SWIMMING POOL AND HOT TUB LIFT
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Important Safety Features:

Before using your lifts, it is important to note some precautions you should take to ensure your safety. As always, nobody should ever swim alone, so make sure someone else is present when using your pool or hot tub incase anything does go wrong.

Securing the Seat:

Before lifting and rotating yourself, you must first place the mesh seat around yourself and make sure it is supporting your weight with an even distribution. To make an upright position while you are lifted and lowered, when attaching the seat, put the upper seat straps on the carabiners on either the red or yellow loop, as opposed to the black loop and put the lower straps on the carabiners on the black loops. This will hold your body upright and allow better support for your head.

![Figure # Mesh Seat](image)

Another safety factor to consider is to make sure when the carabiners are attached to the metal hoops that all four straps are attached and that the carabiners are fully closed.

Motion:

When rotating to either the pool or the hot tub, make sure you have raised yourself up enough so as to not hit anything. This is especially important when exiting the pool and hot tub to return to your chair. While rotating to get into the pool, make sure you rotate far enough so that when you are lowering into the pool, you do not hit the edge of the pool; likewise for the hot tub.
As always, use your lifts with caution as they were built by amateur engineers, though we took all safety into consideration and these lifts were built specifically for you.

**Parts and Accessories:**

1) **Total Lift**
2) Battery
3) Battery Case

4) Remote

5) Rotational Motor

6) Winch Motor
9) Sling Seat

10) Pylons and Supports
Features:

Each lift is designed to accomplish the same goal and has generally the same design, but each lift has unique features as well. The pool lift has a round shaft that is slightly wider and taller than the hot tub lift. The shaft of the hot tub lift is square. One lift has an On/Off switch and power supplied to the lift can be controlled while connected to the battery in that way. The other lift should be disconnected from the battery when not in use to conserve battery power. The protective plastic casings also vary between the lifts, which do not alter the function of the lifts.

Both lifts have rope that extends approximately 2 feet below the bottom of the lift, which will enable you to lower yourself deep enough into the pool or hot tub that you will be fully submerged in water when you unload yourself. Each lift can rotate 360° if necessary, however, both will probably not use the entire 360° for operation.

The batteries used are deep cycle marine 12 volt batteries that can be recharged so they should not have to be replaced within at least the next few years. The batteries are in waterproof battery boxes that attach to the deck by the lift so they do not get shoved around. The batteries may be removed from the boxes if they indeed need to be recharged. Both batteries have a one year warranty if they malfunction and must be replaced.

Both lifts have the same remote and connections, as well as the same motors and gears. Therefore, the operation of either lift is essentially the same. Each lift is designated with a 400 pound capacity.
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1.0 Introduction

1.1 General overview

The lifts constructed are going to allow a great deal of convenience and accessibility which our client has never had before. The two lifts, one for the hot tub and one for the pool are both constructed using older Bruno lifts. At the top of the lift, it starts off with the motors and working down there is circuitry and a bit more concrete stability to make the lifts strong. Underneath the hard plastic coverage used for weather protection, there are two motors, winch and rotational, which supply the movement capability of the lifts. The winch and rotational motors together allow the lift to be used both vertically and horizontally, pulling our client up while swinging him around at the same time. Figure 1.1a and 1.1b show the winch motor and rotational motor respectively.
The winch motor is located at the top of the lifts and end of the boom arm, under a plastic casing used for protection. The motor is what creates the great strength of the lifts and allows for mechanical movement. This winch motor is what permits the heavy duty purple polypropylene winch rope, attached to the top of the motor, to lift the client. This rope is used to secure the seat to the actual lift, and along with carabineers and a stainless steel ring, it creates a secure seat attachment device. The winch rope device is attached to the seat of the lift, which is where the user will sit and be lifted into the pool or hot tub, using the controls. Figure 1.1c shows the winch rope.
The client will place themselves in a full-body mesh sling to be lifted. This particular seat supplies a great deal of support and stability when being lifted from the ground into the pool and/or hot tub. The seat is one that will dry quickly while still offering full head and neck support and a 600 pound weight capacity. Figure 1.1d shows a picture of the mesh seat.

