canopy—jettison time-delay mechanism

Operation of any one of the ejection seat-firing handles will—

(*a*) Jettison the canopy immediately, and

(*b*) Initiate the action of a time-delay mechanism on the back of the seat. When the canopy leaves the aircraft an interference in the time-delay mechanism is removed, enabling it to run its full course. One second after the removal of the interference, the time-delay unit withdraws the ejection gun sear and the seat is ejected. When the firing control of the second seat is operated, there will again be a one-second delay before the seat fires, although the canopy has left ; this also applies to the first seat, if the canopy has previously been manually jettisoned.

6 Barostat time-delay mechanism

The barostat, on the starboard side of the seat is activated by a static rod as the seat ejects. Then:

(*a*) If the height and speed are low enough, the time-delay mechanism starts immediately.

(*b*) If height is above 10,000 feet, the time-delay mechanism does not start until the seat has fallen to that height. A 5,000 metre capsule can be fitted for flights over mountainous territory.

(*c*) If the speed is too high, a " G-stop " device prevents the time-delay mechanism from starting until the deceleration of the seat has fallen to a safe figure for parachute deployment.

(*d*) The time-delay is $1\frac{1}{4}$ seconds, upon completion of which, the unit simultaneously:

(i) Releases the stabilising drogues from the top of the seat, leaving them, however, connected to an apron between the seat back and the pilot, and also to the personal parachute.

(ii) Unfastens the seat-harness, thus also freeing the top ends of the leg-restraint cords.

(*e*) The drogues then separate the pilot from the seat and subsequently deploy his personal parachute.

7 Leg restraint

(*a*) Leg-restraint cords are provided to limit leg flailing during and after ejection. When strapping-in before flight the free ends of the cords are threaded up through leg-restraint garters worn below each knee, and the end-loops are slipped over the seat-harness shoulder strap end fittings before these are fitted into the harness quick-release box.

(*b*) The lower part of the cords are passed (when the seat is being equipped) through snubbing units at the front of the seat-pan and are anchored to the floor by a device embodying a shear rivet. The snubbing units allow the cords to slide freely *downwards*, but prevent them passing *upwards*.

(*c*) On ejection, the floor anchorages pull the cords tight until the legs are close to the seat-pan. The rivets then shear, but the snubbing units prevent the cords loosening again until separation of the pilot from the seat.

(*d*) The snubbing units may be temporarily released for upward movement, by operating a button under each unit. This allows the pilot to pull through sufficient cord for unrestricted rudder pedal movement, when first strapping-in.

8 Manual separation

To allow the occupant to release himself from the seat, should the automatic devices fail to operate, means of manual separation are provided: —

(*a*) A manual over-ride D-ring, fitted over the rip-cord D-ring, is pulled to disconnect the parachute apex line from the automatic gear. This action also uncovers the rip-cord D-ring.

(*b*) If the manual over-ride is used, it should be operated *before* releasing the safety-harness, otherwise the seat will remain connected to the apex of the parachute.

Rear Crew Safety Equipment

9 Rear crew safety equipment

(*a*) The rear crew members wear back-type parachutes Mk 20 and personal survival packs type S. The parachutes have a barostat control which when the static line is used, delays deployment of the parachute until below 13,000 ft. This can be overeridden by the yellow and black knob on the left shoulder strap.

(*b*) Four parachute static lines are fitted on the rear of the centre seat for use when abandoning the aircraft. The static lines are folded in leather protected canvas covers which are secured to a mounting plate by staple clips. One end of each line is secured to a bar on the rear of the seat, while the other end carries the parachute attachment link which, when not in use, is folded back and secured to the canvas cover by a fine cord.

Clothing

10 Air ventilated suits

Provision is made for air-ventilated suits. The system and controls are described in Chap 11 of this Part.

11 Mask and helmet

A G-type helmet is worn with a pressure-breathing mask with toggle-harness, either Types A13A/2, P1A or Q1A. These masks are fitted with a CONNECTOR INLET (WARNING) on the end of their hoses. When connected to the aircraft system, breathing is unrestricted, but if the connection is inadvertently broken, breathing-in becomes difficult. The connection should be deliberately broken when using emergency oxygen—see para 14(*c*).

