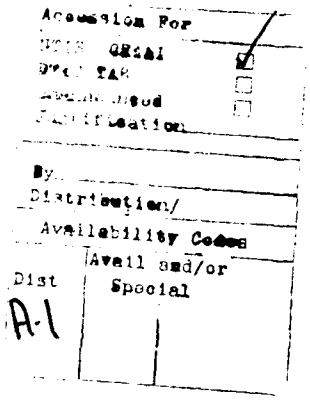
ROYAL AUSTRALIAN AIR FORCE
INSTITUTE OF AVIATION MEDICINE
RAAF WILLIAMS
POINT COOK AUSTRALIA 3027

AVMED-8-92

IMMERSION SUIT USAGE WITHIN THE RAAF

D. B. Watson



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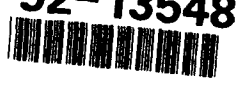

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ABSTRACT:

Military aircrew flying over oceans or lakes are constantly at risk of ditching or ejecting into cold water. Immersion in sufficiently cold water for a sufficient time results in death through hypothermia. Apart from water temperature and time, factors that influence survival in cold water include the insulation and water proofing of the victim's garments, the activity and posture of the victim, the calmness of the water surface, and individual factors such as fitness and body fat.

It is possible to improve the survival chances of immersed aircrew through the wearing of protective insulative garments that reduce the rate of heat loss to the surrounding water. Such immersion suits may be constantly worn during a flight or donned only during particularly risky phases of an overwater flight or once an emergency has been identified. These immersion suits are respectively known as either constant wear immersion suits (CWIS) or quick-don immersion suits (QDIS).

This paper discusses general aspects of immersion hypothermia and its prevention as well as immersion suit usage within the RAAF. A series of brief recommendations concerning the future use of immersion suits within the RAAF are made.

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Military aircrew flying over oceans or lakes are constantly at risk of ditching or ejecting into cold water. Immersion in sufficiently cold water for a sufficient time results in death through hypothermia. Apart from water temperature and time, other factors that influence survival in cold water include the insulation and water proofing of the victim's garments, the activity and posture of the victim, the calmness of the water surface, and individual factors such as fitness and body fat.

It is possible to improve the survival chances of immersed aircrew through the wearing of protective insulative garments that reduce the rate of heat loss to the surrounding water. Such immersion suits may be constantly worn during a flight or donned only during particularly risky phases of an overwater flight or once an emergency has been identified. These immersion suits are respectively known as either constant wear immersion suits (CWIS) or quick-don immersion suits (QDIS).

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CONTENTS.

Tables and Figures.

IMMERSION SUIT USAGE WITHIN THE RAAF

1. INTRODUCTION

1.0.1. The RAAF Institute of Aviation Medicine (AVMED) was tasked by the Principal Medical Officer at RAAF Headquarters - Training Command (PMO HQTC) to review and investigate immersion suit usage within the RAAF[1]. This tasking resulted from a visit by PMO to RAAF Base East Sale (ESL) where concerns about the usage and maintenance of various immersion suits arose.

1.0.2. A related request for AVMED advice concerning immersion suit usage within the RAAF has also been made by Air Headquarters (AHQ)[2].

2. AIM

2.0.1. The aim of this paper is to discuss aviation medical aspects of immersion protective clothing relevant to it's usage by the RAAF and to provide recommendations regarding such immersion suit usage.

3. METHOD

3.0.1. Available documents were reviewed[3]. Feedback was sought from all RAAF flying units[4] as to what, if any, immersion protective clothing they used and the conditions in which it was used. Policy guidance feedback was sought from AHQ and HQTC with respect to the expected survival times or time to rescue of RAAF aircrew forced to ditch into water[5].

3.0.2. Review of the available information and policy guidance has allowed AVMED to provide recommendations to assist in future policy development.

4. RESULTS & DISCUSSION.

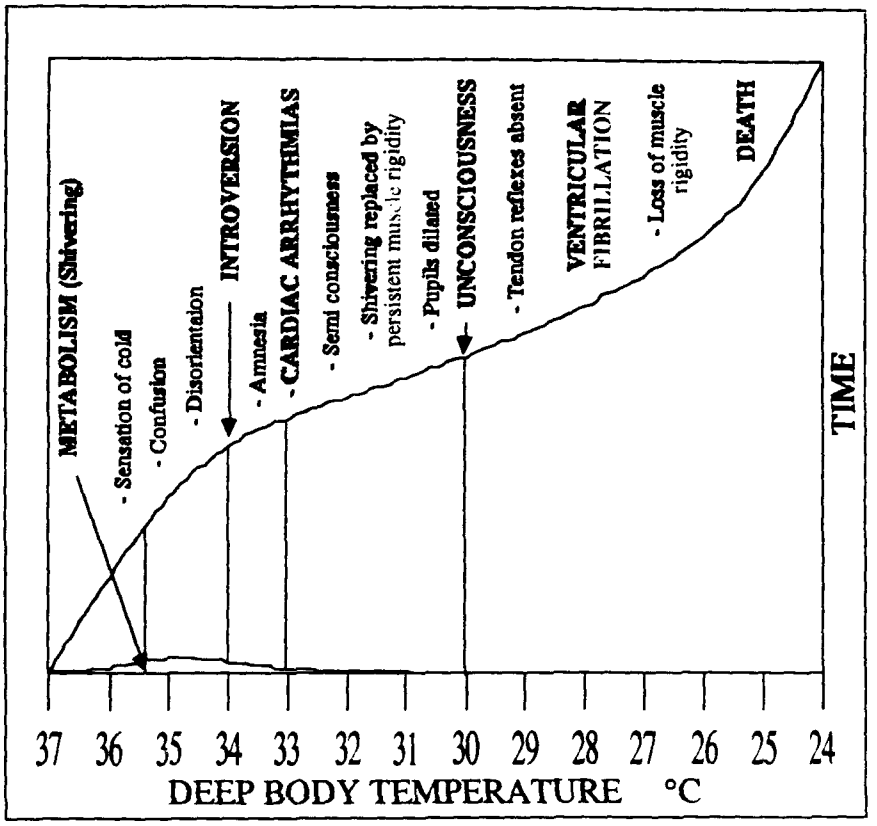
4.0.1. This section begins with a general, non-technical, overview discussion on the subject of cold water immersion hypothermia, it's dangers, and methods of reducing the risk of hypothermia. This is followed by an outline of the role of immersion suits in military flying operations. Next is an outline of current immersion suit usage within the RAAF, discussion on aspects of policy relevant to immersion suit usage, and finally AVMED's recommendations.

4.1. COLD WATER IMMERSION HYPOTHERMIA.

4.1.1. When immersed in water colder than the body's core temperature (which is usually maintained at around 37°C) a man will lose heat to the surrounding water. If the water temperature is lower than 32°C the body's physiological protective mechanisms will probably be unable to adequately control the heat loss and a progressive reduction in the core temperature will result. Reduction of body core temperature, if allowed to continue, can result in functional impairment and eventually death (Figure 1).

4.1.2. Death due to immersion hypothermia occurs because certain chemical reactions within the cells of the body are dramatically slowed due to the cold. This altered cellular chemistry causes the central nervous system and heart to become more 'irritable' than usual. This irritability, in turn, can result in altered conscious state, impaired breathing, convulsions, and irregularities of the heart's rhythm. Death can be due to a progression of any combination of these body malfunctions.

Figure 1[6]
The effects of cold on the human body.



