Chapter 1

AIRCREW EQUIPMENT ASSEMBLY EJECTION SEAT, MARTIN-BAKER TYPES 9B MK 2, 9B1 MK 2 and 9B2 MK 2

(Pre-Mods ES 3700, PA 571 and SE 108)

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (Cont'd)

1 - INTRODUCTION

1.1 - This chapter is primarily concerned with the installation of the aircrew equipment assembly (AEA) in the seat, the strapping-in procedure and the drill to be used when leaving the seat after landing. A brief description of the various components of the AEA and their function is included.

1.2 - Composition of the assembly

1.2.1 - The aircrew equipment assembly consists of the following items which are described in the publications listed:

- Ejection seat	Type 9B Mk 2 or Type 9B1 Mk 2 or Type 9B2 Mk 2	AP 109B-0139-13A
- Parachute	Back Type B Mk 61	AP 108C-0136-1
- Personal survival pack	Type ZJ Mk 1	AP 108E-0539-13A
- Emergency oxygen	Emergency oxygen cylinder fitted to an intertechnique controller with oxygen flow sensor and pressure warning.	AP 107D-0602-13A
▶ - Regulator oxygen man mounted	Type 417A Mk 1	AP 107D-0214-12
- Regulator oxygen man mounted	Type 317A Mk 1 (Only to be used with Command authority. See AP 108B-0001-1, Chap 1-1, Sch 37) ◀	AP 107D-0205-12

2 - DESCRIPTION (figs 1 and 2)

2.1 - Parachute and personal survival pack

2.1.1 - Parachute assembly: The parachute assembly is packed into a rigid moulded pack contoured and shaped to fit into the back of the seat pan. The bottom edge of the pack is provided with two blocks which locate the pack in a channel

in the bottom portion of the back of the seat pan. The top of the parachute pack is prevented from tipping forward by two nylon blocks attached to the inside surface of the seat pan sides which provide sufficient restraint for the purpose, but allow the pack to withdraw during seat/man separation. The lift webs emerging from the top of the pack terminate in Koch fittings which are attached to main lugs on the shoulders of skeletal torso harness during strapping-in. Two short straps attached to the lift webs and Koch fittings both terminate in a nylon roller fitting through which are passed the straps of the harness retraction unit before they are locked into the upper harness locks during the equipping procedure. The straps provide shoulder restraint for the occupant when he is strapped in. Each part of the lift webs (i.e. port and starboard pairs) are held together by two press studs. To retain the lift webs on the occupants shoulders during flight a spring cross-strap is inserted between the lift webs at the position of the press studs nearest to the Koch fittings.

2.1.2 - The parachute rip-cord handle is situated near the Koch fitting of the port lift web to deploy the parachute during a manual separation sequence. The pack opening is on the top face, closure being effected by fabric flaps secured by three cones and rip pins covered by an outer flap secured by a Velcro strip. The rip pins are attached by a short closure line to the parachute portion of the parachute withdrawal line which emerges from the centre of the outer flap and is then routed over the back of the seat pan, through a guillotine unit and up the vertical channel in the front surface of the upholstered head rest where it is attached to the seat portion of the withdrawal line by a screwed coupling. Both portions of the withdrawal line are restrained in the vertical channel by safe ties (fig 9).

2.1.3 - Two retention straps on the bottom of the pack are attached to the survival pack (PSP) on equipping the seat; they provide parachute pack retention to facilitate parachute deployment.

2.1.4 - Seat lap straps: Two adjustable lap straps, one port and one starboard, are provided to restrain the occupant in the seat. Each lap strap terminates in a lug which is locked into the appropriate lower harness lock. The other end of each lap strap terminates in another lug which is locked into the quick-release fitting of the skeletal torso harness during strapping-in. Attached to each lap strap are two short straps, the upper one called the sticker strap terminates in a lug which is inserted into the sticker clip on the seat pan side, the lower one is attached by a quick-release connector to the survival pack.

2.1.5 - Personal survival pack: The Type ZJ Mk 1 personal survival pack is a rigid-cased pack complete with cushion and is housed in the seat pan serving the dual purpose of seat cushion and container for the liferaft and survival equipment. The seat cushion is specially designed and shaped to give maximum support and comfort to the seated occupant. The pack is extended forward in the shape of two horns which give rigid support to the thighs on ejection. It is attached to the lap straps by quick-release connectors fitted to the two side attachment straps on the pack, and the lowering line is attached to a connection on the occupants life preserver. The lap strap connections are made when the seat is being equipped and the lowering

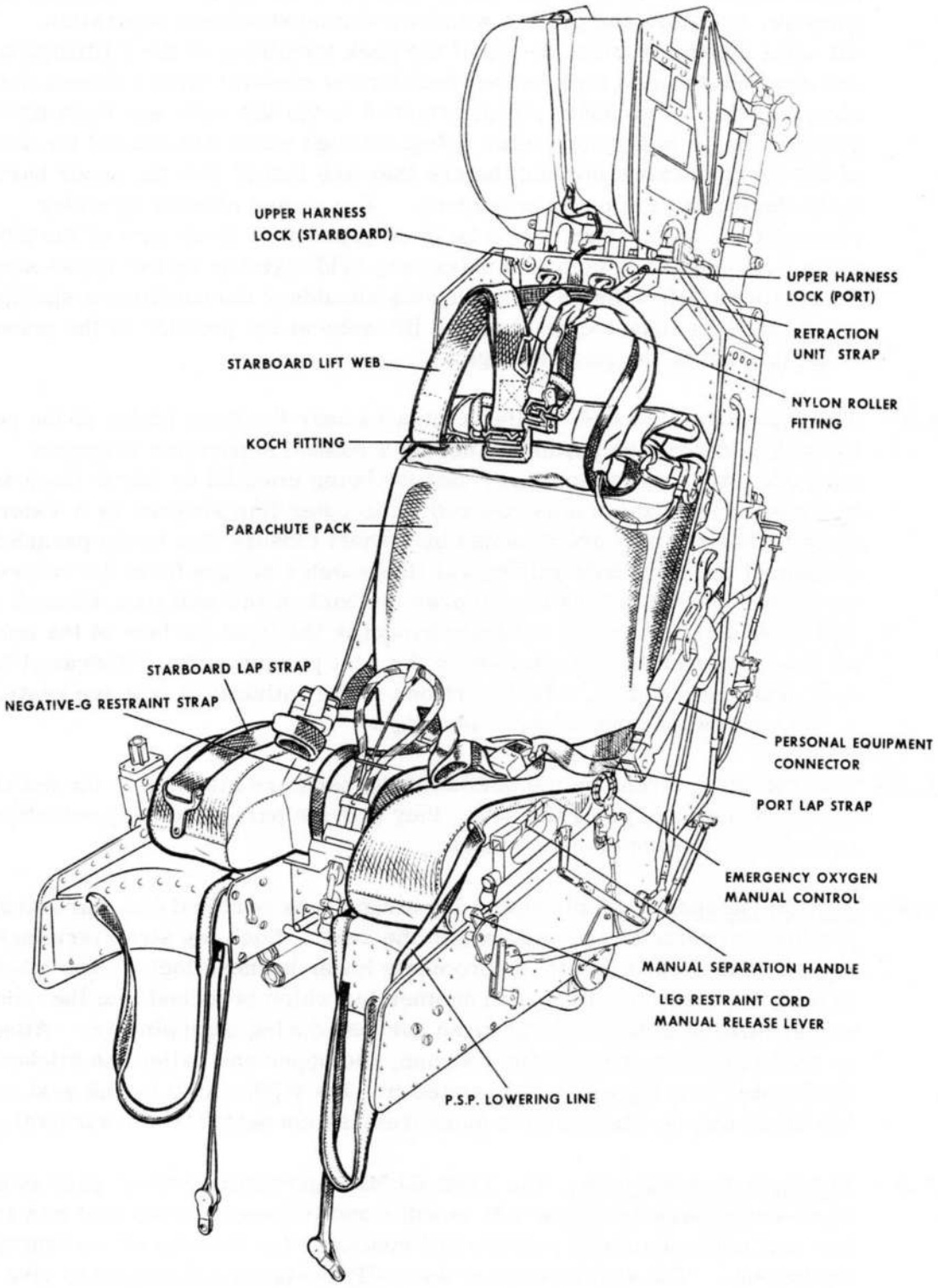

Fig 1 Type 9B Mk 2 ejection seat equipped (port view)
(STI/SE/276 embodied)

