



# Aqua Control, Inc.

## 60 Hz. STATIONARY SERIES INSTRUCTION MANUAL



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### SAFETY INFORMATION

#### WARNING

This product is not intended for use by young children or infirm persons unless they have been adequately supervised by a responsible person to ensure that they can operate the product safely.

Young children should be supervised to ensure that they do not play with the product.

Your Aqua Control, Inc. products are made entirely of corrosion resistant materials including stainless steel, aluminum alloy, bronze and engineered plastics. They will provide safe, long and satisfactory service if properly installed, operated and maintained.

1. Follow all applicable local and state electrical codes.
2. Protect exposed or vulnerable wiring with tubing or conduit.
3. Do not operate the unit when it is obvious the flow rate is reduced.
4. Do not work on the unit when it is turned on or operating.
5. Follow all normal safety precautions when working in and around the water.
6. Prevent tension on the electrical wires.
7. Do not carry or pull the unit by the lights or by the cord. Use the finger pockets on the float.
8. Never try to dislodge debris from the impeller or propeller while the motor is connected to the power supply.
9. **Always verify that the control panel and all electrical equipment are grounded properly.**
10. Any time high voltage electricity is used underwater, a potential safety hazard exists. Aqua Control builds and provides UL listed control panels that are standard equipped with a Class A Ground Fault Circuit Interrupter (GFCI) for both motors and lights. Class A GFCI's are designed to provide protection against electrocution for people. They have a nominal trip level of 5 ma and are designed to shut the circuit off in 25 milli seconds. Such a system will shut off a current resulting from shorts or dangerous leakage, whether from the motor, electrical cables, or controls, before a hazardous current can develop.

### PRE-ASSEMBLY

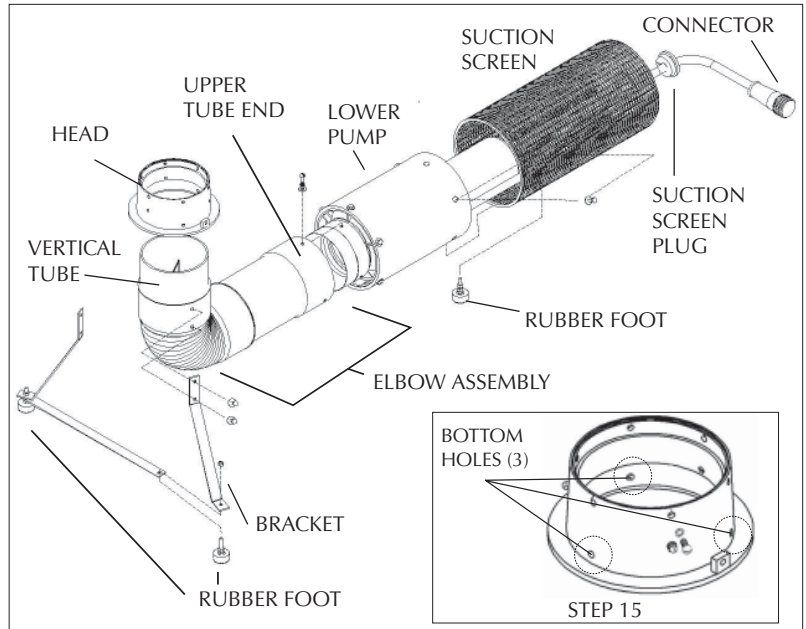
Prior to installing, verify the correct product has been ordered and received. Aqua Control, Inc. **will not** accept any returns for refund or exchange of product or components that have been installed in the water or modified in any way. Keep original packaging for returns to the factory or contact the factory for instructions as to how to obtain packaging for safe return of product.

1. **Check the packing list** that came with the shipment. Make certain all the boxes have been received. Each label will have a box number and total for the shipment (1 of 5, 2 of 5). The packing list has the total number of boxes noted at the bottom.
2. **Verify the incoming voltage** where it will be connected to the control panel. Does the measured voltage match the rated motor voltage requirements? Note the HP, voltage and phase on the packing list.
3. **Is there a VFD operating** from the same power supply or in the vicinity that might interfere with the GFCI?

## STATIONARY FOUNTAINS HORIZONTAL

All horizontal Stationary Series units are routinely shipped assembled however; kits are available if they must be shipped unassembled. The below instructions are for horizontal units that require assembly. If your unit came assembled, proceed to page 3 for the nozzle instructions.

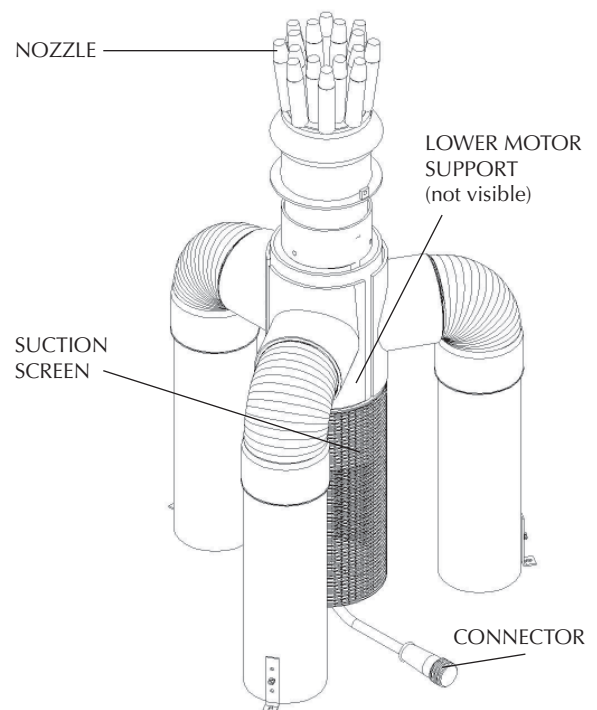
1. Remove the lower pump from its box.
2. Pull the motor lead completely out of the lower tube.
3. Inspect the motor lead and quick disconnect for any shipping damage.
4. Manually spin the propeller/impeller to make sure there is no rubbing on the shroud/diffuser.  
**BE CAREFUL OF SHARP EDGES.**
5. Remove the suction screen and suction screen plug from the box.
6. Remove the (2) two hex head bolts and (1) one rubber foot from the lower motor support. Do not remove the (3) three Phillips head screws.
7. Remove the blue cap from the quick disconnect on the motor lead.
8. Put the quick disconnect through the hole in the bottom of the suction screen. Replace the cap on the quick disconnect to protect it from damage.
9. Slide the suction screen onto the lower tube and replace the bolts from step #6. The suction screen should overlap the lower tube 3 to 3 1/2 inches. Replace the hardware from step #6. The rubber foot needs to be located on the bottom of the pump.



10. Pull the motor lead out of the suction screen as far as it will go. Place the suction screen plug on the motor lead with the tapered end towards the suction screen. Push the plug into place in the hole in the bottom of the suction screen.
11. Remove the elbow assembly from its box.
12. Remove the (3) three screws/bolts from the shroud/diffuser on the lower pump.
13. Attach the elbow assembly sliding the upper tube end over the shroud/diffuser, lining up the holes. Replace the hardware from step #12. Verify the vertical tube on the elbow assembly is pointing upward with the rubber foot in the lower pump sitting on the ground.
14. Remove the (4) four hex head bolts with lock washers from the elbow in the elbow assembly (2 on each side). Line up the two side brackets with these holes and replace the hardware. The unit should now be setting on the (3) three rubber feet.
15. Remove the head assembly from its box. Remove the bolts with cap nuts and lock washers from the bottom holes in the head. See diagram of head with bolt/screw positions.
16. Slide the head over the end of the upper tube, lining up the holes. Replace the hardware with the head of the bolt on the inside of the upper tube and the lock washer and cap nut on the outside of the head.
17. See the nozzle, cord, and light set instructions for attaching these to the unit.