Oxygen System

12 Normal supply

(*a*) Oxygen is supplied by eight cylinders normally charged to 1,800 PSI, four on the starboard and four on the port side of the bomb-bay. Two oxygen master valves, normally wire-locked open, are mounted on the support struts of the crew's floor. The starboard master valve controls the supply from the starboard cylinders, and the port master valve controls the supply from the port cylinders, the contents being shown on gauges at the AEO's station. Either master valve supplies all regulators. An external charging point marked OXY is in the nosewheel bay.

(*b*) Oxygen at a pressure of 200/400 PSI is supplied from four pressure-reducing valves to the crew's regulators, the sextant station, prone bomb-aiming station, and also to two charging points for the portable oxygen set. Three of the valves are beneath the pilot's floor ; one provides a separate low pressure supply for the regulator at the sextant station, the second a common supply for the 1st pilot's and nav/plotter's regulators, and a third, a common supply for the co-pilot's and the bomb aimer's prone station regulators. The fourth, behind the crews controls and instrument panels, supplies AEO's and the nav/radar's regulators.

▶◀

13 Oxygen regulators—general

(*a*) Mk 17 oxygen regulators fitted at each of the seven crew stations control the supply of oxygen. The pilots' regulators (C/22) and (E/43) are at the front of their respective consoles ; the bomb aimer's regulator is on a panel on the starboard side of his prone

