CHAPTER 2

AIRCREW EQUIPMENT ASSEMBLIES

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Introduction

1. In general terms, the main aim of any clothing has always been to protect the body from the unfavourable effects of man's environment. Furthermore, the characteristics of a particular occupation have led to the development of clothing assemblies best suited to the needs of that occupation and its associated workspace. Flying clothing, or in preferred terms, Aircrew Equipment Assemblies (AEA), follows this general concept.

2. Any AEA is a collection of specialized items of clothing and equipment integrated into a functional unit compatible with the aircrew size population, the cockpit workspace and the flying task.

3. The purpose of an AEA is to provide the necessary physiological support and protection required by aircrew to combat the various factors of the aviation environment, and thus allow them to carry out the flying task. The AEA must also provide aircrew with whatever specialized facilities are needed in case of in-flight emergency, escape from aircraft in flight and subsequent survival on land or in the water. It is essential that these latter requirements of an AEA should not impede the normal flying task unduly, nor create an unacceptable work load on aircrew. Consequently, any AEA is always a compromise between that required to sustain normal flight, and that required to give adequate protection during any emergency situation.

4. The principles involved in the development and assessment of aircrew clothing and equipment are relevant to any discussion concerning the AEA. Aircrew clothing and equipment tends to be specific for a particular aircraft type and is dependent upon the role of the aircraft, its theatre of operation and the ergonomics of the cockpit workspace, although any particular AEA is likely to have many features in common with other assemblies. This means that there is an extensive range of assemblies of widely differing complexity. Consequently, it has been recognised for many years that it is essential to have a comprehensive and systematic methodology for evaluating both a prototype and an in-service AEA, and for ensuring that the complete assembly (both as individual items and as a whole) meets the required criteria.

5. Before the design specification for an AEA can be undertaken, it is necessary to obtain critical details concerning the aircraft in question. The major factors which influence the AEA can be listed as follows:

a. *Operational Role and Flight Envelope.* Altitude profiles and operational ceiling, maximum rate of descent, high level/low level capabilities, operational speed envelope, acceleration profiles.

b. *Geographical Area of Operation.* Ground and in-flight thermal environment, survival needs, toxic threats.

e. *Cockpit Environment.* Cabin pressurization profiles, noise patterns, vibration profiles, characteristics of the cockpit and personal conditioning systems, heat loads produced by the aircraft avionics.

d. *Cockpit Workspace.* Design philosophy and dimensions, escape system installation (since it is part of the direct interface between the equipped aircrewman and the aircraft), aircrew size limitations imposed by the cockpit design, characteristics of the g-protection and oxygen systems.

e. *Definition of the Aircrew Population.* Accurate knowledge of anthropometry and thus the range of aircrew to be accommodated, definition of clothing and

equipment size roles bearing in mind a need for compatibility between cost and achieving a satisfactory fit for all aircrew.

6. Once the above details are known it is possible to simulate the major parameters of the aviation environment using facilities such as the man-carrying centrifuge, vibration platform, altitude chambers, climatic chambers, deceleration track and noise chamber. In this way either individual items of an AEA, or a complete assembly can be exposed to the routine hazards of flight as well as the extremes of those hazards, and a study made of the adequacy of the design of the AEA. Additionally, examinations can be conducted of the effects the combination of the AEA and flight parameters have on aircrew performance using the same facilities and appropriate tests of work load capacity, either mental or physical.

7. An important stage is to construct a dimensionally accurate cockpit mock-up so that the man-machine interface may be studied in detail. Using such a facility, individual items of an AEA or the whole assembly can be examined and integrated with the cockpit workspace. Using subjects representing the anthopometric range of aircrew size, evaluations of the AEA size roll, fit and function can be made. It is important to appreciate that certain items of an AEA are worn in particular combinations, and therefore should be correctly sized so as to fit over each other as a multi-layer series of garments. Use of a cockpit mock-up enables all of the possible garment combinations within the AEA to be studied relatively quickly and easily. In this way, logical strapping-in, routine and emergency egress drills can be defined as well as studies made of the ability of different sized subjects to reach and operate the aircraft and cockpit controls and instruments whilst wearing the various items of an AEA. Comfort and mobility of subjects whilst wearing the AEA and strapped into the cockpit mock-up may also be studied. It is also important to examine the profiles of the ejection sequence itself, the capability of the AEA to withstand high speed, low level ejection, man-seat separation and the efficiency and comfort of the restraint and parachute harness assemblies both during flight and during the ejection sequence. As regards the survival aspects of aircrew clothing and equipment, the flotation characteristics of the complete AEA are investigated, including studies of the protection afforded against immersion as well as an assessment of the performance and behaviour of the AEA during dragging on land or in the water.

8. Although most of the evaluation of an AEA can be more readily and comprehensively studied under laboratory conditions, confirmation of the laboratory findings by means of assessments using aircrew subjects in actual aircraft cockpits, either by ground (static) trials or by flight trials, is essential.

9. When aircrew have been issued with the AEA, the training aspects should not be forgotten. Aircrew need to know, and to be instructed on, the capabilities and limitations of the various items comprising an AEA, and to undergo practice sessions using the equipment. The AEA cannot function properly if it is ill-fitting and not of the correct size. Therefore, it is necessary to ensure that the correct combination of garments is worn for the aircraft type, role and area of operation and that the clothing and equipment is a good fit and comfortable. Ground support personnel need to ensure that the AEA is fully maintained in serviceable condition so that it will function as designed when required.

10. Properly authorised items and combinations of aircrew clothing and equipment for each aircraft type in operation with the RAF and other services (both fixed wing and rotary wing) can be found in the AEA schedules issued and updated regularly in AP 108B–00–1. The AEA schedule for an aircraft also indicates the approved com-

bination of AEA items to suit differing roles, eg. Summer/Winter, over land or over water.

11. Further complete and detailed information regarding aircrew clothing and associated equipment is published in the AP 108F series. Where applicable, discussion of the various current items of aircrew clothing assemblies lists the cross-reference to the appropriate chapter in the AP 108 F.

12. NBC portective garments and equipment have not been considered in the general aircrew clothing chapters since full documentation regarding these specialist assemblies is detailed elsewhere in this publication (Vol E, 1, 2, 3).

AIRCREW UNDERWEAR

Drawers, Cotton Fine, and Vest, Sleeved, Cotton Ribbed

13. **Description.** These items of clothing, shown in Fig 1, are provided to give aircrew a comfortable inner-most layer to the various clothing assemblies. The purpose of the cotton underwear is to maximise the evaporation of water vapour from body surface, by allowing sweat to 'wick' away from areas of excessive sweat production. In this way total body thermal comfort is enhanced. The cotton underwear also prevents the skin from being chafed by the heavier and coarser fabrics of the outer layers of flying clothing such as anti-g trousers and aircrew coveralls.

14. **Fitting Criteria.** The cotton drawers are available in 6 sizes ie. waist sizes 32 to 40 ins with 2 in increments plus a special size facility. The sleeved vest is available in 5 sizes ie. small, medium, large, extra large and a special size facility. Both these items of aircrew clothing should be worn with all flying clothing assemblies.

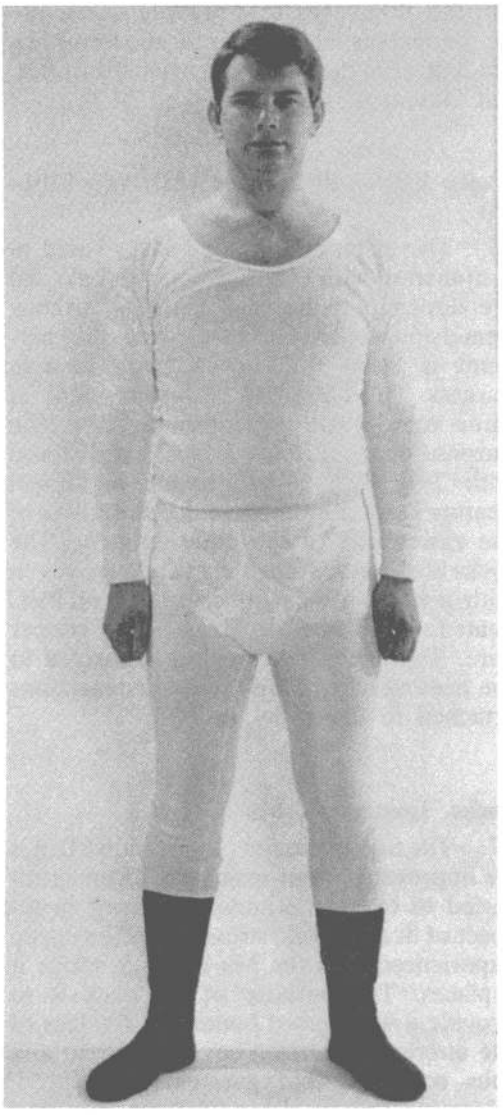

Fig 1 Aircrew Underwear

AIRCREW SOCKS

Socks, Duffle

15. The duffle sock is a thick, calf length sock made of a felt-like fabric. It is only to be used in conjunction with the aircrew Mukluk in Arctic clothing assemblies. The

purpose of the sock is to provide an adequate thermal insulative layer for the lower leg and foot. The duffle sock is available in five unit increment sizes from 7 to 11.

Socks, Electrically Heated (AP 108F–0701–16)

16. The electrically heated socks (used in conjunction with electrically heated gloves) are designed to be used with the aircrew immersion coverall Mk 10 when this garment is fitted with an electrical heating harness. The socks and gloves are made in three sizes, small, medium and large. The purpose of these items, which are powered with 28V DC, is to provide additional heating in situations where undue cooling of the extremities of the body is likely. The socks are knitted from 3 ply yarn interwoven with a heating element consisting of PVC coated, tinsel bound, silver plated copper wire. The heating element is connected to the heating harness by external connections attached to the socks.

Socks, Immersion, Mk 3

17. The Sock, Aircrew, Immersion Mk 3 is an improved design which has been introduced to overcome minor problems in respect of fit and fabric stress across the instep experienced with the Mk 2 design which it replaces. The purpose of the sock is to provide a waterproof bootee on the legs of the aircrew immersion coverall Mk 10 and thus complete that garments waterproof integrity. The provision of a separate, but attachable item allows the correct sizing of the boot to the immersion coverall.

18. **Description.** The sock is constructed of four panel sections of double texture nylon butyl fabric butt jointed together. The joints are taped both internally and externally. The outer surface of the sock is black in colour and the upper leg is cut at an acute pitch to reduce strain across the instep if extension of the foot occurs during the ejection sequence. The Mk 3 immersion sock is available in nine sizes ie 8 single increment sizes from 5 to 12 to match boot size, and a special fit size facility.

19. **Fitting Criteria.** The correct size of sock is selected to fit over the aircrew terryloop sock and inside the 1965 pattern aircrew boot. The assessment of fit should be undertaken in conjunction with the immersion coverall Mk 10 so that the correct sock length can be identified such that there is adequate material to allow for the full range of lower leg and foot movement. The amount of material in the combined items should be neither too short nor too excessive. At fitting, aircrew will be advised which attachment band (upper or lower) is appropriate for their garments.

Socks, Aircrew, Terryloop

20. This sock, olive drab in colour, is the general purpose aircrew sock to be worn with most aircrew clothing assemblies. It is available in 6 unit increment sizes from 8 to 13.

INTERMEDIATE CLOTHING

Shirt, Aircrew, Olive Drab, Mk 2

21. Essentially, this item is a long sleeved, fine weave fabric 'T' shirt having a roll neck. The purpose of the garment is to provide a lightweight additional layer of clothing to the upper torso between the underwear and the coverall, should aircrew require it. It is available in 4 sizes, small, medium, large and extra large.

Jersey, Aircrew, Olive Drab

22. This item is a long sleeved woollen pullover, the purpose of which is to provide a substantially warm intermediate layer of clothing to the upper torso between the underwear and the coverall should aircrew consider it necessary. It may be worn in conjunction with the aircrew 'T' shirt in any combination of aircrew clothing assembly. It is available in 4 sizes number 1 to 4.

ANTI-G PROTECTION

General

23. Anti-g trousers are worn by aircrew operating high performance aircraft in order to reduce the effects of the positive accelerations to which they may be exposed by various flight manoeuvres. The counterpressure applied to the abdomen and lower limbs when the bladders of the anti-g trousers are inflated on exposure to positive acceleration helps to maintain the blood pressure in the upper part of the body and to prevent the pooling of blood in the lower extremities. These physiological effects complement the voluntary manoeuvres which increase tolerance. The use of anti-g trousers also reduces the fatigue produced by repeated exposure to high g levels. (Chapter 3, Section 1 of this part refers). The bladders of the anti-g trousers are connected through a flexible hose and connector system to the outlet of the anti-g valve. The anti-g valve automatically inflates and deflates the bladders with air or oxygen to the appropriate pressure when positive accelerations are applied to the aircraft. A typical pair of anti-g trousers is shown in Fig.2.

Trousers, Anti-g, Internal, Mks 6C, 7C, 7D (AP 108F–0401–126)

24. The Trousers, Anti-g, Internal, Mks 6C, 7C and 7D, (Fig 2 and 3) consist of a restraining bladder-cover, attached to a waistband with associated leg sections. An inflatable bladder is fitted internally. The trousers are fastened by sliding fasteners, one extending down the outside of each leg and one situated vertically across the waistband at the right hip. Closing of the sliding fasteners is assisted by hooks, staples and donning aid loops. Fitting adjustments are made by three webbing straps and buckles across the small of the back and nylon lacing at the calves and thighs. The internal bladder extends across the abdomen and down the front of each leg. On inflation, the trouser fabric is tensioned and pressure is applied to the lower parts of the body.

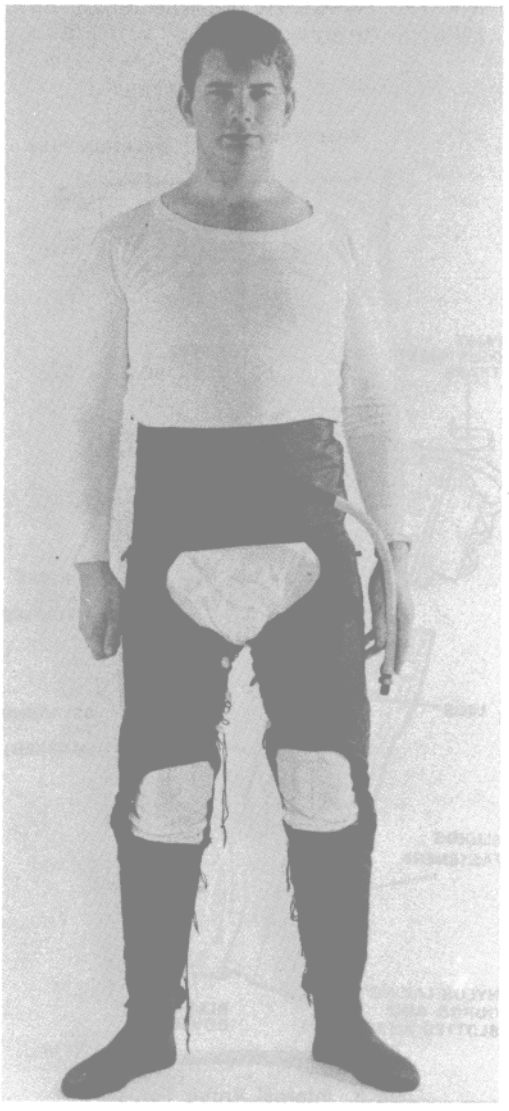

Fig 2 Anti-g Trousers (Internal)

25. The trousers are currently available in a range of three marks (Mk 6C 7C and 7D), viz:

Mk 6C: left hand horizontal inflation tube entry.

Mk 7C: right hand horizontal inflation tube entry.

Mk 7D: As Mk 7C but with longer hose (Harrier aircrew only).

