Underwater Ejection

INVESTIGATING METHODS OF ESCAPE FROM SUBMERGED AIRCRAFT

THIS article, reprinted (with minor amendments) from "Royal Naval Diving Magazine" by courtesy of its editor (CP RO L. Benfield) and permission of the Naval Ordnance Laboratory, gives a factual account of a series of practical investigations into methods of escape from submerged aircraft—in particular, use of the ejection seat in aiding such escapes. Sometimes as a result of official secrecy, but often because of the reticence and modesty of the participants, hazardous experiments of this kind go unpublicized. "Flight" counts it an honour to be able to bring this remarkable story to a wider circle of readers. Its author is Surg. Lt-Cdr. J. S. P. Rawlins, M.B.E., R.N., who was responsible for the inception and direction of the trials.

With the recent influx of advanced jet aircraft types into the Fleet Air Arm new problems in the safety of the crews have arisen. These involve not only flying and carrier-landing questions, but also those of escape from the aircraft in the event of a crash during take-off.

Hitherto, most aircraft have shown a tendency to float for a period of time sufficient to afford the crew a reasonable chance of getting out, although there are few, if any, records of successful escapes from aircraft which have entered the water upside-down. But the present generation of Naval aircraft have drastically altered the picture, for whereas it was formerly the practice to take-off and land with the cockpit hoods open, aerodynamic considerations preclude this in modern jets, and as the all-up weight has increased to more than twice that of a London bus, the aircraft will usually sink far more quickly than did earlier types.

In the Sea Vixen, the observer has to crouch more or less at the pilot's feet with only a small rectangular window in the side of the fuselage to give him a view of the outside world and is sealed-in by a massive 40lb hatch of metal and Perspex which is stamped down into position over his head by one of the flight-deck crew prior to take-off. It was in relation to this aircraft that the Institute of Aviation Medicine was first asked to co-operate in an investigation into problems of underwater escape. This was an unusual assignment for an organization specializing in problems of flight, yet logical because the Institute is an authority on ejection and had already put forward proposals for using the ejection seat as a means of escaping from submerged aircraft. This trial was regarded as a preliminary to a more ambitious programme.

The trials team comprised two doctors from the Institute and a clearance-diving team—Lt-Cdr. Terrell, L/Sea Robbins and A/L/Sea Rove; the trial was conducted at the Admiralty Hydroballistics Research Establishment, Glenfruin, with the co-operation of the staff there and of representatives of the de Havilland Aircraft Co. A section of Vixen fuselage, incorporating both pilot's and observer's compartments, was mounted in a metal frame with 7,000 lb ballast. This was suspended from a hoist which could lower it into the test tank at a maximum speed of 0.8ft/sec.

Preliminary tests were carried out to assess the chances of the walls of the cockpit collapsing from the pressure of water, and when it was apparent that this was unlikely to happen the three divers and one of the doctors took it in turns to descend to various depths and try to jettison the canopies and escape. Pattern 5562A breathing apparatus was worn on all but the last test (in which the subject wore a standard aircraft oxygen mask and made a free ascent to the surface), and a waterproof intercom system permitted the divers in the fuselage to keep in touch with the surface and call out the depth of water within the cockpit as the sinking fuselage flooded up.

It was found that the canopy could not be jettisoned until the cabin was about half-full of water and the pressure difference between the trapped air and the surrounding water was not more than 21 lb/sq in. At this stage, the ejection-seat system would blow off the canopy with a loud bang, and for a brief period the diver would be subjected to a severe buffeting from the inrushing water. As soon as this ceased he could release his seat harness, kick himself free and swim out of the cockpit.

From these trials it was concluded that the chances of escape from a Vixen submerged in the normal attitude were good; but if the aircraft was inverted the essential flooding-up process would cause the pilot's head to be submerged first and his chances of escape against the inrush of water would accordingly decrease.

It was also demonstrated that it was fatalay easy to become snagged by the multitude of equipment which the aviator has to carry, and the difficulties of sorting this out, with little or no visibility, while being dragged down by a sinking aircraft can well be imagined. For this reason it was decided to investigate the use of the ejection seat under water as this offered a means of carrying the pilot clear of the wreckage, and the automatic release system would then separate him from the seat and allow him to float unimpeded to the surface.

It was not really anticipated at the outset that there would be much future in using the seat with the existing explosive charge for, although Lt. McFarlane, R.N., had actually escaped under water by taking his ejection seat, this was because of telling how many others had tried it and failed. However, the first step was to fire a seat and see what happened.

This was carried out in a tank at Farborough with various types of seat, using a 130 lb dummy subject and the following facts were established:

1. Acceleration of the seat, 160ft/sec/sec.
3. Blast pressure from ejection cartridge, 26 lb/sq in.

Could a man withstand the combined effect of the drag resulting from acceleration and velocities higher than had ever voluntarily been experienced under water before, and of the shock-wave acting on his head and chest as he was shot up through a pressure change of over half an atmosphere?

It was decided to try to solve the question of velocity first. On Horsea Island a metal and wire trapeze was constructed and attached via a float and a single sheave to a 2.4 litre Jaguar car. The subjects took it in turns to lie on the bottom of the lake braced between the two bars of the trapeze. Having braced themselves to avoid the danger of lung-rupture during his ejection, the subject was launched stern first into the lake at about 10ft below the surface; a maximum speed of 44ft/sec was achieved in this way. Velocity itself was no problem.

Acceleration and blast pressure were then tackled together by actual ejections, using reduced charges, in the tank at Farnborough. Lt-Cdr. Terrell and L/Sea Cannon were called in to assist. As there was no hoist available the seat was mounted on a frame and attached via a float and a single sheave to a 2.4 litre Jaguar car. The subjects took it in turns to lie on the bottom of the tank and were ejected using a two-way stretch and D.S.E.A., was strapped in. With Lt-Cdr. Terrell standing by as underwater attendant, the tank was filled up with cold, murky water. As soon as a depth of 15ft above the subject's head was reached, the recorders were switched on, the subject pulled the ejection-blinds over his face, spat out his mouthpiece and breathed out hard into the water, and the signal to fire was given. Five seconds later the seat was fired by remote control and the next moment seat and occupant were being lifted out into the sunshine.

The first test, with 350 gr cordite, although a somewhat exhilarating experience, was a complete success; and the next test, with 650 gr, took place a few days later. Exactly the same routine was followed but this time the kick of the ejection seat was much more marked—probably because the subject was not strapped in sufficiently tightly; and both subject and attendant were considerably shaken by the double thump of the explosion and its reflected wave from the sides of the tank. It was decided that future tests must take place in a larger tank, where good visibility would