

Chapter 9B – All You Need to Know About Life Jackets: A Tribute to Edgar Pask

by

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FROM BIBLICAL TIMES TO THE MID 1800s

For full details on the development of life jackets you are referred to *Designed for Life – Life jackets through the ages* by this author [4].

It may not surprise you to know that pneumatic life jackets have been in existence since biblical times. There is a stone carving in the British Museum showing Assur-Nasir-Pals' army crossing a river or moat to attack a castle in 870 B.C. The soldiers are wearing inflated animal skins. It may also not surprise you to know that when the Dalai Lama escaped across the Bramaputra River in 1959, he also used inflated yak skins for flotation.

However, while impressments existed (that is where sailors were forcibly 'pressed' into service in the Royal Navy), the provision of flotation devices was not encouraged. To provide a life jacket gave the sailor the potential opportunity to escape and swim ashore. The Admiralty argued that if the ship sank, there was plenty of buoyant material on which to float or cling on to, i.e. masts, spars, wooden water barrels. The policy of impressments was not discontinued until 1815.

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So there was little development of the life jacket until the mid 1800s – but by 1811, such features as the importance of fitting the crotch strap had been recognized in life jacket design such as Mallison’s Seamen’s Friend and Bathers companion. 200 years later the lesson of the crotch strap has still not been learned. Three experienced and well equipped yachtsman drowned because their life jackets failed them due to lack of a crotch strap. [9]

All three crew of the British yacht ‘Ouzo’ were found to have drowned following a ‘close proximity incident’ with a car ferry in August 2006. Given the favourable sea state (3-4) with a water temperature of 18°C, and the optimal amount and type of clothing they were wearing, a survival time of at least 24 hours could have reasonably been expected. Sadly because they were not wearing crotch straps on their 150N lifejackets, the jackets had slipped up the torso, thereby altering their flotation angle to near vertical, resulting in drowning when consciousness was significantly impaired from hypothermia (Golden, personal communication).

ADVENT OF IRON SHIPS (1850) UNTIL THE TITANIC ACCIDENT (1912)

The first serious decision to manufacture life jackets in quantity was precipitated by the loss of 20 out of 24 river pilots on the River Tyne in the U.K., when their boat capsized in 1851. Capt. John Ross Ward did the first human factors study of different methods of flotation, experimenting with cork, hair, rushes and air. This resulted in the National Life-Boat Institution introducing his own patent cork life jacket which had 24 lbs of buoyancy. This design remained in service even after the Second World War – one hundred years later!!

The introduction of iron ships in the 1850s meant that (a) the ships sank faster and (b) there was little flotsam and jetsum to provide flotation. As a result, marine drowning statistics promptly increased. In 1852, the U.S. was the first country to introduce legislation requiring the carriage of lifejackets for every passenger on board commercial vessels. Slowly the remainder of the maritime world followed suit – Britain (1888), France (1884), Germany (1891), and Denmark (1893).

In 1902, Kapok, the fluffy seed hair of the Bombax tree was first approved as a flotation medium by the U.S. Coast Guard. It has had a checkered career: it is very comfortable to wear and it provides good buoyancy; but if squashed flat, which commonly occurs when stowed in tight compartments, or sat on frequently, which is often the case, then the Kapok rapidly loses its buoyancy. It also loses its buoyancy when exposed to fuel oils such as occurs in marine accidents where there has been a fire and or explosion. Now, it has generally been replaced by various synthetic foams, but is still approved for use in some countries.

In 1904, the General Slocum, a New York Long Island ferry, set afire and beached. 955 people drowned and the investigation revealed that 8 ounce iron bars had been inserted into the cork life jackets to make up the required production weight of the life jacket! Not only this, but many of them were so rotten that upon ship abandonment, the seams split and the granulated cork simply spilled into the water. This is why many countries still insist that a certain number of inherently buoyant life jackets in each batch produced are cut open and examined to check the quality of inherent buoyancy, and ensure that history does not repeat itself.

In 1912, 1480 crew and passengers drowned after the sinking of the SS Titanic off the coast of Newfoundland. The Maritime Nations finally convened, and formed the International Maritime Organization (IMO) and more specifically, the Safety of Life at Sea Committee (SOLAS). A new international regulation was introduced. This required that all commercial vessels carry a 15.5 lb buoyant life jacket for every crew member and passenger.

THE FIRST WORLD WAR (1914), THE SECOND WORLD WAR (1939), AND THE INTERVENING YEARS

In 1914, the Empress of Ireland sank in the Gulf of St Lawrence off Rimouski in 14 minutes. 1012 crew and passengers drowned. There were plenty of life jackets, but in the confusion of a very dark and hurried ship abandonment, many could not locate their life jackets; and many who wore them were found floating *face down* in the water. No one paid much attention to this most significant observation.