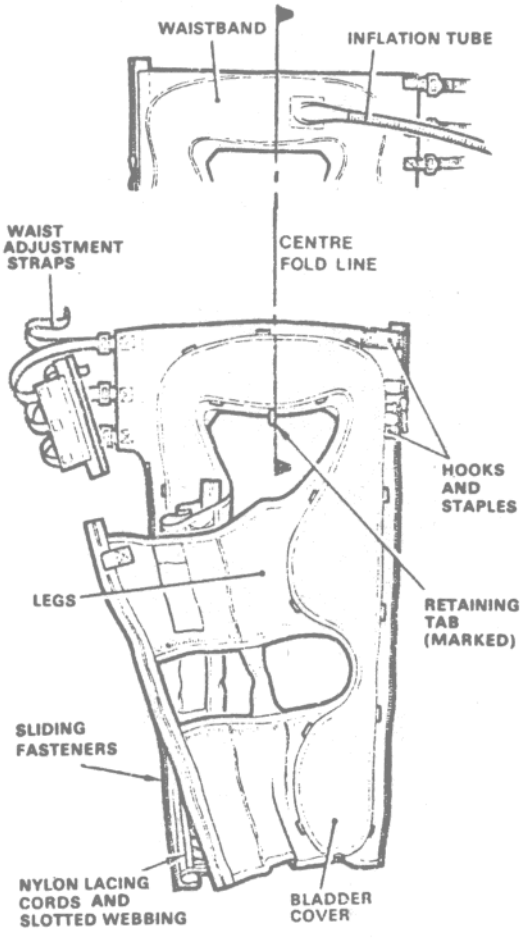

Fig 3 Internal Anti-g Trouser

26. The outer layers of the garment which consists of the two legs, waistband and the bladder cover is constructed from low stretch fabric. The two legs are designed to provide the wearer with complete freedom of movement by means of cut-outs at the knees and crotch areas. Slotted webbing and nylon lacing cords are provided at the calf and thigh so that the girth of the garment at these positions can be adjusted to achieve the correct pressure on inflation. Garments having too slack a fit will ultimately reach the required end pressure but will have unacceptably slow filling times such that the volume of the bladder will not match the designed performance of the anti-g valve. The bladder is constructed from proofed fabric and is protected around the peripheral edge by reinforcement tapes. Spacer blocks of neoprene and polyurethane foam are positioned inside the bladder to ensure a free air flow on inflation. This is particularly necessary at the narrow sections at the top of the thigh and at the knees which may become kinked on leg movement. A neoprene reed is fitted between the internal faces of the abdominal section to restrict expansion at the waist. Fabric retaining tabs are attached at intervals to the edge of the bladder and are the means by which the correct bladder shape is maintained when the garment is worn. Inflation of the bladder is achieved through a rubberized fabric hose strengthened with a helical wound wire insert. The hose is inserted into a short rubber tube attached to the bladder and protrudes through a fabric outlet in the abdominal section of the garment. The inflation hose terminates in a connector which is compatible with the appropriate aircraft or personal equipment connector.

27. **Fitting Criteria.** The body size criteria for initial fit of the anti-g trousers are stature, maximum waist circumference and inside leg measurement. The garment is available in four standard sizes, small, medium, large, extra-large as well as a special fit size facility.

28. These marks of anti-g trouser are designed and intended for wear as an internal garment with preferably as close a fit to the skin as possible ie. over the aircrew long cotton underwear but under all other layers of aircrew clothing, except the NBC inner coverall. The waist adjustment straps should be adjusted to give a snug fit to the abdominal section such that the centre-point of the lower edge of the abdominal bladder

lies approximately 1 inch above the pubic bone. The leg adjustment lacings should be drawn reasonably tight and then tied off and the ends cut. The tension in the laces should not cause undue discomfort but be sufficient so that pressure is felt immediately inflation commences. Where possible, the trousers should be inflated and any final adjustment made with the wearer in the sitting position.

Trousers, Anti-g, External, Mks 1, 2 and 3 (AP 108F–0401–1)

29. The earlier marks of anti-g trousers (worn under aircrew clothing and of necessity a constant-wear garment) have imposed a heat load which has proved to cause discomfort to some wearers especially during 'stand-by' in hot conditions. External anti-g trousers are worn outside all other clothing (summer AEA only) and can be donned immediately before take-off and doffed immediately after landing, thereby relieving the wearer of an unnecessary encumbrance when he is not flying.

30. The external anti-g trouser is currently available in a range of three marks (Mk 1, 2 and 4), viz:

Mk 1: left-hand hose arrangement.

Mk 2: right-hand hose arrangement.

Mk 4: right-hand hose arrangement (Tornado use only, incorporates integrated leg restraint garters).

The trousers, anti-g, external, (Fig 4), perform the same function as, and are similar in style to, the 'internal' anti-g trousers described above. Main differences are:

a. Leg closures are on the inside of the leg.

b. The initial-fitting adjustment laces are covered by a stretch fabric to reduce the snagging hazard.

c. The waist adjustment comprises two series of slotted webbing and laces.

d. An additional sliding fastener, closing a gusset, is fitted at each thigh to provide a quick-tensioning device to allow the wearer to loosen the trousers whilst on the ground, thereby incurring comfort.

e. A knife stowage is fitted to the right thigh.

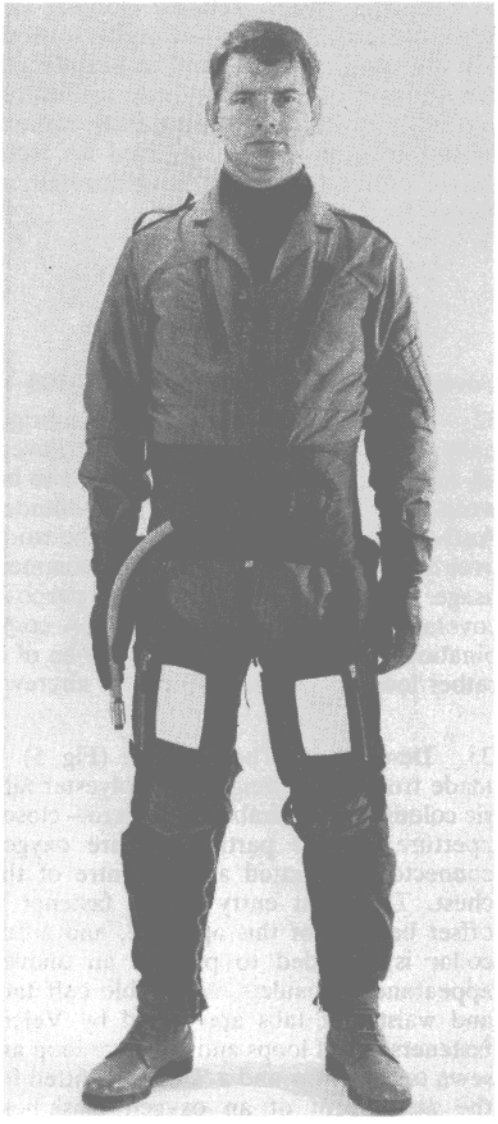

Fig 4 External Anti-g Trouser

f. Pockets are fitted at each thigh and lower leg.

31. **Fitting Criteria.** External anti-g trousers are fitted and adjusted in a manner similar to the 'internal' anti-g trousers. However, it is emphasised that the level of *g*-protection afforded by the external anti-g trouser is markedly reduced when worn over several layers of bulky clothing (ie. Inner coverall Mk 3 and immersion coverall Mk 10) and that there would be a significant difference in fit between summer and winter combination AEAs. Consequently, the external anti-g trouser is intended for wear only over the lightweight flying coverall, as shown in Fig 4.

AIRCREW COVERALLS

Coverall, Aircrew, Mk II (AP 108F–0103–1)

32. The Mk 11 aircrew coverall was originally designed both as a replacement coverall and as a lightweight outer garment to be worn over the Coverall, High Altitude, Anti-g, Ventilated, Mk 2, but may be worn over other clothing assemblies. By common usage it has become the general purpose coverall for use with 'Summer' AEA combinations. Consequently it tends to be of a rather loose fit on the majority of aircrew.

33. **Description.** The coverall (Fig 5) is made from a lightweight flax/polyester fabric coloured olive drab. The Velcro – closed aperture for the partial pressure oxygen connector is situated at the centre of the chest. The front entry sliding fastener is offset because of this aperture, and a roll collar is provided to prevent an uneven appearance. Epaulets, adjustable cuff tabs and waist belt tabs are closed by Velcro fasteners. Scarf loops and a hanger loop are sewn to the collar and a 'D' ring is fitted for the attachment of an oxygen mask/hose assembly. The lower leg openings are fitted with sliding fasteners and gussets so that the coverall can be donned whilst wearing flying boots. Pockets are fitted as follows:

Fig 5 Coverall, Aircrew,, Mk 11

a. Pen and pencil torch pocket on left upper sleeve.

b. One on each breast, closed by sliding fasteners.

c. A two layer pocket on right thigh comprising:

- writing pad pocket fitted with appropriate plastic sheets.
- pencil pocket alongside the window pocket.
- patch pocket, opening downwards and closed by a Velcro flap.

d. A three layer pocket on the left thigh, similar to that on the right thigh but with a third, upwards opening pocket sandwiched between the other two.

e. Patch pockets fitted to each lower leg and closed by Velcro flaps.

f. A pocket at each hip.

A through opening is also fitted at each hip to allow the passage of supply hoses. An aircrew knife retention patch may also be fitted.

34. Coveralls, Aircrew, Mk 11N are identical to Mk 11 coveralls but include modifications (webbing reinforcements on the inside face of the coverall, and six press fasteners, both situated mid-chest either side of the front opening) for the attachment of the manifold of the Aircrew Respirator NBC No 5.

35. **Fitting Criteria.** The Mk 11 coverall is provided in nine sizes based on stature and chest circumference. Correctness of fit is checked by appropriate special tests. A special fit size facility is available for this garment.

Coverall, Aircrew, Mk 14/14A (AP 108F–0107–12)

36. The Mk 14 aircrew coverall was originally designed as a lightweight slim fitting, flame retardant coverall for rotary wing aircrew, and was intended to be worn over a minimum of under garments. Because the flame retardant properties of this coverall are of advantage to all aircrew, it was eventually considered for fixed wing operators. However, the problem now was that the slim design of the Mk 14 coverall, (Fig 6), could not in the majority of cases accommodate the 'internal' anti-g trousers and other bulky under garments worn by fixed wing aircrew (particularly those with larger than average thigh, calf and chest circumferences). This incompatability may be overcome in many situations by the use of the external anti-g trouser. Aircrew may wear the internal anti-g trouser with the Mk 14 coverall in some aircraft 'Summer' AEAs but should seek the advice of their Flight

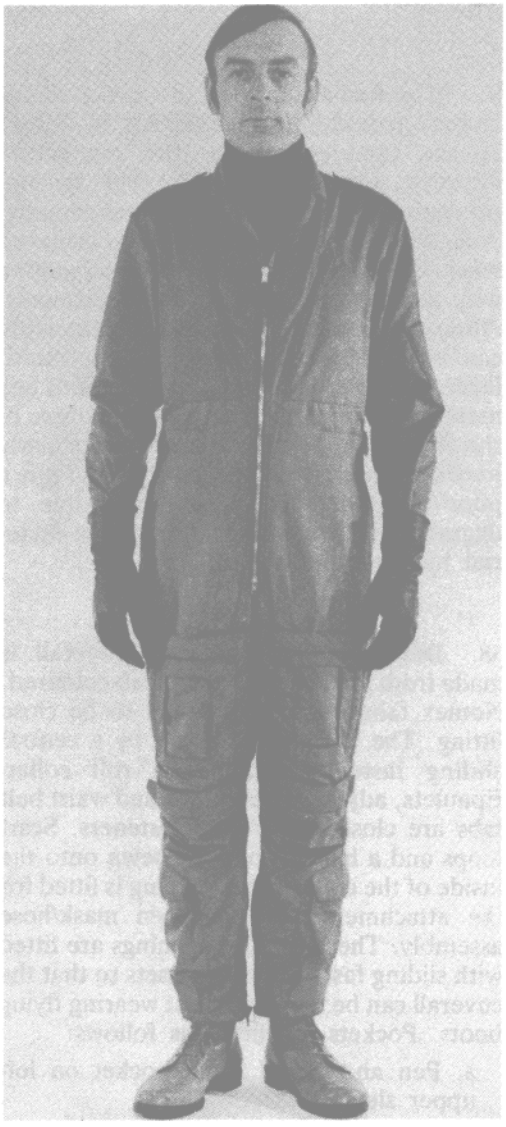

Fig 6 Coverall, Aircrew, Mk 14

Medical Officer before doing so. For those fixed wing, non-ejection seat aircrew who do not wear anti-g trousers, it became apparent that the size of the calf pockets and the integrity of the stitching by which the leg pockets were attached was inadequate for use in this role. Consequently, a slightly modified design having greater leg girth below the knee and reinforced stitching to the pockets was introduced as the Mk 14A coverall.

37. The flame retardant properties of the Nomex material of which the Mk 14, Mk 14 A are made, enhance the protection afforded against flash fire, but do not prevent the material burning eventually. Adequate flame protection is only achieved when the coverall is used in combination with at least one layer of under-garments. Almost the same extent of fire protection can be obtained by employing the multi-layer principle, ie several thin layers of any material between the skin and the source of the flame. Nomex itself is not particularly hardwearing, it is not waterproof and it is a poor insulator. It is also susceptible to degradation by contamination of the material by fuels and oil.

38. **Description.** The Mk 14 coverall is made from lightweight, olive drab coloured, Nomex fabric and is designed to be close fitting. The coverall is closed by a central sliding fastener and has a roll collar. Epaulets, adjustable cuff tabs and waist belt tabs are closed by Velcro fasteners. Scarf loops and a hangar loop are sewn onto the inside of the collar and a 'D' ring is fitted for the attachment of an oxygen mask/hose assembly. The lower leg openings are fitted with sliding fasteners and gussets so that the coverall can be donned whilst wearing flying boots. Pockets are fitted as follows:

a. Pen and pencil torch pocket on left upper sleeve.

b. Pocket on each breast, closed by sliding fasteners.

c. A three layer pocket on each thigh comprising:
- writing pad pocket fitted with appropriate plastic sheets.
- pencil pocket alongside the window pocket.
- a patch pocket, opening downwards and closed by a Velcro flap.
- a further patch pocket, opening upwards and closed by Velcro tabs.

d. A patch, partially boxed, pocket fitted to each lower leg and closed by Velcro flaps.

e. A pocket at each hip.

A through opening is also fitted at each hip to allow the passage of supply hoses. An aircrew knife retention patch may also be fitted.

39. The same 'N' suffix modifications apply to the Mk 14 series of coveralls as to the Aircrew Coverall Mk 11 described above.

40. **Fitting Criteria.** The Mk 14/14A coverall is provided in nine sizes based on stature and chest circumference. Since the design criteria for the Mk 14 coverall are different from those of the Mk 11 coverall it is unusual for aircrew to take the same size of each garment. Correctness of fit is checked by appropriate special tests. A special fit size facility is also available for this garment.

ACCESSORY FLYING SUITS

Suit, Aircrew, Cold Weather, Mk 3 (AP 108F–0104–12)

41. The Cold Weather Flying Suit Mk 3 is a two piece garment designed to give protection to aircrew under medium to severe cold weather conditions. It is not an appropriate outer garment when extensive sorties over water are undertaken (ie. it is only suitable for use in 'Winterland' AEA combinations only).

(AL9, JAN 82)

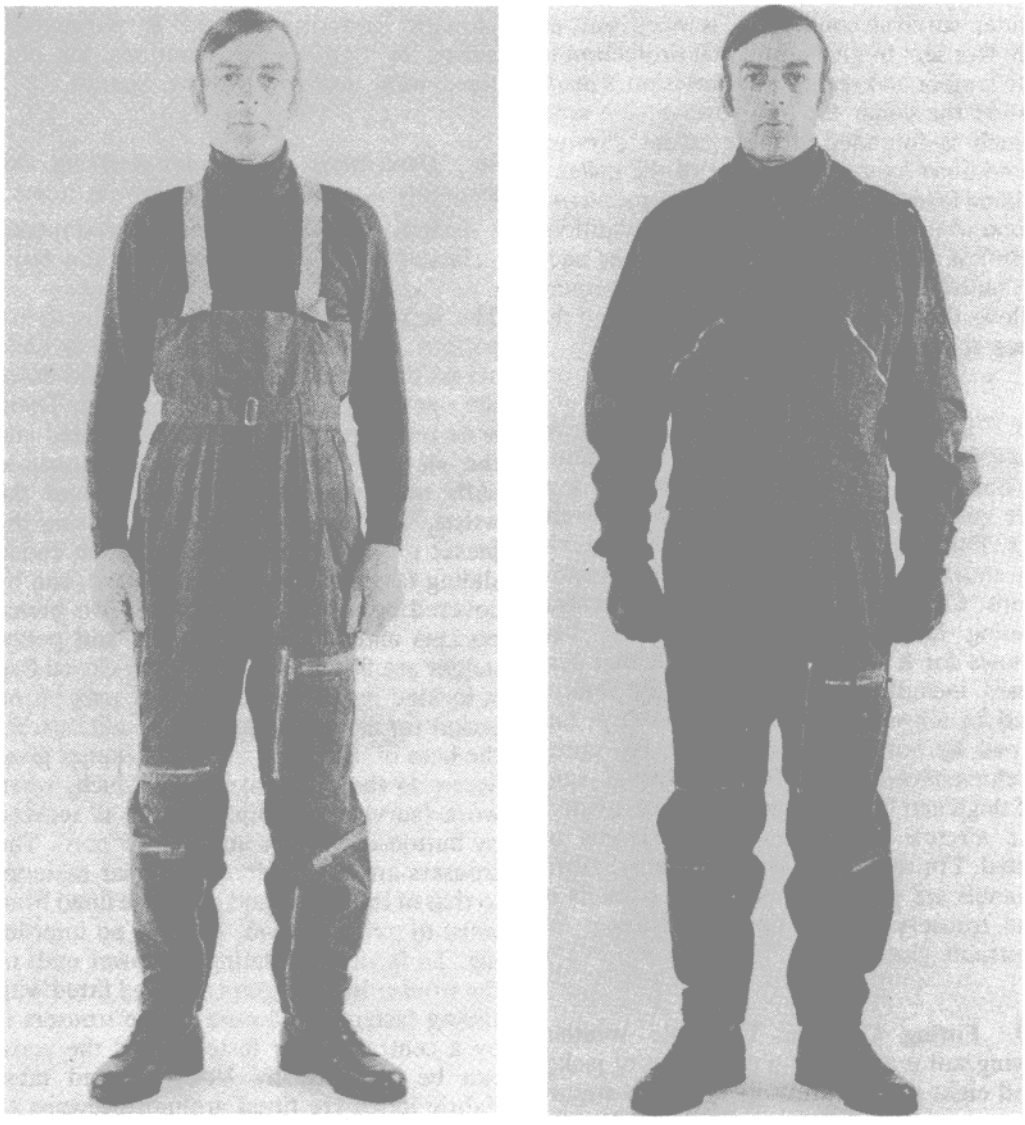

Fig 7 Suit, Aircrew, Cold Weather Mk 3

42. **Description.** The suit (Fig 7) comprises separate jacket and trousers made up of a showerproofed gaberdine outer and a ventile inner lining. Both garments are interlined throughout with nylon mesh. The design of the jacket (short waisted) is such as to allow unimpeded arm movement and the sleeves have Velcro-closed gussetted cuffs to ensure a close fit around the wrists. The primary method of closing the jacket is by a centrally located open ended sliding fastener which, when closed, can be covered by a button-over flap. Two breast pockets are fitted. A large 'let-down' flap fitted with a stretch fabric securing strap is located on the inside of the jacket. The flap, for use

under survival conditions, is worn outside the trousers to give additional protection to the lumbar and seat areas. Provision is made inside the collar for the stowage of a scarf which is intended for use under survival conditions only. At the base of the collar a sliding fastener gives access to the protective hood which, when worn (survival conditions only), is secured across the front of the neck by buttoned tabs. A draw cord arrangement allows the hood to be fitted close around the face if necessary.