## STATIONARY FOUNTAINS VERTICAL

Vertical Stationary Series units are shipped fully assembled. Skip to the instructions for attaching nozzles and lights.



# NOZZLES

Find the nozzle that is being attached to this unit in the table below. This table will tell you which of the five nozzle types a nozzle falls under to locate the correct instructions.

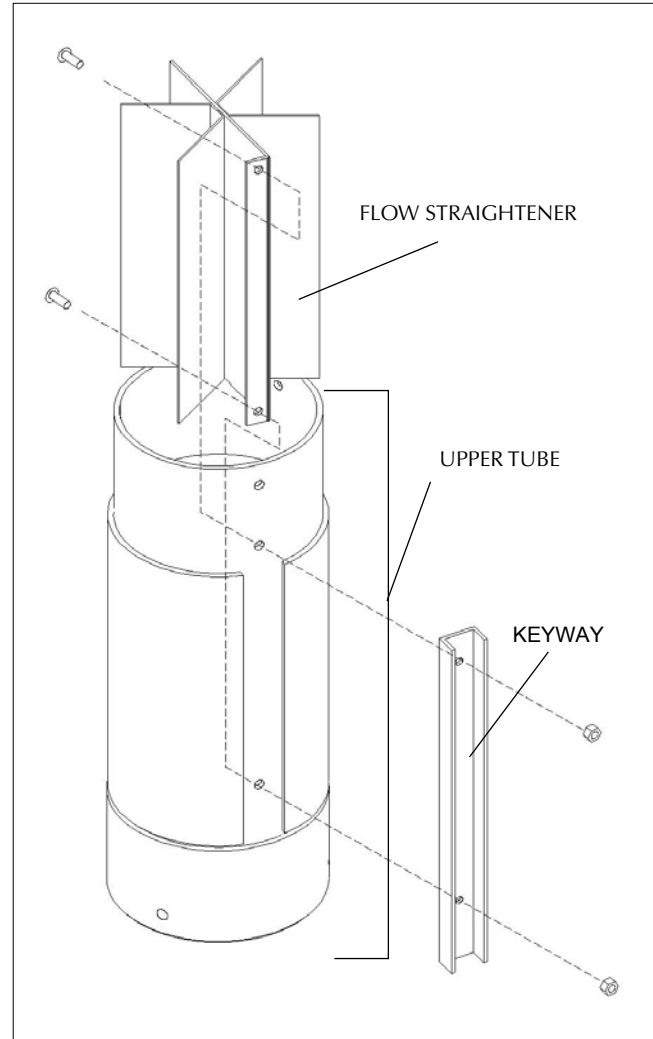
For Select Series nozzles, verify the flow straightener is in the upper tube for vertical units with the exception of the Tornado and Full Geyser nozzles that do not require flow straighteners. Select Series horizontal units also do not require flow straighteners.

Display Aerator nozzles and Fountain nozzles are not interchangeable.

DISPLAY AERATOR NOZZLES	NOZZLE TYPE
Cluster Arch	Type 2
Crown Gusher	Type 2
Daffodil	Type 1
Delmar	Type 1
Double Arch	Type 1
Horizontal Tornado	Type 2
Lily	Type 2
Pentalator	Type 1
Quad	Type 1
Scepter	Type 1
Spider & Arch	Type 1
Super Lily	Type 2
Vertical Tornado	Type 1
Torrent	Type 1
Trillium	Type 1
Triple Tier	Type 2
Weeping Willow	Type 1
Winter Scepter	Type 1

DISPLAY FOUNTAIN NOZZLES	NOZZLE TYPE
Buckingham	Type 1
Flare & Sky Geyser	Type 4
Fleur de Lis	Type 1
Full Geyser	Type 3
Majestic	Type 1
Shooting Star	Type 1
Sky Geyser	Type 1
Spoke & Trellis	Type 1
Tiara	Type 1
Trellis	Type 1
Trellis & Sky Geyser	Type 1

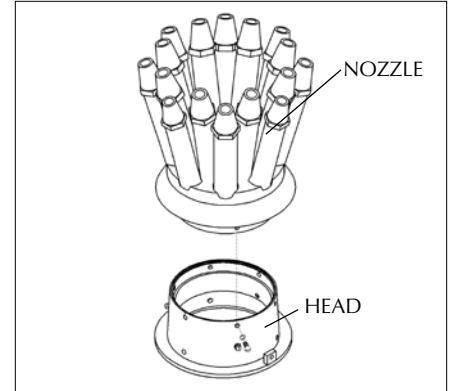
BOWL FOUNTAIN NOZZLES	NOZZLE TYPE
Multi Arch	Type 1
Two Tier Multi Arch	Type 1



# NOZZLES

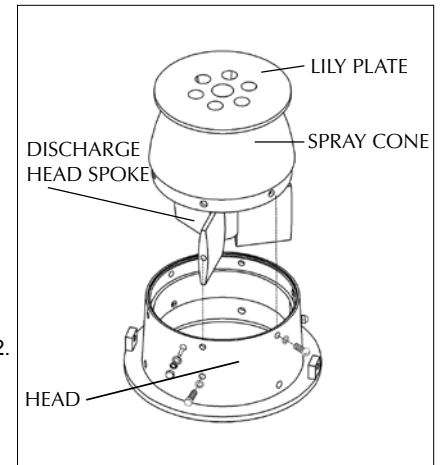
## NOZZLE TYPE 1 – MULTIPLE NOZZLE CASTING/SPRAY CONE

1. Remove the nozzle from its box.
2. Remove the screws with lock washers from the threaded holes in the nozzle.
3. Tear open the packet of petroleum jelly and apply it generously to the o-ring on the flange of the nozzle. Spread it evenly over the o-ring. Never use the petroleum jelly on the electrical quick disconnects.
4. Reattach the hardware removed in step #2.



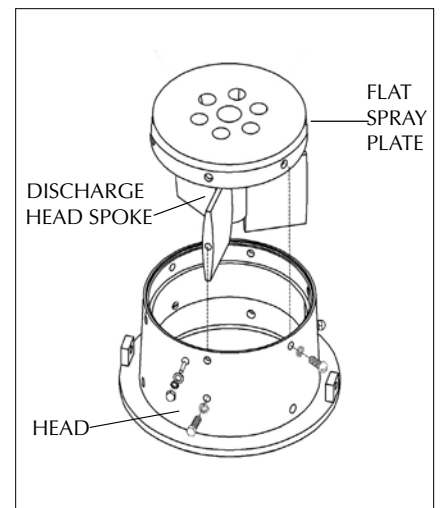
## NOZZLE TYPE 2 – SPRAY CONE WITH DISCHARGE HEAD SPOKE

1. Remove the nozzle from its box.
2. Remove the screws with lock washers from the threaded holes in the spray cone and the hex head bolts, lock washers and flat washers from the discharge head spoke.
3. Remove the hardware in the center row of holes in the head using a 5/16" wrench on the cap nut. This hardware will not be reused.
4. Tear open the packet of petroleum jelly and apply it generously to the o-ring on the flange of the nozzle. Spread it evenly over the o-ring. Never use the petroleum jelly on the electrical quick disconnects.
5. Holding the nozzle by the tip of the threaded rod, line up the threaded holes of the discharge head spoke with the center row of holes in the head. Slide the discharge head spoke inside the head and attach with the hex head bolts, lock washers and flat washers removed in step #2.
6. Slide the flange of the spray cone into the top of the head. Make sure the threaded holes in the flange of the spray cone are lined up with the holes in the top of the head.
7. Reattach the screws with lock washers removed in step #2.
8. The nozzle has been pre-set at the factory.



