

MANUAL OF SAFE AIRBOAT OPERATION

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Table of Contents

INTRODUCTION.....	3
SAFETY AND PRECAUTIONARY NOTES.....	6
Propeller Safety	6
Safety Equipment	8
AIRBOAT OPERATION	
Basic Mechanics of Operation.....	10
Steering and Stability	12
Operating in Windy Conditions	16
Docking.....	17
Getting Stuck (and Unstuck).....	19
Swamping and Sinking	21
Environmental Considerations.....	22
Other Driving Hints.....	23
MALFUNCTIONS, MAINTENANCE, AND REPAIRS	27
Mechanical Failure	27
Troubleshooting Aircraft Engines (27)	
Troubleshooting Automotive Engines (30)	
Maintenance.....	31
Propeller and Frame Maintenance (31)	
Maintenance of Engines and Fluids	34
Aircraft Engines (34)	
Automotive Engines (36)	
Steering Linkage and Rudders.....	38
Electrical System	38
TRAILERING, TOWING, AND LAUNCHING.....	40
Trailer Maintenance	43
OPERATOR ATTITUDES AND AWARENESS.....	43
AIRBOAT CHECKLIST.....	46
Preoperative Checklist.....	46
Starting Procedure	46
Shutdown and Trailering Procedures.....	46
Additional Warnings	47
GLOSSARY OF AIRBOATING TERMS	48
AIRBOAT MANUFACURERS AND SUPPLIERS	54
Acknowledgements	56

Airboat Safety - Foote & Reynolds

INDEX..... 57

INTRODUCTION

Airboats have become an essential tool for many specialized types of work in shallow, vegetation-choked, or muddy conditions where conventional craft cannot travel. State and Federal natural resources personnel use airboats for their work on wetlands, wildlife work, research projects, surveying, and emergency aid. This manual was developed out of the need for a training and safety manual on airboat operation for Department of Interior employees.

Learning to operate airboats has traditionally been a "seat-of-the-pants", trial-and-error experience, or an apprenticeship whereby skills and experience were passed on informally. In this spirit, guidance for this manual was sought from airboat operators working in Louisiana swamps, Utah mudflats, Florida's everglades, and the western prairie pothole region.

There are inherent dangers in airboat operation that are capable of quickly magnifying small errors in operation or maintenance into life-threatening situations. The common sense and good judgement of the operator are essential for airboating.

The following 3 prerequisites are mandatory before operating airboats:

- (1) completion of a certified powerboat or water-safety course such as taught by the Power Squadron or the U. S. Coast Guard, or Department of Interior course DM 485.
- (2) instruction in airboating including study of operating instructions (e.g. this manual), and
- (3) operator's written and field proficiency test - including trailering, loading and launching - under the guidance of an experienced operator.

We have provided this manual with the hope that it will make basic airboating safer and easier to learn. Specialty use of airboats for uses such as enforcement pursuits, operating on ice or in icing

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conditions, night-lighting for waterfowl or electro-shocking are too context-dependent to be properly addressed in this manual.

We also believe that none of us are as smart as all of us collectively, therefore, we welcome your comments and suggestions for future revisions. You may reach me at this address:

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Disclaimer

Neither the authors, the advisors, nor the Agencies they represent can guarantee or assume liability for this collection of suggestions. There are far too many conditions, variables, and situations in airboating to be covered in one short manual.

The use of trade names in this document does not constitute the U.S. Government's endorsement of these specific products.

SAFETY AND PRECAUTIONARY NOTES

Propeller Safety

Air-driven propulsion is what distinguishes airboats from other watercraft and many of the precautions and operating idiosyncracies of airboats are related to their somewhat exposed engines and propellers. Experienced operators stress the danger of the propellers. Be aware that your passengers are sitting 4 feet away from a 40 lb, propeller whose spinning tips approach the speed of sound. The safety rule is simple--do not get close to the propeller. As an operator, be aware of anyone or anything that can contact the propeller. Some examples of things that have passed through propellers include gloves, animals, push poles, jackets, limbs, ropes, wire, pop cans, and nails. Most of these items were destroyed. Air currents can lift items from the bottom of the boat and the propeller can swat them with terrific force through the bottom of the boat or into someone nearby. Safety and prevention of propeller damage requires that all equipment remain secured when underway. Consider using large waterproof containers or coolers to enclose all loose items. As in airplanes, the driver is responsible for everything that occurs in the boat. Therefore, it is the responsibility of the driver to secure all equipment, and instruct all passengers of safety precautions before starting the engine.

Operators should be aware of the 50 meter column of propeller-driven air (prop-wash) behind them that can lift and tumble canoes, turn over trash cans, soak equipment, throw debris, and irritate bystanders. The correct procedure for departing from a landing area is to idle out to a safe operating distance. If you get caught behind an airboat, face away, duck your head, close your eyes, and wait for its departure.

Never touch an unsecured propeller. The prop could spin under compression and injure you. Aircraft engines can run with the ignition key turned off. Therefore, when the magnetos are not

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grounded, the engine could start if the propeller is moved. In fact, some old airplanes had no starters at all; rather, the pilots had to chock the wheels and turn the propeller by hand to start them. There is no safe way to do this on an airplane, much less on a partially enclosed airboat propeller, so do not try it. There are a few circumstances where propellers must be moved for inspection, engine work, travel or storage. In these cases precautions include:

1. Ensure that magnetos are in the OFF position.
2. Allow engine to cool down.
3. Loop a rope or use a boat paddle to position the propeller.
 - 4 Mechanics entering the cage for repairs must remove the battery terminal (or switch the battery box to the off position, tie the propeller off to a strong cage support with a length of rope so it cannot spin if you ground the starter.

Although no extremities should enter the cage, be aware that exposed exhaust manifolds and pipes are glowing hot during operation and pose a burn or fire hazard if plant materials or anything flammable contacts them. On some airboats the manifold is very close to the front of the cage so caution all passengers with long hair to tie it securely to prevent burning.

Safety Equipment

The following safety gear must be worn at all times while operating airboats:

1. Life jackets must be U. S. Coast Guard-approved personal flotation devices (PFDs).
2. Ear muff-style hearing protection.
3. Shatter-proof eye protection such as goggles or tight wrap-around-style safety glasses with side shield flaps. Eyewear must be of a type that will not be pulled off when the operator turns his/her head.
4. Close-fitting, wind-resistant clothes. The combination garments that include an approved PFD

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sewn inside of a windbreaker effectively warm and provide floatation. These are generically called "float-coats".

5.A motorcycle-style helmet/visor combination is an excellent way to protect one's eyes and head and is necessary for work in wooded situations.

Additionally, the following safety equipment must be on board:

1. A paddle or a push pole and shock cords to tie it down when underway.
2. Fire extinguisher suitable for gasoline fires.
3. Water-proof emergency communications equipment.

If operating at night, clear eye protection or goggles should be worn because the large numbers of insects found in most wetlands pose an eye injury hazard. Night operation requires that running lights be turned on and a high-intensity light source such as a Q-beam be available for searching the water surface for obstructions. Because passengers are sitting 1-2 meters above the water surface, be particularly careful of overhanging obstacles when operating airboats at night. Fence wire and trot lines are serious dangers to airboaters. Be particularly careful when moving between upright structures or approaching a dock where powerlines, or cables might be strung.

