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The Seaplane In The U. S. Coast Guard

By

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The U. S. Coast Guard has been interested in the seaplane as a medium of search and rescue since its practical beginning.

Consider the fundamental requirements of a good search and rescue vehicle:

(a) Ability to operate in all weather and conditions.
(b) Speed. This includes speed in getting started on a mission.
(c) Efficiency as a searcher with lookouts, radio, and radar.
(d) Range and endurance.
(e) Ability to do a job on the scene of action.

The seaplane excels the surface ship today in speed and search efficiency, and tails her in all the other needed qualities. The helicopter excels in the ability to make the rescue in spite of rough seas, or shoals or surf, and is disappointing in all the other qualities required in sea rescue.

Arguments are rife on the relative merits of this or that type of rescue equipment. It should be noted that in rescue as in few other fields of endeavor Napoleon's Maxim, "Better an army of rabbits led by a lion than an army of lions led by a rabbit" holds true, so the records show occasional brilliant rescues accomplished by equipment not suited to the work, which would not have been accomplished under average command competence. Partisons for this or that gear will quote such examples as proof of what the equipment used can do. This is not realistic thinking.

Amplifying the speed and range comparison, let us say for a practical average that a ship will get underway in 30 minutes to an hour, proceed at 18 knots, steam 7000 miles and her endurance is measured in weeks. A helicopter will be airborne in 4 minutes, proceed at 60 knots, fly 210 miles and stay airborne 3½ hours and the seaplane will be airborne in 7 minutes, proceed at 130 knots and stay airborne 20 hours. (The 400 mph rescue seaplane and 150 mph helicopter are not yet realities to rescue operations.)

Now for operation in all weather and ability to do a job at the scene of action; with the seaplane we can and do take-off totally blind and can search with radio and radar very efficiently in zero weather for many targets, but the great weakness of the seaplane is inability to land and take-off safely at sea except in daylight and favorable weather.

This does not mean that today's seaplane is helpless to operate in other than a calm sea. The Coast Guard has removed a number of emergency medical cases from ships in seas so rough the surface commander has protested lowering or refused to lower a boat. (In the latter cases the seaplane's rubber dinghy was used to transfer the patient.) But sea waves and swells and winds may appear in a myriad of combinations of heights, lengths and velocities and the seaplane can operate safely in able hands under one set of conditions and be almost helpless under another which is no rougher to a surface vessel. The Coast Guard has made rough water landings successfully in the dark too but it is a terrifying experience to a pilot.

Let us not becloud the issue with our little boasts. The fact stands adamant that the seaplane cannot yet operate with sureness and security in many very moderate seas; that nearly every open sea landing is based on a calculated risk. This limitation of the seaplane in rescue has been a serious concern of the Coast Guard for many years.

The earliest Coast Guard pilots, trained in 1916, used Navy types of seaplanes entirely and those types then rarely emphasized the qualities needed in sea rescue.

Two series of seaplanes were built to Coast Guard specifications in an effort to master this shortcoming. The Fokker FLB (Flying Life Boat), built by General Aviation in 1932 was a high wing monoplane with two 420 hp. radial pushers mounted on top of the wing. This aircraft was slow but very strong and a number of very fine rescues were made with this type. The maximum range of 700 miles with a cruising speed of 90-95 knots and very slow take-off were the principal deficiencies.

The Hall Flying boat built in 1937-39 (PH-2 and PH-3) was a 16000 lb. biplane with two 875 hp. radial tractors mounted between the upper and lower wings; it had an 8 second take-off, slow stall, cruising speed of 110 knots and a range of 2000 miles. It was an excellent rescue aircraft for its day and for the first time extended aircraft search operations to a range that allowed a full day's search in cooperation with a cutter offshore, an obviously efficient team.

The PH series were replaced by the PBYs - the beloved "Dumbo" well known to all; then the Mariner series (PBM-3 and PBM-5) took over and are today the ball carriers for the scoring play.

The MARINER has probably worked successfully in rougher seas more times than any other seaplane in history.