## NOZZLE TYPE 3 – FLAT SPRAY PLATE WITH DISCHARGE HEAD SPOKE

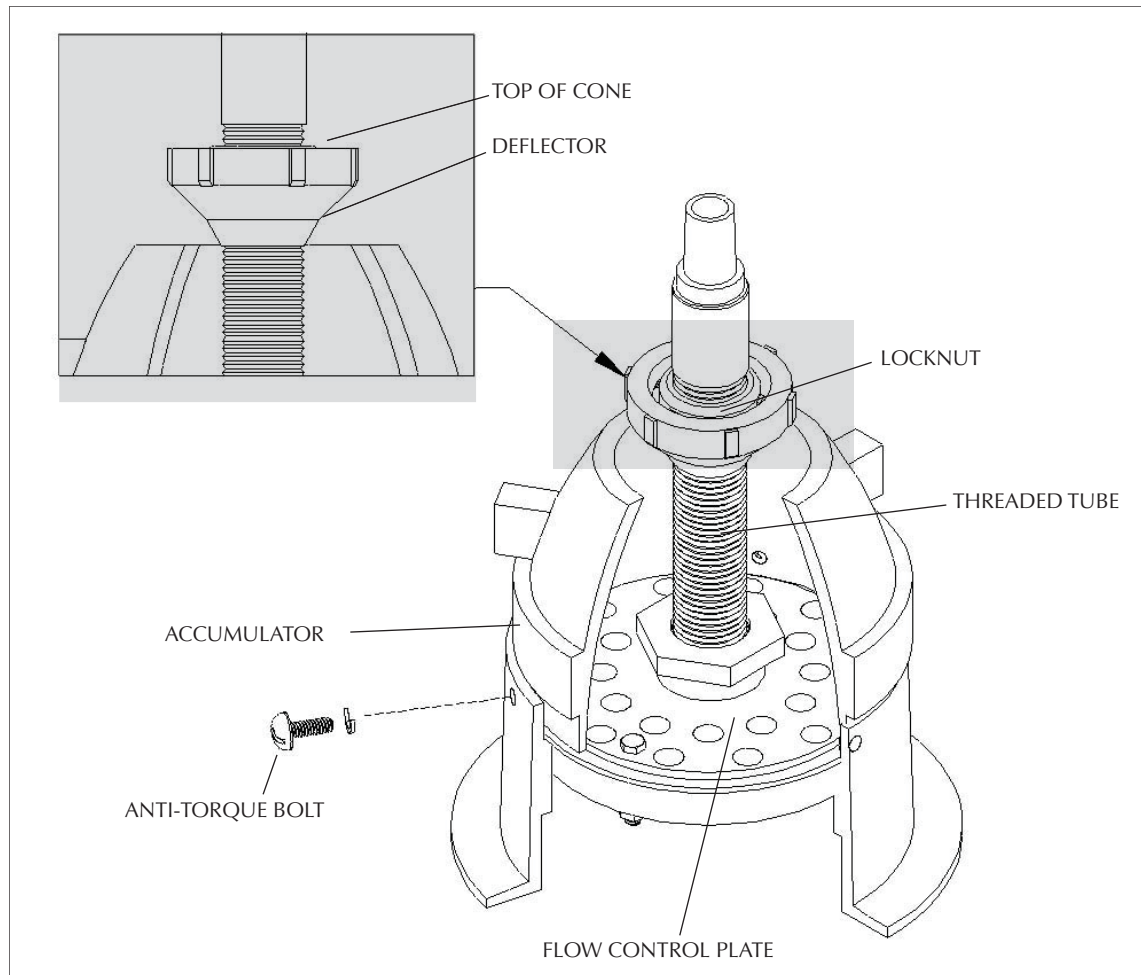
1. Remove the nozzle from its box.
2. Remove the screws with lock washers from the threaded holes in the flat spray plate and the hex head bolts, lock washers and flat washers from the discharge head spoke.
3. Remove the hardware in the center row of holes in the head using a 5/16" wrench on the cap nut. This hardware will not be reused.
4. Tear open the packet of petroleum jelly and apply it generously to the o-ring on the flange of the flat spray plate. Spread it evenly over the o-ring. Never use the petroleum jelly on the electrical quick disconnects.
5. Line up the threaded holes of the discharge head spoke with the center row of holes in the head. Slide the discharge head spoke inside the head and attach with the hex head bolts, lock washers and flat washers removed in step #2.
6. Slide the flange of the flat spray plate into the top of the head. Make sure the threaded holes in the flange of the spray cone are lined up with the holes in the top of the head.
7. Reattach the screws with lock washers removed in step #2.



## NOZZLES

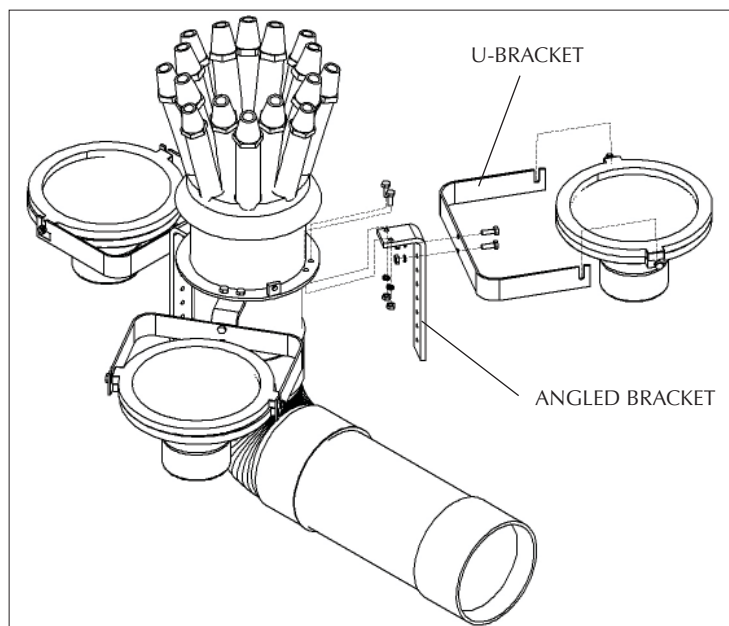
### NOZZLE TYPE 4 – FLARE AND SKY GEYSER

1. Remove the nozzle from its box.
2. Remove the screws with lock washers from the threaded holes in the nozzle.
3. Tear open the packet of petroleum jelly and apply it generously to the o-ring on the flange of the nozzle. Spread it evenly over the o-ring. Never use the petroleum jelly on the electrical quick disconnects.
4. Slide the flange of the nozzle into the top of the head. Make sure the threaded holes in the flange of the nozzle are lined up with the holes in the top of the head.
5. Reattach the hardware removed in step #2.
6. Turn the lock nut counter-clockwise to back it away from the deflector. Unscrew the lock nut to the end of the threads on the tube.
7. Turn the deflector counter clockwise to back it away from the accumulator. Set the deflector so that the bottom of the deflector is flush with the top of the accumulator.
8. Turn the lock nut clockwise until it is locked against the deflector.