43. The trousers are constructed of similar materials to those of the jacket. To facilitate donning the lower ends of the trouser legs are gussetted and fitted with sliding fasteners. Draw cords at the ankles are available to ensure a close fit under survival conditions. Closure of the trousers is by a central sliding fastener, and an adjustable belt allows for a close waist fitting. Other features include all-elastic adjustable braces and an above-the-waist extension flap, fastened by buttons, which covers the upper abdomen/lower chest areas. The usual range of thigh and lower leg pockets are provided. An aircrew knife retention patch can be fitted. For the Tornado aircraft only, fabric tunnels are provided behind the pockets of the trousers for the upper and lower leg restraint garters.

44. **Fitting Criteria.** The cold weather flying suit is available in eight sizes of jacket and eight sizes of trousers based on stature and chest circumference. It is emphasised that any individual aircrew may not necessarily need the same size jacket and trousers. Therefore, the jacket and trousers must be issued separately after the correct selective fitting procedure.

Suit, Aircrew, Combat, Temperate, Mk 2A (5 Piece)

45. The combat flying suit Mk 2A is, in toto, a five piece garment designed to give protection to aircrew under temperate climatic connditions and is particularly suited to "off-base" operations for both fixed wing and rotary wing aircraft.

46. **Description.** The combat flying suit assembly consists of the following items:

Jacket, Trousers, Waistcoat, Rainproof Jacket and Trousers (Figs 8a and 8b).

The jacket is constructed from a disruptive pattern gaberdine material which is lined across the shoulders, upper chest and down the sleeves by a thin ventile material. There is no inter-lining. The jacket is waisted and the sleeves have Velcro-closed gussetted cuffs to ensure close fitment around the wrists. The primary method of closing the jacket is by a centrally located open ended sliding fastener which, when closed, can be covered by a button-over flap. Two breast pockets and two waist pockets and pencil holder are fitted. A large Velcro-closed flap is located inside the lower back part of the jacket for use under survival conditions. At the base of the collar a sliding fastener gives access to the protective hood which, when worn (survival conditions only), is secured by button-down tabs and a draw cord. The trousers are constructed of similar material to that of the jacket and are loose lined from waist to mid calf level. There is no interlining. To facilitate donning the lower ends of the trouser legs are gussetted and fitted with sliding fasteners. Closure of the trousers is by a central sliding fastener and the waist can be adjusted by Velcro closed tabs. Fabric loops are fitted around the waist to support the wearing of a stable belt if necessary. Other features include all-elastic adjustable braces and the usual range of thigh and lower leg pockets.

47. The waistcoat is a sleeveless quilted fabric garment closed at the front by three buttons. It is intended to be worn underneath the jacket should aircrew require an additional thermal insulative layer with this assembly. The rainproof jacket (long-waisted) and trousers are constructed of a

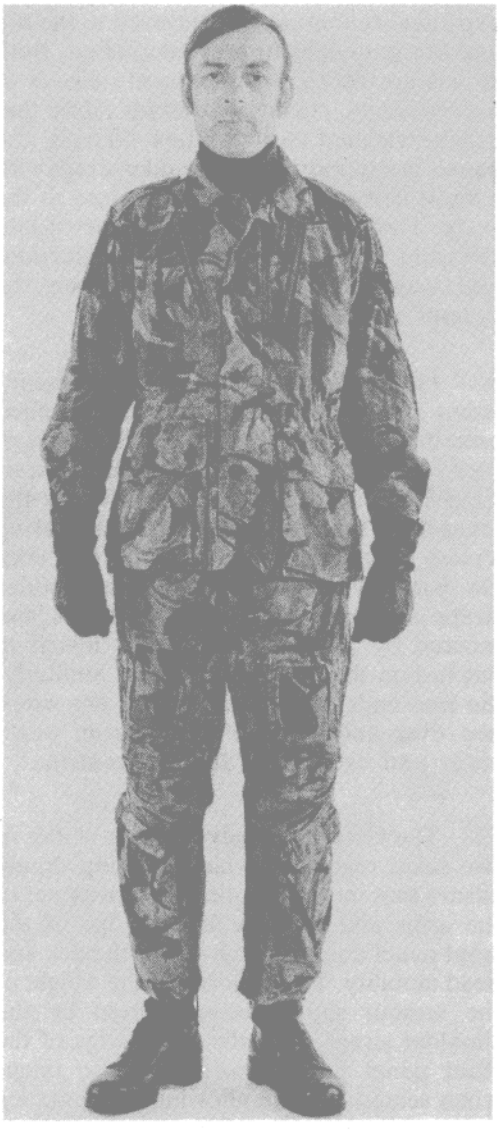

Fig 8a Combat Flying Suit – Trousers and Jacket, Gloves Cape Leather

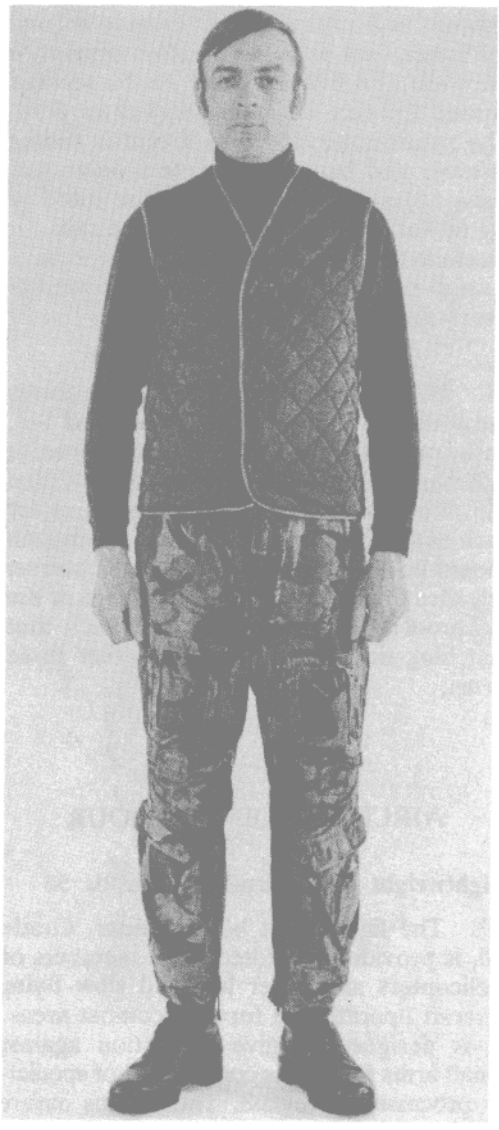

Fig 8b Combat Flying Suit – Trousers, Waistcoat, Aircrew 'T' Shirt, 1965 Pattern Flying Boots

proofed fabric. These outer garments of this assembly are only intended for use on the ground (ie not in flight) or under survival conditions. They can be packed to a small size for easy stowage. The jacket is closed by a centrally located open ended sliding

fastener and a draw cord is situated around the lower hem to facilitate close fitment at the waist. An integral hood can be secured around the face by means of a draw cord. The trousers are closed by a central sliding fastener and button and have a draw cord waist adjustment. No pockets are fitted to the jacket, but the trousers contain slots for access to the main trouser pockets, and have a small pocket fitted to the front of the left lower thigh.

48. **Fitting Criteria.** Each of the five pieces are available in eight sizes, numbered 1–8, based on stature and chest circumference. It may happen that any individual aircrew man will not necessarily need the same size for each of the five pieces. Therefore, each item should be issued separately after the correct selective fitting procedure. The design of the rainproof trousers and jacket is such that matching sizes will fit over the other three items.

AIRCREW BODY ARMOUR

Lightweight Body Armour – Grade 50

49. The lightweight body armour, Grade 50, is provided to protect crew members of helicopters and other low and slow flying aircraft operating in forward combat areas. It is designed to give protection against small arms fire and is constructed of specially processed fibreglass. The fibrous nature of the armour plates also reduces the danger of ricochets from projectiles that strike at high angles of incidence.

50. **Description.** The armour is worn over the outermost layer of the AEA (namely, aircrew flying coverall, combat flying suit or cold weather flying suit) and consists of one contoured torso front panel and one contoured torso back panel, (Fig 9). Both panels are shaped so as to allow free movement of the arms. The front panel has expanded rubber padding bonded to the top and bottom edges to prevent chafing. Both panels are contained in separate covers of hard wearing, chemical resistant fabric that can be cleaned easily. When donned, the panels are supported by shoulder straps with a waist belt to keep the panels close to the body. Three strips of Velcro are sewn into the front panel cover to which the shoulder and waist straps are secured when the armour is assembled.

51. **Fitting Technique.** The two shoulder straps and the two waist straps are stitched onto the back panel cover. The free ends of each shoulder strap and right-hand waist strap have a strip of Velcro sewn to the inner side, the left-hand waist strap having Velcro sewn to both sides of the free end. On assembly, the free ends of the shoulder straps are passed over the shoulders and secured by Velcro strips to the matching patches on the front panel cover. Similarly, the free ends of the waist straps are wrapped over and secured to the front panel cover and each other by Velcro strips.

52. The Grade 50 Body Armour comes in two sizes, regular and large. Fitting should ensure that there is ample free movement of the arms and that the upper edge of the front panel does not interfere with neck and head mobility. The majority of the weight of the armour should be supported by the shoulder straps, with the lower edge of the front panel just supported by the thighs when seated but still allowing adequate leg movement. The shoulder and waist straps should be adjusted so that the body armour panels fit the body as snugly as possible without restricting normal breathing.

53. No servicing or repair is necessary to the armour panels. If damage from a strike occurs, the armour panel(s) should be renewed at the earliest opportunity. However, a panel that has received a strike will still give a good measure of protection against threat in a continuing emergency.

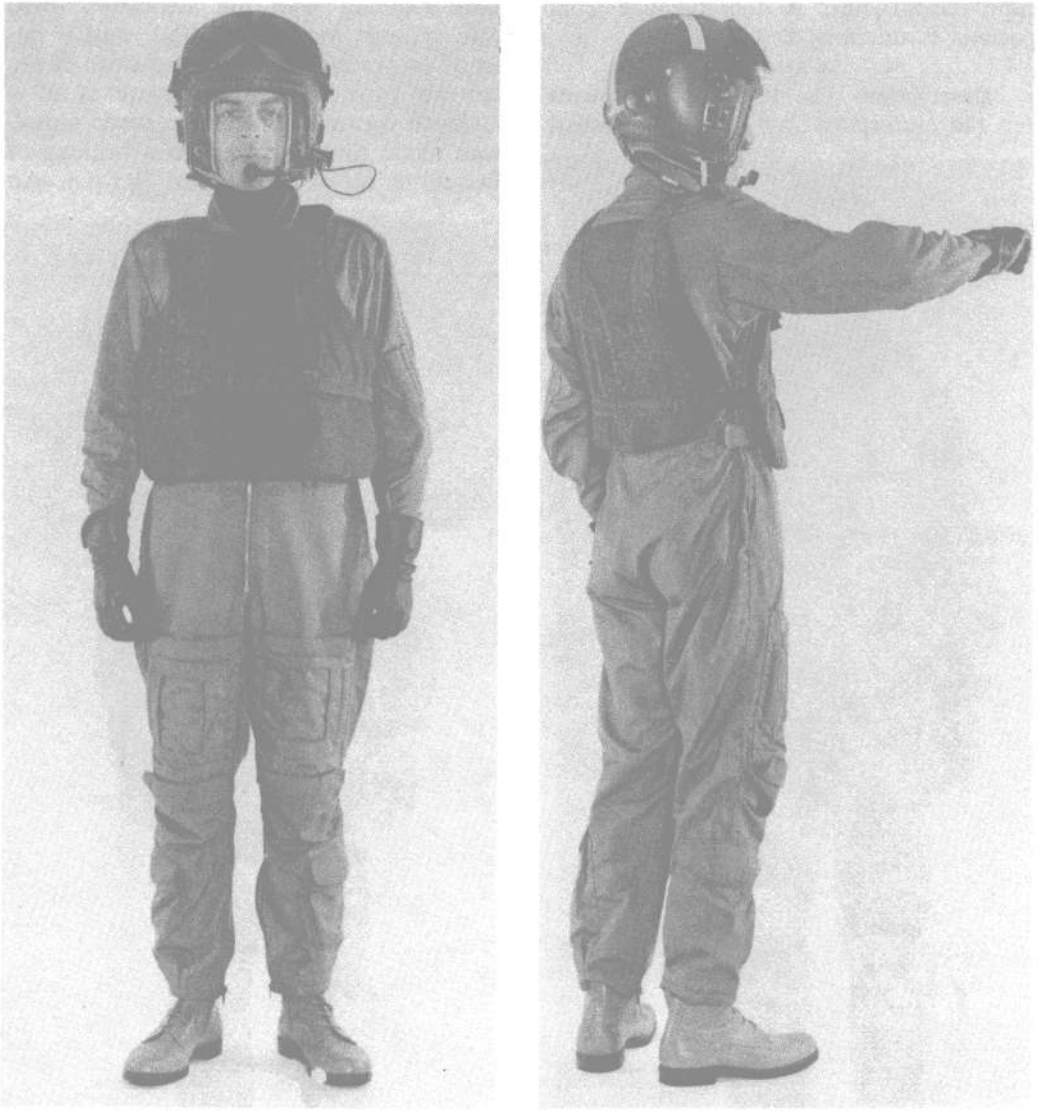

Fig 9 Grade 50 Armour

Body Armour, Fragmentation, Protective. The Torso Plate (AP 108F–1201–16)

54. The Torso Plate, Body Armour Fragmentation Protective, is provided to protect the aircrew of helicopters and other low, slow flying aircraft against high velocity bullets and shrapnel while operating in forward combat areas. The torso plate consists of specially reinforced tiles mounted between two skins of glass fibre reinforced plastic (g.r.p.). High velocity bullets striking the tiles will break up and because of the fibrous nature of the armour skin, fragments will be absorbed. Projectiles striking at high angle of incidence are held

within the structure so that damage from ricochets is minimised.

55. **Description.** The torso plate is worn over the outermost layer of the normal AEA together with the associated torso plate support jerkin (Fig 10a), and is designed to protect the front and sides of the wearer's torso. The torso plate is of a sandwich construction with ceramic aluminium oxide tiles mounted on a backing of glass fibre reinforced plastic (g.r.p.). An

Fig 10 Body Armour, Fragmentation Protective

(a)
Torso Support Jerkin

(b)
Torso Plate-mounted

outer skin of g.r.p is attached to the tile and backing assembly forming the anti-spall shield of the torso plate. The assembly is shaped to fit around the front and sides of the torso and permit free movement of the arms and hips. The lower edge is flared outwards at the front enabling the wearer to operate in a sitting position. It is also flared outwards on the upper section to provide a protective shield for the face and neck from projectiles directed from below (Fig 10b). To prevent chafing to the wearer, cushions of expanded rubber strip are bonded to all edges of the torso plate. The top edge is of extra thickness to protect the face in the event of any sudden forward movement of the head. The whole plate is protected by p.v.c. covered fabric bonded to the inner and outer skins and edges of the assembly. Two lifting straps are provided on each side of the torso plate just below the arm cutaway. A suspension peg is provided in the centre of the front of the panel on which an eyelet of the support jerkin yoke is attached. Above the suspension peg a patch of Velcro is fixed to the front of the panel to provide a securing pad for the yoke handle. Two pegs of 'lift-the-dot' fasteners are positioned on the front panel to mate with the fasteners on the top attachment straps of the support jerkin.

56. **Fitting Technique.** Using the lifting straps position the torso plate on the front torso of the wearer. Lift up the support jerkin yoke and attach the nearest eyelet to the suspension peg. Secure the 'lift-the-dot' fasteners of each support jerkin strap to the respective pegs on the torso plate. Adjust the attachment points as necessary to ensure a snug fit.