The effects of cold on the human body.
The relationship between deep body (core) temperature and human body function. As the deep body temperature falls function is impaired eventually resulting in death if the fall in body temperature continues. Figure adapted from work carried out at the Royal Navy's Institute of Naval Medicine.

4.1.3. The occurrence of immersion hypothermia depends on a number of factors including:

a. The temperature of the water;

b. The duration of immersion;

c. The clothing of the subject;

d. The activity and posture of the subject;

e. The sea state;

f. The percentage body fat carried by the subject;

g. Individual susceptibility of the subject.

g. Individual susceptibility of the subject.

4.1.4. An immersed individual must be able to maintain flotation and avoid death by drowning before cold water immersion considerations become important. It is assumed that adequate flotation equipment is available in all of these discussions.

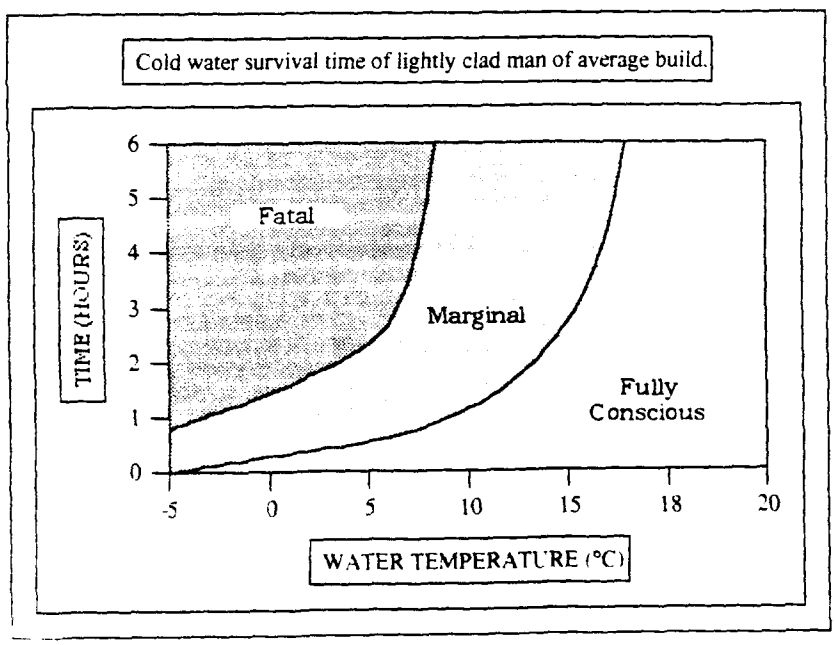
4.1.5. Water temperature.

4.1.5.1. Water temperature is one of the most critical parameters influencing the incidence of cold water immersion hypothermia. The colder the water the shorter the period of immersion before hypothermia becomes a problem. Figure 2 illustrates the relationship between the survival time of a lightly clad, average build, man and the temperature of the water in which he is immersed. It can be seen from Figure 2 that the unprotected person's likely survival time in water of 5°C is approximately 2 hours compared with in excess of 6 hours in 10°C water.

4.1.6. The duration of immersion.

4.1.6.1. Figure 2 also illustrates the relationship between duration of immersion and survival outcome. Hypothermic death upon immersion in 12°C water is unlikely within 1 hour but likely after 5 hours.

Figure 2[7].
Cold water survival of lightly clad man of average build.

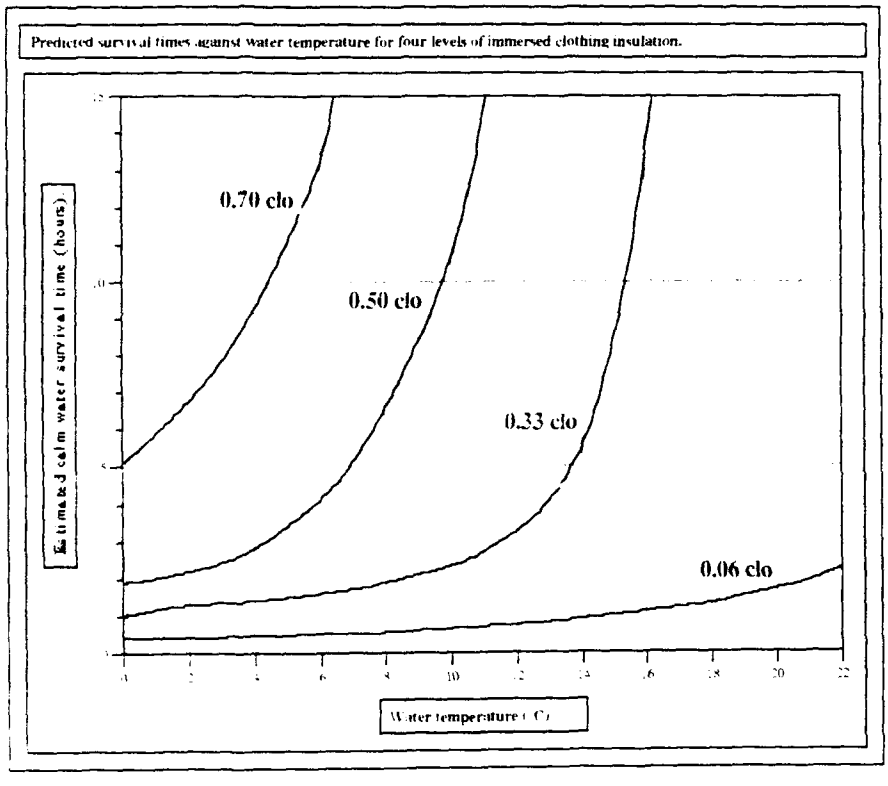


Hypothermia due to immersion in cold water.
Survival of men of average body build wearing light weight clothing upon immersion in water of various temperatures. The curve dividing the 'marginal' from the 'fatal' areas indicates the relationship between water temperature and the likely duration of survival of 50% of subjects. Adapted from British work published in an American Safety and Flying Equipment journal.

4.1.7. The clothing of the subject.

4.1.7.1. The waterproofing and insulative characteristics of the clothing worn during cold water immersion are of paramount importance in the prevention of hypothermic death. Figure 3 illustrates the changes in immersed survival time afforded by clothing with differing degrees of immersed insulation performance.

Figure 3[8].
Predicted calm water survival times for personnel wearing clothing with differing immersed insulative performance.

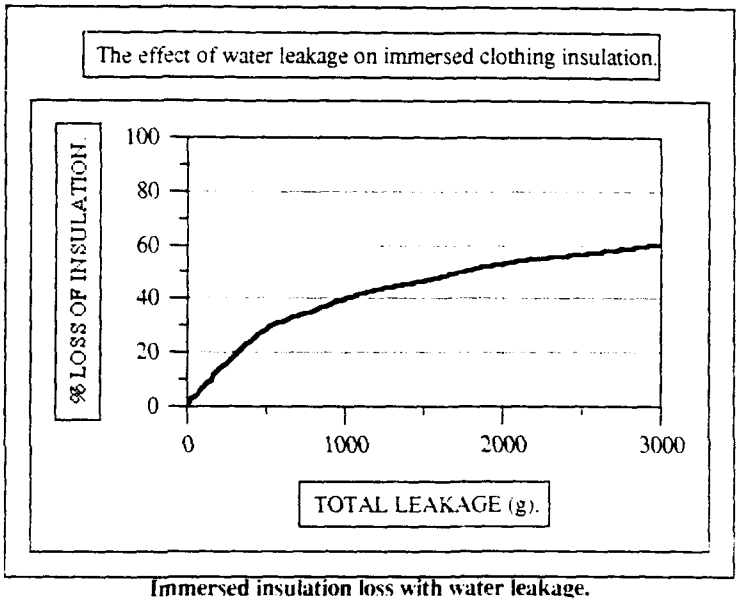


Survival times for garments with differing immersed insulation. Estimated calm water survival times plotted against water temperature for thin individuals (approximately 10th percentile mean skinfold thickness) wearing various levels of immersed clothing insulation. The unit clo denotes the rate of heat loss : 1 clo = 0.155 °C.m^2.W^{-1}. Note that the times from this graph do not correlate exactly with those of Figure 1 as the two graphs were derived using different methods. Adapted from widely published British work included in Air Standards Coordinating Committee publications.