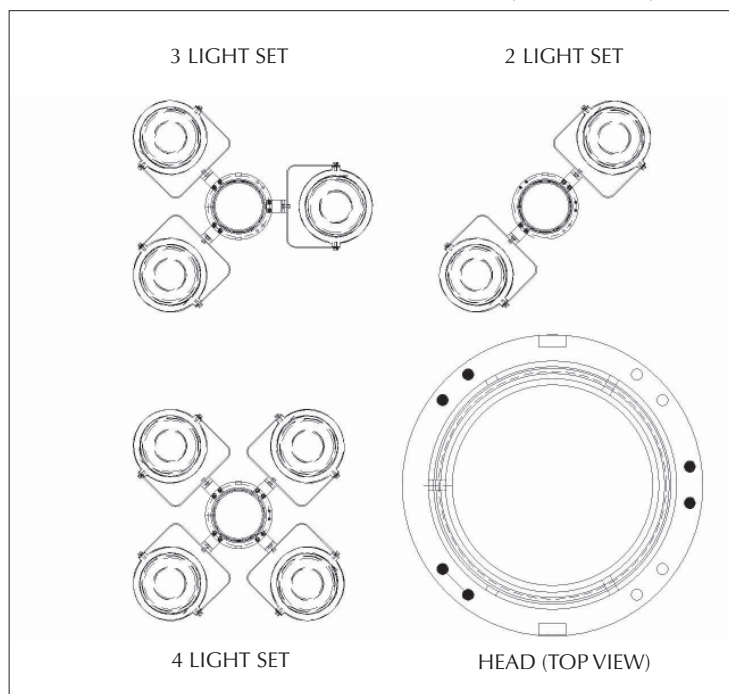


## LIGHT SET ASSEMBLY STATIONARY SERIES FRESHWATER

1. Open the light set box and remove the plastic bag containing brackets and hardware. The package contains (1) one angled bracket, (2) two hex head bolts, (2) two lock washers, and (2) two hex nuts for each light in the set.
2. The number of lights being attached will determine which holes in the head flange will be used. Insert a hex head bolt into each of the head flange holes that will be used.
3. The water depth will determine whether the brackets are attached pointing up or down. The lights must be 2" under the surface of the water at all times. Attach the bracket to the head flange on the bottom side of the head. With the bolts going through the head flange and bracket, place a lock washer on the bolt and thread on a hex nut. Tighten.
4. Take the light canisters with light brackets attached out of the box. Stretch out the light leads to make sure they are not tangled.
5. Loosen the (2) two hex head bolts that attach the light bracket to the light and slide the bracket off the light.
6. Remove the (2) two hex head bolts, (2) two lock washers, and (2) two hex nuts from the light bracket. Use this hardware to attach the light bracket(s) to the angled bracket(s). The slots in the light bracket need to be pointed up towards the top of the unit. The lights must be 2" below the surface of the water when the unit is running.
7. Reattach the light canisters to the light brackets by setting the bolts back into the slots. Retighten the bolts.
8. The unit is ready to be installed after the cord connection(s) have been made.



### LIGHT CONFIGURATIONS (TOPE VIEW)

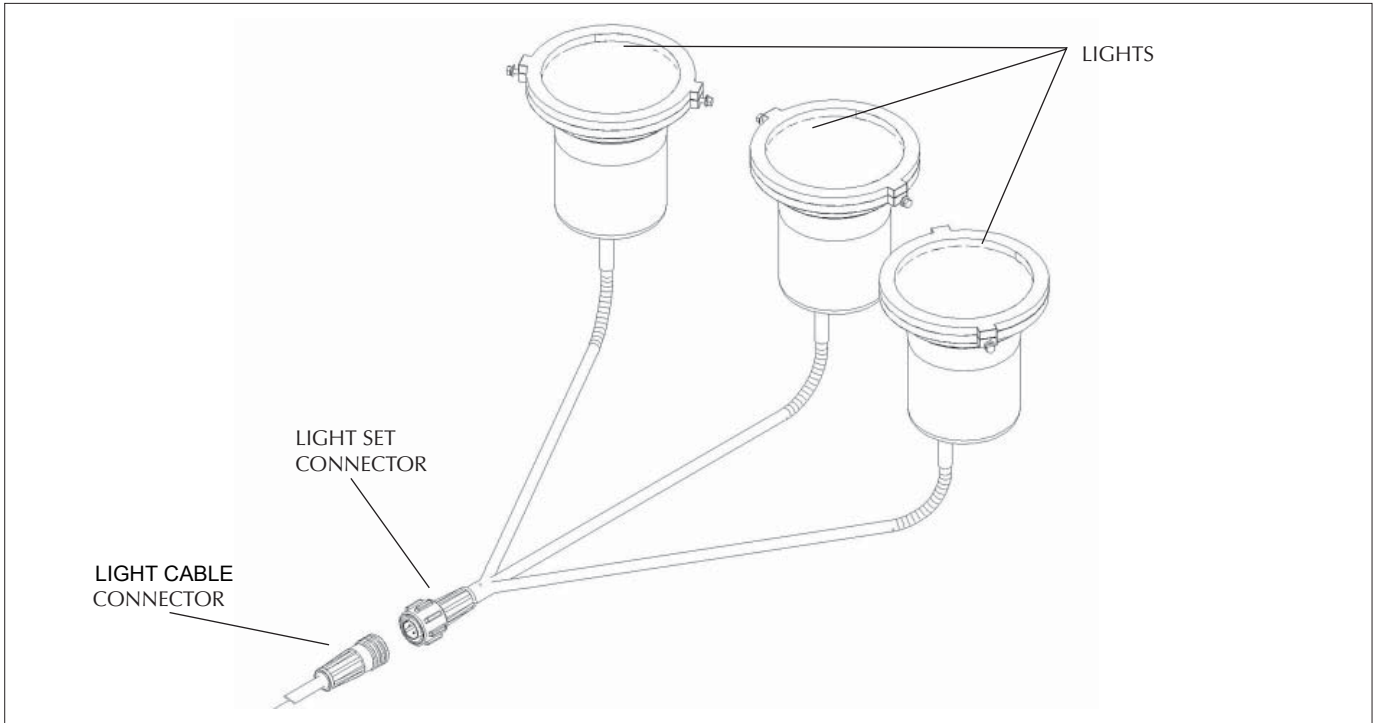


**\*We recommend replacing the gasket when replacing a lens or lamp.**

## LIGHT CABLE ASSEMBLY

### 3-WIRE LIGHT CABLE

One light set will be attached to each quick disconnect. Make sure the quick disconnect is properly aligned with the notches (see picture) in the mating quick disconnect. Firmly push the quick disconnects together. Tighten by holding the quick disconnects and turning the large blue nut on the other quick disconnect. Tighten snugly by hand. No tools are required.



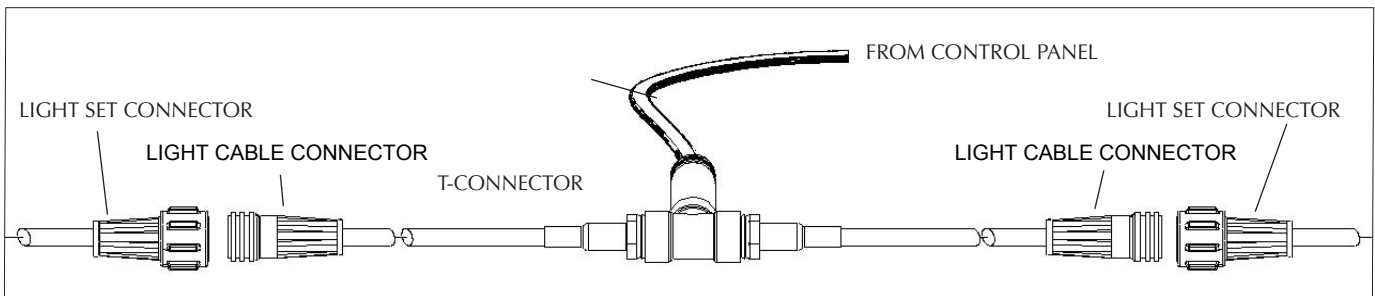
## LIGHT CABLE ASSEMBLY

### 4-WIRE LIGHT CABLE

#### T-CONNECTOR LIGHT CONNECTION

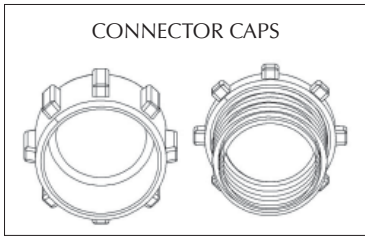
The T-Connector Light cable has (2) tow 3-wire quick disconnects connected to one 4-wire cable. One of the tow quick disconnects coming out of the tee is marked with red tape. That quick disconnect gets its power from the red wire in the 4-wire cable. The one without tape gets its power from the black wire in the 4-wire cable. The two quick disconnects share the ground and neutral line.