57. The torso plate fragmentation armour is designed in six sizes, ie three breadths (slim, medium and broad) in each of two lengths (long and short). Dependent on size, weight of the armour plate is between 13 and 18 lbs (6–8 kg). Fitting should ensure that there is adequate free movement of the arms and legs and that the torso plate does not interfere with head mobility or the visual field of the crewmember.

58. No servicing or repair is necessary to the torso plate. If damage from a strike occurs the torso plate should be renewed at the earliest opportunity. However, a 'hit' panel will still give a good measure of protection against threat in a continuing emergency.

The Support Jerkin (AP 108F–1201–5F)

59. **Introduction.** The torso plate support jerkin (Fig 10a) is designed for use with the body armour fragmentation protective torso plate (see above). The purpose of the jerkin is to support and hold the protective plate in position on the torso. The assembly consists of a jerkin and life preserver. Pockets are fitted to provide stowage for the usual items which assist in the location and rescue of the survivor.

60. **Description.** The support jerkin consists of a waistcoat of olive green fabric which is closed by a sliding fastener running from the centre of the chest towards the left hip. Waist adjustment straps and buckles are fitted. Two webbing shoulder straps stitched to the reinforcing gusset and waistband pass through guide channels over the shoulders of the jerkin and end in metal 'D' rings. Two webbing straps loop through the 'D' rings to provide top attachment straps to the body armour torso plate. 'Lift-the-dot' fasteners fitted at the lower end of the attachment straps mate with the peg fasteners of the torso plate. Velcro patches provide the adjustment facility for these top attachment straps. A 'Y' shaped yoke is provided at the front of the jerkin. It provides a lower support for the torso plate and a means of keeping it close to the body. Four eyelets fitted to the main leg of the yoke allow adjustments for the various sizes of torso plate. When in position the yoke is located on the suspension peg fitted to the torso plate and secured by Velcro fasteners. Release is effected by a handle of webbing loops stitched to the end of the yoke. Pockets are provided on the jerkin for

stowing the equipment which would assist the location and recovery of a survivor. The right-hand side pocket accommodates the personal locator beacon and battery. The left-hand side pocket contains the remainder of the survival equipment. A life preserver stole similar to that fitted to the life preserver aircrew Mk 27 is attached to the jerkin. It is complete with lifting beckets but contains no mini-flares and has a repositioned sea-activated battery and light. A detailed description of the life preserver is given in AP 108F–0810–1.

61. **Fitting Criteria.** The torso plate support jerkin is designed in three sizes (small, medium and large) and is donned in the conventional manner and adjusted for comfort by the waist adjustment straps. The top attachment straps will be adjusted when the torso plate is donned.

62. **Lifepreserver.** Before inflating the lifepreserver of the support jerkin it is necessary to discard the torso plate. To inflate the stole pull down the beaded handle on the left side pouch. Once inflated, the lifepreserver stole can be topped-up using the oral inflation valve housed on the right-hand side. Note: The torso plate armour MUST be discarded before inflation of the lifepreserver.

PERSONAL CONDITIONING GARMENTS

Coverall, Air Ventilated, Mk 2 (AP 108F–0502–16)

63. At present the Mk 2 Air Ventilated Coverall is the only garment of its type currently in Service, all other Marks being obsolete.

64. **Introduction.** Heat is a common stress in military aviation (Part 1, Section 1, Chapter 5 refers). The air ventilated coverall improves the thermal comfort of aircrew by distributing a continuous flow of conditioned air to the inner layers of the clothing assembly. The air flow keeps the skin and clothing dry by evaporation of sweat. Suitable supplies of conditioned air are, however, available in only a limited number of aircraft types.

65. **Description.** The air ventilated coverall (Fig 11) is a simple garment which fastens by tapes which tie at the wearer's back. Full length arms and legs are fastened at the wrists and ankles respectively. The air en-

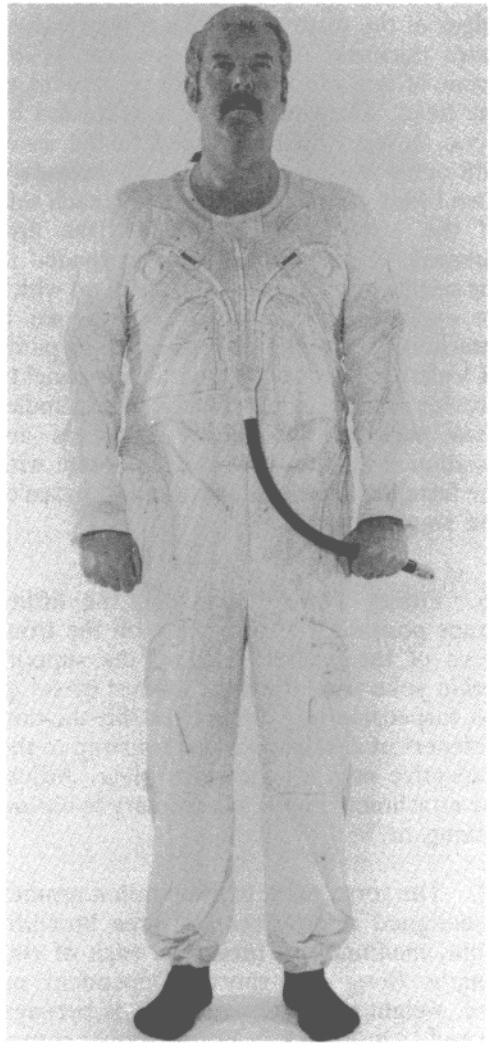

Fig 11 Air Ventilated Coverall Mk 2

ters the suit through an inlet hose of wire re-inforced rubberised fabric leading to a manifold positioned at chest level. From there the air is distributed via a system of multiple branching PVC tubes which expel the air over the arms, legs, upper torso and back. The garment is constructed of light-weight fabric in order to minimise its own heat load when worn.

66. **Fitting Criteria.** The garment is intended to be worn as close to the skin as possible (but outside the cotton underwear sweat wicking layer). Six sizes of garment are available, numbered 1 to 6, based on stature, chest and waist circumferences. The actual size of the garment issued is of less importance than the comfort the garment provides and the latter should be the main criterion when selecting the correct fit of garment.

PRESSURE GARMENTS

Pressure Jerkin Mk 3/4 (AP 108F–0301–12 and AP 108F–0302–12)

67. Two garments are available to the same basic design:

Mk 3: Provided for the use of aircrew normally accommodated in static seats but who move from one position to another for their normal duties. (ie rear-crewmembers).

Mk 4: provided for the use of aircrew accommodated in ejection seats.

The only difference between these two versions is the positioning of the oxygen valve flanged connector port on the right-hand side of the garment and minor differences in hose retaining straps. Therefore, only the basic garment will be described.

68. **Introduction.** The physiological effects of exposure to altitude and protection therefrom have already been described (E, 1, 1, 2). Above 40,000 feet pressure breathing with 100% oxygen is required to prevent hypoxia. The magnitude of the positive breathing pressure required at altitudes above 50,000 feet is such that counterpressure must also be applied to the trunk and lower limbs. The pressure jerkin is a bladder garment which will apply counterpressure to the trunk. The anti-g trousers can be used to apply counterpressure to the lower limbs during pressure breathing.

69. **Description.** The pressure jerkin, shown in Fig 12, is a sleeveless garment

Fig 12 Partial Pressure Jerkin Mk 4

covering the wearer's trunk and upper thighs. It consists of an inflatable bladder confined between an outer layer of inextensible fabric and an inner lining which covers the whole of the inside of the garment with the exception of an area over the buttocks. The opening from the neck to the centre of the left thigh is closed by a sliding fastener. The lining on the left-hand side of the jerkin has an aperture fitted with a sliding fastener to give access to the bladder. The inflatable bladder is constructed of proofed rubberised nylon/silk and is secured in position by a series of fabric tabs around the inner and outer periphery of the bladder. An aperture in the right hand front of the outer garment accommodates a screwed flanged connector to which the personal oxygen hose assembly is connected. The jerkin connector contains a valve which isolates the jerkin from the main breathing line during normal breathing and at all altitudes where pressure breathing is not required. This valve opens quickly and fully during pressure breathing to allow rapid inflation of the jerkin.

70. The jerkin can be adjusted to fit the wearer by means of webbing loops and lacing cords attached to the inside of the jerkin at the centre of the back section and at the sides. A transverse opening across the back of the jerkin, fitted with a slide fastener, gives access to the lacing adjustments. Dependent on the Mark of the jerkin used, hose retainer loops and beckets are also fitted. Fabric enclosed foam rubber blocks are fitted to each shoulder area to retain the parachute harness in position. The jerkin is fitted with an inflatable stole and stole cover similar to that on the aircrew lifepreserver Mk 4. The lifepreserver stole is inflated by means of a carbon dioxide cylinder and manual operating head. Pockets are provided for the S.A.R.B.E. personal locator beacon equipment, McMurdo light and battery, whistle, lanyard and heliograph. Two lifting beckets are also provided, one each side of the lifepreserver stole.

71. **Fitting Criteria.** The correct fit of a pressure jerkin is vital to its efficient function and can only be certified by a Flight Medical Officer. The Pressure Jerkin Mk 3 is available in seven sizes numbered 0 to 6. The Mk 4 jerkin is available in six sizes numbered 1 to 6. Both types have a special fit size facility. Although the correct size of jerkin is based on upper torso dimensions it is emphasised that final fitting must be based on a functional assessment of the garment.

Coverall, High Altitude, Partial Pressure, Mk 2 (AP 108F–0304–12G)

72. Although no longer in current use it is considered helpful to mention the equipment and clothing necessary to provide protection for aircrew at altitudes in excess of 56,000 feet.

73. **Description.** The Coverall, High Altitude, Partial Pressure, Mk 2, shown in Fig 13, is a combined partial pressure, anti-g and air ventilated garment which applies counter-pressure to the body along similar lines to that of the pressure jerkin. It applies counter-pressure to a greater area of the body than the jerkin by including the arms. When used with the appropriate oxygen regulator it provides "get-you-down" protection up to 60,000 ft. When used in conjuction with a different oxygen regulator and the pressure helmet, protection up to altitudes of 65,000 feet is afforded.

EXTREME COLD WEATHER CLOTHING

Mukluks

74. **Description.** Mukluks are an item of footwear designed to give the required protection in conditions of extreme dry cold weather (ie Arctic and similar environments). Under no circumstances must they be worn in conditions of cold wet climates (ie northern latitudes, temperatures around 0°C). The common parts of a mukluk are as follows:

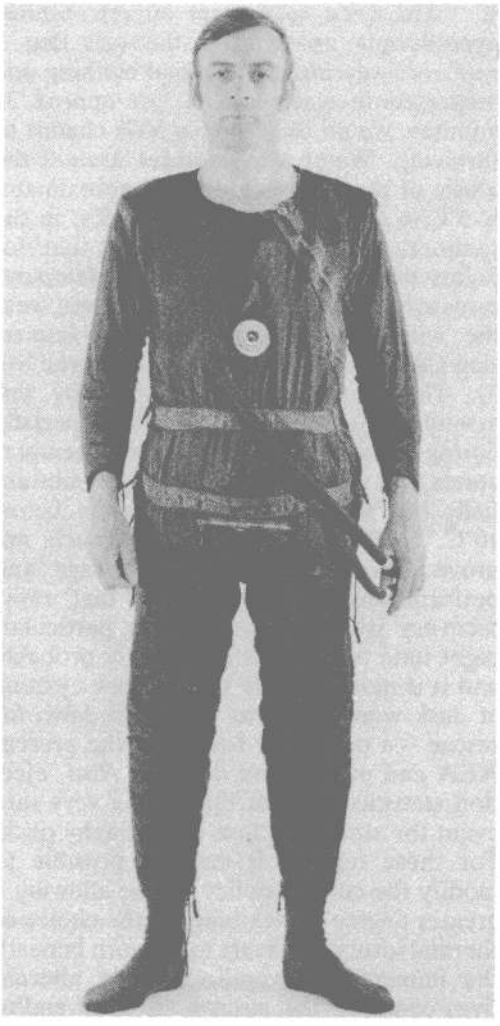

Fig 13 Coverall, High Altitude, Partial Pressure Mk 2

a. White canvas/fabric overboot, calf length, fastened by 'D' rings and laces and having a thick composite rubber sole.

b. 'Saran' insoles, which cosist of woven nylon pads, the purpose of which is to provide a layer in which frozen water vapour from the feet may collect. At the end of each day's wear, these insoles should be removed, all ice shaken out, and thoroughly dried before being reused.

c. Thick felt insole worn on top of the Saran insole. The purpose of this item is to provide a suitable thermal insulatiive layer.

d. Duffle sock – described elsehere in this chapter.

On some occasions aircrew may be issued with the Canadian pattern of mukluk which comprises the same component parts but which is shorter in the ankle and of a black colour. The mukluk is available in 6 unit increment sizes from 6 to 11.

Parka, Outer, Olive Drab

75. The parka is an overgarment designed to give aircrew the necessary protection in conditions of extreme cold weather (ie Arctic and similar environments). When combined with suitable inner clothing the

Fig 14 Aircrew Parka (Extreme Cold Weather)

parka will maintain a normal body microclimate down to environmental temperatures of minus 50°C.

76. The parka is constructed ot two layers of material containing a quilted kapok inner lining. A large hood is provided which has a length of malleable wire inserted in the rim so that the hood will retain a moulded shape around the face. The edge of the hood is trimmed with wolverine fur which has the property of not retaining ice-particles. Draw-cords are provided around the neck and around the lower edge of the jacket, as well as a waist belt, in order to prevent the entry of cold wind and snow. A recent modification provides a Velcro-closed fabric flap to cover the series of button fastenings down the front of the garment. This also prevents the entry of cold wind and snow.

77. The Parka is available in 8 sizes numbered 1 to 8 and is shown in Fig 14.

78. The parka is not suitable for use in flight and is only designed to give protection to personnel on the ground.

IMMERSION PROTECTION

Coverall, Immersion, Aircrew, Mk 10/10A (AP 108F–0604–126)

79. **Introduction.** The aircrew immersion coverall has been designed as a means of providing aircrew with part of the protection needed to combat the effects of immersion in cold water whilst at the same time minimising the thermal stress involved in wearing a bulky garment under normal conditions. Full protection against hypothermia can only be achieved by aircrew wearing thermal insulative clothing beneath the immersion coverall since the insulation afforded by the coverall by itself is low. In summary, the principal function of the immersion coverall is to preserve the insulation afforded by the clothing worn underneath by keeping these garments dry in the event of immersion in water.

80. The need to protect aircrew against hypothermia arises from the fact that a survivor, wearing only normal clothing and immersed in water at 5°C for approx 30 minutes, would only have a 50% chance of surviving. Water temperatures around the coasts of the UK range from approximately 5°C in the winter, to approx 15°C in the summer. Present policy dictates that for flights over the sea, when water temperatures are at or below 10°C, aircrew will wear the 'winter' combination AEA (ie Immersion Coverall Mk 10 and Inner Coverall Mk 3). The thermal stress imposed by this assembly becomes significant, especially during the spring, when ambient air temperatures and solar radiation increase substantially but sea temperatures remain below 10°C. SAR capability is now much improved, both in terms of coverage and performance, with the result that rapid recovery is almost certain. In particular, night time recovery is now highly probable and it is most unlikely that aircrew ejecting at dusk would have to wait until dawn for rescue – a possibility for which the present AEA and policy were devised. Also, ejection statistics confirm that it is a very rare event for aircrew to lose their dinghy pack. For these reasons it may be possible to modify the current policy to one allowing a greater degree of flexibility in the choice of thermal insulative layers to be worn beneath the immersion coverall. Possible alternatives could be the aircrew 'T' shirt and/or the aircrew jersey. However, this possible flexibiity refers only to the garments worn beneath the immersion coverall which must never be worn on its own whatever the conditions. The immersion coverall, with some form of thermal insulation, will continue to be mandatory for flights over the sea when water temperatures are 10°C or below.

81. Sorties planned to fly over isolated or mountainous terrain, especially in the winter, may lead to survival conditions every bit as hazardous as ejection over the sea. Rescue may also be difficult and therefore

delayed. If aircrew take the option to wear the aircrew Cold Weather Suit Mk 3 instead of the immersion coverall, then the level of insulation worn beneath the garment should also be considered in much the same way as for the immersion coverall.