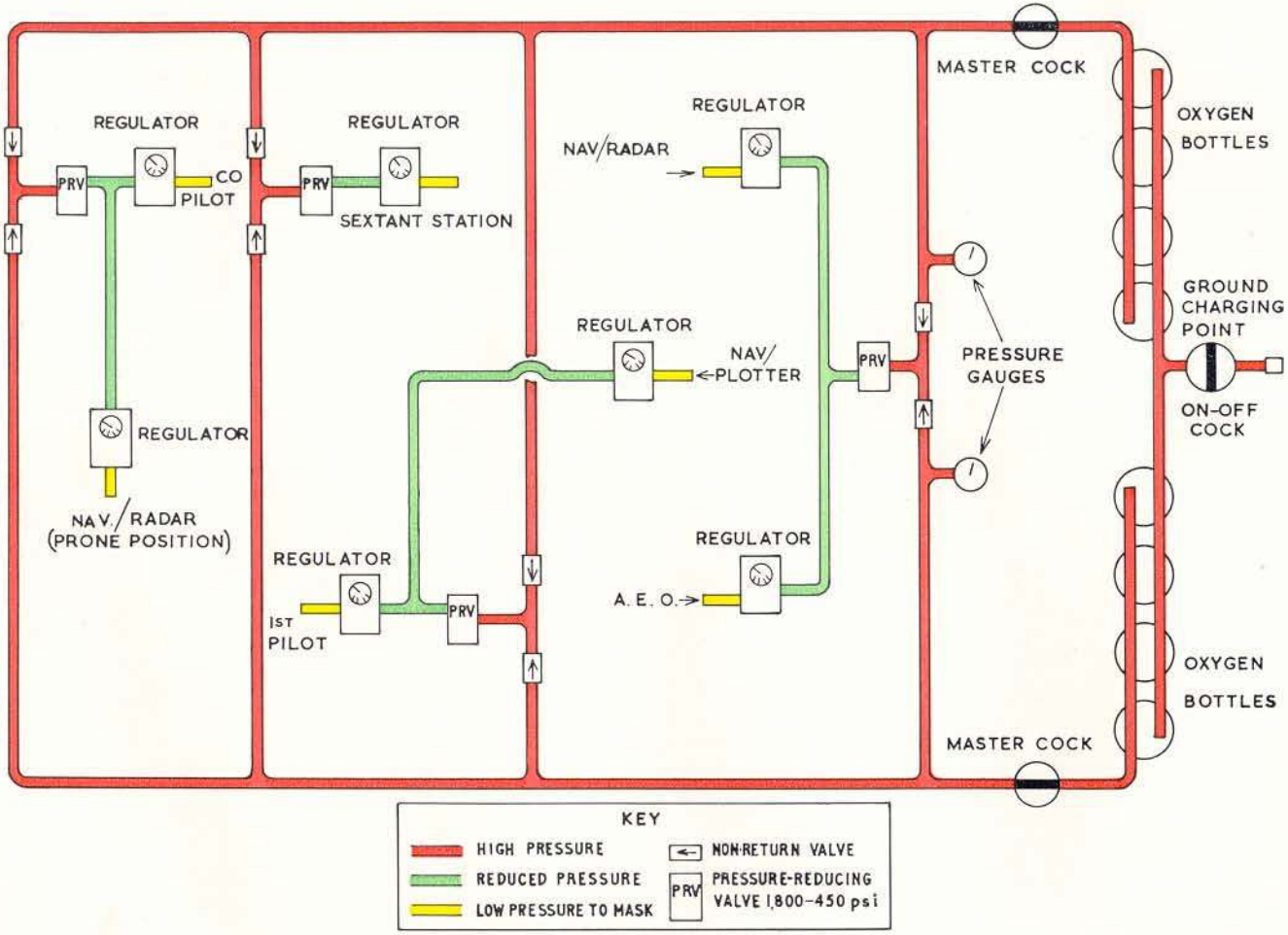

Fig. 2 Oxygen System

station ; three regulators are on panels facing the crew stations and one is fitted at the sextant station. The oxygen supply tubes are fitted with self-closing connections, so that in the event of a station being unoccupied no oxygen loss is incurred.

(*b*) Each regulator has the following controls and indicators:

(i) An ON—OFF cock (wired ON) controlling the oxygen entering the regulator.

(ii) A pressure gauge, indicating the input pressure. This should read between 200-400 PSI (when (i) is ON).

(iii) A magnetic indicator. This shows a white vertical bar when oxygen is being drawn from the regulator on breathing in ; and black when no flow is taken on expiration (or if there is no electrical supply to the regulator).

NOTE: A repeater magnetic indicator is provided at the nav/plotter's station for the regulator at the prone bombing station so that this isolated crew member's oxygen supply can be monitored by the two crew remaining in the cabin.

(iv) An air-dilution switch, marked NORMAL—100% OXYGEN.

(v) An EMERGENCY and test toggle switch. When the switch is moved to right or left a slight continuous pressure is delivered to the user. When pressed in (test), oxygen is delivered to the user under pressure, increasing as the toggle is pressed further ; when fully in, the pressure is approximately five times as great as with the switch in either side position.

(*c*) The regulator is of the pressure-demand type and must be used with one of the masks referred to in para. 11 above. Oxygen is supplied to the mask only on demand, i.e. when inhaling. At *cabin* altitudes below 10-12,000 feet it is delivered at ambient pressure. Above this height, up to 40,000 feet, it is delivered under a slight " safety pressure " to ensure that any leakages do not dilute the oxygen with air. Above 40,000 feet the pressure is steadily increased above ambient, so as to maintain sufficient pressure of oxygen in the lungs for its absorption into the bloodstream. This will involve noticeable " pressure breathing " and is not a condition which can be sustained indefinitely. If cabin pressure is lost so that a cabin altitude of more than 40,000 feet results, the equipment will provide protection for a descent to 40,000 feet to be completed *within 2 minutes* of the loss of cabin pressure. In order to safeguard against decompression sickness (the " bends ") the aircraft should then be brought down to at least 30,000 feet, and preferably 25,000 feet within a further 20 minutes.

(*d*) With the air-dilution switch at NORMAL, an air/oxygen mixture of appropriate proportion is delivered up to a *cabin* altitude of about 32,000 feet. Above this altitude, only 100% oxygen is supplied. This conserves the oxygen supply, but as it makes recognition of low-flow delivery from the regulator difficult, the NORMAL setting must *not* be used with MK17D regulators; it may be used with MK17E (or later) regulators which embody modifications securing sufficient reliability. In the 100% OXYGEN setting, neat oxygen only is delivered at all altitudes, and low flow will be instantly recognised by difficulty in inhaling.