One light set will be attached to each quick disconnect. Make sure the quick disconnect is properly aligned with the notches (see picture) in the mating quick disconnect. Firmly push the quick disconnects together. Tighten by holding the quick disconnects and turning the large blue nut on the other quick disconnect. Tighten snugly by hand. No tools are required.



# CONNECTORS

## CONNECTOR CAPS

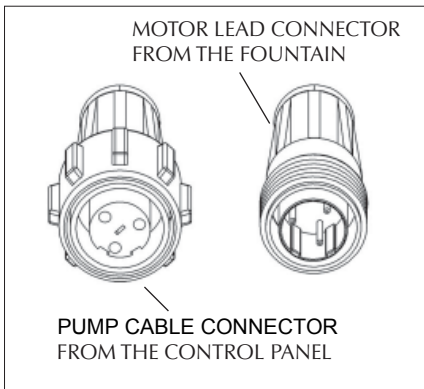


Blue quick disconnect caps are used to protect the quick disconnects during handling and to keep them dry if submerged while unconnected to mating quick disconnects.

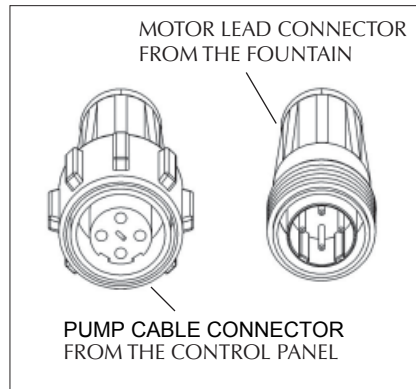
## CONNECTOR IDENTIFICATION

**WARNING:** Do not use grease on connectors. No tools are required for tightening.

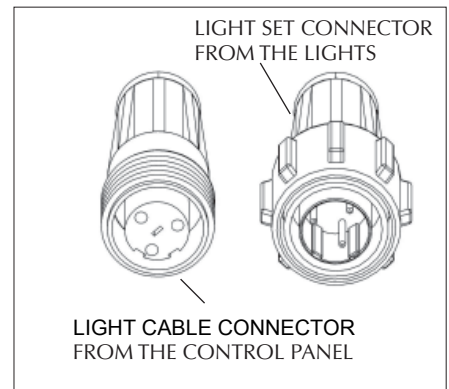
### 3-WIRE PUMP CABLE



### 4-WIRE PUMP CABLE

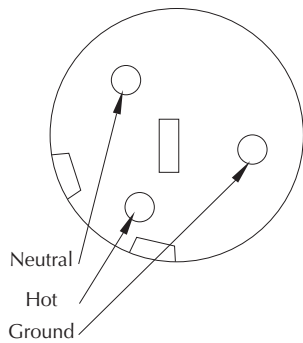


### LIGHT CABLE

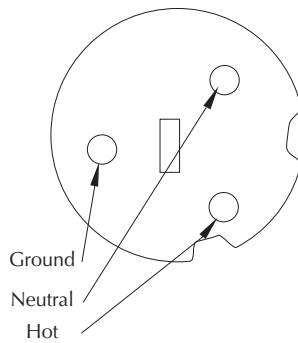


## WIRE IDENTIFICATION

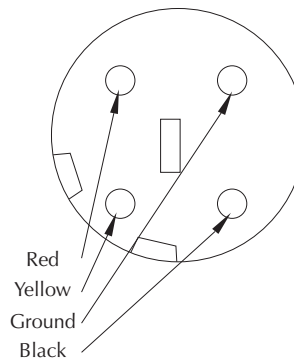
2 Wire with Ground  
Motor Lead Connector  
& Light Set Connector



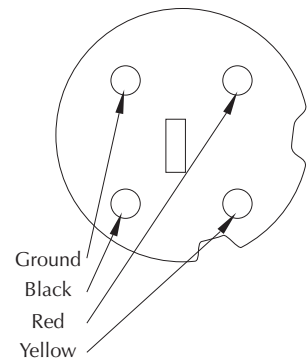
2 Wire with Ground  
Pump Cable Connector  
& Light Cable Connector



3 Wire with Ground  
Motor Lead connector



3 Wire with Ground  
Pump Cable Connector





## INSTALLATION FOR 12V LIGHT SETS

The Aqua Control, Inc. 12VAC Light Sets are shipped without the bulbs installed. These lights require an external transformer to convert the source voltage of 120VAC to the 12VAC required for the lights.

### BULB INSTALLATION OR REPLACEMENT:

**WARNING:** The lighted lamp is HOT! Turn off all power and allow the fixture and lens to cool before replacing the bulb. Bulb installation or replacement must be done with the fixture out of the water. Do not operate the fixture with a missing or damaged lens.

1. Twist the lens cover counter clockwise and remove.
2. Remove the lens.
3. Install the bulb into the socket.

**NOTE:** Use caution when installing the bulb. Hold the bulb by only outer housing. Do not touch the glass lens of the bulb or the inside of the reflector with bare hands. If this happens, clean the bulb with denatured alcohol and lint free cloth.

4. Reassemble the lens and the lens cover to housing. Turn the lens cover clockwise until it snaps into place.

**NOTE:** If the O-Ring comes out during reassembly, lay the O-Ring on the ledge inside the housing below the lens before reassembling. Do not reassemble without O-Ring in place.