It should be mentioned that the Coast Guard has always had a vital interest in the amphibian, from the old Loening to Grumman's new Albatross. A flying boat that goes into salt water only to make the rescue eliminates a lot of anti-corrosion maintenance work and problems, and for operations from very cold or occasionally ice bound shores is more reliable than the seaplane and offers a greater choice of alternates if the bay is closed in on return home.

However, to date no amphibian has proven as good for actual sea landing and take-off as a seaplane version of the same aircraft. And the weight penalty of carrying both a rugged hull and landing wheels cuts down the range as well as the landing and take-off performance.

Both the FLB and PH series of rescue planes mentioned above were built before the use of slots or flaps or other high lift devices were common in seaplanes. By modern standards they were primitive.

The work of the N.A.C.A., the Navy and the various aircraft industry and college research projects working with them on high length beam ratios, variation of dead-rise angles, step design, means of spray control, various high lift devices, etc., has parallelled steady advances in production of stronger materials permitting sturdier hulls, better propellers including efficient and reliable reversible propellers and engines with greatly improved power-weight ratios and specific fuel consumption. The presently available and continually improving rockets for assisting take-off make substantial contributions to safe and efficient seaplane operations in the open ocean. The great shortcoming of the presently used JATO is lack of flexibility. An improved liquid type should remedy this.

A very valuable contribution to progress in the field of open sea seaplane operations has been made by recent and continuate studies of sea wave phenomena by oceanographers. This was for many years a seriously neglected aspect of the problem. Today no other phase of the seaplane design problem - as far as suitability for open sea work is concerned - is more important than acquiring a reasonable understanding of the dimensions, forces, forms and velocities to be met on the sea's surface in her various moods.

The first step here is a flat recognition that the sea's surface is rarely represented accurately by a scaled up Japanese print or picture of Prospect Park Lake; then flight test work should include fairly thorough test operations in sea conditions comparable to those under which the seaplane will be expected to work.

Many of the operational peculiarities which come with new design may introduce new and serious dangers if they are not used with special techniques. An example of this is the reversible propeller which maneuvers a twin engine seaplane beautifully in long or low seas. Within the past few days it was discovered during high steep rough sea taxi tests that in a standing turn from up to down wind the inboard propeller buries its blades deep in green water. If this had been discovered hundreds of miles from the station, the aircraft, unable to take-off with the damaged blades, would immediately become a serious problem to salvage and the situation would constitute very serious jeopardy to the life involved.

Considering that a sea wave is a resultant of wind force, duration, and the area over which that wind was effective, and that local disturbances commonly overlay a substantial swell system or systems which originated in other storm areas hundreds or thousands of miles away, it is obvious that open sea seaplane testing to be thorough cannot be accomplished in a day or two in just one or any sea locality.

The present operating seaplane does much very good work for the Coast Guard. Its work, search and rescue, is maybe 80% search. Total operational missions average about one a day in a typical peacetime year at the Coast Guard Air Station in San Diego, Calif. All mercy missions (recovery or return for hospitalization of lost, sick, or injured mariners and aviators), for one twelve month peacetime period there averaged slightly over one thousand miles per mission.

These could not have been done by the helicopter, and those that could have been accomplished by ship could not have been done so efficiently. This is some comfort to the pilot who has to circle many hours over a sea in which he can't land and then watch a cutter steam up looking as though she didn't feel that sea at all.

This seaplane can range well over two thousand nautical miles with safe reserve, carrying good radio and radar, relays of lookouts, and 1200 lbs of rescue gear, including rubber life rafts, provisions, water, medical kits, hand powered radios, etc., to be put down when sea conditions will not permit a landing.

The interest of the Coast Guard in seaplane improvement is based somewhat on a simple desire to use the best equipment available to do its work, somewhat on a determination to overcome as it can the operational limitations of its present equipment, and somewhat in recognition that it faces new problems in rescue and will need improved equipment to cope with them.