82. **Description.** The coverall (Fig 15) is a one-piece olive drab coloured garment. It is designed for maximum comfort, particularly whilst the wearer is seated, and is therefore cut full and shaped at the knees, seat and arms. The coverall is constructed from two layers of cotton ventile fabric comprising a thicker outer layer and a thinner lining. When dry, the material is permeable to water vapour and therefore aids body comfort. The fabric becomes waterproof when wet. The coverall is closed by a front entry waterproof sliding fastener which runs from the right shoulder to the left hip. A strap-type pull handle is secured to the sliding fastener. The handle can be secured in the donned state by Velcro tabs. To assist donning and doffing, the back length is extended by means of a gusset which is let into the back of the waist. After the garment is donned, a sliding fastener is closed over the gusset which then folds up. Butyl rubber, waterproof seals which fit firmly against the wearer's skin are provided at the wrists and at the neck. The seals may be trimmed to fit the individual wearer. The design of the neck seal is such that full movement of the head and neck is permitted without loss of the waterproof seal. A nylon comfort sleeve is fitted inside the neck seal to aid donning. A urination sleeve is situated behind a sliding fastener. The coverall is supplied with the lower end of the trouser legs open so that the correct size of waterproof Immersion Sock Mk 3 may be attached. Pockets are fitted as follows:

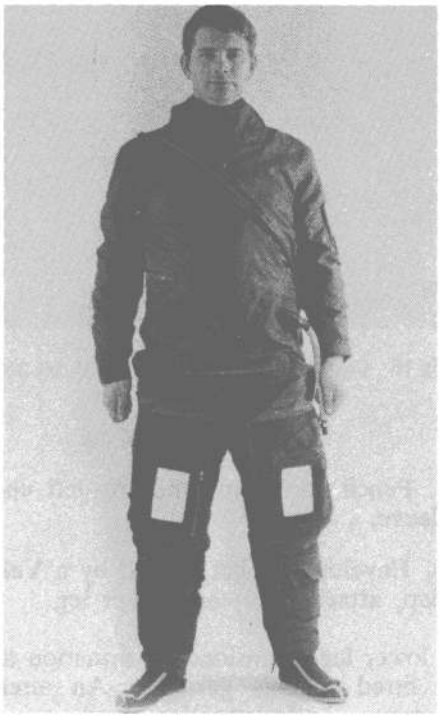

Fig 15 Aircrew, Immersion Coverall

a. A pencil and pencil torch pocket on left upper sleeve.

b. A three compartment pocket on each thigh comprising:
- writing pad pocket fitted with three plastic sheets.
- Pencil pocket alongside the window pocket.
- a centre, patch pocket opening upwards and closed by Velcro tabs.
- a base, downward opening pocket closed by a Velcro flap.

c. The two lower leg pockets are identical and each consists of a single compartment pocket, closed by a Velcro flap, attached to lower leg extensions to the coverall. This arrangement allows a full size pocket to be accommodated on the calf, outside the flying boot.

Single udder, and double udder angular sealing sleeves are available for fitment to the coverall so as to allow a waterproof passage for supply hoses as necessary. Unused udders must be sealed by blanking

plugs. An aircrew knife retention patch may also be fitted.

83. The Immersion Coverall Mk 10A differs from the Mk 10 version by the fitment of the following items:

a. A fabric collar to surround the neck seal and to prevent damage occurring to the seal as a result of the air blast forces encountered during high speed low level ejection.

b. Thigh and lower leg pockets of a boxed construction as opposed to patch pockets.

These modifications are currently only applicable to the Tornado aircraft.

84. **Fitting Criteria.** The Mk 10 immersion coverall is provided in nine sizes based on stature and chest circumference. The design of the garment is such that it is a comfortable fit over the proper thermal insulative undergarment. Correctness of fit is checked by appropriate special tests. A special measure size facility is available for this garment.

Coverall, Immersion, Winchman, Mk 2 (AP 108F–0603–12)

85. **Introduction.** The helicopter winchman's coverall is similar in principle and design to the Aircrew Immersion Coverall Mk 10. The coverall (Fig 16) is designed for winchmen engaged in rescue operations should they accidentally or deliberately enter the water.

86. **Description.** The suit is a one piece garment made from heavy duty nylon/terylene fabric proofed with neoprene. It is traffic yellow in colour. Front entry sliding fastener, rear gusset, wrist and neck seals are similar to those fitted to the Aircrew Immersion Coverall Mk 10/10A. The garment is intended for use with the Aircrew Rubber Immersion Boot Mk 3/4, the correct size being fitted for the individual wearer. Pockets are attached as follows:

Fig 16 Coverall, Winchman Mk 2 with Mk 3/4 Boots

a. Pencil pocket mounted on left upper sleeve.

b. Envelope pocket, closed by a Velcro flap, attached to each lower leg.

No lower leg extensions, or urination tube are fitted to this garment. An aircrew emergency knife retention patch may be fitted.

87. **Fitting Criteria.** The coverall is available in 5 sizes, small, medium, medium large, large, extra large based on stature and chest circumference. A special measure size facility is also available.

Coverall, Inner Mk 3 (AP 108F–0110–12

88. **Introduction.** The inner coverall, constructed of a thick acrylan pile air trapping fabric, is the most suitable means of providing the necessary thermal insulative layer for wear beneath the Immersion Coverall Mk 10.

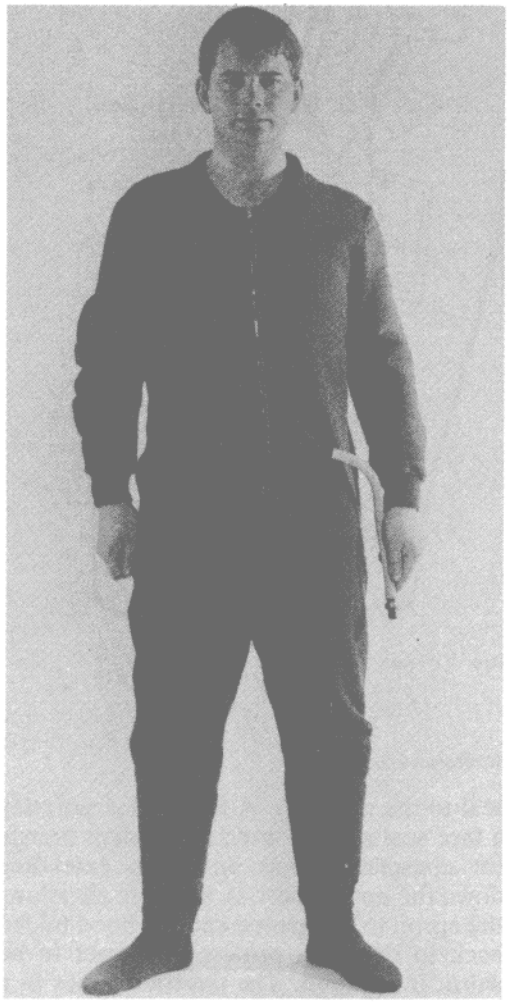

Fig 17 Coverall, Inner Mk 3

89. **Description.** The coverall (Fig 17) is a one-piece garment made from olive drab coloured monacrylic pile fabric, with knitted ribbing at the neck, cuffs and ankles. Unlike the Mark 2, this inner coverall is no longer made of inherent stretch material, although the design is such that the coverall is intended to be a snug fit over the undergarments.

90. The coverall is donned through a sliding fastener which runs down the centre front. A separate sliding fastener, fitted horizontally at the fly, closes a urination aperture. The sleeves and legs of the garment are relatively short in length so as to avoid interaction with the fit of the immersion coverall wrist seals and that of the 1965 pattern flying boot respectively. Elastic thumb-loops and stirrup-loops are fitted at the cuffs and ankles as an aid to donning. Two pockets, one at each breast, are provided, as well as flap covered holes to each side of the lower front for the passage of supply hoses.

91. **Fitting Criteria.** The coverall is manufactured in nine sizes based on stature and chest circumference, three increasing chest girths for each of three height bands. Correctness of fit is checked by appropriate special tests. A special measure size facility is available for this garment.

Quick-Don Immersion Coverall, Mk 1 (AP 108F–0606–126)

92. **Description.** In some aircraft which operate regularly over the sea (eg Nimrod, Shackleton or SAR helicopters), it may be impractical for the crew or passengers to wear the normal type of immersion coverall. They require a garment which can be donned quickly in an emergency, yet gives an adequate degree of protection. It should be of simple design and robust construction and easy to don by individuals who are unfamiliar with it or who may be suffering from minor injuries. These requirements have led to the adoption by the RAF, in

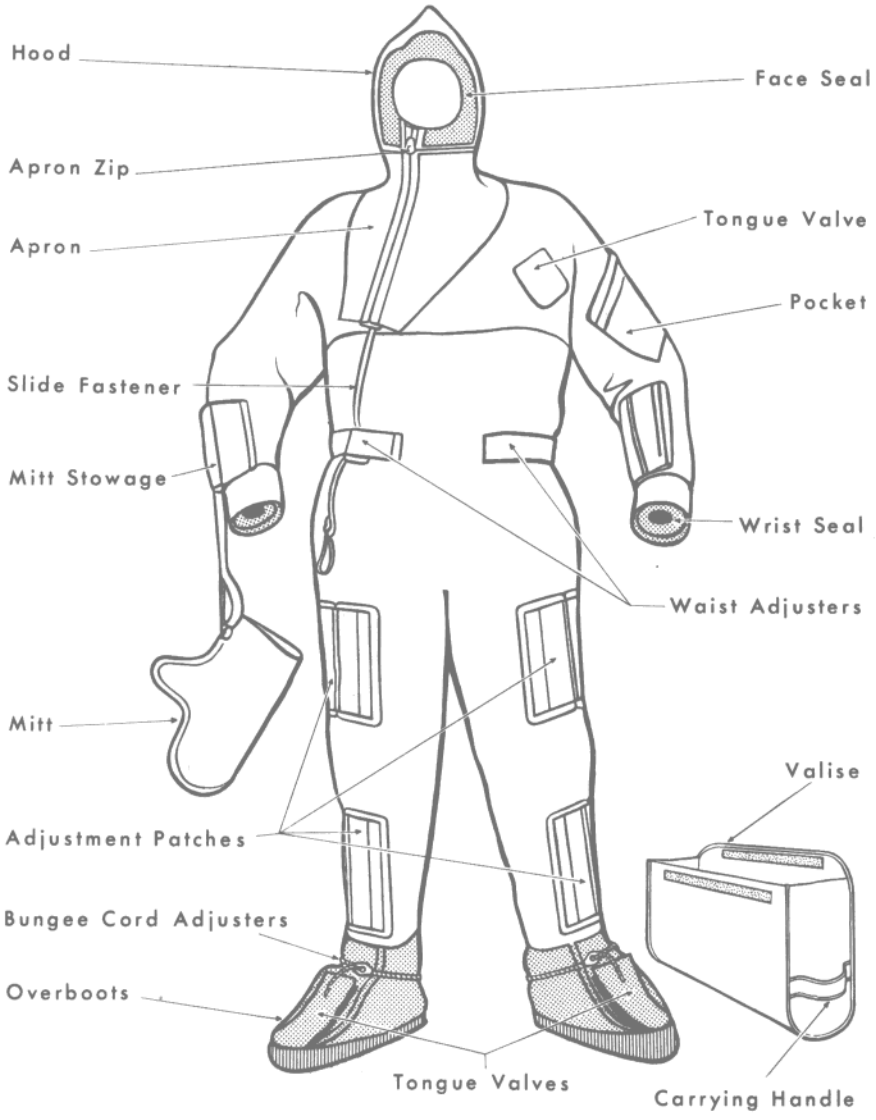

Fig 18 Quick-Don Immersion Coverall

conjuction with the Royal Navy, of the 'Beaufort' quick-don coverall. See Fig 18. Note that the life preserver is worn OVER the coverall. This coverall is a simple one-piece garment made from panels of coated nylon fabric cemented together and fitted with rubber seals at the neck and wrists. To assist donning, a watertight sliding fastener runs diagonally from the centre of the neck seal to the right hip. A hood, incorporating a face seal and coloured fluorescent orange for conspicuity, has an apron extending down the upper chest. A separate zip allows the apron to be opened and the hood folded back to permit a protective helmet to be worn, if required. The coverall comes in a single size but adjusters are provided at the ankles, lower and upper legs and waist, to

enable a reasonable fit to be obtained. The integral rubber-soled boots are worn over normal footwear. The double-skinned mitts, with adjustable wrists and attachment tapes, are stowed in pockets attached to the lower sleeves. Three tongue valves are provided (on left shoulder and each instep) to allow excess air trapped inside the suit to be expelled, to avoid dangerous angles of flotation. Until required for use, the coverall is normally stowed, with both zips open and adjustments free, inside a valise of the same material, the flap of which is sealed with locking thread. An identification label on the suit bears the serial number (repeated on valise handle); any other markings are applied to a separate patch of material, which is bonded to the suit by rubber solution. The coverall must be handled and stored with care because the material is easily damaged by contact with acids, oil and grease or by exposure to high temperatures, strong sunlight or ozone.

93. **Donning.** It is recommended that aircrew adopt and practise a donning method suited to their crew station and having due regard to the conditions likely to prevail in an emergency. Passengers should, if possible, be supervised and assisted during donning. The following procedure is suggested as a basis for individual drills.

a. From a stooping position, insert the right leg into the coverall, followed by the left leg, left arm and right arm.

b. Expel air from the overboots and tighten the bungee cord ankle adjusters.

e. Taking each leg in turn, fold the material as closely as possible around the calf and thigh and fasten the lower and upper leg adjustment tabs.

d. HALF close the main zip upwards, ensuring that the lower slide is correctly docked.

e. Adjust the waist, expelling as much air as possible from the lower half of the suit, and fasten the waist adjustment belts.

f. Fully close the main zip, ensuring that the upper slide is correctly docked at the split neck seal.

g. Remove head gear (eg protective helmet), pull the hood over the head and check the face seal for correct fitting. Close the self-locking apron zip.

h. Don the life preserver as required.

j. Don the mitts, adjusting the wrist size by means of the touch-and-close straps.

Note: Rubber seals are NOT to be trimmed to suit individuals.

AIRCREW LIFEPRESERVERS

Introduction

94. Although there are several different types of aircrew life-preservers all of them share the same design criteria. The aim of this chapter is to provide a basic understanding of the principles and function of any aircrew lifepreserver. The main purpose of a life-preserver is to provide aircrew with sufficient additional buoyancy so distributed that the survivor will achieve a satisfactory flotation attitude with the airway clear of the water under all circumstances (ie landing face down in the water, irrespective of the clothing assembly worn, and in the event of injury).

95. A minimum of 38 lbf buoyancy is required to support adequately an aircrewman wearing any AEA. The most suitable flotation attitude is when the axis of the upper torso lies 45° (±10°) back from the vertical. To achieve this configuration the buoyancy is applied to the upper torso so that the centre of buoyancy (man + lifepreserver) is vertically above the centre of mass of the body. With this arrangement, maximum stability is ensured. The majority of the buoyancy must be located on the front of the chest to give the necessary self-righting properties and to turn the body to face the waves. The extension of the inflatable stole around the sides and back of the neck provides support for the head.

Overall, these design principles provide the most physiologically acceptable and stable attitude in the water.

96. The type test schedule for aircrew lifepreservers requires the following criteria to be met:

a. The stole is to provide a minimum of 38 lbf buoyancy within 5 seconds of initiation of inflation in environmental conditions of air temperature –10°C to +30°C and water temperature down to 0°C.

b. The inflated lifepreserver is to provide a flotation angle of 45°, plus or minus 10°.

c. The inflated lifepreserver is to produce self-righting within 5 seconds of adopting an adverse attitude.

d. The stole is to withstand inadvertent inflation at altitudes up to 50,000 feet.

e. The lifepreserver mechanism is to withstand rigours of the ejection sequence (eg acceleration and high speed air blast).

f. The stole is to be protected against splatter from Miniature Detonating Cord blast.

g. There is to be minimal interaction of lifepreserver mechanisms and associated pockets with restraint and parachute harness (both in the cockpit and suspended under parachute). The lifepreserver must not interfere with any aspect of the flying task.

The buoyancy stole of the current in-service lifepreservers is constructed of a strong butyl fabric bladder inflated by a carbon dioxide cylinder and associated operating head, all stowed within a blast proof cover which contains an additional layer of material to provide protection against splatter from Miniature Detonating Cord. The assembly is arranged as a horseshoe collar and attached to a waistcoat to which are also attached pockets to provide stowage for the survival and location aids and lifting beckets for the attachment of a Grabbit hook. A typical lifepreserver is shown uninflated and inflated in Fig 19a and Fig 19b respectively.

97. There is a disadvantage in the use of carbon dioxide as the gas for filling the stole of the lifepreserver. The rate of inflation of the stole is markedly slowed at low temperatures as a significant proportion of the gas flowing into the stole condenses as snow (dry ice). As heat enters the stole the carbon dioxide snow re-evaporates and fills the stole. This process typically takes 30–60 seconds at sea temperatures of 5°C.

98. The ideal flotation attitude is only achieved when wearing lightweight, minimum bulk clothing asemblies. If a high bulk, air trapping AEA is worn (eg inner coverall and immersion coverall) then its inherent buoyancy leads to adverse flotation attitudes with minimal self-righting. It is therefore important that aircrew should take positive action to expel the trapped air from within the immersion coverall as soon as possible after water entry.

99. In order to improve the chances of survival of unconscious or severely injured/debilitated aircrew after water entry, mechanisms for the automatic inflation of the lifepreserver and for both automatic lowering and inflation of the dinghy are currently under development and could be added to the range of safety equipment for aircrew in the near future.