Most older airboats are constructed without mufflers, so engine noise is particularly loud. Propellers also produce a lot of noise when spinning. Hearing damage is a particular concern around airboats. Always wear adequate hearing protection devices such as ear muffs designed for sound attenuation. If using a motorcycle helmet, foam ear plugs are appropriate. Some operators find that wearing the soft roll-up type foam plugs under ear muffs provides even greater ear comfort. Muffler-equipped exhaust systems are strongly recommended for newly purchased airboat engines.

Because airboats may become incapacitated in areas inaccessible to conventional craft, some form of emergency communication should be carried. In coastal and river regions a marine radio can be

used to seek emergency help, and check for severe weather forecasts. Cellular phones enclosed in floating, waterproof cases provide an excellent emergency link to rescuers. Emergency numbers should be written in the phone case. Position the phone in the airboat so that it can float free and be retrieved if the boat sinks.

A waterproof first aid kit must be stored on board and in addition to the usual contents, should include sunscreen, and spare ear and eye protection. Rubber gloves, space blankets and emergency rations should be considered for winter time operation. Because battery problems are common, jumper cables and a small tool box are often useful to have on board.

AIRBOAT OPERATION

Basic Mechanics of Operation

Although the most basic operator instructions are very simple, the subtleties and skills required for safe operation are quite complex. You should be familiar with all of the driving concepts and the cautionary warnings throughout this manual before attempting the following basic outline of operation.

1. After starting and warming up the engine, the airboat speed may be increased by depressing the accelerator just enough to bring it up to operating speed (on plane). Because airboats do not have brakes, or a reverse gear, it is critical that speeds be moderate. The large amount of power (from 40 horsepower aircooled engines to over 400 hp in some large welded hull or dual-engine boats) is provided for moving the boat over high-resistance surfaces, not for high speeds. Airboats become very unstable and may actually try to fly at high speeds. Never travel at top speed. High speed travel is dangerous, wastes fuel, and is destructive to the boat's engine. Greater driving precision, control, and more evasive options are available at 1/2 throttle than at higher speeds.

2. Power is required for control. Although it seems counterintuitive, one must use the throttle to force air over the rudder to initiate a turn.
2. The boat is turned by pulling the steering lever, called the stick, rearward to turn left and by pushing it forward to turn right. Again, power is required to initiate and complete turns.
3. For abrupt turns or avoidance of obstacles, move the stick in the appropriate direction along with a slight increase the engine power.
4. To stop, reduce power gradually while travelling in a straight line.

Steering and Stability

Airboats come in various lengths and hull configurations ranging from the traditional flat bottomed boats to more modern hulls with more rounded chines and a faint v-bottom. These modern hulls tend to sit deeper in the water, though they have greater deep-water stability. Higher sides (25 inches in some boats), greater boat length, and greater width all provide decreased risk of capsize or swamping. Hull designs such as the "Palm Beach" style have the aft 4-feet of the hull enclosed, thereby reducing the risk of wave run-up over the transom. Most of the following discussion assumes a standard, open-hull designed boat; other designs will benefit from these conservative instructions even if they are not essential.

To steer an airboat there must be substantial air traveling over the rudder. An idling engine does not provide sufficient steering except for a near-stationary boat. Even though it feels unnatural, it is an important concept in airboating that one must use engine power to steer around obstacles. When the operator lifts his or her foot from the accelerator, almost all steering ability is lost.

Most airboats are generally intended for very shallow water operation, however, see the following section on stabilizing features. Many airboat designs are somewhat unstable in deep water where

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their large flat bottom is not supported by either mud, vegetation or the "hydraulic cushion" effects of a shallow bottom. In deep water the angle or attitude of the airboat is changed because the heavier rear of the boat sinks more than the front and the propeller thrust is directed more downward rather than a level push. This feature combined with the necessarily high center of gravity (elevated engine, cage, and operator) and the necessarily low transom (for proper propeller thrust) means that the craft loses some stability and maneuverability. Be aware that in deep water airboats flip over easily, are prone to take water over the sides or stern, do not take waves well, and are hard to maneuver.

Sometimes operators must take airboats into deep water, for example, to cross lakes, rivers or canals to get to their destinations. Understanding an airboat's limitations in deep water can help, as can the following operating tips:

1. Do not overload airboats; watch how deeply the boat sits in the water at various loadings and discuss loading with the manufacturer or an experienced operator to estimate safe weight capacities.
2. Note that during acceleration, the propeller's inertial weight and engine torque combine to tilt the boat upon acceleration. Counterclockwise propeller spin causes the right rear (starboard) quarter of the boat to dip upon acceleration. This phenomenon is a demonstration of a simple law of physics--for every action there is an equal and opposite reaction. Watch this carefully because that is the lowest edge of the boat and water may pour over the edge and result in the swamping of open-hulled boats.
3. Do not decrease the throttle abruptly in deep water because the boat's trailing wave may catch up and curl over the transom, swamping the boat. This effect is accentuated when stopping during a turn. Certain hull designs are more susceptible to this than others.

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4. Do not turn abruptly while you are accelerating from a standstill, lest water pour over the rear quarter.
5. Airboat turns in deep water are accomplished in one of two ways; (a) like a conventional boat by carving an arc in deep water or (b) the combination of power and speed are used to force the rear of the boat to ride up onto the surface of the water and slide through a turn giving a similar impression to the rear end of a car skidding on ice. With practice, both types of turns can be controlled and have their appropriate uses. Beware of entering deep water while negotiating a sliding turn in shallow areas. On flat-bottomed boats the sliding edge that encounters the deep water first may dig in or build a wave that destabilizes the boat leading to a series of lunging, sideways hops. The boat may even take on water over the leading edge. When the leading edge digs in it is called a "highside" and the boat might actually flip.
6. When crossing a levee, or stopping against a shore, either act decisively or not at all; in other words, beware of getting halfway up on an embankment before changing your mind and allowing the boat to slide backwards and sink stern-first. Either leave the boat floating or park it sitting on shore, preferably facing the planned direction of departure.
7. Beachings and levee crossings should be made with a moderately slow approach. Then generously apply power as contact is made with the soil so impact is reduced yet some momentum is maintained and the engine speed is increasing to provide the power to carry the boat up and over the barrier. The power should be completely off as soon as the boat begins its downward travel on the backside of the levee or berm to avoid burying the front of the boat in the water on the other side of the levee. Minimal power is needed to slide downslope.

8. Do not move over squared-off edges of embankments, docks or submersed logs because the boat's rudders or trim tabs (if so equipped) can contact the lip of the shore and be damaged.
9. Stops on firm ground should be made facing the anticipated direction of travel because turns are difficult to negotiate from a standing start.

