



Aqua-Hot®

375D



www.aqua-hot.com



INSTALLATION MANUAL

CAUTION:

The Aqua-Hot tank and heating loop operate at 0.0 psi (zero pressure system). Air pressure applied to the tank MUST NOT exceed 20 psi. Excess pressure will result in internal damage.

CAUTION:

Before welding or plasma cutting on any coach; it is necessary to disconnect the electric wiring to the Aqua-Hot System.

Failure to disconnect the wires from the Aqua-Hot System before using a welder or a plasma cutter on the coach may cause damage to the Aqua-Hot.

Aqua-Hot 375-D Installation Manual

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The Aqua-Hot 375D is a hydronic (water based) heating system, and a tank-less hot water system.

The heating system provides moist, quiet, comfortable, interior heat with up to three separate, thermostatically-controlled temperature zones, and prevents tank and line freezing in the bays. The tank-less hot water system produces 90 gallons per hour of continuous, on-demand hot water.

This TribridHot™ designated system uses one or a combination of heat sources to heat FDA-approved Generally Recognized as Safe (GRAS) propylene glycol based antifreeze solution in the Aqua-Hot's boiler tank. The 375D features a 120 Volt-AC, 1500 Watt electric element, and a 12 Volt-DC powered diesel burner.

When AC power is available, plug in. When dry camping, use the diesel fuel source. The electric power and diesel fuel sources can be used separately or together.



New Low Emissions Technology virtually eliminates smoke and smell from the exhaust by reducing total hydrocarbon emission by 82% making Aqua-Hot the cleanest burning diesel powered hydronic system available.

This Installation Manual is designed to aid in the installation process of the Aqua-Hot 375-D Hydronic Heating System by a trained and experienced technician.

Please note that all Danger, Warning, Caution, and Note boxes, appearing as needed throughout this manual, must be reviewed and adhered to during the installation procedure in order to avoid potential hazards, which could result in injury, death, product damage, or property damage.

Should additional assistance be needed, please contact Aqua-Hot Heating Systems at 1-800-685-4298, Monday through Friday, between the hours of 7:00 AM and 4:00 PM Mountain Standard Time.

Danger, Warning, Caution, and Note Boxes:

Danger, Warning, Caution, and Note boxes appear throughout this manual as a means of alerting the installer to important information.

▲ DANGER ▲

INDICATES THAT PERSONAL INJURY IS LIKELY OR IMMINENT.

WARNING!

Indicates that serious damage to the heater will occur and personal injury is possible as well.

CAUTION

Indicates that damage to the heater is possible.

NOTE: Indicates information that requires special attention by the installer.

Figure 1



Diesel Burner, Heat Input (Firing Rate)	59,000 BTU/hr
Diesel Burner, Fuel Consumption (Continuous Operation).....	0.40 gal/hr
Heater, Voltage/Maximum Power Consumption	12 Volt-DC/245 watts
Electric Heating Element specifications	120 Volt-AC/1500 watts
Zone Heat Circulation Pump specifications	(2) 12 Volt-DC/21 watts each
Number of Heating Zones	Maximum of 2, plus Bay Heat Exchanger
Domestic Water Heating Capacity	Continuous/On-Demand
Dimensions	16.75”H x 18”W x 29.5”L
Dry Weight.....	approximately 155 lbs.
Wet Weight.....	approximately 200 lbs.

NOTE: All vehicle installations must comply with the requirements listed in the Recreational Vehicle Industry Association’s (RVIA) ANSI/NFPA 1192 Handbook for Recreational Vehicle Standards. To receive a copy of this handbook and other pertinent RVIA Standards, write to: Recreation Vehicle Industry Association, 1896 Preston White Drive, P.O. Box 2999, Reston, VA 22090-0999, call them at (703) 620-6003, or visit them online at www.rvia.org.

SECTION 1: AQUA-HOT HYDRONIC HEATING SYSTEM

Each Aqua-Hot heating system possesses an I.D. label on the unit itself. This I.D. label details the specifications of the

heater, to what standard it has been tested, and important safety notices.



Aqua-Hot®

HYDRONIC HEATING SYSTEM

For installation only in a compartment that is completely closed off from living quarters and accessible only from the outdoors.

The Exhaust System **MUST NOT** terminate beneath the vehicle or under an openable window or vent.
Combustion Air **MUST BE** supplied from outside the vehicle.

 CAUTION: THIS APPLIANCE OPERATES ON BOTH AC AND DC POWER.

USE COPPER CONDUCTORS ONLY!

Use a 30-Amp fuse for over-current protection for the DC power supply.

Use a circuit breaker that cuts power at 20-Amps maximum for over-current protection for the 120-VAC power supply.

Mount the Heater near a bay/storage door so that the Access Cover can be easily removed for service.

 WARNING: DO NOT OPERATE APPLIANCE WITH ACCESS COVERS REMOVED.

Minimum Heater Clearances:
 Front - Open Access
 Back - **1 Inch**
 Top - **6 Inches**
 Sides - **1 Inch**

Install in strict compliance with local codes, NFPA 1192, and the manufacturer's instructions.



3069328

Certified for use in a Recreational Vehicle ONLY!

Direct Vent Appliance

0 PSI	245	1500
Maximum Tank Pressure	Watts (DC)	Watts (AC)
.35 / 60	12 VDC	120 VAC, 50/60 Hz
Nozzle Size/Angle	Volts	Volts
59,000 BTU / 17.3 kWh	145 PSI / 10.0 bar	
Input Firing Rate	Pump Pressure	
AH-5000		DIESEL
Diesel-Burner Model Number	Diesel-Burner Serial Number	Fuel Type
AHE-375 — 		
Model Number	Serial Number	Manufactured Date

15549 East Highway 52 • Fort Lupton, CO 80621 • 1.800.685.4298 • www.aqua-hot.com

Figure 2

CAUTION:
 The Aqua-Hot tank and heating loop operate at 0.0 psi (zero pressure system). Air pressure applied to the tank **MUST NOT** exceed 20 psi. Excess pressure will result in internal damage.

Figure 3

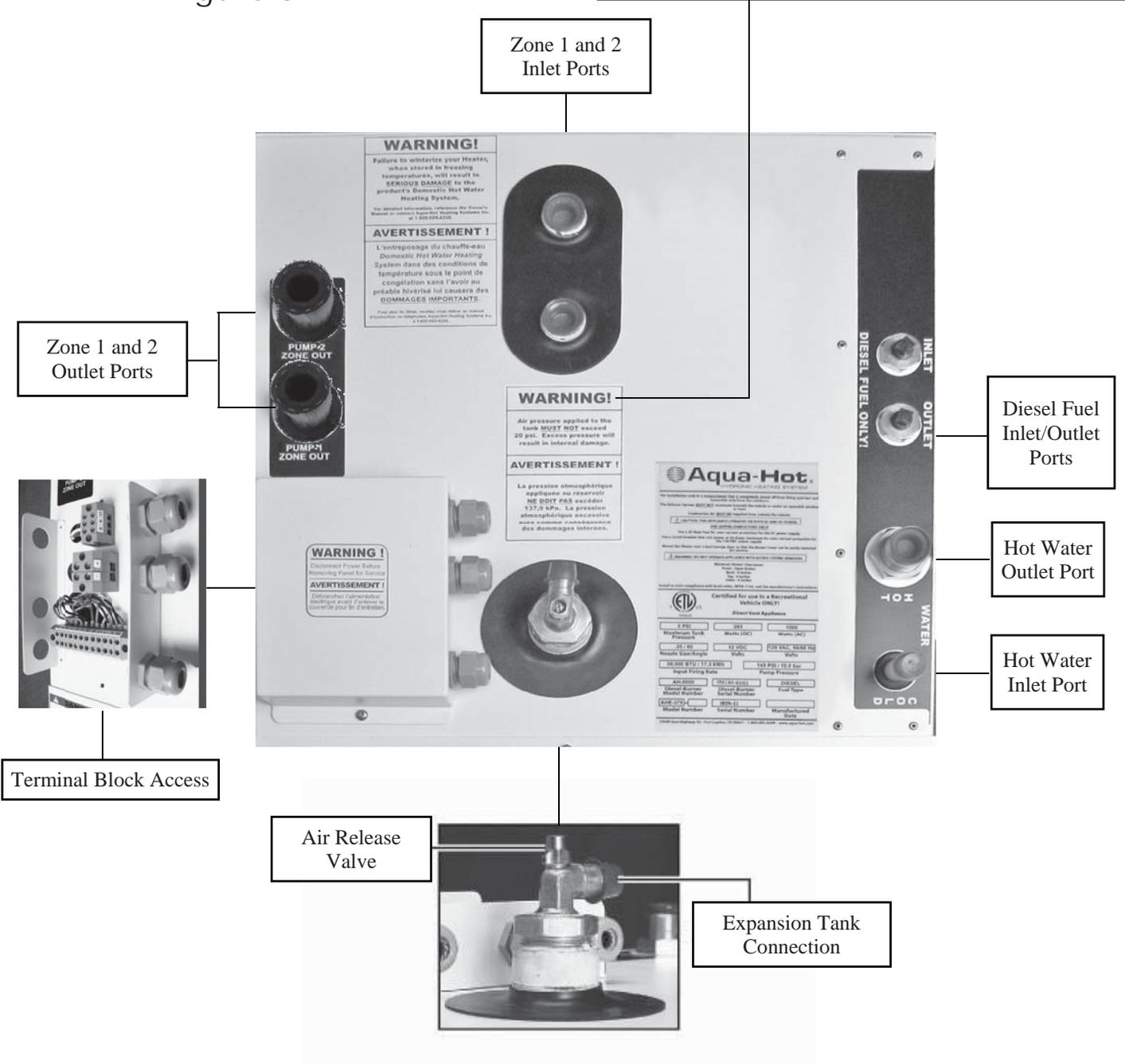
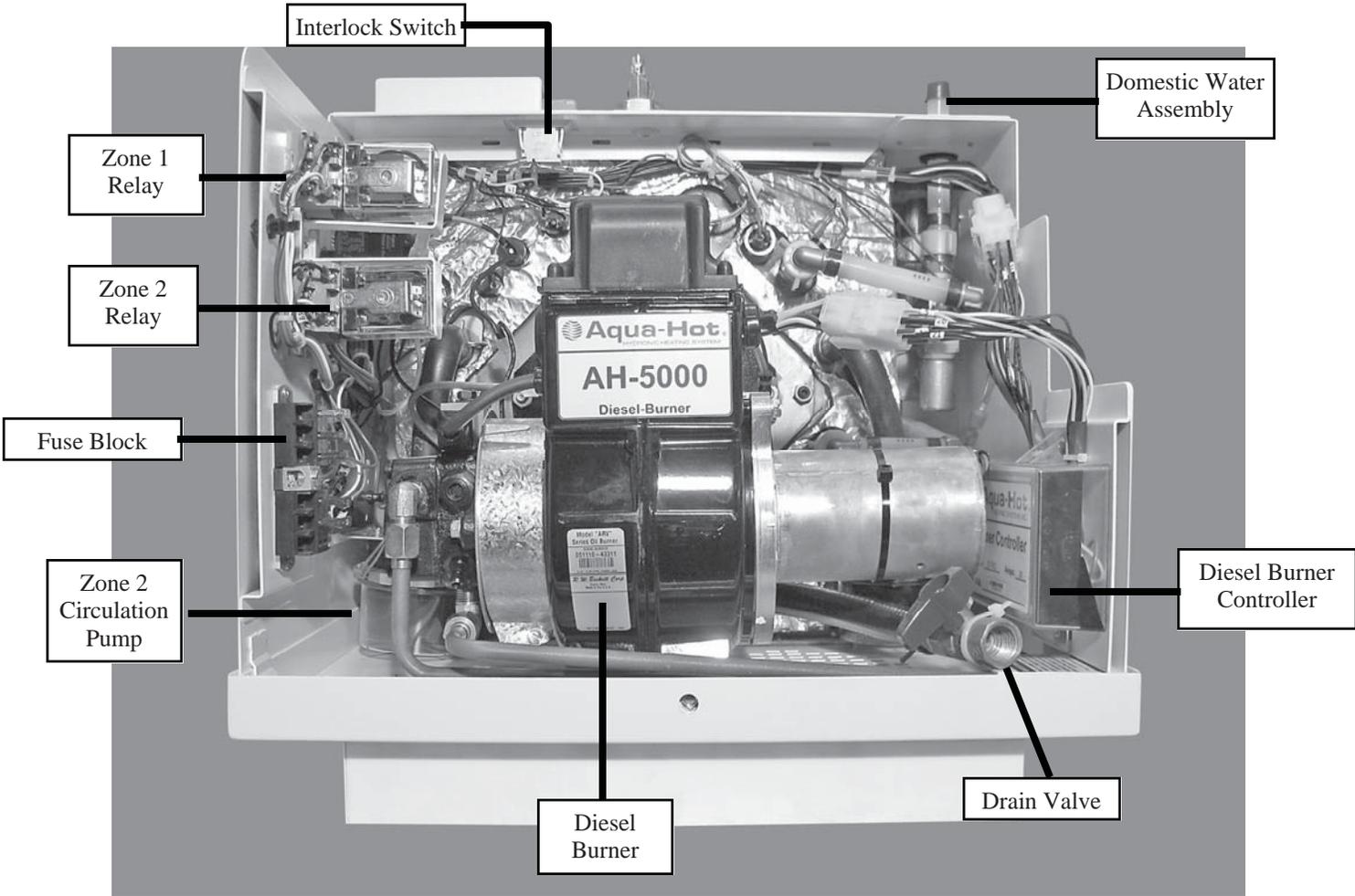


Figure 4



Installing the Mounting Tray and the Aqua-Hot:

The Aqua-Hot must be installed in a compartment that is completely closed-off from living quarters and accessible only from the outdoors.

