

OPERATING YOUR DUFFY ELECTRIC BOAT

Uncover, unplug & untie your Duffy. All "Duffy" models are equipped with non-skid boarding steps for easy entrance. Step into the boat and take the helm.

To start your cruise, insert your key in the electronic "ignition", make sure the control switch handle is in neutral and turn the key on. This will activate the Duffy Infa-Speed Controller allowing single actuated speeds in both forward and reverse.

In front of the driver is the dash panel, where the horn, stereo, running lights, bilge pump, interior lights and optional dimmer can be activated. In addition, each boat is equipped with an energy meter which indicates battery condition while underway. Use this gauge as you would the fuel gauge in your car. It reads empty (red) to full (black) and "On Charge" (white). **For an accurate energy meter reading the charger must be unplugged and the boat running.**

When engaging the control switch into forward or reverse there will be an audible click when the control lever is moved from the neutral position. This indicates the power is on, allowing the desired power to the motor. The speed variations from neutral moving towards full speed are virtually silent and allow total control of your Duffy in docking and maneuvering. The control switch is a bit more sensitive to speed changes towards the last 3/4 of throw. In addition, our hydrodynamic rudder system provides excellent steering control in forward speeds.

Running times will increase and decrease based upon boat speed, and which will be reflected in the energy gauge. We will talk more about running times later in the manual.

SLOWING & STOPPING: When going from forward to reverse treat the control switch like a car's transmission. Take a second before switching speeds. Our infinite speed controller has a built-in protection device to avoid any damage should there be a sudden direction change (forward to reverse). Use reverse to slow down or stop the boat. Take time to note the time and distance required to stop your boat under various speed, wind and current conditions. This will help you with safe and easy docking in the future. For example: Let's say you are in full speed forward and you put the switch in full reverse in a fast manner. The boat will take a second to respond, and regenerate to full speed in the opposite direction. This feature is built into the variable speed controller to help protect the electrical system from electrical and mechanical damage.

STEERING IN REVERSE: All inboard boats with single engines and direct shaft drives are inherently more difficult to maneuver in reverse. To compensate we provide you with a specially designed rudder to allow the maximum performance available. You will become proficient at steering in reverse given a little practice.

Relax and plan your moves before you begin in reverse. This isn't necessary in forward because the boat reacts immediately to your commands. The boat operator will find a much different sound when traveling in reverse compared to forward. This is normal "cavitation" caused by lack of water flow to the propeller. All boats similar to our design, particularly sailboats, experience this condition. The reason is that the keel is located directly in front of the propeller, which gives the prop a hard time finding 'clean' water. As you begin to move in reverse, the cavitation will diminish as the prop hits 'clean' water.

IMPORTANT: When backing up, particularly in full speed reverse, the steering might feel difficult to turn. Do not force the steering wheel in either direction. Simply slow the boat up and let the pressure release. This condition is a result of the water rushing against the rudder while it is hard over to one side.

Docking: All sailors are taught to dock into the wind, never downwind. If a downwind docking is unavoidable, then use full caution on approach...SLOW DOWN. By aiming into the wind, you can always control your next move by using forward speed and the prop.

THE CHARGING SYSTEM

Each boat has a built in 20 amp charger DC charger, (15 amp in the Duffy Sport) . The charger is located under the aft seat hatch on each model (port storage hatch on the Duffy 17). There is ample room in these storage areas to keep an extension cord. The charger requires 110 volt a.c., and is also available in 220-240 a.c., for Europe and commercial power set-ups. Each charger is equipped with an automatic start/stop mechanism, (this means you simply plug an extension cord into the charger and it will determine the appropriate charge rate to bring your batteries to FULL, then shut itself off).

The charger is programmed to sense the voltage going into the battery pack, and shuts off when the voltage stops rising over a period of time. We recommend you plug in your boat every time you come back from a cruise. **THE CHARGER WILL NOT OVERCHARGE YOUR BATTERIES.** Under-charging is much more likely, and will limit the life expectancy of your batteries. We cannot over emphasize the importance of keeping your boat charged up. Simply plug your extension cord into the charging outlet located on

the port, aft side of the boat. A 30 amp twist lock fitting is required for this outlet. Given your dock power is adequately providing the required AC voltage, and standard 20 amp household current, (if not consult an electrician), the energy gauge needle will move into the "On Charge" area of the meter, and the green indicator light on the dash panel will turn on. There is about a 25 second delay before the charger turns on, so make sure you wait to see the light come on.