During the First World War, the Royal Navy lost 12,000 sailors, the British Merchant Navy lost 10,000 seamen, and the German Navy lost 5,000 sailors. The general mentality was still that loss of life was fate and an occupational hazard. In 1915, the Carley Float was introduced. This looked like a life raft and was constructed around an oval tubular frame covered in canvas. The floor was filled with a grating which flooded freely, and there were becketed lines strung around the outside of the float. The idea was that very sick people could sit inside the float (still up to their waists in water!) and the more healthy people could cling to the becketed lines on the outside. This principle of floating people **in** the water rather than **out** of the water was Royal Navy teaching up until the 1950's! It was general policy up until the end of the Second World War that ship's companies were issued Carley Floats for ship abandonment.

The US Navy introduced head support for their life jackets in the 1920's. When the SS Vestris sank in the Chesapeake Bay in 1928, 112 crew and passengers drowned. Yet again, it was noted that they were all wearing cork block life jackets, but floating *face down*. The Captain of the USS Wyoming recommended to SOLAS that a US Navy style head support would be helpful and should be included in the specifications for new commercial life jackets, but again, no one paid any attention to this fact.

The Royal Navy went to War in 1939 with a crude Admiralty Pattern 14124 inflatable life ring which provided about 8.5 lbs of buoyancy. Up until then, no one had examined the behavior of an unconscious human in the water. This was to change quite suddenly.

The loss of precious RAF fighter pilots who drowned during the Battle of Britain was the catalyst to conduct research and look into the problem. They wore the Mae West, which was considered to be **the** best life jacket. It had about 15 lbs of inherent buoyancy and 20 lbs of inflatable buoyancy from the CO₂ cartridge. However, the Air Sea Rescue services found the pilots lying *face down* with fully inflated life jackets. How could this be?

This resulted in the pioneering work of Macintosh and Pask on the behavior of an unconscious human in the water with and without a life jacket. In 1940/41, Pask was anaesthetized, intubated and lowered into the deep end of the Farnborough swimming pool [10, 11]. Much to everyone's surprise – he sank! Over many weeks, he was fitted with all the different allied and enemy life jackets to assess flotation angle, self righting capability and times, and freeboard. Due to his selfless dedication to human service, one can honestly say he is the father of the modern life jacket. All of the SOLAS, ISO and other standards stem from this work. Due to the secrecy of the War work, it was not published in the British Journal of Industrial Medicine until 1957 [9, 10, 12]. However, the potential dangers to which he exposed himself were entirely understated in the paper. The British Standard BS3595 introduced in 1963 was the culmination of all this work for the commercial marine operators. It has basically been copied and modified worldwide ever since.

Concurrently with the loss of the British fighter pilots, the Luftwaffe noticed that they had also drowned many of their pilots. Their very efficient Air-Sea Rescue Service considered that many of the deaths occurred

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around or shortly after rescue and correctly assumed it was some form of post-rescue collapse (see lecture on the dangers of sudden unexpected immersion in cold water). This observation led to the unfortunate Dachau experiments. However, after the sinking of the Bismark, Lt. Kentrat in U-74 who was first on the scene noted that at least 40 corpses were bobbing up and down in their life jackets with their heads *face down* in the water. The Kriegsmarine immediately modified all of the Naval life jackets to provide better self-righting and added head support. All of Pask's experiments demonstrated that the design of the German life jacket was far superior to anything worn by the Allies.

THE PRODUCTION OF THE NEW INFLATABLE LIFEJACKET (1946 – 1960)

In 1946, the Royal Navy Talbot Report concluded that 30 – 40,000 officers and men had died at sea during the Second World War. One third had been killed in action and two thirds had drowned in the survival phase. This was principally due to poor survival equipment. As a result, the Royal Navy Personnel Research Committee undertook an extensive research programme which included the work of Pask and work at the Royal Navy Medical School, several UK University laboratories with an interest in cold water physiology, the Medical Research Council and Industry interested in producing new survival equipment. From this was created the new RFD Admiralty pattern 5580 inflatable life jacket; a marvel in design simplicity, performance and durability. It was introduced into the Royal Navy in 1952 and has been copied all over the world, and is still in service in 2007.

In the early 1950s, the US Navy also concluded that the majority of their drownings at sea had been due to poor equipment. They too conducted three very large trials and introduced a copy of the RN pattern 5580 life jacket in 1955. The only other Naval development since then has been issue of the 275 Newton Hazardous Duty type life jacket for the Royal Marines, the addition oro-nasal splash protection and improvements in manual and automatic inflation devices for all lifejackets.