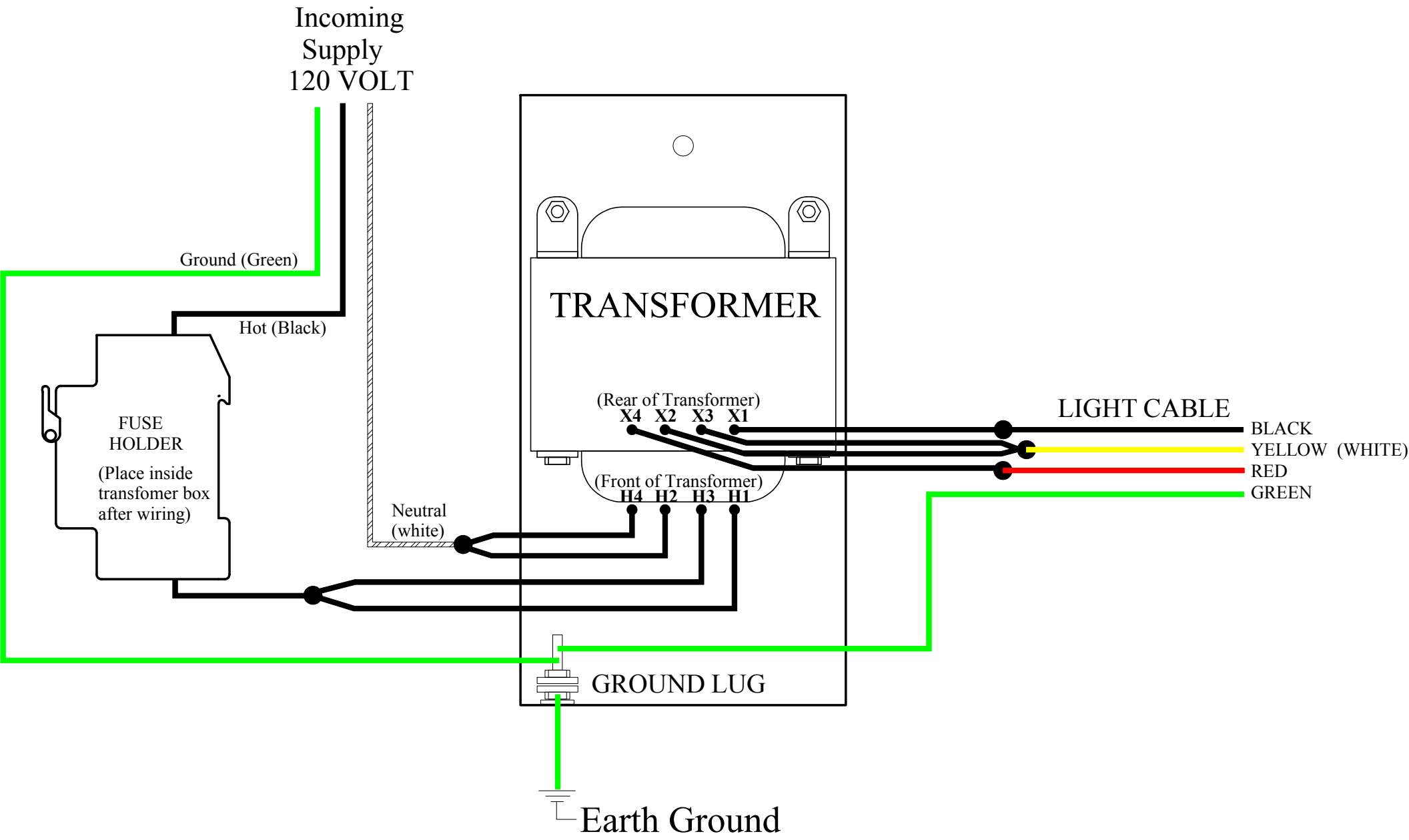
5. Mount the fixtures to the float or head using supplied brackets and hardware. The fixtures could be used in or out of water. The maximum submergence of the fixture is 6 inches below the water surface.

**NOTE:** If sinking the unit for winter storage, remove the light set from the unit before sinking to prevent any water from entering the lights.

### ELECTRICAL INSTALLATION:

A qualified electrician who will follow these instructions and knows the state and local electrical codes should do all electrical installations. The required external transformer is shipped with a 3A fuse and fuse holder installed on the primary (120V AC) side. See attached wiring diagram.

1. Input - 120V AC - from Aqua Control, Inc. Control Panel.
  - a. Hot (120V AC) to fuse holder inside of transformer, which is pre-wired to Transformer H1 and H3.
  - b. Neutral to Transformer H2 and H3.
2. Output - 24/12V AC - to Light Cable.
  - a. Transformer X1 (12V AC) to Black wire on Light Cable.
  - b. Transformer X4 (12V AC) to Red wire on Light Cable.
  - c. Transformer X2 and X3 (COM) to Yellow (White) wire on Light Cable.
3. Grounding - use ground connection in bottom of transformer.
  - a. Ground transformer to Earth.
  - b. Ground incoming 120V AC supply.
  - c. Ground Light Cable using Green wire on Light Cable.



# CONTROL PANELS

## INSTALLATION

Aqua Control Inc. (ACI) is certified to manufacture UL Listed Industrial Control Panels (UL 508A), and all control panels are UL listed except 460V panels or panels built with prior agreement for certain special configurations. Certain special configurations, the 1hp-115V, all 460V and all 575V control panels cannot be UL Listed because of the National Electric Code and UL requirements.

(If an ACI control panel was ordered with your unit, the control panel instruction manual may be found inside the control panel enclosure.)

## LOCATION OF CONTROL PANELS

Control panels should always be installed in a manner that minimizes heat inside the panel since the panels generate some heat and they contain heat sensitive components (motor overloads). Sunlight is the most significant source of heat, so the control panels should be installed out of direct sun as much as possible. The door of the control panel, particularly, should not face south or west unless it is protected from sunlight.

## PRE-START UP

Verify voltage at the rotary disconnect prior to start up. Each outer leg should be 120 volts to Neutral unless you have 460/480 volt 3-phase power. If you have power with a hot leg e.g., 230 volt 3-phase power, that wire should be connected to the center lug of the rotary disconnect.

It is good practice to provide power to the motor for a few seconds prior to installing the unit. This provides an opportunity to verify that a 3-phase motor will spin in the correct, counter-clockwise direction. This also, ensures that all wiring is correct.

## START UP

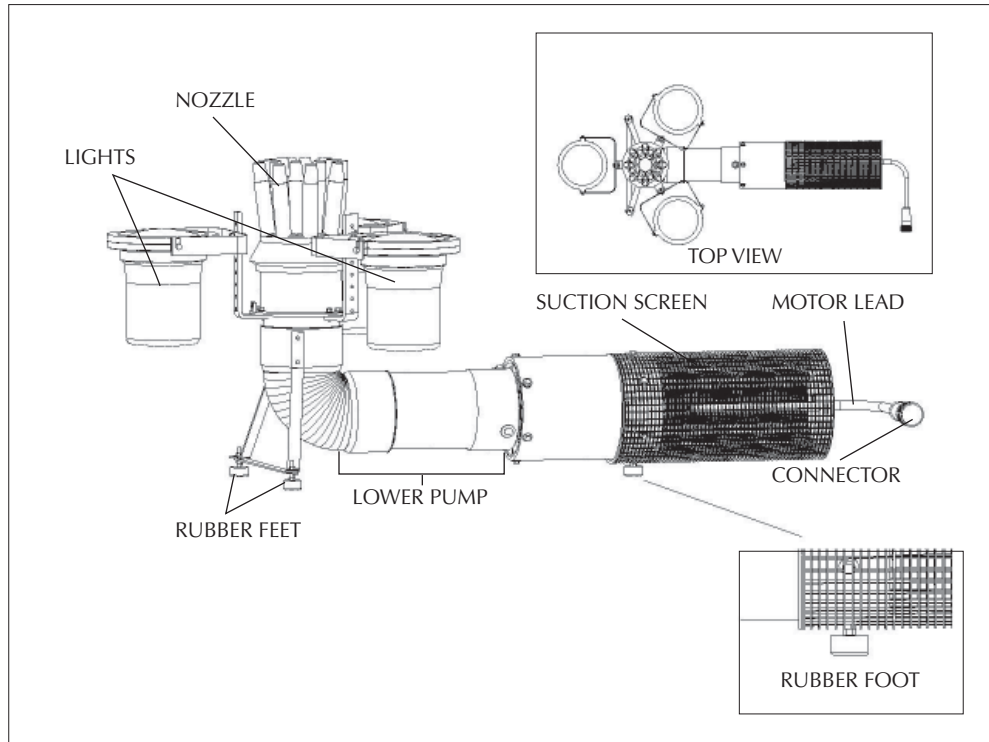
At installation and initial start up, it is recommended to record the actual voltage under load (while the unit is running) and the running amperage of the unit. This can be kept inside the control panel for future reference. This allows for easy determination if something at site or with the installation has changed. The correct voltage and amperage ratings are on the schematic and on the door label of the control panel.