NOTE: Be sure to complete the following when installing the Aqua-Hot:

Inspect the area beneath the mounting location to insure that no structural members will interfere with the cut-out for the mounting tray.

Verify that an adequate support system has been provided for the Aqua-Hot.

Secure the mounting tray into place prior to installing the Aqua-Hot.

Remove the access cover fastener from the Aqua-Hot prior to installation of the Aqua-Hot into the mounting tray.

Mount the Aqua-Hot securely into the mounting tray to ensure that the unit does not move or shift under normal operating conditions.

1. Reference the following illustrations for mounting information:
 - Overall Aqua-Hot dimensions - Figure 8
 - Mounting tray information - Figure 7
 - I.D. Label noting the "Open Access" clearance requirement for the front of the heater - Figure 2
 - Service access clearances - Figure 5
2. Cut out the required mounting tray opening. Reference Figure 7.
3. Install the mounting tray flange into the cut-out opening. Reference Figure 6.
4. Insert a #10 machine screw into each of the embossed holes in the mounting tray (total of six required) and tighten to secure the mounting tray to the motorhome.

NOTE: Remove the bolt securing the front of the access cover to the mounting tray; this bolt will need to be re-installed once the total installation procedure is complete. Remove the access cover.

Figure 5

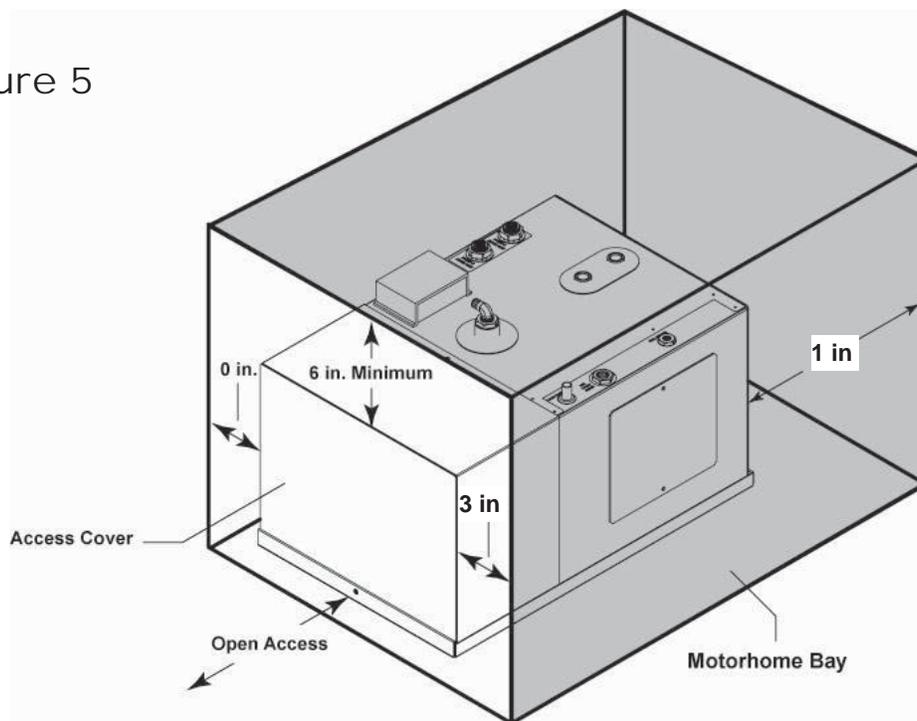
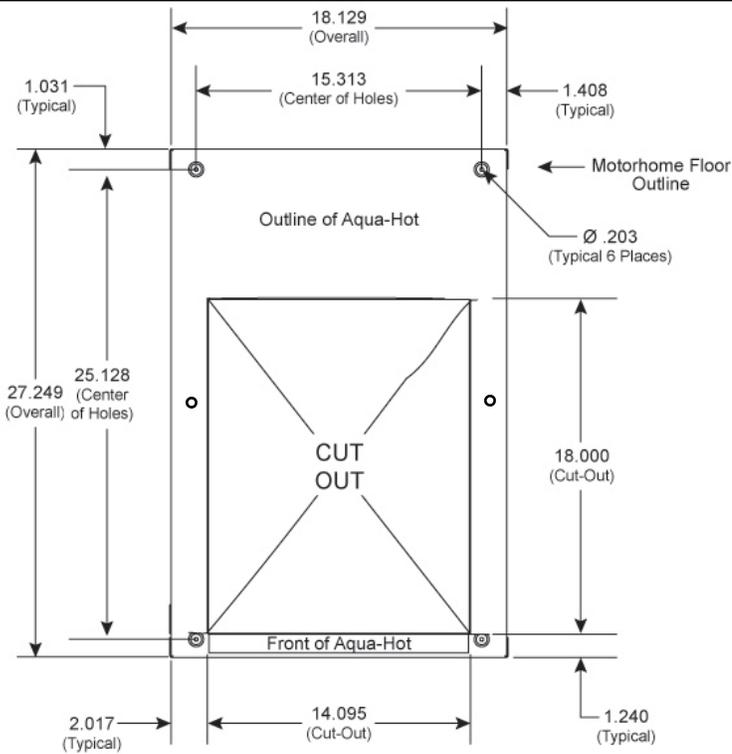


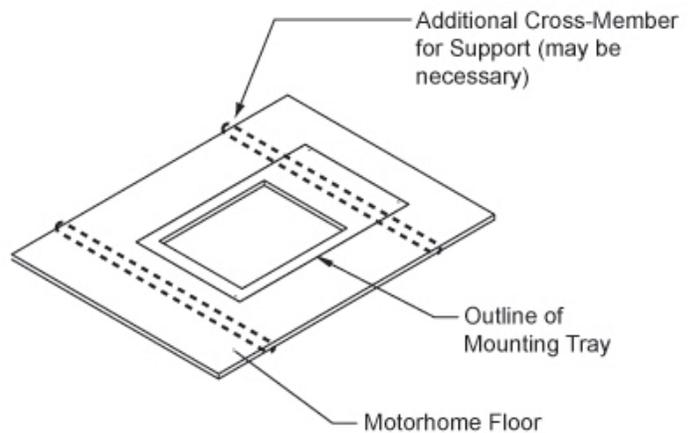
Figure 6

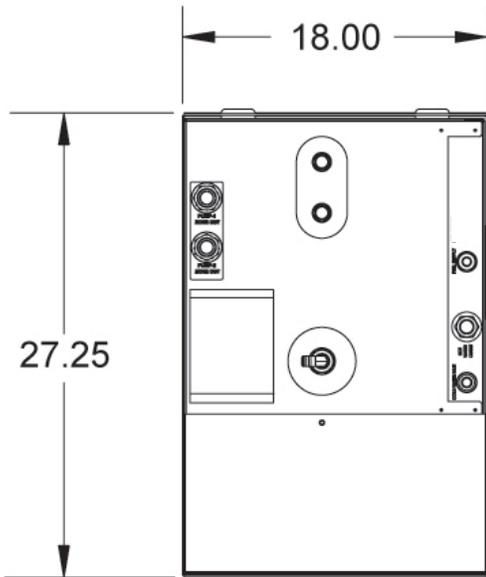
Underside of Mounting Tray



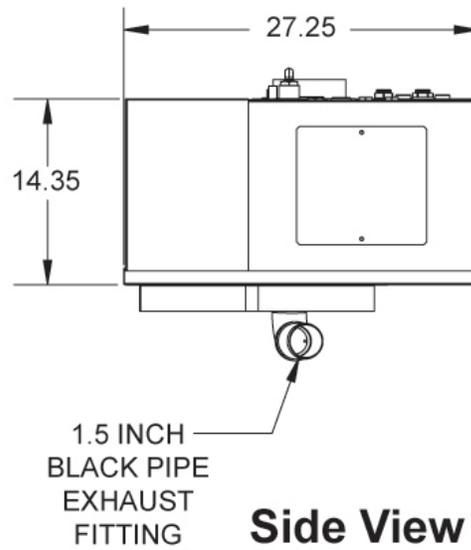
NOTE: All measurements are in inches

Figure 7



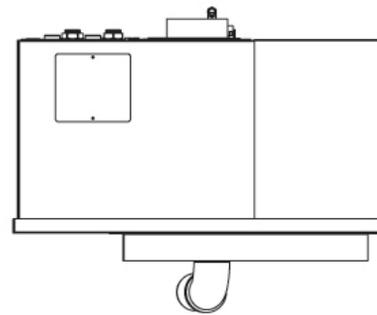


Top View

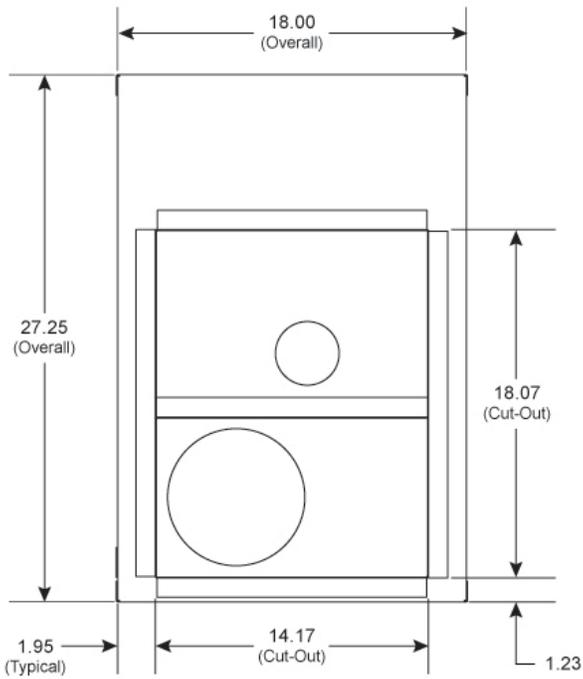


Side View

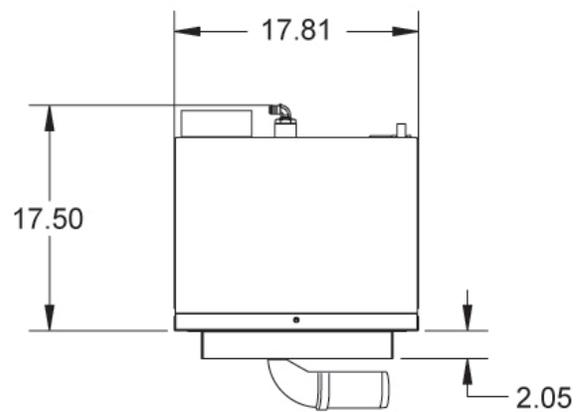
Figure 8



Side View



Bottom View



Front View

NOTE: All measurements are in inches.