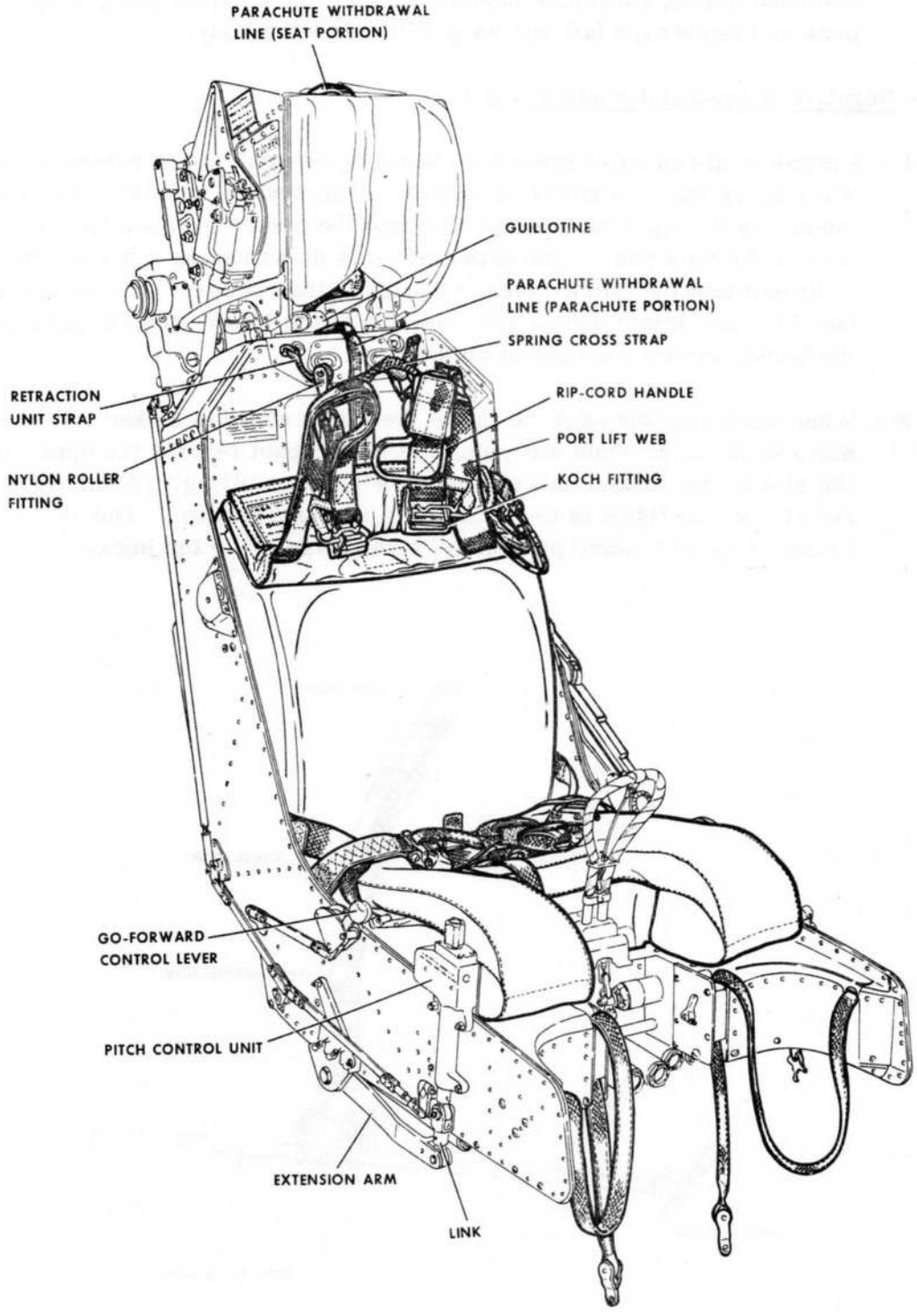

Fig 2 Type 9B Mk 2 Ejection seat equipped (starboard view) (STI/SE/276 embodied)

line by the occupant when strapping-in. The lowering line being attached to the life preserver enables the torso harness quick-release fittings to be released during parachute descent so that the survival pack, empty parachute pack and lap straps fall and hang 15ft below the body.

2.2 - Negative-g restraint system (fig 3)

2.2.1 - A negative-g restraint system is fitted to the seat pan to restrain the occupant when subjected to negative-g forces. The system consists of two straps, the lower one having a lug which locks into the centre harness lock in the front face of the seat pan. The upper strap is short having a lug at one end which is locked into the quick-release fitting on the occupant's torso harness and a buckle at the lower end. The free end of the lower strap is passed through the buckle giving a means of adjustment.

2.2.3 - When equipping the seat the lug of the lower strap is locked into the centre harness lock and when strapping in the occupant inserts the upper lug into the slot in the bottom half of the quick-release fitting. After tightening the lap straps, he tightens the negative-g restraint strap. The strap can be loosened by an upward pull on the strap attached to the buckle.

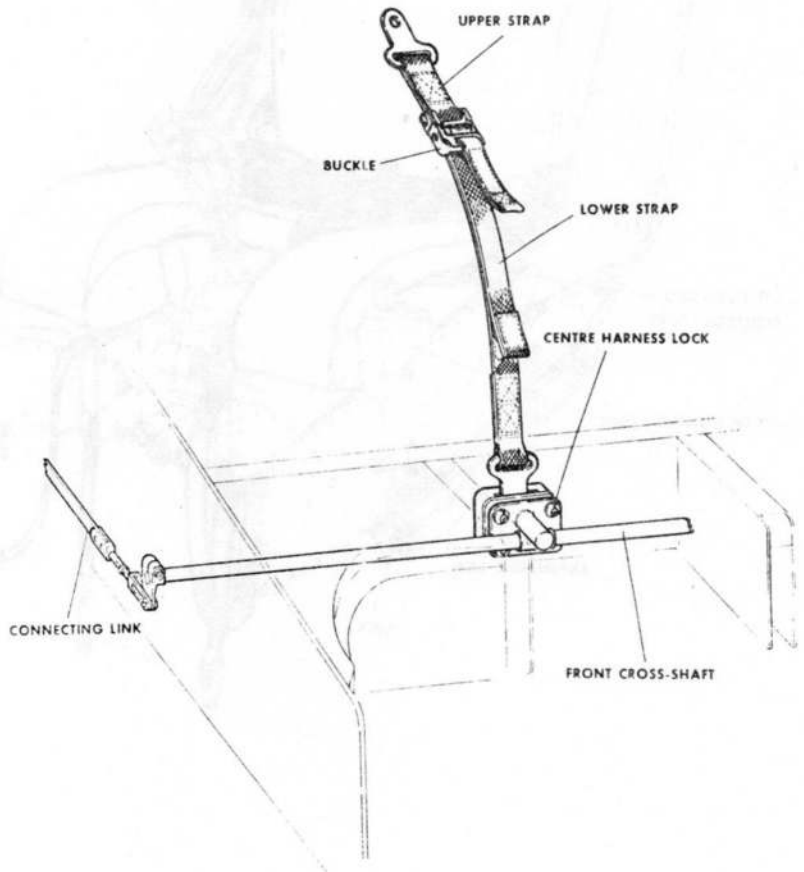

Fig 3 Installation of negative-g strap

2.3 - Leg restraint system (fig. 4)

2.3.1 - The leg restraint system is fitted to ensure that the legs are drawn back and held close to the seat pan during and after ejection. The system consists of two leg restraint lines, two snubbing units, two taper plug assemblies and two leg restraining garters.

2.3.2 - The lower end of each leg restraint line is attached to the floor of the aircraft by a fitting incorporating a shear rivet designed to fail at approximately 400 lbf. From this fitting each line is routed up through the snubbing unit, passed inboard to outboard around the front of the leg through the rings on the garter and finishing with the end fitting plugged into the taper plug assembly on the inside face of the seat pan extension.

