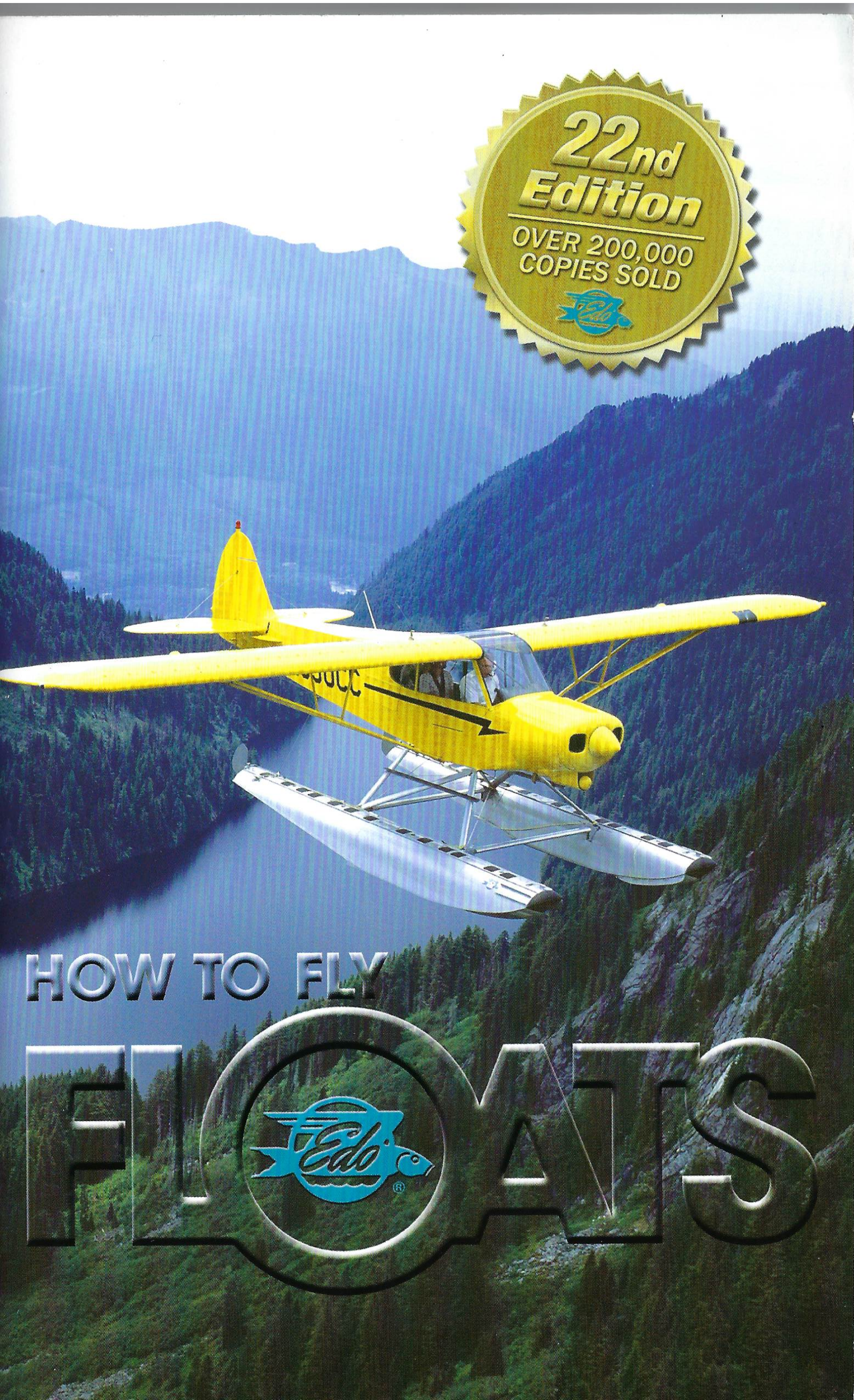
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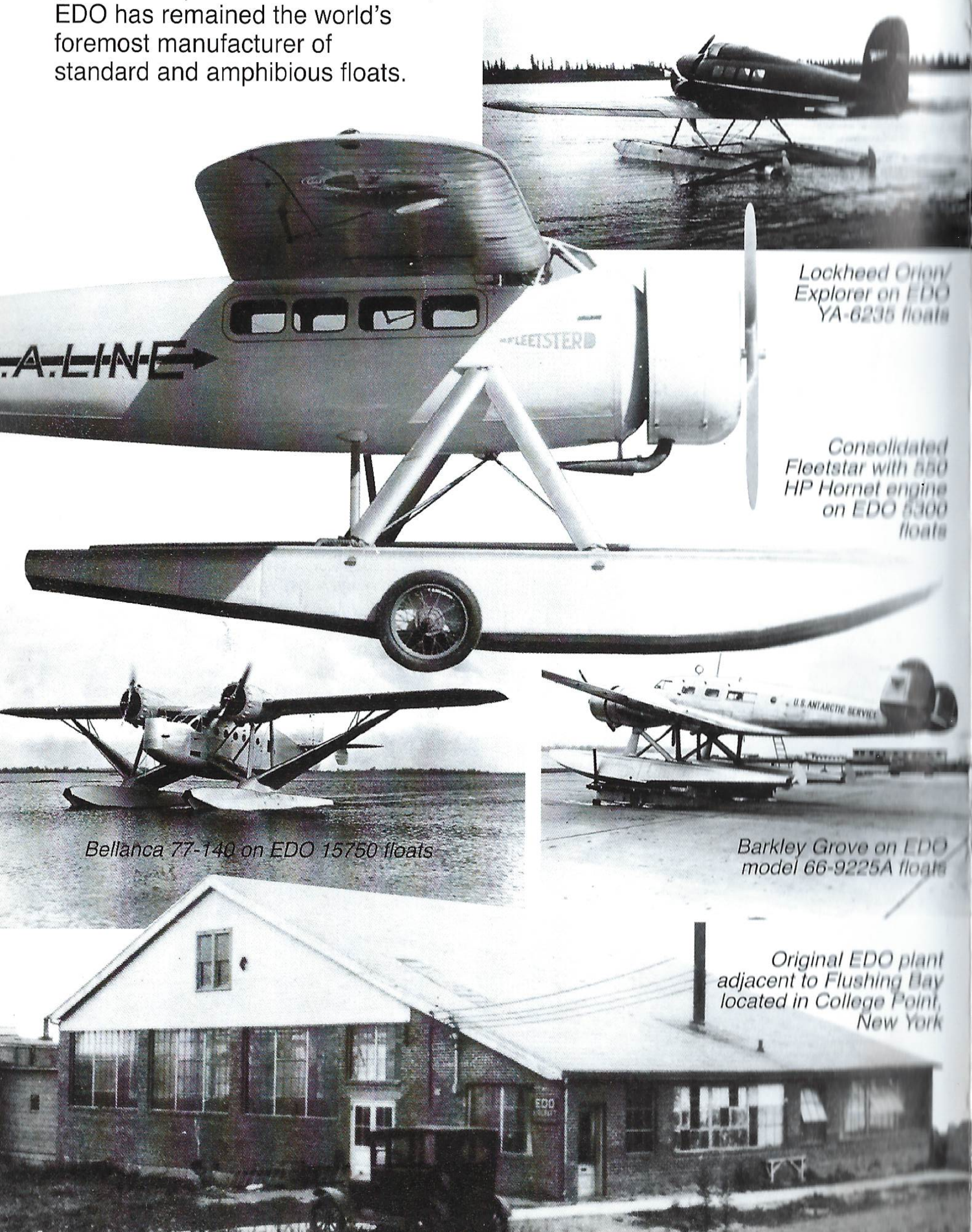

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Cessna 206 on EDO 3500 Amphibious floats on the Colorado River in the Grand Canyon.

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kenmore air harbor

by C. Marin Faure

On March 21, 1946, three friends slid a two-place, forty-horsepower Aeronca Model K into the water at the north end of Lake Washington and got it ready to fly. Robert Munro and Reginald Collins had purchased the plane as a wreck and rebuilt it in the evenings after their jobs as mechanics at Pan American World Airways. Jack Mines had flown a Navy patrol bomber during the war, and would pilot the Model K on its first flight. As the tiny plane buzzed around over the lake, a passing motorist noticed and drove down to the shore to inquire about taking lessons. Kenmore Air Harbor had its first customer.

That July, Jack Mines lost his life while air-dropping supplies in the Cascade Mountains. A few months later, Reg Collins left to take a job in California. Bob Munro was left to run the company on his own.

Flight instruction and airplane repair formed the core of the company's business for the first few years. Situated on the muddy site of an abandoned shingle mill, the Air Harbor's headquarters building was a converted chicken coop. Beside it, a one-car garage served as the maintenance shop.

In June, 1947, a local car dealer bought a Republic Seabee and based it at Kenmore. The rugged amphibian was an ideal airplane for the Pacific Northwest, with its countless islands, bays, and lakes. Within a year, over thirty privately owned Seabees were based at the Air Harbor.

When a local newspaper reporter began writing columns about his fabulous fishing trips to Vancouver Island in the Air Harbor's Seabee, the phone in the office began to ring with requests for fishing and hunting charters. Kenmore was also becoming expert at salvaging wrecked or damaged Seabees, rebuilding them, and selling them for a profit.