4.1.7.2. Figure 4 demonstrates the degradation of insulative performance of immersion protective clothing with the leakage ingress of water. Note that the passing of urine into a waterproof protective garment will also degrade it's insulative characteristics.

4.1.7.3. The standard RAAF nomex flying suit, worn with long cotton underwear and issue boots and gloves provides around 0.06 clo (See text attached to Figure 3) immersed insulation while the various 'immersion suits' commercially available usually provide between 0.3 - 0.9 clo immersed insulation.

Figure 4[9].
Immersed insulation loss with water leakage.



Immersed insulation loss with water leakage.
Shows the percentage loss of insulation plotted against the water leakage into the insulation worn beneath an immersion suit. Graph adapted from British work published in American Aviation Space and Environmental Medicine journal.

4.1.8. The activity and posture of the subject.

4.1.8.1. The more active a person is when immersed in cold water the more heat is lost to the environment. Activity generally produces more metabolic heat within the body but this is rapidly lost as more cold water contacts the body's surface. Provided that buoyancy is maintained an absolute minimum of movement is advisable in an immersion survival situation.

4.1.8.2. Posture also plays an important role in cold water immersion survival. A large proportion of body heat can be lost from the head, armpits, groins, and trunk of an immersed person. Most survival manuals [9] recommend adoption of a Heat Escape Lessening Posture (HELP) which involves holding the arms firmly against the side of the chest and raise the thighs to protect the groins. Adoption of the HELP may increase cold water immersion survival time by up to 50%.

4.1.8.3. Group immersion survival prospects are enhanced by the formation of a 'huddle' pressing the sides of each other's chests together.

4.1.9. The sea state.

4.1.9.1. Wave motion has two effects that can reduce cold water survival times. Firstly wave motion may cause the immersed person to need to make an effort to maintain stability and freeboard resulting in increased movement and loss of heat. Secondly wave motion acts to continuously flush cold water against the exposed body further potentiating heat loss.

4.1.10. The percentage body fat carried by the subject.

4.1.10.1. Fat is a reasonably effective insulating material and so thin people are generally less able to survive when immersed in cold water. A high level of physical fitness usually allows the body to mobilize increased amounts of heat energy if necessary. A combination of fatness and fitness is probably the best combination to prevent body cooling during cold water immersion, unfortunately the two are usually mutually exclusive.

4.1.11. Individual susceptibility of the subject.

4.1.11.1. Taking all of the above into consideration there is still an element of 'individual variation' in human cold water immersion survival. Some people may appear 'innately' more able to survive than others. This is usually of little help as it is not possible to easily identify those cold water survivors amongst the general population.

4.1.12. Air temperature and movement.

4.1.12.1. While air temperature and the movement of the air affect the rate of heat loss in an immersed person they are of quite minor importance when compared to the other factors mentioned.

4.1.13. The waters to which RAAF aircrew may be exposed.

4.1.13.1. Figure 5 is an isothermal chart of the waters surrounding Australia during October, the month with the coldest water off the Southern coastline. The average water temperature in Bass Strait during this time of the year is around 12 - 14°C. The sea surface temperature generally increases with Northward travel in Australia.

4.1.13.2. RAAF aircrew travelling away from Australia to New Zealand, Antarctica, Europe, or the USA may find themselves flying over water significantly colder than that surrounding Australia. Sea surface temperatures of less than 10°C are not infrequent in far Northern or Southern waters and extremely cold waters occur in both polar regions.

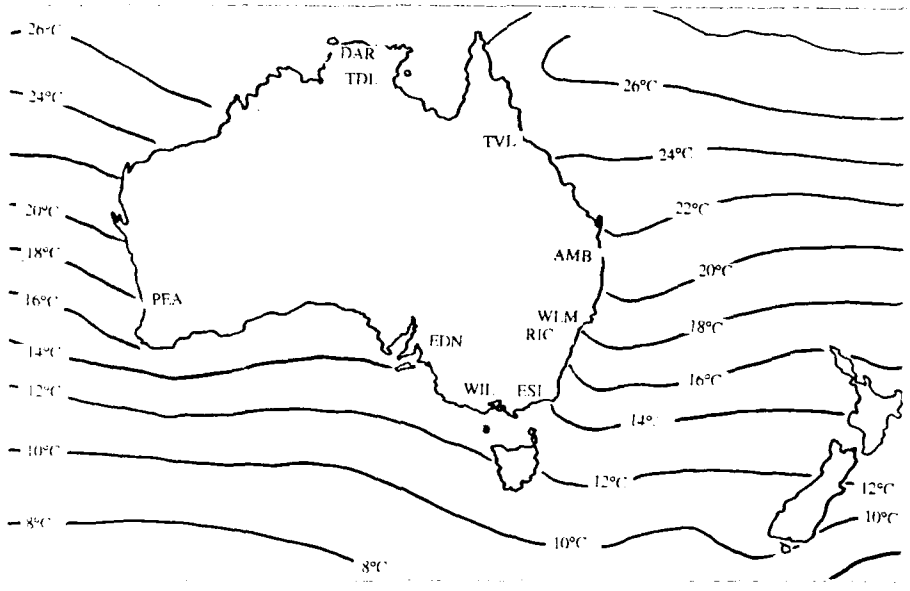
4.1.14. Other factors.

4.1.14.1. Immersion survival depends on protection from drowning, protection from the cold, adequate water and food, and avoiding predatory animals. Likelihood of rescue depends on accuracy of localization (be it due to locator beacon, distress calls, or flight planned information), readiness of Search and Rescue (SAR) facilities, equipment available to the SAR service, range and weather through which SAR units must travel, and survival/communication aids held by the victim.

4.1.14.2. Training and currency of training are also factors that influence the likelihood of survival in a cold water immersion situation. The training of the survivor in effective methods of combating heat loss as well as the procedures and operation of any survival equipment is of obvious importance. Similarly the training and currency of the SAR crews is also an important factor.

4.1.14.3. The search and rescue survival equation is a simple one. In essence the aim is to prolong the estimated survival time so that it exceeds the likely rescue time. This relationship is well illustrated in Figure 6[3].

Figure 5[12].
Water surface temperatures around Australia's coastline in October.



Water temperatures around Australia.
Diagram shows the mean water surface temperatures in the Australian region during the month of October. Temperatures are expressed in degrees Celsius.

4.2. IMMERSION SUITS IN MILITARY AVIATION.

4.2.1. General.

4.2.1.1. Military aviation missions over, or in the vicinity of water, carry with them the risk that an accident or malfunction may cause the aircraft to ditch or the pilot to eject into water. Should an airman survive the ejection or ditching subsequent survival depends on the factors outlined in Figure 6.

