FLIGHT TRAINING MANUAL

Lake AIRCRAFT

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606 N. Dyer Blvd.
Kissimmee Airport
Kissimmee, FL 32741
Telephone: (407) 847-9000
TELEX: 52-3258 (LAKE AIR KISS)
FAX: (407) 847-4516

500 West Perimeter Road
Renton Airport
Renton, WA 98055
Telephone: (206) 226-2100
TELEX: 32-6052 (LAKE AIR WEST)
FAX: (206) 228-9769
TRAINING MANUAL

THE CONTENTS OF THIS TRAINING MANUAL ARE TO PROVIDE A RECOMMENDED GUIDELINE FOR THE INSTRUCTOR AND THE STUDENT.

THIS MANUAL CONTAINS INFORMATION EXTRACTED FROM "FEDERAL AVIATION REGULATIONS", AIRMAN'S INFORMATION MANUAL AND THE FAA APPROVED AIRPLANE FLIGHT MANUAL.
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LAKE AIRCRAFT
606 N. DYER BLVD
KISSIMMEE AIRPORT, KISSIMMEE, FL 32741
TELEPHONE: (407) 847-9000
FAX: (407) 847-4516
TELEX: 52-3258 LAKE AIR KISS

LAKE AIRCRAFT, NORTH
50 AIRPORT ROAD
LACONIA AIRPORT
GILFORD, NEW HAMPSHIRE 03246
TELEPHONE: (603) 524-5868
FAX: (603) 524-5728
TELEX: 95-3554 LAKE AIR LANA

LAKE AIRCRAFT, NORTH
500 W. PERIMETER ROAD
BUILDING A
RENTON, WASHINGTON 98055
TELEPHONE: (206) 226-2100
FAX: (206) 228-9769
TELEX: 32-6052 LAKE AIR WEST
ASSIGNMENTS

1. Study this Training Manual.

2. Read the approved Airplane Flight Manual.

3. Cockpit familiarization and check lists (take note of foot position for proper application of rudder & brake).


5. Read this Training Manual.

6. Study the following Sections in this manual:
   SECTION XVI, (pertaining to swells and emergency ditching).
   FAR 91.5, (pertaining to Preflight)
   FAR 91.69, (water right-of-way rules)

7. Fill out recommendation form provided in this Training Manual.


9. Become familiar with VFR Sectional Charts for area in use.


Put check in blocks as assignments are completed.
GROUND SCHOOL

POINTS TO BE STRESSED

1. Importance of proper trimming.

2. Operation in confined areas, especially takeoffs and landings in crosswinds.

3. When to "hide" (find shelter) from rough water.

4. How to find shelter.

5. How to survey the landing area in advance for obstructions, wind direction & velocity, available length, water conditions, etc.

6. How to handle water-oriented emergencies.

7. How to handle failure of hydraulic and electrical systems.

8. How to handle engine-out and in-flight emergencies.

9. How to recognize and handle rough water. Keep in mind that rough water begins at approximately 12 inches for the inexperienced.

10. How to recognize and handle glassy water.

11. How to handle glassy conditions in confined areas without obstacles. (Note: Don't attempt a glassy landing in confined short areas with obstacles).

12. How to work weight & balance problems.

13. How to prevent the wing floats from submerging.

14. Performance, range, Koch Charts or DENTAL Computers, etc.

15. Special tips that are applicable to: cold weather, maintenance, cross country, special equipment, etc.

LAND OPERATIONS

(CLASSROOM SESSION)

1. Preflight: Including check of all proper documents (pilot & aircraft) and proper weight & balance limits.

2. Familiarization with check list.

3. Taxi patterns.

4. Coordination exercises.

5. Slow flight & minimum control airspeed: stressing flaps up/down differences.


7. Takeoff & departure stalls should be demonstrated at a safe altitude, as required by FAR 91.71.

8. Approach stalls; refer to #7.

9. Accelerated stalls; refer to #7.


11. Takeoffs & landings.


13. Short takeoffs & landings.


WATER OPERATIONS

(CLASSROOM SESSION)

1. Survey of landing area for wind direction and velocity, obstructions, length, water conditions, etc.

2. Step taxi: developing attitude awareness prior to step landings.

3. Step landings.


5. Step turns.

6. Crosswind landings.

7. Rough water landings.

8. Stall landings.


11. Ramping.

12. Docking.


14. Water emergencies (simulated): ripped floats, damaged hull, sudden squalls, porpoise, unexpected wakes, shallow versus deep water operations, aborting wing-low initial takeoff run, etc.

15. Emergency evacuation procedures.


17. Spot landings.

18. STOL (Short TakeOff & Landing) Operations

19. High density altitude situations (simulated if need be).

20. Full gross weight operations.

GENERAL AIRCRAFT PREFLIGHT

Keep in mind you have the following categories to check:

1. Fuel.
2. Oil (general scrutiny of engine area, including oil quantity and oil cooler and air inlets free of obstruction).
3. Water items (seven plugs - water rudder, paddle, bow line, anchor if desired).

*Inspect ballast compartments, you should note the weight and balance of the aircraft. Also check the baggage area for unsuspected items aboard.

DETAILED PREFLIGHT

PART I (COCKPIT)

1. Unlock BOTH doors.
2. Check landing gear handle DOWN.
3. Remove control locks.
4. Check MAGS OFF, master switch ON.
5. Check gear and flap position lights.
6. Check fuel quantity indication.
7. Master switch off.

PART II (CHECK ENGINE AREA)

1. Oil quantity. *
2. Security of nuts, bolts, screws.
3. Check propeller for nicks, cracks, excessive oil or grease and general condition.
4. Fuel level, main tank, use dipstick if less than full.

* LA-4-200  6 to 8 quarts
  LA-250     8 to 12 quarts
  LA-270     8 to 10 quarts
PART III  CHECK LEFT WING

1. Drain fuel lines and tank sumps at quick drains.
2. Check vent openings free of obstructions.
3. Check left landing gear for security, brake condition, extension of strut, condition of tires and hydraulic lines, up and down locks for freedom of operation.
4. Check fuel quantity - use fuel dipstick.
5. Check pitot tube for security and openings free of obstructions.
6. Check lift detector. (Stall warning tab).
7. Check hinge pins on ailerons; bolts and nuts on flaps.
8. Check vertical and horizontal stabilizers, check ballast.
9. Note rudder push rod boot drain clear.
10. Check elevator, trim tabs and air rudder hinge pins and rod ends.

PART IV  CHECK RIGHT WING

1. Check hydraulic reservoir for proper quantity.
2. Check right flap bolts, nuts and aileron hinge pins.
3. Check right landing gear for security, brake condition, extension of strut, condition of tires and hydraulic lines, up and down locks for freedom of operation.
4. Drain fuel lines and tank sumps at quick drains.
5. Check fuel quantity - use fuel dipstick.

PART V  BOW AREA

1. Check nose wheel shimmy damper, inflation of strut and tire condition.
2. Bow locker, anchor, line and ballast.
PART VI  PREFLOAT CHECK

1. Exercise water rudder.

2. Drain all six water-tight compartments (seven plugs installed).

3. Check water rudder for proper extension.

IF FLIGHT AT NIGHT IS PLANNED, CHECK OPERATION OF ALL LIGHTS AND MAKE SURE A FLASHLIGHT IS ON BOARD:

**NIGHT WATER OPERATIONS ARE NOT RECOMMENDED**
STARTING PROCEDURES

FUEL INJECTED BUCCANEER/200 EP/LA 250 RENEGADE

After entering the cockpit, note Landing Gear handle "UP" or "DOWN" as appropriate, turn on the switches located on the left-hand side of the panel for the battery, alternator and hydraulic pump. The main fuel valve is located on the bulkhead at the rear of the cabin; it must be set in "on" position.* The brakes should be applied and locked, propeller control forward for high rpm, magnetos on "both".

*The main fuel valve on the LA 250 is located on the overhead panel on the right side; or on the newer models at the pilot's left side panel.

COLD START

1. Open throttle approximately 1/4 inch.
2. Move mixture to full-rich position.
3. Turn on electric fuel pump for approximately 7 seconds, then off.
4. Engage starter.
5. If the engine does not fire within five to ten seconds, disengage starter and re-prime.

HOT START

1. Open throttle approximately 1/4 inch.
2. Leave mixture control at idle cut-off.
3. Turn electric fuel pump on for a few seconds, then off.
4. Engage starter.
5. When engine fires, move mixture control to the full-rich position.
6. Should the engine not start, flood it deliberately and use the procedure described below.

FLOODED START

1. Open throttle full.
2. Leave mixture control at idle cut-off.
4. Engage starter until engine fires.
5. Move mixture control forward slowly to full-rich position and retard throttle.
WARM-UP AND RUN-UP

1. If aircraft is on the water, ensure that its movement will be clear of obstructions.

2. After-start check list:

   Check oil pressure and engine gauges. If no pressure is indicated within 30 seconds, close the throttle, stop the engine and locate the cause of the failure. If the oil pressure reading is normal, advance the throttle until the tachometer is between 800 and 1200 RPM. Warm up the engine for approximately two minutes in warm weather and four minutes in cold weather. Engine warm-up is sufficient when the throttle can be opened without the engine faltering.

3. Following the warm-up period, advance to 1800 RPM* and check the magnetos. The magneto drop should not exceed 125 RPM, with a max difference of 75 RPM. Then, propeller control briefly to "High Pitch". Engine speed should reduce approximately 500 RPM. It is mandatory that the engine be warm for this check, as the propeller pitch mechanism is operated by the engine oil. Do not use excessive manifold pressure with low RPM or damage to the engine may result.

   *In the LA 250 and LA 270T, magneto check at 2200 RPM and propeller at 1800 RPM.

4. Pre-Takeoff:

   Magnetos.................both on
   Master switch............on
   Alternator switch........on
   Fuel Boost Pump..........on
   Hydraulic pump...........on
   Flaps...................down
   Water rudder.............up
   Trim.....................set
   Propeller...............set
   Mixture..................set
   Fuel Valve...............on
   Engine Instruments.......check
   Flight Instruments.......set
   Controls................free

5. Normal climb check list:
   a) Establish climb speed according to the flight manual for your aircraft.
   b) Hydraulic pressure check, then gear-up if applicable.
   c) Climb at full power.
   d) Flaps up as recommended.

6. Cruise check list:
   a) Sample setting: 24.0 squared 200 or standard 250. (Check Engine Owners Handbook for cruise power setting.
   b) Fuel pump: off and check fuel pressure.
TAKEOFF TRIM (LAND OR WATER)

CHECK VISUALLY FROM COCKPIT

FLAPS DOWN ARE RECOMMENDED FOR ALL TAKEOFFS AND LANDINGS.

APPROXIMATE LOCATION OF TRIM SURFACES FOR TAKEOFF WITH ONE PERSON ABOARD. (SLIGHTLY UP)

CHECK VISUALLY

STANDARD POSITION FOR LAND OR WATER TAKEOFF. (TRIM INDICATOR AT THE REAR OF THE GREEN ARC)
PRELANDING CHECK LIST

THE FOLLOWING RULE APPLIES AT ALL TIMES WHEN IN FLIGHT:

Do not attempt to move the gear without first checking for adequate hydraulic pressure—anywhere in green arc can be considered adequate.

CHECK LIST AS PLACARDED:

<table>
<thead>
<tr>
<th>TAKEOFF</th>
<th>CHECK LIST</th>
<th>LANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAGNETOS......BOTH ON</td>
<td>ALTERNATOR SWITCH...ON</td>
<td>FUEL BOOST PUMP...ON</td>
</tr>
<tr>
<td>MASTER SWITCH......ON</td>
<td>HYDRAULIC PUMP...ON</td>
<td>WHEELS DOWN......(LAND)</td>
</tr>
<tr>
<td>ALTERNATOR SWITCH.ON</td>
<td>WHEELS UP......(WATER)</td>
<td>FLAPS............DOWN</td>
</tr>
<tr>
<td>FUEL BOOST PUMP...ON</td>
<td>WATER RUDDER........UP</td>
<td>WATER RUDDER........UP</td>
</tr>
<tr>
<td>HYDRAULIC PUMP...ON</td>
<td>TRIM..............SET</td>
<td>TRIM..............SET</td>
</tr>
<tr>
<td>FLAPS..............DOWN</td>
<td>PROPELLER...........SET</td>
<td>PROPELLER...........SET</td>
</tr>
<tr>
<td>WATER RUDDER........UP</td>
<td>MIXTURE.............SET</td>
<td>MIXTURE.............SET</td>
</tr>
<tr>
<td>TRIM..............SET</td>
<td>FUEL VALVE.........ON</td>
<td>ENGINE INSTR CHECK</td>
</tr>
<tr>
<td>PROPELLER...........SET</td>
<td>ENGINE INSTR CHECK</td>
<td>CONTROLS........FREE</td>
</tr>
</tbody>
</table>

The landing check list as taught in the program backs up the above placard and adds a little more CAUTION.

THE LANDING CHECK LIST:

1. Out loud: (type-landing) and gear position.
2. Initial power reduction: set 15" or as needed.
3. Check hydraulic pressure.
4. Gear (proper configuration for land or water).
5. Flaps down.
6. Water rudder up.
7. Trim as needed.
8. (Overhead): mixture and prop forward, fuel on... Pause here and make a common sense confirmation using 9, 10, 11.
9. Visually inspect wheels up or down as appropriate.
10. Visually inspect wheel and flap lights for proper indication.
11. Hydraulic pressure holding within the green arc.
LOCATION OF CONTROLS RELATED TO LANDING CHECK LIST

THIS CHECK LIST IS IN ADDITION TO YOUR RAMP CHECK AND IS TO BE RUN PRIOR TO INITIATING TAKEOFF OR LANDING.

ONE THROUGH NINE CONTAINS:

The \textit{HABIT FLOW} portion of the check list. If accomplished in the proper order, \textit{it is a smooth flow}. After the initial power reduction, a steady movement from left to right places you near each control as per check list.

Example:

1. (\textbf{OUT LOUD}) "This is a water landing, my gear is up." Visually check for clean hull.
2. Reduce power to 15", or as appropriate.
3. The four far-left circuit breaker/switches to "ON".
4. Adequate hydraulic pressure.
5. The nearest applicable control to your hand now will be the gear handle (check for up & up light).
6. Near to hand now is the flap control handle (check for down & down light).
7. Now water rudder (check up).
8. Nearest now is trim control.
9. Now to the overhead (mixture and prop forward and fuel on).
10. Now the commonsense check. At this point the aircraft should be well trimmed and headed for the water in the proper configuration. Let's pause here and run through the three (3) most important items:

A. \textbf{Outside:} Visually check for three wheels up for the water.
B. \textbf{Inside:} Check lights for wheels securely locked up and flaps down.
C. \textbf{Confirm} hydraulic pressure.

One further point: Inbound to any pattern, good pilot technique dictates that you check engine performance gauges, fuel gauges, hydraulic pressure, etc. This is standard procedure prior to initiating the pattern check list.
() Indicates size of circuit breaker.

To the reader:

This illustration shows the general layout of one particular panel.
"HABIT FLOW PATTERN"

NOTE: Typical Instrument Panel
STALL DEMONSTRATIONS

PRIOR TO SLOWFLIGHT OR STALL DEMONSTRATIONS, CLEARING TURNS ARE REQUIRED.

ACCELERATED STALL:

1. Use a reduced power setting: (example: 15"), mixture rich, prop forward.

2. Slow to 80 mph and make a 45 degree banked turn about some object on the ground. Use yoke to maintain altitude ("foolishly").

3. Now correct to level flight using rudder, ailerons and power. Strive to lose no altitude whatsoever.

The above stall may happen unexpectedly when sight-seeing at low altitudes and the power is reduced for slow flight. Distraction by the terrain, trees, lake or whatever, caused the pilot to mistakenly use the wrong control (the yoke) to hold altitude under these conditions.