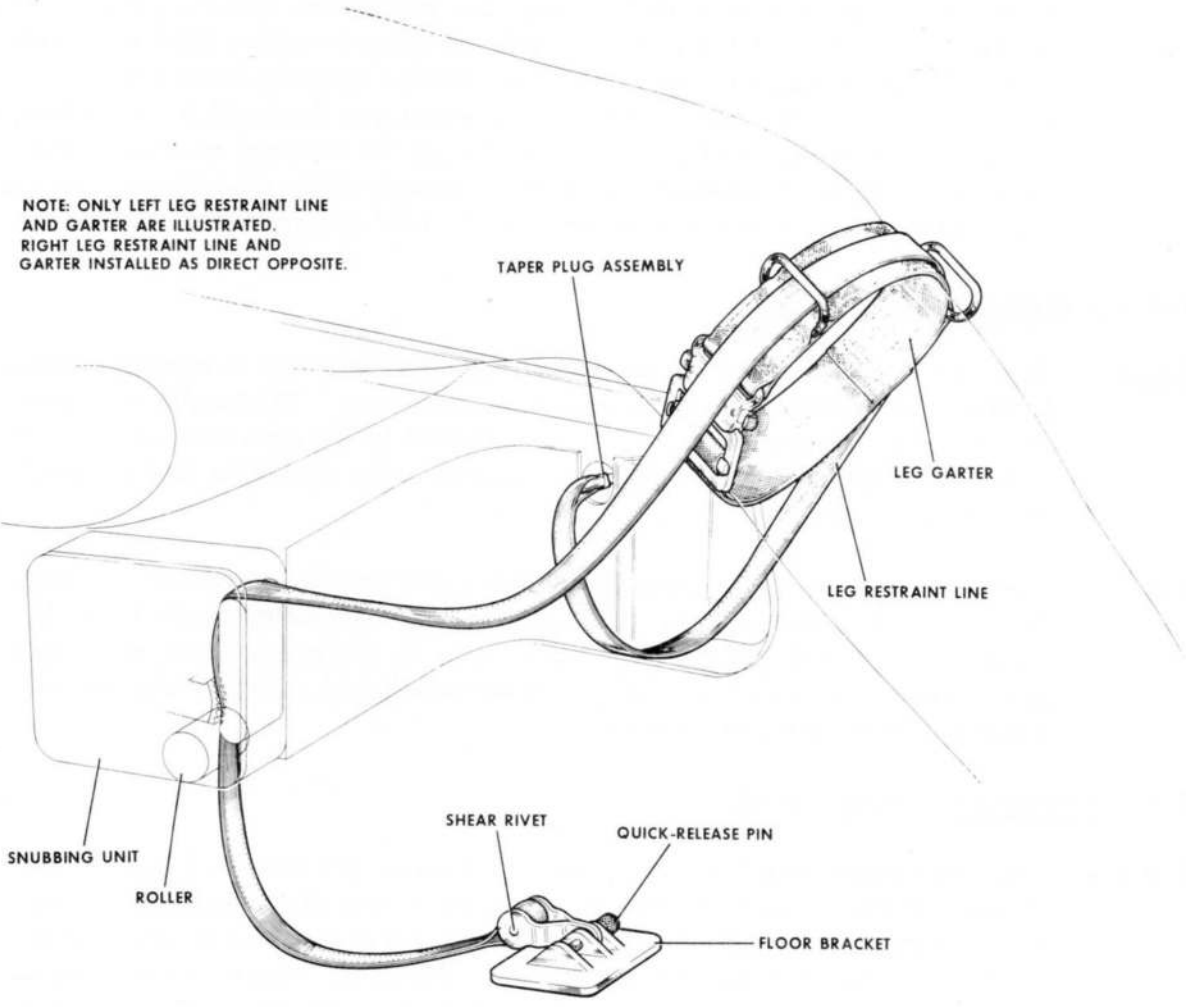

Fig. 4 Leg restraint line routing
◀ (Leg garter altered) ▶

2.3.3 - The taper plug assemblies are interconnected with the harness release mechanism to ensure that the lines are released simultaneously with the harness. Fitted to the port side of the seat pan is a release lever, which, when operated manually releases the leg restraint line end fittings from the taper plug assemblies, prior to vacating the seat.

2.3.4 - The snubbing units permit the leg restraint lines to be drawn downward through the unit but prevent the lines being pulled upward. To release the snubbing units to permit adjustment of the leglines it is necessary to operate the release lever situated on the inboard face of each unit.

2.4 - Go-forward mechanism

2.4.1 - A go-forward mechanism is fitted to the seat to allow the occupant freedom to lean forward and backward, this movement is obtained by the operation of a go-forward control lever mounted on the starboard side of the seat pan, the lever is connected by a linkage to the operating shaft of the harness retraction unit.

2.4.2 - Operation of the go-forward control lever fully to the rear and releasing it to the centre position operates through the linkage the operating shaft of the harness power retraction unit, the shaft operates a ratchet pawl and holds it out of engagement with the teeth of the ratchet spool by means of a geometric lock. Any application of excessive g in the vertical or horizontal plane will cause the ratchet pawl to overcome the lock and re-engage the teeth of the spool to prevent movement. Return of the go-forward lever to the forward position will also overcome the lock and re-engage the ratchet.

2.5 - Manual separation system

2.5.1 - In the event of failure of the automatic release facilities, a manual separation handle is provided on the port side of the seat pan. The handle is connected by linkage to the guillotine firing unit mounted on the port rear face of the seat pan, a pipe run connects the firing unit to the guillotine unit situated on the top of the seat pan.

2.5.2 - Operation of the manual separation handle releases the parachute harness, lap straps, negative-g strap, P.E.C. and leg restraining cords from their respective locks and at the same time fires the guillotine firing unit, operating the guillotine unit to sever the parachute withdrawal line thus freeing the parachute from the seat structure.

2.6 - Emergency oxygen system

2.6.1 - The emergency oxygen system consists of an oxygen cylinder fitted to an Intertechnique controller mounted on the port rear of the seat pan. The main oxygen supply and oxygen flow sensor and pressure warning switch cables also pass through the controller. From the bottom of the controller an emergency oxygen supply hose is connected to the seat portion of the P.E.C. Another hose, to supply main oxygen and anti-g requirements is connected to the aircraft portion of the P.E.C.

Operation of the emergency supplies is accomplished by withdrawal of the operating cable from the controller.

2.6.2 - When the assembly is installed on the seat the operating cable is connected to a trip lever on the rear of the seat pan. On ejection the main oxygen supply is broken at the quick disconnect and the emergency supply is tripped. Means are provided for the selection of emergency oxygen if the main oxygen should fail. A ring handle situated forward of the P.E.C. is connected by flexible cable to the trip lever on the rear of the seat pan.

2.6.3 - Personal equipment connector: The personal equipment connector (P.E.C.) is fitted to the port side of the seat pan. It enables main oxygen, emergency oxygen, mic/tel and anti-g suit to be connected or disconnected in one action. The P.E.C. comprises three components:-

- Aircraft portion. Connected by the main oxygen hose and oxygen flow sensor and pressure warning switch cables to the Intertechnique controller and including a mic/tel lead which is connected to a socket on the side of the seat pan. It makes the Intertechnique equipment compatible with standard British flying clothing.

- Seat portion. Bolted to the seat pan and connected to the emergency oxygen supply. Fitted with valves on the oxygen connections to close when the man portion or aircraft portion are disconnected, and with latch plungers and springs to retain the aircraft and man portions. Connected by linkage to the harness release mechanism.

- Man portion. Attached to the flying clothing by personal supply lines and released from the seat portion by operation of the harness release mechanism or by a pull on the handle lanyard.

2.6.3.1 - On ejection personal supplies are disconnected at a quick disconnect and the aircraft portion remains attached to the seat portion. On operation of the harness release mechanism the man portion is released from the seat portion.

2.7 - Rocket motor

2.7.1 - A multi-tubed rocket motor is fitted under the seat pan to sustain the thrust of the ejection gun giving a higher trajectory enabling a safe ejection to be made from zero speed, zero altitude. It is also beneficial in cases of aircraft at low altitude with a high sink rate.

2.7.2 - Either one of two rocket motors may be fitted depending on the aircraft and crew position in which the ejection seat is to be fitted. The motors differ only in that one outer efflux nozzle is enlarged to provide divergent trajectories.