4.2.1.2. Various items of safety equipment are available to enhance the survival prospects of an airman immersed in cold water. Some of the items of safety equipment, specific to the cold water immersion survival, include:

a. Life raft - a suitably visible, buoyant, and stable liferaft is one of the most important survival aids for water survival.

b. Buoyancy vest - even if a liferaft is available a buoyancy vest is a necessary survival aid.

c. Clothing - Cold water survival is markedly enhanced by the wearing of suitable 'immersion suits'. While the type of aircraft operation often dictates limitations concerning which type of suit can be worn there are immersion suit designs available that are compatible with virtually every type of aircraft operation.

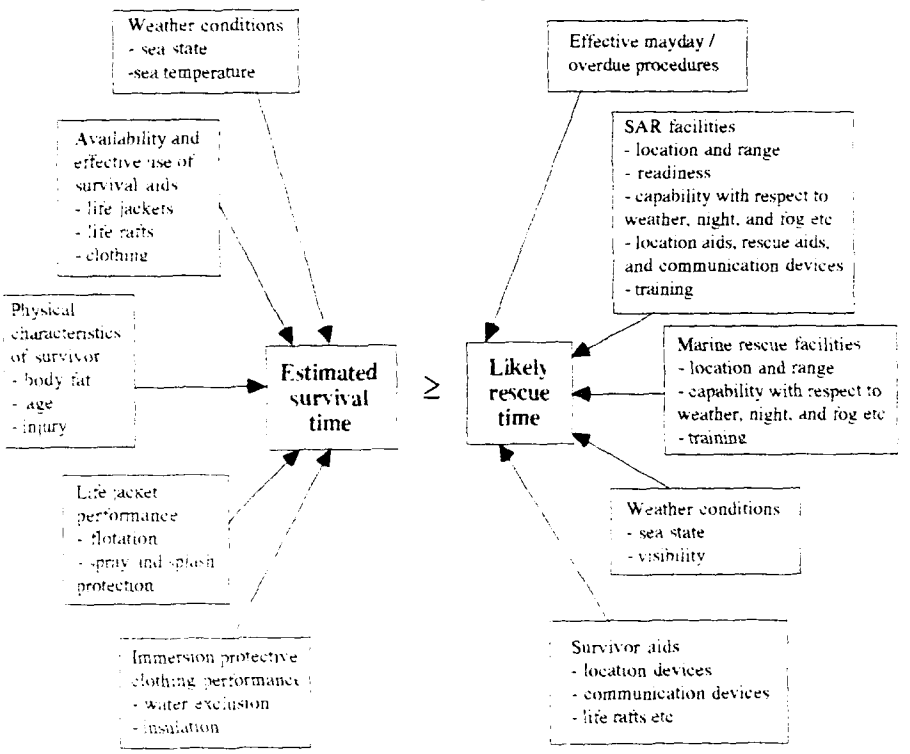
d. Communication / location devices - Radio locator beacons, flares, fluorescein water marker dye, strobe marker lights, and heliograph signal mirrors all potentially reduce rescue time and therefore enhance survival prospects. Search aircraft may be equipped with infra-red sensors, thus a

suitably IR visible material may enhance the likelihood of the survivor being located.

e. Water and food - only become an issue if the immersed survival time stretches beyond hours into days.

f. Training - It's impossible to overstress the importance of adequate training and frequent currency retraining as an essential element of any survival / SAR situation.

Figure 6.
The survival equation.



The survival equation.
A successful survival / SAR scenario depends on survival time exceeding rescue time. This relationship and many of the influencing factors are illustrated above.

4.2.2. Current RAAF survival equipment.

4.2.2.1. Presently the RAAF provides the following aircrew safety equipment items designed to enhance cold water immersion survival prospects.

a. Life raft - RAAF aircraft are all fitted with liferafts. The number and size of life rafts varies with aircraft type.

b. Buoyancy vest - Most RAAF aircrew are provided with a Secumar vest which incorporates a buoyancy device as well as other safety equipment. Some aircrew use a USAF style 'LPU' buoyancy vest instead of the Secumar.

c. Clothing - Standard flying suit, jacket, boots, gloves and thermal underwear are available to aircrew. Three different immersion suit types are presently used within the RAAF. These are the UVIC Quick-Don Immersion Suit (UVIC QDIS), the Multifabs Constant Wear Immersion Suit (MULTIFABS CWIS), and the RNZAF CWIS manufactured by the MACPAC company (MACPAC CWIS). A purchase is presently underway, by AIRENG1E, for another type of Quick-Don Immersion Suit.

d. Communication / location devices - The Secumar jacket pockets are usually configured to carry a PRC90 Radio locator beacon, penlight flares (sometimes also a day-night flare), fluorescein water marker dye, a heliograph signal mirror, and an emergency whistle amongst their safety equipment. The larger RAAF liferafts may also carry additional similar safety equipment items.

e. Water and food - Most survival packs on RAAF aircraft contain a minimal amount of drinking water and some items of 'survival rations'. Liferafts also contain chemical desalination kits and solar stills.

4.2.3. Immersion protective clothing currently in use.

4.2.3.1. The immersion protective clothing currently used by the RAAF provide additional insulation and reduce the risk of hypothermia during cold water immersion. These immersion suits are not designed as buoyancy devices or as storage/mounting platforms for other items of safety equipment.

4.2..3.2. Two styles of Constant Wear Immersion Suit (CWIS) are currently in service with the RAAF (Table 1). A CWIS is designed for use in aircraft types where either type of operation or cabin space precludes the donning of an immersion suit once an emergency has been recognized. While a CWIS must provide adequate insulation and waterproofing to immersed aircrew it must also be comfortable and light enough to wear for the duration of a mission. Most CWISs rely on a light outer garment for water resistance and an insulated inner garment for prevention of heat loss. This type of CWIS is not complete and cannot be expected to function correctly unless both outer and inner garments are worn.

4.2.3.3. A Quick-don Immersion Suit (QDIS) is designed to be stored until an emergency is identified and then rapidly donned prior to ditching of the aircraft. This type of suit must be designed so that it can be unpacked and donned in a minimal time. Because it does not need to be worn for the duration of a flight a QDIS may be heavier and more cumbersome than a CWIS. QDISs generally have insulation performance slightly superior to their constant wear counterparts.

4.2.3.4. The UVIC jacket has been in RAAF service for many years and is not the best currently available Quick-don immersion suit. AVMED has previously considered the issue of suitable QDIS equipment for RAAF usage[13] and recommended features for Logistic Command to incorporate into a purchase tender. At the time of writing AVMED understands that the purchase has been tendered, tendered items evaluated, and a successful tender selected.

4.2.4. Current RAAF policy concerning Immersion Suit use.

4.2.4.1. There appear to be two main sets of policy for the use of immersion suits throughout the RAAF. Different flying units wear or carry immersion suits in different conditions. The present policies concerning RAAF immersion suit usage are outlined in Table 2.

4.2.4.2. The Maritime Patrol Squadrons decide whether or not to use immersion suits by considering the sea surface water temperature. A temperature cutoff of 16°C has been defined below which Immersion Suits (UVIC Jackets) are to be worn. As the sea surface temperature is reasonably predictable from year to year a simplification has evolved stating that Immersion suits should be worn when flying over water South of 35°S between May and October or South of 40°S between April and November.