(*e*) The EMERGENCY test facility should be used before flight for checking the absence of mask leaks. Pressing in the button, and holding the breath should cause the indicator to show black. In flight the button can be deflected sideways to give safety-pressure at altitudes below 10-12,000 feet (cabin) where safety pressure comes on automatically, or to double the safety pressure at that height. An appropriate use would be where noxious fumes are present in the cabin.

14 Emergency oxygen sets

(*a*) Each pilot has an emergency oxygen set mounted on the inboard beam of his seat. The operating cable passes down into a conduit on the cockpit floor and ends with a yellow knob projecting upwards from the end of the conduit, inboard of the rear of each seat. Both pilots can operate either their own or the others knob if an emergency supply is required, and the sets are also automatically turned on as the seats eject. On separation from the

seat after ejection, the supply tube between the set and the pilot is automatically broken near its centre, close to the pilot's hip.

(*b*) Each of the rear crew members has an emergency oxygen set in his MK20 parachute pack. This may be turned on in the cabin by pulling the red plastic grip handle on the left shoulder strap. It is also turned on automatically, by operation of the parachute static line, when escaping by parachute.

(*c*) The emergency oxygen sets are all of the continuous flow type, delivering a flow greater than requirements at the beginning, which reduces as the cylinder pressure falls. If used in the cabin, it is necessary to disconnect the mask from the main oxygen system at the CONNECTOR INLET (WARNING) to allow the initial excess to escape, otherwise breathing difficulties will be experienced. The relief valve in this connector is set so as to give an initial breathing pressure similar to that obtained on the main system at 47,000 feet.

(*d*) The endurance of an emergency oxygen set is only of the order of 10 minutes, at the expiration of which the crew member must be brought down to an effective altitude of not more than 10,000 feet where oxygen is not required—or must be connected to an alternative oxygen supply. If the situation requiring an emergency supply is merely the failure of a main regulator an alternative exists, which would avoid the necessity to reduce aircraft altitude or increase the cabin pressurisation ; the crew member can transfer for the remainder of the flight to the sextant station regulator, or even that at the bomb aimer's station.

15 Additional emergency oxygen facilities

A bag is fitted to the back of the nav/radar's seat for stowage of a dual-feed oxygen coupling, an extension tube assembly, and (taped to the tube) an extension mic/tel cable. The dual-feed coupling is a Y-piece assembly which may be plugged into any oxygen point on the aircraft and allows two mask tubes to be plugged into it. The extension tube assembly is a 3 feet length of hose with a suitable connection at one end to fit the oxygen points on the aircraft (or an outlet of the dual coupling) and at the other end a connector to fit the mask tube ; while the mic/tel extension is an electrical equivalent. The extension tube and cable can be used by any crew member to connect to one of the two vacant regulators if his normal regulator fails. It can also be used by rear crew members if they require to move to parts of the cabin beyond the reach of the normal hoses. In the really exceptional case, the dual connector allows two of the crew to breathe off one regulator, but in view of the possibility of pressurising the cabin to the cruise setting where oxygen is not needed, and the provision of 'spare' regulators and the extension hose, such a course should rarely be necessary. If it does have to be resorted to, the 'blinker' indications on the regulator will be erratic and the two crew concerned should avoid physical effort likely to increase seriously their depth of breathing.

Use of Aircrew Equipment Assemblies

16 Strapping in procedure—pilots

(*a*) Adjust the height of the seat.

(*b*) When seated, connect the dinghy lanyard to the life-saving waistcoat.

(*c*) Secure the parachute harness.

(*d*) Secure the seat harness and leg-restraint cords as follows:

(i) Fasten the leg-restraint garters below the knees with the D-rings to the rear (if not permanently embodied in flying suit).

(ii) Fasten the lap straps of the seat harness, but do not tighten them. Bring the negative-G restraint strap up between the legs, ensuring that it is to the *rear* of the seat-pan firing handle and *not passing through* it. Pass the negative-G strap under the quick-release fitting of the safety-harness.

(iii) Pass the left nylon cord through the left leg D-ring, under the safety-harness lap strap and insert the left shoulder safety-harness eyepiece through the loop on the cord, then through the appropriate loop of the blue " Y " piece of the negative-G strap. Secure the shoulder safety-harness in the quick-release box.