CAUTION: Remember, when the extension cord is plugged into your dock power it is "live". Be careful not to let it drop in the water. The manufacturer highly recommends a Ground Fault Interrupter circuit installed at the dock power source.

The lower your battery pack's energy level, the longer the charge cycle to bring them to full. Typically, a 10 hour charge cycle will bring an "empty" (80% discharged) set of batteries to full. The beauty of our system is that you never have to set a timer; the charger will set the rate of charge and shut itself off.

IMPORTANT: Plugging your boat in will start only one charge cycle. This means when the charger shuts off. it will not re-start until you unplug the extension cord and plug it back in. This can be performed at either end of the extension cord, i.e. in the boat or at the power source. If you don't use your boat for extended periods, i.e. for four weeks and on, your batteries will slowly dissipate, (release energy), at approximately 10% per month. (We will discuss this in further detail in the battery section). Therefore, we recommend you start a new charge cycle every five weeks, if possible. This is the minimum. We want you to charge your batteries after every cruise, no matter how long you were out! This will insure the best exercise and longevity for the battery pack.

For absentee owners, you can install a simple timer at the power source, which will interrupt the circuit and start the charger. This can be programmed to your convenience. We recommend once every six weeks.

CAUTION! Never run the motor while the boat is charging. As a precaution, keep the ignition key in the off position whenever the boat is tied up, thus preventing somebody from accidentally turning the motor on. The charger is equipped with a fuse to prevent damage to the electrical system.

THE BATTERY SYSTEM

Duffy Electric Boat Co. utilizes the most proven deep cycle batteries on the market. The technical specifications are a 6 volt, 220 amp, lead/acid deep cycle battery. These batteries are utilized in the golf cart industry, and are readily available from your dealer. The batteries are wired in series to produce a 36 volt system. The unique aspect of your electric boat's batteries, as opposed to your car's battery, are their ability to "charge and discharge" hundreds of times over it's lifespan. **Charging is simply plugging your boat in on a regular basis, as discussed in the previous section, and discharging is USING YOUR BOAT.**

Some of our customers have experienced up to six years use on one set of batteries. Keeping the terminals clean, proper water levels in each cell, and fully charged is the easy care necessary for a happy and healthy set of batteries!

Batteries are centrally located on each boat to maximize stability and provide proper ventilation when charging. Batteries are securely placed underneath the forward seating areas, port and starboard. Each model is standard with six

deep cycle batteries and can be equipped with a 12 battery system.

To access your batteries, simply remove the necessary cushions, and remove the white battery hatches. The cushions and hatches will stand up vertically on the carpet and against the bulkhead, allowing room to work. Each battery is equipped with white caps to access the water. These caps allow access to the individual "cells" of the battery where water is added and electrolyte levels can be checked with a hydrometer. **BE CAREFUL!** The battery acid is toxic and can burn your skin if you come in contact with it. If this happens, immediately flush the affected area with fresh water, and when in doubt, consult a physician.

BATTERY MAINTENANCE PROCEDURES

A. Adding Water. Water should be added when the level drops about 1/2" below the full level.

1. Add only approved water to the cells. Distilled water is recommended. Water with a high mineral content must not be used.
2. Add water to batteries only after charging to prevent overflow of acid due to expansion.
3. Fill all cells to the proper level. Do not overfill cells. Fill to within 1/8" level indicator or 1/2" over the top of the separators. Do not use a hose to water batteries. Watering guns or automatic watering systems are available and recommended.
4. Do not allow the electrolyte level to drop below the top of the separators since this will lead to shortened battery life.

B. Clean batteries after watering or when washing equipment.

1. Wash the tops of the batteries making sure the vent caps are in place. Do not allow water or other foreign matter to enter the cells.

2. Use a solution of baking soda and water; one cup for each bucket of water, to wash batteries if there is an accumulation of acid residue.