TAKEOFF & DEPARTURE STALLS:

Use the name of the maneuver and strive to make the situation real in your mind. Takeoff and departure stall means you are on the numbers when you initiate the stall.

1. Reduce to approximately 15", mixture rich, prop forward.

2. Put yourself mentally on the runway numbers and run your pattern check list for takeoff.

3. Full power, lift off at 60 mph and take note of altitude of your runway.

4. Retract gear and "foolishly" climb too steeply. Also simulate turning to miss some object and initiate a constant 15 degree bank.

5. On stall recovery, attain best angle of climb (Vx) above the altitude you noted in step 3.
APPROACH STALL:

Mentally put yourself in a downwind position (purposely too far away for a power-off approach) and run your pattern check list.

Takeoff stall - mentally put yourself here and run pattern check list.

Approach stall - put yourself here and run pattern check list.

Other airwork - slowflight - steep turns - etc., to be performed as usual.
TIPS FOR LAND APPROACHES AND LANDINGS

FULL FLAPS RECOMMENDED FOR TAKEOFF AND LANDING

1. A slightly steep approach to a slow touchdown is preferred.

2. Recommended final approach speeds with full flaps: LA4-200: 70 mph IAS, 200 EP: 65 kts IAS, and LA 250: 70 kts IAS as a minimum; remember some power will be required.

3. Smoothly reduce to idle during flare unless loaded near aft C. G. In that event, leave some power until nearly stopped.

4. Using the proper threshold speed, initiate a smooth rotation no higher than 10 to 12 feet. Thirty foot stair-step approaches are not permissible. Water transitions require precision, therefore proper land drill is essential to maintain the proficiency needed for water work.

5. Power-off stall and power-on stall are the same speeds.

6. High approaches are the smoothest and safest, especially on gusty days or at full gross weight.

7. Repeating a very important point: especially favor the high approach during gusty and high gross conditions.

8. Crosswind runway landings are made in the wing-low manner while water crosswind landings are made in the wings-level or crab manner. This is not just threshold info, but also applies to touchdown as wind dictates.

9. For certification: FAR's require crosswind landing at 20% of \( V_{S0} \) \( (45) \) which equals 9 as a component. While demonstrated component is much higher, we'll leave this figure in this training manual as a conservative \textbf{STUDENT} recommendation.

Conventional technique works as well in the Lake.
LANDING INFO (LAND OR WATER)

Flaps **DOWN** are recommended for all takeoffs and landings.

Not a **VISUAL** check on landing (only on takeoff). Trim by feel on approach.

One soul aboard (170 lbs. or less) trim slightly nose-heavy during approach phase, making flare feel conventional due to slightly aft C.G. when operating solo.

Not a **VISUAL** check on landing, (only on takeoff). Trim by feel on approach.

More than one soul aboard, trim for a "HANDS OFF" feel on approach.

Conventional trimming
WATER LANDING PROFILES

STEP LANDING

WATER CONDITION:
Normal rippled water

CHOICE OF TECHNIQUES, HOW ACCOMPLISHED: FLAPS DOWN
Use normal power approach to a STEP landing. 70 mph Buccaneer, 65 kts EP, 70 kts LA/250. Essentially a power approach so as to maintain a reasonable glide angle. Flare at a slightly lower height than for either water stall landing or land stall landing and ease power off during flare.

GLASSY WATER LANDING

WATER CONDITION:
Glassy (mirror-like) surface

CHOICE OF TECHNIQUES, HOW ACCOMPLISHED: FLAPS DOWN
Maintain touchdown attitude throughout approach. Approximately 55 to 60 mph in Buccaneer, 55 kts in EP, 60 kts in LA/250. Use power to maintain approximately 200 fpm maximum descent. Upon touchdown ease power to idle.

STALL LANDING

WATER CONDITION:
Rough water: 9 to 12-inch wave height

CHOICE OF TECHNIQUES, HOW ACCOMPLISHED: FLAPS DOWN
Use power-on or-off approach to a STALL landing. 70 mph Buccaneer, 65 kts EP. Approach to a normal stall-landing flare height, with a conventional tail-low attitude. There should be no energy or lift left prior to touchdown. If power on, reduce during flare.

In the LA/250, execute a rough water landing with partial power flaps down. Touchdown area on the hull should be concentrated to mid-hull, or skeg area. Upon touchdown, maintain step attitude with slight pitch-up condition. Close the throttle gradually preventing the bow from rising or falling, until the aircraft comes to a stop.
WATER LANDINGS

DO NOT ATTEMPT GLASSY WATER LANDING WITHOUT A GOOD CHECK-OUT AND SURFACE SCANNING.

CROSSWIND:

TAKEOFF

Water rudder down until power applied.

Full aileron into wind until control response.

Lift-off normal.

LANDING

Approach normal.

Keep wings level.

If narrow, use crab technique.
WATER TAKEOFF

NORMAL CONDITIONS AND GLASSY WATER:

Water rudder UP.
Control wheel back.
Full power (apply gradually).
Relax back pressure as aircraft starts to climb onto step.
If porpoising begins — reapply slight back pressure.
Attempt to keep aircraft on last 12" of step. (In the Buccaneer DO NOT force airplane into air. Allow it to fly itself off. In the EP there is sufficient control response and lift to be able to rotate the aircraft from the water at approximately 45 to 50 kts). Variables such as density altitude and high gross weight will change the aircraft performance.

ROUGH WATER:

Same as normal conditions, except:
Hold bow slightly higher to preclude premature flight due to being bounced into air.
Flaps UP until plane is on step.

SWELLS: (AVOID IF POSSIBLE)

Takeoff and landing.
Movement: Always parallel, never perpendicular — regardless of wind.

NOTE: The above diagram is intentionally exaggerated. Don't confuse swells and chop. Make parallel landings for swells regardless of wind. Make into-wind landings for chop.
WATER TIPS

1. Taxi at a slow speed unless taxiing on the step.

2. The aircraft will tend to weathercock into the wind during slow taxiing.

3. Do not exceed 1200 RPM when plow taxiing. It is better to generally avoid plow taxiing and instead choose slow or step taxiing, as may be applicable.

4. Water rudder is used for slow taxi work and for transition to and from step when taxiing in a crosswind.

5. For step and rough water landings, the approach to a touchdown should be made with near-zero vertical velocity. (You must control the rate of descent for any landing).

6. The glassy water approach is to be performed with due caution.

7. When near the water, (on takeoff or landing), never allow the nose to drop below the horizon.

8. Most of the land airports you frequent have had much effort spent making runways. When you land on water be willing to spend time to "make" your runway (relative to the wind) when scrutinizing the area for the landing. Also consider the departure carefully.

9. Always take off and land with wings level. Water crosswind technique is to have wings level and allow drift, or use crab technique to offset drift if area dictates.

10. Generally land somewhat near-shore. In the event of difficulty, shallow water will be near.

11. Keep the aircraft trimmed for water operations.

12. The water run for glassy water takeoffs will be longer.

13. On climb-out, do not raise the flaps until the appropriate airspeed has been reached as indicated in the flight manual for your aircraft.

14. Power reductions should be made in the pattern 1° at a time.

15. Refer to FAR 91.69 for RIGHT-OF-WAY-RULES; WATER OPERATIONS.

16. For correction of a bad step landing, conversion to the stall landing is normally the best choice.
WATER TIPS CONTINUED

17. The right-of-way-rules do not apply when using private narrow channels. A slow taxi should be executed, (along the dotted line shown in the illustration below), when the wind direction is as indicated.

A proper takeoff or landing transition track will be the center of the channel at all times.

18. During a transition period, the bow will act temporarily as a sail and the wind will force the aircraft toward the downwind side of the channel. It is important to maintain enough drift control so the effect of the crosswind will be canceled.

19. While the Lake is capable of much rougher water, approximately 15 mph wind velocity and/or BEGINNING of whitecap conditions and defined wind streaks are indications that the student should seek sheltered conditions.

20. Slow taxi downwind turns can prove difficult due to weather-vaning tendencies. However, the same tendencies make an upwind turn very easy.

21. During step taxi, turning upwind can prove unsafe due to centrifugal force and wing tipping. When turning downwind, centrifugal force and wing tipping will cancel out.

22. When glassy water is encountered, landing near the shoreline is a good practice for better peripheral vision altitude clues.
23. (A) Terrain and wind present different situations requiring varying techniques. A safe technique (A) would be to accelerate to the step attitude into the wind, maintain 25 to 30 mph during the turn and use either crosswind runway. The wind cancels the effect of the centrifugal force and skid.

(B) Is an unsafe condition, with wind as indicated.

(C) This method is preferred when transitioning to or from the step in either direction.
24. Wind as indicated, choice of sheltered runways would be in the following order:

**1ST CHOICE (A)**
Pick a natural inlet if available.
- a. Into wind
- b. Shelter
- c. Go-around room

**2ND CHOICE (B)**
If no natural inlet is available, pick B type runways—heading for points.
- a. Basically into wind
- b. Shelter
- c. Go-around room

**3RD CHOICE (C)**
If water too rough at B, pick C. Direct crosswind—C—the approach may prove gusty but the touchdown area will be sheltered.

25. Rough water takeoff - keep the bow higher than normal and if desired, delay lowering of flaps until established on the step. However, just leaving the flaps down throughout would be a better choice than glancing in the cockpit at a critical moment to lower them. Therefore, the recommendation for students is: flaps down.
BUCCANEER

V SPEEDS IAS

\[
\begin{align*}
V_{so} & \quad 45 \text{ mph Power on or off} \\
V_{sl} & \quad 52 \text{ mph Power on or off} \\
V_x & \quad 60 \text{ mph (Flaps down)} \\
& \quad \text{not applicable (Flaps up)} \\
V_y & \quad 65 \text{ mph (Flaps down)} \\
& \quad 85 \text{ mph (Flaps up)} \\
V_{lo} & \quad 125 \text{ mph} \\
V_{fe} & \quad 125 \text{ mph} \\
V_{ne} & \quad 146 \text{ mph (154 mph Ser. No. 1037 and on)}
\end{align*}
\]

RECOMMENDED BEST APPROACH SPEED: 70 mph (Flaps down)

BEST GLIDE

\[
\begin{align*}
& \quad 85 \text{ mph (Flaps up)} \\
& \quad 70 \text{ mph (Flaps down)}
\end{align*}
\]

V SPEEDS MUST BE FIRMLY MEMORIZED!
**EP 200**

**V SPEEDS (IAS)**

<table>
<thead>
<tr>
<th>Vso</th>
<th>39 kts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vsl</td>
<td>53 kts</td>
</tr>
</tbody>
</table>
| Vx   | 52 kts (Flaps down)  
       | not applicable (Flaps up) |
|Vy    | 57 kts (Flaps down)  
       | 74 kts (Flaps up) |
| Va   | 107 kts |
| Vlo  | 109 kts |
| Lfe  | 109 kt |
| Vne  | 134 kts (127 kts. prior to Ser.No. 1037) |

**RECOMMENDED BEST APPROACH SPEED:**

<table>
<thead>
<tr>
<th>65 kts (Flaps down)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 kts (Flaps down)</td>
</tr>
<tr>
<td>Power off</td>
</tr>
</tbody>
</table>

**BEST GLIDE**

<table>
<thead>
<tr>
<th>74 kts (Flaps up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65 kts (Flaps down)</td>
</tr>
</tbody>
</table>

---

**V SPEEDS MUST BE FIRMLY MEMORIZED!**
RENEGADE

V SPEEDS (IAS)

Vso  49 kts
Vsl  55 kts
Vx   58 kts (Flaps down)
      66 kts (Flaps up)
Vy   62 kts (Flaps down)
      76 kts (Flaps up)
Va   115 kts
Vlo  107 kts
Vfe  107 kts
Vne  145 kts

RECOMMENDED BEST APPROACH SPEED: 70 kts (Flaps down)

BEST GLIDE

84 kts (Flaps up)

70 kts (Flaps down)

V SPEEDS MUST BE FIRMLY MEMORIZED!
**V SPEEDS**

Fill blanks with the speeds that are appropriate to the aircraft to be utilized, i.e.:

**BUCCANEER, EP, RENEGADE**

<table>
<thead>
<tr>
<th>KTS</th>
<th>MPH</th>
<th>AIRCRAFT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vso</td>
<td></td>
<td>Power On or Off</td>
</tr>
<tr>
<td>Vsl</td>
<td></td>
<td>Power On or Off</td>
</tr>
<tr>
<td>Vx</td>
<td></td>
<td>Flaps Down</td>
</tr>
<tr>
<td>Vx</td>
<td></td>
<td>Flaps Up (not applicable Buccaneer)</td>
</tr>
<tr>
<td>Vy</td>
<td></td>
<td>Flaps Down</td>
</tr>
<tr>
<td>Vy</td>
<td></td>
<td>Flaps Up</td>
</tr>
<tr>
<td>Va</td>
<td></td>
<td>Maneuvering</td>
</tr>
<tr>
<td>Vlo</td>
<td></td>
<td>Max. landing gear operating</td>
</tr>
<tr>
<td>Vfe</td>
<td></td>
<td>Max. flap extended</td>
</tr>
<tr>
<td>Vne</td>
<td></td>
<td>Never exceed</td>
</tr>
</tbody>
</table>

Flaps-up best glide speed as per *Airplane Flight Manual*.

<table>
<thead>
<tr>
<th>KTS</th>
<th>MPH</th>
<th>AIRCRAFT TYPE</th>
</tr>
</thead>
</table>

Flaps-down best glide speed as per *Airplane Flight Manual*.

<table>
<thead>
<tr>
<th>KTS</th>
<th>MPH</th>
<th>AIRCRAFT TYPE</th>
</tr>
</thead>
</table>

**V SPEED LEGEND:**

- **Vso** — Stall speed gear and flaps down
- **Vsl** — Stall Clean
- **Vx** — Best Angle of Climb
- **Vy** — Best Rate of Climb
- **Va** — Maneuvering Speed
- **Vlo** — Max. Landing Gear Operating
- **Vfe** — Max. Flap Extended Speed
- **Vne** — Never Exceed
Loss of Aircraft Performance During Hot Weather

Thin air reduces lift. You get thin air at high altitudes and in hot weather. The hotter the temperature, the thinner the air. Do you realize that Kansas City Airport with an elevation of 744 feet above sea level can have an effective elevation identical to Stapleton Field, Denver, at 5325 feet above sea level, under conditions of extreme heat and low pressure?

Do you realize that Brees Airport at Laramie, Wyoming, at 7273 feet above sea level, can be above the safe operational altitude of your aircraft during hot weather?

NOTE: The effective elevation of Brees Airport at 86°F, for example, is 10,250 feet—Caution!

The rarefied air at higher altitudes lowers the efficiency of engine and propeller, and lessens a plane’s rate of climb. A typical light plane has a maximum rate of climb at sea level of 420 feet per minute, whereas its maximum rate of climb at 5,000 feet altitude is only 225 feet per minute.

This plane might be able to clear a 400 foot hill or factory stack located a few miles from a sea level airport, but if the pilot tried it at 5,000 feet, he would smack right into the middle of the obstruction.

Remember: Any increase in operating altitude (due to elevation or high temperature) greatly increases takeoff and landing roll.

See chart and example on next page

This chart indicates typical representative values for personal airplanes. For exact values consult your Airplane Flight Manual. This chart may be conservative for airplanes with supercharged engines. Also remember that long grass, sand, mud or deep snow can easily double your takeoff distance.
THE KOCH CHART FOR
ALTITUDE AND TEMPERATURE EFFECTS

TO FIND THE EFFECT OF ALTITUDE AND TEMPERATURE
CONNECT THE TEMPERATURE AND AIRPORT ALTITUDE
BY A STRAIGHT LINE.