In the early 1950s, the Air Harbor added a pair of Noorduyn Norsemen to their fleet. With its six-hundred horsepower engine and large cabin, the Norseman was the aerial equivalent of a pickup truck. In March, 1953, the Air Harbor was hired to fly an entire mining camp from a bay in Southeast Alaska to the surface of the Leduc Glacier in British Columbia. Using the two Norsemen and a Seabee, pilots Bob Munro, Bill Fisk, and Paul Garner hauled fuel, food, lumber, diesel air compressors, a bulldozer, ore cars, track, pipe, dynamite, and even a washing machine to the surface of the Leduc Glacier. The glacier camp evolved into the Granduc Mine, one of the largest copper producers on the west coast.

In 1958, Kenmore bought its first Cessna 180. Fast and efficient, the 180 quickly became the mainstay of the Air Harbor's fleet. More planes were added, and the company became a Cessna sales and service dealer in 1964.

In 1966, as a result of trying to win a Navy transportation contract, a new plane appeared at the Air Harbor. The De Havilland DHC-2 Beaver on EDO 4580 floats had been an instant success in Canada, but other than the Army orders that made up the bulk of production, the plane had been slow to catch on in the US. But one flight convinced Bob Munro that the Beaver was the best bush plane ever built. Rugged, capable of carrying seven passengers or almost a ton of freight, and fitted with the incredibly reliable Pratt & Whitney R-985 engine, the Beaver was the perfect plane for the Air Harbor. Within a year, the company had purchased four of them, and was on the lookout for more.

In 1968 the company got a phone call from a scientist who wanted to know if the Air Harbor would be willing to transport passengers and supplies to a research station on the South Cascade Glacier. The first flight, to the tiny meltwater lake at the foot of the glacier, was a success, and the Air Harbor supported the project for the next ten years. In the summer the Beavers landed on the lake, but when it began to freeze over in the fall, Munro shifted his operations to the surface of the glacier itself. Despite the rough and hazardous conditions, the Beaver and its rugged EDO Model 4930 floats performed flawlessly.

The Air Harbor's success on the South Cascade glacier did not go unnoticed by the scientific community. In 1970 the company was hired to support the University of Washington's research station on the Blue Glacier. Flowing off the summit of 7,965' Mt. Olympus, the Blue Glacier presented a different set of challenges. The only suitable place to land was the Snow Dome, a relatively flat spot near the top of the glacier. But there wasn't enough room on the Snow Dome to take off. So the Beavers were pitched off the side of the glacier, accelerating down a forty-five degree slope until they were going fast enough to fly. The Air Harbor supplied the Blue Glacier station for seven years. As with the South Cascade operation, Kenmore's Beavers and their EDO floats never faltered.

By 1980, the Air Harbor had built up an impressive network of passenger routes. In addition to serving the San Juan Islands, Kenmore provided daily air service to a number of fishing lodges and resorts in British Columbia. While the Beaver seemed perfect as-built, it didn't take long for the Air Harbor's mechanics to come up with improvements. From low-drag seaplane fins to larger rear windows to a lightweight electrical system, the Air Harbor has developed so many modifications that the airplanes run through the company's rebuild program are referred to as "Kenmore Beavers," and they have become the standard by which all Beavers are judged.

The company entered the jet age in the mid-1980s with the acquisition of a pair of Turbine Beavers on EDO 679-4930. Replacing the planes' original engines with modern Pratt & Whitney PT6A-135 powerplants, Kenmore's mechanics created fast, quiet, trouble-free airplanes that were not only popular with passengers, but helped reduce the noise impact of the company's operations.

The success of the Turbine Beavers convinced the company of the benefits of turbine operations. When the Air Harbor bought its primary competitor, Lake Union Air Service, in 1992, it took over that company's scheduled service between Seattle and Victoria, BC. The popularity of the Victoria route, and the growing passenger traffic to the company's destinations along the BC coast made it obvious a larger plane was needed. The Air Harbor's piston Otter was converted to turbine power with the installation of a Vazar Dash-3 conversion kit. Using the same PTA-135 powerplant Kenmore had used in its Turbine Beaver conversions, the turbine Otter had the capacity, reliability, and passenger appeal Kenmore was looking for. By the year 2001, the company's fleet included six turbine Otters, two turbine Beavers, and ten piston Beavers.

When The EDO Corporation put its float operation up for sale in the mid 1990s, the manufacturing and assembly tooling was initially purchased by a Seattle Company, and later the EDO float Division was acquired by the Air Harbor. Kenmore has been selling and servicing EDO floats for decades in addition to manufacturing float components, and so is uniquely qualified to continue the production and support of EDO's superior, all-metal floats.

Bob Munro retired from his position as company president in March, 2000. The Air Harbor had changed almost beyond recognition, but one thing was no different than it had been in 1946: the company's way of doing business.

"I can't predict the future, so it's hard to say what the company will be like a few years down the road. But I like to think we've started something that will keep going. I absolutely believe if we take the attitude that we're going to do a good job, whether it's fixing a plane or delivering a part or flying a passenger, and we deliver what we promise, we'll succeed."

Robert Munro

---

foreword

" Once you've tasted the sheer fun of float flying, you'll never want to go back to land flying again."

Great testimonial...and all too predictable. Those words were written in 1972— they are ever truer today. But words can't do justice to the real thing. You have to get out there and experience the excitement of float flying yourself. Just once, and you're in-curably hooked on a new world. A nautical, salty world. A world of boats and ATV's, bare feet and sneakers, fishing and camping, the great outdoors, as you've never enjoyed it before. An opportunity to enjoy the romantic world of float flying without all the burdens of the restrictive environments that are being imposed by TCAs, ARSAs, etc.

This updated booklet is the product of an enduring love affair with float flying and is dedicated to similarly-afflicted seaplaners everywhere. Hopefully, it may encourage more "landlubbers" to get out onto the water. Its purpose is to supplement the education of the beginning seaplane pilot in all phases of float flying, with special emphasis on those aspects of seaplane operations which are different from landplane flying. It is recommended that you thoroughly review the FAA Airplane Flying Handbook (FAA-H-80-83-3) before proceeding with your seaplane rating, and special emphasis be placed on the seaplane Chapter 15. It is further recommended you discuss your training with your instructor.

It is impossible, in the space of this booklet, to include specific handling characteristics on each and every aircraft TC'd or STC'd for floats. We have tried, however, to review the methods and techniques applicable to most popular seaplanes now in production and use. For the majority of the current aircraft, there will be a specific section relating to seaplane operation in the manufacturer's Pilot Operating Handbook (POH) and this section should be carefully reviewed before flying your seaplane.

The writer is indebted to Mr. George B. Post, former Vice President of Sales, EDO Corporation, for his original work and manuscripts of float flying. The assistance of Mr. Bob Munro of Kenmore Air Harbor, Kenmore, Washington and Mr. Jack Brown of Brown Seaplane Base, Winter Haven, Florida is gratefully acknowledged.

Because handling characteristics vary between individual floatplanes and because of the difference in individual pilot proficiencies, Kenmore Air Edo Floats L.L.C. accepts no responsibility for any accident which may result from the use or misuse of information contained herein.

Designed & Produced by Lars + Associates, Inc. • Hibernia, N.J.

contents

Top: *Cessna 206 in Planing Attitude.*
Bottom: *Cessna 172 on EDO 2000 Floats in Northern New Hampshire.*

introduction

Float planing is the best of two worlds, flying and boating, with the added freedom of going anywhere, anyplace there's water. The floatplane lets the sportsman-flyer develop his own private playground, be it a remote fish-filled lake or a secluded vacation cottage.

Float flying is generally regarded as the easiest type of flying to learn for the beginner. And for the seasoned land plane pilot, it comes quickly and naturally. The seaplane is easier to fly and more "forgiving" than its land-based counterpart. Landings and take-offs are easy because water areas are generally large and comparatively traffic-free. In most instances, the landing and take-offs are done into the wind, so the pilot does not have to overly concern himself with the problems caused by crosswind landings and take-offs encountered in operating from a hard surface runway. The student rarely is confronted with physical and mental distractions such as boundary fences and congestion at the all-important moments of landing and take-off.

Smooth over-water air also makes less demands upon the pilot, while his energy is further conserved by the ease with which rivers and shore lines may be followed. The work and strain of tiresome navigation are taken out. How much easier and more pleasant it is to fly along effortlessly, following a visual course, almost oblivious to wind shifts, compass variations, etc.

For the licensed private pilot, only a few hours are needed for the transition from land rating to seaplane rating.

The seaplane is probably the safest of all aircraft to fly and the pilot rarely need expose himself to many of the ordinary risks. For instance, a seaplane may be "flown" or taxied on the water, safely and legally, under a ceiling which would ground a land plane. A forced landing on water is seldom an emergency. And flying over land, the seaplane pilot has great peace of mind since he knows he can *land on land with little or no difficulty!*

The floatplanes we shall concern ourselves with in this booklet are conventional, single or twin engine light aircraft on which wheels and landing gear have been replaced by two identical floats. Installed below the fuselage, they provide the aircraft with buoyancy in the water. There are two basic types we shall consider: the straight float or pontoon, equipped with a retractable water rudder and designed exclusively for all-water operations and the amphibious float, equipped with retractable rudder and retractable main and nose wheels for both land and water operations.