Operating in Windy Conditions

Besides operator error, wind is probably the greatest contributing factor to capsizing. The large amount of surface area (cage, platform, engine, driver) mounted high above the transom act to accentuate the "tippy-ness" of these boats. In general, if water conditions approach whitecaps (steady 15 knots), or even if they are gusty, reconsider operating the boat in exposed deepwater areas. Most of these boats have no floatation, and so if they tip or roll, they sink quickly, usually in 3-10 seconds. In two cases the boats were loaded and negotiating a slow speed turn (walking speed) when the wake caught up with the boat, lifted one side, which lowered the other side enough to spill water over the edge and the boats filled and sank almost instantly. Crew members were able to jump free and in one case were able to shut off the ignition switches on the way down.

If winds increase while you are afield, running directly into or with the wind causes the least change in control whereas winds perpendicular to the rudder cause the greatest impairment of control. Try to get the boat on firmer ground or into a sheltered area before negotiating a turn. You might be forced to tack from one safe turning location to another to get to where you want to go. A more prudent approach would be wait until the winds subside to operate the boat.

Docking

Airboat docking techniques are a little different from other boats. Because airboats have no reverse,

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conventional boat-docking techniques would become a controlled "crash" for an airboat. The best landings are done onto soft, sloped banks; however, often wharfs or piers must be used. As you approach your destination, visualize how you want to stop well away from the dock. Line up so that you approach into the wind, since wind resistance will act as a brake, and idle toward your stopping point from 30 yards out. If your approach is too fast, you may elect to turn the boat in a tight 360 degree circle to scrub off some momentum. Engine idle-speed is reduced slightly by turning off one magneto switch on aircraft engines. Small blips of the throttle onto a sharply angled rudder accomplish direction control without adding much speed. At this point you should be approaching at the speed of a slow walk. When you are 5-10 yards away, kill the engine and come to a stop near the dock, paddle in if necessary. Never lean over the front of the boat or extend a leg to slow a rapidly moving boat from colliding with a pier, even a small bump will crush bones. Likewise, wave off bystanders who try to help. It is far better to dent some aluminum (which is easily repaired) than the alternative of painful and expensive human repairs. Sometimes the rear of the boat will swing around and the cage will bump the dock first. This is another reason to stop away from the dock and to be sure the engine is off. Hot engines often continue to sputter and backfire, sometimes even spinning the propeller backwards for a short time while the engine "diesels". Dieseling is the spinning of the engine when the ignition is off and the sparkplugs are not firing. It happens because the traces of gasoline that remain in the engine are combusted by the combination of heat and compression of the piston movement caused by engine and propeller inertia. Someone trying to help you dock could easily encounter a whirling propeller on a dieseling engine even though you had turned the ignition off previously. If you have any doubts, stop well clear of the dock and paddle in.

Remember that airboats have no reverse. Approaches and stopping areas require a clear path forward to proceed away from your stopping location. Airboats do not slide backwards particularly well, and if you stop on bare mud with a tree on each side and one in front of you, you will be quite stuck indeed. Try to approach barriers as if you were traveling on a circular driveway; stop at the

apex of your turn then later continue forward and away.

Getting Stuck (and Unstuck)

Even airboats get stuck. The best solution is to learn what types of surfaces to avoid before you get on them. In south Louisiana, for example, surfaces known as "dry floats" can provide enough resistance to pull planed out airboats under full power down to a stop. These floating marsh types are often identifiable where they are covered with marsh fern or other indicator plants, and there is little surface water. Similarly, in other areas wet sand or peat are high-friction surfaces. When encountering these surfaces underway, the airboat operator will feel a high-resistance, sliding-tugging force as the boat loses speed. This situation requires full power to be applied, and the boat should be steered towards deeper water or a slicker surface. Certain marshes and floating weeds have sticky or rough surfaces and are capable of completely stopping an airboat's forward momentum. One option being offered by custom boat builders in Louisiana is to mount sprayer nozzels on the front of the boat. The nozzles are attached to a hand-pumped spray bottle from which a slippery liquid is sprayed onto the vegetation or the bottom of the boat. This provides a surface with less friction for short distances and allows the boat to continue moving. When a front-mounted sprayer is employed it is essential to use the appropriate lubricant. Farmer's cooperatives sell a very slippery plant wetting agent (called a sticker) that does little plant damage and sprays well. The use of these spray systems is controversial because of their potential misuse. The best option is to use judgement that does not require sprayers.

If you do get stuck do not panic. Clear a pathway in front of the boat by removing vegetation, stomping a clear path and wetting it with water. Ice from an ice chest makes a very slick surface to travel over in an emergency. Remove as much weight as possible and never allow passengers to stand near the cage to push. An outboard boat in nearby deep water may be attached to a rope or strap tied to the airboat's bow to tow it forward. Ropes with pulleys or a hand winch such as a come-

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along may be used to inch a stuck airboat forward. Avoid using a second airboat to pull a stuck boat out. The possibility of a loose or snapped rope flying into the spinning propeller of the pulling boat is too great a risk. One solution is to await higher water levels (tide) to make headway. Airboats can be lashed together side by side for emergency towing. Boat fenders (rubber bumpers), wooden chocks, or even spare PFDs should be used as cushions between the hulls and the towed boat should be lashed slightly forward of

the pushing boat for greater steering control. If towing is attempted in very shallow water or dense vegetation the lashed boats will simply spin in a circle and will not travel forward.

Swamping and Sinking

The pessimists phrase the question not "IF you will sink your airboat," but rather, "WHEN will you sink it?" Airboat sinking should not happen, however, if your boat does sink, there are some priority considerations. First, make sure all boat passengers escape the boat and are safely out of the water. Try to gather all floating objects, particularly things important to your rescue such as communication equipment and emergency clothing. Carefully mark the location of the sunken boat if it is in deep water.

To extricate the boat you will need to determine its orientation since they often turn upside down or on their sides. Ideally, a cable lift on a large boat or barge will be available to lift the boat clear of the water. Conversely, the boat may be winched, towed or even dragged with pulleys to shallower water where it can be bailed out and floated to a landing.

To repair an airboat engine after it has been submerged, a mechanic will need to remove the spark plugs, drain all fluids, dry the ignition systems, charge the batteries, and dry the wiring. The sooner the repairs can be made the less rust and corrosion will be a problem. Moisture in the magnetos of

aircraft engines requires special attention. Freshwater sinkings are much less destructive than saltwater sinkings.

Environmental Considerations

Be aware of how noisy and how offensive airboats are to many people. Like the snowmobile noise-pollution issues in the north, many wetland users despise airboat noise. Simple consideration and agency public relations dictate that operators try to reduce disturbance to people at landings, at their camps, or those out enjoying the solitude of remote areas. Airboat noise can cause a great deal of wildlife disturbance. Large areas of wintering or staging groups of waterfowl and waterbirds can be flushed with a single pass of an airboat. If you are aware of congregation areas, or you see bird concentrations, you should avoid these areas to minimize disruption.

Airboats generate noise from both the engine and the spinning propellers. Consider using the newer technology of some of the late-model airboats, including mufflers and small multi-blade composite propellers, both of which greatly reduce noise pollution.