Moving down the lift, away from the winch motor, is where the shaft of the lifts are located. Comprised of metal the shafts are relatively lengthy and supply high torsion strength. The shafts contained several holes to allow for adjustments but they are now plugged with rubber. The rubber plugs add extra protection against the harsh weather conditions the lift is likely to sustain. Since the lift is specifically for one client, the holes throughout the shaft were securely closed in the correct place to protect against any dangers or weathering damages as seen
in Figure 1.1e. Since we built it accordingly to the user, the plugs should never need to be removed.

**Figure 1.1e: Shaft with rubber plugged holes**

Reaching the base of the lifts, each is comprised of three legs. The base is crucial for the safety and stability of the constructed lifts. The legs reaching out from the base allow a better attachment to the deck or whatever surface they will be placed on. The base of the lift is seen in Figure 1.1f below. The angles of the leg placement were made, taking into consideration the forces and weights that would be placed on the lifts at various points. One leg of a lift be longer and extend further out to accommodate for the constant pull and weight of gravity it will be under. The base is also comprised of a gear and chain, the rotational motor, which are responsible for the lift rotation. Also covered with plastic casing like the winch motor, the rotational motor is necessary for shaft rotation, permitting horizontal movements.

**Figure 1.1f: Legs of the lift**

Throughout the lifts there is a great deal of circuitry as well and it required special attention for protection against weathering and so on. The wires that were exposed all along the length of the shaft and at the lower section of the lifts required safety precautions. In order to fight against any electrical damage in the future, self adhesive electrical tape was used to wrap all exposed wire connections on the lifts as seen in Figure 1.1g. Each connection is vital, so special attention was paid to each rather than just wrapping the wires all together as a whole.
Attached to each lift is a 12 V M-2 deep cycle marine battery used to power the machine. Each battery is further protected by a battery box specially designed for the specific batteries used. It is very important that the batteries be protected from any outside weather conditions or damages which may affect the functionality of the battery. The top of the battery boxes were sealed and waterproofed, leaving open space only for necessary circuitry. The battery is what powers the lifts to work and weighing around 42 pounds each, is one of the heavier components of the lift.

The lifts also come with remotes which will allow the user to control the lift movement manually. The remote offers the user both vertical and horizontal movement around the pool and hot tub. Comprised of all plastic, the remote is directly connected to the circuit board on the lift. All of the wiring and the remote were protected using special coating to avoid any water damages.

Once all of the above mentioned components were tested and protected, the final connections were made. In order to make the device operational all of the individual parts were connected together using circuitry and the device was then ready for safe usage. There is a great deal of wiring throughout both constructed lifts and being controlled by remotes, it is important all of the connections are made where they need to be. Since all of the separate parts of the lifts needed to be, for the most part, functional independently of the others it is mostly quick connections that needed to be protected. Using the self fusing electrical tape, each individually wrapped connection was later combined to form one large protective outer layer.

Figure 1.1g: Wrapped electrical wires

Figure 1.1i: Remote control for lifts
1.2 Step by step instructions

1. Place operator inside of mesh seat
2. Using one carabiner, place both straps on the left in the carabiner. The top one on the red or yellow loop, and the bottom on the black loop.
3. Attach the carabiner to the metal loop and make sure the carabiner is fully closed.
4. Repeat steps 2&3 for the right side, using the other carabiner.
5. Using the remote to move vertically, lift up the seat and ensure there is enough clearance space to smoothly move over the pool or hot tub.
6. Now that the necessary vertical movement is complete, use the control to move from left to right, accordingly to ones location.
7. Located above the pool or hot tub, the user should now be able to slowly lower themselves closer to the water.
8. Once the water is beneath you, about hip length, place the control on a dry surface such as a deck.
9. Release one carabiner to let yourself out of the seat and into the pool.
10. When you are done enjoying the pool or hot tub, place the seat around you and reattach the carabiner to the metal loop.
11. Using the remote, lift yourself up using the up button until you are at a height higher than the deck.
12. Rotate yourself using the button back to wheelchair.
13. If necessary raise yourself to the height needed to get back into your seat.