(iv) Repeat for the other cord, passing the right cord through the right leg D-ring, under the safety-harness lap strap and insert the right shoulder safety-harness eye-piece through the loop on the cord, then through the appropriate loop of the blue "Y" piece of the negative-G strap. Secure the safety-harness.

(v) Sit well back and tighten the lap straps.

(vi) Tighten the negative-G restraint strap by pulling *downwards* on the free end of the blue straps. These straps are to be as tight as possible as they provide the principal restraint under all conditions. The quick-release box should be as low as possible consistent with comfort and must be below and not obstruct the parachute harness quick-release fitting. To loosen the negative-G restraint strap, pull down on the yellow tabs attached to the snubber.

(vii) Ensure that the shoulder straps lie under the life-jacket stole. Tighten the shoulder straps. Do not overtighten as this may cause the back to arch, resulting in possible injury on ejection.

(viii) Check that the leg-restraint cords do not impede full rudder movement.

NOTE 1: *It should be particularly noted that in this Mark of Vulcan, the leg restraint cords are not crossed.*

NOTE 2: If the available leg-restraint cords are too short, pressure on the button below the snubbing units will enable more cord to be pulled through.

(*e*) Connect the main oxygen and emergency oxygen supply tubes to the oxygen mask tube, and the locating chain to the life-saving waistcoat.

NOTE: To prevent possible entanglement, ensure that the emergency oxygen tube is not connected through the harness.

(*f*) Connect the intercomm. lead.

(*g*) Check that the face-screen firing handle can be reached with both hands together.

(*h*) Remove and stow the pip-pins from the canopy jettison levers and have the canopy jettison-gun safety-pin removed and the pip-pin inserted in the operating lever.

(*j*) Have the safety-pins from the ejection gun and time-delay mechanism removed and stowed in their stowage.

(*k*) Where Mod. MB881 is embodied, remove and stow the safety-pin for the seat-pan firing handle.

17 Strapping in procedure—rear crew members

Prior to entering the seat, ensure that the safety-pins have been removed from the EO cylinder.

(*a*) When seated, connect the lanyard of the personal survival pack to the left webbing strap of the life-jacket, adjusting the length of the latter so that the quick-release fitting will lie clear below the harness lap strap when subsequently connected.

(*b*) Fasten the parachute harness:

(i) Pass the left half of the waist-belt over the life-jacket/survival pack lanyard connection.

(ii) Pass the right lap strap over the right thigh, thread it up through the right crutch loop and connect to the quick-release box on the waist-belt.

(iii) Connect the left lap strap similarly, ensuring that it passes over the survival pack lanyard.

(iv) Fasten the right shoulder strap into the quick-release box, ensuring that it lies *under* the stole of the life-jacket.

(v) Clip the hook of the right half of the waist-belt over the end fitting just connected.

(vi) Fasten the left shoulder strap into the quick-release box, ensuring that this strap passes between the cylinder and stole of the life-jacket.

The objectives are:

1 To leave the parachute static line hook, emergency oxygen control and override knob completely unobstructed.

2 To obscure the life-jacket cylinder red cap as little as possible.

3 To trap as little as possible of the life-jacket stole.

(vii) Fit the safety-pin between the disc and the body of the quick-release box. Ensure that its webbing safe-tie is clear so that the clip can be rapidly disengaged.

(viii) Tighten the lap straps.

(*c*) Connect the quick-release couplings of the PSP to the parachute harness and tighten the restraining straps.

(*d*) Put on helmets and connect mask tube. Connect the emergency oxygen and attach the tube-locating chain to the life-jacket D-ring. Plug in the mic/tel lead.

(*e*) Fasten the safety-harness and adjust the seat position.

(*f*) Check the intercomm. and oxygen regulator.

18 Normal exit procedure—pilots

(*a*) Ensure seat safety-pins are re-fitted.

(*b*) Remove helmet and mask, disconnecting the mask tube, emergency oxygen, and intercomm.

(*c*) Release the safety-harness and parachute-harness.

(*d*) Disconnect PSP lanyard.

(*e*) Remove leg-restraint cords.

(*f*) Retract arm rests and vacate seat.