100. Historically, the advent of assisted escape systems introduced the requirement to protect the AEA (and the lifepreserver in particular) against the effects of high speed air blast. For this reason the old Mk 4B lifepreserver was unsatisfactory since the folded inflation stole and restrainer were uncovered. Thus the Mk 14 and Mk 17 series of lifepreservers were developed which embodied a strong fabric blast-proof cover over the lifepreserver stole. With the introduction of the Phantom aircraft into

Fig 19 A Typical Aircrew Lifepreserver

RAF/RN service, it was necessary to provide a blast-proof lifepreserver which was compatible with the skeletal torso harness and the man-mounted oxygen regulator. A similar requirement developed for the Harrier, Jaguar and Buccaneer (panel mounted regulator) aircraft. Thus the aircrew lifepreservers Mks 10, 11 (RN only) and 12 were introduced. The waistcoats of these lifepreservers supported the skeletal torso harness and were closed by a two-part metal chest plate which provided an anchorage for the oxygen regulator or the upper end of the PEC oxygen hose. For those aircraft where it was unnecessary to have a high degree of blast protection, the Mk 15 lifepreserver was developed. This lifepreserver was initially used by the RN whilst the RAF used the Mk 4B for its rotary wing and some fixed wing aircraft. A derivative of the Mk 15 lifepreserver is now in general use for this application. Thus the aircrew lifepreserver Mk 4B was superseded by the Mk 14, Mk 15 and Mk 17 lifepreservers. The Mk 14 lifepreserver is now obsolete. Lifepreservers Mks 15 and 17 are now identified as the Mk 25 and Mk 27 respectively following the introduction of the Pye Personal Locator Beacon (PLB) instead of the S.A.R.B.E. beacon. With the advent of the seat mounted simplified combined harness (SCH) as a replacement for the skeletal torso harness, plus the locator beacon change, lifepreservers Mks 10, 11 and 12 have become Mks 20 and 22.

101. At the present time, pending the development and introduction of an automatic (ie water activated) lifepreserver, aircrew lifepreservers can be divided into three basic groups:

a. Mk 25 series, for use in rotary wing, and non-ejection seat, fixed wing aircraft.

b. Mk 20, 22 series, for use in the Jaguar, Harrier, Phantom and Buccaneer aircraft.

c. Mk 27 series, for use in the remaining ejection seat fixed wing aircraft.

(AL9, JAN 82)

102. Aircrew lifepreservers are issued in two sizes of waistcoat dependent on chest circumference, namely; 'regular' size (no suffix to Mk) and 'large' size (having "A" suffix to Mk). For example:

Mk 27: Lifepreserver Mk 27, regular size
Mk 27A: Lifepreserver Mk 27, large size.

The suffix "N" is added if the lifepreserver has been modified to accept the attachment of aircrew NBC respirator assemblies, and applies to all Marks, for example Mk 27N, Mk 27NA. The suffix "S" is used to denote the addition of sleeves to the lifepreserver to support the arm restraint mechanism in the Tornado aircraft, eg Mk 27S, Mk 27SA. An "H" suffix indicates that the lifepreserver is used for the Hawk and Sea Harrier aircraft, eg Mk 27H, Mk 27HA. Suffixes "S" and "H" apply only to the Mk 27 series of lifepreserver.

Aircrew Lifepreserver, Mk 25 (AP 108F–0816–12)

103. **Introduction.** The lifepreserver Mk 25 series, shown in Fig 20, consists of a waistcoat, a protective pouch, a stole container, and a stole which is designed to be a snug fit on the chest and around the neck. The stole is inflated from a CO_2 cylinder larger in size and gas charge than that normally fitted to aircrew lifepreservers. Stowage pockets are provided on the lifepreserver for equipment which assists in the location and recovery of the wearer in a survival situation.

Fig 20 Aircrew Lifepreserver, Mk 25

104. **Description.** The waistocoat is made from olive drab coloured terylene fabric and is closed at the front by three buttons. Waist adjustment straps and buckles are fitted to the rear lower edge. An adjustable PSP attachment strap is fitted to the front bottom edge at each side and an attachment strap for the PSP lowering lanyard is provided adjacent to the right-hand PSP attachment strap. Appropriate quick-release connectors are assembled on the straps as required for different aircraft types. A 'D' ring, fitted between the upper and middle closure buttons, forms an attachment point for an oxygen mask supply hose assembly as required. Lengths of webbing, attached to the waistcoat at each side of the front, are formed into loops and are sufficiently strong as to form lifting beckets for use with the Grabbit hook of a helicopter. When not in use each loop is retained by two press fasteners to the respective lobe of the stole container.

105. A Pye PLB pocket is fitted in the left-hand side of the waistcoat. It accommodates the trans/receiver unit in the lower compartment, and a battery unit, housed in an open ended sleeve pocket, in the upper compartment. The pocket flaps are closed by a nylon draw rod (no wooden toggle fitted), press fasteners and sections of Velcro fastener. An aperture and sleeve are located on the underside of the pocket to allow for routing of the PLB turret cap and housing of the activation toggle, cord and pin assembly.

106. On conversion from the Mk 15 standard of lifepreserver the pocket (previously used to house the S.A.R.B.E. battery unit) on the right-hand side of the waistcoat is retained. It accommodates the following items of equipment:

- Pyrotechnic signal kit.
- Heliograph and ground/air emergency code label and razor blade.
- First Aid Kit.

New Mk 25 series lifepreservers have the standard survival aids pocket as fitted to the Mks 20, 22 and 27 lifepreservers. A sea-activated battery pocket is stitched to a base patch one edge of which is stitched to the blast-proof pouch right-hand rear panel so that, when the lifepreserver is inflated by the wearer on water entry, the battery is activated. It is constantly immersed without being removed from the pocket. The McMurdo light housing is fitted to the rubber button on the right-hand lobe of the stole container.

107. The inflation equipment consists of a nylon operating head and a cylinder containing 45g carbon dioxide (CO_2). The operating head is attached to the rear panel of the left hand lobe of the inflation stole and protrudes through an aperture in the stole container. The CO_2 cylinder, located in a fabric loop, is attached to the top of the operating head. The cords from the operating head mechanism are routed through a webbing loop and form part of a beaded operating handle assembly. The beaded handle is secured to the outer face of the protective pouch by means of press fasteners.

108. The protective pouch consists of front, rear and side panels of synthetic, olive drab coloured, fabric. One edge of the port and rear panels is stitched to the waistcoat and one edge of the side panel is attached to the free edge of the front panel. Closure of the side panel to the rear panel is achieved by an unbroken length of Velcro fastener. Five press fasteners (four at lower right-hand side, one at the lower left-hand side) provide reinforcement to the Velcro closure. A webbing hinge is fitted between the bottom of each lobe of the protective pouch and the waistcoat to permit passage of the relevant parachute/restraint harness straps.

109. A lifeline and toggle is attached to the left-hand lifting becket. A lanyard and whistle are attached to the right-hand lifting becket.

110. The stole container is conspicuously coloured to assist in the visual location of a survivor. An aperture at the back of the neck portion, closed by a sliding fastener, provides access to the inflation stole. A webbing hinge is fitted between the bottom of each lobe and the waistcoat so that the correct flotation angle is achieved. The right-hand lobe is fitted with pockets to house the oral inflation valve. The left hand lobe of the stole container is fitted with a Pye PLB aerial mounting patch, a radio frequency choke retaining loop and counterpoise housing sleeve. The inflation stole, made from proofed nylon fabric, coloured traffic yellow, is enclosed and restrained by the stole container. The stole is attached to the operating head and the oral inflation valve. Two press fasteners located at the bottom of the lobes are fitted so as to ensure that the stole is correctly retained within the stole container.

111. **Fitting criteria.** The lifepreserver should be fitted and the size functionally checked over both the minimum and maximum bulk AEA to be worn in the appropriate aircraft type. It may rarely be necessary to have the regular size lifepreserver for use with a 'summer' AEA combination, and the large size lifepreserver for use with a 'winter' AEA combination.

Aircrew, Lifepreserver, Mk 20/22 (AP 108F–0806–12)

112. **Introduction.** the aircrew lifepreserver Mks 20 and 22 series replaces the Mk 10 and Mk 12 lifepreservers. Each consists of a waistcoat, a blast-proof pouch enclosing a stole container and an inflation stole, and pockets for the Pye PLB and other survival aids. The fabric flaps fitted to the waistcoat for the retention of the skeletal torso harness are no longer used.

113. **Description.** Instead of a button fastening the waistcoat is closed by a two-part metal closure plate with the left-hand plate being used as the mount for the miniature oxygen regulator (or the manifold of the aircrew NBC respirator). The plates interlock to fasten and are unfastened by operating a spring loaded catch at the top of the left hand plate. The Mk 22 lifepreserver has closure plates the mirror image of those just described. The waist adjustment incorporates a two-part buckle with an "S" fold stitched into each strap to prevent disconnection from the relevant buckle. An adjustable PSP lanyard, and a flap to secure the mic/tel lead and HP oxygen hose are sewn into the bottom front edge of the waistcoat (left or right side dependant on aircraft type).

114. Lifting beckets, webbing hinge, Pye PLB pocket, Pye PLB aerial assembly, survival aids pocket, sea-activated light and battery, lifeline and toggle, whistle and lanyard, oral inflation tube are identical to those described above (Mark 25 lifepreserver).

115. The inflation equipment consists of a 34 gram charged cylinder of carbon dioxide and an operating head, both of which are housed in a compartment fitted with a sliding fastener. The compartment is positioned internally at the bottom of the left-hand side of the blast-proof pouch. The design allows access to the compartment fastener and hence the contents without disturbing the lacing of the blast-proof pouch. A personal equipment connector (PEC) disconnect lanyard is stitched to the waistcoat rear panel and ends in a spring loaded clip for attachment to the main portion of the PEC (Mk 20 only). On the lifepreserver Mk 22, the PEC lanyard is attached to the lower right front edge of the waistcoat. On the Phantom aircraft the PEC lanyard is functionally sized for each individual aircrew.

116. The blast proof pouch is made from two panels of olive drab terylene fabric, one fitted with slotted webbing, the other with webbing loops (which are threaded through the relevant slots) and retained by the nylon tails of a draw wire. The draw wire attached to the beaded operating handle, first unlocks the blast proof pouch by withdrawing the tails from the loops, and then operates the inflation mechanism when pulled firmly and smoothly downwards. The draw wire is partially housed in a preformed black PVC extrusion fitted internally. The periphery of the blast proof pouch is closed by a sliding fastener which is covered by a Velcro closed flap to afford abrasion protection from the parachute and restraint harness straps. When the lifepreserver is used in aircraft fitted with miniature detonating cord (MDC) for canopy clearance, the front panel of the blast proof pouch is lined with a layer of cotton fabric to protect the internal stole and stole container from damage due to hot-lead splatter. The stole and stole container are similar to those described above for the Mk 25 lifepreserver (there being only minor differences in size and shape).

117. **Fitting criteria.** The lifepreserver should be fitted and the size functionally checked over both the minimum and max-

imum bulk AEA likely to be worn for a particular aircraft type. (NB. Size PEC lanyard if necessary). If aircrew require different sizes of lifepreserver for summer and winter AEA use, then the latter should be issued.

Aircrew, Lifepreserver, Mk 27 series (AP 108F–0806–12)

118. **Introduction.** The Mk 27 series of aircrew lifepreserver replaces the Mk 14/Mk 24 version as the lifepreserver in general use for fixed wing, ejection seat aircraft (except Phantom, Jaguar, Harrier and Buccaneer). The Mk 24 and Mk 27 lifepreserver are identical except that the former is not fitted with a webbing hinge between the bottom of each lobe of the blast proof pouch and the waistcoat. As with other types, the Mk 27 series consists of a waistcoat, blast proof pouch enclosing a stole container and inflation stole, and pockets for the Pye PLB and other survival aids.

119. **Description.** The aircrew lifepreservers Mk 27 series, shown in Fig 19a, are similar to the Mk 20 version described above with the exception that:

- The waistcoat is closed by three buttons instead of closure plates.
- A 'D' ring is fitted at the level of the middle button for attachment of the personal oxygen hose assembly.
- Two liferaft attachment loops and a PSP lanyard loop are fitted (NB varies with aircraft type).
- The internal parachute/restraint harness retaining flaps and the PEC lanyard are not fitted.

The lifepreservers are similar in respect of all other constituent parts. Some later versions of the Mk 27 series of lifepreserver may have the inflation stole constructed of a slightly thicker single layer, proofed butyl fabric, coloured traffic yellow, in which case the stole retainer will have been deleted. MDC protective flaps are fitted inside the blast proof pouch as necessary. Fitting criteria are similar to those previously described for other marks of aircrew lifepreserver.

Fig 21 Aircrew Lifepreserver Mk 27S

120. Special to type versions of the Mk 27 series lifepreserver are as follows:

a. Mk 27S. This lifepreserver (Fig 21) is designed for use with the Tornado aircraft only. It is identical to the 'normal' Mk 27 but with the addition of:

(1) Sleeves which carry the main portion of the arm restraint mechanism. The cuff of the sleeve is adjusted by means of a webbing strap and buckle which prevents the sleeve material riding up the forearm during application of arm restraint. The arm restraint tape, positioned on the sleeve by a Velcro fastener, runs between two arm restraint bands, one around the upper arm, and the other around the lower

arm. Each sleeve restraint tape is connected across the back of the lifepreserver waistcoat and carries a metal arrow head connector to which the seat portion of the arm restraint system is attached.

(2) PSP lanyard attached to the left-hand lower edge of the waistcoat. This lanyard is fitted with a mechanism to operate the Pye PLB automatically at man-seat separation during the ejection sequence.

The Mk 27S lifepreserver is designed to have three separate sleeve lengths for each size of waistcoat. (ie six sizes overall). This is to ensure that the lower arm restraint band is positioned correctly on the forearm. Again, fitting (waistcoat and sleeves) should be undertaken over both minimum and maximum bulk aircrew clothing assemblies. It may be necessary to issue a different sleeve length/waistcoat size for use with the winter AEA combination.

b. Mk. 27H. This lifepreserver is designed for use with the Hawk aircraft only. It is identical to the normal Mk 27 lifepreserver with the exception that the PSP lanyard and associated mechanism as fitted to the Tornado version is also fitted to this lifepreserver. Fitting only involves the size of the waistcoat.

121. Following the introduction of the Pye PLB for most aircraft types, development is proceeding to fit the automatic operation mechanism similar to that fitted (but not used at present) for the Hawk and Tornado aircraft. Subsequently, therefore, lifepreservers for these other aircraft types will incorporate PSP lanyards similar to those fitted to the Mk 27S and 27H lifepreservers.

AIRCREW HELMETS

Introduction

122. In general terms, the mechanisms of head injury can be summarised as being due to:

a. Direct impact (soft tissue and bony injury).

b. Linear acceleration (concussion).

c. Angular acceleration (concussion).

In the absence of head impact, forces transmitted through the neck may cause fractures to the base of the skull, or concussion by initiating high angular accelerations of the head.

123. Ideally, protection against these effects can be afforded by the provision of a hard, rigid shell around the head to minimise direct impact damage, and a means of increasing the distance through which the head travels after impact before stopping, thereby reducing the accelerative forces involved. There are two basic energy absorbing systems which can be employed in helmets, though several others have been considered. Current RAF aircrew protective helmets employ a frangible fibreglass shell which breaks up on impact (dissipating some of the energy). The impact load is transmitted to the head and distributed over a wide area by means of a webbing suspension harness which provides an initial air gap of about one inch (to maximise the stopping distance). Energy is absorbed by the shell inelastically each time a glass-fibre ruptures, or is pulled out of the resin matrix. Peripherally, energy is absorbed by crushable foams. Use of this technique implies a compromise with the requirement for a strong rigid shell. A second mechanism, more favoured by the US Forces, makes use of a layer of crushable foam beneath the shell.

124. The aircrew helmet must also serve several secondary functions:

a. Intercommunication facility.

b. Noise attenuation.

c. Oxygen mask suspension mechanism.

d. Eye protection against birdstrike, solar glare, air blast.

e. Mounting platform for vision enhancement devices (passive night goggles).

The end design of a protective helmet for aircrew use must inevitably be a compromise between the extent of the protection provided against impact, the overall weight (to allow good head and neck mobility), size (so as not to be too unwieldy) and noise attenuation.

125. Recent advances in airframe design which allow the performance of repeated high-g air combat manoeuvres has indicated a possible requirement to reduce the weight of the aircrew helmet. At present, RAF aircrew helmet/mask combinations weigh approximately 2 Kg irrespective of type.

Helmet, Flying, GP, Type G and Protective Mk 1A (AP 108F–0204–12)

126. **Description.** The General Purpose Helmet Type G, shown in Fig 22, is of fabric construction, and is fitted with earphones housed in noise attenuating earpads. Studs on each side of the helmet provide fastenings for the oxygen mask attachments which vary with different types of mask. The Protective Helmet, Mk 1A is constructed of a rigid shell made up of bonded laminations of nylon and fabric, and webbing suspension harness. The helmet, fitted with a tracked, tinted visor mechanism (Fig 22), is worn over the general purpose helmet. The visor mechanism incorporates a spring loaded locking device which enables the visor to be located in any one of a number of intermediary positions. The helmet also has a press-stud closed chin strap fitted to retain the helmet on the head.

Fig 22 Aircrew Helmets 'G' Type Inner Plus Mk 1A Outer

127. The Type G cloth helmet is available in 4 sizes, and the Mk 1A helmet is available in 15 sizes, narrow, regular and broad fittings in each of 5 sizes. The Mk 1A helmet is also available without visor track mechanism for the rear crew members of some aircraft.

Helmet, Flying, Protective Mk 3 Series (AP 108F–0203–12)

NOTE: All Mk 2A helmets in Service will have been converted to the Mk 3C standard as described below. The difference between the various types of Mk 3 Series helmet are listed in para 133 of this Chapter.