READ THE INCREASE IN TAKE-OFF DISTANCE AND THE
DECREASE IN RATE OF CLimb FROM STANDARD SEA
LEVEL VALUES HERE

EXAMPLE LINE (see data below)

ADD THIS PERCENTAGE TO
YOUR NORMAL TAKE-OFF DISTANCE

*FOR FIXED PITCHED PROPS
ADD 50%

EXAMPLE: The diagonal line shows that 350% must
be added for a temperature of 100° and a pressure
altitude of 6,000 feet. Therefore, if your standard
temperature sea level take-off distance, in order to
climb to 50 feet, normally requires 1,000 feet of
runway, it would become 3,500 feet under the con-
ditions shown. In addition, the rate of climb would
be decreased 76%. Also, if your normal sea level
rate of climb is 600 feet per minute, it would become
120 feet per minute.

This chart indicates typical representative values for "personal" airplanes.
For exact values consult your airplane flight manual.
The chart may be conservative for airplanes with supercharged engines.
Also remember that long grass, sand, mud or deep snow can easily double
your take-off distance.
<table>
<thead>
<tr>
<th>CHECKED OUT FOR</th>
<th>DATE</th>
<th>CHECK PILOT SIGNATURE</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Flights</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross Country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Night Flight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IFR Flight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pilot's name________________________Medical date____Class____
Certificate #, type & ratings_____________________________
Total flying time-SEL:___ MEL:___ Last 90 days-SEL:___ MEL:_____
Aircraft Make & Model_____________________________________
Total Fuel Capacity?____________________________________
     Grade of fuel?______________________________________
     Range in hours_________________________ at 75% Power?
     Color of fuel?______________________________________
Name all unsafe gear indications:________________________
How does the emergency gear extension operate?____________
Alternator output in amps?_____________________________
Maximum weight of passengers & baggage with full fuel & oil?___
Best angle of climb? (Vx)_______________________________
Best rate? (Vy)______________________________________
Minimum runway length, no wind, max. gross, sea level & std.
     conditions for takeoff?_____________________________
     For landing?______________________________________
Stall speed, clean? (Vsl)______________________________
     Gear/flaps down? (Vso)____________________________
Normal cruising RPM's?_________________________________
     Manifold pressure?________________________________
Maneuvering speed? (Va)_______________________________
Never exceed speed? (Vne)______________________________
LOW ALTITUDE ENGINE-OUT PROCEDURE

COMMIT THESE FIVE ITEMS TO MEMORY:

1. *Glide and fuel *pump on.
2. *Pick landing site into wind as possible.
5. +Configuration for the landing*
   *Fly it
   +Troubleshoot it

EXPLANATION OF ABOVE:

1. Maintain flying control (glide) and check the circuit breaker for the aux. fuel pump. Memorizing best glide speed allows you to set up an immediate glide during stress and also do a very rapid bit of troubleshooting without interrupting your efforts to glide and spot a landing area.

2. Self explanatory.

3. Fuel, the most common reason for engine failure. Mixture rich, fuel on, aux. fuel pump on, management of aux. tanks.

4. Electrical possibilities, mags on "both", re-start possibilities, radios.

5. Configuration implies wheels and flaps in proper position & switches turned off as appropriate when committed.
### SAMPLE WEIGHT AND BALANCE

Lake LA-4-200 2600 lbs. gross weight.  
Lake LA-4-200 with aux. tanks 2690 lbs. gross weight. Refer to Airplane Flight Manual.

ISSUED TO AIRPLANE SERIAL NO.__________________________

### SAMPLE LOADING

#### A. FORWARD C.G. AT MAXIMUM WEIGHT

<table>
<thead>
<tr>
<th>ITEM</th>
<th>WEIGHT</th>
<th>ARM</th>
<th>MOMENT/1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Weight</td>
<td>1600</td>
<td>112.5</td>
<td>180.00</td>
</tr>
<tr>
<td>Front seat occupants</td>
<td>340</td>
<td>61.0</td>
<td>20.74</td>
</tr>
<tr>
<td>Rear seat occupants</td>
<td>340</td>
<td>92.0</td>
<td>31.28</td>
</tr>
<tr>
<td>Oil: 8 quarts</td>
<td>15</td>
<td>117.0</td>
<td>1.76</td>
</tr>
<tr>
<td>Fuel: 40 gallons</td>
<td>240</td>
<td>118.0</td>
<td>28.32</td>
</tr>
<tr>
<td>Baggage</td>
<td>65</td>
<td>118.0</td>
<td>7.67</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>2600</td>
<td>103.0</td>
<td>269.77</td>
</tr>
</tbody>
</table>

#### B. AFT C.G. AT MAXIMUM WEIGHT

<table>
<thead>
<tr>
<th>ITEM</th>
<th>WEIGHT</th>
<th>ARM</th>
<th>MOMENT/1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty weight</td>
<td>1600</td>
<td>112.5</td>
<td>180.00</td>
</tr>
<tr>
<td>Front seat occupants</td>
<td>340</td>
<td>61.0</td>
<td>20.74</td>
</tr>
<tr>
<td>Rear seat occupants</td>
<td>205</td>
<td>92.0</td>
<td>18.86</td>
</tr>
<tr>
<td>Oil: 8 quarts</td>
<td>15</td>
<td>117.0</td>
<td>1.76</td>
</tr>
<tr>
<td>Fuel: 40 gallons</td>
<td>240</td>
<td>118.0</td>
<td>28.32</td>
</tr>
<tr>
<td>Baggage</td>
<td>200</td>
<td>118.0</td>
<td>23.60</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>2600</td>
<td>105.1</td>
<td>273.28</td>
</tr>
</tbody>
</table>

#### C. AFT C.G. AT REDUCED WEIGHT

<table>
<thead>
<tr>
<th>ITEM</th>
<th>WEIGHT</th>
<th>ARM</th>
<th>MOMENT/1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty weight</td>
<td>1600</td>
<td>112.5</td>
<td>180.00</td>
</tr>
<tr>
<td>Pilot</td>
<td>170</td>
<td>61.0</td>
<td>10.37</td>
</tr>
<tr>
<td>Oil: 8 quarts</td>
<td>15</td>
<td>117.0</td>
<td>1.76</td>
</tr>
<tr>
<td>Fuel: 15 gallons</td>
<td>90</td>
<td>118.0</td>
<td>10.62</td>
</tr>
<tr>
<td>Ballast</td>
<td>10</td>
<td>25.0</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>1885</td>
<td>107.7</td>
<td>203.00</td>
</tr>
</tbody>
</table>

WEIGHT & BALANCE COMPUTED BY: ____________________________________________
SECTION XI
PAGE 2

LA-4-200/EP
LA-4-200
LA-4 180

Datum Line 0

Ballast 25"
Front Seat 61"
Rear Seat 92"
Within Envelope 102.5" 108"
Empty C.G. (Near) 112"
Oil 117"
Fuel & Baggage 118"

Answer the following from the diagram:

1. What three possible locations would be permissible for loading a small parcel weighing 40 pounds during solo pilot operation with a full tank of gas?

2. Which of the three locations would be the best choice?

3. With three souls on board where would you load an 80 pound parcel?
<table>
<thead>
<tr>
<th>BASIC AIRCRAFT EMPTY WEIGHT</th>
<th>WEIGHT</th>
<th>ARM</th>
<th>MOMENT/1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOW LOCKER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRONT SEAT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REAR SEAT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAGGAGE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZERO FUEL C.G.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FUEL</td>
<td></td>
<td>C.G.</td>
<td></td>
</tr>
<tr>
<td>TAKE OFF C.G.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SAMPLE REVISION PAGE

### WEIGHT AND BALANCE AND EQUIPMENT LIST

<table>
<thead>
<tr>
<th>AIRCRAFT MAKE &amp; MODEL</th>
<th>REGISTRATION NUMBER</th>
<th>SERIAL NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA4/200</td>
<td>N8508V</td>
<td>1090</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IN</th>
<th>OUT</th>
<th>ITEM</th>
<th>WEIGHT</th>
<th>ARM</th>
<th>MOMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td></td>
<td>AIRCRAFT—OLD AS EQUIPPED:</td>
<td>1714.5</td>
<td>112.95</td>
<td>193652.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>APOLLO LORAN C INSTALLED</td>
<td>3.7</td>
<td>40</td>
<td>148</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1718.2</td>
<td>112.79</td>
<td>193800.8</td>
</tr>
</tbody>
</table>

GROSS WEIGHT 2690  
EMPTY WEIGHT 1718.2  
E.W. C.G. 112.79  
MOMENT 193800.8  
USEFUL LOAD 971.8

NAME VANCE D. HABERMAN  
CERT. NO. A & P 1905519

LAKE AIRCRAFT  
606 N. DYER BLVD.  
KISSIMMEE AIRPORT  
KISSIMMEE, FLORIDA 32741  
407-847-9000
LA 250

In reference to the approved Airplane Flight Manual, the aircraft empty C.G. must fall between stations 164.6 and 166.4

LOADING INSTRUCTIONS

The allowable weight and C.G. envelope is shown below.

C.G. LOCATION, INCHES AFT OF DATUM

NOTE: It is the operator's responsibility to insure that the aircraft is properly loaded in accordance with the approved Airplane Flight Manual.
The useful load items and their locations are as follows:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>ARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOSE BALLAST (130 POUNDS MAX.)</td>
<td>54.5</td>
</tr>
<tr>
<td>PILOT AND COPILOT NOMINAL POSITION:</td>
<td>96.0 (TRAVEL RANGE</td>
</tr>
<tr>
<td></td>
<td>91.0 TO 100.0)</td>
</tr>
<tr>
<td>MID SEAT OCCUPANTS NOMINAL POSITION:</td>
<td>126.0 (TRAVEL RANGE</td>
</tr>
<tr>
<td></td>
<td>122.0 TO 129.0)</td>
</tr>
<tr>
<td>REAR SEAT OCCUPANTS</td>
<td>147.0</td>
</tr>
<tr>
<td>BAGGAGE</td>
<td>168.0</td>
</tr>
<tr>
<td>FUEL: MAIN TANK</td>
<td>168.0</td>
</tr>
<tr>
<td>FUEL: AUXILIARY TANKS</td>
<td>168.0</td>
</tr>
<tr>
<td>TAIL BALLAST (50 POUNDS MAX.)</td>
<td>284.0</td>
</tr>
<tr>
<td>FUEL WING TANK 17 GALLONS USABLE (1</td>
<td>151.0</td>
</tr>
<tr>
<td>GALLON UNUSABLE EA. WING. FIGURED</td>
<td></td>
</tr>
<tr>
<td>IN BELOW.)</td>
<td></td>
</tr>
</tbody>
</table>
### Sample Loading Problems

<table>
<thead>
<tr>
<th></th>
<th>Weight (Pounds)</th>
<th>Arm (Inches)</th>
<th>Moment (Lb.-In./1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Airplane Empty</strong></td>
<td>2044</td>
<td>164.6</td>
<td>336.44</td>
</tr>
<tr>
<td><strong>Pilot and Copilot</strong></td>
<td>340</td>
<td>96.0</td>
<td>32.64</td>
</tr>
<tr>
<td><strong>Mid Seat Passengers</strong></td>
<td>340</td>
<td>126.0</td>
<td>42.84</td>
</tr>
<tr>
<td><strong>Rear Seat Passengers</strong></td>
<td>200</td>
<td>147.0</td>
<td>29.40</td>
</tr>
<tr>
<td><strong>Tail Ballast</strong></td>
<td>35</td>
<td>284.0</td>
<td>9.94</td>
</tr>
<tr>
<td><strong>Fuel: Main Tank 15 Gal.</strong></td>
<td>90</td>
<td>168.0</td>
<td>15.12</td>
</tr>
<tr>
<td><strong>Fuel: Aux. Tanks 0 Gal.</strong></td>
<td>0</td>
<td>168.0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Fuel: Wing Tanks 0 Gal.</strong></td>
<td>0</td>
<td>151.0</td>
<td></td>
</tr>
<tr>
<td><strong>Totals at Takeoff</strong></td>
<td>3049</td>
<td>(153.0)</td>
<td>466.38</td>
</tr>
<tr>
<td><strong>Subtract Fuel to Destination 6 Gallons</strong></td>
<td>-36</td>
<td>168.0</td>
<td>6.05</td>
</tr>
<tr>
<td><strong>Totals at Landing</strong></td>
<td>3013</td>
<td>(152.8)</td>
<td>460.33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Weight (Pounds)</th>
<th>Arm (Inches)</th>
<th>Moment (Lb.-In./1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Airplane Empty</strong></td>
<td>2000</td>
<td>166.4</td>
<td>332.80</td>
</tr>
<tr>
<td><strong>Pilot</strong></td>
<td>170</td>
<td>96.0</td>
<td>16.32</td>
</tr>
<tr>
<td><strong>Fuel: Main Tank 40 Gal.</strong></td>
<td>240</td>
<td>168.0</td>
<td>40.32</td>
</tr>
<tr>
<td><strong>Fuel: Aux. Tanks 14 Gal.</strong></td>
<td>84</td>
<td>168.0</td>
<td>14.11</td>
</tr>
<tr>
<td><strong>Fuel: Wing Tanks 0 Gal.</strong></td>
<td>0</td>
<td>151.0</td>
<td></td>
</tr>
<tr>
<td><strong>Ballast: Bow Compartment</strong></td>
<td>100</td>
<td>54.5</td>
<td>5.45</td>
</tr>
<tr>
<td><strong>Totals at Takeoff</strong></td>
<td>2594</td>
<td>(157.7)</td>
<td>409.0</td>
</tr>
<tr>
<td><strong>Subtract Fuel to Destination 45 Gallons</strong></td>
<td>-270</td>
<td>168.0</td>
<td>-45.36</td>
</tr>
<tr>
<td><strong>Totals at Landing</strong></td>
<td>2324</td>
<td>(156.5)</td>
<td>363.64</td>
</tr>
</tbody>
</table>

*Plotting these points on the weight-moment diagram shows that they are within the permitted envelope.*
<table>
<thead>
<tr>
<th></th>
<th>WEIGHT</th>
<th>ARM</th>
<th>MOMENT/1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASIC AIRCRAFT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMPTY WEIGHT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOW LOCKER</td>
<td></td>
<td>54.5</td>
<td></td>
</tr>
<tr>
<td>FRONT SEAT</td>
<td></td>
<td>96.0</td>
<td></td>
</tr>
<tr>
<td>MID SEAT</td>
<td></td>
<td>126.0</td>
<td></td>
</tr>
<tr>
<td>REAR SEAT</td>
<td></td>
<td>147.0</td>
<td></td>
</tr>
<tr>
<td>BAGGAGE</td>
<td></td>
<td>168.0</td>
<td></td>
</tr>
<tr>
<td>FUEL: MAIN TANK GAL.</td>
<td></td>
<td>168.0</td>
<td></td>
</tr>
<tr>
<td>FUEL: WING TANKS GAL.</td>
<td></td>
<td>151.0</td>
<td></td>
</tr>
<tr>
<td>FUEL: AUX. TANKS GAL.</td>
<td></td>
<td>168.0</td>
<td></td>
</tr>
<tr>
<td>TAIL BALLAST</td>
<td></td>
<td>284.0</td>
<td></td>
</tr>
<tr>
<td>TAKEOFF WEIGHT</td>
<td></td>
<td></td>
<td>C.G.</td>
</tr>
<tr>
<td>ZERO FUEL C.G.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDING WEIGHT</td>
<td></td>
<td></td>
<td>C.G.</td>
</tr>
</tbody>
</table>

AIRCRAFT N°__
WEIGHT AND BALANCE TEST

Reference the weight & balance data of the aircraft to be flown, extract the proper information for computing all of the following problems.