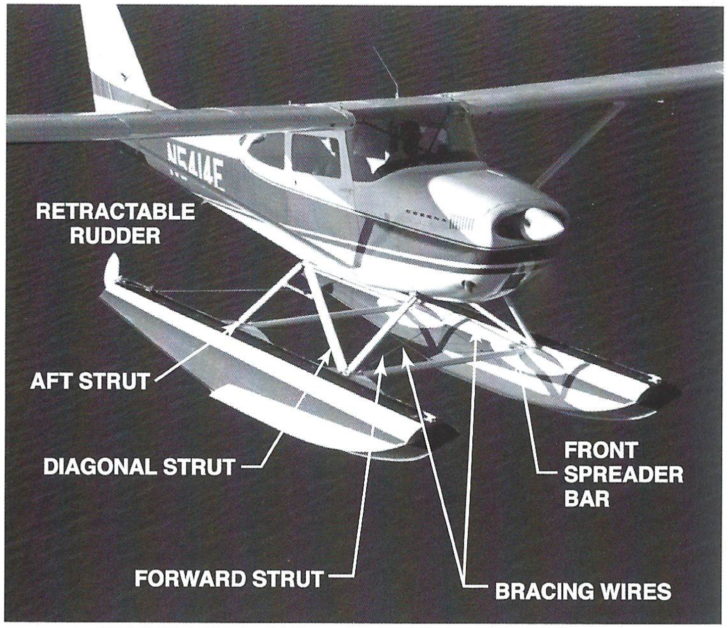


FIGURE 1. *Typical Float Gear and Attachment Fittings*

The terms "floatplane", "seaplane" and "ship", are used interchangeably to mean any aircraft fitted with twin floats for water operation on lake, river, bayou or ocean. Amphibians are specifically identified.

The floats used pictorially throughout this booklet were produced by EDO Corporation, College Point, New York. EDO floats offer the ultimate in lightweight construction, sturdiness and aerodynamics for optimum performance in both air and water. Appendix A contains a list of aircraft that have been installed for use with EDO straight and amphibious floats. All float models have multiple water-tight compartments which render the seaplane virtually unsinkable. Figures 1 and 2 show typical float installation and construction details.

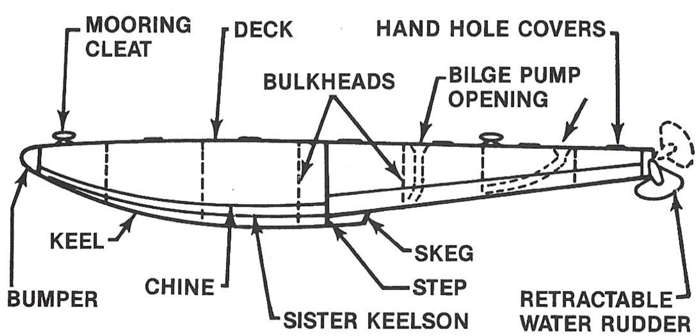


FIGURE 2. *Basic Float Construction and Nomenclature*

preflighting

Preflight checkout of the float plane is generally similar to that of a land plane. Here, your aircraft Owner's Manual or the Pilots Operating Handbook (POH) is your guide. One major difference is the requirement for daily preflight inspection of the floats and some of the more modern aircraft POHs contain a floatplane supplement that should be reviewed.

Floats, wires and attachment gear must be thoroughly checked for holes, buckled struts or damaged fittings. If discrepancies are found, the aircraft should not be flown until necessary repairs are made.

Leakage Checks

The floats themselves should be inspected daily before each flight for possible leakage. The presence of a slight amount of water — less than a cupful in any one compartment — is not unusual and is due to normal leakage and condensation. More than a cupful is excessive, and the compartment should be completely pumped out and the handhole cover removed to inspect and pinpoint the source of leakage. If the floats do not have a built-in bilge funnel (Figure 3), individual compartments must be pumped out by removal of the float covers and use of a hand-operated bilge pump. Care should be taken to make sure that the bilge tube is connected to the funnel and is properly located at the lowest point of the float. We have seen instances where the tube has become disconnected and, since no water was removed from the float during pumping,

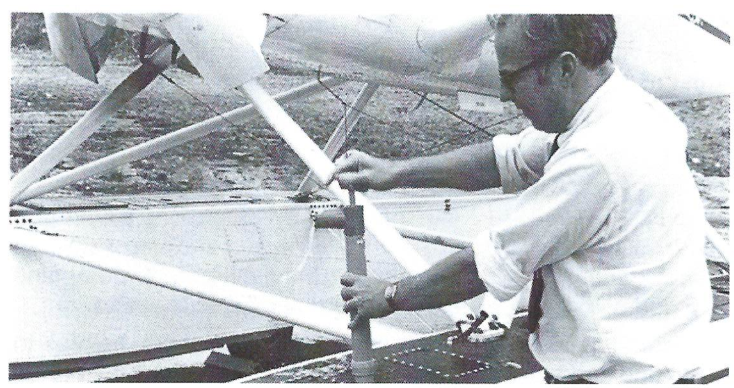


FIGURE 3. *Bilge Pumping of Excess Water from Amphibian Float Compartment.*

a major problem could develop. This can be checked by listening carefully as you pump each compartment and, if there is any noticeable change in the noise or suction, further investigation should be undertaken.

Water is kept from entering the float compartment through the bilge pump opening by a soft rubber ball. This ball must be removed before pumping the compartment. The balls keep out rain, spray and any water that might break over the float deck and the float pilot should carefully reinspect all balls after pumping to make sure that they are properly installed. If a ball is missing, the aircraft should not be flown until they are replaced. Remember that one gallon of water left in the floats weighs eight pounds and it does not take too many gallons before you can have a large increase in the weight of your float plane.

Rudder Controls

Before attempting to fly a floatplane, you should familiarize yourself with the location and operation of the water rudder controls. Preflight inspection of water rudder controls and pulleys is a "must" requirement. Any limitation to their free and unrestricted movement will result in difficulty in maneuvering the aircraft on water.

The water rudders are located at the rear of the floats and are connected to either the aircraft rudder or rudder pedals by means of springs and cables. In any case, when the water rudders are raised they still move with the air rudders. The water rudders are used for directional control of the aircraft during water taxiing at slow speeds while the air rudder controls the aircraft on water at high speeds. As part of your preflight, you should look back at the float water rudders and make sure that you are getting full deflection in both directions and, when the water rudder retract handle is either raised or lowered, the water rudders are travelling to the proper position. It is most important to make sure the water rudders are fully extended into the water when the handle is placed in the down position.

Wind and Water Conditions

Knowing the prevailing wind and water conditions prior to taxiing or flying are the final important steps in the preflight procedure. Before leaving the dock, the pilot should evaluate water and surface conditions, wind velocity and wind direction to determine their combined effects on taxiing and take-off maneuvers.

Listed below are some tips which will prove helpful in evaluating wind and water conditions:

- The band of slick flat water next to the shore line on one side of a body of water will determine the direction of the wind. Wind always blows *from* the direction of the flat area. A narrow band of flat water indicates a strong wind. A wide band of flat water indicates a light wind. Your local marine forecast provides another reliable gauge of the general water conditions that can be expected; it is recommended you listen to these forecasts, if broadcast, to determine the wind direction and velocity.
- Listed in Appendix B is a Surface Wind Force Table and Beaufort Scale for use in checking wind and water conditions. Wind direction or wind line can be observed by noticing the wind streaks on the water. Care should be taken not to confuse these streaks with current flow lines that are found in rivers. The best indicator of wind direction in your area is *the wind sock which will be found at most seaplane bases.* Once wind direction has been established, use this wind line for your take-off direction.

Area Check

All obstacles which might affect the movement of the aircraft should be observed, with special attention given to anything near the intended direction of taxiing. If the aircraft is tied to a dock,

FIGURE 4. *Cessna 206 Tied to Busy Dock at Lake Parker, Florida*

special care should be taken before shoving off to be sure your plane will clear wing tips and tails of other planes, as well as boats and other structures secured to, or on, the dock (Figure 4). When leaving a congested dock, a knowledgeable attendant should be used to assist the seaplane pilot. It is most important the attendant be fully aware of the proper handling techniques for a floatplane, as we have seen numerous instances where the uneducated have caused damage to the aircraft. If conditions are favorable, it is recommended the aircraft be turned perpendicular to the dock and the attendant hold the tail and keep it in that position until the engine is started.

Elevator Trim Adjustment

One additional aircraft preflight check involves the elevator trim. It should be adjusted to give neutral stick pressure, when in the step taxiing condition. As described later, abnormally high stick pressure may cause difficulty during the planing phase of take-off.