Airboats are often the lowest-impact method of traversing wetlands by motorized craft--better than mudboats, marsh buggies, ATVs, or outboard motors. However, contrary to what some people contend, airboat passage does inflict some damage to wetland vegetation. Personal observations in the field and on annual aerial photographs clearly show bare mud trails, broken stems, and the colonization of different plant species in areas sustaining multiple passes by airboats. The operator has the option to go across open water, wetland vegetation, or, with some powerful boats, even across dry land. Whenever possible, choose open-water travel paths, which do the least amount of damage.

Travel through tall or dense weeds has inherent risks because rocks or stumps are easily concealed beneath the foliage. Go as slow as conditions will comfortably permit.

Other Driving Hints

One way to reduce your exposure to sinking is to remain in shallow water while underway. Hug the banks and protected shorelines of lakes and waterways. If there are engine problems, waves, or high winds encountered that the boat cannot handle, you should steer the boat up onto the shoreline for protection or repairs. Because airboats do not have a propeller projecting below the bottom of the boat, they have an advantage over conventional outboard boats in that there is less concern about hitting submersed objects or running the boat up and onto a shoreline.

Many airboats are outfitted with trim tabs. Trim tabs are small hinged plates on the rear of the boat bottom that function like a small ski to lift the rear of the boat up, thereby forcing the front of the boat down to change the boat's angle, or trim, while moving. Trim tabs are officially used to reduce "porpoising." Porpoising is the rhythmic bobbing and slapping down of a boat while underway. Porpoising is a symptom of a boat that is either loaded improperly, not trimmed appropriately, or is travelling too fast and allowing air pressure to build under the bow. The combination of light weight, concentration of mass in the rear, and broad flat bottoms make airboats prone to porpoising when they are operated at high speeds or into a strong head wind. When the front of the boat is lowered it catches less wind and tends to porpoise less. Trim tab depression may also lift the rear of the boat up to two inches above the water's surface while underway, thereby providing some protection from waves that threaten to overtop the edge of the boat. Trim tabs should be activated very gradually and only after you are on plane at operating speed. The boat will cease porpoising, and the center of the trailing wake will show a faint depression instead of a pointed vee at its center. If you depress the trim tabs too far however, the boat will not slide through turns properly, a constant irritating front spray of water will emanate from under the bow, and the boat's rear end will try to whip around in an uncontrolled fishtail while the driver fights the rudder for control. There are few situations that really need to achieve the speed that calls for trim tabs. If trim tabs are set in the

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down position, much greater resistance will be encountered while crossing levees or operating on high-friction surfaces. In addition to doing more damage to the marsh surface, you run the risk of hanging up on marsh obstacles.

When airboats encounter waves, whether from a boat wake or winds, the driver should try to intercept them at a quartering or 45° angle; that is, the driver should cut the waves with one of the front corners of the boat. Because airboats have a broad, smooth bottom, they tend to slide down the front of waves much like a surfboard. If the waves are hit head-on, the boat will punch through them, wetting passengers and gear. If waves are encountered at high speeds the boat may become airborne or slam down on the rear of the wave with a large amount of shock to the boat's frame.

Finally, and this is a delicate matter of feel, there are certain situations where drivers may be able to accelerate out of trouble. For example, if a trailing wave starts to overtake the boat, slight acceleration will move the boat out of its way. If heavy cargo shifts position and the boat begins to take on water, the application of moderate acceleration will move you toward a shallow area where the boat's bottom will be supported. If water has begun entering the boat, the propeller will throw lots of water out of the boat and the rise of the boat out of the water (a planing effect much like a water skier rising out of the water when moving) will increase the gunwale height. Another advantage of operating close to shore is that if the boat does sink, it will be in shallower water where the engine will remain above the water level. A word of warning here, though; if there is so much water in the boat that the propeller is splashing the water level, the operator risks engine damage or shattering the blade. Shattered propellers can have devastating consequences to passengers or the operator so do not risk it. In the above situation, the appropriate action is to turn off the ignition and reduce the chance of the engine sucking water into the carburetor. Think about your emergency options and plan your actions before you are in this situation.

Inexperienced airboat operators often tend to go too fast. High speed reduces the driver's options for evasive action. When on plane, some airboats can coast a surprising distance, especially in shallow water, and there are no brakes. A good operating speed is the slowest speed that will maintain the boat on plane, thus providing control and minimal draft yet slow enough to stop or to take evasive action if needed.

A particular danger in airboats is capsizing. Although the boats are designed to allow some sideways sliding, it is possible to encounter unexpected resistance and do what is called a "highside" or flip in the direction you are sliding. This is particularly dangerous because the operator is in a position to be crushed. Passengers and operator should be prepared to jump from a tipping or sinking boat, preferably well away from the boat. Because of inertia it is rarely possible to jump away from the direction of a rolling boat. The cage structure of the boats presents some danger of entanglement or entrapment, so stay in a position to jump clear and mentally plan your escape route before danger arises. The need for quick escape from a sinking or flipping boat is one reason that airboats do not have seatbelts.

MALFUNCTIONS, MAINTENANCE, AND REPAIRS

Mechanical Failure

Airboats are very high-maintenance vehicles. The aircraft engines seem finicky, temperamental, frustrating and mysterious even on good days. The automotive engines are simpler but have some quirks such as dieseling (indicating low gas quality) and overheating (clogged radiators). Listed below are some of the simple things even nonmechanics can troubleshoot.

Troubleshooting Aircraft Engines

Aircraft engines will not start without the magnetos on, the fuel pump primed, the battery switchbox

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on, and rich/lean knob (sometimes hidden under the driver's seat) on full rich (usually all the way in). If the battery show 10 amps or less, you may get a quiet whirring from the starter. Do what is necessary to get more electrical power. Substitute batteries, switch the battery box to "both," use jumper cables, or charge the batteries.

Some aircraft-engined boats have a tendency for the starter's bendix gear to stick in the "engaged" position after starting. This seems to be caused by salt spray, and an exposed, rusty spindle on the starter. If you hear the gears rattling after you release the key, stop the engine quickly. Spray the starter gear with a penetrating lubricant such as WD-40 or CRC. Pry or tap it gently with a screwdriver, then try it again. Bendix spindles should be lubricated with longer lasting products such as white lithium grease, Corrosion Guard, or Yamaha's Lubes-Zall. Remember to always secure the propeller with rope or an anti-spin block before working inside the cage. To prevent starting the engine with the block in place, it may help to attach the keys to the rope or block so the operator is forced to remember that the propeller is tied before starting the engine.)

If the engine will not start immediately, do not give up. Hold the key in the start position for a series of 12 to 15-second cranks with a few minutes between to let the starter and battery cables cool. If you have two batteries, be sure to run the boat on each of them separately during the day to keep them both charged. Aircraft engines have bottom-draft carburetors, and it sometimes takes a little cranking to get fuel pulled up into the combustion chambers. Fully depressing the accelerator pedal several times and running the auxillary fuel pump should help. It is very hard to flood aircraft engines. Some operators use a shot of ether (starting fluid) to help stubborn engines start after periods of non-use. Ether is a significant fire hazard in use, and potentially explosive if improperly stored. Starting fluid must not contact skin or being inhaled.