*Note, both carabiners and the seat will be used for both lifts. All other components are duplicated for respective lift.

2. Maintenance

It is vital that these lifts are kept in their best condition and are checked frequently to make sure they are in proper working form. There are multiple components that must be appropriately kept up to date to be able to ensure longevity of your lifts. These parts can each be categorized into electrical components, mechanical components, and environmental considerations that may affect the lifts.

Electrical Maintenance

Because your lifts are powered by remotes, it is of vast importance that each part of the electrical system be protected.
1) Wiring: The wiring travels from the motors along the boom of the lift and down the shaft into the circuit housing. As the wires are not naturally connected as one unit, they have a male/female clip connection at various points along the wires, as shown in fig. 2.1 below.

![Figure 2.1 Clip connections used to connect wires](image1)

These connections have been made permanent by using a self-adhesive waterproofing electrical tape, shown in fig 2.2, that when stretched and wrapped around the wires essentially forms a sleeve to protect the connections and keep water from getting into the wiring.

![Figure 2.2 Self-Adhesive Electrical Tape Wrapped Wire Connections](image2)

Each connection was wrapped individually, as shown in fig 2.3, and then combined with each other to form a protective outer layer, as shown above in fig. 2.2. It is important that this stays wrapped properly because if it tears or is compromised, water could get into the wiring and destroy the function of the lifts. If it is apparent that the electrical tape or any wiring is torn or exposed, it is important that it be repaired before the circuit is damaged. Self-adhesive electrical tape can be purchased for under five dollars at most hardware stores if repairs are needed.
2) Circuits: The circuit boards are well protected with both chemical and physical waterproofing. The circuit boards have been polished with an acrylic conformal coating used for protecting the circuit from water and chemical reactions. This should not require much upkeep as long as the physical barrier is kept on the outside. On each lift the circuit box is attached to the lift using two screws, so to open the box, it must first be removed from the base using a Phillips head screwdriver. The box is also kept closed using Phillips head screws, so to open it they must also be removed. Figure 2.4 depicts an open circuit box.

As you can see, the wire connections to the circuit board are not sealed or permanent, so it is important that they not be jostled or removed. They can be reconnected but it is important to take notice of where each wire connects because each wire serves the battery, remote, or a motor. If something is not functioning, check the wire connections and if something has come detached, remove connection to the battery and reattach the loose wire.

The metal circuit box should provide the circuit with protection, but if it corrodes to form a hole or break, it should be covered with a protective layer of a waterproof material. This could be anything from wrapping it with plastic wrap, or replacing the box altogether. It is important that no matter what, the circuit does not get stagnant.
water sitting inside it, because although the acrylic coating is water resistant, it will likely not withstand constant contact with water.

3) Motors: Each lift has two motors: one that controls the winch and one that controls rotation. If either motor fails, they should be replaced or repaired. Motors can be purchased online. To ensure the longevity of motor function, it is vital that no excess weight is left hanging on the lifts when it is not in use. It is also important that the power be removed from the lifts when not in use in case the remote falls and/or is pressed and runs the motor out of function.

4) Remotes: The remotes are composed of circuit boards with an outer plastic casing. Like the other circuits, they too have been coated with the acrylic coating to protect against water and chemicals. It is understandable that these remotes will be getting wet with use near and in a pool, but it is of utmost importance that the remotes do not remain in the water for long, lest they get water logged and the circuits get compromised. When using the remotes to lower yourself into the pool or hot tub (if nobody else is there to assist you), once you are done lowering yourself, put the remote on the deck rather than let it float in the water. If a remote’s function fails, there are replacement remotes that must just be switched with the non-functioning remotes; however, it is better if failure is avoided at all costs.

5) Batteries and On/Off Switch: One lift has an on/off switch for power, so when not in use, it should be switched to the Off position so as to not drain the battery. The other lift, to ensure a long battery life, should be disconnected for battery power when not in use. The batteries are deep cycle marine batteries that are rechargeable, though even without charging they should last at least a year. Each battery has a One Year Warrantee, so if they stop functioning within a year, you may contact Die Hard Battery and get a replacement.