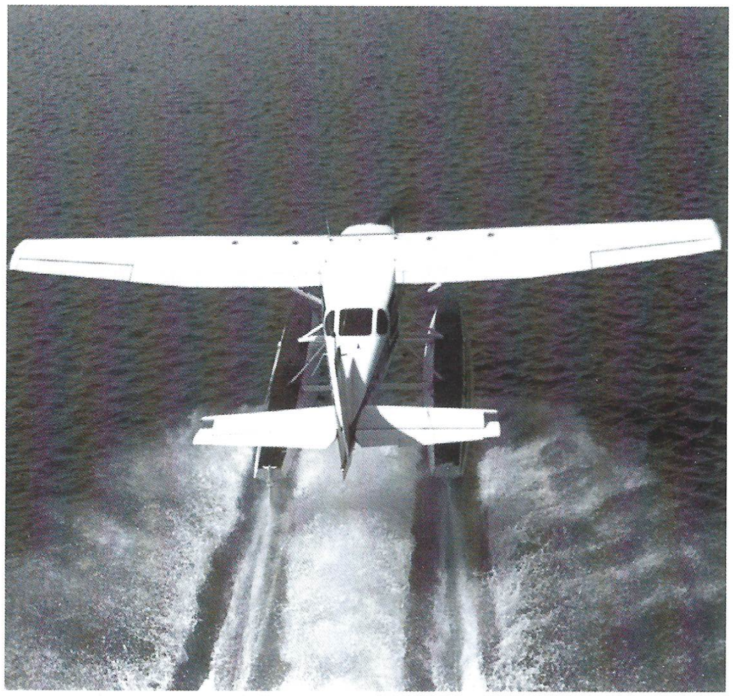


FIGURE 5. *Cessna 206 Step Taxiing*

taxiing

The novice floatplane pilot immediately experiences one of the distinguishing features of land planes vs. seaplanes. . . braking power or, rather, the lack of it. While land-based craft remain in one position, with the engine running, the unmoored floatplane moves constantly. This movement is along a path which is the result of several different wind and thrust forces.

Basic Handling Tips

Any normal seaplane which is floating free (with its engine dead or at idle) will "weathercock" or turn like a weather vane, its nose pointing into the wind (upwind). In this position, it will creep forward or drift backward, depending upon the relative effectiveness of propeller thrust, wind velocity and water currents. To put the craft on any course other than upwind and hold it there requires the application of considerable propeller thrust. Even more is needed to make a complete downwind turn.

Directional control of the floatplane, when taxiing at slow speeds, is accomplished with the water rudder. For most conditions the seaplane will be taxied with the water rudders down. Again, prevailing conditions should be checked in advance, with an eye toward how the "ship" is likely to respond. If wind velocity and water currents are both light and the take-off area wide open and free of large waves and/or swells, there's little to worry about before shoving off. Rarely are all conditions ideal, so the taxiing problem should be considered carefully before getting underway.

Three General Rules

Rule One: One of the most important rules for the novice float pilot to learn is to hold the stick all the way back, all the time his ship is taxiing at slow speed on water. Normally, the only exception is during actual take-off sequences or when taxiing at high speed with considerable power on. The stick-back position lifts the nose, reduces spray on the propeller and improves overall maneuverability of the ship.

Rule Two: Always taxi as slowly as possible ... unless there's a long distance to cover and conditions are favorable for running the ship at high speed "on-the-step" (see page 11). The aircraft should never be taxied in a "plowing" condition except when turning downwind, and then, only in strong winds. At idling speed, for instance, the propeller will never pick up spray, nor will the engine overheat. As a general rule of thumb, you should idle-taxi at an RPM that will

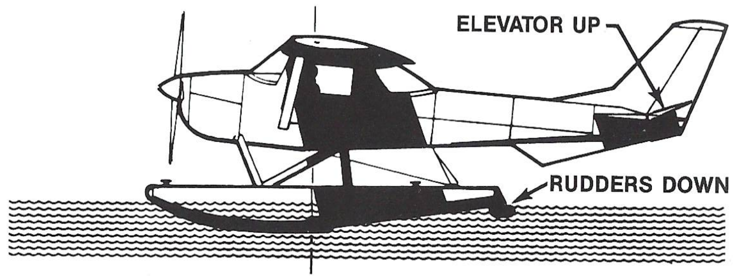


FIGURE 6. *Displacement Attitude for Low Speed Taxiing*

not give an increase in pitch attitude. When the floatplane is taxied at slow speeds, it should remain in the displacement condition (Figure 6), similar to being at rest in the water. In light wind conditions, it can be turned downwind or crosswind with very little difficulty.

In a very short period of time, a considerable amount of damage can be done to an expensive propeller if the aircraft is taxied in a condition where spray is encountered. In observing low-time float pilots, one of the major mistakes I have seen is that too much power is carried, and that a spray condition is developed. Again, we wish to emphasize that idle RPM should be used for minimum taxi speed.

Rule Three: Sometimes, when taxiing downwind under conditions of extremely strong tail wind and heavy swells with a light aircraft, the stick must be held forward to keep the tail from being picked up and blown over, when coming down on the swell. When conditions are this severe, it is recommended the pilot not try to taxi downwind, but "sail" the aircraft.

Low-Speed Taxiing and Turns

Once in the open, it's wise to get a feel for the amount of directional control which you have over your ship by making turns in both directions. This will give you a feeling of how the aircraft will

FIGURE 7. *Soloy Turbine Powered 206 EDO 3500's Demonstrating Low Speed Taxiing.*

respond should you get into tight conditions calling for immediate maneuverability and action.

If a small turning radius is required, remember the aircraft will turn easier to the left (port), due to torque. Also, *short bursts* on the throttle are best for turning in a small radius. Sustained excess power tends to straighten out the air and water rudders, causing a buildup of speed and a larger turning radius.

In windy conditions, difficulty may be experienced in turning the floatplane to a downwind direction. The preferred way to achieve the downwind position is by a "plow" turn, as illustrated in Figure 8. A plow turn is started into the wind (water rudders down)

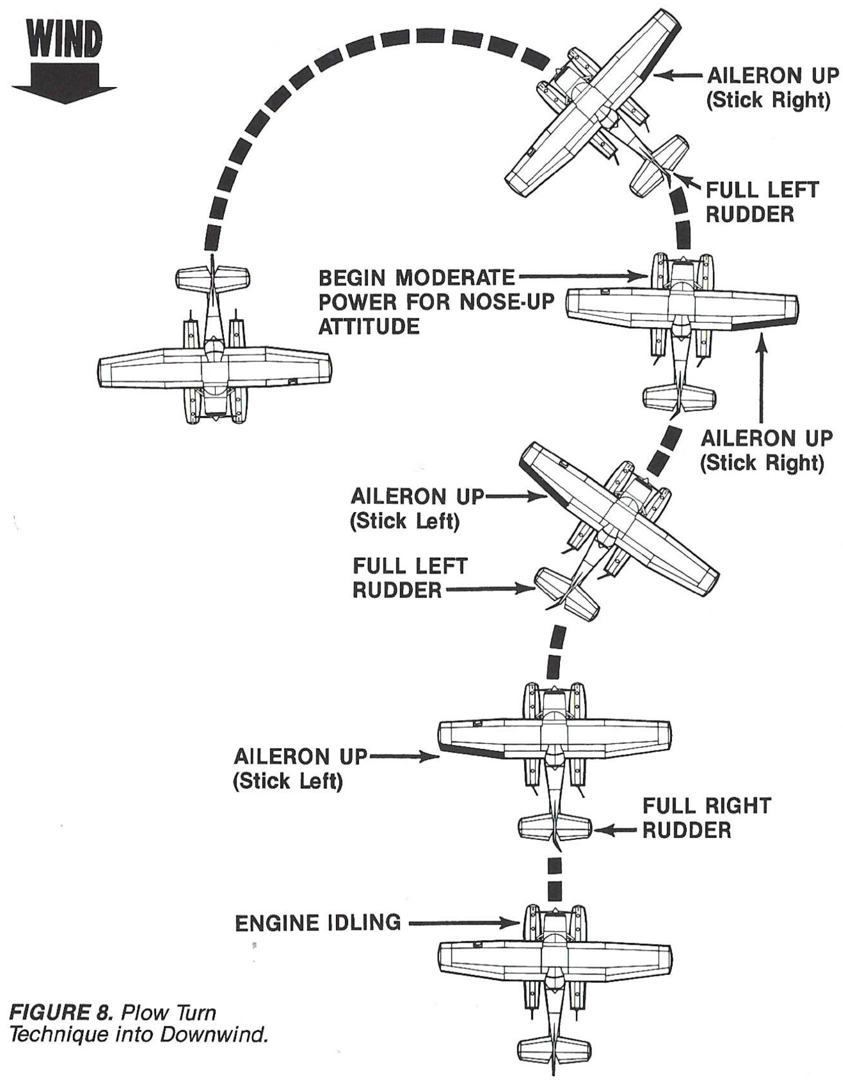


FIGURE 8. *Plow Turn Technique into Downwind.*

with enough engine power added so that the nose of the aircraft is high on the horizon, and the tail low. Note, in Figure 8, that a small turn to the right is initiated so that when the aircraft is turned back to the left, the water rudders will be fully over to assist in making the turning maneuver.

Once the aircraft is plowing, the turn is made using both the aircraft and water rudders. In windy conditions, careful attention should be paid to the use of the floatplane ailerons when either taxiing or turning. The ailerons utilize the same procedure for floatplanes and land planes. They are used to keep the wind from getting under or lifting up a wing, which would then cause the downwind float to be forced into the water, thus causing additional drag and the possibility of capsizing the floatplane. THE AILERONS SHOULD BE USED TO KEEP THE WING THAT IS *INTO* THE WIND, DOWN. The stick or wheel is turned or pushed, toward the side from which the wind is blowing. When the craft assumes the downwind direction, the ailerons are placed in their neutral position.

Plow turning has several disadvantages, namely, more power must be carried for small increases in speed, creating the possibility of engine overheating. Also, visibility is greatly restricted, when in a plowing attitude. The advantages of plowing are protection of the propeller and greater turning maneuverability in windy conditions.