PROBLEM 1. Compute the weight and balance for our training aircraft with the following loading:

A. Pilots: yourself and 170 lb. passenger - front seat
B. 10 lb. flotation and emergency gear - rear seat
C. Full oil
D. Full fuel: main tank only
E. 10 lb. anchor - bow compartment

Takeoff gross wt. ___________ C.G. ___________

Are the gross wt. and C.G. within permissible limits? Y____ N____
If not, how would you correct them? ________________________________

PROBLEM 2. Compute the weight and balance for our training aircraft with the following loading:

A. Pilots: yourself and 150 lb. passenger - front seat
B. Passengers: 180 lb. and 150 lb. - rear seat
C. Full Oil.
D. Full fuel - main and aux. tanks 54 gallons.
E. Luggage: 40 lb. - baggage area.
F. 10 lb. anchor - bow compartment

Takeoff gross wt. ___________ C.G. ___________

Are they within permissible limits? Y____ N____
If not, how would you correct them? ________________________________
SAMPLE

WEIGHT AND BALANCE

Lake LA-4-200 2600 lb. gross weight.

ISSUED TO AIRPLANE SERIAL NO.__________________

Approved weight/C.G. envelope:

<table>
<thead>
<tr>
<th>1600</th>
<th>1800</th>
<th>2000</th>
<th>2200</th>
<th>2400</th>
<th>2600</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CENTER OF GRAVITY, INCHES AFT OF DATUM

USEFUL LOAD VARIABLES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>STATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel - main tank: 40 gallons</td>
<td>118.0</td>
</tr>
<tr>
<td>Fuel - aux. tank: 15 gallons</td>
<td>118.0</td>
</tr>
<tr>
<td>Oil - 8 quarts</td>
<td>117.0</td>
</tr>
<tr>
<td>Pilot &amp; passenger - front seat</td>
<td>61.0</td>
</tr>
<tr>
<td>Passengers - rear seats</td>
<td>92.0</td>
</tr>
<tr>
<td>Baggage - 200 lbs. maximum (center of forward portion)</td>
<td>118.0</td>
</tr>
<tr>
<td>(CONCENTRATED LOADS MUST BE LIMITED TO FORWARD PORTION OF COMPARTMENT)</td>
<td></td>
</tr>
<tr>
<td>Nose ballast</td>
<td>25.0</td>
</tr>
</tbody>
</table>
EMERGENCY HYDRAULIC INFORMATION

For schematic refer to Airplane Flight Manual.

"Check that the hydraulic pressure is in the green arc before moving the gear handle." This will keep the gear mechanically locked up or down and prevent a "between worlds" situation.

1. Electric pump off.
2. Place trim, flap and gear handles in a position which is exact center (detent*) and monitor hydraulic gauge.
3. Having isolated the supply and demand sides of the system you may now hand pump or electric pump the pressure into green arc.
4. Upon obtaining GREEN operate gear as desired.
5. With basic problem now solved, you may troubleshoot remaining flap and trim systems as desired.

NOTE: On the outside chance you were unable to restore pressure during step #3, the following would apply:

A. Gear committed to present locked position, so pick suitable surface.
B. Trim would trail. (Aircraft is manageable in this configuration).
C. If flap down position is not possible, add at least 10 mph for no-flap approach.
D. For suspected micro switch difficulty, use of mirror on float allows inspection of nose wheel. Flap is directly visible.

* Trim control valve does not have a "detent" position. Control is automatically centered by springs attached to handle.
SEAPLANE OPERATIONS
(From FAA Flight Training Handbook AC 61-21A)

This chapter is intended to introduce seaplane flying, as well as to provide a general review for experienced seaplane pilots. It contains general explanations of commonly accepted techniques and procedures for operating seaplanes on the water, with special emphasis on those which are different from landplane flying.

The explanations herein apply to light single-engine and multiengine seaplanes typical of those used in general aviation operations. For information regarding specific types and models of airplanes approved as seaplanes, reference should be made to that AIRPLANE'S OPERATING MANUAL and the MANUFACTURER'S RECOMMENDATIONS.

In addition to material contained herein, there are numerous commercially produced publications relating to water operations that contain additional valuable information. All this information used collectively with good training and practice will result in a safe and pleasurable experience during water based operations.

The operation of an airplane on water is somewhat different than operating one on land, but should be no more difficult if the pilot acquires the essential knowledge and skill in the techniques involved. This is particularly important because of the widely varying and constantly changing conditions of the water surface.

WATER CHARACTERISTICS

The competent seaplane pilot must be knowledgeable in the characteristics of water to understand its effects on the seaplane. Water is a fluid, and although it is much heavier than air it behaves in a manner similar to air.

Since it is a fluid, water seeks its own level, and if not disturbed, lies flat and glassy. It yields, however, if disturbed by such forces as winds, undercurrents, and objects traveling on its surface, creating waves or movements.
Because of its weight, water can exert a tremendous force. This force, a result of resistance, produces drag as the water flows around or under an object being propelled through it or on its surface. The force of drag imposed by the water increases as the square of the speed. This means that as the speed of the object traveling on the water is doubled, the force exerted is four times as great.

Forces created when operating an airplane on water are more complex than those created on land. When a landplane's wheels contact the ground, the force of friction or drag acts at a fixed point on the airplane; however, the water forces act along the entire length of a seaplane's hull or floats with the center of pressure constantly changing depending upon the pitch attitude, dynamic hull or float motion, and action of the waves.

Since the surface condition of water varies constantly, it becomes important that the seaplane pilot be able to recognize and understand the effects of these various conditions of the water surface.

Under calm wind conditions, the waveless water surface is perhaps the most dangerous to the seaplane pilot and requires precise piloting techniques. Glassy water presents a uniform mirror-like appearance from above, and with no other visual references from which to judge height, it can be extremely deceptive. Also, if waves are decaying and setting up certain patterns, or if clouds are reflected from the water surface, distortions result that are even more confusing for inexperienced as well as experienced pilots.

Wave conditions on the surface of the water are a very important factor in seaplane operation. Wind provides the force that generates waves, and the velocity of the wind governs the size of the waves or the roughness of the water surface (Fig. A-1).
<table>
<thead>
<tr>
<th>Beaufort Scale and Map Symbol</th>
<th>Terms Used by U.S. Weather Bureau</th>
<th>Velocity mph</th>
<th>Estimating Velocities on Land</th>
<th>Estimating Velocities on Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Calm</td>
<td>Less than 1</td>
<td>Smoke rises vertically.</td>
<td>Surface like a mirror.</td>
</tr>
<tr>
<td>1</td>
<td>Light air</td>
<td>1 - 3</td>
<td>Smoke drifts; wind vane unmoved.</td>
<td>Ripples with the appearance of scales are formed, but without foam crests.</td>
</tr>
<tr>
<td>2</td>
<td>Light Breeze</td>
<td>4 - 7</td>
<td>Wind felt on face; leaves rustle; ordinary vane moves by wind.</td>
<td>Small wavelets, still short but more pronounced; crests have a glossy appearance and do not break.</td>
</tr>
<tr>
<td>3</td>
<td>Gentle Breeze</td>
<td>8 - 12</td>
<td>Leaves and small twigs in constant motion; wind extends light flag.</td>
<td>Large wavelets; crests begin to break. Foam of glistening appearance. (Perhaps scattered whitecaps.)</td>
</tr>
<tr>
<td>4</td>
<td>Moderate Breeze</td>
<td>13 - 18</td>
<td>Dust and loose paper raised; small branches are moved.</td>
<td>Small waves, becoming longer; fairly frequent whitecaps.</td>
</tr>
<tr>
<td>5</td>
<td>Fresh Breeze</td>
<td>19 - 24</td>
<td>Small trees in leaf begin to sway; crested wavelets form in inland water.</td>
<td>Moderate waves; taking a more pronounced long form; many whitecaps are formed. (Chance of some spray.)</td>
</tr>
<tr>
<td>6</td>
<td>Strong Breeze</td>
<td>25 - 31</td>
<td>Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.</td>
<td>Large waves begin to form; white foam crests are more extensive everywhere. (Probably some spray.)</td>
</tr>
<tr>
<td>7</td>
<td>Moderate Gale</td>
<td>32 - 38</td>
<td>Whole trees in motion; inconvenience felt in walking against the wind.</td>
<td>Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind.</td>
</tr>
<tr>
<td>8</td>
<td>Fresh Gale</td>
<td>39 - 46</td>
<td>Twigs broken off trees; progress generally impeded.</td>
<td>Moderately high waves of greater length; edges of crests break into spindrift. The foam is blown in well-marked streaks along the direction of the wind.</td>
</tr>
<tr>
<td>9</td>
<td>Strong Gale</td>
<td>47 - 54</td>
<td>Slight structural damage occurs.</td>
<td>High waves; dense streaks of foam along the direction of the wind. Sea begins to roll. Spray may affect visibility.</td>
</tr>
<tr>
<td>10</td>
<td>Whole Gale</td>
<td>55 - 63</td>
<td>Trees uprooted; considerable structural damage occurs.</td>
<td>Very high waves with long, overhanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole, the surface of the sea takes a white appearance. The rolling of the sea becomes heavy and shock-like. Visibility is affected.</td>
</tr>
<tr>
<td>11</td>
<td>Hurricane</td>
<td>Above 75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Courtesy Grumman Aerospace Corporation
Calm water resists wave motion until a wind velocity of about 2 knots is attained; then patches of ripples are formed. If the wind velocity increases to 4 knots, the ripples change to small waves that continue to persist for some time even after the wind stops blowing. If this gentle breeze diminishes, the water viscosity damps the ripples and the surface promptly returns to a flat and glassy condition.

As the wind velocity increases above 4 knots, the water surface becomes covered with a complicated pattern of waves, the characteristics of which vary continuously between wide limits. This is referred to as the generating area. This generating area remains disarranged so long as the wind velocity is increasing. With increasing wind velocity, the waves become larger and travel faster. When the wind reaches a given velocity and remains constant, waves develop into a series of equidistant parallel crests of the same height.

An object floating on the water surface where simple waves are present will show that the water itself does not actually move along with waves. The floating object will describe a circle in a vertical plane, moving upward as the crest approaches, forward and downward as the crest passes, and backward as the trough between the waves passes. After the passage of each wave the object stays at almost the same point at which it started. Consequently, the actual movement of the object is a vertical circle whose diameter is equal to the height of the wave. This theory must be slightly modified however, because the friction of the wind will cause a slow downwind flow of water resulting in drift. Therefore, a nearly submerged object, such as a hull or float, will slowly drift with the waves.

When the wind increases to a velocity of 12 knots, waves will no longer maintain smooth curves. The waves will break at their crest and create foam — whitecaps. When the wind decreases, the whitecaps disappear. However, lines or streaks form which can be used as an accurate indication of the path of the wind. Generally, it will be found that waves generated by wind velocities up to 10 knots do not reach a height of more than one foot.

A great amount of wind energy is needed to produce large waves. When the wind ceases, the energy in the wave persists and is reduced only by a very slight internal friction in the water. As a result, the wave patterns continue for a long distance from their source and diminish at a barely perceptible rate. These waves are known as swells, and gradually lengthen, become less high, but increase in speed.

If the wind changes direction during the diminishing process, an entirely separate wave pattern will form which is superimposed on the swell. These patterns are easily detected by the pilot from
above, but are difficult to see from the surface.

Islands, shoals, and tidal currents also affect the size of waves. An island with steep shores and sharply pointed extremities allows the water at some distance from the shore to pass with little disturbance of wave motion. This creates a relatively calm surface on the lee side. If the island has rounded extremities and a shallow slope and outlying shoals where the water shallows and then becomes deep again, the waves will break and slow down. This breaking will cause a considerable loss of wave height. On the lee side of the shoal, the waves will not break.

When waves are generated in nonflowing water and travel into moving water such as a current, they undergo important changes. If the current is moving in the same direction as the waves, they increase in speed and length but lose their height. If the current is moving opposite to the waves, they will decrease in speed and length, but will increase in height and steepness. This explains "tidal rips" which are formed where strong streams run against the waves. A current traveling at 6 miles per hour will break almost all waves traveling against it. When waves break, a considerable loss in wave height occurs to the leeward side of the breaking.

Another characteristic of water that should be mentioned is the ability of water to provide buoyancy and cause some objects to float on the surface. Some of these floating objects can be seen from the air, while others are partially submerged and very difficult to see. Consequently, seaplane pilots must be constantly aware of the possibility of floating debris to avoid striking these objects during operation on the water.

CHARACTERISTICS OF SEAPLANES

A seaplane is defined as "an airplane designed to take off from and land on water." Seaplanes can be generally classified as either flying boats, or floatplanes. Those that can be operated on both land and water are called amphibians.

The floatplane is ordinarily understood to be a conventional landplane equipped with separate floats instead of wheels, as opposed to a flying boat in which the hull serves the dual purpose of providing buoyancy in the water and space for the pilot, crew, and passengers. The float type is the more common seaplane, particularly those with relatively low horsepower. It may be equipped with either single float or twin floats; however, most seaplanes are the twin-float variety. Though there is considerable difference between handling a floatplane and handling a flying boat, the theory on which the techniques are based is similar. Therefore, with few exceptions, the explanations given here for one type may be considered to apply to the other.
In the air the seaplane is operated and controlled in much the same manner as the landplane, since the only major difference between the floatplane and the landplane is the installation of floats instead of wheels. Generally, because of the float's greater weight, replacing wheels with floats increases the airplane's empty weight and thus decreases its useful load and rate of climb.

On many floatplanes, the directional stability will be affected to some extent by the installation of the floats. This is caused by the length of the floats and the location of their mass in relation to the airplane's C.G. To help restore directional stability, an auxiliary fin is often added to the tail. The pilot will also find that less aileron pressure is needed to hold the floatplane in a slip and holding some rudder pressure during in-flight turns is usually required. This is due to the water rudder being connected to the air rudder or rudder pedals by cables and springs which tend to prevent the air rudder from streamlining in a turn.

Research and experience have improved float and hull designs throughout the years. Figs. A-2 and A-3 illustrate the basic construction of a float and a flying boat. The primary consideration in float construction is the use of sturdy, lightweight material, designed hydrodynamically and aerodynamically for optimum performance. All floats and hulls now being used have multiple watertight compartments which make the seaplane virtually unsinkable, and prevent the entire float or hull from becoming filled with water in the event it is ruptured at any point.

Both the lateral and longitudinal lines of a float or hull are designed to achieve a maximum lifting force by diverting the water and the air downward. The forward bottom portion of the float (and a hull) is designed very much like the bottom surface of a speedboat. The rearward portion, however, differs significantly from a speedboat.
A speedboat is designed for travel at an almost constant pitch angle and, therefore, the contour of the entire bottom is constructed in approximately a continuous straight line. However, a seaplane float or hull must be designed to permit the seaplane to be rotated or pitched up to increase the wing's angle of attack and gain the most lift for takeoffs and landings. Thus, the underside of the float or hull has a sudden break in its longitudinal lines at the approximate point around which the seaplane rotates into the lift off attitude. This break, called a "step," also provides a means of interrupting the capillary or adhesive properties of the water. The water can then flow freely behind the step, resulting in minimum surface friction so the seaplane can lift off the water.

The steps are located slightly behind the airplane's center of gravity, approximately at the point where the main wheels of a landplane are located. If the steps were located too far aft or forward of this point, it would be difficult, if not impossible, to rotate the airplane into a pitch-up attitude prior to planing (rising partly out of the water while moving at high speed) or lift off. Although steps are necessary, the sharp break along the float's or hull's underside causes structural concentration, and in flight produces considerable drag because of the eddying turbulence it creates in the airflow.

SEAPLANE BASES

With few exceptions seaplane operations are authorized on U.S. Army Corps of Engineer lakes. Some states and cities are very liberal in the laws regarding the operation of seaplanes on their lakes and waterways, while other states and cities may impose stringent restrictions. It is recommended that before operating a seaplane on public waters, the Parks and Wildlife Department of the state, the State Aeronautics Department, or the FAA General Aviation District Office nearest the site of planned operation be contacted concerning the local requirements. In any case, seaplane pilots should always avoid creating a nuisance in any area, particularly in congested marine areas or near swimming or boating facilities.