2.7.3 - An extension arm from the centre body is attached by a link to the pitch control unit fitted to the starboard side of the seat pan. Rotation of the handwheel on top of the unit rotates the rocket motor about its axis thereby altering the angle of incidence between the rocket motor and the seat pan, thus varying the direction of thrust of the efflux nozzles to compensate for the effects of the occupant's weight upon the seat centre of gravity. A system of pinions connects an indicator drum to the handwheel. The seat occupant must set the pitch control unit so that the number visible through the window in the unit agrees with his boarding weight. Rotation clockwise raises the rocket motor decreasing the weight compensation and vice versa.

2.8 - Connections to the aircraft

2.8.1 - On an installed seat the following items are connected to the airframe or fixed portion of the seat:-

1) Port side of the seat

a) Trip rod from the drogue gun to the cross beam

b) Personal supplies quick disconnect

2) Starboard side of the seat

a) Trip rod from time-release unit to the cross beam.

b) Rocket motor remote firing unit static cable to bracket on the time release trip rod.

c) I. F. F. switch operating cable

3) Front of the seat

a) Leg restraining cords to aircraft floor

3 - SEQUENCE OF EVENTS DURING EJECTION

3.1 - On pulling the seat pan firing handle the sear is withdrawn from the firing unit in the port horn of the seat pan; this action fires a cartridge, the gas from which is piped to the harness retraction unit to ensure that the occupant is pulled back to the correct ejection position. The gas pressure then passes to the sear withdrawal plunger unit which operates a cross-shaft to remove the sears from the canopy jettison firing unit and the ejection gun breech time-delayed firing unit, thereby initiating canopy jettison and seat ejection. As the seat ascends the guide rail the following sequence occurs:-

1) The harness retraction unit is locked.

2) The leg restraint cords tighten until the rivets shear.

3) The drogue gun sear is withdrawn by the trip rod actuating the drogue gun mechanism.

4) The barostatic time-release unit trip rod withdraws the firing pin.

5) The seat actuator electrical lead and personal supplies from the aircraft systems are disconnected.

6) The emergency oxygen supply is turned on.

7) As the seat leaves the aircraft the remote rocket firing unit static line becomes taut withdrawing the sear to fire the cartridge, gas pressure operates the rocket motor firing unit, heat and pressure from the fired cartridge ignites the rocket motor to sustain the thrust of the ejection gun. ◀

8) Approximately 0.55 seconds after ejection, the drogue gun fires ejecting the piston and deploying the drogues which stabilize and retard the seat. If the ejection occurs at high altitude the seat will eventually fall in a near vertical attitude with the occupant restrained from falling forward by the lap straps and shoulder straps. At low altitudes there may not be time for the seat to attain the near vertical position. During this phase the occupant will be breathing emergency oxygen from the system fitted to the seat.

9) When the conditions of height set on the barostat are met the barostatic time-release unit will commence to function, after a delay of approximately 2 secs. the unit will operate, the occupant's harness will be released from the seat locks and the only restraint will then be provided by the sticker strap clips. The scissor shackle will be released, releasing the drogues and commencing parachute deployment. The parachute, when deployed, lifts the occupant from the seat pulling the sticker straps from their clips, a normal parachute descent now follows. This arrangement ensures that there is no possibility of collision between the seat and occupant after separation.

3.2 - On two seater aircraft the seats are ejected on diverging trajectories - ensuring that each seat has a clear trajectory path.

4 - EQUIPPING THE SEAT

4.1 - The following procedure is to be used when installing the equipment in the seat, refer to figs 1 to 10 for detail as necessary. The seat may be equipped before installation if this is advantageous:-

1) Ensure that the seat has been made safe for servicing in accordance with current instructions and the Lethal Warning page.

2) The emergency oxygen system must be fitted before the ejection seat is equipped, see A.P.109B-0139-13A.

3) Ensure the seat pan is clean and that the leg restraint cords are clear of the seat pan.

Para. 4.1 (continued)

4) Ensure that the manual separation handle is in the locked position and that the time-release unit is cocked.

5) Fit the negative-g restraint strap, buckle forward, into its lock on the front face of the seat pan. Lay the strap over the front face of the seat pan.

6) Position the lap straps ready for fitting.

Note...

The lap straps are handed and when fitted, the largest lug attached to the single strap, is inserted into the lower harness lock, the survival pack quick-release connector hangs below the strap, the sticker strap lies above the lap strap, and the buckle faces outboard.

Insert the lugs into the lower seat locks and pull hard on the straps to ensure that they are correctly locked. Insert the sticker strap lugs into the clips on the inside face of the seat pan.

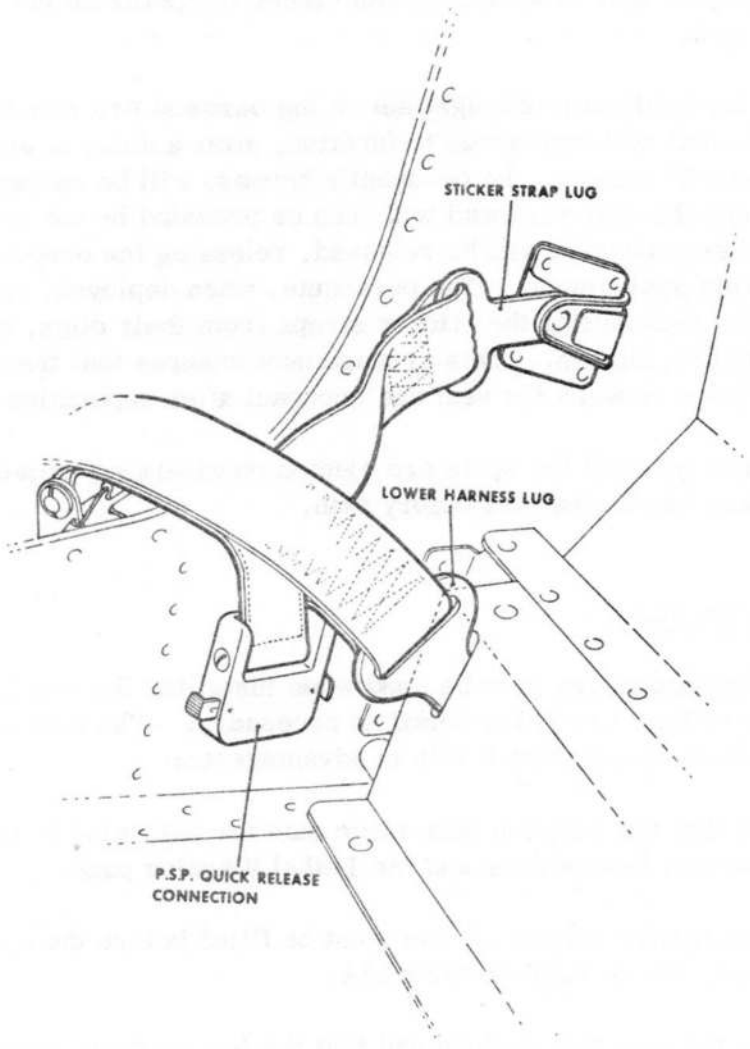

Fig 5 Fitting starboard lap strap (port similar)

Para. 4.1 (continued)

7) Place the personal survival pack in the seat pan taking care that the lowering line stowage in the port side of the cushion is not disturbed. The lowering line arrow-head connector will lay over the port end of the front face of the seat pan. Withdraw the side attachment straps from under the cushion and connect them to the quick-release connectors on the lap straps. Pull on the connections to ensure they are securely made, tuck the connectors under the cushion and secure with the Velcro beckets provided. Check that the lowering line safe-tie is intact.