4.2.4.3. The Tactical Fighter Squadrons wear their Immersion Suits (CWIS) "during fleet support if combined air/sea temperature is less than 31°C or at other times as directed by Authorizing Officer". If the first part of this guideline is to be strictly adhered to it would be necessary to know both the sea surface temperature and the air temperature in the area of maritime operation. This method does not have the simplicity of that employed by the Maritime Patrol Squadrons. While air temperature is certainly a factor in the development of exposure hypothermia when aircrew are in liferafts it is of less importance when immersed in the water. The extra parameter of air temperature may add little to the effectiveness of this policy.

4.2.5. Role of an Immersion Suit.

4.2.5.1. The prime role of an immersion suit, whether it is of the QDIS or CWIS variety, is to provide insulative protection to immersed aircrew and prevent or delay the development of hypothermia. An immersion suit aims to protect a person while immersed in a body of water. The need for an immersion suit assumes that, for some reason, a life-raft is not available. Should a life-raft be available an immersion suit, while not becoming redundant, takes on an importance secondary to the raft.

4.2.5.2. Constant Wear Immersion Suits are worn by aircrew for the duration of an over-water mission. The suit is donned, along with other flying safety garments, prior to entering the aircraft cockpit. Because it is worn continuously a CWIS must be physically and thermally comfortable. This need for comfort limits the weight and bulk of a CWIS. In many aircraft types a CWIS must be used due to limitations in cockpit space or operation type that preclude the use of a Quick-Don Immersion Suit.

4.2.5.3. Quick-Don Immersion Suits (QDIS) are usually packaged and stored within an aircraft cabin and only donned in specified circumstances, usually an overwater emergency. A QDIS may also be donned during specified high-risk overwater operations. As a QDIS is only worn for limited periods physical and thermal comfort are of less importance than with the CWIS. Because of this a QDIS can be designed incorporating heavier materials which, therefore, provide better insulation. QDISs are limited to aircraft types with adequate space for the storage of the suits and for aircrew to don their suits once an emergency or high risk situation is identified. The use if a QDIS is limited by the need for an adequate donning time to be available. This usually requires that several minutes be available between the identification of an emergency and impact with the water.

4.2.5.4. The material and construction of most immersion suits also provides a degree of additional buoyancy. This buoyancy may, however, degrade with time of immersion as air leaks out of the suit. Some immersion suits (QDIS) are manufactured with integral buoyancy devices. Most RAAF aircrew wear, or have available, a Secumar vest for overwater operations. The Secumar, or similar USAF LPU style device, provides adequate buoyancy for an immersed airman with, or without, an immersion suit.

4.2.5.5. It is also possible to incorporate a variety of other items of safety equipment, such as pockets containing flares and heliographs etc, into an immersion suit design. This would add to the weight an complexity of the suit and is probably not needed in the RAAF as most necessary items are already carried in the pockets of the Secumar vest.

4.2.5.6. Like any other items of flying clothing and safety equipment an immersion suit has limitations in its efficacy. An immersion suit is only able to provide a limited amount of insulation and an aircrewman immersed for a sufficient period in cold enough water may die of hypothermia whether or not he wears a suit. Using a thicker material to provide improved insulation would increase the weight and bulk of the suit and compromise its storage, donning time, and dexterity of movement. An inherently buoyant immersion suit may potentially present problems if worn as an aircraft sinks below the surface of the water. The suit may cause its wearer to experience difficulty moving against the buoyancy if it was necessary to travel downwards to reach an emergency exit.

4.2.5.7. An immersion suit should provide no interference with the operation of other items of safety equipment. A CWIS should not interfere with the aircrew's g-suit operation[14] while a QDIS should allow the aircrew to replace their helmets and strap themselves back into their seats. Both suit types should allow aircrew to operate their PRC90 emergency radio/beacons and penlight flares while floating in the water and to climb from the water into a life-raft.

4.2.6. **Time to rescue.**

4.2.6.1. As outlined in Figure 6 a successful emergency immersion depends on the aircrew survival time exceeding the time-to-rescue. It can be debated whether there is any point prolonging cold water immersed survival time to, for example, 12 hours when rescue is highly unlikely within less than 48 - 72 hours.

Table 1 (See also Annex A).
Immersions suits currently used by RAAF aircrew[15].

Unit	Base	Aircraft	Immersion Suits	Comments
1SQN	AMB	F111C	None	Ejection capsule aircraft
3SQN	WLM	FA18	50 Multifabs CWIS	10 U/S (3SQN, 77SQN, & 2OCU)
6SQN	AMB	F111C	None	Ejection capsule aircraft
10SQN	EDN	P3C	202 UVIC QDIS held at 492SQN	(10SQN, 11SQN, & 292SQN)
11SQN	EDN	P3C	202 UVIC QDIS held at 492SQN	(10SQN, 11SQN, & 292SQN)
25SQN	PEA	MB326H	10 MACPAC CWIS	
32SQN	ESL	HS748	UVIC QDIS	? Number
33SQN	RIC	B707-338C	None	
34SQN	FBN	Falcon 900	None	
35SQN	TVL	DHC-4A	None	
36SQN	RIC	C130H	UVIC	
37SQN	RIC	C130E	UVIC	
38SQN	RIC	DHC-4A	UVIC	
75SQN	TDL	FA18	None	
76SQN	WLM	MB326H	MACPAC CWIS	None arrived yet
77SQN	WLM	FA18	50 Multifabs CWIS	10 U/S (3SQN, 77SQN, & 2OCU)
292SQN	EDN	P3C	202 UVIC QDIS held at 492SQN	(10SQN, 11SQN, & 292SQN)
ARDU	EDN	Various	16 MACPAC CWIS	
2OCU	WLM	FA18	50 Multifabs CWIS	10 U/S (3SQN, 77SQN, & 2OCU)
1FTS	WIL	CT4A		
2FTS	PEA	PC9A	None	
CFS	ESL	PC9A	4 - 6 MACPAC CWIS	
SAN	ESL	HS748	UVIC	Issued to all aircrew

Approximate holdings -	UVIC Jackets	Several hundred
	MACPAC CWIS	50 - 90
	Multifabs CWIS	50

4.2.6.2. Australian Defence and Civil Search and Rescue (SAR) resources are not sufficiently numerous around our huge coastline to guarantee rapid location and rescue of RAAF aircraft that have either ditched or ejected into the ocean. Similarly the range and endurance of SAR helicopters is inadequate to assure rescue cover for all RAAF maritime patrol missions. Rescue from a ditching/ejection in such offshore waters would depend firstly on location of survivors by long range maritime patrol aircraft and then pick-up by either re-routed nearby shipping or a specific naval or civil sea rescue mission. While it is possible to have SAR helicopters 'on stand-by' for planned 'near shore' fleet support exercises it is, unfortunately, likely that several days would elapse before the crew of a transport aircraft or maritime patrol aircraft forced to ditch en route to the USA or UK would be located and rescued.

4.2.6.3. As it is not possible to provide an immersion suit that would guarantee survival in all water temperatures that RAAF aircrew fly over for sufficient time to rescue in all cases a compromise must be reached. An immersion suit should provide insulation adequate for survival for a reasonable amount of time in water of temperatures most likely to be encountered by RAAF aircrew.

Table 2 (See also Annex A).
Immersions suit usage policy throughout the RAAF [14 16].