C. Inspection.

1. When watering batteries inspect battery and other terminal connections for:

a. Corrosion-Clean connections with soda solution (described above) and plastic brush, and apply a non-metallic grease, protective spray, or treated felt washer to retard further corrosion.

b. Loose Connectors-Be sure all connections are tight and that there is good contact with terminals. Loose connectors can also cause explosions and serious injury.

c. Broken or Frayed Cables-Replace any which look suspicious.

CAUTION: Never let a metal object touch both positive and negative terminals of a battery at the same time. This is very dangerous, and care should be taken whenever the batteries are exposed. Note each battery terminal, both negative and positive have a red, felt washer below the bolts. This 'treated felt washer' will prohibit corrosion on the battery terminals.

2. Once a week after the batteries have been charged, spot check two or more cells for specific gravity reading. Gravity should be 1250-1275. If low readings are noted:

a. Check charger to insure that proper charge is being returned to the batteries.

b. Check connections as specified

The most accurate test of a battery's energy level is with the proper use of a hydrometer. If you feel your batteries are not fully charged we recommend using a hydrometer to find the energy level. The following table translates the hydrometer readings:

<u>Hydrometer</u>	<u>Battery Energy Level</u>
1250-1275	Full
1175-1249	1/2 to 3/4
1125-1174	1/4 to 1/2
1100-1125	Empty to 1/4

Again, be careful when extracting water with a hydrometer so as not to spill this acid on yourself, the cushions or the carpet. To prevent damage to the plates, remember not to put the nozzle of the hydrometer too far into the cell. Simply squeeze the ball of the hydrometer to extract enough fluid to make the meter float.

All the batteries should be close in "gravity level", i.e. 1225, etc. If you find a cell in which varies by 30 points or more you may have located a "dead cell" in the battery pack. Notify your dealer, and immediately replace the battery or place an individual 6 volt trickle charger to bring the battery even to the remaining batteries. Your charge cycle will not be 100% effective with a dead cell in the pack.

OFF-SEASON BATTERY CARE

A. THERE IS NO NEED TO REMOVE THE BATTERIES FROM YOUR ELECTRIC BOAT FOR OFF-SEASON STORAGE. SIMPLY FOLLOW THESE PROCEDURES:

B. Prior to storing your boat for the off-season, batteries should be cleaned, fully charged and properly leveled.

C. While in storage the batteries should be recharged to full charge at time intervals, as follows:

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Storage Temperature

Below 40 degrees F
40-60 degrees F
60 degrees F and above

Charge

Every 6 months
Every 2 months
Once a month

D. Check batteries after storage and before service begins. Follow inspection and trouble shooting procedures to determine the condition of batteries.

RUNNING TIMES

Running times discussed in this section take into account common factors such as wind, current, a clean bottom and beginning the cruise with a fully charged battery pack. The standard battery pack is comprised of (6) 220 amp batteries. They are connected in series to act as one BIG battery, or 220 amps at 36 volts. A fully charged battery pack will provide from 3.5 - 8 hours of cruising. This means if you are to operate at cruising speed, 3 knots, the entire time the boat will run for 8 hours. Decrease your speed and elongate this even further. Increase the speed to full speed, and the entire cruising range is 3.5 hours.

The proof is in the math. For example, the Duffy 18 will draw or use 55 amperes at full speed. If you have 220 total amperes, than simply divide 55 into 220, resulting in 4 hours. We adjust downward to 3.5 allowing a time factor of returning to the point of origin. Your energy meter is an indicator of time remaining at the speed the boat is operating. As the speed increases, the energy meter will move away from full, indicating you are using more energy.

A (12) battery system is available in some Duffy models. This essentially doubles the running times indicated above, to 7 hours at full speed, and 16 at cruising speed. This feature is highly

recommended for Duffy boats utilized in commercial applications, or for boats with multiple owners.

IMPORTANT: The factory does not recommend adding (6) batteries to a Duffy 18 originally equipped with the standard battery pack. When a 12 battery boat is produced at the factory, the cement ballast is not added, to maintain the proper boat weight. If the batteries are added with ballast, you will experience the boat riding very low in the bow section.