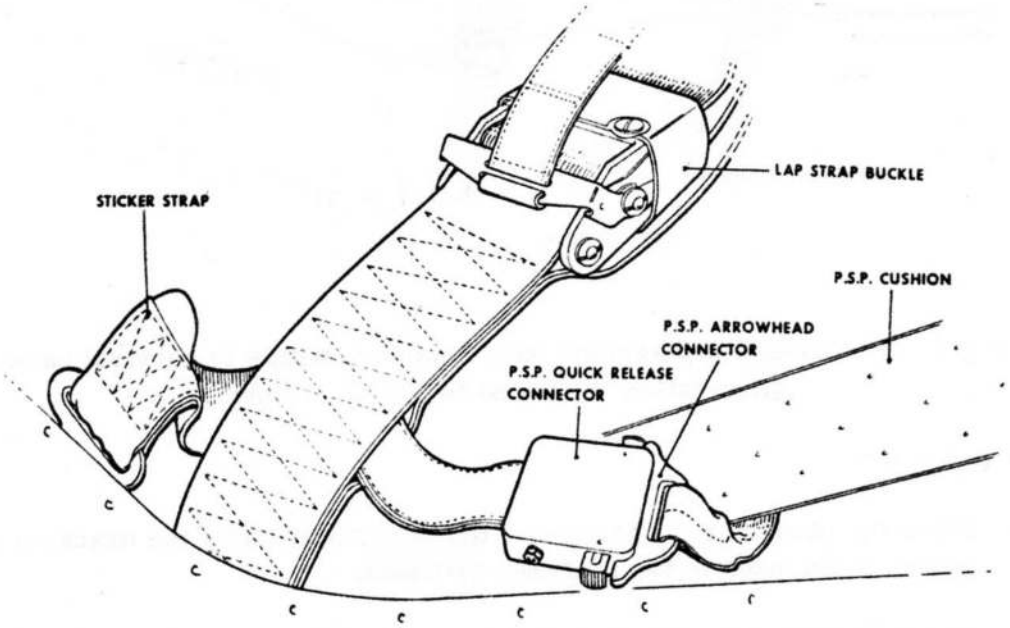

Fig 6 Attachment of personal survival pack to starboard lap strap

8) Lay the parachute pack face down on top of the survival pack. Attach the parachute pack retention straps to the buckles on the rear of the survival pack. The straps are to be routed down the rear face of the survival pack cushion rearwards through the buckle under the slider bar, up around the bar and forward through the buckle again above the slider bar and secured by the press stud fasteners, (fig 7).

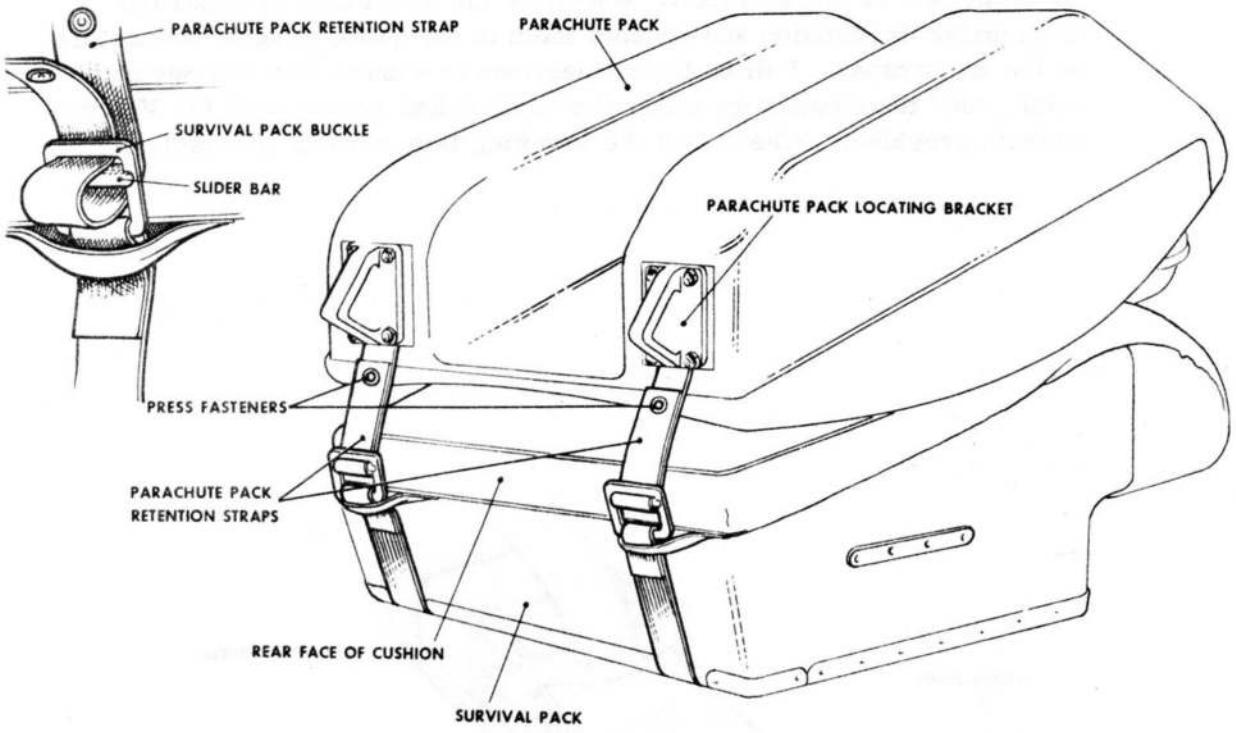

Fig 7 Attachment of parachute pack retention straps to survival pack
(Illustration amended to STI/SE/275A)

Para. 4.1 (continued)

9) Place the parachute in the back of the seat pan locating the brackets on the bottom of the pack in the recesses provided.

▶ 10) Carefully open the outer flap of the parachute pack and ensure that the rip pins are correctly positioned through the cones and that the scarlet cotton tie securing the starboard rip pin is unbroken. Route the withdrawal line out through the centre of the outer flap. Replace the flap pressing it down to make the touch-and-close fastener. Ensure that the alignment ring safe-tie is intact. (fig 8). ◀

11) Push the parachute pack back into the seat pan; ensure it is retained by the nylon blocks. Route the withdrawal line up between the upper locks and attach it to the top face of the seat pan by the touch-and-close tape.

Note...

If the nylon blocks do not retain the parachute pack in position, place shims MBEU/40882 between the blocks and the inner faces of the seat pan.

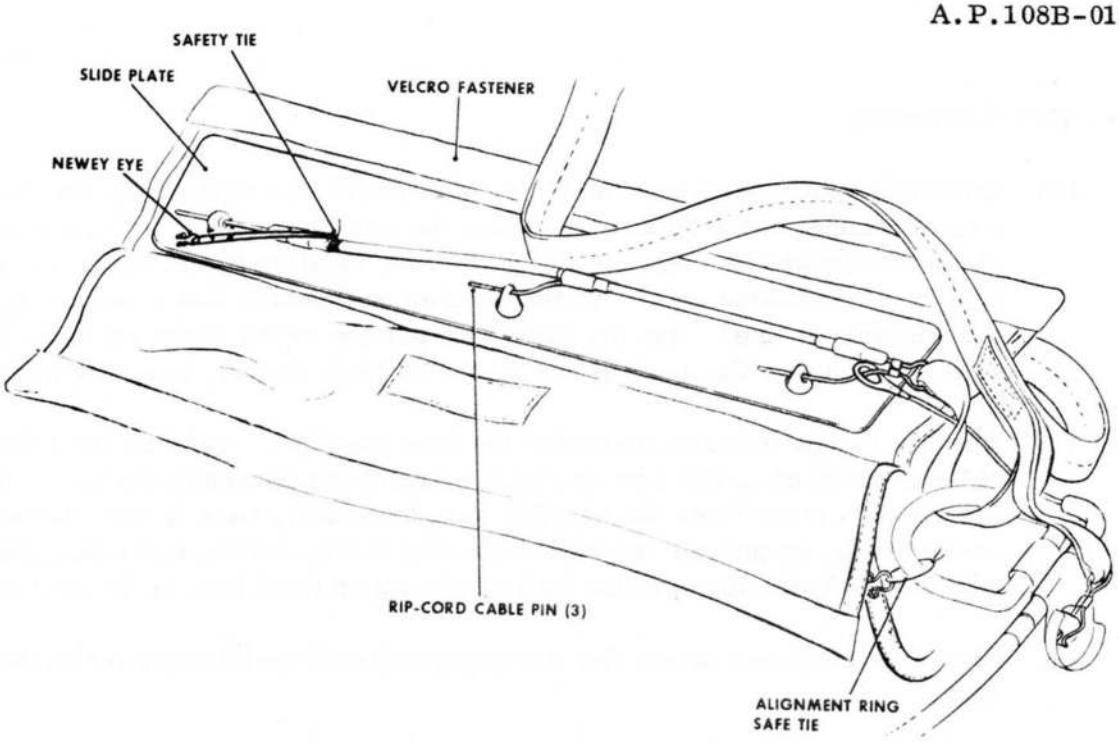

Fig 8 Parachute and alignment ring safe ties
(SI/SE 101C incorporated)