With the aircraft plow turning or plow taxiing, its center of buoyancy shifts aft (Figure 9), giving it a tendency to weathercock *to a downwind position.* If the wind velocity is 10 knots or more, you will encounter very little difficulty in turning downwind, when in a nose-high attitude. The reason for this condition is, when you place

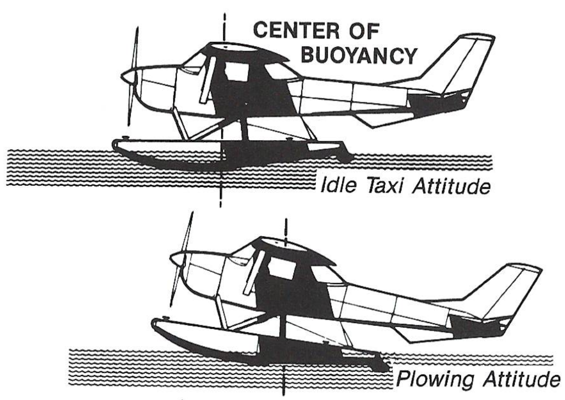


FIGURE 9. *Center of Buoyancy Shift — Idle vs. Plow Attitude*

the aircraft in the nose-high attitude, the center of buoyancy is shifted back on the float and there is more area forward of this point, therefore, the aircraft will turn downwind by itself. For maximum

directional control while taxiing downwind, enough power should be carried and the wheel or stick held back so the center of buoyancy remains aft.

On some specific models of aircraft, such as the Piper J-3 or PA-11, this tendency of reverse weathercocking is very pronounced and can easily be demonstrated.

You can also taxi downwind under reduced power. However, your directional control will be limited very closely to the actual wind direction. Should the craft start to weathervane during slow downwind taxiing, the condition is quickly corrected by adding more power and pulling back on the yoke to shift the center of buoyancy aft. The aircraft will then stabilize downwind, allowing you to ease up on power. Actual wind and water conditions determine precisely how much correction is needed.

In extremely windy conditions, a plow turn should not be attempted, due to the vulnerable position of the aircraft when broadside to the wind. It is possible, in a position broadside to a strong wind, to bury or swamp the downwind float, while the wind force acts, at the same time, to pick up the upwind wing. If wind conditions are very strong and the aircraft does not turn easily, avoid attempting a turn and "sail" your aircraft to the desired destination (See Sailing).

To taxi crosswind, on some aircraft such as the Piper J-3 or PA-11, the center of buoyancy may be moved by raising the nose of the aircraft, and utilizing up elevator and increased power. Again, consideration must be given to wind velocities greater than the aircraft's or pilot's capabilities. If wind conditions are such that you can taxi crosswind, you can maintain a crosswind heading by playing the center of buoyancy and finding the point that gives satisfactory stability over the intended direction of travel. Familiarization with crosswind handling characteristics is most important and necessary for taxiing in narrow channels or rivers. With prolonged crosswind taxiing, there is a possibility that you will subject the propeller to water spray.

Step Taxiing

Under favorable wind conditions and where long distances must be covered on water, the floatplane pilot may consider step taxiing. To place the aircraft on-the-step for step taxiing, the stick is held back all the way and power applied until the float begins to come up out of the water and the aircraft is in the hump phase as shown in Figure 10. At this point, the stick is relaxed and eased forward to a more or less neutral position. The floats will then begin to plane and run along in a level position on-the-step (Figure 11). In some cases the stick must be pushed forward of neutral to get the aircraft to climb on-the-step. Once on-the-step and planing, the throttle is reduced to a point where enough power is maintained to keep the aircraft in a planing position without excessive buildup of speed.

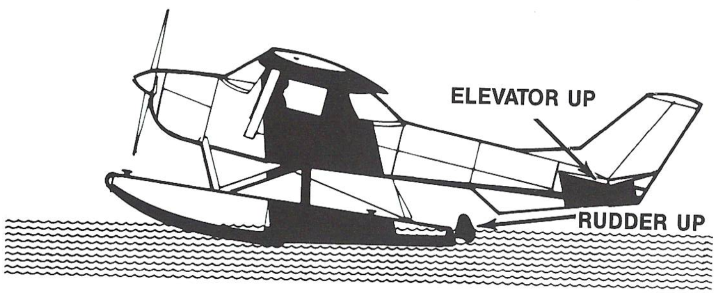


FIGURE 10. Hump Phase — Nose-Up Attitude

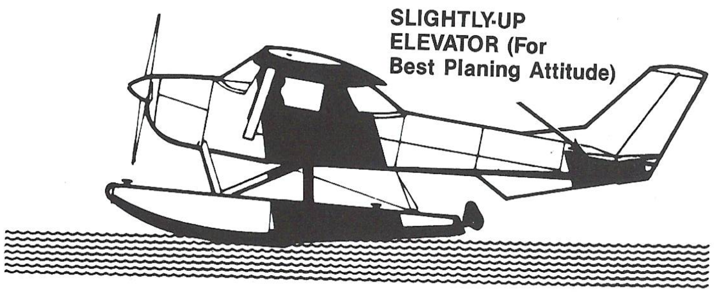


FIGURE 11. Planing Phase — On-the-Step

For step taxiing, the water rudders are raised (Figure 12) and the air rudders take over primary directional control. If the water rudders are not raised during step taxiing, they have a tendency to pound and become damaged. Perhaps an obvious, but possibly overlooked precaution before step taxiing, is to check the area ahead to make sure it's clear of floating objects and boats.

FIGURE 12. Piper Super Cub Taxiing On-The-Step

Step taxiing is the most often used maneuver in float flying and plays an important role in both landing and take-off operations. It requires maximum pilot judgement and skill and is a maneuver which certainly gives him the most "feel" for his floatplane. Mastering the art of step taxiing and step turns adds enormously to the understanding and usefulness of float flying.

Step Turns

During any float maneuvers, two primary forces, wind and centrifugal force, act upon the aircraft. When turning from *upwind to downwind,* these forces oppose and tend to cancel each other out, as illustrated in Figure 13. When turning from downwind to upwind, however, both forces act in the same direction and the aircraft becomes unstable. It is important this instability or capsizing tendency is clearly understood and you're prepared to cope with it.

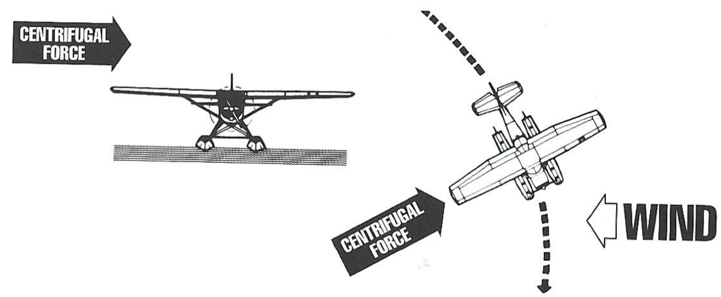


FIGURE 13. Canceling Effect of Wind and Centrifugal Force During Step Turn Out of Wind.

Let's look at the forces involved more closely. When a pilot lets his ship weathercock around into the wind from a downwind direction, engine throttle closed, forward motion is negligible and the craft rotates or swings around its own center of gravity with minimum centrifugal force. Minimum capsizing force is exerted by the wind as the aircraft swings slowly through the crosswind position.

Now apply power, such as when step turning the aircraft back into the wind, and you create a faster turn, but much greater centrifugal force (see Figure 14), because centrifugal force is directly related to speed. Apply enough power and let the speed build and you generate enough force to exert a capsizing effect on the aircraft. Combined with strong winds, it could be enough to tip the airplane. Given the proper set of adverse conditions, the ship will lean toward the downwind side (outside of turn), burying the down-

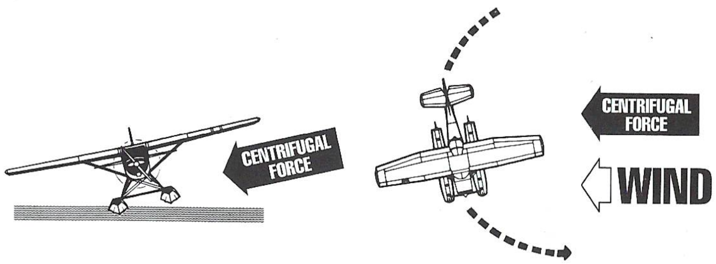


FIGURE 14. Capsizing Effect of Wind and Centrifugal Force When Turning into the Wind.

wind float. Once buried, additional drag and resistance are created. If conditions are severe enough, the downwind wing may then dig into the water and the aircraft could capsize. *Accordingly, all turns from DOWNWIND to UPWIND under windy conditions should be done at MINIMUM SPEED, THROTTLE CLOSED and the aircraft in a DISPLACEMENT CONDITION.*

FIGURE 15. Step Turn in No Wind Situation

take-offs

Obviously, before take-off maneuvers are initiated, the area to be used should be carefully surveyed for obstacles or boats in the water. Be especially observant for low-profile objects like logs, barrels, sand bars or rocks which barely break the water. The aircraft engine, of course, should be thoroughly warmed up. Differences between the land plane and the seaplane are largely reflected in the differences in take-off techniques.