Unit	Conditions for use of immersion suit and source of policy quoted.
1SQN	Not required to wear or have access to immersion suits.
3SQN	Wear during fleet support if combined air/sea temperature is less than 31°C or at other times as directed by Authorizing Officer. 81WG Flying Order C1 Dated 10 December 1990.
6SQN	Not required to wear or have access to immersion suits.
10SQN	UVIC jacket access required if flight over water mass with temperature <16°C. (S OF 35°S May-Oct, or S OF 40°S Apr-Nov). DI(AF) AAP 7215.004-1 (P3C Flight Manual) RAAF Supplement.
11SQN	UVIC jacket access required if flight over water mass with temperature <16°C. (S OF 35°S May-Oct, or S OF 40°S Apr-Nov). DI(AF) AAP 7215.004-1 (P3C Flight Manual) RAAF Supplement.
25SQN	Wear during fleet support if combined air/sea temperature is less than 31°C or at other times as directed by Authorizing Officer. 81WG Flying Order C1 Dated 10 December 1990.
32SQN	UVIC jacket access required if flight over water mass more than 40nm from land with temperature <16°C (S OF 35°S May-Oct, or S OF 40°S Apr-Nov).
33SQN	Not required to wear or have access to immersion suits.
34SQN	Not required to wear or have access to immersion suits. Air Command - Air Staff Instruction Volume 1 No 3/E/6.
35SQN	None
36SQN	UVIC jacket access required if flight over water mass more than 40nm from land with temperature <16°C (S OF 35°S May-Oct, or S OF 40°S Apr-Nov). 36 Squadron Standard Operating Procedure.
37SQN	UVIC jacket access required if flight over water mass more than 40nm from land with temperature <16°C (S OF 35°S May-Oct, or S OF 40°S Apr-Nov). 37 Squadron Standard Operating Procedure.
38SQN	UVIC jacket access required if flight over water mass more than 40nm from land with temperature <16°C (S OF 35°S May-Oct, or S OF 40°S Apr-Nov). Air Command - Air Staff Instruction Volume 1 No 3/E/6.
75SQN	Wear during fleet support if combined air/sea temperature is less than 31°C or at other times as directed by Authorizing Officer. 81WG Flying Order C1 Dated 10 December 1990.
76SQN	Wear during fleet support if combined air/sea temperature is less than 31°C or at other times as directed by Authorizing Officer. 81WG Flying Order C1 Dated 10 December 1990.
77SQN	Wear during fleet support if combined air/sea temperature is less than 31°C or at other times as directed by Authorizing Officer. 81WG Flying Order C1 Dated 10 December 1990.
292SQN	UVIC jacket access required if flight over water mass more than 40nm from land with temperature <16°C (S OF 35°S May-Oct, or S OF 40°S Apr-Nov). DI(AF) AAP 7215.004-1 (P3C Flight Manual) RAAF Supplement.
ARDU	Not known.
2OCU	Wear during fleet support if combined air/sea temperature is less than 31°C or at other times as directed by Authorizing Officer. 81WG Flying Order C1 Dated 10 December 1990.
1FTS	UVIC jacket access required if flight over water mass more than 40nm from land with temperature <16°C (S OF 35°S May-Oct, or S OF 40°S Apr-Nov).
2FTS	?
CFS	?
SAN	UVIC jacket access required if flight over water mass more than 40nm from land with temperature <16°C. (S OF 35°S May-Oct, or S OF 40°S Apr-Nov). 32 Squadron Standard Operating Procedure.

5. AVMED IMMERSION SUIT POLICY RECOMMENDATIONS.

5.1. AVMED recommends that :

a. Immersion suits are appropriate items of safety clothing for use by aircrew and that RAAF aircrew at risk of cold water immersion be provided with adequate immersion suits;

b. RAAF immersion suits should aim to provide in excess of 24 hours of survival support without a life-raft in water temperatures that aircrew are most likely to ditch/eject into;

c. A single set of 'conditions for use' be designed based on sea surface temperatures, which can in turn be simplified to specify latitudes and months in a manner similar to that presently employed by RAAF Maritime Patrol units;

d. RAAF immersion suits be of one purpose design with no additional buoyancy or safety equipment incorporated, the Secumar being adequate to provide these features;

e. Immersion suits, when worn, be compatible with all other equipment and operations in the aircraft and after ditching/ejection;

f. Constant Wear type of Immersion Suits be used by aircrew in FA18, MB326H, PC9, Winjeel, and CT4A aircraft types, accepting the fact that CWIS generally provide less insulation than their QDIS counterparts;

g. Quick-Don type of Immersion Suits be used, with the option of CWIS use, in P3C, C130, and HS748 aircraft types;

h. F111 aircrew not be required to use immersion suits;

i. Adequate training and maintenance personnel and facilities be available to ensure serviceability of RAAF immersion suits and adequate training of aircrew in their use.

DR. D. WATSON
RESO AVMED
Ext 1450

30 December 1991

Annexes:

Annex A Details of immersion Suits used throughout the RAAF.

6. REFERENCES

1. PMO 1802/2/12/MED (13) Dated 21JAN91

2. AHQ 85/10/AIR Dated 10 December 1990

3. Various folios from MNTESL 2528/11/TECH

   RNZAF DEMU 18475/2 Dated 30MAR87

   Various folios from AVMED 1802/10/MED

   Various ASCC standards

   AVMED 1802/10/MED Part 4 (50) Aviation Medical Report : Quick-don immersion suits.Evaluation of items available and end user needs. Dated NOV90

   AF88/8749/1 (62) MIS392 - Aircrew immersion protection projects procurement directive A/L1 Dated 29AUG88

   Various scientific and defence publications concerning immersion protective clothing. Some referenced specifically below.

4. AVMED 1802/10/MED Part 5 (2) Dated 27FEB91

5. AVMED 1802/10/MED Part 4 (60) Dated 11FEB91

6. Sea survival training. LTCDR V. J. Sherratt RN. J. Nav. Eng., 31 (2), 465-467. 1988.

7. Adapted from: The introduction of the inner immersion coverall for British military aircrew. P. Willett. Aircrew Equipment Branch , Ministry of Defence, Procurement Executive, London. SAFE Proceedings 27. 1989.

8. Adapted from:

   ASCC AIR STD 61/40A. Technical basis for specifying the insulation of immersion protection clothing. Air Standards Coordinating Commitee. 10 May 1989;

   Aviation Medicine, Ernsting, J. and King, P. Chapter 18, Thermal protection by J. R. Allan. Butterworths, London, 1988.

9 Adapted from: The effect of leakage on the insulation provided by immersion-protection clothing. J. R. Allan et. al. Aviat. Space Environ. Med. 56: 1107-9. 1985.

10. Stay alive: A handbook on survival. Dunlevy, M. Australian Government Publishing Service. Canberra. 1981.

11. Aviation Medicine, Ernsting, J. and King, P. Chapter 19, Survival by P.J. Sowood and J.R. Allan. Butterworths, London, 1988.

12. Australian Beureu of Meteorology.

13. Quick-Don Immersion Suits: Evaluation of items available and end-user needs. Dr. D. Watson. RAAF Institute of Aviation Medicine Report 4-90. November 1990.

14. The Canadian Forces have developed an integrated G-suit / Immersion suit assembly for use by their F18 and F5 aircrew.

Integrated G-Suit / Immersion Suit. J. A. Frith and J. C. Steffler. DCIEM No. 89-TR-22. Defence and Civil Institute of Environmental Medicine, Canada. 1989.