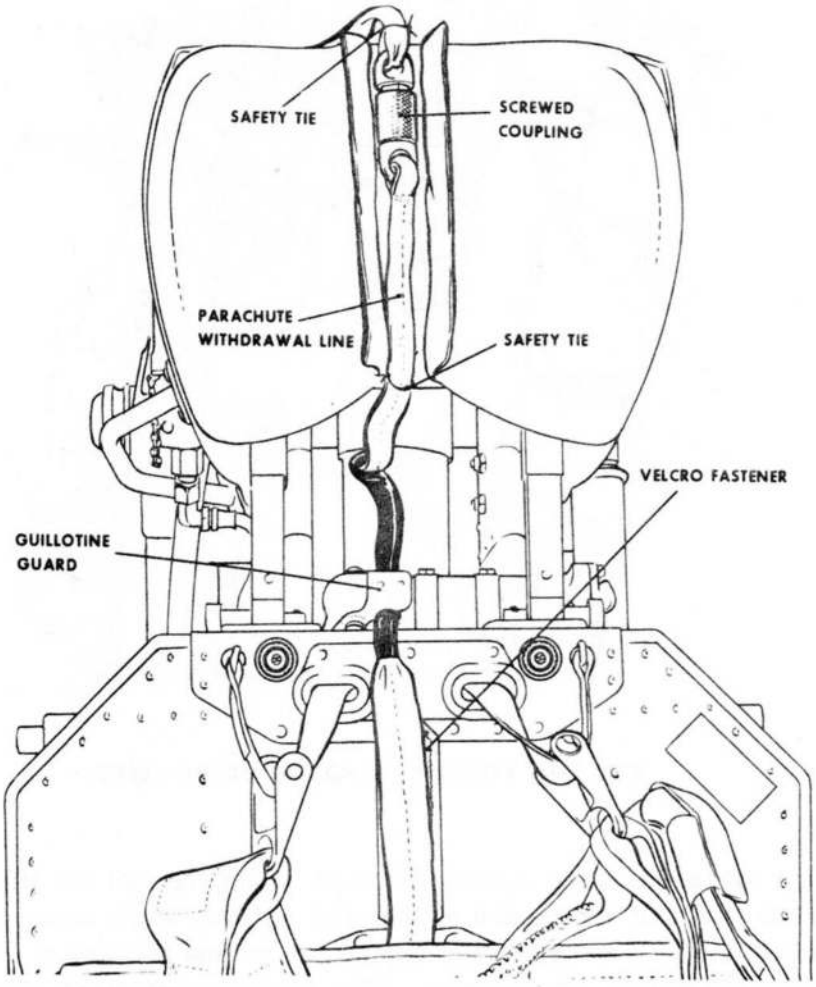

Fig 9 Routeing of parachute withdrawal line

Para. 4.1. (continued)

12) Connect the parachute portion of the withdrawal line to the seat portion in the centre channel of the headrest. Open the guillotine guard and route the parachute withdrawal line through the guillotine, locating the P.V.C. covered portion in the guillotine gate. Close the gate and ensure that it correctly retains the withdrawal line. Tie the parachute portion to the lower tie plate in the centre channel of the headrest using No 12 linen thread, breaking strain 25 lbf.

13) Operate the go-forward control to the free position. Take up the roller shackle attached to the port shoulder strap of the parachute harness, pull out the port strap from the harness retraction unit, pass it over the spring cross strap, up through the roller shackle and insert the end taper plug into the port side top harness lock on the upper front face of the seat pan.

14) Similarly route and attach the starboard strap of the harness retraction unit.

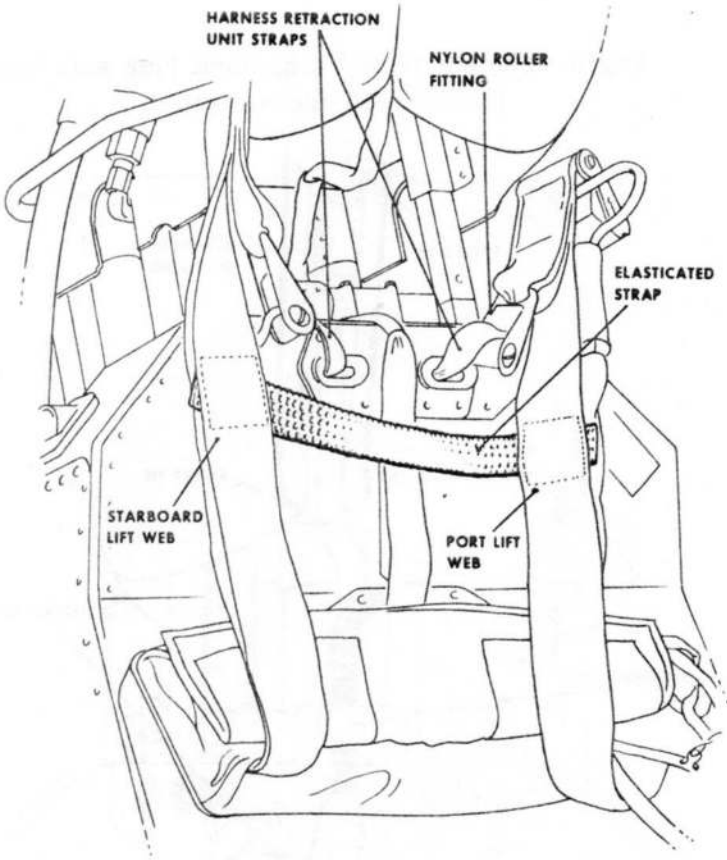

Fig 10 Position of spring cross strap

15) Pull outwards on the shoulder straps. Ensure that the lift webs and harness retraction unit straps are not twisted and that when extended the harness retraction unit and shoulder straps are routed inboard of the lift webs and above the spring cross strap. The spring cross strap should be retained between the pair of press studs on the lift webs nearer to the Koch fittings.

Para. 4.1 (continued)

16) Ensure that the Koch fittings on the parachute lift webs are set with the safety flap over the release bar. Pull and lift the shoulder straps to secure them in the stowage position with the touch-and-close fastener tape on the port side of the drogue container for the port shoulder strap and on the top surface of the back of the seat pan for the starboard shoulder strap. Return the go-forward control to the forward locked position.

17) Extend the lap and negative-g straps to their fullest extent. Stow the lap straps by inserting the lugs into the spring clips on the outer side skin of the seat pan and lay the negative-g strap on the survival pack.

18) Pull the leg restraint cords back through the snubber units to preclude the necessity for the occupant to do so when strapping-in.

5 - STRAPPING-IN PROCEDURE

5.1 - The procedure for strapping-in is as follows, refer to figs 11 to 13 as necessary:-

1) Remove and stow the P.E.C. dust cover. Sit in the seat.

2) Remove the cover from the man portion of the P.E.C., insert the forward end first in an inclined attitude and press down with a hinging motion until it locks into place. Test for correct fitment by checking the Tel/mic systems.

3) Adjust the height of the seat pan to a satisfactory position.

4) Note...

◀ The leg restraint garters are to be fitted before entering the aircraft. Ensure that the crank in the male portion of the quick-release connector follows the curvature of the leg. They are to be fitted ▶ around the legs below the knee with the D-rings to the front of the legs equal distance each side of the shin bone and the quick-release connectors to the inside of the legs. The free end of the garter strap, when secured by the Velcro, must be at least one inch from the outboard D-ring. If necessary the excess strap is to form a loop to the rear of the leg.

Pass the leg restraint cord emerging from the port snubbing unit around the front of the left leg and from inboard to outboard through the rings on the left leg garter and plug the end fitting into the port side taper plug assembly. Similarly route the starboard leg restraint cord through the rings of the right leg garter and plug into the starboard taper plug assembly. Adjust the cords to permit the required leg movement.

5) Connect the survival pack lowering line to the quick-release connector on the life preserver routing the line outside the left leg.

Note...

If the connection is short extend the strap attached to the life preserver Do not pull to extend the lowering line as this is tied to the survival pack.

6) Adjust the rocket motor pitch control unit to register occupant's dressed weight.

7) Bring across the lap straps, routing the left strap over the survival pack lowering line, and insert the lugs into the quick-release fitting on the skeletal torso harness.