128. **Description** (Figures 23, 24, 25 and 26). The Mk 3 Series protective flying helmet was intended to replace the Type G and Mk 1A helmets, and provide the same facilities as these separate items in a single integral headpiece. The helmet is constructed with a rigid outer shell of glass fibre resinate with locally formed lobes to accommodate the telephone receiver and microphone connector plug. Shallow bosses are moulded on each side of the helmet in the region of the ears. Inside, immediately under the crown, the helmet is padded with a layer of cork which is covered by a sateen

lining. Below this, a harness of nylon webbing forms a suspension cradle to keep the shell clear of the head. The initial tension of this cradle is adjusted to suit the wearer by means of adjusting cords, one controlling the front and the other the rear cross webbings. When adjusted satisfactorily the tensioning cords are locked in small exterior screw clamps on the left-hand side of the helmet. Another adjustable strap is provided inside the helmet and passes behind a pad at the back of the head to embrace the nape of the neck. This strap is provided for longitudinal adjustment to suit the wearer. It is tensioned by external toggle buckles on either side of the helmet. When the toggle buckles are turned towards the rear, the nape strap is relaxed and the helmet can be either donned or doffed comfortably. After donning the helmet the toggles are turned forwards, tightening the nape strap and pulling the helmet back so that the ears are in the correct alignment with the telphone ear pads.

Fig 24 Aircrew Helmet Mk 3C, Interim NBC Modification (ie. Side Furnishings Removed)

Fig 23 Aircrew Helmet Mk 3C Unmodified

129. The lining of the helmet is removable and comprises sponge rubber padding covered with soft leather, shaped to form a seal around the face aperture. Leather covered flaps are provided at the forehead, nape of the neck and behind the ear capsule recesses. The chin strap is in two sections attached by screws to the rigid part of the helmet shell and passing through slots in the lining. It has a special quick-locking buckle and is adjustable in length. The free end is stowed by adhesion to a Velcro patch mounted on a leather comfort pad attached to the lining. The shear pin, originally incorporated in the chin strap, has now been deleted.

130. The ear capsules are connected by acoustic tubes to a single miniature telephone installed in the lobe at the rear right-hand side of the helmet and attached by stitching to the shell. The ear capsules are surrounded by either fluid filled or foam rubber seals which are kept in close contact with the

Fig 25 Aircrew Helmet Mk 3C, Full NBC Modification (Removable Side Furnishings)

side of the head by means of a wire spring suspension mechanism. The capsules can be slid vertically on wire frames so that they are located over the ears. Looped tapes attached to the capsules allow the wire spring headset to be pulled open when donning the helmet. The microphone connector plug is housed in a shaped aperture on the left-hand side of the helmet and is connected by internal cable to the telphone assembly. The coiling loom and connectors are designed for the standard RT system. The loom has a "pigtail" which terminates in a jack plug which hangs from the back of the helmet.

131. The oxygen mask attachment hooks are designed to suit any oxygen mask with a "chain-type" harness. The hooks pass through slots in the material of the lining and are adjustable in a fore and aft direction on threaded shanks running in knurled captive nuts. Vertical adjustment is by means of a slotted anchorage plate attached to the inside of the shell behind the padding. A cable retaining loop is provided on the left-hand from corner of the helmet rim for attachment of the oxygen mask microphone lead.

132. Three different types of visor mechanism are available on the Mk 3 Series of helmets:

a. Single visor, track and mechanism. The track and mechanism for the single visor (identical to that fitted to the Mk 1A helmet) is attached to the front centre of the shell. The track mechanism is fitted with a spring loaded locking mechanism. This type of single visor is fitted to the basic type of Mk 3 helmet, the Mk 3B (helmet identical to Fig 23 but with visor mechanism as in Fig 22 fitted).

b. Double visor system (Mark 3C helmets). The double visor system comprises an inner visor of clear polycarbonate for blast protection and protection against bird strike, and an outer tinted visor for glare protection. Both visors are hinged

Fig 26 Aircrew Helmet Mk 3E

from common side pivots. The inner visor can be locked in the 'down' position by a spring-loaded locking device fitted with a thumb release catch. This mechanism is fitted to the right-hand side of the helmet. The tinted outer visor can be independently positioned but not locked. Note: the hinge mechanism does not allow the tinted outer visor to be 'down' and the inner clear visor 'up'. Mk 2A helmets and Mk 3B helmets are both modified to Mk 3C standard by the addition of the double visor modification kit in place of the original visors.

c. Single visor using the suspension system from the double visor mechanism (Mk 3E helmets). For those aircraft which fly routinely at high altitudes where internal reflections between two visors are extremely troublesome and bird strike protection is not required the inner clear visor can be dispensed with. In the Mk 3E helmet the tinted antiglare visor is mounted on the inner pair of hinges. This visor can be locked in the down position.

133. The differentiation of the Mk 3 helmet types is as follows:

a. Mk 3B. This is the basic Mk 3 with single visor on a central track mechanism. It is authorized for use by aircrew of some non-ejection seat, fixed wing aircraft.

b. Mk 3C. This is the Mk 3 helmet shell fitted with the double visor mechanism. This has now become the general purpose helmet for most aircraft types. The Mk 3C helmet in its unmodified state is shown in Fig 23. Further modifications to produce variants of the Mk 3C are:

(1) 'Cut away' tinted visor. This is only applicable to non-independent double visors and issue is limited to special roles such as flight at high altitude.

(2) 'Cut away' side furnishings to accommodate the Aircrew Respirator NBC No 5 (Fig 24). This modification is applied in association with the change to foam ear capsule seals.

(3) Final standard of NBC side furnishings modification to provide replaceable pads as required. Fig 25 shows this variant with the pads in situ.

(4) Conversion for use with Tornado aircraft. This incorporates a second 'dummy' telephone capsule to provide the correct impedance for the intercommunication system and the provision of a 'Lemo' connector on the mic/tel helmet down lead.

(5) Provision of an independently operable double visor mechanism for this series of helmet is under development.

c. Mk 3D. This variant is not illustrated. It incorporates attachments for passive night vision goggles and at present is only for use in rotary wing aircraft.

d. Mk 3E. This is similar to the Mk 3C but has a single cutaway visor mounted inboard on the double visor mechanism. Its application is limited to special role (high altitude) aircraft.

Mk 4 Helmet (AP 108F–0205–12)

134. The Mk 4 aircrew protective helmet is currently under development. Some early models are in use with particular aircraft types. The basic helmet follows similar design principles to the Mk 3 helmet with the following exceptions:

a. Slightly reduced weight.

b. Enlarged facial aperture to minimise vision restriction.

c. Larger 'cut-away' at the nape of the neck to increase head mobility.

d. Completely redesigned communication system and ear capsules to give markedly improved noise attenuation and communication properties.

Variants of the Mk 4 helmet are:

a. Mk 4. Mk 3C double visor mechanism, 4 sizes of helmet.

b. MK 4A. Mk 3C visor system, 5 sizes of helmet.

c. Mk 4B. Final development. Incorporates independent double visor mechanism, 5 sizes of helmet.

AIRCREW BOOTS

Boots, Aircrew, 1965 Pattern

135. **Introduction.** The 1965 pattern aircrew boot (Fig 27) was introduced to provide aircrew with a rugged item of footwear suitable for use in flight and in any survival situation.

136. **Description.** The boot consists of black leather uppers which are lined and bonded to a tough composition sole. The uppers are extended high on the ankle and are fitted with a foam padded rim for comfort. Fastening is by means of two rows of eyelets and laces. The underside of the sole is moulded into a non-skid, anti-FOD pattern. The leather of which the boot is constructed is proofed to provide the maximum degree of protection in a land survival situation.

137. **Fitting criteria.** The 1965 pattern boot is available in 17 sizes (Medium and Large in 8 basic unit increment sizes from 5–12 plus a special fit size facility) and should be sized to give a comfortable fit over the thickest socks likely to be worn. It is usual to issue the 1965 pattern boot to fit over two pairs of terryloop socks or terryloop sock plus immersion sock Mk 3 fitted to the aircrew immersion coverall Mk 10.

138. The design and construction of the 1965 pattern boot is suitable for wear with either 'summer' or 'winter' AEA, although it is essential to wear this pattern of boot with the latter assembly.

Fig 27 Boots, Aircrew, 1965 Pattern

Boots, Aircrew, Lightweight

139. **Introduction.** The lightweight aircrew boot (Fig 28) was introduced to provide aircrew with a lighter and more comfortable style of boot than the 1965 pattern, which would be more suited for use in summer temperature or hot climates.

140. **Description.** The lightweight boot consists of unlined brown leather uppers bonded to a composition sole. The uppers have a low ankle height and are fastened by eyelets and laces. The leather used in the construction of the boot is thinner than that

Fig 28 Boots, Aircrew, Lightweight

in the 1965 pattern boot and is unproofed so that it allows a certain amount of water vapour permeability for foot comfort in warmer weather. The underside of the sole is moulded into a similar pattern to that on the 1965 pattern boot. Because of the lightweight construction this boot is totally unsuitable and inadequate for use with 'winter' AEAs.

141. **Fitting criteria.** The lightweight aircrew boot is available in 16 sizes (medium and large in 8 basic unit increment sizes from 5 to 12) and should be sized to give a comfortable fit over a thin pair of socks.

Boots, Aircrew, Rubber Mk 3/4

142. This item is a completely waterproof rubber boot which is fitted to and used with the Coverall, Immersion, Winchman Mk 2 (AP 108F–0603–6, 0603–12). Further details of this boot are given with the description of the latter garment earlier in this chapter. The boot is available in 8 unit increment sizes from 5 to 12.

AIRCREW GLOVES

Gloves, Cape Leather, Sweat Resistant, Olive Drab, Mk 2

143. **Description.** The cape leather glove forms the general purpose flying glove for aircrew use. It is constructed from strong, supple close fitting leather which provides protection against abrasion and from fire, whilst minimising the decrement in tactility and dexterity. The glove is available in half size increments from size 7 to 10 plus a special fit size facility.

Gloves, Cape Leather, Water Resistant. Undyed, Mk 1. Olive Drab, Mk 2

144. **Description.** The waterproof cape leather glove is of similar construction to the above except that slightly thicker leather is used and the sewing of all seams are waterproofed by coating with a waterproof solution on the inside. Additionally a rubber wrist seal is attached inside the wrist of the glove to complete its waterproof integrity. The glove is available in half size increments from size 7 to 10 plus a special fit size facility. The waterproof cape leather glove should be worn in conjunction with those AEA combinations where immersion in water may occur.

Gloves, Helicopter Winchman, LH and RH

145. **Description.** This glove is constructed of stout, rough leather and is fitted with metallic reinforcing to the index finger and thumb in order to withstand chafing from the moving wire strop of a helicopter winch. Available in half size increments from 7½ to 10.

Gloves, Electrically Heated, Inner and Outer (AP 108F–0701–16)

146. **Description.** The electrically heated gloves (used in conjunction with electrically heated socks) are for use on 28 volt systems and are intended for use with the aircrew immersion coverall Mk 10 when this garment is fitted with an electrical heating harness. Available in three sizes, small, medium and large.

Gloves, Silk

147. **Description.** A thin, natural fibre glove intended to be worn as a thin inner glove where necessary in cold climates.

THE COMPLETE ASSEMBLY

General

148. So far in this chapter, a comprehensive description has been given of the major individual items which comprise an Aircrew Equipment Assembly. Although it is convenient to detail the various garments as separate items, it is emphasised that any AEA, whether for fixed wing or rotary wing aircraft, for flights over land or sea, or for use during the summer or winter seasons, is

always worn as a combination of garments. As outlined in the introduction, the AEA is designed as a carefully integrated, functional system which ensures that the appropriate degree of protection is afforded to aircrew and at the same time is fully compatible with the aircrewman's ability to perform the flying task with a minimum of restriction.

149. In order to demonstrate more fully the integrated nature of an AEA combination, the following two sequences of Figures have been included which illustrate firstly, the summer/land AEA (Figs 29a to f), and secondly (Fig 30a to f), the winter/sea AEA. Both of these are applicable to aircrew operating the Tornado aircraft.