15. TFG 85/3/AIR PT2 (79) Dated 12MAR91

92WG 85/3/AIR Dated 13MAR91

34S 85/3/AIR PT2 (11) Dated 6MAR91

35SQN 797/CO Dated 05MAR91

TELECON SQNLDR Smith 6SQN/RESO AVMED Dated 18MAR91

TELECON FLTLT McGee 1SQN/RESO AVMED Dated 18MAR91

TELECON FLTLT Toft 11SQN/RESO AVMED Dated 22MAR91

TELECON RESO AVMED/UFSO 38SQN Dated 16APR91

TELECON FLTLT Bryant 75SQN/RESO AVMED Dated 19MAR91

TELECON FLTLT Rich 2FTS/RESO AVMED Dated 21MAR91

TELECON RESO AVMED/FLTLT Quinn SAN Dated 9APR9

TELECON RESO AVMED/PLTOFF Querin 37SQN Dated 9APR91

TELECON RESO AVMED/WOFF Dransfield 36SQN Dated 9APR91

TELECON RESO AVMED/FSGT Wellsby ARDU Dated 16APR91

TELECON SGT Dennison MNTESL/RESO AVMED Dated 18MAR91

16. 81WG Flying Order C1 Dated 10 December 1990.

DI(AF) AAP 7215.004-1 (P3C Flight Manual) RAAF Supplement.

Air Command - Air Staff Instruction Volume 1 No 3/E/6.

ANNEX A TO

AVMED-8-92

IMMERSION SUIT USAGE WITHIN THE RAAF

Dated January 1992

DETAILS OF IMMERSION SUITS USED BY RAAF FLYING UNITS.

IMMERSION SUITS USED BY FLYING UNITS WITHIN THE RAAF

UNIT	1 SQN
BASE	AMB
AIRCRAFT TYPE	F111
REFERENCE	Telecon FLTLT McGee 1SQN/RESO AVMED Dated 18 Mar 91
IMMERSION SUIT USED	None
HOLDINGS	None
REQUIREMENTS	None
USAGE POLICY REFERENCE	None
USAGE POLICY	
COMMENTS	

UNIT	3 SQN
BASE	WLM
AIRCRAFT TYPE	FA18
REFERENCE	TFG 85/3/AIR PT2 (79) Dated 12 Mar 91
IMMERSION SUIT USED	Multifabs CWIS
HOLDINGS	50 (10 U/S)
REQUIREMENTS	
USAGE POLICY REFERENCE	81WG Flying Order C1 Dated 10 Dec 90
USAGE POLICY	Wear during fleet support if combined air/sea temp <31°c or at other times as directed by authorizing officer
COMMENTS	

UNIT	6 SQN
BASE	AMB
AIRCRAFT TYPE	F111C
REFERENCE	Telecon SQNLDR Smith 6SQN/RESO AVMED Dated 18 Mar 91
IMMERSION SUIT USED	None
HOLDINGS	None
REQUIREMENTS	Possible need
USAGE POLICY REFERENCE	None
USAGE POLICY	
COMMENTS	SRG aircraft spend a significant proportion of their time over water in fleet support roles. despite having the survival capsule it may be worth considering the additional use of cwis when overflying cold water.

UNIT	10 SQN
BASE	EDN
AIRCRAFT TYPE	P3C
REFERENCE	92WG 85/3/AIR Dated 13 Mar 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	202, in 12 Sizes, held by ALSS 492SQN.
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	DI(AF) AAP 7215.004-1 (P3C Flight Manual) RAAF Supplement No 92
USAGE POLICY	UVIC QDIS access required if flight over water mass with temp <16°C (S of 35°S MAY-OCT, or S of 40°S APR-NOV) Many aircrew believe the survival qualities of the uvic jacket are not good enough to warrant overcoming the many difficulties associated with using them.

UNIT	11 SQN
BASE	EDN
AIRCRAFT TYPE	P3C
REFERENCE	92WG 85/3/AIR Dated 13 Mar 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	202, in 12 sizes, held by ALSS 492SQN.
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	DI(AF) AAP 7215.004-1 (P3C Flight Manual) RAAF Supplement No 92
USAGE POLICY	UVIC QDIS access required if flight over water mass with temp <16°C (S of 35°S MAY-OCT, or S of 40°S APR-NOV)
COMMENTS	Many aircrew believe the survival qualities of the uvic jacket are not good enough to warrant overcoming the many difficulties associated with using them.

UNIT	11 SQN
BASE	EDN
AIRCRAFT TYPE	P3C
REFERENCE	Telecon FLTLT Toft 11SQN/RESO AVMED Dated 22 Mar 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	No comment
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	No comment
USAGE POLICY	UVIC QDIS access required if flight over water mass with temp <16°C (S of 35°S MAY-OCT, or S of 40°S APR-NOV)
COMMENTS	

UNIT	25 SQN
BASE	PEA
AIRCRAFT TYPE	MB326H
REFERENCE	TFG 85/3/AIR PT2 (79) Dated 12MAR91
IMMERSION SUIT USED	RNZAF CWIS (MACPAC)
HOLDINGS	10
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	81WG Flying Order C1 Dated 10 Dec 90
USAGE POLICY	Wear during fleet support if combined air/sea temp <31°C or at other times as directed by authorizing officer
COMMENTS	

UNIT	32 SQN
BASE	ESL
AIRCRAFT TYPE	HS748
REFERENCE	Telecon SGT Dennison MNTESL/RESO AVMED Dated 18 Mar 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	
REQUIREMENTS	
USAGE POLICY REFERENCE	
USAGE POLICY	
COMMENTS	

UNIT	33 SQN
BASE	RIC
AIRCRAFT TYPE	B707-338C
REFERENCE	Telecon RESO AVMED / FLTLT Duncan 33SQN Dated 16 Apr 91
IMMERSION SUIT USED	None
HOLDINGS	None
REQUIREMENTS	None
USAGE POLICY REFERENCE	None
USAGE POLICY	None
COMMENTS	None

UNIT	34 SQN
BASE	FBN
AIRCRAFT TYPE	Falcon 900
REFERENCE	34S 85/3/AIR PT2 (11) Dated 6 Mar 91
IMMERSION SUIT USED	None
HOLDINGS	None
REQUIREMENTS	None
USAGE POLICY REFERENCE	Air Command - Air Staff Instruction Volume 1 No 3/E/6
USAGE POLICY	Not required to wear or have access to immersion suits
COMMENTS	

UNIT	35 SQN
BASE	TVL
AIRCRAFT TYPE	DHC-4A
REFERENCE	35SQN 797/CO Dated 05 Mar 91
IMMERSION SUIT USED	None
HOLDINGS	None
REQUIREMENTS	No comment

UNIT	36 SQN
BASE	RIC
AIRCRAFT TYPE	C130H
REFERENCE	Telecon RESO AVMED/WOFF Dransfield 36SQN Dated 9 Apr 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	UVIC QDIS
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	36SQN SOP
USAGE POLICY	UVIC QDIS access required if flight over water mass more than 40nm from land with temp <16°C (S of 35°S MAY-OCT, or S of 40°S APR-NOV)
COMMENTS	

UNIT	37 SQN
BASE	RIC
AIRCRAFT TYPE	C130E
REFERENCE	Telecon RESO AVMED/PLTOFF Querin 37SQN Dated 9 Apr 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	UVIC QDIS
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	37SQN SOP
USAGE POLICY	UVIC QDIS access required if flight over water mass more than 40nm from land with temp <16°C (S of 35°S MAY-OCT, or S of 40°S APR-NOV)
COMMENTS	

UNIT	38 SQN
BASE	RIC
AIRCRAFT TYPE	DHC-4A
REFERENCE	Telecon RESO AVMED/UFSO 38SQN Dated 16 Apr 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	Uncertain
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	Air Command - Air Staff Instruction Volume 1 No 3/E/6
USAGE POLICY	UVIC QDIS access required if flight over water mass more than 40nm from land with temp <16°C (S of 35°S MAY-OCT, or S of 40°S APR-NOV)
COMMENTS	38SQN to review their SOPs

UNIT	75 SQN
BASE	TDL
AIRCRAFT TYPE	FA18
REFERENCE	Telecon FLTLT Bryant 75SQN/RESO AVMED Dated 19 Mar 91
IMMERSION SUIT USED	None
HOLDINGS	None
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	As per TFG
USAGE POLICY	
COMMENTS	75SQN only has access to tropical waters from tdl. fleet support deployments to PEA present potential problems. macchi fleet support uses immersion suits if combined air/water temp less than 31°C. FA18 aircrew not particularly concerned b/s of twin engine config.