The location of established seaplane bases is symbolized on aeronautical charts by depicting an anchor inside a circle. They are also listed in Airport/Facility Directories. The facilities provided at seaplane bases vary greatly, but most include a hard surface ramp for launching, servicing facilities, and an area for mooring or hangaring seaplanes. Many marinas designed for boats also provide seaplane facilities.

In many cases seaplane operations are conducted in "bush country" where regular or emergency facilities are either poor or non-existent. The terrain is often hazardous, the waterways treacherous, and servicing must be the individual pilot's responsibility.
Too many times pilots receive their water training in the "lower 48" states where facilities are mostly excellent, and shortly after receiving a seaplane rating head north to Alaska or the north woods of Canada. The results are frequently tragic. Prior to operating in the "bush," it is recommended that pilots obtain the advice of FAA appointed Accident Prevention Counselors who are familiar with the area.

RULES OF THE ROAD

In addition to Federal Aviation Regulations, the "Rules of the Road" applicable to the operation of boats, apply also to seaplane operations. "Inland Rules of the Road" apply to all vessels navigating upon certain waters inshore of the boundary line which divides the inland waterways from the high seas; "International Rules of the Road" apply to all public or private vessels navigating on the high seas outside the boundary line. The U.S. Coast Guard, of course, has jurisdiction over operations on the high seas. It is strongly recommended that seaplane pilots acquire copies of the pertinent rules, become thoroughly familiar with their contents, and comply with the requirements during all operations.

In the interest of safety, it is particularly important that seaplane pilots become familiar with such navigation aids as buoys, day and night beacons, light and sound signals, and also steering and sailing rules.

PREFLIGHT INSPECTION

Generally, with a few exceptions, the preflight inspection of a seaplane is similar to that of a landplane. The major difference is the checking of floats or hull. The manufacturer's manual or handbook should be used in conducting the inspection.

The pilot should first note how the seaplane is setting in the water prior to each flight. If the sterns of the floats are very low in the water, consideration should be given to how the seaplane is loaded. Also, if lower than normal for a given load, a rear compartment may have a leak.

Floats and hulls should be inspected for obvious or apparent defects and damage, such as loose rivets, corrosion, separation of seams, punctures, and general condition of the metal skin. Because of the rigidity of float installation, fittings and adjacent structure should be checked for cracks, defective welds, proper attachment, alignment and safetying. All hinged points should be examined for wear and corrosion, particularly if the seaplane is operated in salt water. If water rudders are installed, they should be inspected for free and proper movement.
It is important to check each compartment of the floats or hull for any accumulation of water before flight. Even a small amount of water, such as a cup full, is not unusual and can occur from condensation or normal leakage. All water should be removed before flight, because the water may critically affect the location of the seaplane's center of gravity.

If an excessive amount of water is found, a thorough search for the leak should be made. If drain plugs and inspection plates are installed, a systematic method of removing and reinstalling these plugs and plates securely should be used. Naturally, it is extremely important to ensure that all drain plugs and inspection plates are securely in place before launching the seaplane onto the water. It is recommended that each plug and plate be counted and placed in a receptacle upon removal and counted again when reinstalled.

Float compartments, water rudders, etc., should be inspected for ice if near freezing temperatures are encountered. Airframe icing, resulting from water spray during a takeoff or landing, must also be considered. Part of the preflight inspection should include a cabin inspection. All items must be secured, such as anchors and paddles prior to takeoff. Flotation gear should be available for each occupant. During the preflight and boarding of passengers, a thorough passenger briefing is very important. Evacuation of a seaplane causes a few problems not encountered with the land-plane. Location and operation of regular and emergency exits should be known by all persons on board. The pilot should assure that all passengers are familiar with operation of seatbelts and shoulder harnesses, most especially that all persons can UNFASTEN their own seatbelts and shoulder harnesses in the event an accident occurs on the water.

Before beginning any seaplane operation, it is especially advisable to consider the existing and expected water condition, and the windspeed and direction to determine their combined effects on the operation.

**TAXIING**

One of the major differences between the operation of a seaplane and that of a landplane is the method of maneuvering the aircraft on the surface. The landplane will usually remain motionless with the engine idling, particularly with the brakes applied, but a seaplane, since it is free-floating, will invariably move in some direction, depending upon the forces exerted by wind, water currents, propeller thrust, and inertia. Because a seaplane has no brakes, it is important that the pilot be familiar with the existing wind and water conditions, effectively plan the course of action, and mentally stay "ahead" of the aircraft.
There are three positions or attitudes in which a seaplane can be moved about on the water:

1. the "idling" position (Fig. A-4),
2. the "plowing" position (Fig. A-5), and
3. the "planning" or "on the step" position (Fig. A-6).

FIGURE A-4 IDLING POSITION

IDLING POSITION

When taxiing with the engine idling or at a low rpm, the seaplane will remain in what is considered a DISPLACEMENT condition similar to being at rest on the water (Fig. A-4). This is the "idling" position. The recommended taxi speed is usually below 6 or 7 knots so that the propeller will not pick up water spray which causes serious erosion of the propeller blades. Displacement taxiing should be done with the water rudder down to provide more positive steering and control. Since seaplanes have no brakes, it is especially important to taxi at this slow speed in congested or confined areas because inertia forces build up rapidly, making the seaplane vulnerable to serious damage even in minor collisions.

FIGURE A-5 PLOWING POSITION
PLowing POSITION

When the power is increased significantly above idling, the seaplane will usually assume a nose-up or "plowing" position (Fig. A-5). Most seaplane experts do not recommend the plowing position for taxiing, except in rough water when it would be desirable to raise the propeller clear of the spray, or when turning the seaplane downwind during strong wind conditions. To attain this position, full power should be applied and the elevator control held in the full aft position. Sea planes that have a high thrust line will tend to nose down upon application of power, in which case it is imperative that the elevator control be held in the full aft position. The "plowing" position is brought about by the combination of the propeller slipstream striking the elevator and the hydrodynamic force of the water exerted on the underside of the float's or hull's bow. After the planning position is attained, the power should be reduced to maintain the proper speed.

If the water conditions are favorable and there is a long distance to travel, the seaplane may be taxied at high speed "on the step." This position (Fig. A-6) is reached by accelerating the seaplane to the degree that it passes through the plowing phase until the floats or hull are literally riding on the water in a level position.

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FIGURE A-6 PLANING POSITION

PLANING POSITION

Basically, the planing or step position is best attained by holding the elevator control full aft and advancing the throttle to full power. As the seaplane accelerates it will then gradually assume a nose-high pitch attitude, raising the bow of the float or hull and causing the weight of the seaplane to be transferred toward the aft portion of the float or hull. At the time the seaplane attains its highest pitch attitude, back pressure should be gradually relaxed, causing the weight to be transferred from the aft portion of the float or hull onto the step area. This can be compared to a speedboat's occupants moving forward in the boat to aid in
attaining a planing attitude. In the seaplane we do essentially the same thing by use of aerodynamics (elevators). As a result of aerodynamic and hydrodynamic lifting, the seaplane is raised higher in the water, allowing the floats or hull to ride on top of rather than in the water.

The entire process of planing a seaplane is similar to that of water skiing. The skier cannot make the transition from a submerged condition to that of being supported on the surface of the water unless a sufficiently high speed is attained and maintained.

As further acceleration takes place the flight controls become more responsive just as in the landplane and elevator deflection must be reduced in order to hold the required planing/pitch attitude. This of course is accomplished by further relaxing back pressure, increasing forward pressure, or using forward elevator trim depending on the aircraft flight characteristics.

Throughout the acceleration, the transfer of weight and the hydrodynamic lifting of the float or hull may be seen from the cockpit. When the seaplane is taxiing slowly, the water line is quite high on the floats or hull as compared to "on the step" (Fig. A-6). At slow taxi speeds a small wake is created close to the bow of the float or hull and moves outward at a very shallow angle. As acceleration commences, the wake starts to move from the bow aft toward the step area and the wake now turns into an outward spray pattern. As speed and lifting action increase, the spray pattern continues to move aft toward the step position and increases in intensity, i.e., slow speed spray may be approximately one foot outboard compared to about a 20-foot outboard spray at higher speed on the step position. Some seaplane pilots use the spray pattern as an additional visual reference in aiding them in determining when the seaplane has accelerated sufficiently to start easing it over onto the step.

After the planing position has been attained, proper control pressures must be used to control the proper pitch attitude/trim angle. Usually this will be maintained with slight back pressure. As for the amount of pressure to be held, the beginner will find a very "thin line" between easing off back pressure too much or too little. It can perhaps best be described as finding the "slippery spot" on the float or hull. Too much back pressure, acceleration rate decreases. Not enough back pressure or too much forward pressure also decreases acceleration rate. So that fine line or "slippery spot" is that position between not enough or too much back pressure.

If one does not want to take off and just wants to continue to taxi on the step, a reduction in power is initiated at approximately the time the seaplane is eased over onto the step. Power requirements
to maintain the proper speed with wind, load and current action will vary. More power will be required taxiing into the wind or an upcurrent or with a heavy load. However, 65 to 70 percent of maximum power can be used as a starting point.

From either the plowing or on-the-step position, if power is reduced to idle, the seaplane will decelerate quite rapidly and eventually assume the displacement or idle position. Care must be taken to use proper flight control pressures during the deceleration phase because weight is now being transferred toward the bow and drag is increasing; hence, some aircraft have a nose-over tendency. This is of course controllable by proper use of the elevator controls.

**Turns**

If water rudders have the proper amount of movement, a seaplane can be turned within a radius less than the span of the wing during calm conditions or a light breeze. It will be found that water rudders are usually more effective at slow speeds because they are acting in comparatively undisturbed water. At high speeds, however, the stern of the float churns the adjacent water, thereby causing the water rudder to become less efficient. Furthermore, because of the high speed, the water’s impact on the rudders may tend to force them to swing up or retract.

Particular attention should always be given to the risks involved in making turns in a strong wind or at high speeds. Any seaplane will tend to weathervane into a strong wind if the controls are not positioned to prevent it. In a single-engine seaplane rudder should be applied as necessary to control the turn while aileron is held into the wind. On twin-engine seaplanes this tendency can be overcome through the use of differential power—using a higher setting on the upwind side. The rate at which the seaplane turns when it weathervanes is directly proportional to the speed of the crosswind. When taxiing downwind or crosswind, the seaplane will swing into the wind as soon as the flight controls are neutralized or power is reduced.

During a high speed taxiing turn, centrifugal force tends to tip the seaplane toward the outside of the turn (Fig. A-7). Simultaneously, when turning from a downwind heading to an upwind heading, the wind force striking the fuselage and the under side of the wing increases the tendency for the seaplane to lean to the outside of the turn. If an abrupt turn is made, the combination of these two forces may be sufficient to tip the seaplane to the extent that the outside wing drags in the water, and may even tip the seaplane onto its back (Fig. A-8). Obviously, the further the seaplane tips, the greater will be the effect of wind, since more wing area on the windward side is exposed to the wind force.
When making a turn into the wind from a crosswind condition, the air-rudder may be neutralized and the seaplane allowed to weathervane into the wind. If taxiing directly downwind, a turn into the wind may be started by deflecting the air rudder in the same direction that the turn is desired. As soon as the seaplane begins to turn, the rudder should be neutralized; if the wind is strong, some opposite rudder may be needed during the turn. The amount of opposite rudder depends upon the rate at which the seaplane turns. The greater the amount of opposite rudder, the slower the rate of turn. Normally, the power should be reduced to idle when the turn.
begins because with the power on the left turning tendency of the seaplane may become excessive. Short bursts of power are best for turning in a small radius, but sustained excessive power causes a build-up of speed and a larger turning radius.

The seaplane tends to use its center of buoyancy (COB) as a pivot point wherever it may be. Center of buoyancy moves laterally, as well as forward and aft. Each object in water has a point of center of buoyancy. In a twin-float installation the effects of wind, power and flight controls are shared by the two floats and the average COB is free to move significantly.

The center of buoyancy (COB), or average point of support, moves aft when the seaplane is placed in a nose-up or plowing position (Fig. A-5). This position exposes to the wind a considerable amount of float and fuselage side area forward of the center of buoyancy. Therefore, when taxiing crosswind in this position, many seaplanes will show a tendency to turn downwind because of the wind force on the exposed area of the float and fuselage. For this reason it is sometimes helpful to place the seaplane in a nose-up position when turning downwind, particularly if the wind velocity is high. Under high wind conditions, the throttle may be used as a turning device by increasing power to cause a nose-up position when turning downwind, and decreasing power to allow the seaplane to weathervane into the wind.

**FIGURE A-9 TAXIING/SAILING IN STRONG WIND**
Occasions often arise when it is advisable to move the seaplane backward to one side because wind or water conditions, or limited space make it impractical to attempt a turn (Fig. A-9). In this situation, particularly if there is a significant wind, the seaplane can be "sailed" into a space which to an inexperienced pilot might seem extremely cramped. Even if the wind is calm and the space is inadequate for making a normal turn, a paddle (which should be part of every seaplane's equipment) may be used to propel the seaplane or to turn the nose in the desired direction.

In light wind conditions with the engine idling or shut down, the seaplane will naturally weathervane into the wind and then sail in the direction the tail is pointed (Fig. A-10). With a stronger wind and a slight amount of power, the seaplane will usually sail downwind toward the side in which the nose is pointed. Rudder and aileron can be deflected to create drag on the appropriate side to control the direction of movement. Positioning the controls for the desired direction of motion in light or strong winds is illustrated in Fig. A-10. Lowering the wing flaps and opening the cabin doors will increase the air resistance and thus add to the effect of the wind; however, the effect of the air rudder may be reduced in this configuration. Since water rudders have little or no effect in controlling direction while sailing, they should be lifted. With the engine shut down, most flying boats will sail backward and toward the side to which the nose is pointed, much as a sailboat tacks, regardless of wind velocity because the hull does not provide as much keel (side area) as do floats in proportion to the size of the seaplane. To sail directly backward in a seaplane having a hull, the controls should be released and the wind allowed to steer the seaplane.

Sailing is an essential part of seaplane operation. Since each type of seaplane has its own minor peculiarities, depending on the design of the floats or hull, it should be practiced until thorough familiarization with that particular type is gained.

During initial seaplane training, sailing should be practiced in large bodies of water such as lakes or bays, but sufficiently close to a prominent object in order to evaluate performance. Where there are strong tides or a rapidly flowing current, such as in rivers, care must be taken in observing the relative effect of both the wind and the water current. Often the force of the current will be equal to or greater than the force of the wind.
Before taxiing into a confined area, the effect of wind and the current should be considered carefully. Otherwise, the seaplane may be carried into obstructions with resulting damage to the wings, tail surfaces, floats, hull, or other parts of the seaplane. Generally, with a seaplane of average size and power at idle, a water current of 5 knots will more than offset a wind velocity of 25 knots. This means that the seaplane will move against the wind.

PORPOISING

Porpoising in a seaplane is much like the antics of a dolphin—a rhythmic pitching and heaving while in the water. Porpoising is a dynamic instability of the seaplane and may occur when the seaplane is moving across the water while on the step during takeoff or landing. It occurs when the angle between the float or hull, and the water surface exceeds the upper or lower limit of the seaplane's pitch angle. Improper use of the elevator, resulting in attaining too high or too low a pitch (trim angle) sets off a cyclic oscillation which steadily increases in amplitude unless the proper trim angle or pitch attitude is re-established.