DEVELOPMENT OF COMMERCIAL STANDARDS (1960 – 2007)

As recreational boating became more popular, there were more people out on the water with a consequential increase in civilian drowning statistics. By 1971, the US Coast Guard recorded 20.2 deaths per 100,000 registered boats. It commenced a series of studies between 1969 and 1974 to look at human performance in the water with different levels of flotation. [3, 5, 7, 8]

In 1973, it introduced the 70 Newton (15.5 lb) Personal Flotation Device (PFD) Standard into the recreational boating community. This has been an outstanding success and by 1993, when it changed the method of reporting, the drowning statistics were reduced to below 4 fatalities per 100,000 registered boats.

The next step was for all the National and International Regulators to introduce new standards based on the work of Pask, that of the RNPSC and the U.S. Coast Guard studies. Briefly these are:

- 1973 US Coast Guard Type I – Type 5 PFD standard.
- 1975 Air Standardization Coordination Committee – 35 lb pneumatic life jacket in one action.
- 1974/84 5th IMO SOLAS Convention – approval for inflatable life jackets, self righting in 5 seconds and 120 mm freeboard.
- 1976 US Coast Guard UL1191 components for life jackets.

- 1990 US Coast Guard UL1123 Marine Buoyant Device.
- 1994 ISO/CEN standards for 50, 100, 150 and 275 Newton life jackets.
- 1995 US Coast Guard U.L.1180 standard for inflatable PFDs.
- 2003 Amalgamation of all ISO/CEN standards under one standard.
- 2003 New IMO/SOLAS life jacket standard.

REMEMBER – IT IS VERY EASY TO DROWN

The basic drowning statistics can be found in Bierens – Handbook of Drowning [2]. It is a new book published in 2006. This is highly recommended for all survival instructor and maritime aircrew. It only takes the inhalation of 150 mls of sea water to drown. The average worldwide drowning statistics are 7.4 per 100,000 population. By comparison, it is 13.1 in Africa, 4.4 in Brazil, 1.9 in the Netherlands, 1.4 in Australia and 1.2 in Canada. A second new book produced by Dr Peter Barss in 2006 for the Canadian Red Cross is called Drowning – Ice and Water Immersion, a ten year study. This extends the information in the Bierens book and is also highly recommended [1].

This paper was being revised ahead of time for the R.T.O. publication. On the day of completion, this article appeared in the local newspaper.

**Fisherman dies after falling overboard,
The Chronicle Herald, Halifax
July 9, 2006**

A 35-year-old man is dead after falling off a fishing vessel near Newfoundland. The vessel was about 25 kilometres off Bonavista when search-and-rescue officials were called Saturday at around 12:30 p.m. A Cormorant helicopter was dispatched from Gander, Newfoundland, as well as a Coastguard vessel and a fast rescue craft. The body of the man, who has not been identified, was found about two hours later. He was not wearing a lifejacket. RCMP have taken over the case and are investigating.

I am sure you read the same articles in your papers too. What an unnecessary waste of a life, a huge domestic/social catastrophe for the family, and of course a huge expenditure of precious funds to conduct the search and then conduct the investigation. This could have been prevented by the use of a life jacket. Why do we still not learn?

The front cover shows Dr. Dick Allan wearing the Crewsaver Crewfit lifejacket while sailing single handed many miles offshore. He clearly demonstrates that a modern life raft is comfortable, efficient and causes minimal restriction to body movement.

SO WHERE ARE WE IN 2007?

Considering that no progress was made on the understanding of how a human floated in water for the first half a million years, we have done well to progress this much since 1945 – but we must not rest on our laurels!

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There are still over 140,000 open water deaths each year [6]. What are the issues that still need investigation and resolution?

- The relationship between the fit of the life jacket and freeboard.
- Should testing be done in turbulent water rather than still water?
- If so, how turbulent should it be?
- The importance of designing life jackets and immersion suits together as an integrated unit.
- Emphasis on the importance of:
 - a) Face/airway protection; and
 - b) Use of crotch straps.
- If humans are used for testing life jackets for approval:
 - a) How many subjects should be used?
 - b) What should be the male/female ratio?
 - c) What should be the anthropometric sizes?
- The development of a good system to test infant (under 10 kg) lifejackets.
- Should manikins be used for testing life jackets?
- If reference life jackets are used for comparative testing, how should they be validated in the first instance, and indeed after use should they be revalidated after a set time or number of immersions?

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