UNIT	76SQN
BASE	WLM
AIRCRAFT TYPE	MB326H
REFERENCE	TFG 85/3/AIR PT2 (79) Dated 12MAR91
IMMERSION SUIT USED	RNZAF CWIS (MACPAC)
HOLDINGS	None
REQUIREMENTS	30
USAGE POLICY REFERENCE	81WG Flying Order C1 Dated 10 Dec 90
USAGE POLICY	Wear during fleet support if combined air/sea temp <31°C or at other times as directed by authorizing officer
COMMENTS	SG5 has promised 30 MACPAC suits for 76SQN. 76SQN higher priority than FA18 units because MB326H is single engined.

UNIT	76SQN
BASE	WLM
AIRCRAFT TYPE	MB326H
REFERENCE	2528/7/TECH 76S (3) Dated 27 March 91
IMMERSION SUIT USED	RNZAF CWIS (MACPAC)
HOLDINGS	None
REQUIREMENTS	30
USAGE POLICY REFERENCE	81WG Flying Order C1 Dated 10DEC90
USAGE POLICY	Wear during fleet support if combined air/sea temp <31°C or at other times as directed by authorizing officer. Must be a long range SAR helicopter on standby. Sorties to be completed before sunset. Sea state to be less than Beaufort 5 and wind less than 30 kts gusting to 35 kts.
COMMENTS	30 MACPAC CWIS are presently on order from their New zealand manufacturer. A substantial delay is anticipated.

UNIT	77 SQN
BASE	WLM
AIRCRAFT TYPE	FA18
REFERENCE	TFG 85/3/AIR PT2 (79) Dated 12MAR91
IMMERSION SUIT USED	Multifabs CWIS
HOLDINGS	50 (10 U/S)
REQUIREMENTS	
USAGE POLICY REFERENCE	81WG Flying Order C1 Dated 10DEC90
USAGE POLICY	Wear during fleet support if combined air/sea temp <31°C or at other times as directed by authorizing officer

UNIT	77 SQN
BASE	WLM
AIRCRAFT TYPE	FA18
REFERENCE	Telecon UFSO 77SQN / RESO AVMED Dated 16 Apr 91
IMMERSION SUIT USED	Multifabs CWIS (8475-99-721-32-28 through 36
HOLDINGS	60 (20 fitted and operable, 20 U/S, and 20 remain to be assembled)
REQUIREMENTS	
USAGE POLICY REFERENCE	81WG Flying Order C1 Dated 10DEC90
USAGE POLICY	Wear during fleet support if combined air/sea temp <31°C or at other times as directed by authorizing officer
COMMENTS	77SQN holds all of 81WG immersion suits as Safety Equipment personnel at 77SQN are the only ones qualified to assemble and repair the suits. 77SQN is in the process of requesting 23 MACPAC CWIS.

UNIT	292 SQN
BASE	EDN
AIRCRAFT TYPE	P3C
REFERENCE	92WG 85/3/AIR Dated 13 Mar 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	202, IN 12 SIZES, HELD BY ALSS 492SQN.
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	DI(AF) AAP 7215.004-1 (P3C Flight Manual) RAAF Supplement No 92
USAGE POLICY	UVIC QDIS access required if flight over water mass with temp <16°C (S of 35°S MAY-OCT, or S of 40°S APR-NOV)
COMMENTS	Many aircrew believe the survival qualities of the uvic jacket are not good enough to warrant overcoming the many difficulties associated with using them.

UNIT	ARDU
BASE	EDN
AIRCRAFT TYPES	CT4A PC9A UH1H MB326H
REFERENCE	Telecon RESO AVMED/FSGT Wellsby ARDU Dated 16 Apr 91
IMMERSION SUIT USED	RNZAF CWIS (MACPAC)
HOLDINGS	16
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	Unknown
USAGE POLICY	Unknown
COMMENTS	ARDU also hold heat seal devices necessary to fit and assemble the MACPAC CWIS. Associated green woolen undergarments also held by ARDU Safety Equipment Section. Safety Equipment Section at ARDU is unclear as to how or why the suits are with them. Apparently requests by 77SQN to borrow these suits have been rejected by ARDU despite ARDU's non-usage of the suits.

UNIT	2 OCU
BASE	WLM
AIRCRAFT TYPE	FA18
REFERENCE	TFG 85/3/AIR PT2 (79) Dated 12 Mar 91
IMMERSION SUIT USED	Multifabs CWIS
HOLDINGS	50 (10 U/S)
REQUIREMENTS	
USAGE POLICY REFERENCE	81WG Flying Order C1 Dated 10 Dec 90
USAGE POLICY	Wear during fleet support if combined air/sea temp <31°C or at other times as directed by authorizing officer
COMMENTS	

UNIT	1 FTS
BASE	WIL
AIRCRAFT TYPE	CT4
REFERENCE	Telecon RESO AVMED/UFSO 1FTS Dated 16 Apr 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	47
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	DIs
USAGE POLICY	UVIC QDIS access required if flight over water mass with temp <16°C (S oF 35°S MAY-OCT, or S of 40°S APR-NOV)
COMMENTS	The CWIS being 'trialled' at ESL may be more appropriate to 1FTS.

UNIT	2 FTS
BASE	PEA
AIRCRAFT TYPE	PC9A
REFERENCE	Telecon FLTLT Rich 2FTS/RESO AVMED Dated 21 Mar 91
IMMERSION SUIT USED	None
HOLDINGS	None
REQUIREMENTS	Previously held RNZAF CWIS (MACPAC) suits have been passed to 25SQN who now perform the fleet support function
USAGE POLICY REFERENCE	
USAGE POLICY	
COMMENTS	

UNIT	CFS
BASE	ESL
AIRCRAFT TYPE	PC9A
REFERENCE	Telecon SGT Dennison MNTESL/RESO AVMED Dated 18 Mar 91
IMMERSION SUIT USED	RNZAF CWIS (MACPAC)
HOLDINGS	4 - 6 operational units 20 units remaining to be made
REQUIREMENTS	
USAGE POLICY REFERENCE	
USAGE POLICY	
COMMENTS	MNTESL is tooled up to complete the remaining approx 20 units.

UNIT	SAN
BASE	ESL
AIRCRAFT TYPE	HS748
REFERENCE	Telecon RESO AVMED/FLTLT Quinn SAN Dated 9 Apr 91
IMMERSION SUIT USED	UVIC QDIS
HOLDINGS	Every airman at SAN has an individual suit
REQUIREMENTS	No comment
USAGE POLICY REFERENCE	32SQN SOPs
USAGE POLICY	UVIC QDIS access required if flight over water mass with temp <16°C (S of 35°S MAY-OCT, or S of 40°S APR-NOV)
COMMENTS	

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