A seaplane will travel smoothly across the water while on the step, so long as the floats or hull remain within a moderately tolerant range of trim angles. If the trim angle is held too low during planing, water pressure in the form of a small crest or wall is built up under the bow or forward part of the floats or hull. As the seaplane's forward speed is increased to a certain point, the bow of the floats or hull will no longer remain behind this crest, and is abruptly forced upward as the seaplane rides over the crest. As the crest passes the step and on to the stern or aft portion of the floats or hull, the bow abruptly drops into a low position. This again builds a crest or wall of water in front of the bow resulting in another oscillation. Each oscillation becomes increasingly severe and if not corrected will cause the seaplane to nose into the water, resulting in extensive damage or possible capsizing. Porpoising can also cause a premature lift off with an extremely high angle of attack, resulting in a stall or being in the area of reverse command and unable to climb over obstructions.

Porpoising will occur during the takeoff run if the trim angle is not properly controlled with proper elevator pressure just after passing through the "hump" speed, or when the highest trim angle before the planing attitude is attained; that is, if up-elevator is held too long and the angle reaches the upper limits.

On the other hand, if the seaplane is nosed down too sharply, the lower trim range can be entered and will also result in porpoising. Usually, porpoising does not start until a degree or two after the seaplane has passed into the critical trim angle range, and does not cease until a degree or two after the seaplane has passed out of the critical range.
If porpoising does occur, it can be stopped by applying timely back pressure on the elevator control to prevent the bow of the floats or hull from digging into the water. The back pressure must be applied and maintained until porpoising is damped. If porpoising is not damped by the time the second oscillation occurs, it is recommended that the power be reduced to idle and elevator control held firmly back so the seaplane will settle into the water with no further instability.

The correct trim angle for takeoff, planing and landing applicable to each type of seaplane must be learned by the pilot and practiced until there is not doubt as to the proper angles for the various maneuvers.

The upper and lower trim angles are established by the design of the aircraft; however, changing the seaplane's gross weight, wing flap position, and center of gravity location will also change these limits. Increased weight increases the displacement of the floats or hull and raises the lower limit considerably. Extending the wing flaps frequently trims the seaplane to the lower limit at lower speeds, and may lower the upper limit at high speeds. A forward center of gravity location raises the lower trim limit at high speeds, and an aft location increases the possibility of high angle porpoising especially during landing.

**SKIPPING ON LANDING**

Skipping is a form of instability which may occur when landing with excessive speed at a nose-up trim angle. This nose-up attitude places the seaplane at the upper trim limit of stability, and causes the seaplane to enter a cyclic oscillation when touching the water, resulting in the seaplane skipping across the surface. This action may be compared to "skipping" flat stones across the water.

Skipping can also occur by crossing a boat wake while fast taxiing on the step or during a takeoff. Sometimes the new seaplane pilot will confuse a skip with a porpoise. Pilot's body feelings can quickly determine whether a skip or a porpoise has been encountered. A skip will give the body vertical "G" forces similar to bouncing a landplane. The porpoise is a rocking chair type forward and aft motion feeling.

Correction for skipping in a hull craft is accomplished by maintaining the touchdown attitude after the first "skip" has occurred, allowing the aircraft to settle onto the water for a second or possibly a third time. The height of each skip will be progressively smaller until eventually the aircraft will remain on the water surface. At that point power is reduced, thus allowing the aircraft to transition to a displacement position.

Skipping will not continue increasing its oscillations, as in
porpoising, because of the lack of forward thrust with reduced power.

TAKEOFFS

Unlike landplane operations at airports, seaplane operations are often conducted on water areas at which other activities are permitted. Therefore, the seaplane pilot is constantly confronted with floating objects, some of which are almost submerged and difficult to see—swimmers, skiers, and a variety of watercraft. Before beginning the takeoff, it is advisable to taxi along the intended takeoff path to check for the presence of any hazardous objects or obstructions. Thorough scrutiny should be given to the area to assure not only that it is clear, but that it will remain clear throughout the takeoff. Operators of motorboats and sailboats often do not realize the hazard resulting from moving their vessels into the takeoff path of a seaplane.

To accelerate during takeoff in a landplane, propeller thrust must overcome only the surface friction of the wheels and the increasing aerodynamic drag. During a seaplane takeoff, however, hydrodynamic or water drag becomes the major part of the forces resisting acceleration. This resistance reaches its peak at a speed of about 17 knots, and just before the float or hull are placed into a planing attitude.

The hydrodynamic forces at work during a seaplane takeoff are shown in Fig. A-11. The point of greatest resistance is referred to as the "hump" because the increasing and decreasing effect of water drag causes a hump in the resisting curve. After the hump is passed and the seaplane is traveling on the step, water resistance decreases.

Several factors greatly increase the water drag or resistance; heavy loading of the aircraft, or glassy water conditions in which no air bubbles slide under the float or hull, as they do during a choppy water condition. In extreme cases, the drag may exceed the available thrust and prevent the seaplane from becoming airborne. This is particularly true when operating in areas with high density altitudes (high elevations/high temperatures) where the engine cannot develop full rated horse power.

FIGURE A-11 WATER DRAG ON TAKEOFF
For this reason the pilot should also practice takeoffs using only partial power to simulate the long takeoff run usually needed when operating at water areas where the density altitude is high and/or the seaplane is heavily loaded.

The seaplane takeoff may be divided into four distinct phases:

1. the "displacement" phase,
2. the "hump" or "plowing" phase,
3. the "planing" or "on the step" phase, and
4. the "lift off."

The first three phases were previously described in the section on taxiing. The "lift off" is merely transferring support of the seaplane from the floats or hull to the wings. This results in the seaplane lifting off the water and becoming airborne.

To avoid porpoising during the takeoff run, it is important to maintain the proper pitch angles. Too much back elevator pressure during the planing or lift off phases will force the stern of the floats or hull deeper into the water, creating a strong resistance and appreciably retarding the takeoff. Conversely, insufficient back elevator pressure will cause the bows to remain in the water, which also results in excessive water drag. Experience will determine the best angle to maintain during takeoff for each seaplane, and if held at this angle, the seaplane will take off smoothly.

Because the seaplane is not supported on a solid surface and the float or one side of the hull can be forced deeper into the water, left aileron control is usually required to offset the effect of torque when full power is applied during takeoff.

The spray pattern for each particular seaplane should also be considered during takeoff. During acceleration the water is increasingly sprayed upward, outward, and rearward from the bow portion of the floats or hull, and on some seaplanes will be directed into the propeller; eventually causing erosion of the blades. This water spray is greater during the hump phase. The spray can be reduced during takeoff, however, by first increasing the planing speed about 10 knots, then opening the throttle as rapidly as practical. This method shortens the time that propellers are exposed to the spray. Again, the best technique must be learned through experience with each particular seaplane. Bear in mind that a rough water condition creates more spray than does smooth water.

Glassy water takeoffs in a low-powered seaplane loaded to its maximum authorized weight presents a difficult, but not necessarily a dangerous, problem. Under these conditions the seaplane may assume a "plowing" or nose-up position, but may not "unstick" or get "on the step" because of the adhesive action of smooth water; consequently, always plan ahead and consider the possibility of
aborting the takeoff. Nonetheless, if these conditions are not excessive, the takeoff can be accomplished using the following procedure.

After the bow has risen to the highest point in the plowing position with full back elevator pressure, it should be lowered by decreasing back elevator pressure. The bow will drop if the seaplane has attained enough speed to be on the verge of attaining the step position. After a few seconds, the bow will rise again. At the instant it starts to rise, the rebound should be caught by again applying firm back elevator pressure, and as soon as the bow reaches its maximum height, the entire routine should be repeated. After several repetitions, it will be noted that the bow attains greater height and that the speed is increasing. If the elevator control is then pushed well forward and held there, the seaplane will slowly flatten out "on the step" and the controls may then be eased back to the neutral position.

Whenever the water is glassy smooth, a takeoff can be made with less difficulty by making the takeoff run across the wakes created by motorboats. If boats are not operating in the area, it is possible to create wakes by taxiing the seaplane in a circle and then taking off across these self-made wakes.

In most cases an experienced seaplane pilot can safely take off in rough water, but a beginner should not attempt to takeoff if the waves are high. Using the proper procedure during rough water operation lessens the abuse of the floats, as well as the entire seaplane.

During rough water takeoffs, the throttle should be opened to takeoff power just as the bow is rising on a wave. This prevents the bow from digging into the water and helps keep the spray from the propeller. Slightly more back elevator pressure should be applied to the elevator than on a smooth water takeoff. This raises the bow to a higher angle.

After planing has begun, the seaplane will bounce from one wave crest to the next, raising the nose higher with each bounce, and each successive wave will be struck with increasing severity. To correct this situation and to prevent a stall, smooth elevator pressures should be used to set up a fairly constant pitch attitude that will allow the aircraft to "skim" across each successive wave as speed increases. Remember, in waves, the length of the float is very important. It is important that control pressure be maintained to prevent the bow from being pushed under the water surface or "stubbing its toe," which could result in capsizing the seaplane. Fortunately, a takeoff in rough water is accomplished within a short time because if there is sufficient wind to make the water rough, the wind would also be strong enough to produce aerodynamic lift earlier and enable the seaplane to become airborne.
quickly.

With respect to water roughness, one condition that seaplane pilots should be aware of is the effect of a strong water current flowing against the wind. For example, if the velocity of the current is moving at 10 knots, and the wind is blowing at 15 knots, the relative velocity between the water and the wind is 25 knots. In other words, the waves will be as high as those produced in still water by a wind of 25 knots.

The advisability of canceling a proposed flight because of rough water depends upon the size of the seaplane, wing loading, power loading, and, most important, pilot's ability. As a general rule, if the height of the waves from trough to crest is more than 20 percent of the length of the floats, takeoffs should not be attempted except by the most experienced and expert seaplane pilots.

Downwind takeoffs are possible, and at times preferable, if the wind velocity is light and normal takeoffs would involve clearing hazardous obstructions, or flying over congested areas before adequate altitude can be attained. The technique used for downwind takeoffs is almost identical to that used for upwind takeoffs. The only difference is that the elevator control should be held further aft, if possible. When downwind takeoffs are made, it should be kept in mind that more space is needed for the takeoff. If operating from a small body of water, an acceptable technique may be to begin the takeoff run while headed downwind, and then turning so as to complete the takeoff into the wind. This may be done by planing the seaplane while on a downwind heading then making a step turn into the wind to complete the takeoff. Caution must be exercised when using this technique since wind and centrifugal force will be acting in the same direction and could result in the seaplane tipping over.

Crosswind takeoff techniques will be discussed later in the chapter.

**LANDINGS**

In comparison, the land surfaces of all airports are of firm, static matter, whereas the surface of water is changing continually as a fluid. Floating obstacles and various activities frequently present on the water surface may present serious hazards during seaplane landings, especially to the careless pilot. For these reasons, it is advisable to circle the area of intended landing and examine it thoroughly for obstructions such as buoys or floating debris, and to note the direction of movement of any boats which may be operating at the intended landing site.

Most established seaplane bases are equipped with a windsock to
indicate wind direction, but if one is not available the wind can still be determined prior to landing. The following are but a few of the methods by which to determine the wind direction.

If there are not strong tides or water currents, boats lying at anchor will weathervane and automatically point into the wind. It is also true that sea gulls and other water fowl usually land facing the wind. Smoke, flags, and the set of sails on sailboats also provide the pilot with a fair approximation of the wind direction. If there is an appreciable wind velocity, streaks parallel to the wind are formed on the water. During strong winds, these streaks form distinct white lines. However, wind direction cannot always be determined from these streaks alone. If there are whitecaps or foam on top of the waves, the foam appears to move into the wind. This illusion is caused by the waves moving under the foam.

In seaplanes equipped with retractable landing gear (amphibians), it is extremely important to make certain that the wheels are in the retracted position when landing on water. Wherever possible, a visual check of the wheels themselves is recommended, in addition to checking the landing gear position indicating devices. A wheels-down landing on water is almost certain to capsize the seaplane, and is far more serious than landing the seaplane wheels-up on land. The water rudder should also be in the retracted position during landings.

The landing approach procedure in a seaplane is very similar to that of a landplane and is governed to a large extent by pilot preference, wind, and water conditions.

![Figure A-12 Normal Landing](image)

Under normal conditions a seaplane can be landed either power-off or power-on; however, power-on landings are recommended in most cases, because this technique gives the pilot more positive control of the seaplane and provides a means for correcting errors in judgment during the approach and landing. So that the slowest possible airspeed can be maintained, the power-on landing should be accomplished with maximum flaps extended. The seaplane should be trimmed to the manufacturer's recommended approach speed, and the approach made similar to that of a landplane. Touchdown on the
water should be made in a pitch attitude that is correct for taxiing "on the step," or perhaps a slightly higher attitude (Fig. A-12). This attitude will result in the hull first contacting the water at a point on the step. Once water contact is made the throttle should be closed and back elevator pressure gradually released. The application of forward pressure reduces the tendency for the amphibian to nose up due to the increase drag of the hull as it contacts the water. If the seaplane or flying boat has a tendency to nose down with full flaps extended it is recommended that subsequent approaches and landings be made with less flaps. Remember the objective is to land the seaplane or flying boat at the slowest possible speed in a slightly nose-up or near-level attitude.

After contacting the water gradually decrease the amount of back elevator pressure. It may be desirable at times to remain on the step after touchdown. To do so, add sufficient power to maintain the planing attitude.

**GLASSY WATER**

Flat, calm, glassy water is perhaps the most deceptive condition that a seaplane pilot will experience. The calmness of the water has a psychological effect in that it tends to overly relax the pilot when there should be special alertness. Consequently, this surface condition is frequently the most dangerous for seaplane operation.

From above, the mirror-like appearance of smooth water looks most inviting and easy to land on but as many pilots have suddenly learned, adequate depth perception may be lacking. Even experienced pilots misjudge height above the water, making timely roundouts difficult. This results in either flying bow first into the water or stalling the seaplane at too great a height above the water. When the water is crystal clear and glassy, pilots often attempt to judge height by using the bottom of the lake as a reference, rather than the water surface.

![Figure A-13 Glassy Water Landing](image)

**FIGURE A-13 GLASSY WATER LANDING**

An accurately-set altimeter may be used as an aid in determining height above the glassy water. However, a more effective means is to make the approach and landing near the shoreline so it can be
used as a reference for judging height above the water. Another method is to cross the shoreline on final approach at the lowest possible safe altitude so that a height reference is maintained to within a few feet of the water surface.

Glassy water landings should always be made power-on, and the need for this type of landing should be recognized in ample time to set up the proper final approach.

During the final approach the seaplane should be flown at the best nose-high attitude, using flaps as required or as recommended by the manufacturer (Fig. A-13). A power setting and pitch attitude should be established that will result in a rate of descent of 150-200 feet per minute and at an airspeed approximately 10 knots above stall speed. Throughout the approach the seaplane performance should be closely monitored by cross checking the instruments until contact is made with the water.

Upon touchdown elevator control pressure should be applied as necessary to maintain the same pitch attitude. Throttle should be reduced or closed only after the pilot is sure that the aircraft is firmly on the water. Several indications should be observed.

1. A slight deceleration force will be felt.
2. A slight downward pitching moment will be seen.
3. The sound of water spray striking the hull of the aircraft will be heard.

All three cues should be used because accidents have resulted from cutting the power rapidly after initially touching the water. To the pilot’s surprise a skip had taken place and it was found that when the power was cut, the aircraft was 10 to 15 feet in the air and not on the water, resulting in a stall and substantial damage.

Maintaining a nose-up, wings-level attitude, at the correct speed and a small rate of descent, are imperative for a successful glassy water landing. All aspects of this approach and landing should be considered prior to its execution. Bear in mind that this type of approach and landing will usually consume considerable landing distance. Landing near unfamiliar shorelines increases the possibility of encountering submerged objects and debris.

**STALL LANDING**

It is impractical to describe an ideal rough water procedure
FIGURE A-14 STALL LANDING

because of the varying conditions of the surface, (Fig. A-14). In most instances, though, the approach is made the same as for any other water landing. It may be better however, to level off just above the water surface and increase the power sufficiently to maintain a rather flat attitude until conditions appear to be more acceptable, and then reduce the power to touchdown.