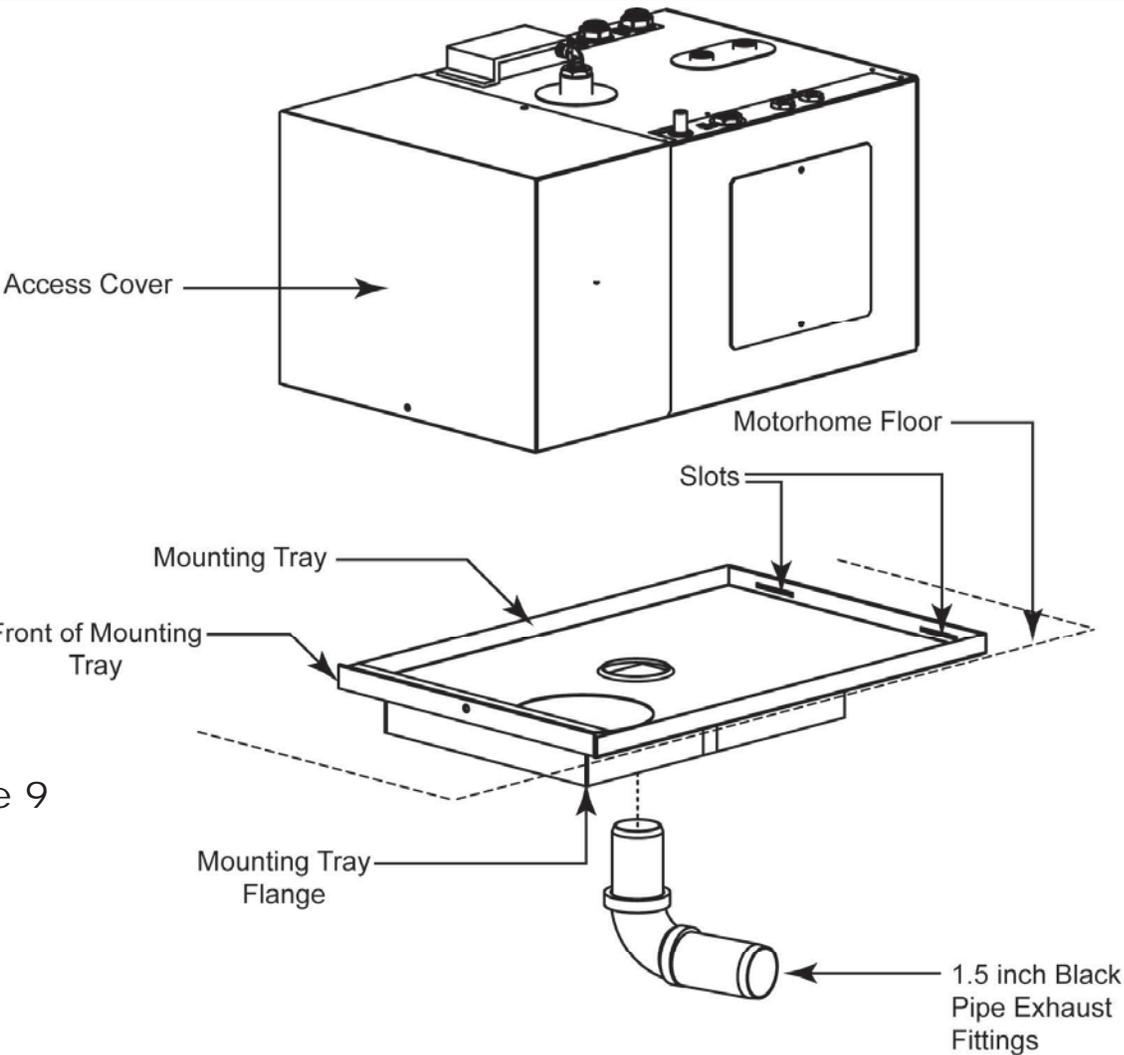
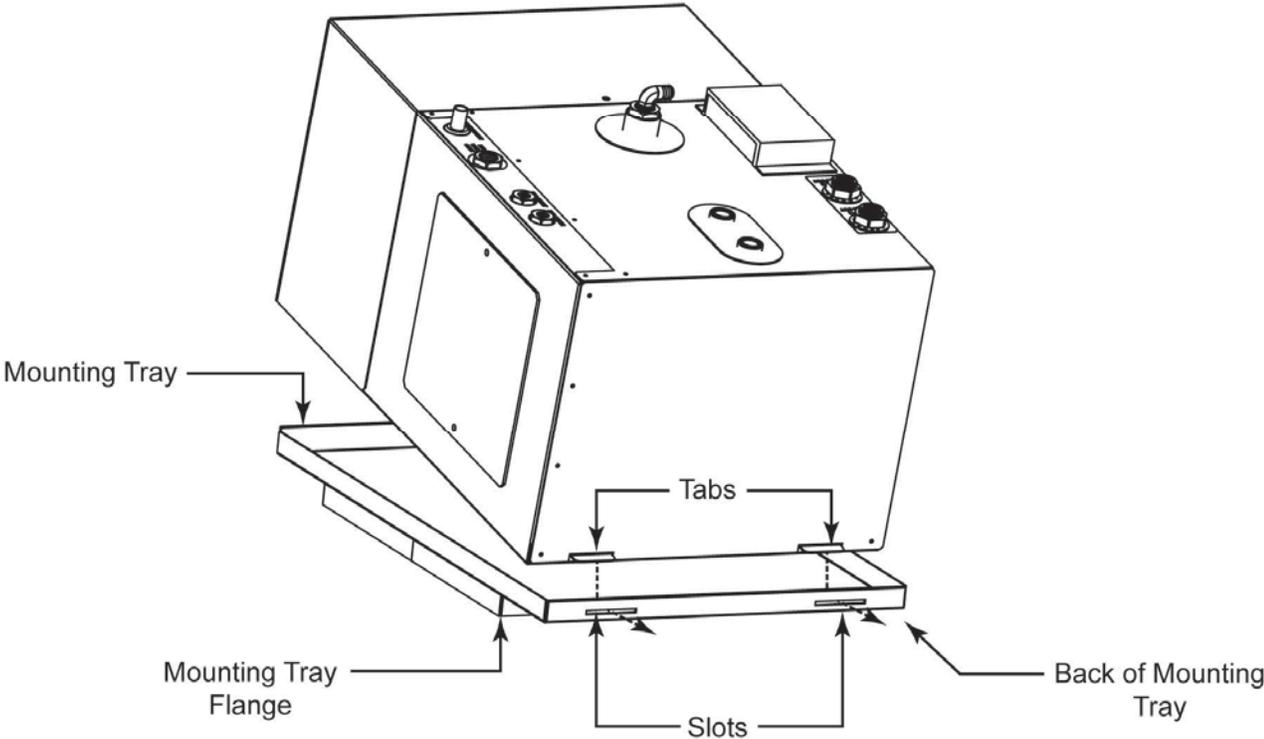


Figure 9



SECTION 2: AQUA-HOT INSTALLATION

Installing the Cable-Clamp Fittings:

Cable-clamp fittings can be installed on either side of the terminal access area

1. Determine the port side best suited for the current application. Reference Figures 10 and 11.
2. Remove the terminal block access cover and set aside in a location where it will not become damaged or scratched.
3. For each cable-clamp fitting, remove the nut from the fitting, insert the fitting into the port with the wire-entry side facing away from the terminal block access area, screw the nut onto the fitting, and hand-tighten. Reference Figures 10 and 11.

Installing the Wires into the Terminal Blocks

NOTE: It is recommended that the wire numbers in Appendix A be used when installing the Aqua-Hot in order to assist with differentiating between the separate heating zones and to aid service personnel with troubleshooting.

1. Loosen the cable clamps on the installed cable-clamp fittings. Reference Figure 11.
2. Insert the wires into the terminal block access area through the appropriate port's cable clamp fitting and into the proper terminal.
3. Secure the wires into their terminals by tightening the corresponding screw on the terminal block. Tighten terminal screws to 5 inch pounds using a slotted blade no wider than 1/8".
4. Hand tighten the cable clamps on each of the cable-clamp fittings.
5. Re-install the terminal block access cover and tighten the screws securing the cover to the Aqua-Hot.

NOTE: A ferrule is required if stranded wire is being used to connect to the terminal block

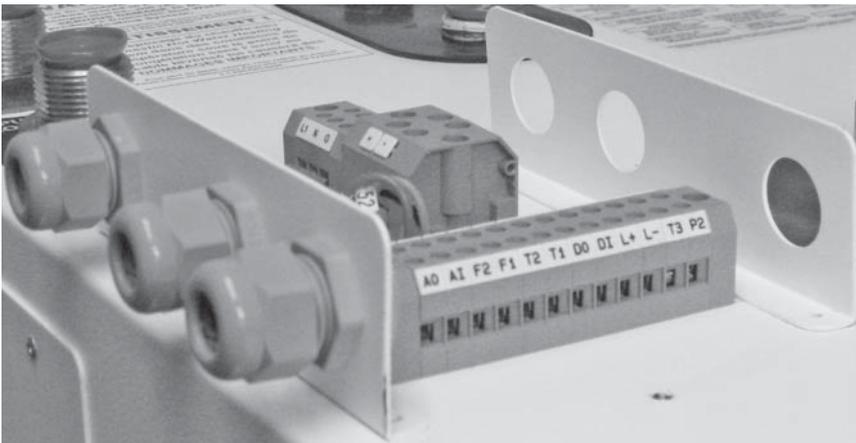


Figure 10



Figure 11

Installing the Expansion Tank:

Select a mounting location that allows for easy access and clear visibility whenever the particular storage bay door is open.

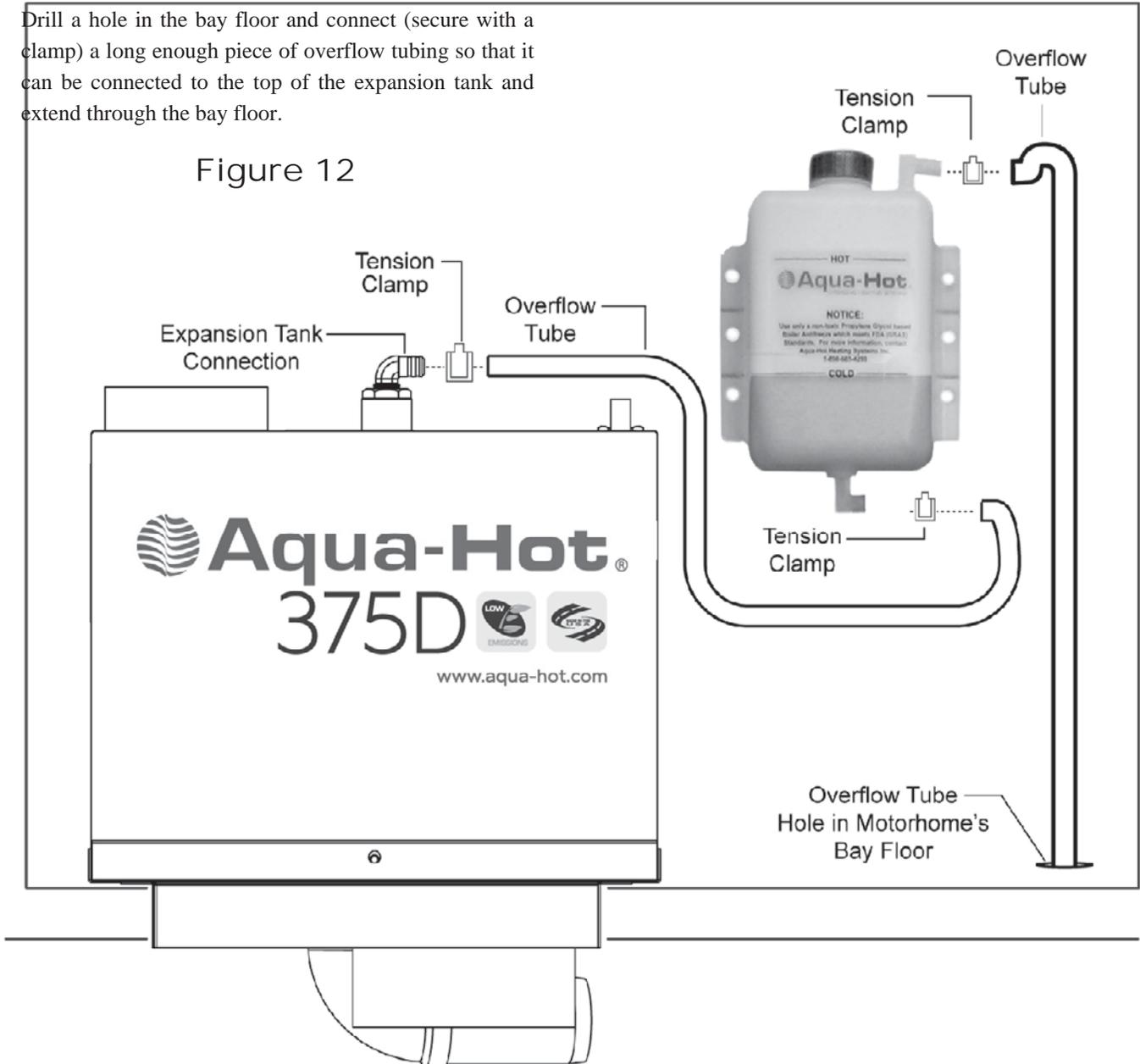
NOTE: Avoid dips and bends in the overflow tubing from the Aqua-Hot to the expansion tank as air can become trapped in these dips and bends, preventing the expansion of the heating solution from properly depositing in the expansion tank.