Check Lists

It is recommended the seaplane pilot develop a check list which is applicable to the type of aircraft he is operating and he consistently use this list before starting his take-off or landing. One such check list developed by Jack Brown of Brown Seaplane Base, Winter Haven, Florida, and dubbed the "CARS" System, goes as follows:

C — Carb Heat Cold
A — Area Clear (This could save your life)
R — Rudder(s) Up
S — Stick (wheel) Back

If the aircraft has a fuel injection engine, you might substitute the word "PARS" with the P representing "PROP". The universally-used "GUMP" list is always good for landing, especially when flying amphibians:

G — Gas
U — Under Carriage
M — Mixture
P — Prop

Taking-Off

Once the aircraft is maneuvered into the wind, the water rudder is retracted (raised) for the take-off run. Immediately open the throttle wide and pull the stick all the way back, thus lifting the bows of the floats (hump phase — see Figure 10), to get through the spray period as quickly as possible. With an average ship, the floats will normally rise at the bow to a certain height and stabilize there.

As soon as the pilot sees his nose height has stabilized, he lets the stick ride forward to a more or less neutral position. The floats will immediately begin to plane and run along in a nearly level position on-the-step (see Figure 11). Only in rare cases does the pilot have to push the stick forward slightly ahead of neutral to help the plane onto the step. It is important the pilot be aware of whether his aircraft requires a little nudge or positive forward pressure, when getting upon the step because each type of float plane requires a different technique and the differences are sometimes considerable. If forward pressure is not applied, there is the possibility of a delay in the take-off run or of developing a porpoising condition.

Once on-the-step, the stick usually requires a slight back pressure to hold the floats in the most efficient planing position, i.e., approximating the ship's attitude when at rest on the water. If correct pre-flight adjustments have been made to the aircraft elevator trim, there should be neutral stick pressures during planing. If stick pressure is abnormally high in the planing attitude, the pilot should re-trim the aircraft to eliminate these conditions. Figure 16 illustrates the correct position of floats, stick and elevators during the take-off maneuver.

The planing attitude should be maintained as steadily as possible until take-off speed is reached, at which time a slight additional back pressure on the stick will lift the ship clear of the water.

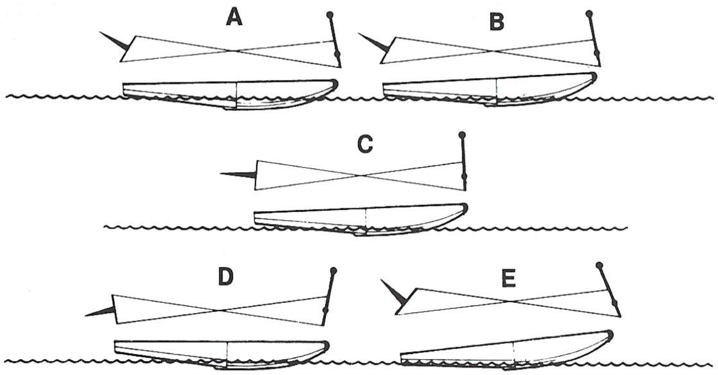


FIGURE 16. *Diagrams above indicate position of floats, stick and elevators when plane is: (A) at rest on water, (B) partially on-step with full throttle used, (C) fully on-step with full throttle, (D) fully on-step but with* ***tail too high,*** *(E) fully on-step but* ***tail too low.***

Optimum Planing Angle

An important technique to master, particularly with heavy loads on glassy water, is that of achieving the most efficient planing angle of the floats. Minimum resistance on-the-step is achieved at that angle at which the tails of the floats almost, but not quite, touch the water. Running the ship at a flatter angle (nose to low) as shown in Figure 16 (D), tends to wet more of the forward bottom of the floats, thereby increasing resistance and diminishing speed. This latter effect can generally be felt by greater drag and a slight nosing-over tendency.

Conversely, running at too large an angle (nose too high) as shown in Figure 16 (E), drags the tails of the floats in the water giving a noticeable increase in resistance. In actual practice, the "nose too high" attitude is one of the most common mistakes of the average land plane pilot when he first takes to the water. It deserves careful attention during the early learning stages of float flying. When an attempt is made to drag a seaplane off the water with the stick well back, the ship "feels" reasonably okay. If it then fails to break loose, there is an almost irresistible urge on the part of the novice to haul back still further on the stick in a vain effort to get airborne. None but the most powerful of ships, however, will respond to this treatment. The correct procedure is to let the nose fall again to the proper angle and keep it there until flying speed has been attained.

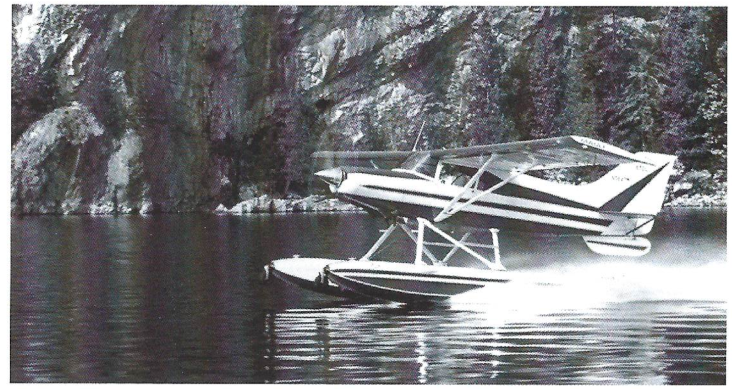


FIGURE 17. *Maule M6 on EDO 2500 Amphibs Step Taxiing with Correct Planing Angle for Take-Off.*

Theoretically, the best take-off procedure is to plane the floats at an angle which produces the least resistance (Figure 17) and hold them there until sufficient flying speed is attained, at which point a very slight increase in angle should lift the ship cleanly off the water without difficulty.

Earlier than expected take-offs may surprise the beginning pilot. If his ship is trimmed for a very steep climb and the controls are released as the ship starts to go on-the-step, it is quite possible for the aircraft to hit the perfect angle all by itself and immediately take to the air. On some ships, under glassy water conditions a slight, but quick, jerk back on the controls is sometimes helpful in picking the floats out of the water once getaway speed has been reached. Another good trick, particularly with light planes, is to use the ailerons and lift one float out of the water at a time. If flaps are available, they can be applied to a modest degree (approximately 20°) just before take-off speed is reached. Flaps, however, are likely to hinder getting on-the-step, particularly if extended too far.

Once the aircraft is airborne, climb speed should be achieved and the flaps retracted, if used. Most modern aircraft are equipped with flaps, the first half of their operating range yielding increased lift and reduced stall speed characteristcs. Because of this, take-offs should be made with one or two notches of flaps, or whatever position is recommended in the Owner's Manual.

In unusually rough water, it is advisable *to keep the nose of the floats slightly higher than* would otherwise be correct under smoother surface conditions. This helps to reduce spray and a tendency to bury the floats. Under these conditions, the ship may bounce off and stall before attaining full flying speed, in which case, holding the nose too high will only cause the aircraft to stall back into the water. It is better to obtain *a slight nose-up attitude so the floats will run through the water* and the aircraft not be pitched into the air before flying speed is attained.

Inflight Handling

Very little need be said in regards to air work and changes in normal flying procedures. The average ship handles almost identically to its wheeled sisters in the air. Many pilots detect little, if any, difference, even in slow rolls and spins. . .except the strange sensation when they first peer over the side and see the floats. While the speed of some land planes fitted with floats has been known to increase, it is rare. More often, a loss of speed is to be expected, although usually never more than 10 percent. Longitudinal and lateral stability is generally not affected. Directional stability, however, tends to decrease somewhat. In the case of certified seaplanes, this condition will already have been corrected by the installation of a small fin on the fuselage, or additional air rudder springs which will return the ship to its normal directional characteristics.

Glassy Water Take-Offs

Because of its importance, additional attention must be given to glassy and rough water conditions, as they affect normal take-off procedures.

Under no-wind water conditions, when water turns smooth as a mirror, the take-off techniques described above apply, but the pilot should also be aware of a few tricks and possible problems. He will need these tricks because glassy water will make the float difficult to separate from the surface. He can get some assistance in "unsticking" his aircraft by circling around and taking-off through his taxi wake. The small wake left behind from his initial run "roughs up" the surface and helps un-stick the aircraft.

In large bodies of water, swells may be encountered even during no-wind conditions. A swell can cause damage or capsize a float

plane and, if encountered, the best course of action is to pull the power off and abort the take-off. A take-off run across the swells may result in porpoising of the aircraft. (See below for a detailed discussion). Under such conditions the run should be made parallel to the crest and trough of the swells. One final and important reminder in glassy water take-offs is to establish *a positive rate of climb.* A glassy surface provides the pilot with few visual clues so depth perception is greatly reduced and it is difficult to tell exactly where the surface is. Establishing a positive rate of climb will prevent the pilot from flying his aircraft back into the water!

Rough Water Take-Offs

When possible, take-offs in rough water should be avoided. Before attempting a rough water take-off, do some reconnaissance of the area first. You may happen to find more favorable surface conditions nearby. Pay special attention to any severe swell conditions that may exist and keep an eye out for swells produced by moving boat traffic. There is a very good possibility that severe damage can be done to either the floats, the attachment gear or the aircraft in big swell or wave conditions.

A rough water take-off (Figure 18) is very similar to a soft field take-off on land, the idea being to get out of the water as soon as possible at the slowest possible speed. After the throttle is opened, the aircraft will quickly transition to the planing mode, at which point, it is vital to establish a slight nose-up attitude. The objective is to prevent the nose of the floats from catching in a wave. If conditions are such that the waves are large, each bounce will throw the nose of the aircraft into the air. Be prepared to apply a little forward pressure on the stick to avoid hitting the next wave in a stalled condition. Then, just before the wave is reached, apply back pressure to avoid a nose-on collision with the wave.