19 Normal exit procedure—rear crew members

(*a*) Remove helmet and mask, disconnecting the mask tube, emergency oxygen and intercomm.

(*b*) Disconnect safety-harness and parachute-harness.

(*c*) Disconnect PSP lanyard.

(*d*) Vacate seat.

20 Abandoning the aircraft in flight

NOTE: This paragraph describes the use of the safety equipment but does not include information on crew movement to the exits and launching, for which refer to Part V, Chap 3, Para 2.

(*a*) The Captain operates the ABANDON AIRCRAFT switch. This depressurises the cabin.

(*b*) *Rear crew*

(i) The nav/plotter to select EMERGENCY DOOR OPEN.

(ii) Release the safety-harness.

(iii) Operate the emergency oxygen and disconnect the main oxygen supply and mic/tel lead. Tuck the latter under harness to avoid flailing.

(iv) Move towards the exit and connect the static line. (Check cabin depressurised, if necessary operate CABIN PRESSURE RELEASE handle in roof.)

(v) The first crew member to reach the door must ensure that the door opening lever is placed in the gated EMERGENCY position.

NOTE: The parachute should deploy at 13,000 feet (or two seconds after jumping if below that height). It it fails to do so (and always in high mountainous areas) pull the black and yellow knob on the left shoulder strap.

WARNING. Take care not to confuse this with the red cap of the life-jacket cylinder which is close to it.

(vi) After the parachute has deployed:

1 Disconnect the survival pack side connections and allow the pack to hang by its 15ft. lowering line attached to the life-jacket.

2 Disconnect the emergency oxygen at the CONNECTOR INLET (WARNING).

3 If alighting in water, discard the oxygen mask and helmets, but not if alighting on land.

(*c*) *Pilots*

(i) Pull the face-screen firing handle fully down over the face, ensuring that the elbows are kept well in, and that the head and back are pressed firmly against the seat.

NOTE: Expect a one-second delay before ejection while the canopy jettison mechanism operates. This delay applies to both seats.

(ii) If, after ejecting, automatic separation fails to operate at 10,000 feet or 5,000 metres (or after 1-2 seconds delay, if below that height) ; and always in high mountainous areas :

1 Pull the manual override D-handle on the parachute harness.

2 Release the safety-harness and fall clear of the seat.

3 Pull rip-cord handle.

(iii) After the parachute has deployed :

1 Disconnect the survival pack side connections and allow the pack to hang on the 15 ft. lowering line attached to the life-jacket.

2 If alighting in water, discard the oxygen mask and helmets, but not if alighting on land.

21 Ditching

(*a*) *Pilots*

If time permits, complete the following actions :

(i) Disconnect the emergency oxygen supply from the mask. Retract the arm rests.

Disconnect oxygen mask tube-locating chain from life-jacket. Select 100% OXYGEN.

Disconnect the two PSP couplings to parachute-harness and the one to the life-jacket.

Release parachute-harness, tighten safety-harness.

NOTE : If detachable or quick-release leg-restraint garters worn, they can be unfastened before tightening the safety-harness.

(ii) *After ditching* : —

NOTE : If there has been insufficient time to take the above actions before ditching, some of them must be done after ditching. These are indicated in brackets below : —

Disconnect the oxygen mask tube (EO and chain clip).

Release safety-harness (and parachute-harness).

Remove leg-restraint cords from end fitting of shoulder straps. (Disconnect the three PSP connections).

Leave the seat as quickly as possible.

If there is time, pull the PSP out of the seat-pan and hand out to crew member to stow in dinghy.

Inflate the life-jacket, leave aircraft and board dinghy.

(*b*) *Rear crew*

(i) Before ditching :

Disconnect the emergency oxygen supply from the mask.

Disconnect oxygen mask tube-locating chain from life-jacket. Select 100% OXYGEN.

Disconnect PSP couplings to parachute-harness and life-jacket. Release parachute-harness.

Tighten the safety-harness.

(ii) After ditching :

Disconnect the oxygen mask tube, release safety-harness and leave seat.

Escape by dinghy aperture and inflate life-jacket when clear of the aircraft.

If time permits, the PSP may be taken from the aircraft into the dinghy.