NOTE: The top of the expansion tank should always be mounted at least four inches higher than the highest point on the Aqua-Hot's boiler tank.

CAUTION:
The Aqua-Hot tank and heating loop operate at 0.0 psi (zero pressure system). Air pressure applied to the tank MUST NOT exceed 20 psi. Excess pressure will result in internal damage.

1. Mount the expansion tank as illustrated in Figure 12.
2. Connect and clamp the overflow tubing from the expansion tank to the Aqua-Hot's expansion tank connection. Reference Figure 12.
3. Drill a hole in the bay floor and connect (secure with a clamp) a long enough piece of overflow tubing so that it can be connected to the top of the expansion tank and extend through the bay floor.

Figure 12



SECTION 3: HYDRONIC HEATING SYSTEM

Heat Exchanger Locations and Clearances:

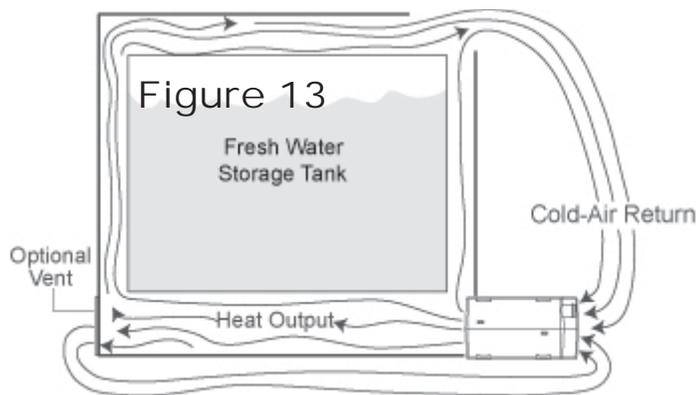
- Place the heat exchangers so that even heat distribution will be felt throughout the interior of the motorhome. Reference Figure 15.

NOTE: For single slide-out configurations, it is usually simplest to place a heat exchanger on the opposite side of the motorhome pointing towards the slide-out.

- Place the heat exchangers where they will be accessible for potential servicing and cleaning.
- Centralize and position a heat exchanger in the fresh water storage tank plumbing bay. Reference Figure 13.

NOTE: In order to achieve the best heating results, place the heat exchanger as close to the floor of the plumbing bay as possible (heat will naturally rise).

- Reference Figures 14, 15, 16, and 19 for mounting location information.
- Reference Figure 14 for clearance information.



NOTE: An accessory device is available for the Cozy Heat Exchanger for the purpose of redirecting the airflow from the heat exchanger. Reference Figures 17 and 18.

Mounting Requirements:

- Sufficient ventilation (return-air) must be supplied to each interior heat exchanger. Reference Figures 15 and 16.

NOTE: Mounting the heat exchangers without sufficient ventilation will severely reduce their overall heating performance (heat output).

In order to provide sufficient ventilation, the return-air registers must be the same size, or larger, than the outlet-air registers.

Return-air must be supplied from the corresponding interior heating zones.

Figure 14

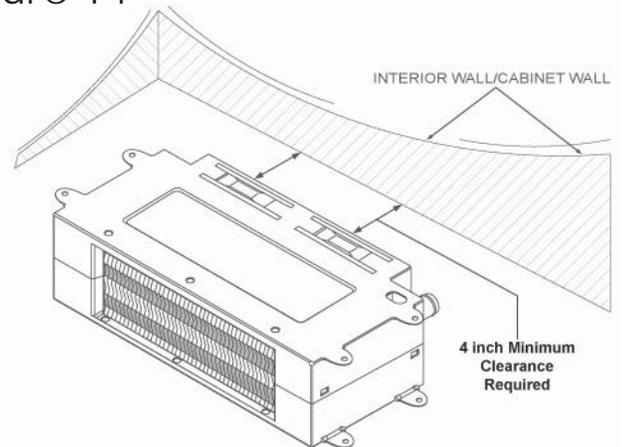
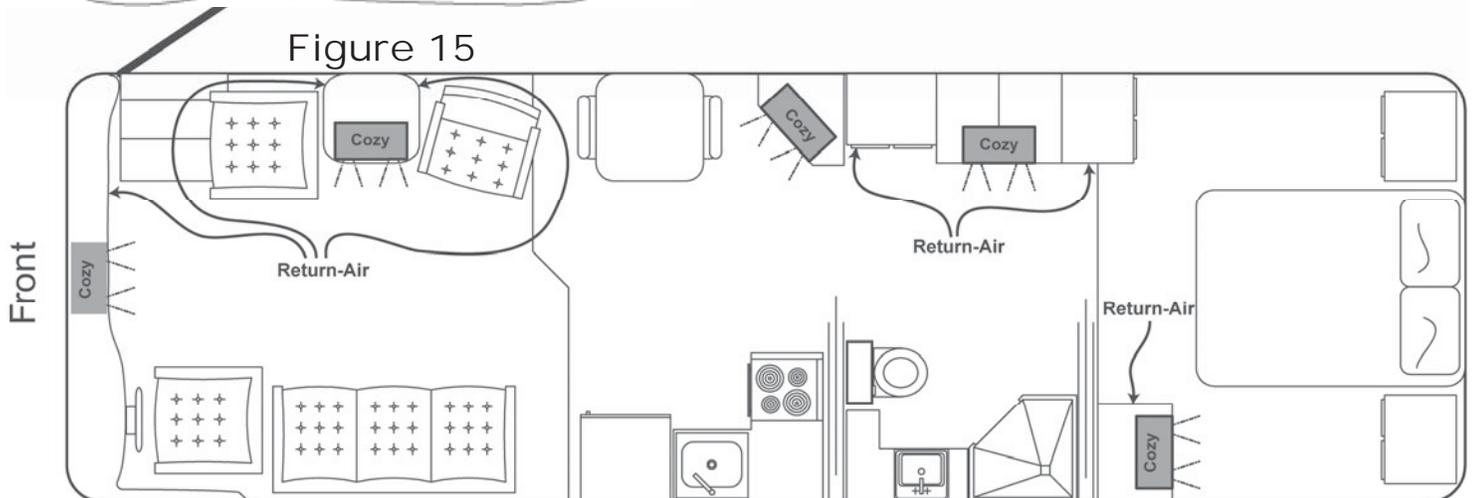


Figure 15



Indicates sample mounting locations for the Cozy heat exchangers. Actual placement and quantity vary based on the individual design of the coach. For specific design assistance, contact Aqua-Hot at 303-659-8221

Mounting the Heat Exchangers:

1. Cut out a 2.5 inch H x 10 inch W opening for each heat exchanger outlet and cold-air return register. Reference Figure 21.
2. Mount each heat exchanger permanently into place.
3. Install the hot-air outlet and cold-air return registers. Reference Figure 16.

NOTE: Please note that a return-air register may not be required; however, adequate return-air must be provided to each particular heat exchanger. This means that the total cross-sectional area of the return-air opening must be equal to or greater than the cross-sectional area of the hot-air outlet opening of the heat exchanger.

Figure 16

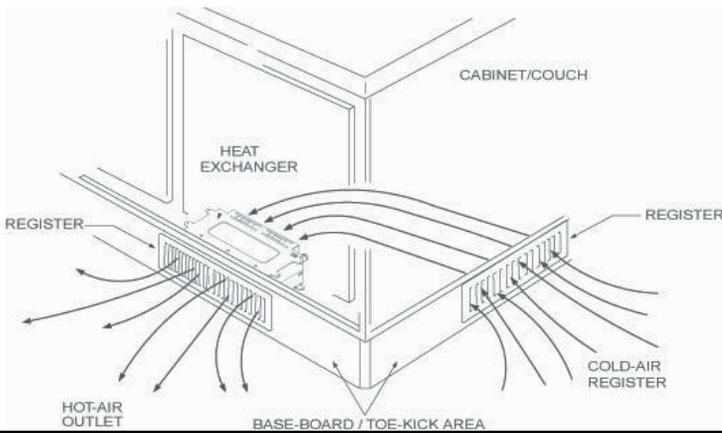
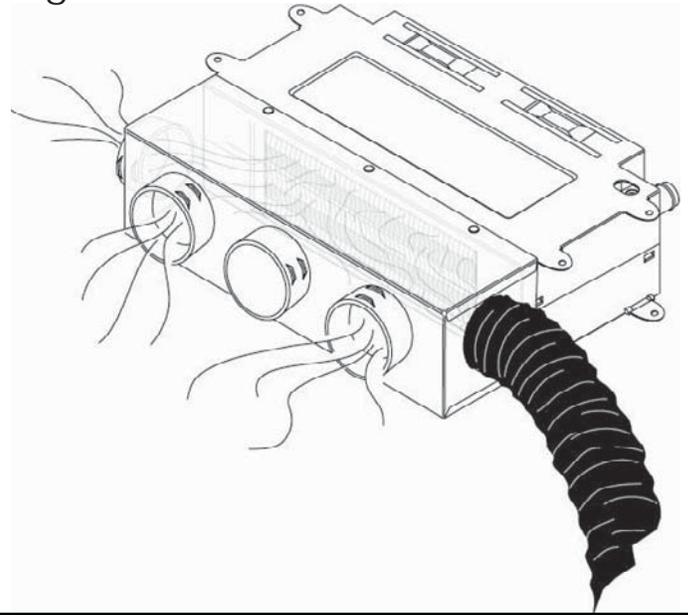


Figure 17



If the toe-kick areas in the motorhome are inadequate to house a heat exchanger for regular installation, a plenum may be used on the heat exchanger, which can be used with a

smaller vent as seen in Figure 18. The plenum allows only the desired outlets to be opened by removing the metal insert on the vent.