Some boats have two fuel tanks with a selector valve to switch between them. If the engine will not

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run, check for gasoline in the appropriate tank. If the boat has a clear fuel filter, visually check for water or debris. If the fuel filter is clogged the fuel will not reach the carburetor, or in some cases, the boat will idle yet lose power under acceleration. When clogged, most see-through filters will appear dark; when clean, they appear whitish. Some fuel filters unscrew and should be blown out or rinsed clean with an appropriate solvent. When the fuel filter is slightly clogged you may use the electric fuel primer pump to get more fuel through it. This will deplete the battery so replace or repair the filter at your first opportunity, and continue operating the boat without the electric fuel pump. The engine-driven fuel pump is adequate alone except for the initial priming and starting. Be sure to switch off the battery box and put out all flames, welders, cigarettes or other ignition sources before working on gasoline lines. In case of fire, there should always be a fire extinguisher on board, ideally mounted as far from the engine and fuel as possible. Airboats contain large tanks of gasoline on board and in case of fire it would be wise to simply leave the boat unless the fire is localized, small, and easily extinguished, or if leaving the boat is a more perilous option such as in frigid waters far from shore.

An option available on recently constructed airboats is to have a layer of polymer sheeting (often incorrectly called "teflon") riveted or screwed to the hull to reduce sliding resistance. Polymer sheets are tough, but the material is affected by sunlight and pulls away from the screws and rivets. The sheeting scratches and eventually may wear through to the aluminum hull. Losing a sheet of polymer while underway can cause a dramatic spin or possibly a capsize. Check the bottom condition carefully for damage or wear; if a polymer sheet loosens while you are afield, trim it clear and motor slowly (not on plane) back to the trailer.

Troubleshooting Automotive Engines

Though most people are more familiar with automotive engines, these engines have some quirks in airboat applications. A common problem is overheating due to restricted airflow over the radiators.

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Some wetland plants contain waxy or resinous leaf contents and these get pulverized and sprayed onto the rear-mounted radiators along with intact leaves and stems. These radiators need to be cleaned regularly and sometimes even soap and water are insufficient to remove the baked-on resinous sap.

Gasoline used in automotive engines should be of a premium grade and if gasoline is going to sit unused for more than 3 months, it should have a commercial gasoline stabilizer added to the tank. Fuel systems should be protected from contamination by water in the form of splashing or condensation, so, always store fuel tanks fully fueled or completely dry and tightly capped. An in-line fuel/water separator is a good idea on all airboats.

Maintenance

Although airboats have a reputation for breakdowns, proper maintenance will reduce problems greatly. After use, boats should be washed with fresh water and then run briefly to dry the engine before storage. Protectant or rust-inhibiting lubricant should be applied to rust-prone or sticking parts. Engine and seat covers should remain on when boats are not in use, and when possible, boats should be stored out of the weather and out of direct sunlight.

Propeller and Frame Maintenance

Propeller vibration results from damage, uneven moisture accumulation or warpage due to exposure. If propellers are out of alignment, warped, damaged in any way or show significant cracks or delamination, or nicks larger than a thimble, they must be replaced or sent to the manufacturer for restoration to prevent engine damage. Store wooden propellers in the horizontal position to prevent moisture migration into the lower blade. Moisture migration will unbalance wooden propellers.

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Three general types of propellers are currently available. The most modern are the multi-bladed, modular synthetic (carbon-fiber) propellers that are bolted to a central plate. Each propeller blade may be removed independently if damaged, or adjusted for various pitches.

Large-blade composite propellers look like regular wooden propellers but are made of synthetic

material that is less prone to nicking and warpage. Even though they are more durable and weather proof, they cost well over \$1,000 each.

Laminated birch or maple wood propellers are the most widely used. Replacement propellers are available in various configurations from the suppliers listed in the appendix of this manual. Propellers should be matched to the boat and the engine since improper pitch (the angle of the blades) on propellers will affect performance by over taxing the engine or allowing the operator to exceed a safe engine speed. High speed propellers look more like airplane propellers, whereas the more common airboat propeller is called a "paddle prop." Paddle propellers provide more torque for low-speed operation and rapid acceleration. Paddle propellers usually have squared-off tips with protective metal on their leading edges. Consult the boat manufacturer for the appropriate propeller. These propellers cost approximately \$700 in 1995.

Most propellers are attached to the engine crankshaft with multiple bolts, studs, lock washers, nuts, and a pressure plate. The bolts serve to hold the metallic disc called a pressure plate against the propeller. The friction of the pressure plate is what transmits engine power to the propeller and it is essential that the bolts are torqued to the appropriate tension. The nuts and bolts should have holes drilled transversely through them so that they may be wired together in pairs to prevent loosening. Wiring propeller bolts is rather simple but it must be done properly to prevent the propeller spin from loosening them and such wiring should only to be done by those who have been shown the

proper technique.

Engine vibration during normal operation causes metal fatigue in the engine-mounting brackets, frame welds and engine cages. Metal at these junctures slowly crystalizes and cracks when fatigued.

All welds should remain painted so when cracks develop the rust line becomes evident and the weld can be repaired. Such cracks are inevitable and should be expected after approximately 300 hours of normal use. Repairing frame and cage cracks requires complete removal and rewelding.

Maintenance of Engines and Fluids

Airboats that are powered by aircraft engines should be fueled with aviation gasoline, called avgas, available from most airports for approximately twice the cost of conventional fuel (\$2.45 per gallon in 1995). Avgas is required to keep aircraft engines running at full power, to prevent knocking, and to keep them from overheating. Aviation gas has octane ratings from 110-120. Premium auto gasoline may be used in an emergency but an octane booster (available through most automotive stores and some gasoline stations) should be added at that time. Continued use of automotive gasoline in an aircraft engine will shorten its life.

Any major aircraft engine work should be done by airboat or airplane mechanics because of the specialized tools required for certain repairs, but simple items such as changing oil and cleaning air filters can be done by users. Oil should be changed while warm, so idle the engine for 10 minutes before removing the bottom drain plug and allowing the old oil to run into a bucket or basin. Dispose of oil at a proper collection facility.

Aircraft Engines

Replace the plug and fill the crankcase with 50-weight aviation oil (for warm weather operation). During the first 40 hours after rebuilding airplane engines should be run on 50-weight, non-detergent castor oil. Thereafter they use 50-weight, high-detergent oil such as AeroShell. Air filters are

usually bottom-mounted, screen-type filters that are held on by 4 bolts. This filter must be removed and cleaned in solvent after every 100 hours of operation or more frequently if operated in areas with large amounts of plant chaff (such as cattail seeds). The boats need to be serviced by an airport mechanic after the first 100 hours of operation for valve adjustments and tune-ups, and thereafter, every 200 hours.

Aircraft engines are constructed with loose engine tolerances (e.g. gaps between the cylinders and pistons) to allow for expansion with engine heat, therefore they should be warmed up before operating at high speeds. Aircraft engines generally have large, yet slow-moving pistons and their maximum engine speeds are substantially lower than a comparable automotive engine. Do not exceed the maximum permitted revolutions per minute (RPM) range which is usually about 3000, though this varies with engine type and to a large extent propeller size and pitch. Propellers must fit the engine powerband to prevent engine lugging or excessive engine speed.