8) Bring the negative-g strap up between the legs ensuring it is to the rear of the seat pan firing handle and not passing through it and that the buckle is facing forward. Insert the lug into the quick-release fitting of the skeletal torso harness.

9) Tighten the lap straps evenly ensuring that the quick-release fitting is positioned centrally in the lap. Roll up the free ends of the straps and secure using the Velcro tape. Tighten the negative-g restraint strap by pulling down on the free end locating the quick-release fitting over the pubis.

Note...

It is important that the lap straps and negative-g restraint strap are as tight as possible as they provide the principal restraint under all stress conditions. The straps can be loosened by pulling on the tabs attached to the snubber bars on the adjusting buckles.

10) Operate the go-forward control, pull on the parachute lift webs and connect the Koch fittings to the lug on each shoulder of the skeletal torso harness. To fit, it is necessary to raise the safety flap of the Koch fittings and push the lug into the fitting until it locks into place. An audible "click" will be heard on correct engagement and full return of the safety flap will indicate positive locking (fig. 11). Insert the safety pins attached to the lift webs through the hole in the outboard flange of each Koch fitting to secure the safety flap.

Note...

To release a Koch fitting remove the safety pin, lift the safety flap and rotate the release bar downward (fig. 11). The bar is knurled on the top to improve the grip.

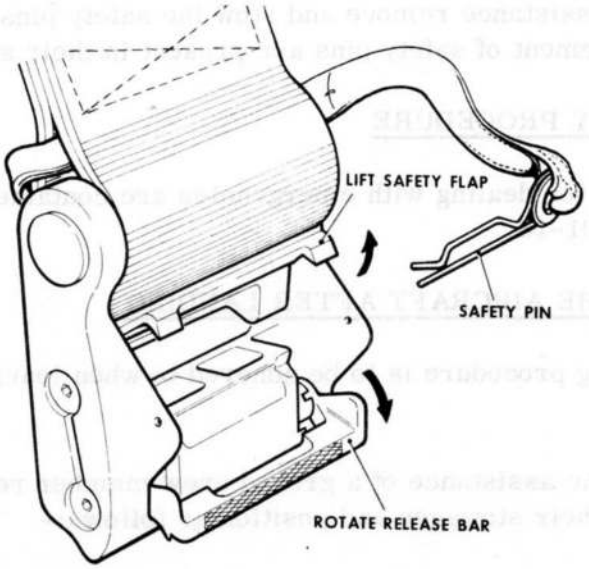

Fig 11 Operation of Koch fitting
(STI/SE/248 and 276 embodied)

11) Return the go-forward lever to the locked position and lean hard back in the seat.

12) Tighten the torso harness shoulder connector adjustment straps. Tuck the ends down under the parachute harness torso adjustment straps.

13) Tighten the torso harness negative-g strap.

14) Don the flying helmet and fasten the chin straps. Connect the oxygen mask hose. Connect the mic/tel lead locating the connector outside the left hand stole and with the connector tucked behind the left hand edge of the mini regulator.

15) Carry out the following functional checks:

a) Raise and lower the seat pan to its full extent. Re-position to desired height.

Note...

The permitted operating time limit of the seat actuator is 1 minute in 5 minutes.

b) Carry out oxygen flow checks and test tel/mic circuits.

c) Ensure that leg restraint lines are securely locked in their sockets.

d) Move the go-forward lever to the rear position, release it to return to the central position and check that movement forward is free. Lean fully forward, return the lever to the forward position and check progressively that all forward movement is restricted.

16) With assistance remove and stow the safety pins. Ensure that a full complement of safety pins are present in their stowages.

6 EMERGENCY PROCEDURE

6.1 Instructions for dealing with emergencies are contained in Aircrew Manual AP 101B-3101-15.

7 LEAVING THE AIRCRAFT AFTER LANDING

7.1 The following procedure is to be adhered to when leaving the aircraft after landing:-

1) With the assistance of a ground crew member remove the safety pins from their stowages and position as follows:-

   a) Sear of the seat pan firing unit.

   b) Manual separation handle.

   c) Sear of the canopy jettison unit.

   d) Sear of the remote rocket firing unit.

2) Remove oxygen mask, turn off oxygen supply.

3) With right hand rotate the torso harness quick-release fitting through 90 degrees to release the lap straps and negative-g strap and, at the same time using the left hand operate the leg restraint cord release lever to free the cords.

4) Using the left hand press the plungers on the P.S.P. lowering line connector to release the lowering line.

5) With the left hand release the man portion of the P.E.C. from the seat portion.

6) Using both hands, remove the safety pins from the Koch fittings; lift the safety flaps and rotate the release bars to free the shoulder straps.

7) Fit dust cover to seat portion of P.E.C. and rubber protective cover to man portion of P.E.C.

8) Vacate the aircraft.

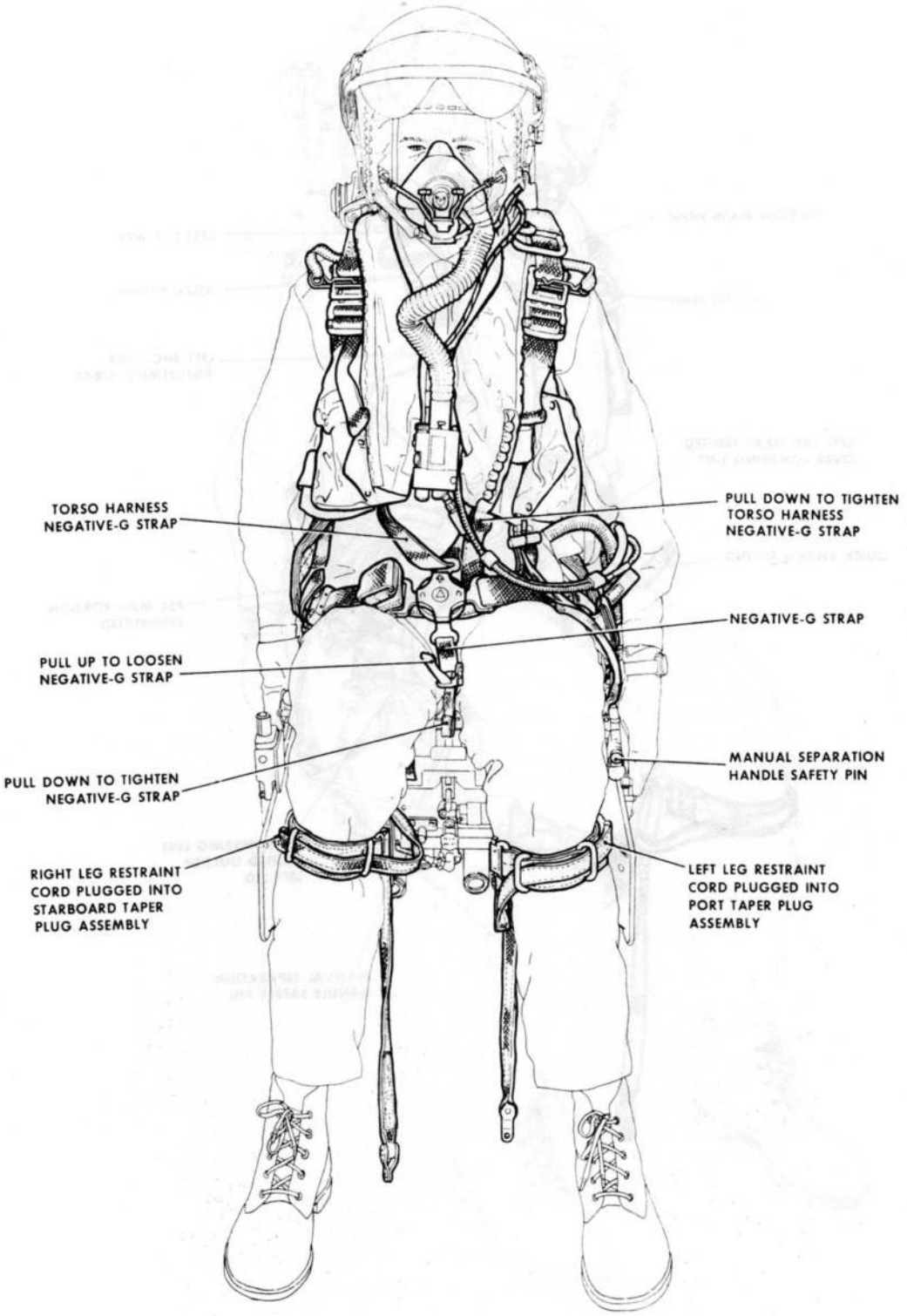

Fig 12 The seat occupied - front view
(Mic/tel lead rerouted)