Mechanical Maintenance

The mechanical structure of each lift is the driving force of how the lifts are able to work properly, so it is necessary for the integrity of the lifts to stay intact.

1) Metal: These lifts are rated for a weight capacity of 400 pounds. Please make sure no extra weight aside from the user and the seat are attached to the lift at any given time. There are rubber plugs in each hole in the metal shaft and boom on each lift, as shown in fig 2.5. These plugs should remain in place and if one falls out or is removed moisture or chloride ions could get inside the lifts, allowing corrosion to occur and the mechanical properties to be compromised if corrosion becomes advanced.
2) Spray Coating: The entire lift has been covered with a black waterproof, corrosion proof spray-paint. This should keep any structural damage from happening to the lifts. It is important that if any chipping or wearing away of the paint occurs, it be retouched with the spray coating. If it is not entirely and evenly coated, corrosion will begin to happen in the area that is exposed.

3) Gears and Chains: At the base of each lift, under the hard shell, there is a gear and chain, depicted in fig. 2.6, responsible for the rotation of the lift. This gear and chain is oiled, but may require re-oiling every now and again to keep rotation smooth. The chain is also kept taut but with just the slightest bit of slack. If the bolt anchoring the motor and small gear in place loosens, the whole piece may slide towards the large gear making the chain loose enough that it can fall off or away from it so the chain becomes too taut. If this occurs, the function of the gear and chain will be debilitated. In such a case, loosen the bolt enough that you may manually move the box holding the motor and small gear to the correct position and retighten the bolt. Again, the chain should have a little bit of slack, but be held tight enough that it may not slip one way or another over the small gear.
4) Seat Connection: The seat is connected using two metal plates held together with two nuts and bolts. These nuts and bolts must remain intact to keep the mechanical strength of the attachment. Regular tightening of these nuts and bolts should be done to make sure they do not get loose and fall off. If they do fall off, they must be replaced before use of the lift.

Also helping to ease seat attachment are solid metal rings. These do not need much upkeep except to make sure they are not left in the pool water for hours on end because they could begin to see the effects of chlorine and that could weaken their strength properties. The other aspect of seat attachment is the carabiners. There are two carabiners, which should be used to attach the left straps and the right straps, respectively, to the rings. They should be pushed tightly shut to lock, to ensure that they do not release you while you are being lifted. There is not much upkeep involved in these, however if one breaks or fails, replacement carabiners may be purchased at any hardware store or camping store for under ten dollars.
Environmental Effects Protection

Because these structures are permanently outdoors, and will have to withstand harsh New England weather, it is important to make sure they are well prepared for the winters as well as the corrosive environment they will be near in the summer.

1) Winter: During the winter, these lifts should be covered by a tarp. This will prevent corrosion from occurring due to begin exposed to snow for extended periods of time. Giving a physical barrier between the lifts and the weather is the best bet to protect them during the winter months.

2) Seat: The seat provided to be used with both lifts is a mesh seat. It should be left to dry when not in use. This will prevent any mildew or bacteria from growing in it. The seat is also machine washable and should be washed every few weeks, depending on frequency of use. It should not be used in a dryer.

3) Chlorine: These lifts will be near corrosive environments being that they will be located directly next to areas that contain high chlorine content. It is important that though the lifts will likely get water with diluted chlorine on them, that no direct contact with chlorine, or shock, or any chemical on its own come in contact with the lifts. The less chemical contact with the lifts possible, the better. If it is possible, washing any deposits left on the lifts should be washed away as soon as possible, though it may be inconvenient and hopefully rain will contribute.

While these lifts are very strong and can perform quite well, it is important they be kept as close to their initial state as possible to prevent any failure or injury from usage.