Any Aqua Control, Inc. aerator can be operated continuously or intermittently as desired except during freezing weather. If a less than normal flow is observed, it is imperative that the cause be promptly investigated and corrected. Failure to do so can cause cavitation resulting in pump and motor damage and will void the warranty. Reduced flow will usually be due to a blockage that must be removed.

# INSTALLATION STATIONARY SERIES

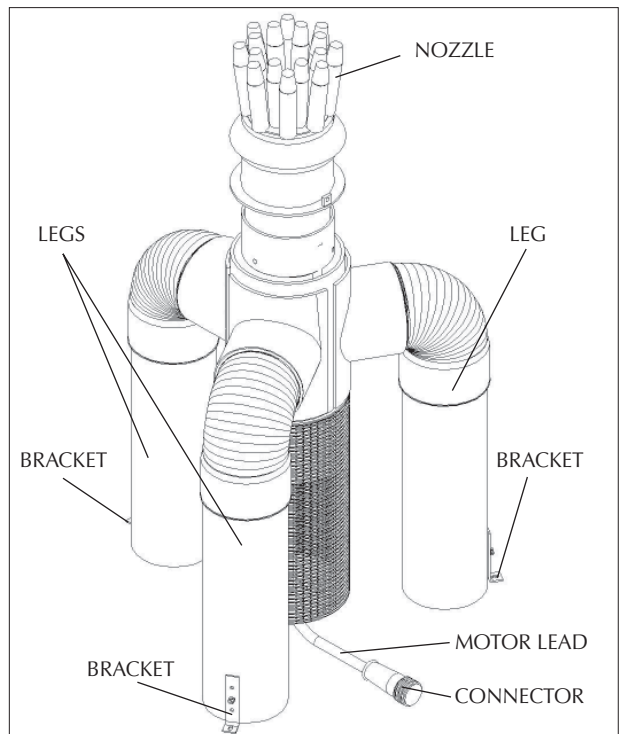
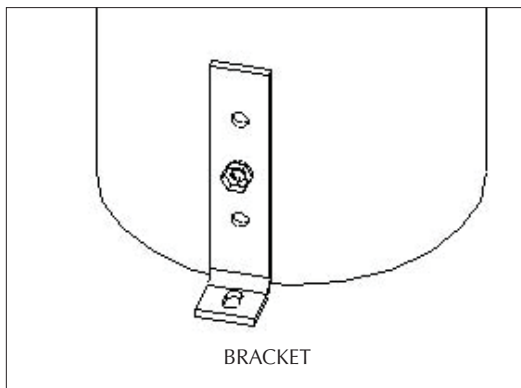
## HORIZONTAL

After assembling the horizontal unit, place the unit on the flat bottom of the bowl.



## VERTICAL

1. Attach the L-bracket to each leg making sure that the bottom bracket is flush with the bottom of the leg tube (as shown).
2. Attach each leg bracket base (3), to a suitable hard surface. Aqua Control, Inc. recommends stainless steel hardware for anchoring the unit to the bottom.



# TROUBLESHOOTING

## GENERAL TROUBLESHOOTING

### 1. Set Up the Multimeter

#### a. Ohms

- i. Know the range of Ohms available for your multimeter and whether your meter is auto-ranging.
- ii. Set the multimeter to the lowest Ohm (resistance) setting. Resistance is designated by Ohms.
- iii. Determine how your multimeter designates open line. Observe the reading when both probes are held in the air, not touching.
- iv. Determine how your multimeter designates continuity. This is done by touching the two probes. This should be either zero or very close to zero. If not zero, this may be resistance internal to the meter and should be subtracted from all subsequent readings. If your meter has an "auto-zero" feature, use it to zero the meter.

#### b. Volts

- i. Set the multimeter to the highest setting
- ii. Select AC volts. This is usually designated by VAC.

#### c. Amps - Use only a clamp ammeter e.g. Amprobe.

### 2. Check Neutral to Ground Voltage

- a. Set multimeter to AC voltage, highest rating.
- b. Check the voltage between Neutral and Ground.
- c. The voltage should be zero.
- d. If the voltage is other than zero, the neutral line may be bad.
- e. A bad neutral may lead to faulty GFCI tripping.

### 3. Check Input Voltages - readings should be within 10% of nominal voltage.

#### a. Single Phase

- i. Each line to Neutral should be approximately  $\frac{1}{2}$  of the input voltage.
- ii. Each line to one another should be the source voltage.

#### b. Three Phase

- i. 208 volt, Y
  1. Each line to Neutral should be 120 volts.
  2. Each line to one another should be source voltage.
- ii. volt, Delta
  1. L1 and L3 to Neutral should be half source voltage.
  2. L2 to Neutral should be substantially higher. This must be the wild leg connection.
- iii. volt / 480 volt grounded.
  1. Each line to Neutral should be approximately 277 volts.
  2. Each line to one another should be source voltage.
- iv. 480 volt Delta
  1. Each line to one another should be source voltage.

#### c. Analysis

- i. If lines read good to Neutral but zero to one another, the same leg is used for both lines. Correct this at the source.
- ii. If the lines read bad to one another or bad to Neutral, the power source or power cord must be corrected
- iii. A three-phase 240 volt delta power source must have the wild leg connected to L2, the center input of the disconnect switch.

### 4. Check Output Voltages

#### a. 2-Wire: T1 - T2

#### b. 1-Phase: Black - Yellow

#### c. 3-Phase: T1 - T2, T1 - T3, T2 - T3

#### d. Analysis

- i. Each reading should give source voltage.
- ii. If good, problem is not in control panel although overloads or GFCIs may be too sensitive and cause premature tripping.
- iii. If zero voltage: backtrack through components, checking input vs. output voltages, to determine which one is tripped or faulty.
- iv. If low voltage: very unlikely, control panel wired incorrectly.

### 5. Check Amps – readings should be within 10% of nominal voltage.

#### a. Single phase – check yellow wire.

#### b. Three phase – check each hot wire; readings should be within 5% of one another.

### 6. If GFCI tripped, perform "GFCI Troubleshooting Procedures"

### 7. If overload tripped, perform "Overload Troubleshooting Procedures"

## GENERAL TROUBLESHOOTING

### CABLE TROUBLESHOOTING

Two problems affect cable integrity, shorted lines and broken or open lines. The following procedures will determine cable integrity. The cable should be disconnected from both the motor and the control panel. Verify the power is off before removing the cable.

1. Set up the multimeter
  - a. Set the multimeter to the lowest Ohm (resistance) setting. Resistance is designated by Ohms.
  - b. Determine how your multimeter designates open line. This is done by observing the reading when both probes are held in the air, not touching.
  - c. Determine how your multimeter designates continuity. This is done by touching the two probes. This should be either zero or very close to zero. If not zero, this may be resistance internal to the meter and should be subtracted from all subsequent readings.
2. Disconnect the cord from the control panel and the load (pump or lights). Both end must be dry. Verify the power is off before removing the cable.
3. Check for shorted lines. A short is an unintentional electrical path and can be caused by faulty insulation.
  - a. Set the multimeter to the highest Ohm (resistance) setting.
  - b. Take readings by touching the probes to each pair of wires; e.g. red-black, red-yellow, black-yellow, etc.
  - c. Analyze the readings.
    - i. The readings should be the same as the open line readings you observed in step 1b.
    - ii. If the readings designate continuity by giving a zero reading or any reading less than open line, a short exists.
    - iii. If any of the readings with green (ground) indicate continuity, a leak to ground exists.
  - d. Determine the action to take
    - i. **Visually inspect the cable.**
    - ii. Any manual connection sites are candidates for inspection, e.g. junction boxes, splices.
    - iii. **It may be impossible to determine the location of the short and a new cable may be the best solutions.**
4. Check for open lines. An open line is a break in a wire.
  - a. Set the multimeter to the lowest Ohm (resistance) setting.
  - b. **At the control panel, with the cable disconnected from the control panel, join two wires, e.g. red and yellow, by wrapping the ends together.** If you have four wires, you may wish to connect the other two together. Note which wires are connected.
  - c. **From the other end of the cable select one of the pairs of joined wires and take readings by touching the probes to each wire or socket of the quick disconnect.**
  - d. Analyze the readings.
    - i. The readings should indicate continuity, (either zero or close to zero). The readings should not exceed a few Ohms.
    - ii. If the readings indicate either open line or a very high number, a break or partial break exists.
    - iii. If a break exists, one or both of the wires tested may be involved.
    - iv. Determine the action to take.
      1. **Visually inspect the cable.**
      2. Any manual connection sites are candidates for inspection, e.g. junction boxes, splices.
      3. **It may be impossible to determine the location of the open line and a new cable may be the best solution.**
  - e. Perform these steps for each combination of wire pairs.