Figure 18

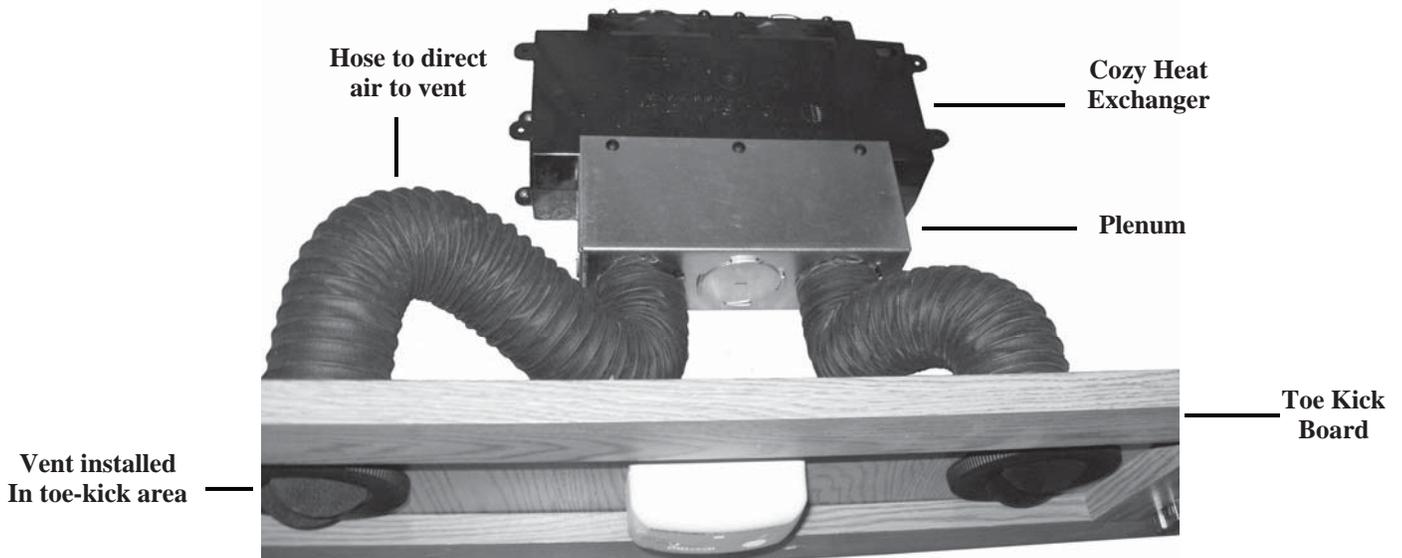


Figure 20

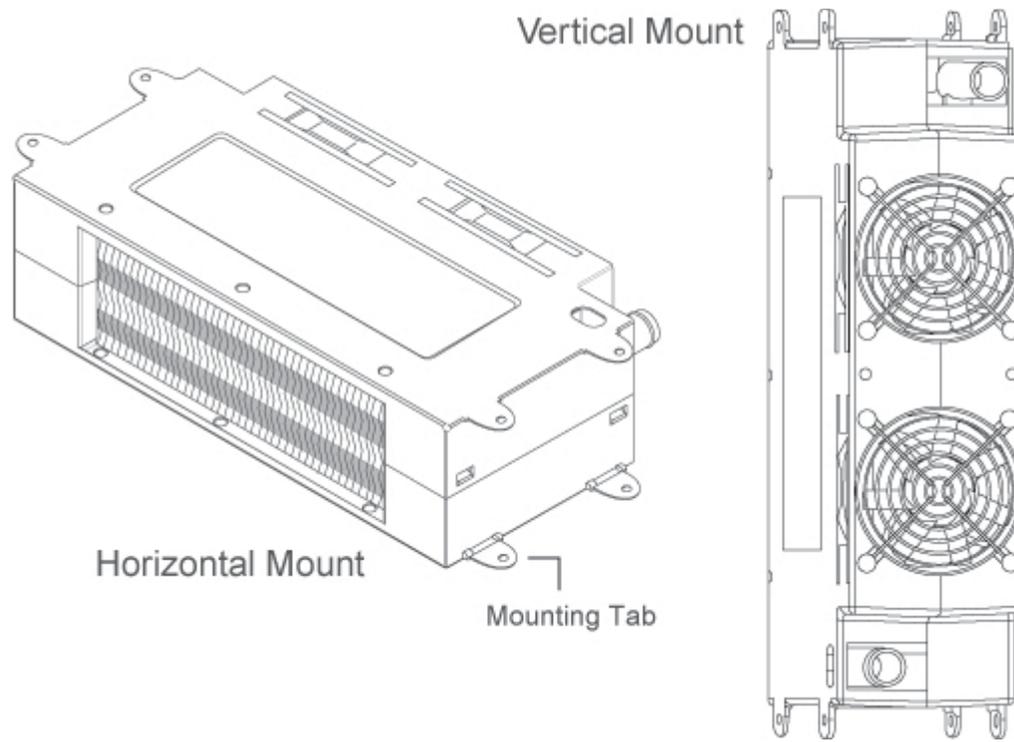
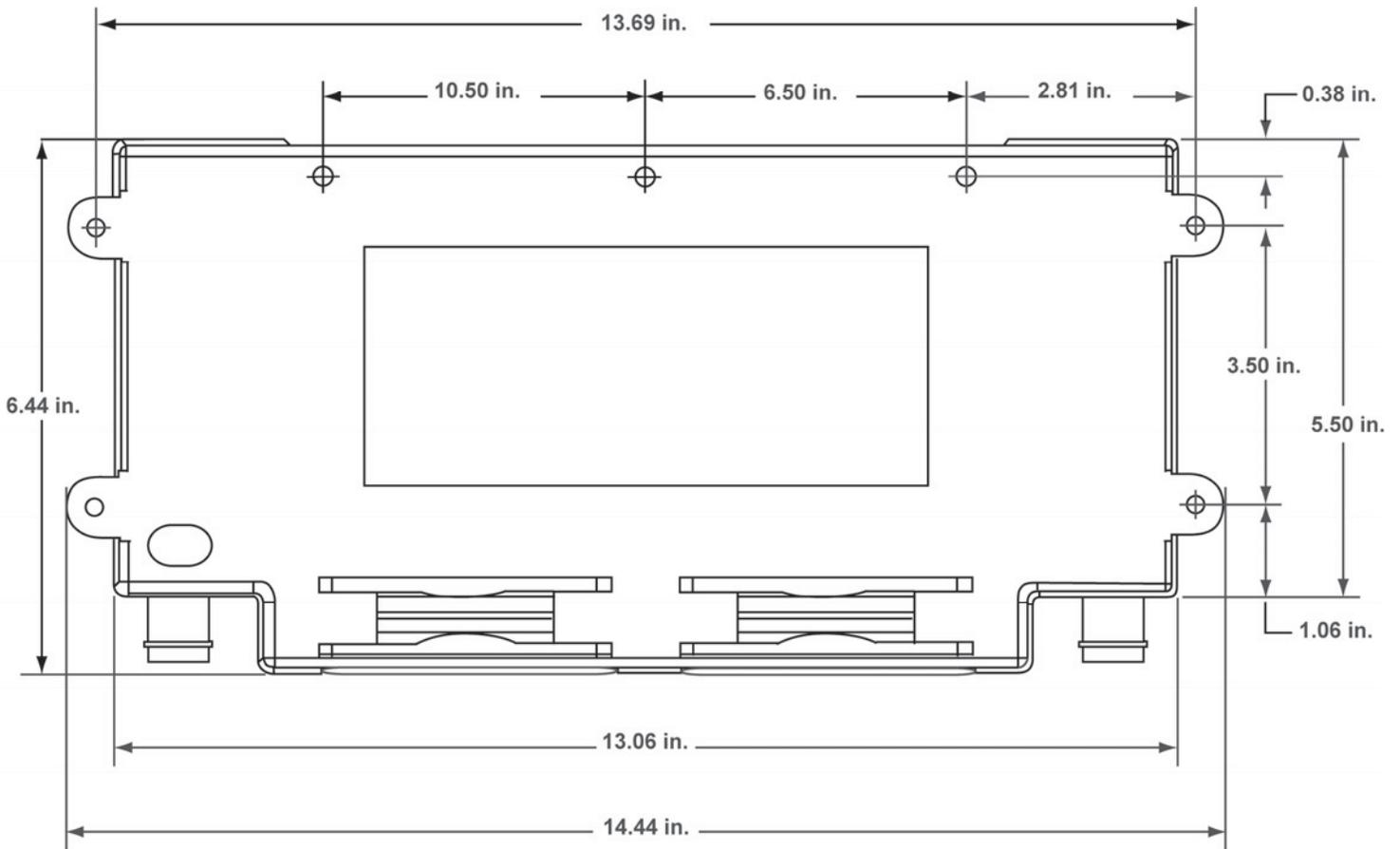


Figure 21



Generalized Motorhome Heating System Floor Plan

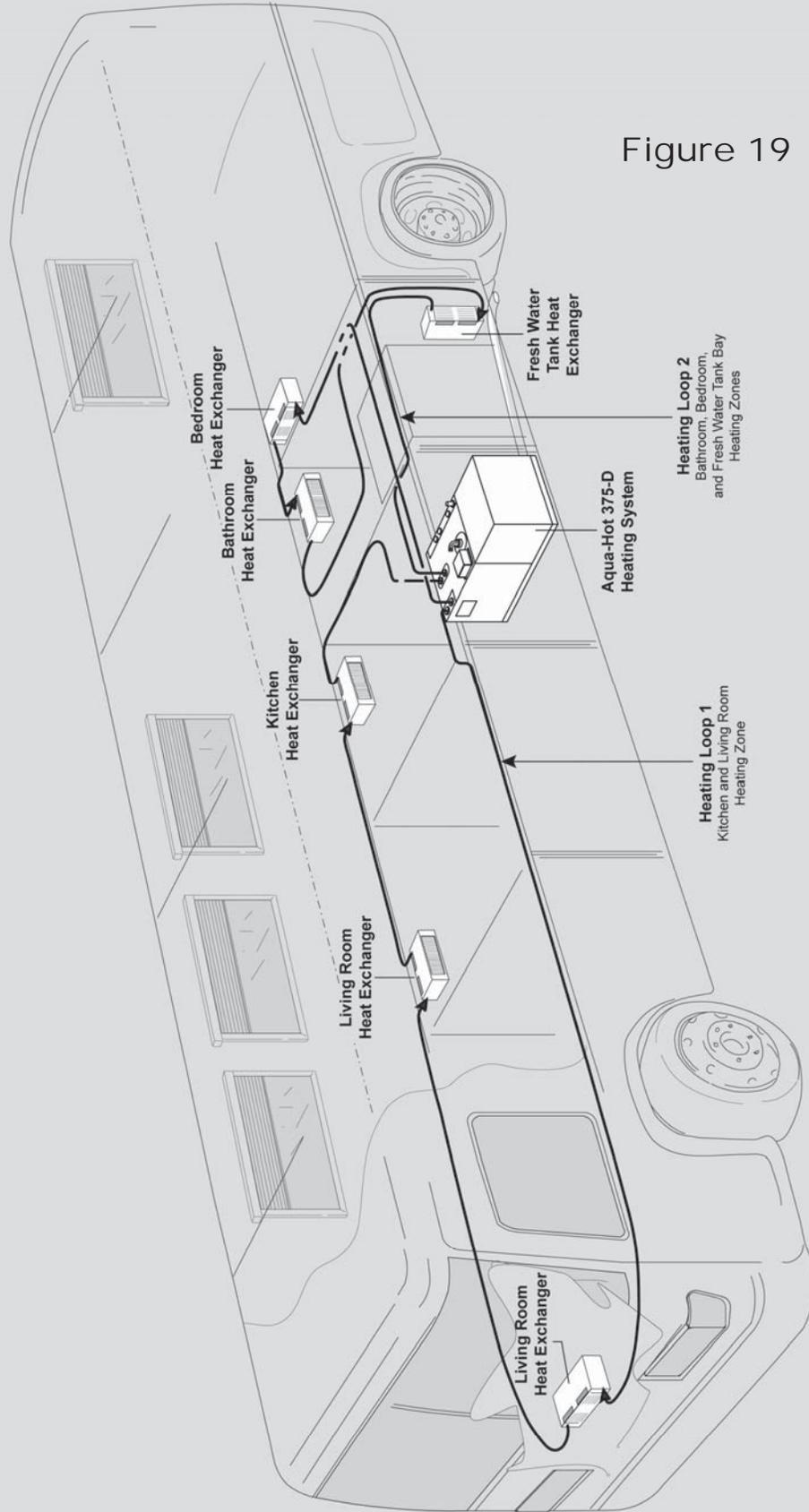


Figure 19

Wiring the Heat Exchangers:

1. Within each heating zone, run an 18-gauge wire - black for negative, from each heat exchanger's black wire to the chassis ground source. Reference Figure 23.
2. Within each heating zone, run one 18-gauge - red for positive, from the heat exchanger farthest from the Aqua-Hot past all other heat exchangers in that zone to the terminal block.
3. Within each heating zone, connect the red heat exchanger wires to the 18-gauge wire ran in step 2. Be sure that the wire end (farthest from the Aqua-Hot) is either attached to the last heat exchanger or covered to prevent additional connections.
4. Attach each zone wire ran in step 2 to the Aqua-Hot terminal block - position F1 for zone 1 and position F2 for zone 2. Reference Figure 22. Tighten the screw in the terminal to secure the wire in place.
5. Label the wires indicating the heating zone they pertain to (e.g., Living Room, etc.)