3. Technical Description

3.1 Battery

The batteries used to power the two lifts are 12 volt DieHard M-2 Marine Deep Cycle batteries. This battery has a group size of 24M, but since our batteries don’t need to fit in a car, the size is mostly irrelevant. It just has to be compact enough to be easily moveable. The batteries are 9 7/5 inches tall, 10 4/5 inches long, and 6 4/5 inches wide. They weigh 42 pounds each, and come with a carrying handle for easier maneuvering. They have 565 CCA (cold-cranking amps), which relates to the battery’s ability to start in cold conditions. The Battery Council International defines CCA as "the discharge load in amperes which a new, fully-charged battery at 0°F can deliver for 30 seconds and maintain a voltage of 1.20 volts per cell or higher"
These batteries have a reserve capacity (RC) of 105 minutes. It is defined by the Battery Council International as the amount of time a new and fully charged battery at 80 °F can be discharged at 25 amps and maintain a voltage of 1.75 volts per cell. So for our 12 volt batteries, 105 minutes represents the amount of time that the battery can maintain a voltage of 10.5 volts [1]. Lastly, these batteries come with a 12 month warranty and free replacement if anything should happen to them. Figure 3.1a below shows a picture of the M-2 battery.

![Figure 3.1a: Picture of M-2 Marine Deep Cycle Battery](image)

3.2 Battery Case

These batteries will be placed outside next to the lifts, so it is important that they are in a tough casing that will protect them from the elements and any other physical damages. The black boxes that protect them fit the batteries perfectly, but there were vents on the top where water could have gotten in. These vents were filled in with caulk, which seals and waterproofs the lid of the case. The wires that connect the battery to the lift for power will extend out the side of the lid and downwards. This orientation will prevent water from getting inside the box and potentially ruining the battery. These cases have handles on the outside so that they may be moved around easily. Figure 3.2a below shows one of the battery cases.
3.3 Control Circuit

The circuit that controls the entire lift is located at the base of each lift under the rotational motor. The battery powers this circuit, and the circuit then distributes this power to each motor appropriately as manually commanded by the user-controlled remote. Figure 3.3a shows a close-up picture of one of the circuits.
Figure 3.3a: Control Circuit located at base of lift

The red wire that is inserted in the right side of the circuit is the positive lead of the M-2 Marine Deep Cycle battery. The black wire on the extreme left side of the circuit is the negative lead of the battery. These wires share the voltage with the rotational motor (the red and black middle wires) and the winch motor (the orange and blue middle wires). The multiple wires entering the red socket on the upper half of the circuit connect to the remote. This controls the up and down movement, as well as the left and right rotation. This circuit was covered in an acrylic conformal coating, which is a non-conductive liquid which protects against corrosion and moisture buildup. This will ensure that the circuit will still work even if water makes it through the protective plastic covering.

3.4 Remote

The remote of the lift represents the only user interface and is therefore a crucial component. It is connected to the circuit board via a long spiraling wire that coils back up on itself so that it doesn’t tangle. The circuit connections inside of the remote were also covered in an acrylic conformal coating in case of water interference. Figure 3.4a below shows a picture of the remote.

Figure 3.4a: Picture of the remote of the lift

This remote is made out of a plastic casing, so it is important that it is not dropped in cold temperatures. However, since the pool won’t be used during cold temperatures, this won’t be a problem. This could potentially be a problem with the hot tub, since it could be used in the winter, but as long as the remote is treated with care it should be fine.
3.5 Shaft Extensions

An important part of both lift designs was the shaft extension. Since both lifts were only about 32 inches before modification, it was necessary to raise both booms by about 24 inches so that the client could pull up next to the lift in his wheelchair without hitting his head. In Figure 3.5a below, section D of the diagram is the shaft that will be extended.

![Diagram of lift components. Part D is the shaft to be extended on both lifts](image)

**Figure 3.5a:** Diagram of lift components. Part D is the shaft to be extended on both lifts

This extension was accomplished slightly differently for the two lifts due to materials at hand from the disassembly of the other two lifts. The extension weld on Lift 1 was an inner collar weld and is shown in Figure 3.5b below. The extension weld on Lift 2 was an outer collar weld, and can be seen in Figure 3.5c below. The difference in welding techniques shouldn’t make a difference in the lift’s structural integrity. Both welds are equally strong in theory. These welds were spray-painted over before installation to prevent corrosion at the weld point. Some sections of the main shaft had holes in it, as can be seen in Figure 3.5b. These holes were filled in with rubber cylinders, which should prevent water from getting inside the hollow shaft and causing internal corrosion. These rubber stoppers can also be spray-painted over to create a uniform look for the final lift product.
Figure 3.5b (left) and 3.5c (right): An inner collar weld (left) and outer collar weld (right) where the shafts of each lift were extended.