Automotive Engines

New automotive engines require a 3-6 hour break-in period. During this break-in period, constant engine speeds, maximum acceleration, and high engine temperatures should be avoided. Oil changes should follow manufacturers recommendations.

Most automotive engines used in airboats are high performance types with high-compression pistons, steep cam angles and header-style performance exhaust systems. Because they are high performance engines, premium gasoline from a name brand dealer should be used to prevent advanced detonation of gas due to compression (also called knocking or pinging). Almost all discount dealers add ethanol to their gasoline and although ethanol is beneficial in certain ways, it is hydrophillic (attracts water) and degrades certain types of rubber hoses, making it particularly

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unsuited for airboat uses. Dealers who do not put ethanol in their premium gas include Chevron, Texaco, Shell, and Exxon. Almost all automotive engines are liquid-cooled and use an aluminum radiator to cool the antifreeze and a smaller radiator to cool the oil. Both of these radiators are prone to fouling with flying debris and insects during summertime operation. Be sure to keep them filled and cleaned.

Automotive engines operate at substantially higher engine speeds than do aircraft engines. Observe the tachometer gauge that indicates engine revolutions per minute (RPM) and do not exceed the maximum safe operating speed. Manufacturer's redlines vary so check the owner's manual.

Because higher engine speeds are produced by automotive than by aircraft engines, automotive engines employ a belt drive to a reduction gear which turns the spindle attached to the propeller. The reduction gear provides optimum torque and propeller speed for normal operation. This reduction gear unit requires grease lubrication after every 20 hours of operation. The belt must be inspected for cracking or fraying at each lubrication, and if any damage is found, it must be replaced.

A maintenance log should be maintained in the tool kit in each boat to record the amounts of oil used, battery water consumption, antifreeze leaks and other maintenance needs. These are all very important indicators of engine condition. Be sure to record any problems in the log book and bring them to the service personnel's attention before the boat goes out again. Listen carefully for the way that the boat sounds when it is new and running well, and if you detect something different, investigate. This will allow the operator to prevent chipping the teeth off the gearwheel if the starter gear sticks and jingles; or to detect a loose spark plug rattling, or a hissing hole in a radiator hose.

Steering Linkage and Rudders

Older airboats usually have a mechanical arm linkage whereas most newer boats have a push-pull

cable-style linkage that connects the rudder to the steering control. Both styles have zerk grease fittings (small nipples into which grease is pumped from a grease gun) at various points along their length. Zerks should be greased lightly if grease is not visible around the seal. After greasing, wipe off any excess with a rag. Check all brackets along the length of the linkage for tightness, especially the top and bottom spindles that attach the rudder to the boat.

Rudders are usually made of thin-gauge aircraft aluminum, therefore, they are easily damaged and expensive to repair. They also extend 2 feet or more beyond the transom, so be alert to backing the boat and trailer or of letting a floating boat drift into objects. Rudders are mounted on the cage and transom and trailering on bumpy roads has caused the frames to break. Check these mountings occasionally for stress cracks.

Electrical System

Airboats, particularly aircraft engines, require a strong battery to start. The starter motors draw a large electrical current to spin these high-compression, bottom-draft engines and to whirl the oversized propellers which are always engaged. Airboat electrical systems are probably the weakest link in the entire system, so special attention to battery condition is important. Some boats have dual batteries and a circular, red, Perco switching box. These airboats have a heavy duty 75 ampere alternator and can charge batteries while the boat is running, but remember that batteries charge best when charged individually. Notice the condition of the alternator belts. Long-term exposure to sun, wear, and oil causes belts to slip, fray or break. If this happens underway you may not know it until you are stuck with a dying engine and no simple way to restart it after you turn it off.

Batteries are usually stored in black plastic boxes under the seats. These boxes heat up in the summer sun and evaporate the water out of the batteries; therefore, battery water levels should be checked monthly and distilled water added to bring the level up to the bottom of the split ring visible in the filling holes. Maintenance-free batteries should be used when possible to reduce this need. If

the boats swamp or fill up with rain water, floor-mounted batteries will ground out and go dead. This is a good reason to keep the boat drain plugs out when storing boats outside. In cold climates batteries may freeze and crack, therefore the plastic containers are important to prevent acid spills on the hull. Remove batteries to warmer storage conditions in extreme cold weather.

The electrical breaker panel is usually visible as a fuse box or hidden on the lower left inside of the instrument panel, adjacent to the operator's right thigh. Older model boats often have replaceable automotive-style fuses, but most new boats have electrical breakers that are reset by depressing the pop-out breaker buttons. Some of these consoles also have an electric cigarette lighter-style plug for attaching a Q-beam, a cellular phone, or laptop computer. Keep the contacts in this outlet well-coated with a dielectric grease or electrical lubricant and keep the plug covered with its cap when not in use because the thin metal contacts will rust off and become inoperable.

TRAILERING, TOWING, AND LAUNCHING

Because airboat hulls are usually shaped differently from outboard boats, their trailers must be adjusted to fit the bottom configuration and to properly support the weight of the boat. Such support is particularly important with the fiberglass hulls found on older designs. Carpet-covered boards can be adjusted in height to support the bottom over a longer span than can rollers.

Trailer attachment must be with a properly sized and matched trailer hitch and trailer tongue, safety chains, and appropriate trailer light hookups.

Trailer tires must be adequately inflated to prevent overheating, and balanced to prevent uneven

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wear. Some users prefer radial tires because they claim that they track better on the road and run cooler. Higher trailering speeds cause disproportionately fast wear on tires.

Trailering airboats requires some forethought. Automotive engines on a normal trailer frequently exceed 10 feet in height. Be wary of low bridges, gas station awnings, and car washes.

The large cage on airboats provides substantial wind resistance, so crosswinds greatly influence the stability of towed airboats. Because wind resistance increases greatly with increased travel speed set a 55 mph maximum tow speed. Some operators have damaged automatic transmissions on tow vehicles. Do not use overdrive for towing and if possible use vehicles with a towing package (reinforced suspension, proper gearing, and adequate cooling systems for engine and transmission).

The polymer bottoms of airboats makes them slide on marsh surfaces as well as off of their trailers. One Utah airboater that lost his front hook attachment while trailering and the airboat slid off the back of the trailer at interstate speeds. Fortunately, the boat slid to a stop, upright, in the passing lane of the interstate with minor damage to the hull.

Always secure boats with at least 3 attachment points so that should any two attachments fail and there would still be a backup. Examples of redundant tiedowns include a trailer winch cable hooked to the front of the boat, the bow line tied to the trailer, a rear tie-down strap to prevent bouncing. Trailers can be fitted with elevated side bars to prevent side-to-side movement.

Airboats can be loaded and unloaded at conventional boat ramps, but always back down very slowly when you are launching because of the very low transom behind the propeller. Airboats may also be loaded and unloaded on damp grass or mud, but this requires experience and a low trailer because loading this way may cause the boat to pivot upwards causing the bow to point skyward then come

crashing down.

Drain plug installation before launching is particularly important on airboats because (1) they have no floatation, (2) access to the plugs is not possible while afloat, and (3) a passenger might panic and try to install the plugs in a running boat. Because the drain plugs are located under the propeller, this could be catastrophic. This is the reason some airboats are manufactured without drain plugs and all water must be bilged out. Some operators prefer to install drain plugs from the outside facing inwards to avoid having to lean into the boat to access them.