Terminal Block for Switches, Heat Exchanger Fans, and Thermostats

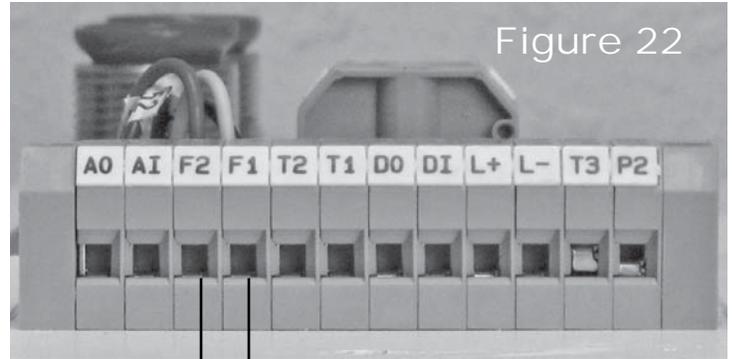


Figure 22

Terminal for Heating Zone 1's positive heat exchanger wire (F1)

Terminal for Heating Zone 2's positive heat exchanger wire (F2)

NOTE: It is recommended that the wire numbers in Appendix A be used when installing the Aqua-Hot in order to assist with differentiating between the separate heating zones and to aid service personnel with troubleshooting.

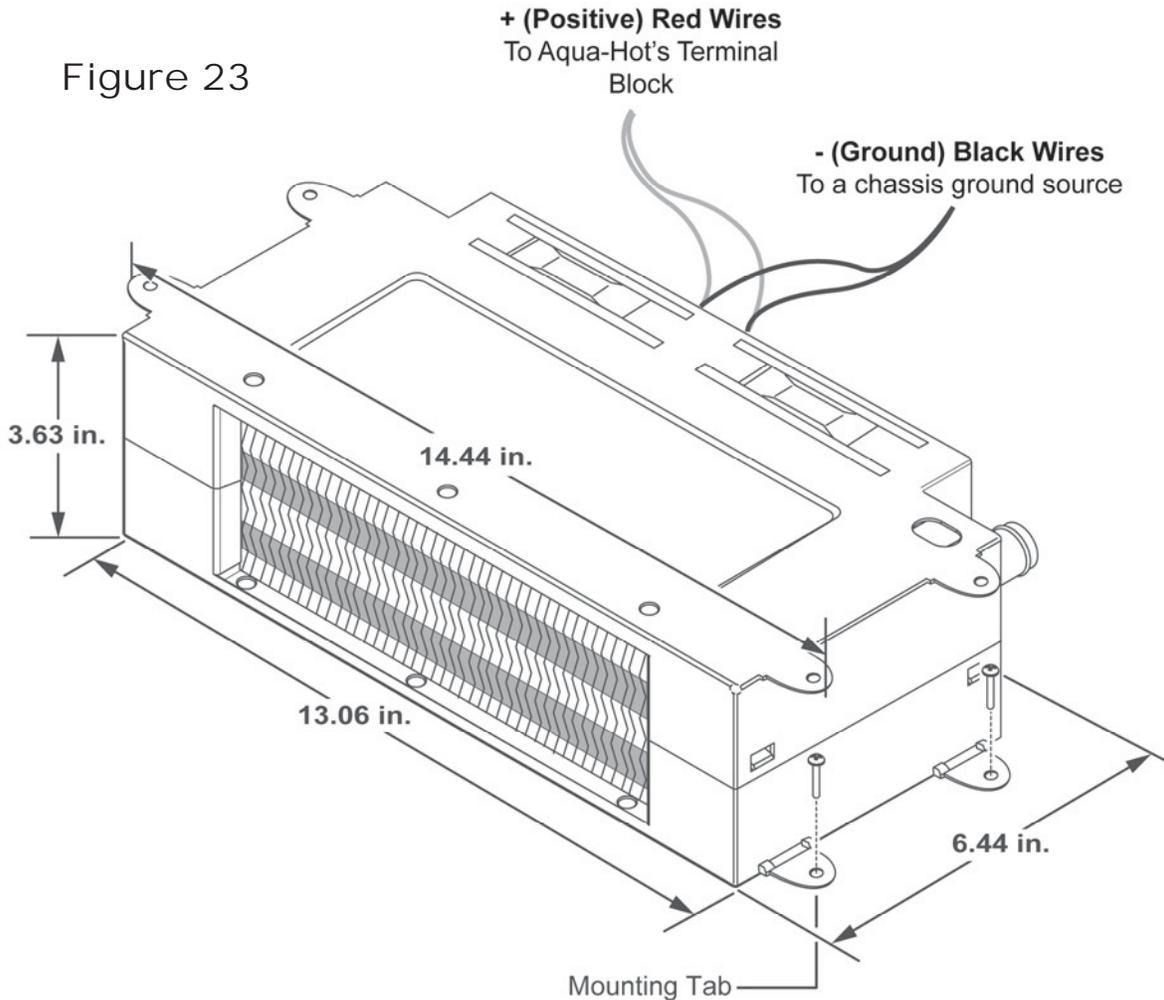


Figure 23

When wiring the heat exchangers in-parallel, the main 18-gauge wire is split to allow the heat exchanger wires to com-

bine with the main wire to be powered or grounded, respectively.

Figure 25



Plumbing Requirements:

Once all heat exchangers have been mounted, formulate a plan for the routing of the plumbing lines from each heating zone to the Aqua-Hot.

All plumbing lines should be laid as flat as possible, and any extreme rises in height should be avoided to eliminate any potential air-traps.

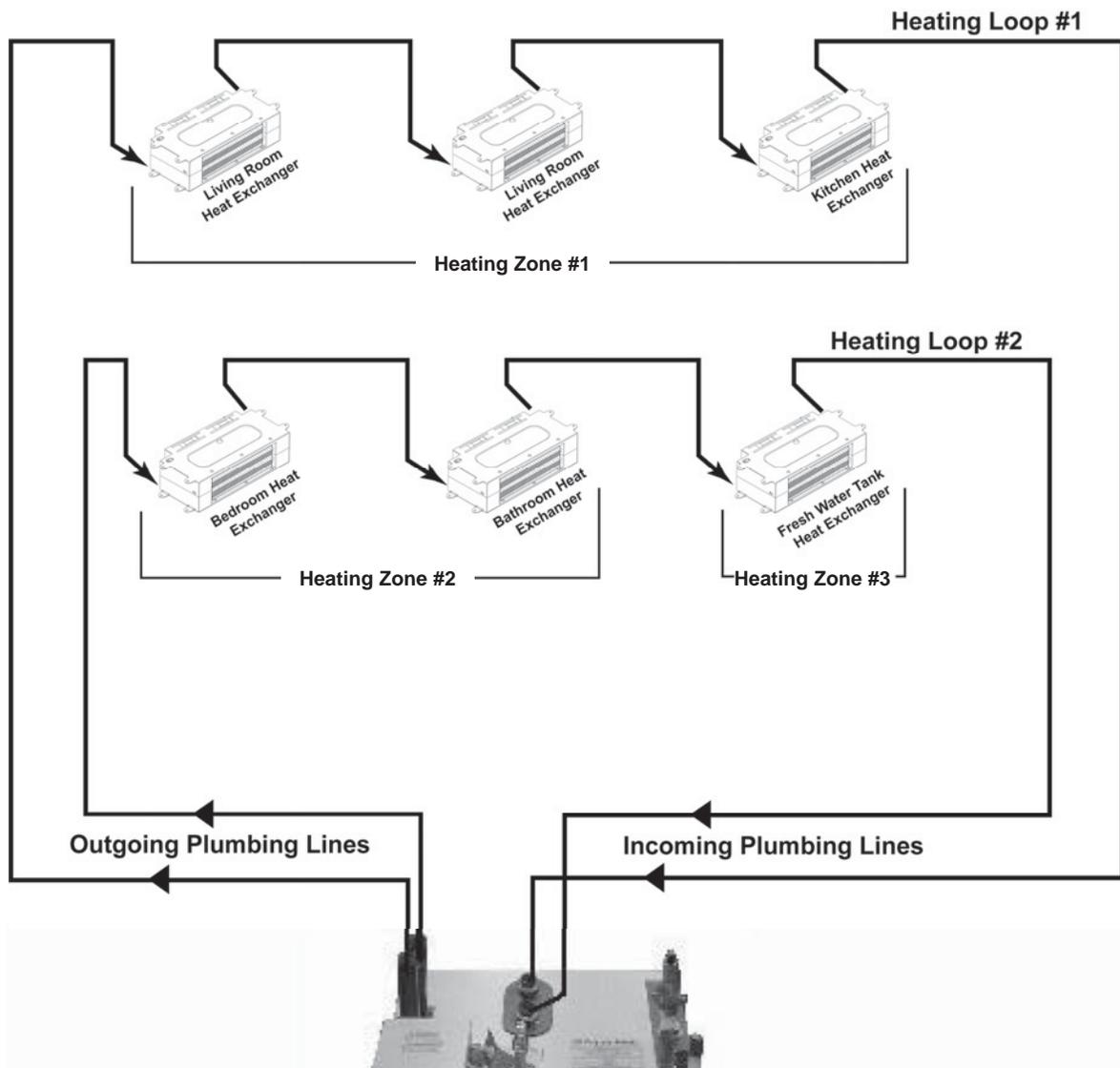
The kitchen and living room heat exchangers (typically three) must be plumbed together **in-series** on “Heating Loop 1.” Reference Figure 26.

The fresh water tank, bedroom, and bathroom heat exchangers (typically 3) must be plumbed together **in-series** on “Heating Loop 2.” Reference Figure 26.

Use 5/8 inch I.D. (Inside Diameter) plumbing lines for both heating loops.

Use wide-sweeping elbows or “bend supports” whenever the plumbing lines may be susceptible to kinking (i.e., 90° bends).

Figure 26



Plumbing the Hydronic Heating System:

1. Lay out the plumbing lines for all heat exchangers.
2. Label each line with the heating loop number and designate as an inlet or an outlet line.

NOTE: Run all plumbing lines in areas where they cannot be pinched off or damaged under normal operating conditions.

Be sure to secure all lines where necessary and apply protective shielding in areas where chafing may occur.

Rubber Coated/Closed-Type clamps are recommended when securing the plumbing lines.

3. Connect and clamp the outlet line from the heater to the lowest port on the heat exchanger with the longest run, for both heating loops. Reference Figure 27. Then, connect each additional heat exchanger in the same arrangement (low to high).

4. Connect and clamp the inlet line from the heater to the highest port on the last heat exchanger for both heating loops. Reference Figure 27.

NOTE: Reference Figure 28 for visual instructions on connecting PEX-type tubing to each heat exchanger.

Plumbing heat exchangers in this manner will allow air to escape naturally. If air is trapped in any heat exchanger, it will significantly reduce the heat exchanger's overall heating performance (heat output).

5. Connect and tighten all interior plumbing lines, outlet and inlet, to the Aqua-Hot's appropriate heating loop ports. Reference Figure 29 and Figure 30.

NOTE: The inlet and outlet plumbing lines can be installed with a straight fitting or an elbow fitting.