CROSSWIND TECHNIQUES

Because of restricted or limited areas of operation, it is not always possible to take off or land the seaplane directly into the wind. Such restricted areas may be canals or narrow rivers. Therefore, skill must be acquired in crosswind techniques to enhance the safety of seaplane operation.

The forces developed by crosswinds during takeoffs or landing on water are almost the same as those developed during similar operations on land. Directional control is more difficult because of the more yielding properties of water, less surface friction, and lack of nosewheel, tailwheel, or brakes. Though water surface is more yielding than solid land, a seaplane has no shock absorbing capability, so all the shock is absorbed by the hull or floats and transmitted to the aircraft structure.

As shown in Fig. A-8, a crosswind tends to push the seaplane sideways. The drifting force, acting through the seaplane's center of gravity, is opposed by the water reacting on the area of the floats or hull in contact with the water. This results in a tendency to weathervane into the wind. Once this weathervaning has started, the turn continues and is further aggravated by the addition of centrifugal force acting outward from the turn, which again is opposed by the water reaction on the floats or hull. If strong enough, the combination of the wind and centrifugal force may tip the seaplane to the point where the downwind float will submerge and subsequently the wingtip may strike the water and capsize the seaplane. This is known as a "waterloop" similar to a "groundloop" on land.
Because of the lack of clear reference lines for directional guidance, such as are found on airport runways, it is difficult to quickly detect sidedrift on water. Fortunately, early detection of sidedrift is not really essential, because the seaplane takeoff and landing can be made without maintaining a straight line while in contact with the water. This will allow the seaplane to dissipate its forward speed prior to its weathervaning into the wind. By doing this, centrifugal force while weathervaning will be kept to a minimum and better aircraft control will result with less turnover tendency.

The technique used in Lake Aircraft to compensate for crosswinds during water operations is considerably different from the procedure used on land; due to the mid-wing configuration and wing float installation a wing-low side-slip is inappropriate. Setting the aircraft up in a wings level crab with a normal approach to a step landing and then touching down on the water surface with the crab correcting for wind drift is the normal and correct crosswind technique for Lake Aircraft. This technique will handle crosswinds of up to 10 knots quite well.

Another technique used to compensate for crosswinds (preferred by many seaplane pilots) is the downwind arc method. Using this method, the pilot creates a sideward force (centrifugal force) that will offset the crosswind force. This is accomplished by steering the seaplane in a downwind arc as shown in Fig. A-15.
The pilot merely plans an arced path and follows this arc to produce sufficient centrifugal force so that the seaplane will tend to lean outward against the wind force. During the run, the pilot can adjust the rate of turn by varying rudder pressure, thereby increasing or decreasing the centrifugal force to compensate for a changing wind force.

In practice, it is quite simple to plan sufficient curvature of the takeoff path to cancel out strong crosswinds, even on very narrow rivers. As illustrated in Fig. A-16, the takeoff is started at the lee side of the river with the seaplane heading slightly into the wind. The takeoff path is then gradually made in an arc away from the wind and the liftoff accomplished on the downwind edge of the river. This pattern also allows for more climbout space into the wind.

**FIGURE A-16 CROSSWIND LANDING**

It should be noted that the greatest degree of the downwind arc is during the time the seaplane is traveling at the slower speeds of takeoff or landing. At the faster speeds, the crosswind effect lessens considerably, and at very slow speeds the seaplane can weathervane into the wind with no ill effect.
Unless the current is extremely swift, crosswind or calm wind takeoffs and landings in rivers or tidal flows should be made in the same direction as the current. This reduces the water forces on the floats or hull of the seaplane.

Again, experience will play an important part in successful seaplane operation during crosswinds. It is essential that all seaplane pilots have thorough knowledge and skill in these maneuvers.

ANCHORING

Anchoring can best be described as securing a floating object to the bottom by means of a wedge/grappling type device and a rope or chain. This prevents the object drifting with the wind or tide. The water should be deep enough to ensure that the seaplane will not be left high and dry during low tide. The same principle is used to secure a flying boat such as the LAKE AIRCRAFT.

There are several devices that a seaplane pilot can use, but in general a good Danforth-type anchor is by far the best, with 50-75 feet of nylon rope. A rule of thumb is ten feet of rope for every foot of water.

Due to the different types of river, lakes, and ocean beds, care must be taken in selection the proper anchor. Mushroom anchors serve well in soft muddy bottoms. Danforth-type anchors which are most common, serve ideally in sandy pebble areas and can grab as well on rocky bottoms. Techniques in recovering or retrieving the anchor can be obtained from any boating manual.

RAMPING

Before ramping, plan a course of action. Determine the wind direction or current movement that would affect the aircraft track. Position the aircraft in alignment with the ramp center line. Extend the landing gear at a sufficient distance from the ramp to allow for complete gear extension prior to contacting the ramp. When contact is made add sufficient power to keep the aircraft moving up the ramp and out of the water. Maintain sufficient power to climb the ramp and maintain directional control. Reduce power after the aircraft is clear of the ramp. With a strong current or strong wind great care must be exercised in ramping.

BEACHING

Beaching can be accomplished in many different forms. One is to taxi at a speed no faster than a fast walk. As the bow and keel of the hull make contact with bottom (in case of sandy bottom) apply power together with rudder in the desired direction of turn. As the
aircraft starts to turn the wing will come onshore. Continue to apply power until the aircraft fuselage is parallel to the shoreline. At this point stop the engine and secure the aircraft. To depart, apply power and rudder to turn the aircraft away from shore, then use sufficient power to pull the aircraft off the bottom and away from shore.

MOORING

In securing an aircraft to a buoy, approach into the wind or against the current, whichever is the predominant factor. Generally, approaching a mooring downwind or downstream is not advisable. The engine should be cut at a sufficient distance from the mooring to allow the aircraft's speed to diminish to near zero prior to contacting the mooring. Use paddle or water rudders to continue forward momentum in close maneuvering.

DOCKING

The procedure for docking is essentially the same as that used for mooring. Properly planning the approach to the dock under existing conditions, and skill in handling the seaplane in congested areas are essential to successful docking. Bear in mind that a seaplane is fragile and striking an obstruction could result in extensive damage to the seaplane.

Basic procedures together with pilot judgment and technique in the water environment enable us to accomplish each maneuver safely.

ALWAYS LEAVE YOURSELF AN OUT!!!
This section is directed towards pilots with limited water experience (in type). The recommendations given here are somewhat conservative for the experienced. Keep in mind, this is a training manual. This aircraft is capable of some outstanding feats but it needs a proficient pilot. The student should take the time to look up and study the referenced note upon reading the common error.

ERRORS:

1. Beginning landing flare transition at wrong altitude to suit type landing desired: (For proper guidance consult Section VII, Page 1 and Section VIII, Page 2). Applies: WATER & LAND

2. Improper Trimming: (consult Section VII, Page 2). Applies: WATER & LAND

3. Lack of attention to wings-level technique during water crosswind landing: (Section VIII, Pages 2 & 3).

4. Lack of attention to forces involved and techniques required during water crosswind takeoff. (Section VIII, Pages 2, 3, and 4).

NOTE: Early in the takeoff run, as the bow is forced upward during the plow phase, the bow is vulnerable to crosswind forces. The downwind wing float will tend to plow and sometimes there may also be a tendency for the aircraft to turn or drift downwind. A direct crosswind may result in the necessity to abort the attempt because of the downwind float digging in or may result in loss of directional control. Having determined that the aircraft wants to roll toward downwind under these conditions, let's project a south departure with nine mph easterly crosswind conditions in a 150 foot-wide channel. If we line up on 180 degree heading and commence the takeoff, we would experience the right float digging in and would find that we do not have sufficient aileron control at the slower speeds. We would also experience the aircraft beginning to drift to the right anyway under these conditions, so why not begin the operation from a location near the west bank on a heading of approximately 150 degrees?
MOST COMMON ERRORS

Heading the aircraft more nearly aligned into the wind will assist with the aileron control, problem and heading left of the desired track seems reasonable since the forces involved tend to roll and drift us to the right. We start with the water rudder down, remembering to bring it up just after adding in full power. We have an initial heading of 150 degrees, and we make a small step turn to approximately 175 degrees for the departure; resulting in a wings-level crab technique for the remainder of the run. The example headings are for orientation here. In reality the pilot would use outside references, not headings, to maintain desired track instinctively.

5. Operating in rough water when unnecessary. (Consult Section VIII, Page 4 for shelter guidance).

Anything in excess of one-foot waves is to be considered rough unless pilot involved has a reasonable amount of experience in type. Some of the cues that indicate operations should not be conducted in open (non-sheltered) water are wind streaks, beginning whitecaps, and over 15 mph wind velocity. As the pilot gains experience and begins to handle slightly heavier water, then the technique is as follows:

Inbound, start the landing transition high enough to allow time to get in slow flight mode, then drag the tail gently in the water first. The optimum touch is when the pilot runs out of aft control travel at the moment of touch and the aircraft stays in water contact. If the optimum is not experienced and the aircraft bounces, don't arbitrarily hold the yoke back, but handle pitch control as necessary for a second touch.

Outbound: In rough water, comply with these three rules:

A. Trim well up, as applicable with loading.

B. Bow held slightly higher than usual.

C. Most Important: Ready (spring-loaded) to abort. Beginners abort at one healthy thump on the nose or two on the aircraft belly. More experienced pilots abort also at one thump on the nose and possibly three on the belly. If they don't have it cushioned by then, they also had better quit.
MOST COMMON ERRORS

(continued)

6. Lack of attention to pitch attitude control during touchdown and throughout stopping phase (Same as #1).

7. Abrupt power changes and unwillingness to guard aircraft pitch control during go arounds, touch and goes, etc., for both land and water. (Refer to your own basic common sense and good pilot technique).

8. Lack of attention to roll (wings level) during water touchdown and stopping phase. (Section VIII, Page 2)

9. Failure to immediately arrest any tendency to rock (porpoise) whether on takeoff or landing.

10. Failure to use right rudder and to keep wings level during water takeoff run.

11. Unwillingness to admit the step landing is blown after a normal water landing bounce and attempting to put it back on the step again from altitude.

This is probably the most common single error. The step landing just is not that important when landing in normal water with surface vision. Inbound, your "Plan A" landing was to put it gently on the step. Your "Plan B" was to put the tail gently into the water. If you goof "A" then admit it and go to "B". The aircraft has an extremely forgiving wing, but once the water clutches at the aircraft there is considerable drag involved. Therefore, generally low power or power-off (Tail Landing) saves rather than an abrupt full-power go around. You might take note that the style of landing is worded "Tail Landing" not "Stall Landing". The reason for this wording is that the words STALL LANDING tend to connote to some pilots to pull the yoke all the way back and wait for something to happen.
HIST COMMON ERRORS

(continued)

On the other hand, the words TAIL LANDING denote that the pilot should do whatever seems necessary to insert the tail of the aircraft gently into the water. The name of the maneuver is TAIL LANDING, not tail crash. If the aircraft is in an ascending mode at the time of decision, relax pressures as necessary to ease down to low ground (water) effect and then tail-touch with back pressure. On the other hand, if it bounces and is low and settling heavily, haul back and prevent sudden contact with the water. Power can be used in these corrections in small amounts, but excessive use aggravates this condition.

12. Operating in glassy water when unnecessary. The novice pilot should avoid glassy water and develop a keen sense of feel and attitude control in normal conditions prior to glassy water. The pilot should strive to avoid glassy conditions until he feels he is part of the aircraft. At this level of experience, he should conduct a four or five minute airborne glassy water practice session to determine power setting for a maximum of 200 feet per minute sink and also set the trim as close as possible to maintain a step-low attitude. Then he is CURRENT to make the touchdown using peripheral vision as much as possible by landing along the shore line. You should reference your Airplane Flight Manual for approved speeds. The need for the airborne practice session is to adjust the figures for the loadings, density altitude, etc. The attitude described is step-low, not tail-low and definitely not nose-low. This accuracy of sight picture takes time to develop. Practice makes perfect. ANYTIME the eye cannot focus on the surface, (like binoculars out of adjustment), glassy techniques may be the order of the day even though the water isn't "mirror" shiny.

In the event of a bad landing on glassy water, there is no blanket statement to cover the situation. While advice for a bad landing correction when surface vision is adequate is generally to tail land, there is usually an exception to a rule. For glassy water continue the landing if possible, or initiate a gentle go around, reserving the tail landing technique for the last choice, being certain that shore line peripheral vision is nearby for some altitude judgment.
MOST COMMON ERRORS
(continued)

The care given in presetting the glassy approach as well as the stable conditions involved result in a "bad" landing to be only a little skip, versus a high bounce. (This is not going to hold true of course if the pilot rationalized he had surface vision when he did not, and failed to set up for glassy water). Having encountered one of these skips, normally DO NOT reduce power. If, during the airborne currency practice, 15 inches manifold pressure did the job, then maintain that power setting until glued to the water, only converting to the go-around or tail landing if all else fails.

13. Failure to use flaps down for all takeoffs and landings, water and land, crosswind included.

The aircraft is extremely forgiving in the touchdown range airspeeds with flaps down, but not with them up. So use them!! That's the way it's designed.

14. Failure to maintain a "proper" step taxi speed when intention is to operate as a speed boat, not an aircraft.

A speed-boat can have too large an engine installed and become a hazard, or too small and be too awkward to achieve the step (planing) position. Relating this to the aircraft we find that around 16 to 18 inches manifold pressure tends to "install" the proper size engine. However, in actual practice we use full (break-away) power to get up and go, and once established on the step bring power back into the neighborhood of the above recommendations and experiment from there for the proper speed. The proper speed takes some degree of "feel" to maintain. Here are some clues:

It is recommended to maintain about 25 mph resultant water surface speed. Airspeed indicator may range from 20 to 35, upwind versus downwind, up or down current, etc. Safe step taxi speed could be further described as minimum water ski speed. When below this balance speed the aircraft tends to maintain a slow flight tail-low attitude of its own accord without pilot interference in pitch axis.
MOST COMMON ERRORS

(continued)

This is due to bow pressure and center of buoyancy being forward. As the proper speed is approached the aircraft tends to sit neatly on the step of its own accord, in pitch. Pilot needs to control roll and yaw but continue to monitor pitch. During this period water contact should be heard from beneath the rear seat. If the speed is allowed to exceed the safe speed, then the center of buoyancy has moved further aft and the aircraft wants to skim along nose low.

DON'T FORGET THERE ARE NOSE WHEEL DOORS UP THERE AND PORPOISE ENERGIES ARE BEING DEVELOPED, SO THIS IS IMPROPER.

If water contact is heard around the pilot's feet during the transition period from step to takeoff this is wrong! To correct for this condition, simply apply slight back pressure to the yoke, allowing the center of buoyancy to move forward.

15. Failure to allow sufficient room in close quarters in crosswinds.

During slow taxi the aircraft acts as if there is a sail installed on the tail and pilot should be protective of an upwind bank. During starting and stopping (transition and plow) phases, the tail effect is transferred to the bow and the pilot should be protective of a downwind bank. (Section VIII, Pages 3 and 4).

16. Failure to realize that step turns from downwind to upwind are hazardous, if tried in strong winds.

The aircraft will tend to tip its high-speed float towards the water if the roll axis is left unattended. Centrifugal force and wind add up to a possible skid outward.
17. Failure to realize that step turns from upwind to downwind are convenient to make since the wind tends to tip the aircraft onto the slow float if roll axis left un guarded.

The direction of turn is forgiving in that centrifugal force is outward while the wind is holding inward, resulting in a balance that helps guard against skidding in the turn. Turning to miss an obstruction when landing is a safe practice, if speed is allowed to dissipate to around 25 to 30 mph prior to beginning the turn.