The rough water take-off should be started just as the bows of the floats are rising on a wave. At this moment, full throttle should be applied. It is most important to realize that once on-the-step, there

FIGURE 18. *Cessna 150 in Rough Water Take-Off*

is only a slight difference in the nose attitude during a rough water take-off and a normal take-off. The nose is carried slightly higher, but great care must be taken to keep the nose of the floats down as far as possible, to keep from stalling when bouncing from wave to wave.

In summary, a take-off in very rough water is a succession of bounces from wave crest-to-wave crest. Under certain conditions the aircraft will literally be tossed into the air with a minimum flying speed. The pilot must exercise precision control to prevent the aircraft from stalling back into the waves. In rough water conditions, the pilot should carefully review his options to see if the aircraft could be taxied to a more protective area where he would encounter a less rough condition and, in some cases, it might be better to postpone the take-off rather than risk damage.

Some aircraft, such as the Cessna 185 and 206, when operated in high wind in excess of 20 knots and rough water conditions, can take-off with full flaps. This condition helps to eliminate the pounding of the rough water, but once airborne, the aircraft must be levelled out and the flaps carefully retracted, so that you do not settle back into the rough water.

Take-Offs in Restricted Areas

Occasionally the float pilot is forced to operate from a small pond or in a restricted area (see Figure 19). It is essential to develop a take-off method that can be utilized in tight spaces. One method,

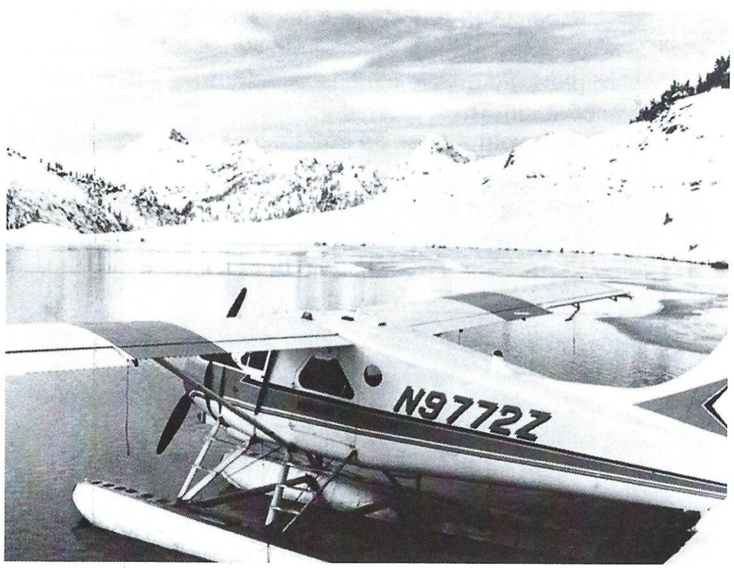


FIGURE 19. *Beaver on Small Glacier Lake (Elevation 6,000 ft.) in the Cascade Mountain Range.*

excellent in light wind conditions, which works well with small, under-powered aircraft is to place the aircraft on-the-step in a downwind direction and make a step turn into the wind at a speed just below take-off. Once the aircraft is free of the water, the pilot should continue his spiraling climb in order to avoid any obstructions along the shore line.

Crosswind Take-Offs

There are times and places in the operation of your float plane when you will be unable to take-off directly into the wind. Restricted areas on narrow canals are examples. If crosswinds are light, the take-off is similar to the method used in take-off of a land plane under crosswind conditions. In strong crosswinds, there is always danger, while getting on-the-step, of the downwind float becoming buried as the nose rises. Should this situation develop, immediately cut the throttle and allow the aircraft to weathercock into the wind. If the downwind float actually becomes buried to the point where there is danger of losing the aircraft, cut the throttle and immediately turn downwind, toward the buried float. This will reduce the speed of the buried float and stop it from diving further under water. If the throttle is not immediately cut, the downwind float will continue to bury or dive and there is a high probability the aircraft will be rolled over. If the aircraft float is not buried, but the pilot feels the situation is becoming dangerous, he should immediately cut the throttle and turn the aircraft into the wind.

A better crosswind take-off method, space permitting, is to start the run into the wind and then make a turn to the desired heading. Once turned crosswind, the upwind wing must be held down and enough opposite rudder given to hold the aircraft on the correct heading. Normal procedure is to keep the upwind wing *down* until the aircraft is well into the air. In severe crosswinds, you might find yourself unable to keep the aircraft heading straight. The water rudders should then be lowered. This is one of the few cases where a take-off is made with the water rudders in the down position in an effort to maintain directional control. After take-off, the rudders should be raised.

Porpoising

When the aircraft fails to remain between the upper and lower limits of trim, a dynamic instability may occur in the form of a rhythmic pitch and heave, known as porpoising. Severe porpoising can be dangerous and, if allowed to continue beyond one or two oscillations, there's a chance the motion will become so violent, loss of control and damage to the seaplane may occur.

Porpoising action results from an improper angle between the floats and the water surface. It may happen during either take-off or landing. In most cases, porpoising occurs when the bows of the floats are in a nose-low attitude, but it may also be encountered if the bows are held too high, such as when transitioning from being partially on-the-step mode, to fully on-the-step.

While step taxiing, porpoising can be checked by use of the elevator control. Simply apply back pressure to the elevator. This prevents the nose of the float from dragging or digging in. If the stern is dragging, forward elevator pressure should be applied. In any event, corrective action must be taken immediately and the elevator change made at the height of the float oscillation. Thus, if the bows are rising, back pressure on the stick should be applied at the top of the oscillation. It is important the correction not be made too late or it could contribute to and aggravate the motion. Some pilots feel they are able to correct a porpoising condition, but in almost all cases, you end up out of phase with the porpoise and only increase the severity of the situation. A good rule to follow, if you're unable to correct a porpoising condition almost immediately, is to close the throttle and come back on the stick. Once everything is under control start your take-off again.

Of course, each floatplane has different and uniquely individual porpoising characteristics. What might work to correct the condition in one, might exaggerate the condition in another. It takes practice and familiarization with your ship to determine its individual characteristics.

FIGURE 20. *Cessna 206 on 3500's Step Taxiing*

landings

Landing a floatplane is less difficult than bringing in a land plane, since most of the time you're setting it down directly into the wind onto a large open surface.

Aerial Inspection

Careful inspection of the water strip cannot be over-stressed. This is best done from a low altitude (Figure 21) where the pilot can check for floating objects and boats and become familiar with the surrounding terrain. Always be on the lookout for bridges or other obstacles which may be hidden around the corner, particularly when landing on narrow bodies of water such as rivers or bayous. Also consider hills, high trees or buildings that could cause problems later on during take-off. Keep in mind the floatplane can be landed in an area smaller than is later needed for taking-off, which means you can get into places you can't get out of. Special attention should be given to power wires; if you see poles, chances are almost 100 percent there are wires strung between them. Power lines are virtually impossible to see from the air and have been the cause of many floatplane accidents. Islands and island groups deserve special caution. Wires are usually strung either to the mainland or between individual islands, so when landing for the first time, make a careful survey. The pilot should pay special attention to any objects or obstacles in the water. Many accidents have also been caused by landing in water too shallow or by running the aircraft over a submerged sandbar. Special care should be taken when landing in exceptionally clear water, since water depth is difficult to judge.

After inspecting the terrain, the pilot should establish wind direction and velocity, as well as prevailing water surface conditions at the landing site. The floatplane should always be landed into the wind at the slowest possible speed. The pilot can use any indicators that are available such as smokestacks and flags, to arrive at wind direction and velocity. When flying in remote areas, wind direction and velocity become more difficult to determine.

The experienced float pilot learns much from tell-tale signs on the water. Watch the water for streaks which always run parallel to the wind and can be depended upon to chart its direction accurately. For the first few times, under mild wind conditions, the novice may experience some difficulty in seeing wind streaks; they will show up as smooth streaks parallel to the wind direction. Under strong wind conditions, it's easier to see a wind streak

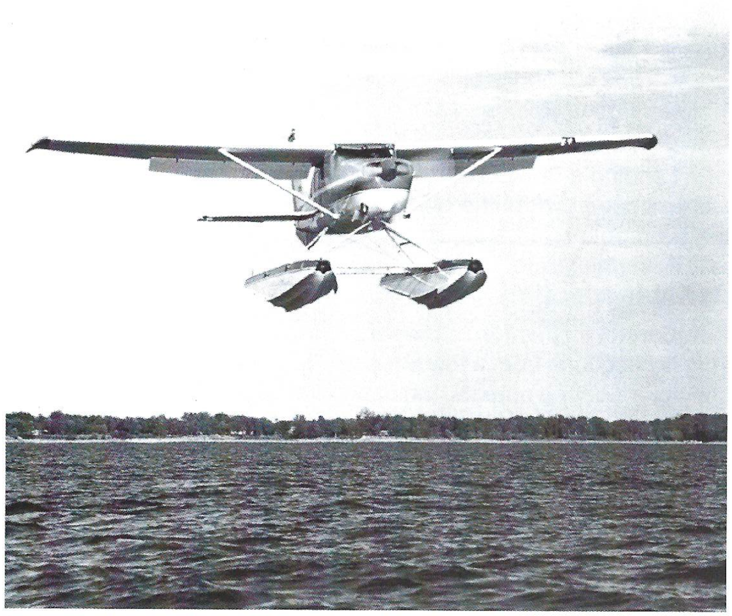


FIGURE 21. Low Altitude Inspection of Landing Area Prior to Touchdown.

because of the foam associated with it. Sometimes, you may become confused about the actual direction from which the wind is blowing (i.e, from north or south). Keep in mind that waves move faster than foam which drifts on the surface and appears to be moving through the waves. Normally, waves are at right angles to the wind even though streaks are parallel to it. In shifting wind, waves will not change at once and only streaks can be depended upon to give the correct directional. Seagulls or ducks on the water quite consistently head into the wind; but don't count too much on boats at anchor, for currents and tides easily swing them from upwind headings.