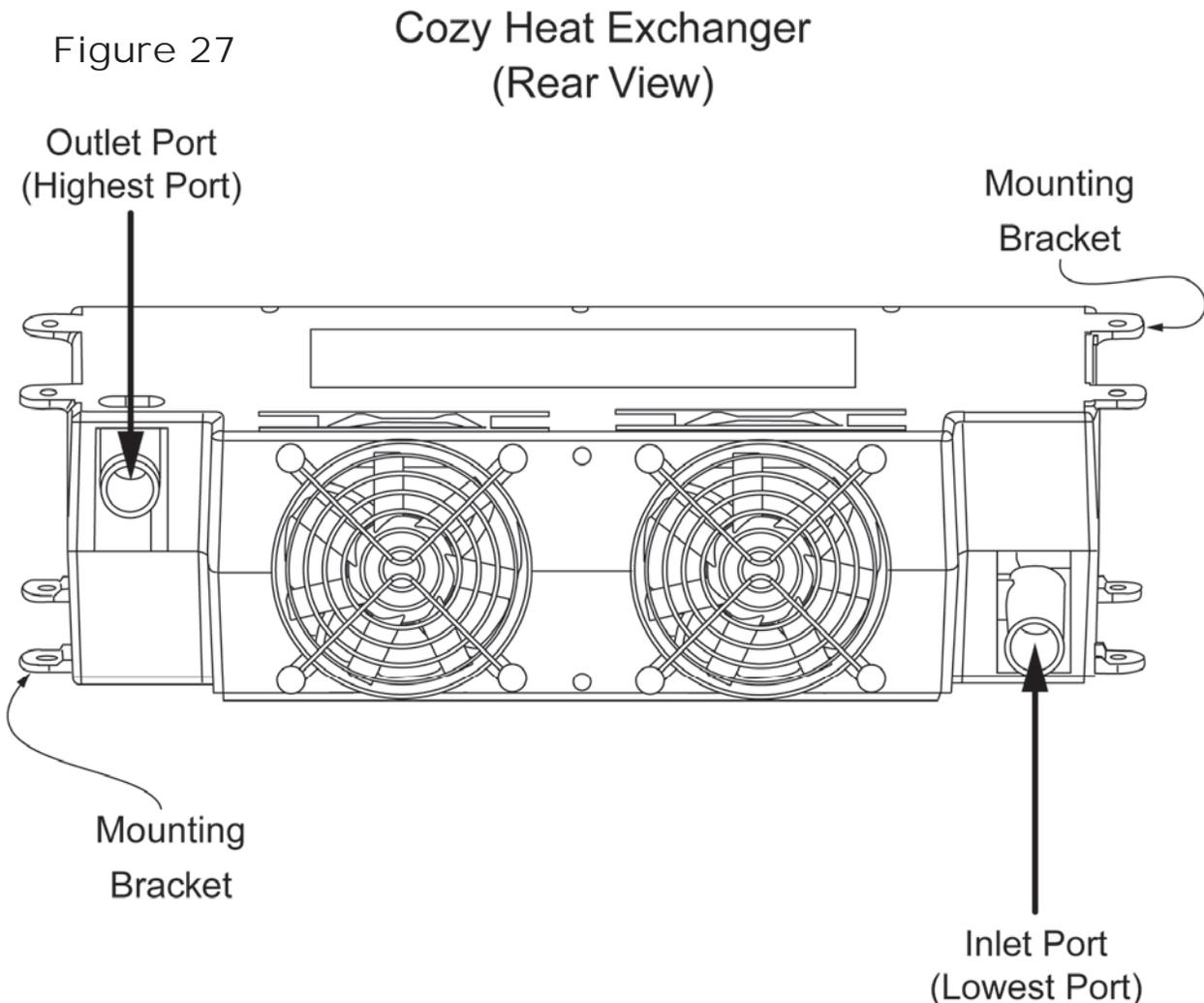


Figure 28

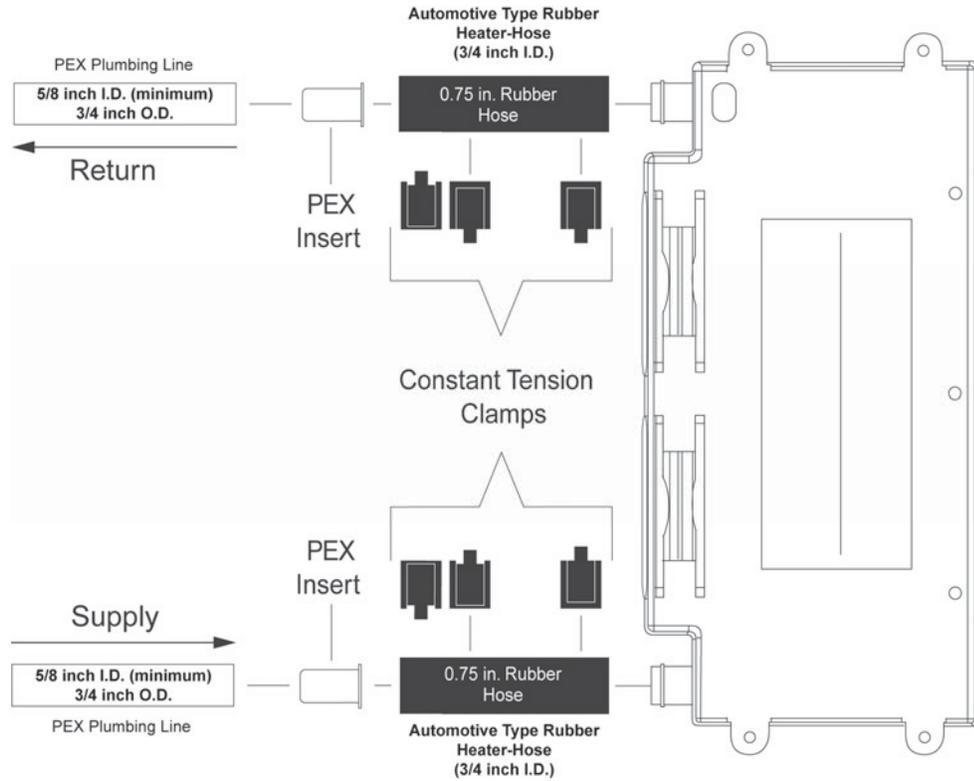
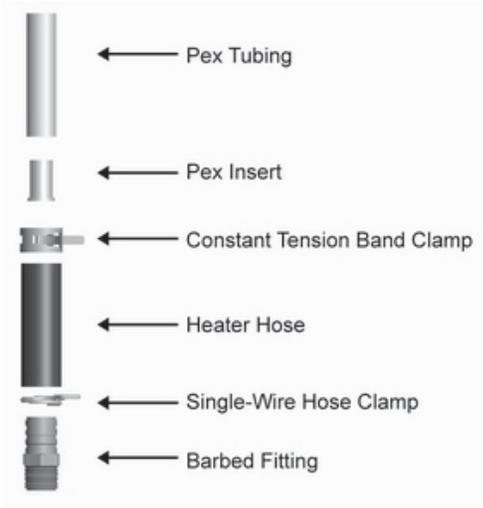
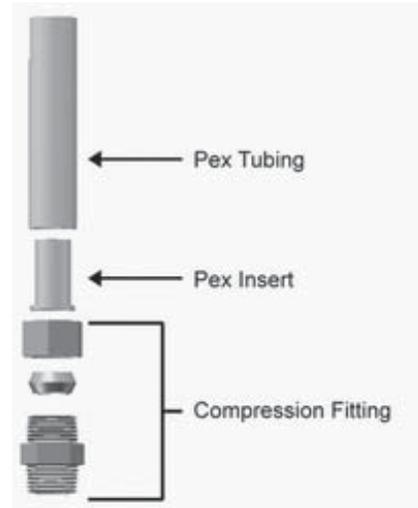


Figure 29

Inlet Heating Loop Connection Examples



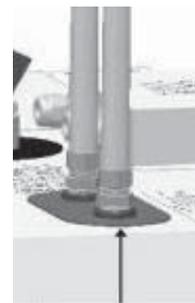
Barbed Fittings Components



Compression Fitting Components



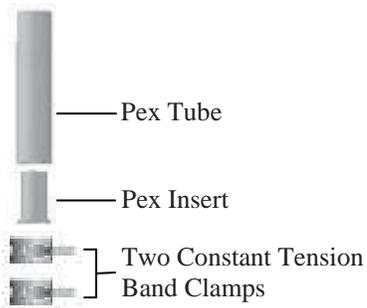
Barb Fittings Components Installed



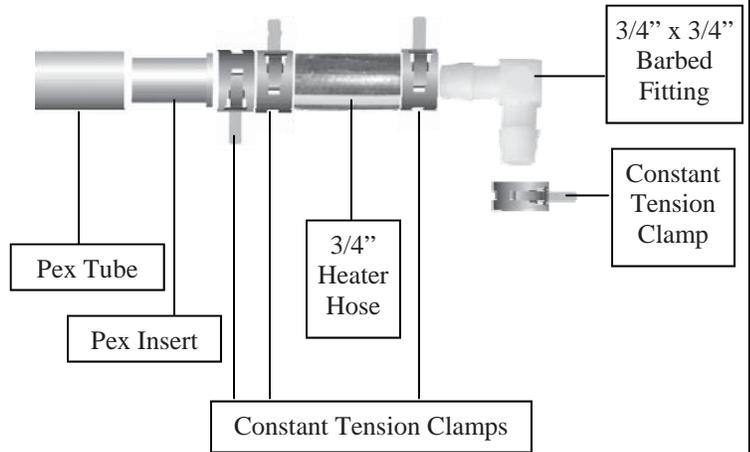
Compression Fittings Components Installed

Figure 30

Outlet Heating Loop Connection Examples



Straight Connection Components



90° Connection Components



Straight Connection Components Installed



90° Connection Components Installed

SECTION 4: THERMOSTATS

Fresh Water Tank Thermostat Locations:

Select a location that will ensure even-heat distribution throughout the fresh water storage tank bay compartment in order to prevent the domestic water and plumbing system from freezing.

Typically only the bulb of the thermostat needs to be physically mounted in the area requiring heat (usually in close proximity to the domestic water pump). Reference Figure 30.

Do not mount the thermostat bulb in a drafty area or along the ceiling of the bay.

The selected mounting location should allow for easy operator access and should be as low in the bay area as possible.

Avoid mounting the fresh water tank thermostat's bulb too close to the bay heat exchanger.

Fresh Water Tank Thermostat Mounting:

1. Select a location for the thermostat bulb in the fresh water storage tank bay compartment.
2. Once the thermostat has been completely wired, permanently mount the thermostat in place. Reference Figure 30.

Fresh Water Tank Thermostat Wiring:

1. Run two 18-gauge wires from the terminal block (positions T3 and P2) to the fresh-water tank thermostat.
2. Splice the wire from position T3 on the Aqua-Hot's terminal block to the fresh water tank thermostat's black wire. Reference Figure 31.
3. Run an 18-gauge wire from the positive (red) wire on the fresh water bay heat exchanger to the fresh water tank thermostat.
4. Both the wire from the P2 position on the Aqua-Hot's terminal block and the wire connected to the positive wire on the fresh water tank bay heat exchanger will need to be connected to the fresh water tank thermostat's blue wire. Reference Figure 31.

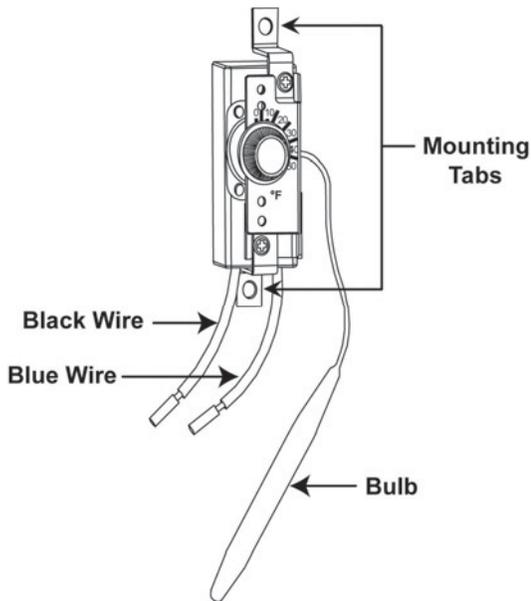
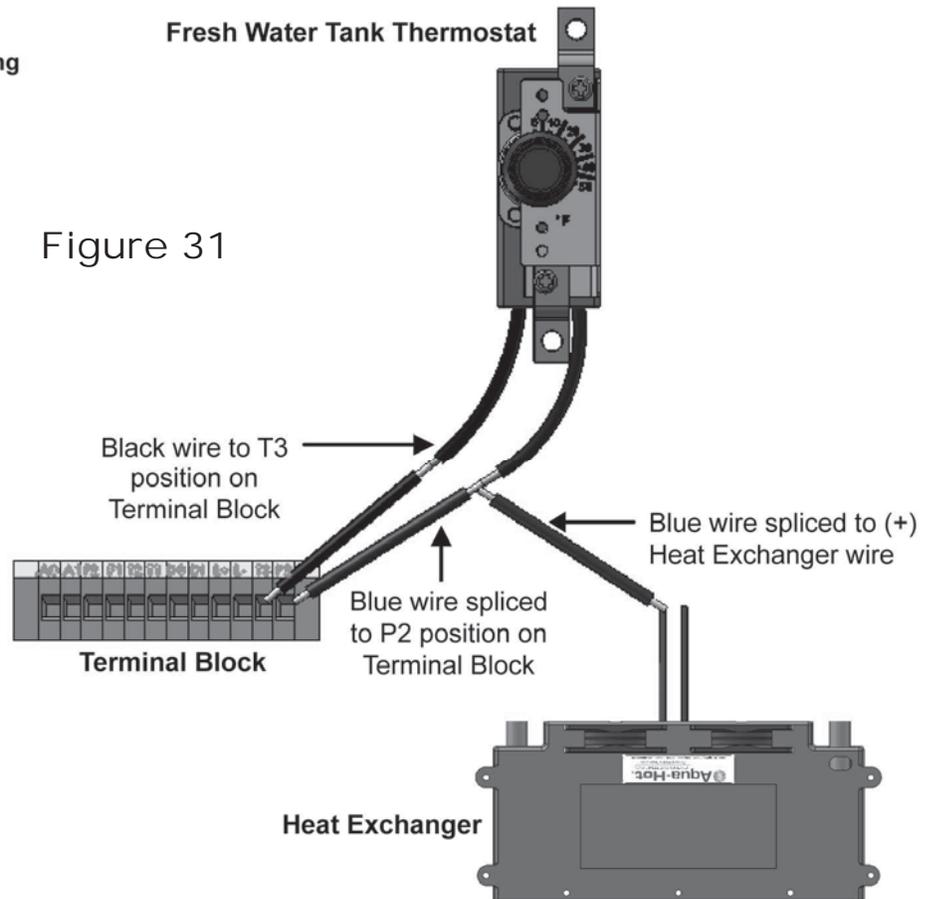


Figure 31



Room Thermostat Locations:

Select a location that will insure even-heat throughout each heating zone.