Trailer Maintenance

Do not forget to maintain airboat trailers. Wash the salt and fouling off when you wash the airboat. Check tire inflation (tire inflation can be a continuing problem related possibly to slow leaks through the galvanized rim's bead). Grease the lift jack on the trailer tongue. Pump a small amount of grease (just enough to move the buddy-bearing spring slightly) into the axles periodically, and lubricate the rollers and winch. Wheel bearings should be removed and greased every 2 years under moderate use. Bearing buddies (a type of spring-loaded axle cap with a grease fitting in place) work well for maintenance, but they are not foolproof.

Check the turn signals. If your trailer blows bulbs or fuses upon submergence, unplug them before backdown launches, and plug them back in before travel. Keep the boat tongue towing hitch locked regardless of whether it is attached to the towing vehicle or not. Because keeping up with keys can be a problem, keep a float on each key ring, and try to keep an extra set of trailer and ignition keys hidden under the driver's seat of each boat for emergencies.

OPERATOR ATTITUDES AND AWARENESS

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Many people seem to undergo a personality shift when they take the controls of bulldozers, fast motorcycles, or airboats. An elation-filled sense of freedom, power and control can cloud judgement. Indeed, the most dangerous period for new airboat drivers seems to come with the first flush of confidence, which arrives well ahead of their reflexive competence. Eventually, much of the charm of airboat driving is replaced by caution and a deep realization of the responsibilities and risks associated with their use. They are a tool, a vehicle, or work equipment to various users, but Government airboats should never be treated as toys for joy riding or thrill-seeking.

The best airboat operators develop an almost sixth sense of awareness around them. In his book [A Twist of the Wrist](#), Keith Code uses the analogy of a motorcycle racer only having 100 cents worth of attention to spend wherever he or she wants. If one spends 40 cents on fear (or talking to passengers or fiddling with a raincoat zipper) while underway, there is only 60 cents worth of attention available for the more important task at hand--driving.

It is helpful to think of an airboat underway as having risk zones of various sizes surrounding the boat as determined by speed and conditions. For example, the driver's attention is directed about 25% on all sides while idling. Attention shifts more to forward and rearward on acceleration, and while underway it hovers about 90% on reading the upcoming terrain in the path of travel. There is an 80% focus on the outside rear quarter when negotiating slow turns. This "sphere of awareness" is a technique used by airplane pilots, and it is taught in advanced motorcycle safety courses. It is a very fluid and dynamic way of prioritizing attention, and eventually develops into a habit. Another feature this incorporates is anticipation and visualization. Training oneself to think ahead and to know what to expect prevents surprises and poor, panicked decisions. Good airboat operators plan what is going to happen at least ten seconds before it happens. This is about the amount of time it takes to stop if the conditions are something they do not want to tackle. Experienced operators obtain

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a smoothness and confidence that translates into safer operation, fewer demands on equipment, and reassurance to passengers. Be aware, stay in control, be safe.

AIRBOAT CHECKLIST

The following check list alone does not provide sufficient information to operate an airboat safely. Safe operation requires demonstration and practice as well. This is a reminder checklist for trained and experienced operators.

Preoperative Checklist

1. Propeller intact and propeller bolts tight.
2. Fuel tank filled with proper fuel.
3. Oil reservoir filled with proper oil and four spare quarts on board.
4. Oil cap is seated firmly (some have an odd clip spring) and there are no oil or fuel leaks visible.
5. Clear range of motion for steering linkage.
6. No loose clothing or equipment in boat.
7. All occupants have adequate ear and eye protection.
8. All occupants wearing approved life jackets.
9. First aid kit is on board.
10. Brief passengers on safety/protection equipment and problems.
11. Push pole, bow line, chest waders.
12. Detailed floatplan registered.
13. Drain plug(s) installed.
14. Radiator filled (automotive engines) and cap secure.
15. Running and navigation lights operative.
16. Throttle and rudder fully operational.
17. Fire extinguisher on board and firmly secured.
18. Filed float-plan and emergency contingency plan.

Starting Procedure

1. Battery box set to "1" or "2," use "both" if necessary.
2. Rich/lean knob all the way in (rich)
3. One magneto switch on to start, use both to run (aircraft engines). Engine speed drop of no more than 200 rpm on individual magnetos.
4. Confirm that the area behind the boat is clear.
5. Be prepared for boat to move forward when engine starts.
6. Allow 2-5 minute warm up before high-speed operation.
7. Oil pressure should remain between 35 and 90 PSI.
8. Temperature should not exceed 190.
9. Voltage meter should read 12-14 volts while running.

Shutdown and Trailering Procedures

1. Allow a 1-minute low-speed cool down.

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- 2.If engine diesels or spins backward on shutdown, starve the fuel supply by pulling the lean-out knob.
- 3.Turn off magnetos and ignition switch.
- 4.Bilge out water.
- 5.Turn battery switching box to "off."
- 6.Position propeller horizontally.
- 7.Secure tie down straps, seat covers, rudder, bow line.
- 8.Wash boat.
- 9.Spray starter bendix with WD-40 to prevent sticking.
- 10.If stored outside, cover engine with tarp and bungee down.
- 11.Store boat with fuel tanks full to prevent moisture condensation.
- 12.Remove drain plug and use wheel chocks in parking lot.

Additional Warnings

- 1.Monitor engine temperature in hot weather to prevent overheating.
- 2.Keep riders seated or standing with secure hand grips.
- 3.Attach Q-beam to the battery that is being recharged by the engine and not to the back up battery.
- 4.Use good judgement, look far ahead to plan turns and stops.
- 5.Avoid objects and obstructions.
- 6.Avoid high speeds. They are rarely necessary.

GLOSSARY OF AIRBOATING TERMS

Airboat A boat that is propelled by air thrust from a motor-driven propeller.

Avgas High-octane (110-120 octane) fuel used in aircraft engines. It is available at most airports for approximately twice the price of regular automotive gasoline.

Bendix Gear The retractable gear and spring apparatus attached to the spindle of the starter motor. Upon turning the key it engages the teeth on the flywheel. When the ignition key is released it is designed to retract. If it is fouled it stays engaged and damages the flywheel gear.

Buddy Bearings Spring-loaded caps that fit on the end of trailer axles and maintain pressure on grease to force it into the wheel bearings.

Cage A shield of welded tubular metal and welded wire that encircles the motor and front portion of the propeller on an airboat.

Cellular Phone Battery powered, cordless phone for emergency calls for help.

Chine The angular intersection of the bottom and sides of a boat

Composite Propeller A durable but expensive propeller made of synthetic materials, usually layers of carbon-fiber. They replace the more conventional laminated birchwood propellers or may be set in arrays of 6 or more on a central spindle.

Dieseling An undesirable run-on of the engine after the ignition has been turned off. Dieseling

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occurs most often in high compression, hot engines as they continue to suck fuel in and combust it from heat and compression. It is destructive to engines and should be prevented in airboat engines by shutting off the fuel supply (pulling the lean out knob).