If the wind is so strong the waves are breaking in white caps, you can be sure that its velocity is in *excess* of 15 mph and you should look elsewhere for a spot to land.

Landing areas must also be carefully checked for large swells. Swells are found in open water and are caused by a previous wind condition or by the wake or wash from the sterns of large boats. The size of the swell from a boat depends more on the boat's speed than on it size. If a seaplane is landed in heavy swells, it can be tossed into the air and severely damaged. As a general rule, avoid landing your aircraft in heavy swell conditions. If you must, be sure to land *parallel* to the swell and forget about wind direction. It is important the pilot not land in swells caused by boats. A good practice is to circle the landing area until the swells have dissipated.

Landing in Normal Water

Landing the float plane may be done in either power-off or power-on modes. The power-on landing is recommended, since there is less chance for pilot error.

The power-on landing gives the pilot positive control over his aircraft. It should be done at maximum approved flap setting so the aircraft comes in at the slowest possible air speed. The approach is the same as with a land plane, with the aircraft trimmed to the recommended approach speed. Touchdown should be made in an attitude similar to, or slightly higher, than is recommended for taxiing on-the-step. This attitude will result in the floats making contact at the rear of the step and possibly the rear of the after body (Figure 22). Once the floats make contact with the water, close the throttle, hold the stick firmly and gradually apply back pressure. Back pressure overcomes the slight tendency of the aircraft to nose forward due to the increased drag of the floats as they make contact with the water surface.

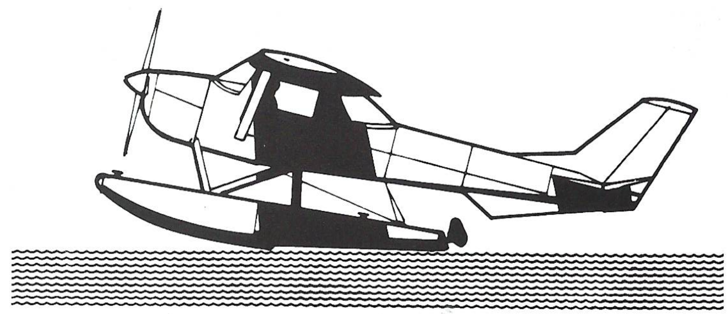


FIGURE 22. Correct Nose-Up Landing Attitude

The float pilot soon realizes the faster he lands, the more drag he encounters, causing a greater nose-down pitch. If your airplane tends to assume a severe nose-down attitude at maximum flap setting, it is recommended you consider using only two notches or approximately 20° of flaps. Your objective is to land the aircraft in a slightly nose-up attitude at the lowest possible air speed. As the aircraft slows down, the elevator should be brought fully back. In average water conditions, the seaplane may be landed in full stall. However, this is not recommended, especially for beginners, due to the difficulty in judging the aircraft's height above the water. In rough water, it's best to contact the water at minimum speed, so a full-stall landing is ordinarily recommended.

Landing in Rough Water

Varying conditions make it difficult to describe an ideal rough water procedure. In some cases, carrying power and approaching just above stall speed is preferred and, when conditions look right, you chop power to land. Power is carried and the aircraft is kept in a more or less flat condition so it will not contact the water at a high angle of attack. It should be realized that utilizing engine power will increase the speed but will make for a flatter approach angle which should help in eliminating the aircraft being tossed in the air. The pilot should always be ready to use power for recovery from severe bounces. If conditions are so rough that the pilot is unable to get his aircraft down on the water surface without severe bouncing, he can, and should, survey the area for a more ideal landing spot.

Glassy Water Landing

The single most deceptive phenomenon experienced by the seaplane pilot is a flat, calm condition known as glassy water. Calmness of the water tends to relax the pilot, where it should actually alert him. Glassy water is one of the most dangerous surface conditions you will encounter with your floatplane.

The water surface looks mirror-like, inviting, easy and in many cases, reflects the surrounding mountains and trees. Unknowingly, depth perception fails, making it extremely difficult to flare or roundout the aircraft in time. Glassy water accidents are caused by the pilot misjudging his height above the water. He either flies into it, or stalls out above it! Many experienced float pilots have been caught up in the deception. This is probably the most dangerous condition that the floatplane pilot will encounter.

If the pilot encounters a situation where he has only partial glassy water, he should treat it as total glassy water and use the landing procedure outlined below. He should also realize when landing under glassy water conditions in clear water, he will sometimes be looking at the *bottom of the lake and not at the surface of the water.*

A glassy water landing is *always a power-on landing,* and should be started when the aircraft is approximately 150-200 feet above the water. An accurate altimeter should be on board. If not, stay near the shore to maintain a reference above the water or, if at all possible, cross the shore line at the lowest safe altitude. The aircraft should be set up with not more than 20-30 degrees of flaps or a flap setting that will give the best nose-up attitude. The nose should be slightly above your normal landing attitude so there will be no possibility of digging the float bows in when the plane touches down on the water. The best speed is approximately 10 miles above stall with a rate of descent of 150 feet per minute. With constant power setting and a positive nose-up attitude, the air speed should be maintained fairly stable. Use the power setting that will give you 150 feet per minute rate of descent with a positive angle of attack. Do not become fixated on the air speed, change the power setting only if the air speed drops too low. Closely control the throttle so a constant descent is steadily maintained all the way down, until the aircraft makes contact with the water. As soon as contact is made, the throttle is immediately closed. Simultaneously apply a small amount of back pressure to the aircraft so that its natural nose-down tendency (caused by float drag) is overcome.

It is important that no changes be made in heading once the aircraft is within 200 feet of the surface since there is a possibility an accident could be caused by catching the airplane's wing tip in the water. Once a pilot has set up his aircraft for a glassy water landing he should use every aircraft instrument at his command (artificial horizon, rate of descent, air speed indicator, etc.) until water contact is made. Wings level and a nose-up attitude all the way are imperative!

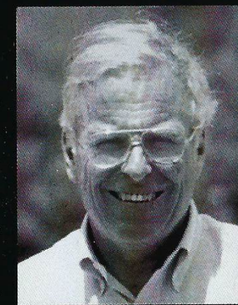
Glassy water landings consume a considerable landing distance. Check it out beforehand to make sure there's enough room. If you must land in a space that doesn't offer adequate room for the power approach, try to land as nearly as possible to the shore line or next to a boat. . .anything that can be used as a reference point. Caution should be exercised when landing next to an unfamiliar shore line due to the possibility of damaging the floats on submerged objects. The pilot should also respect the rights of boat operators and should stay far enough away from them. In isolated, remote regions, far from land or shore, I've heard of cases where a life jacket or map has been thrown in the drink as a reference marker on glassy water.

Night Landing

If possible, avoid getting yourself into a situation where you must undertake a night landing with your seaplane. It is recommended that you carefully plan your flight so that you arrive at your destination during daylight. Night landings can be extremely dangerous, since it is difficult or almost impossible to see boats, floating objects or other debris. In overcast conditions, it may also be difficult to distinguish between open fields and lakes. If a situation does arise where you must land your float plane on an unfamiliar water area, seriously consider the alternative of landing at a lighted airport. While this may seem a hazardous recommendation, there is actually little danger in landing the seaplane at a land airport. . . far less, in fact, than landing on unfamiliar water at night.

Emergency Landing

If the seaplane is flown cross-country and an emergency, such as engine failure develops, the pilot may be forced to make a landing on land. He should encounter less difficulty in such a landing than he would with a land plane. The seaplane may be



ABOUT THE AUTHOR

The author of HOW TO FLY FLOATS, J.J. Frey, is retired from EDO Corporation where he was Vice President of the Seaplane Operation. He had been with the company's Float Operation for over 35 years. Mr. Frey has been a licensed private pilot since 1964, and has flown extensively throughout Canada and the United States, including Alaska. With flight time of almost 5000 hours, he holds an instrument rating, as well as SEL (Single Engine Land), MEL (Multi-Engine Land), SES (Single Engine Sea), MES (Multi-Engine Sea) endorsements to his license.

In 1985 the FAA awarded Mr. Frey its Distinguished Service Award, recognizing his expertise and untiring support of aviation safety. In 1997 he was also given by the FAA an Award of Extraordinary Service, for his exceptional support in fostering safety as an aviation safety counselor for the Albany District office. He is an Aviation Safety Counselor for the FAA. Mr. Frey is currently the President of the Seaplane Pilots Association where he was Chairman of the Board for 15 years.

HOW TO FLY FLOATS was first published in the early 1970's and has sold more than 200,000 copies. It is widely recognized as the most authoritative guide on the subject of flying floats and is used by the majority of seaplane pilots. It has been translated into three languages.

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