Before the last war trans-ocean passenger transport by airplane was pretty much a novelty. During that war it increased many thousand percent. Today the traffic is counted in the hundreds of thousands. In the near future it may well be counted in millions. Many thousands of these passengers are women and children and sick and injured. Air carriers now commonly fly over high latitudes and future routes with jet transports may be nearly transpolar to use or avoid the 100 mph plus "Jet Streams" of wind found at high altitudes. Cold waters and low temperature complicate survival and rescue.

While the law of gravity holds and human error is a factor there will be some disasters.

The fact that the percentage lost will be very tiny is not a release from this problem for rescue people. Many people today travel by steamship because it is "Safer" yet ships, including big ships, are disabled and lost at sea every year. In periods of violent storms the Coast Guard never has enough cutters.

So, in the future, in addition to a constantly increasing number of merchantmen, fishermen and yachtsmen on the surface of the sea, a constantly increasing flow of traffic in the air over the sea must be visualized and the rescue of the airborne casualty forced down on the sea will demand more speed and efficiency than ever before because of the greater shock and exposure he will suffer.

The seaplane of the future, to make its proper contribution to the problem should have ability to:

(a) Land safely in any but a very bad sea; let us say up to fifteen feet high and complex.

(b) Ride the sea safely and easily on any heading, maneuvering freely regardless of wind.

(c) Take-off from a rough sea with forty passengers aboard. (That is one tenth of a full load of a C-99).

(d) Cruise economically two thousand miles at one hundred and eighty knots plus two thousand at one hundred and twenty to thirty knots.

(e) Escort a jet transport five hundred miles at two hundred and sixty knots at above twenty thousand feet.

(f) Search comfortably at 500 feet at one hundred and twenty knots.

(g) Jettison fuel fast and safely.

(h) Carry best available radar.

(i) Provide adequate oxygen from tanks or candles for fifty persons for six hours.

(j) Provide litter accommodations for 30 persons.

(k) Provide a superior type of airfoil and propeller de-icers for possible use in arctic seas.

(l) Provide for bringing passengers aboard from life boats or rafts safely in boisterous waves.

(m) Provide four efficient search stations, bow and tail, and small blisters port and starboard.

(n) Contain a small first aid or operating compartment with proper lights and fixed equipment for medicos.

(o) Carry the best possible aids to navigation and instrument and night flying.

These requirements are very conservative when we think in terms of the future. Except for the open sea landing qualities and small special items which pose no greater problems they are practically available in aircraft already built, if we substitute fuel for pay load. The open sea landing, surface operation, and take-off are the nub of the problem. In fact, when that weakness is thoroughly mastered we can refuel from our cutters far at sea and will not need the range specified.

The solution to the open sea operation involves:

(a) Strength to take racking, pounding and twisting from the sea.

(b) Improved lateral stability. (Surely feasible without substantial drag penalty by inflating boots about wing-tip floats only while maneuvering on the water).

(c) Slow touchdown speed. (Slots, improved flaps, droop snoot, variable aspect ratio).

(d) Quick decleration. (Spoilers, water brakes, reverse thrust, retractable step).

(e) Very quick take-off. (Combination of flaps and JATO should do this easily).

(f) Very good aileron, rudder and elevator control at slow speed.

(g) Comfort, convenience, and a good view of the sea ahead for the pilot.

(h) All especially vulnerable parts such as propellers, flaps and empennage positioned as high as possible.

(i) Wing-tip floats to ride in half down - but braced - position while running on the step.

Voices will say the cost in money and talent to develop a modern rescue seaplane is not justified.

A ditched military pilot saved from the sea is worth more than thirty-five thousand dollars in replacement value alone (in a great war we might run low on quality replacement material too) and the morale value to him, his squadron mates and his family is immense. A few very rich men saved will pay income taxes the rest of their lives that will amortize the cost entirely.

Maybe we cannot afford <u>not</u> to build this aircraft.

In view of past design and construction progress by American engineers the technical problems posed are elementary. If they can harness the shattered atom, pierce the sonic barrier and progress simultaneously in great strides in all other aspects of science and engineering, a supine surrender to the new hazards from the sea is unthinkable.