3.6 Rotational Motor

The rotational motor sits at the base of the lift and is covered by a plastic casing. Figure 3.6a below shows the rotational motor and the gears that it turns in order to achieve shaft rotation. This motor works by turning an inner shaft which has magnetic brushes in a guide, pressured by springs that push these brushes up flush to the motor shaft. There was an instance when these brushes popped out of their guides and had to be placed back in the track. This was tricky to do however because the springs had to be compressed while the magnet brushes were placed back in the track. Figure 3.6b shows a picture of the inside of the motor. The hole in the center is where the shaft extends through, and the magnets are at the ends of the twisted copper metal on either side of this hole.
3.7 Winch Motor

The other motor on the lift is the winch motor located at the top of the lift at the end of the boom arm. This motor is what turns the gear that winds the flat purple polypropylene rope to lift the client in the sling seat. It runs very similarly to the rotational motor, it just turns the
rotational movement into axial movement. Figure 3.7a shows one of the winch motors with a plastic covering over it to protect it from the elements. The flat polypropylene rope can also be seen extending down from the far end of the motor. It is off of this rope from which our client will hanging in the sling seat.

![Figure 3.7a: Winch motor at the top of a lift](image)

### 3.8 Seat Attachment Device

The method to attach the seat to the polypropylene rope consisted of a stainless steel 3 inch diameter ring and two stainless steel carabiners. The metal ring was folded up in the flat rope and several metal plates and 2 small screws secured the rope so that the ring was secure. Figure 3.8a shows the overall set-up of the seat attachment device. The end of the polypropylene rope was melted to stop fraying and ensure that the strength of the rope maintained intact as weight is applied to it. The seat straps will hook onto the carabiners, two on each one. The left sides of the seat will attach to the left carabiner, and the right sides of the seat will attach to the right carabiner. This way, our client only has to unhook one carabiner in order to get into the water.
Figure 3.8a: Seat attachment device

3.9 Sling Seat

The seat for this lift is a large heavy duty Graham Field Mesh Full-Body Sling. Our client will sit in this blue mesh seat that will dry quickly after it is dunked in water. This seat offers full head and neck support so that the client won’t strain his head or shoulders while moving from his wheelchair to the pool or hot tub. The seat has a 600 pound capacity, which is more than enough to lift our client who is 250 pounds. The width of the seat is 44 ¾ inches and the length of the seat is 54 ¼ inches. Figure 3.9a below shows a picture of the seat when it is laid out flat. When the seat is hanging, all four of the loops at the corners will be attached over the client’s head to the carabiners.
3.10 Pylons and Supports

The last key components to the lift system are the pylons and cement sonotubes underneath the lifts which provide strength and added security to base stabilization. This support system was placed in by a contractor. The cement sonotubes have an 8 inch diameter and a depth of 3 feet. There will be 160 pounds of cement in each sonotube. The pylons that are placed in the cement are 4 inches by 4 inches, which will fit easily into a cement cylinder with a diameter of 8 inches. The lift will be bolted through the deck into the pylons to provide the support necessary for the lift. Figure 3.10a below is a Solidworks drawing of the sonotubes and pylons placed below the lifts by the contractor.
4. Troubleshooting

4.1 Reversal of controls on the remote

If, for example, pressing the down button on the remote results in the seat to go up, that means there must be something wrong with the wiring of the lift. First, in pool lift, check the to make sure that the red wire from the lift is connected to the positive knob of the battery and the black wire from the lift next to the red wire is connected to the negative knob of the battery as shown below.
Figure 1: The red wire connects to the positive end of the battery; the black wire connects the negative side of the battery.