# GENERAL TROUBLESHOOTING

## MOTOR CONTROL BOX (MCB)

1. Test Overloads – perform test for each overload. Verify the power is off before testing.
  - a. Overload identification
    - i. Left overload is “Run” or “Main.”
    - ii. Right overload is “Start.”
  - b. Push red reset button to verify closure. It may be necessary to press these buttons very hard to reset.
  - c. Set ohmmeter to lowest range.
  - d. Test resistance between the two soldered connections on the top of the overload.
  - e. If the resistance is less than 0.5 ohms, the overload is good.
  - f. If the resistance is greater than 0.5 ohms, replace both overloads.
  
2. Check the amps on the red wire from MCB.
  - a. This test requires careful attention. The amp readings may change within seconds.
  - b. Power off the control panel.
  - c. Attach the ammeter to the wire connected to the “RED” terminal of the MCB.
  - d. Power on the control panel.
  - e. If amps do not jump, go to “Test Capacitor” and check “Start” capacitors.
  - f. If amps jump and stay high, go to “Test Relay.”
  - g. If amps jump and return to zero, go to “Test Capacitor” and check “Run” capacitors.
  - h. If amps jump and return to normal “Red” amps (see table below) the MCB is functioning correctly.
  - i. Normal Amp Readings

HP	YELLOW AMPS	BLACK AMPS	RED AMPS
1	10	10	0
2	13	12	3
3	17	13	6
5	28	19	11
7.5	42	41	5
10	51	48	9
15	75	63	17

3. Test Capacitor. Verify the power is off before testing.
  - a. Capacitor Identification – usually “Start” capacitors are large and black and “Run” capacitors are small and silver.
  - b. Set ohmmeter to 20,000 ohms.
  - c. Remove all wires from one terminal of the capacitor.
  - d. Test resistance between the two terminals.
    - i. Resistance should climb towards infinity (open line). If testing the 5HP Start Capacitor, the resistance should climb to 15,000 ohms.
    - ii. If resistance does not climb, switch meter leads.
    - iii. If the resistance still does not climb, replace capacitor.
  - e. If the meter has capacitance checking capability, check the capacitance. See table below.
  - f. Reconnect the leads to the capacitor.

HP	# RUN CAPS	RUN $\mu$ F	# START CAPS	START $\mu$ F
2	1	20	1	105-126
3	1	45	1	208-250
5	2	20/40	1	270-324
7.5	1	45	2	270-324/216-259
10	2	35	2	270-324/350-420
15	3	45	2	350-420

## GENERAL TROUBLESHOOTING

### MOTOR CONTROL BOX (MCB) continued

4. Test Relay. Verify the power is off before testing.
  - a. Test Coil
    - i. Disconnect all wires from terminal 5 (upper right terminal); yellow wire and possibly red if panel has light circuit(s).
    - ii. Set ohmmeter to 10,000 ohms.
    - iii. Check resistance between terminals 2 (center terminal, red) and 5 (where the yellow wire was connected).
    - iv. Readings between 4,500 ohms and 7,000 ohms are good.
    - v. If resistances are out of that range, replace relay.
    - vi. Reconnect the all wires removed from terminal 5 in step i.
  - b. Test Contact
    - i. Disconnect the orange lead from terminal 1.
    - ii. Set ohmmeter to lowest range.
    - iii. Check resistance between terminals 2 (red) and 5 (where the orange wire was connected).
    - iv. If resistance is greater than 1 ohm, replace relay.

## OVERLOAD TROUBLESHOOTING

1. Check motor amps
  - a. Determine "true" amp (yellow) requirement of motor. This is listed on the schematic as "Pump Motor amps," on a decal on the panel door as "Motor FLA" and in the ACI brochures.
  - b. Power on control panel.
  - c. Check all output leads to motor for proper amps.
  - d. If amps are good, go to "Nuisance Tripping."
  - e. If amps are high, continue.

1-PHASE			3-PHASE		
HP	VOLTS	AMPS	HP	VOLTS	AMPS
1/2	115	12	1	208	6
1/2	230	6	1	230	5
1	115	16	1	460	3
1	208	11	2	208	9
1	230	10	2	230	8
2	208	14	2	460	4
2	230	13	3	200	12.5
3	208	20	3	230	10.9
3	230	18	3	460	5.5
5	208	30	5	200	20.5
5	230	28	5	230	17.8
7.5	230	15	5	460	8.9
10	230	51	7.5	200	30.5
15	230	75	7.5	230	26.4
			7.5	460	13.2



# GENERAL TROUBLESHOOTING

## OVERLOAD TROUBLESHOOTING

2. Check line-to-line resistance. Verify the power is off before testing.
  - a. Power off control panel.
  - b. Remove the pump cable connections from the terminal blocks at the bottom of control panel.
  - c. Set the ohmmeter to lowest resistance range.
    - i. Check each pair of pump cable wires, excluding Ground. Readings should be 2 – 20 ohms.
      1. Single Phase 3-wire: Black-Yellow < Red-Yellow < Black-Red.
      2. Single Phase 2-wire: T1-T2.
      3. Three Phase: T1-T2, T1-T3, T2-T3; all readings should be identical.
    - ii. Readings of zero indicate a “Short”; readings greater than 20 ohms indicate an “Open” or partially broken line. Either of these readings indicate a problem.
  - d. If line-to-line readings indicated a problem, it is necessary to isolate the problem.
    - i. Any connection points, e.g. junction boxes, splices, connectors etc., provide a potential problem area. Additionally, animal bites, cuts or scrapes could create a problem.
    - ii. Perform step# 2c at each connection point from the end of the cable at the control panel to the motor lead, until a good reading is found. The problem will be in the previous connection tested. If the final test is at the motor lead, the problem is with either the motor or the motor lead.
  - e. If line-to-line readings are good, continue.
3. Investigate Mechanical Problems
  - a. 70% of overload problems are mechanical e.g. worn or bad bearings, locked rotors, bent motor shafts, or broken shrouds. An improperly pitched prop, missing shims or nozzle problems may cause overloads to trip.
  - b. When thrust bearings are worn, the motor shaft may be pulled 1/8” or more. When radial bearings are worn, the motor shaft may be moved side to side slightly.
4. Nuisance Tripping
  - a. Nuisance tripping can be caused by temporary voltage irregularities e.g. brownouts, spikes.
  - b. Excessive heat, above 122°F may cause overload tripping. A control panel in direct sunlight will heat up and temporarily degrade thermal overloads protection. One possible solution is to remove the cover of the motor control box. Another solution is to cover the control panel with an awning or face the panel North or West.