ELECTRIC MOTOR & CONTROL CONSOLE

The beauty of our propulsion system is the motor. Duffy Electric Boats are equipped with specially designed Electric Motor...the **DUFFY POWER DRIVE**. With only one moving part, we eliminate oil changes, spark plugs, cams, carburetors, etc...

The Duffy Drive is designed to our unique specifications. This highly sophisticated and engineered motor is rated for 5 hp at 48 volts. We develop the necessary horsepower for each boat to provide the optimal speed and running time for a fully loaded boat while maintaining a motor warranty of excellent value to the end user.

IMPORTANT: The best way to insure a long lasting, healthy motor is to keep your BILGE DRY. If water accumulates in the bilge from rains or washing the boat down for extended periods of time, it creates moisture in the motor box.

Open your motor box and inspection hatches, (located under the carpet in front of the motor box), and take a look inside. If there is water, pump it out...it's that simple. Each boat is equipped with an automatic bilge pump which will be activated if the water level exceeds 3". **It's a boater's responsibility to physically inspect the boat during or after storms. Don't**

completely rely on bilge pumps and covers to keep water damage from taking place. The motor and electronics are isolated from the bilge to prohibit corrosion. The dripless shaft seal will keep water from entering this area.

When operating the pump, make sure the water is being pumped out by looking over the port aft side of the hull, where the pump thru-hull is. The motor is connected to the shaft with a V-Belt system. A gas shock keeps consistent tension on the belt. As the belt wears, the gas shock will extend and maintain maximum torque. This maintains maximum shaft RPM, and minimizes maintenance. NOTE: Belt residue may be noticed in the bilge. This is normal with new belts, and will diminish as the belt seeds itself into the motor pulley. **NOTE: Duffy Sport, Duffy 16 LC and Duffy 17 owners:** We utilize a very efficient and simple direct drive system, via shaft coupling device. See p. 9 for a further description of these systems.

12 VOLT ACCESSORY SYSTEM

To activate the various controls on the dash panel, simply push the appropriate button into the 'on' position. Each boat is equipped with a bow running light, stern light, interior lights, bar light, bilge pump, horn, dome light and stereo, (optional on the Duffy 16).

The "meter" on the dash panel indicates the energy level in your battery pack, similar to the fuel gauge in your car. When the boat is in full speed, the reading on the gauge will settle on the actual level of energy, (empty to full). It will also indicate when your boat is charging.

IMPORTANT: Remember to turn off the key when the boat is not in use. If left in the "on" position it will discharge the 12 volt battery pack. The key switch activates the system and turns on the motor box cooling

fan. It is very important to turn the key and dash panel switches off when not using the boat.

STORAGE, ACCESSORIES & HARDWARE

FOUR SPEAKER MARINE STEREO SYSTEM:

This feature is the perfect touch for your Electric Boat adventures. The complete digital tuner is equipped with a cassette player and four marine speakers. See the stereo owners manual for complete instructions on operation, features and warranty.

STORAGE: The Duffy 16 & Duffy 18 are equipped with three storage hatches: Two under the front seats, and one under the aft seat. These areas are ideal for your life jackets, boat supplies, towels, food, etc. The Duffy 21 is equipped with under seat storage and two side hatches located on the bench seat bulkheads forward.

SURREY CANOPY AND FRAME: Each Duffy Electric Boat is standard with a stainless steel surrey frame and marine canvas canopy. For people who store the boat during winter months, the frame can be removed and set on top of the boat. This makes it much easier for indoor or garage storage. The canvas canopy is equipped with a zipper at the door entrance on both port and starboard sides. Unzip the canopy for easy access in and out of your boat. It also provides excellent sunlight if rolled back and tucked under the stainless crossbar.

BIMINI FRAME (D-Sport, D-17 & D-Cat 18)

A convertible bimini frame and canopy are standard features on these three models. For the D-17 simply fold the frame on the fore deck for complete sunshine in the boat. The Duffy Sport frame will fold 3/4 back for easy entry in and out of the boat, or fold completely on the aft deck.

DOMelight: The light is activated by turning on the interior light switch. There is also an on/off switch on the dome light itself. The factory also offers a dimmer switch for this light and the floor lights.