Summarizing: High speed in excess of 25 to 30 mph is improper. When the wind is strong and the pilot is running close to an upwind shore for shelter, the turn to the downwind to miss obstructions is allowable. When conditions are calm and more runway is needed, the turning takeoff from downwind into a light wind is allowable, provided that speeds over 25 to 30 mph are delayed until in the straight-ahead run.

18. Failure to realize that it is proper to lightly skim the inboard bloat (slow float) during a step turn. Step turns are not made in a wings-level attitude.

19. High-speed step turns resulting from failure to practice straight-ahead step taxi for speed awareness prior to attempting step turns. Refrain from extensive plow taxi; it tends to wet the prop.
MOORING TIPS

Judge the distance to the shore. Lower, do not throw the anchor into the water. Rope corresponding to seven to 10 times the depth in the water should be let out.

Safety line with buoy. The line is attached to the lower part of the anchor and may be used to drag it out of its attachment if it holds too tightly.

Go shoreward. When the rope is tight the anchor is dragged after the boat until it gets a good hold. Repeat this move if the hold is not adequate. A chain between the anchor and the rope will calm the movements and give the anchor a better hold. With some yards of chain along the bottom you need not be afraid of damage to the ropes. A weight or a chain is a load on the mooring so that the anchor is positioned along the bottom in the best configuration for a good hold.

USING THE ANCHOR THE WRONG WAY. The anchor is thrown as far away from the boat as possible. At worst you will lose your balance and fall into the boat or into the water. If the anchor is let out too close to the boat, the movements or the tide lifting the boat will drag the anchor up and out from the bottom. It is only the anchor's weight which keeps the boat in position.

THE S.A.V. 3.5 LB. FOLDING ANCHOR IS AVAILABLE FROM THE PRODUCT SUPPORT DEPT. OF LAKE AIRCRAFT. IT WILL FIT IN THE BOW COMPARTMENT OF ALL LAKE MODELS.
MOORING TIPS

A. With this wind direction the wind may carry the plane towards shallow water if the anchor doesn't have a sufficiently firm hold. Pay attention to this danger if you have to leave the plane.

B. If the anchor should slip, it could get a new and better hold before the wind carries the plane into a dangerous position.

C. If there is a current, or turbulent water, two anchors will reduce the constant drag on the plane. The dragging tears at the ropes' plane attachment and works the anchor attachment.

D. By keeping two ropes ashore and the plane heading into the wind, you can be more confident that the mooring will hold. The anchor will keep the plane quiet. Be aware the wind may change.

SOME ADVICE AND HINTS

1. Changes in the current, wind, or tide conditions may work on the anchor so that it loses its hold. There is no guarantee that the anchor will then get a new hold.

2. A proper anchor laid out in the right way will attach much better to the bottom (see the figure).

3. The anchor weight is important to its ability to dig down and thus get a good hold. It may prove practical to keep two different weight classes onboard - one for general moorings and a larger and heavier one for moorings under adverse conditions. In certain cases it will be advantageous to use both simultaneously (see figures).

4. A rope or a chain is generally strong enough if not worn or damaged. One usually chooses a dimension larger than strictly necessary in order that the mooring may be accomplished more easily.
5. If you are uncertain about bottom conditions, you should use a safety line. If the anchor gets stuck, you may, by pulling the safety line which is attached to the rear eye hook, loosen the anchor from its hold. This is done from the direction opposite to the one in which one has moored.

6. The moorings should never be quite tight. If tight, when the waves, the current, and the wind work on the plane, the anchor will lose its hold at the bottom. At exposed moorings you may protect the rope by a split plastic hose tied around the rope, or lashings around the rope, in the chafing area. If there is a length of chain at the anchor, this will prevent wear on the rope along the bottom. It also produces a spring action which causes the mooring to hold better.

**Information has been taken from SAV MARINE'S BROCHURE.**
NOTE: THIS IS NOT REQUIRED KNOWLEDGE FOR YOUR SEAPLANE RATING, BUT IS OFFERED FOR YOUR GENERAL MARINE INFORMATION.

5/28/85

TABLE 337-1
SEA STATE CODE

(WORLD METEOROLOGICAL ORGANIZATION)

<table>
<thead>
<tr>
<th>SEA STATE CODE</th>
<th>DESCRIPTION OF SEA</th>
<th>SIGNIFICANT WAVE HEIGHT METERS</th>
<th>SIGNIFICANT WAVE HEIGHT FEET</th>
<th>WIND SPEED KNOTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Calm (glassy)</td>
<td>0</td>
<td>0</td>
<td>0-3</td>
</tr>
<tr>
<td>1</td>
<td>Calm (rippled)</td>
<td>0 - 0.1</td>
<td>0 - 1/3</td>
<td>4-6</td>
</tr>
<tr>
<td>2</td>
<td>Smooth (wavelets)</td>
<td>0.1-0.5</td>
<td>1/3 - 1/2</td>
<td>7-10</td>
</tr>
<tr>
<td>3</td>
<td>Slight</td>
<td>0.5-1.25</td>
<td>1 2/3 - 4/3</td>
<td>11-16</td>
</tr>
<tr>
<td>4</td>
<td>Moderate</td>
<td>1.25-2.5</td>
<td>4-8</td>
<td>17-21</td>
</tr>
<tr>
<td>5</td>
<td>Rough</td>
<td>2.5-4</td>
<td>8-13</td>
<td>22-27</td>
</tr>
<tr>
<td>6</td>
<td>Very Rough</td>
<td>4-6</td>
<td>13-20</td>
<td>28-47</td>
</tr>
<tr>
<td>7</td>
<td>High</td>
<td>6-9</td>
<td>20-30</td>
<td>48-55</td>
</tr>
<tr>
<td>8</td>
<td>Very High</td>
<td>9-14</td>
<td>30-45</td>
<td>56-63</td>
</tr>
<tr>
<td>9</td>
<td>Phenomenal</td>
<td>OVER 15</td>
<td>OVER 45</td>
<td>64-118</td>
</tr>
</tbody>
</table>

NOTES: (1) The significant wave height is defined as the average value of the height (vertical distance between trough and crest) of the largest one-third of the waves present.

(2) Maximum wave height is usually taken to be 1.6 x significant wave height: e.g., significant wave height of 6 meters gives maximum wave height of 9.6 meters.

(3) Wind speeds were obtained from appendix of the AMERICAN PRACTICAL NAVIGATOR by Nathaniel Bowditch, LL.D.; published by The U.S. Naval Oceanographic Office, 1966.
PART 91—GENERAL OPERATING AND FLIGHT RULES

Section 91.5 - Preflight action.

Each pilot in command shall, before beginning a flight, familiarize himself with all available information concerning that flight. This information must include:

a) For a flight under IFR or a flight not in the vicinity of an airport, weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which he has been advised by ATC.

b) For any flight, runway lengths at airports of intended use, and the following takeoff and landing distance information:

1) For civil aircraft for which an approved airplane or rotocraft flight manual containing takeoff and landing distance data is required, the takeoff and landing distance data contained therein; and

2) For civil aircraft other than those specified in subparagraph (1) of this paragraph, other reliable information appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature.

Section 91.69 - Right-of-way rules; water operations.

a) General: Each person operating an aircraft on the water shall, insofar as possible, keep clear of all vessels and avoid impeding their navigation, and shall give way to any vessel or other aircraft that is given the right of way by any rule of this section.

b) Crossing: When aircraft, or an aircraft and a vessel are on crossing courses, the aircraft or vessel to the other's right has the right-of-way.

c) Approaching Head-on: When aircraft, or an aircraft and a vessel, are approaching head-on or nearly so, each shall alter its course to the right to keep well clear.

d) Overtaking: Each aircraft or vessel that is being overtaken has the right-of-way, and the one overtaking shall alter course to keep well clear.

e) Special Circumstances: When aircraft or an aircraft and a vessel, approach so as to involve risk of collision, each aircraft or vessel shall proceed with careful regard to existing circumstances, including the limitations of the respective craft.
A SAFE AND ENJOYABLE WATER TRANSITION

NOTE: This information has been extracted from the publication AIRCRAFT EMERGENCY PROCEDURES OVER WATER.
DEFINITIONS OF OCEANOGRAPHIC TERMINOLOGY:

SEA: The condition of the surface that is the result of both waves and swells.

WAVE or CHOP: The condition of the surface caused by local winds.

SWELL: The condition of the surface which has been caused by a distant disturbance.

SWELL FACE: The side of the swell toward the observer. The backside is the side away from the observer. These definitions apply regardless of the direction of swell movement.

PRIMARY SWELL: The swell system having the greatest height from trough to crest.

SECONDARY SWELLS: Those swell systems of less height than the primary swell.

FETCH: The distance the waves have been driven by a wind blown in a constant direction, without obstruction.

SWELL PERIOD: The time interval between the passage of two successive crests at the same spot in the water, measured in seconds.

SWELL VELOCITY: The velocity with which the swell advances with relation to a fixed reference point, measured in knots. There is little movement of water in the horizontal direction. Swells move primarily in a vertical motion, similar to the motion observed when shaking out a carpet.

SWELL DIRECTION: The direction from which a swell is moving. This direction is not necessarily the result of the wind present at the scene. The swell encountered may be moving into or across the local wind. Swells, once set in motion, tend to maintain their original direction for as long as they continue in deep water, regardless of changes in wind direction.

SWELL HEIGHT: The height between crest and trough, measured in feet. The vast majority of ocean swells are lower than 12 to 15 feet and swells over 25 feet are not common at any spot on the oceans. Successive swells may differ considerably in height.
AIRMAN'S INFORMATION MANUAL CONT.

EMERGENCY PROCEDURES CONT.

It is extremely dangerous to land into the wind without regard to sea conditions. The swell system, or systems, must be taken into consideration. In ditching parallel to the swell, it makes little difference whether touchdown is on top of the crest or in the trough. It is preferable, if possible, to land on the top or back side of the swell. If only one swell system exists, the problem is relatively simple even with a high, fast system. Unfortunately, most cases involve two or more systems running in different directions. With many systems present, the sea presents a confused appearance.

One of the most difficult situations occurs when two swell systems are at right angles. For example, if one system is 8 feet high, and the other 3 feet, a landing parallel to the primary system, and down swell on the secondary system is indicated. If both systems are of equal height, a compromise may be advisable - selecting an intermediate heading at 45 degrees down swell to both systems. When landing down a secondary swell, attempt to touch down on the back side, not on the face of the swell. Remember one axiom - AVOID THE FACE OF A SWELL.

If the swell system is formidable, it is considered advisable in landplanes to accept more crosswind in order to avoid landing directly into the swell.

The secondary swell system is often from the same direction as the wind. Here, the landing may be made parallel to the primary system, with the wind and secondary system at an angle. There is a choice of two headings paralleling the primary system. One heading is downwind and down the secondary swell; and the other is into the wind and into the secondary swell. The choice of heading will depend on the velocity of the wind versus the velocity and height of the secondary swell.

The simplest method of estimating the wind direction and velocity is to examine the wind streaks on the water. These appear as long streaks up and downwind. Some persons may have difficulty determining wind direction after seeing the streaks on the water. Whitecaps fall forward with the wind but are overrun by the waves thus producing the illusion that the foam is sliding backward. Knowing this, and by observing the direction of the streaks, the wind direction is easily determined. Wind velocity can be accurately estimated by noting the appearance of the whitecaps, foam and wind streaks.
A successful aircraft ditching is dependent on three primary factors. In order of importance they are:
1. Sea conditions and wind.
2. Type of aircraft.
3. Skill and technique of pilot.

The behavior of the aircraft on making contact with the water will vary within wide limits according to the limits of the sea. If landed parallel to a single swell system, the behavior of the aircraft may approximate that to be expected on a smooth sea. If landed into a heavy swell or into a confused sea, the deceleration forces may be extremely great – resulting in breaking up of the aircraft. Within certain limits, the pilot is able to minimize these forces by proper sea evaluation and selection of ditching heading.

When on final approach the pilot should look ahead and observe the surface of the sea. They may be shadows and whitecaps—signs of large seas. Shadows and whitecaps close together indicate that the seas are short and rough. Touchdown in these areas is to be avoided. Select and touchdown in any area (only about 500 feet is needed) where the shadows and whitecaps are not so numerous.

Touchdown should be at the LOWEST speed and rate of descent which permit safe handling and optimum nose up attitude on impact. Once first impact has been made, there is often little the pilot can do to control a landplane.

Once preditching preparations are completed, the pilot should turn to the ditching heading and commence letdown. The aircraft should be dragged low over the water, and slowed down until ten knots or so above stall. At this point, additional power should be used to overcome the increased drag caused by the nose up attitude. When a smooth stretch of water appears ahead, cut power, and touchdown at the best recommended speed as fully stalled as possible. By cutting power when approaching a relatively smooth area, the pilot will prevent overshooting and will touchdown with less chance of planing off into a second uncontrolled landing. Most experienced seaplane pilots prefer to make contact with the water in a semi-stalled attitude, cutting power as the tail makes contact. This technique eliminates the chance of misjudging altitude with a resultant heavy drop in a fully stalled condition. Care must be taken not to drop the aircraft from too high an altitude, or to balloon due to excessive speed. The altitude above water depends on the aircraft. Over glassy smooth water, or at night without sufficient light, it is very easy for even the most experienced
AIRMAN'S INFORMATION MANUAL CONT.

EMERGENCY PROCEDURES CONT.

pilots to misjudge altitude by 50 feet or more. Under such conditions, carry enough power to maintain nine to 12 degrees nose up attitude, and 10 to 20% over stalling speed until contact is made with the water. The proper use of power on the approach is of great importance. If power is available on one side only, a little power should be used to such an extent that the aircraft cannot be turned against the good engines right down to the stall with a margin of rudder movement available. When near the stall, sudden application of excessive unbalanced power may result in loss of directional control. If power is available on one side only, a slightly higher than normal glide approach speed should be used. This will insure good control and some margin of speed after leveling off without excessive use of power. The use of power in ditching is so important that when it is certain that the coast cannot be reached, the pilot should, if possible, ditch before fuel is exhausted. The use of power in a night or instrument ditching is far more essential than under daylight contact conditions.

If no power is available, a greater than normal approach speed should be used down to the flare-out. This speed margin will allow the glide to be broken early and more gradually thereby giving the pilot time & distance to feel for the surface decreasing the possibility of stalling high or flying into the water. When landing parallel to a swell system, little difference is noted between landing on top of a crest or in the trough. If the wings are trimmed to the surface of the sea rather than the horizon, there is little need to worry about a wing hitting a swell crest.

The actual slope of a swell is very gradual. If forced to land into a swell, touchdown should be made just after passage of the crest. If contact is made on the face of the swell, the aircraft may be swamped or thrown violently into the air, dropping heavily into the next swell. If control surfaces remain intact, the pilot should attempt to maintain the proper nose attitude by rapid and positive use of the controls.

In most cases drift caused by crosswind can be ignored; the forces acting on the aircraft after touchdown are of such magnitude that drift will be only a secondary consideration. If the aircraft is under good control, the "crab" may be kicked out with rudder just prior to touchdown. This is more important with high wing aircraft, for they are laterally unstable on the water in a crosswind and may roll to the side in ditching.

NOTE: This information has been extracted from the publication AIRCRAFT EMERGENCY PROCEDURES OVER WATER.
FAA EXCERPTS

FLIGHT TRAINING MANUAL

EMERGENCY PROCEDURES

WIND-SWELL-DITCH HEADING SITUATIONS

DIRECTION OF SWELL MOVEMENT

Landing parallel to the major swell

Landing on the face and back of swell

Single swell system - wind 15 kts

Double swell system - wind 15 kts

Double swell system - wind 30 kts

Wind - 50 kts

Aircraft with low landing speeds - land into the wind.
Aircraft with high landing speeds - choose compromise
Both - land on back side of swell.

ADJUSTED FOR AIRCRAFT TRAINING FORMAT