Second, in the hot tub lift, make sure the red wire connects from the positive end of the battery to the single input wire. The black wire connects from the negative lead of the battery to the metal plate shown below.

Figure 2: The red wire connects to the single battery input wire to the positive lead on the
battery while the black wire connects the negative lead of the battery to the metal base plate.

Please make sure, when switching the wires that NO METAL PARTS FROM EACH WIRE TOUCH EACH OTHER. If that occurs, you will end up with a short in which you must replace the entire circuitry of the lift. Also the short would also be harmful since you are in the vicinity of the short

4.2 Electrical Short

An electrical short is a problem which occurs when an accidental path is created in a circuit, generating a connection where one did not exist before. If a distinctive popping noise is heard when connecting the lifts to the battery, that means a short has occurred. If that happens, you must quickly step back for your own safety. The short is very quick so once the noise is over, quickly remove the wires from the battery. Observe the wires that were connected to the battery if any of the plastic covering has been melted. If melting has occurred, we strongly suggest you buy another wire or wires. If no melting as occurred, reconnect the wires to the battery again, this time more carefully than before and test the lift by using the remote to move the lift left and right. If the lift moves according the button pushed on the remote, then everything is fine. If the lift does not move at all, that means the short has damaged the main circuit board therefore you must contact Bruno© to ask about other circuit boards they may have the replace the broken one. The circuit board of each lift is shown below.

![Figure 3: The circuit board for Bruno© Lift 1: Pool Lift](image-url)
Figure 4: The circuit board of the Bruno© Lift 2: Hot Tub Lift is covered with a metal box but can be removed by using a screwdriver. Its circuit board is similar to Lift 1’s circuit board

4.3 Battery runs out of power

Always test the left and right controls before going on the lift. If the lift does not move left or right and there was no electrical short, then the battery must have ran out of power. If that is the case then either replace the battery with a new one or recharge the battery since the DieHard© Marine Deep Cycle batteries are rechargeable. We strongly suggest you recharge your batteries after the winter months due to exposure to cold may hamper the battery’s electrical energy.

4.4 One or both motors fail

If one or both motors fail, open up the motor or motors. The magnets are spring pressured to push against the rotation shaft in the motor and if you see these magnets ejected from their guides or any other abnormal disfigurements like burn marks or loose pieces we recommend you to find a mechanic who is capable of fixing these motors or contact Bruno© to ask for a replacement motors. A taken apart motor is shown below.
Figure 5: The parts of the motor

Figure 6: The coiled magnets out of their guides.
If the damage of the on the motors is too great, the motors need to be replaced, the motors below are the motors that are recommended to purchase for replacement.

**Figure 7**: The motor on Bruno© Lift 2: Hot Tub Lift
4.5 The lifts fail while in use

If the lift fails while in use, whether the batteries die, the circuit shorts, or the motors fail, the first thing to worry about is the safety of the person on the seat. If the person is over the pool/hot tub, the red tab on the base of the shaft as shown in the pictures below (Figures 7 and 8), are the fail safe levers. By pushing the red tab down, it allows a second person to rotate the lift back on ground or over a wheelchair. We suggest when lifting a person from his or her chair that it would not be more than 1 ft from the seat so in case of the scenario above, the person as a safe distance to fall back on his or her chair.

If the lift fails while in use but the person in the water, then it is safe for the person to fall back into the water and other means of lifting the person out of the water must be used.
4.6 Bolts holding the lifts down are worn, corroded, or broken

The bolts are ½ diameter 10in. long. If these bolts become worn, corroded, or broken, then do not use the lifts and replace these bolts as soon as you can. The bolts that are needed to pin down the lifts are shown below.

Figure 11: Red fail-safe level for Bruno© Lift 2: Hot Tub Lift

Figure 12: The bolts being used to pin the lifts down on the patio
4.7 The lift becomes discolored

If the lift becomes discolored, we recommend using the spray below to not only recover the color but protect it from rust and weather elements. However, it is still safe to put a tarp over the lifts during the winter months.

Figure 13: Rust-oleum hammered black protective spray.