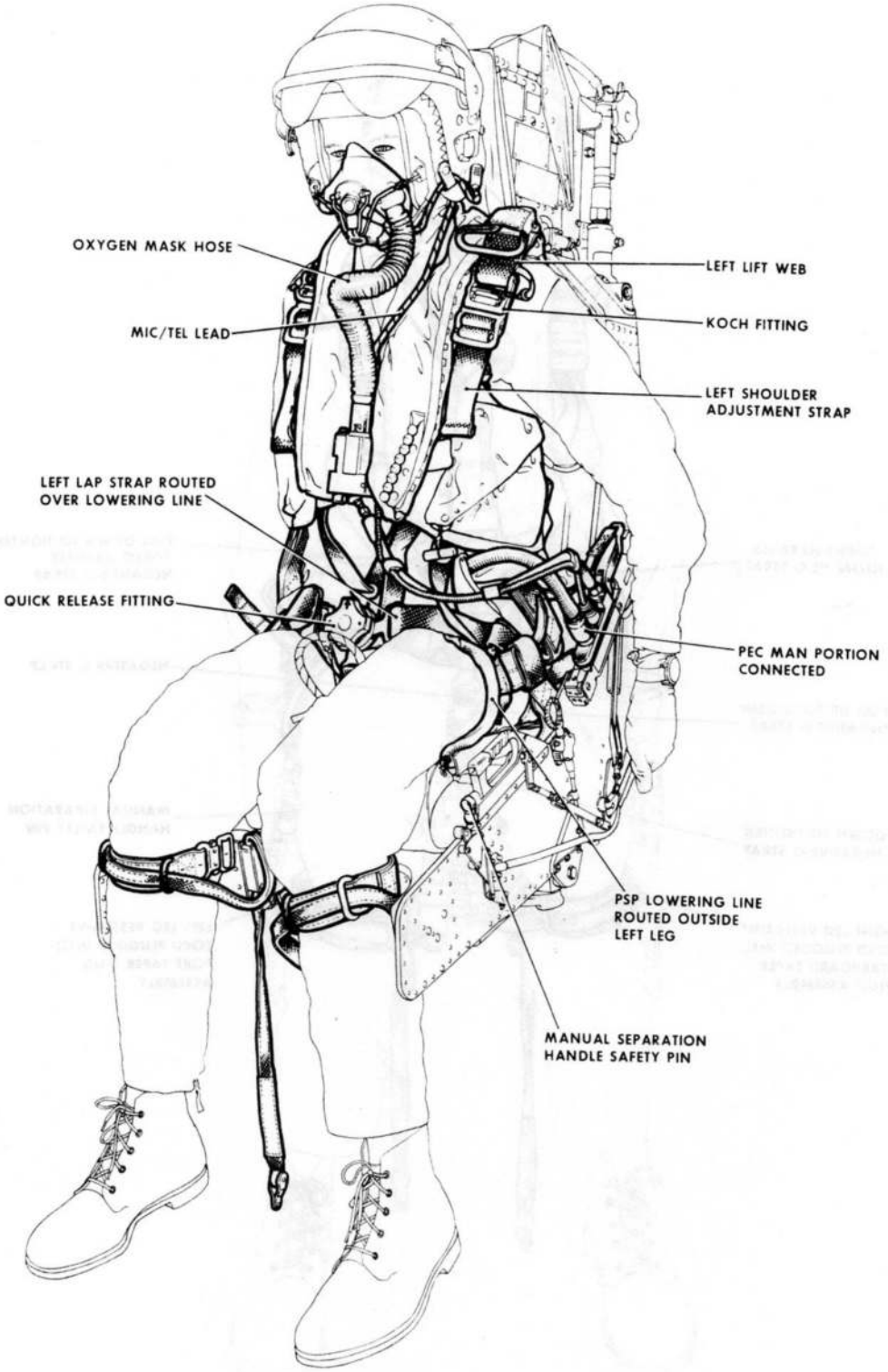

Fig 13 The seat occupied - port view
(Mic/tel lead rerouted)

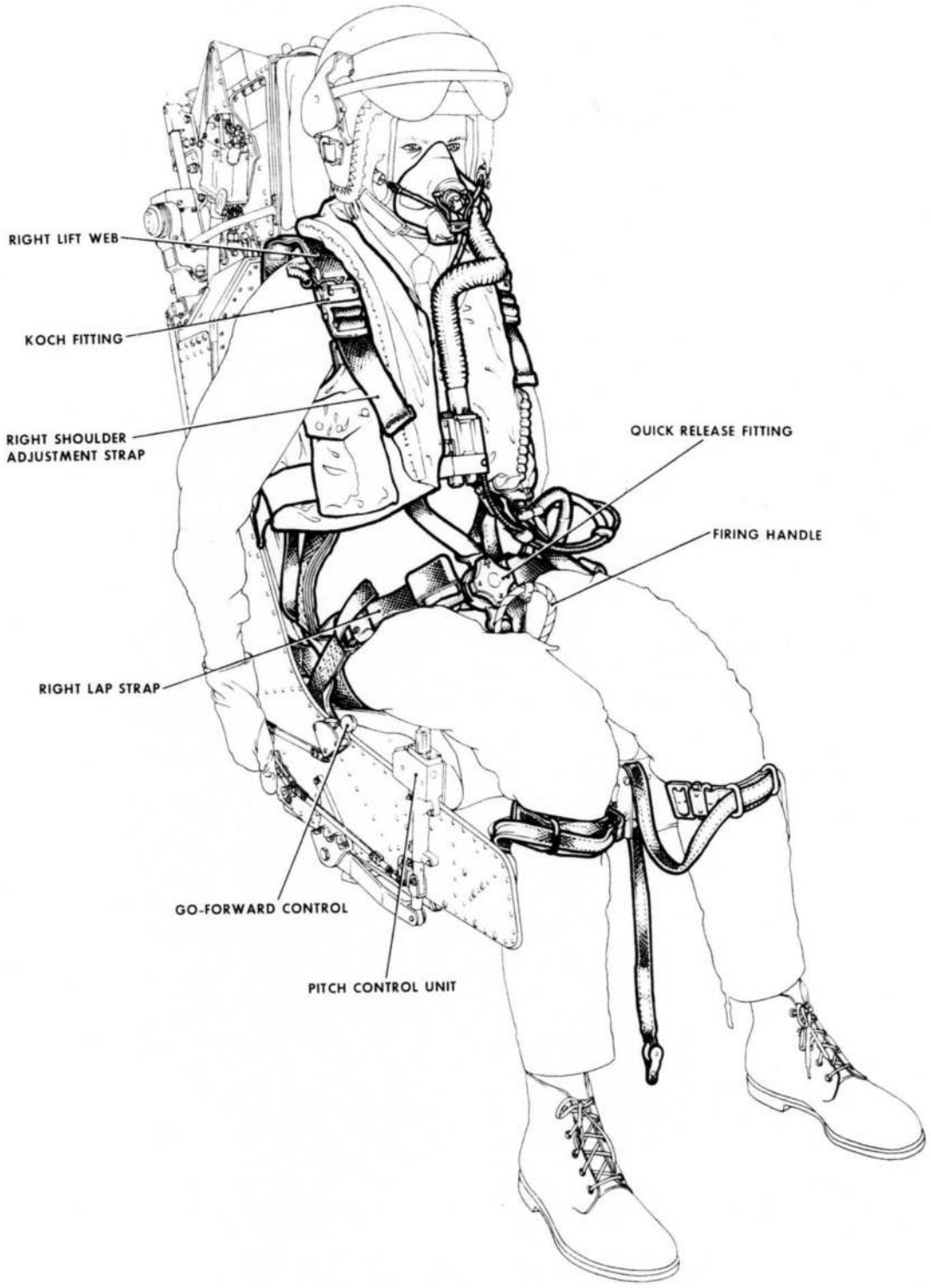

Fig 14 The seat occupied - starboard view
(Mic/tel lead rerouted)