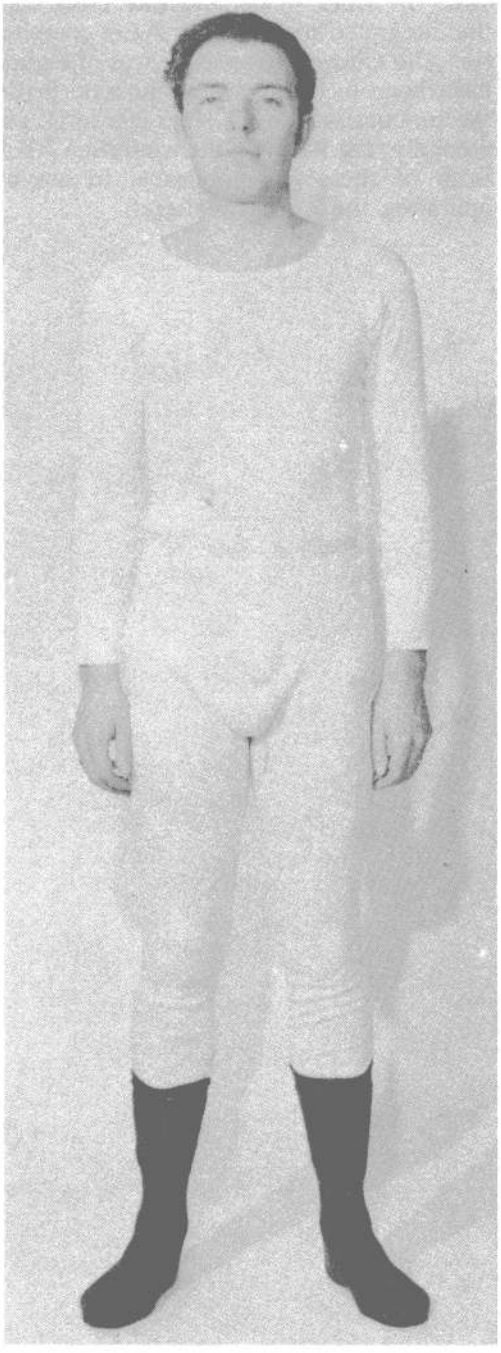

Fig 29a Tornado Summer/Land AEA, Underwear

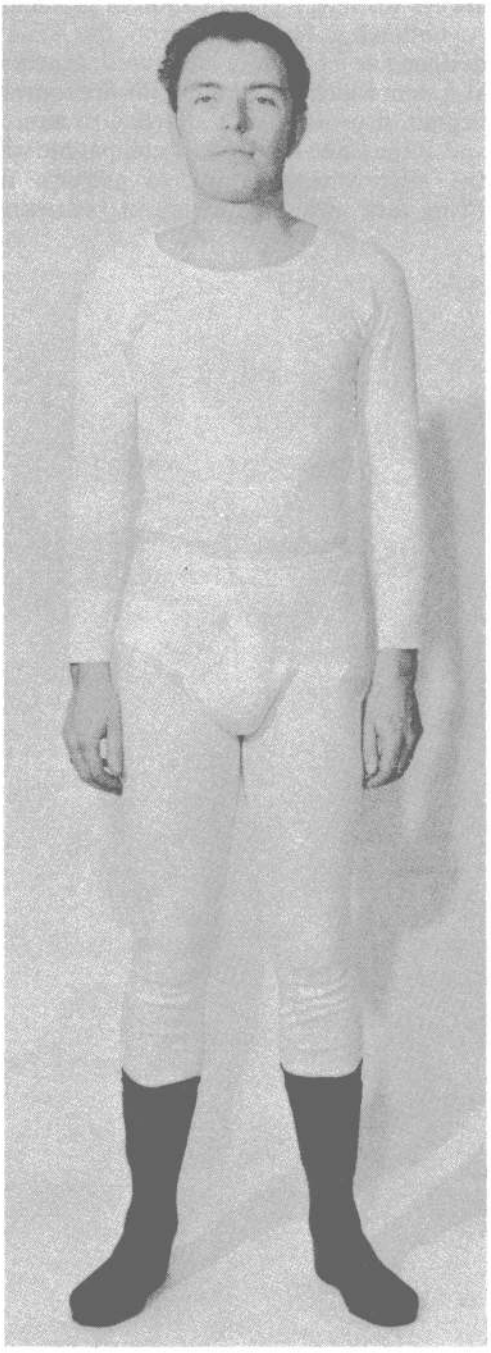

Fig 30a Tornado Winter/Sea AEA, Underwear

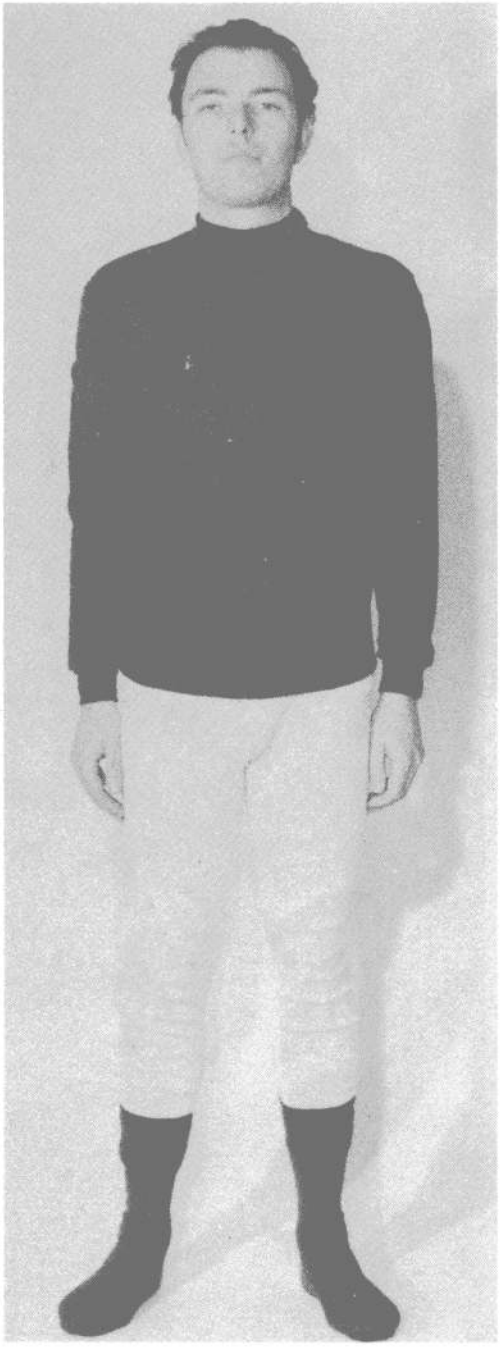

Fig 29b Tornado Summer/Land AEA, 'T' Shirt

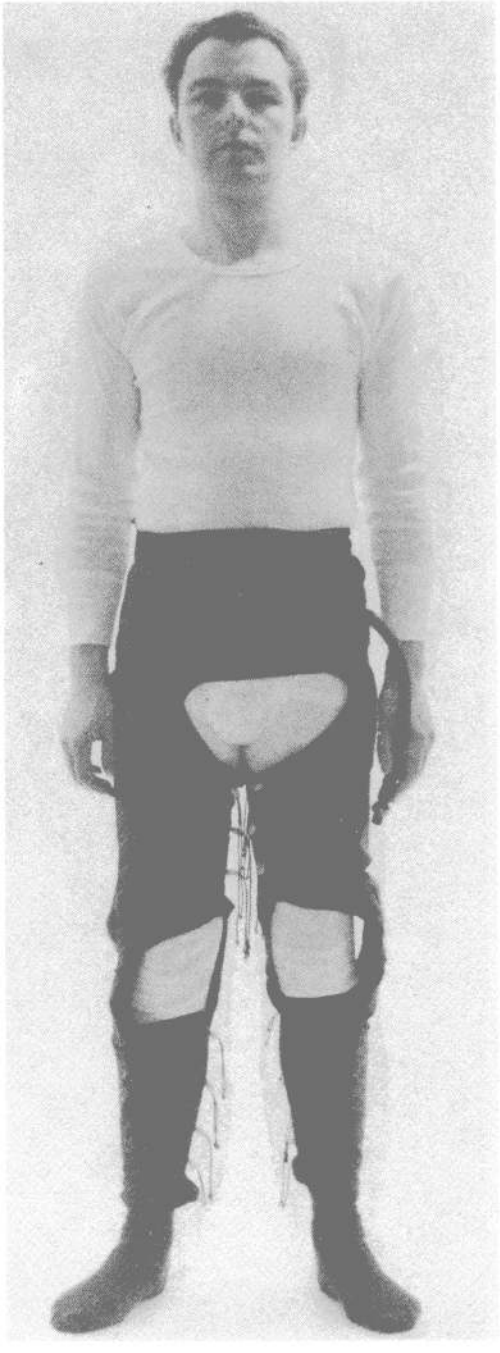

Fig 30b Tornado Winter/AEA, Anti-g (Internal)

Fig 29c Tornado Summer/Land AEA Coverall and Boots

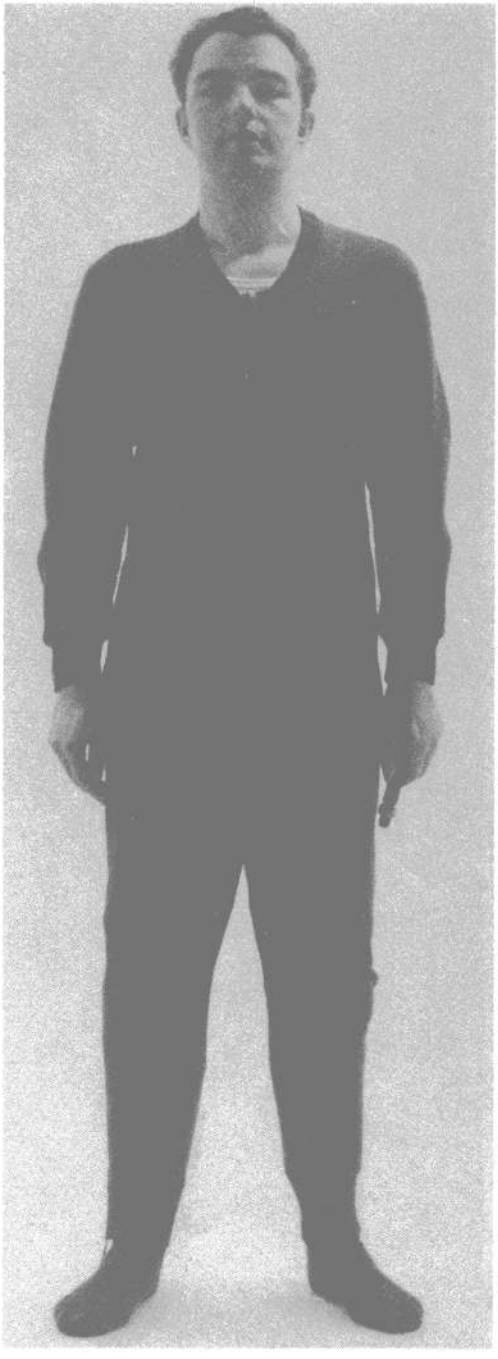

Fig 30c Tornado Winter/Sea, Inner Coverall

Fig 29d Tornado Summer/Land AEA, External Anti-g Trousers

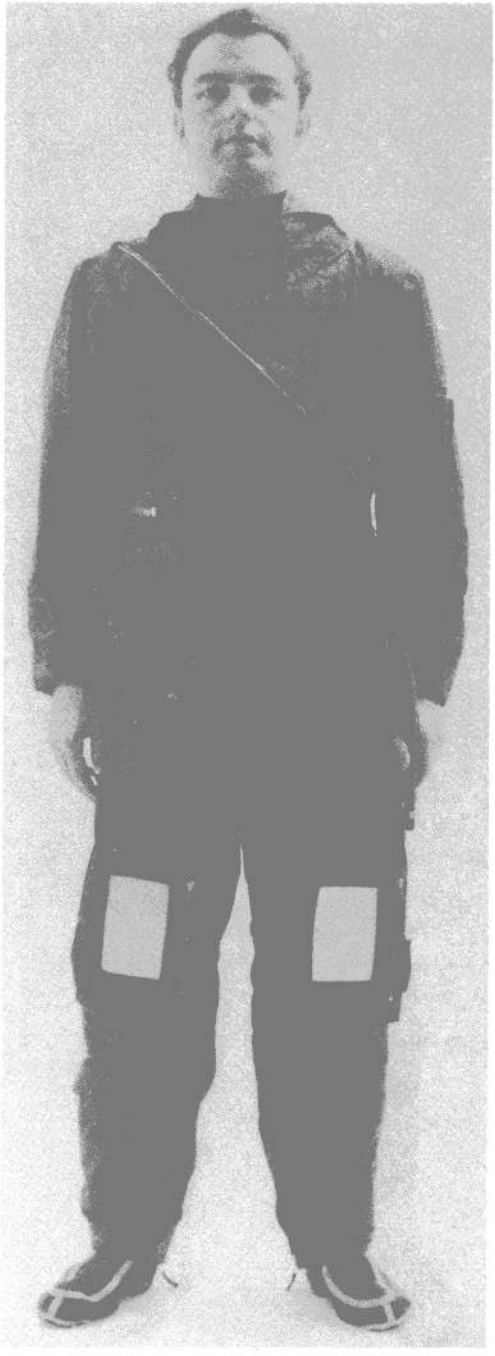

Fig 30d Tornado Winter/Sea AEA, Immersion Coverall

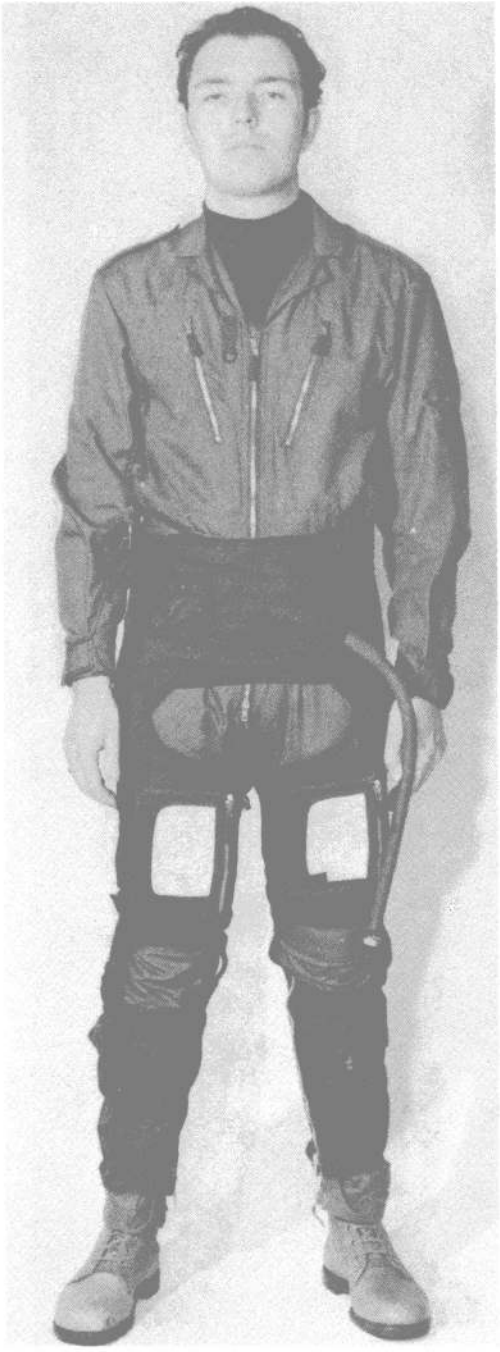

Fig 29e Tonado Summer/Land AEA, Lifepreserver and Gloves.

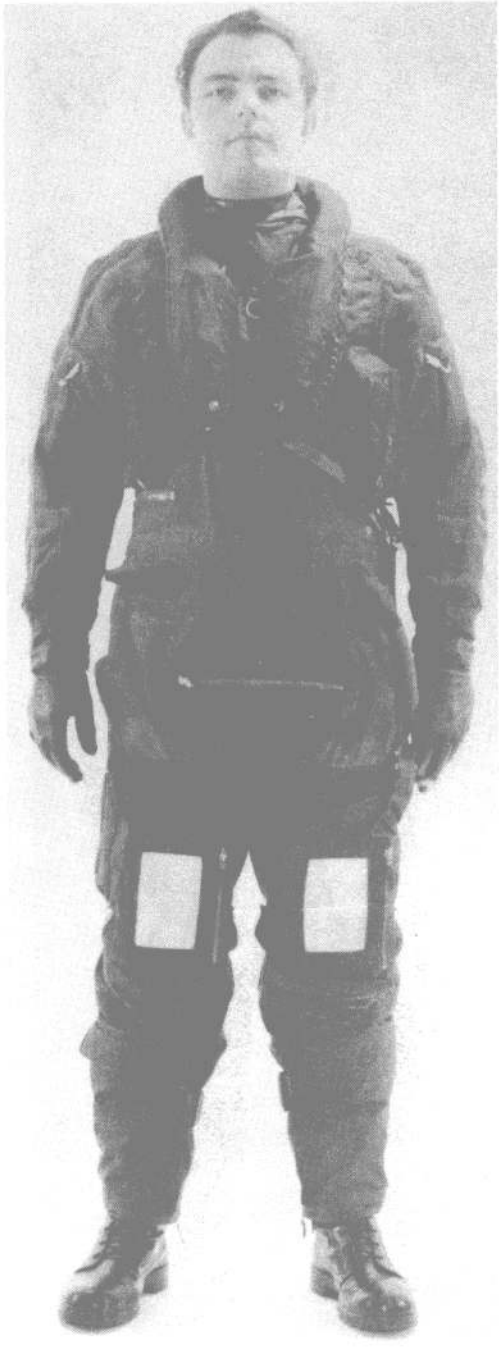

Fig 30e Tornado Winter/Sea AEA, Lifepreserver Gloves and Boots

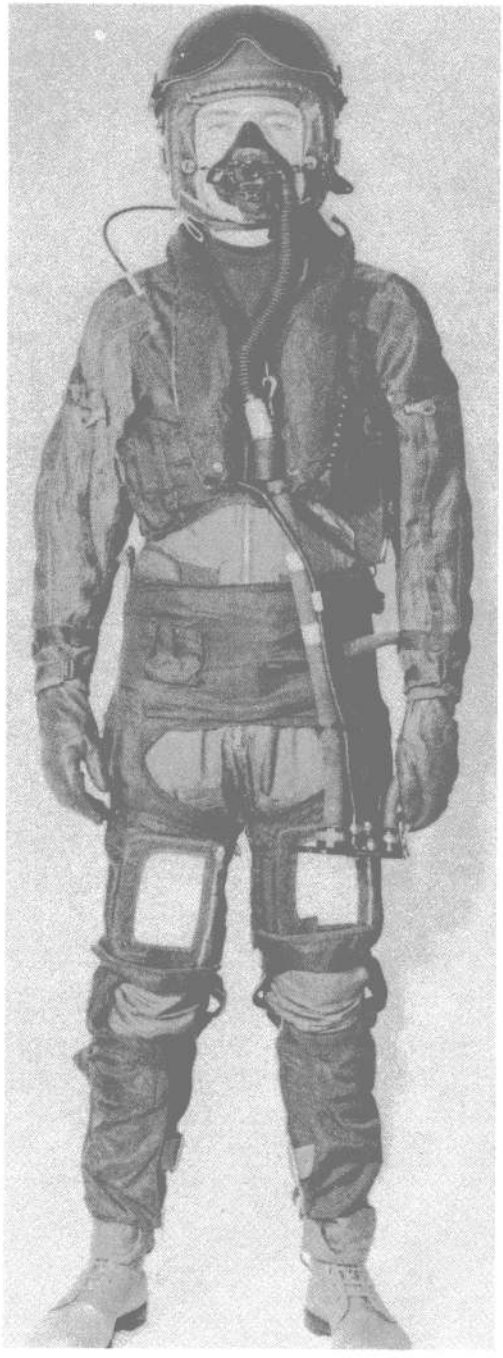

Fig 29f Tornado Summer/Land AEA, Complete Assembly

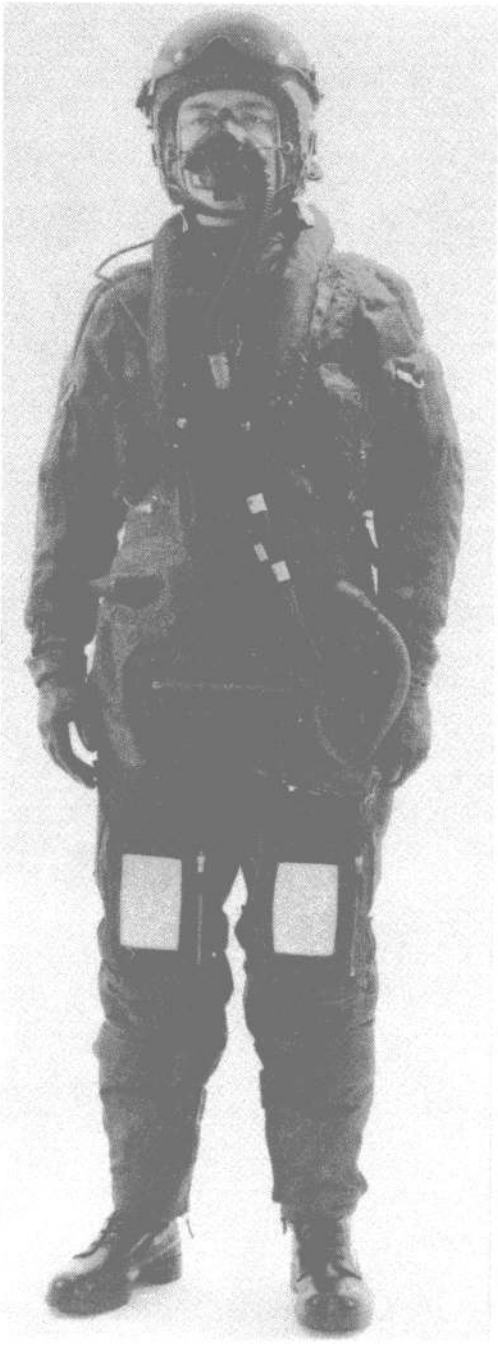

Fig 30f Tornado Winter/Sea AEA, Complete Assembly

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