Float Plan A comprehensive list of locations, date, passengers, time on the water, time off and rescue plan suggestions to be filed with a contact person on shore. A critical feature of the plan is an activation time for a search and rescue mission if boaters fail to return at the specified time.

Friction Plate The metal disc through which the propeller bolts extend. This plate provides the friction that holds the propeller onto the engine drive shaft. It should be tightened to factory specifications.

Highside Catching the edge of the boat while sliding sideways. Highsiding may lead to violent hops or even capsize.

Hull The sides and bottom of the airboat.

Magneto (or "mag") A high energy capacitor mounted on the front of aircraft engines. The magneto provides the electrical current burst to the spark plugs which ignites the gasoline charge in the cylinder. The magnetos must be shorted out with the mag switches to stop the engine.

PFD Personal Floation Device. Life jackets or life vests. (Make sure that they are U. S. Coast Guard approved.)

Paddle Props Large style of propeller designed for maximum propulsion at typical airboat speeds. Airboats operate at lower speeds than aircraft.

Pitch The amount of angle or twist of the propeller blade. Pitch, diameter, and configuration of the propeller determine its performance and they must be matched to the boat.

Plane The effect of boats rising up to ride on top of the water when they are moving rapidly enough. A boat may motor through the water slowly or "plane out" by moving rapidly along the surface of the water much like a water skier planes out. Boat handling characteristics become much different once a boat has planed out.

Porpoising The rhythmic bobbing of a boat in which the power source is not parallel to the water's surface. The attitude of the boat will be changed by loading characteristics, speed, wind resistance, or trim tab configuration. Porpoising is undesirable and should be eliminated by adjusting the trim.

Prime An initial trace of gasoline to help engines start. Aircraft engines usually have their carburetors mounted below the engine and assistance in pumping fuel to the cylinders is provided by an electrical pump or a piston attached to the throttle linkage.

Prop wash The column of air emitted rearward from an airboat by the propeller.

Red Line The mark on an engine's speed guage (tachometer) that indicates the maximum safe engine speed. Engines should not be operated near red line except in rare short bursts when maximum power is needed.

Reduction Gear, Belt The belt-driven pair of gears on the rear of automotive airboat engines. This reduction matches the crank speed to an appropriate propeller speed for optimal thrust production.

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RPM Revolutions per minute. This is a measure of engine speed indicated by the number of times an engine's crankshaft spins around its axis in a minute.

Rudder The airfoils, fin or fins mounted behind the airboat propeller and attached to the steering stick by a cable or rod. The rudder provides directional control by directing the propeller's air flow in the opposite direction of the desired movement of the rear of the boat.

Sprayer A pressurized hose and nozzle arrangement to spray a slippery liquid solution onto the boat's hull to reduce friction and permit the hull to slide over obstacles.

Stick The lever that the driver's left hand controls to steer the airboat.

Tachometer A primary gauge that shows the rate of spin of an airboat's engine- see "red line."

Teflon A hard, slippery plastic-like polymer (not true teflon) material. When sheets of polymer are riveted to airboat hulls it permits them to slide over vegetation with less resistance.

Transom The rear wall of an airboat's hull. That portion of the boat behind the propeller. Airboat transoms are usually lower than conventional boats to permit maximum propeller thrust to escape.

Trim The angle of the boat in the water. Important for proper travel (see porpoising).

Trim Tabs Adjustable plates mounted on the hull near the lower transom that affect water resistance and can be used to adjust the trim of the boat to enhance control and performance.

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Zerk Fitting A metal, self-sealing nipple into which grease is pumped to lubricate moving metal parts.

AIRBOAT MANUFACTURERS AND SUPPLIERS

The U. S. Government does not specifically endorse individual manufacturers or suppliers and the authors recognize that the following list is not complete.

Aerostick Manufacturing
7011, 10th St.
Saint Petersburg, FL 33702.
(More economical propellers)

Airboat Engineering Inc.
2715 South St.
W. Palm Beach, FL 33407
(407) 833-9520
(Specialties include smaller boats)

Airboat Headquarters
4158 NW 132 St.
Opalocka, FL 33054
(305) 685-2933

Classic Airboats
306 Shearer Blvd.
Cocoa, Fl. 32922
(407) 633-4026

Kline Airboats
Antique Arms
3191 E. Road
Loxahatchie, FL 33470
(407) 793-3672

Panther Airboats
300 Wilson Ave.
Cocoa, Fl. 32922
(407) 632-1722
(One of the most widely known makers. Produce metal and fiberglass hulls and various engine configurations)

Marks Welding and Airboat Connection
1401 Norman Bauer Dr.
Franklin, LA 70538

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(318)828-0404

(Specializes in heavy duty welded aluminum airboats with automotive engines, the style favored by the oil companies in Louisiana)

Sensenich Propeller Co.

P.O. Box 5100

Lancaster, PA 17601-0100

(Premier wooden propellers in the \$750 range)

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INDEX

Aircraft engine	29
Alternator	33
Automotive engine	30
Avgas	29
Battery	7, 9, 24, 25, 33, 40, 41
Bendix gear	24
Breaker	34
Carburetor	22, 25
Cellular phone.....	34
Checklist	2, 39
Deep water	12, 13, 17, 18
Dieseling	16, 23
Docking.....	15
Drain plugs.....	34, 36
Electrical	24, 33, 34, 43, 44
Engines.....	2, 6, 7, 9, 10, 15, 16, 19, 23-26, 29-31, 33, 35, 39, 41-44, 47
Eye protection.....	8, 9, 39
First aid kit	9
Fuel.....	10, 24-26, 29, 39, 40, 42, 44
Fuel filter.....	25
Hearing protection	8, 9
Highside	13, 23
Launching	2, 5, 34, 36
Levee	13, 14
Lubrication.....	32
Maintenance.....	2, 4, 23, 27, 32, 36, 37
Maintenance log	32
Mechanical failure	23
Mufflers.....	9, 19
Noise	9, 19
Oil.....	29-33, 39, 47
Operating Speed	10, 21, 23, 31
PFD	8
Polymer	26, 35, 45
Priming.....	25
Prop-wash	6
Propeller.....	6, 7, 12, 16, 18, 20, 22, 24, 27, 28, 30, 31, 36, 39-45, 47
Radiator.....	31, 32
Reduction gear	31, 32

Airboat Safety - Foote & Reynolds

RPM	30, 31, 39
Rudder	10, 11, 15, 21, 32, 39, 44
Safety equipment	8
Sinking	2, 18, 20, 23
Slide	13, 14, 16, 21, 35, 44, 45
Stability	2, 11, 12, 35
Starter	7, 24, 32, 33, 40, 41
Starting	6, 10, 24, 25
Starting fluid	25
Steering	10, 11, 18, 32, 39, 44
Steering linkage	39
Tachometer	31, 44
Teflon	26, 45
Torque	12, 28, 31
Towing	18, 35, 37
Trailer	26, 33, 35-37, 41
Trailing wave	13, 22
Trim tab	43
Water separator	26
Waves	12, 21, 22
Welds	29
Wildlife disturbance	19
Wind	15, 21, 35