Locate each thermostat at approximately chest level, if applicable.

NOTE: The selected location should prevent the thermostat from being affected by:

- drafts or dead spots behind doors and in corners
- hot or cold air from ducts
- radiant heat from the sun or appliances
- heat from concealed pipes and chimneys
- unheated or uncooled areas such as an outside wall behind the thermostat

NOTE: It is recommended that the wire numbers in Appendix A be used when installing the Aqua-Hot in order to assist with differentiating between the separate heating zones and to aid service personnel with troubleshooting.

Room Thermostat Mounting:

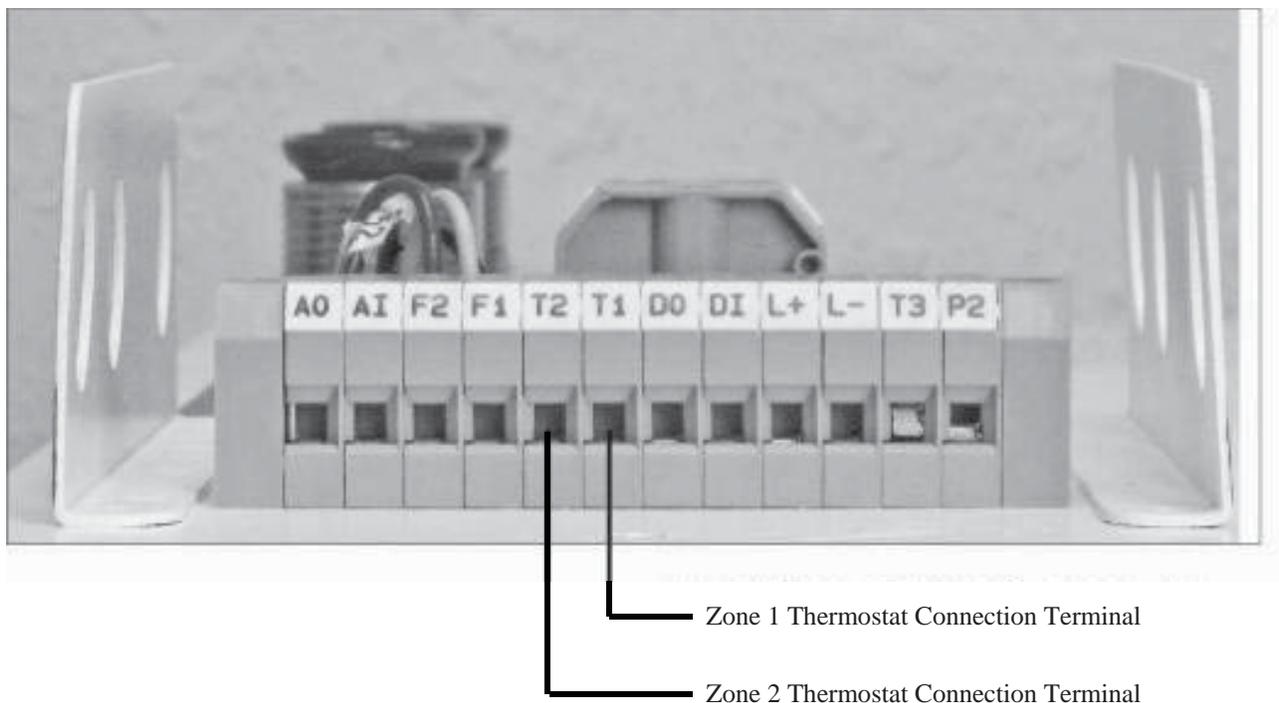
Once the room thermostat has been wired, permanently mount the thermostat in place.

Be sure to then turn **OFF** both interior room thermostats.

Room Thermostat Wiring:

1. Run one 18-gauge wire from each room thermostat mounting location to the Aqua-Hot terminal block.
2. Attach the zone 1 thermostat to the T1 location on the terminal block and attach the zone 2 thermostat to the T2 location. Reference Figure 32.
3. Attach the T1 wire to one side of the zone 1 thermostat and attach the T2 wire to one side of the zone 2 thermostat.
4. Connect a wire from the other side of both thermostats to the chassis ground.

Figure 32



Domestic Water System Requirements:

NOTE: Please note that it may be necessary to utilize an accumulator tank within the domestic water system. Reference Figure 34. Although the Aqua-Hot is equipped with a pressure-relief valve, the use of an accumulator tank will help prevent excessive “weeping” of the valve. Manufacturers of pressure-relief valves indicate that excessive weeping of these valves will cause the “seat” in the valve to deteriorate, and, in turn, the valve will fail prematurely. For additional information regarding accumulator tanks, please be sure to reference the Recreational Vehicle Industry Association’s (RVIA) technical publication titled “Recreational Vehicle Plumbing Systems.” To obtain a copy of this particular publication, please contact RVIA at (703) 620-6003 or visit them online at www.rvia.org.

Use the RVIA-provided table below in order to determine the proper sizing of pipe and tubing required to insure maximum efficiency.

The size of water supply piping and branch line shall not be less than specified in the table below.

NOTE: A water heater or ice maker shall not be counted as a “water-using fixture” when computing pipe sizes.

NOTE: As stated directly from the ANSI A119.2/NFPA 501C Standard on Recreation Vehicles, 1993 Edition:

“Piping Systems shall be sized to provide an adequate quantity of water to each Plumbing Fixture at a flow rate sufficient to keep the Fixture in a clean and sanitary condition without any danger of back-flow or siphoning.”

The Aqua-Hot is equipped with a pressure-relief valve, which releases excessive pressure in the domestic water system, if necessary, as well as a tempering valve in order to regulate the temperature of the hot water.

Domestic Water System Plumbing:

1. Connect a domestic water plumbing line from the domestic water demand pump/water manifold to the cold water inlet port on the Aqua-Hot. Reference Figures 33 and 34.
2. Connect a domestic water plumbing line from the Aqua-Hot’s hot water outlet port to the hot water system’s distribution lines/water manifold. Reference Figures 33

Number of Fixtures	Tubing		Pipe
	Inner Dia. (inches)	Outer Dia. (inches)	Iron Pipe Size (inches)
1	1/4**	3/8**	3/8
2	1/4***	3/8***	3/8
3	3/8	1/2	1/2
4	3/8	1/2	1/2
5 or more	1/2	5/8	1/2

* Minimum size for toilet water supply line shall not be less than the size recommended by the toilet manufacturer.
 ** 12-feet (3.7 m) maximum length allowable only from water service connection to a single fixture.
 *** 6-feet (1.8 m) maximum length.

Switch Panel Location:

Select a location that allows for easy operator access. The switch panel should be easily visible as it incorporates a blinking fault indicator light (Diesel-Burner switch only), which indicates a diesel-burner malfunction.

Switch Panel Mounting:

1. Cut out a 2.5" W x 1.5" H opening for the switch panel plate. Reference Figure 35.
2. Once the switch panel has been completely wired, permanently mount the switch panel in place.
3. Move both switches to an **OFF** position by pressing them in a downward motion.

Switch Panel Wiring:

1. Run 16-gauge wires from the switch panel to the terminal access block.

NOTE: It is recommended that the wire numbers in Appendix A be used when installing the Aqua-Hot in order to aid service personnel with troubleshooting.

2. Strip and crimp insulated female terminals onto each wire at the switch panel location.

NOTE: Be sure to attach a jumper wire for the electric switch from Pin 4 to Pin 1. Reference Figure 37.

3. Connect all switch wires to the appropriate switch connections as illustrated in Figures 36 and 37. Reference Appendix A for additional wiring information.
4. Insert all switch wires into the appropriate terminal/switch panel connection on the terminal access block. Reference Figure 37 and Appendix A.

Figure 35

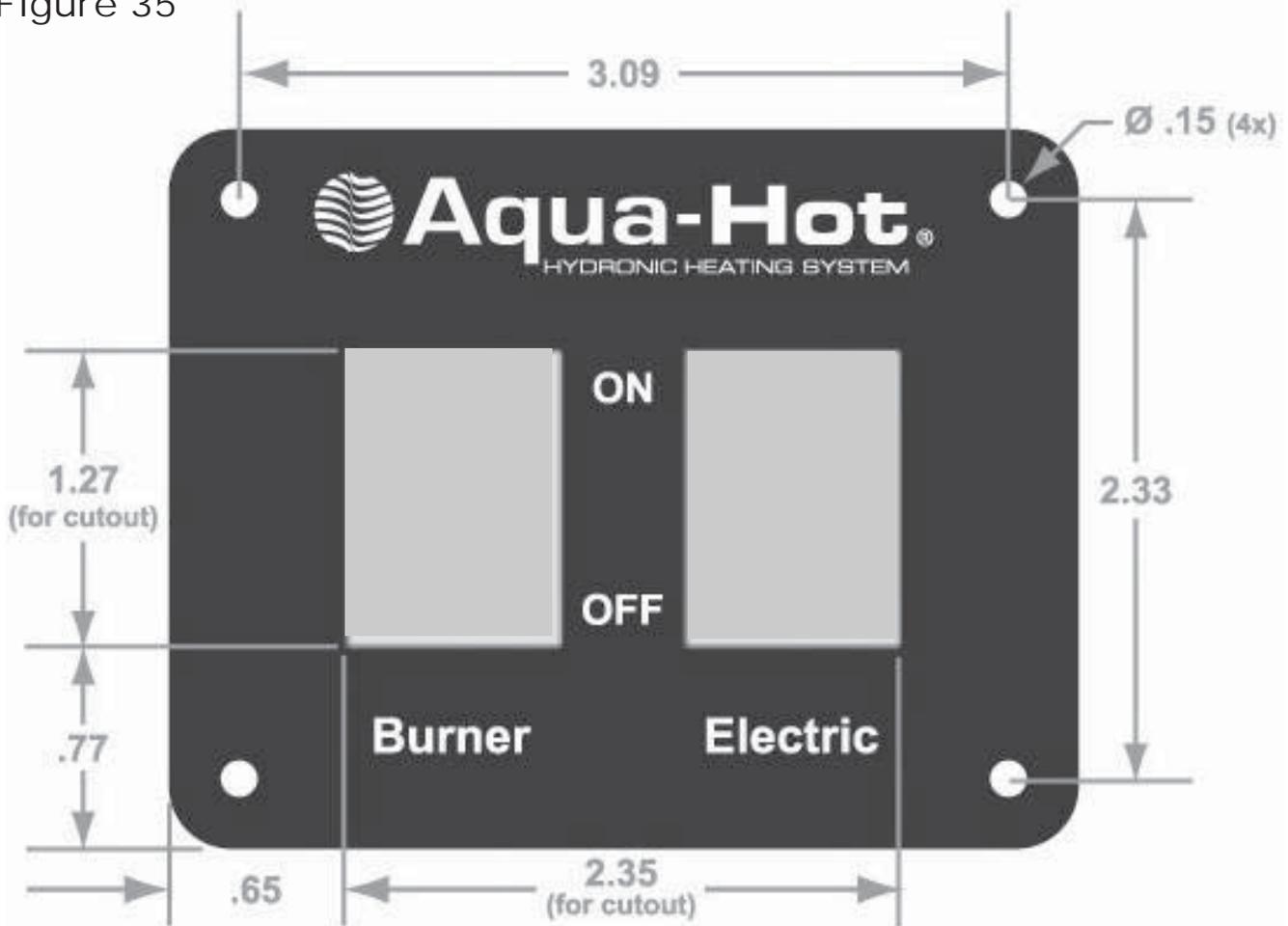


Figure 36

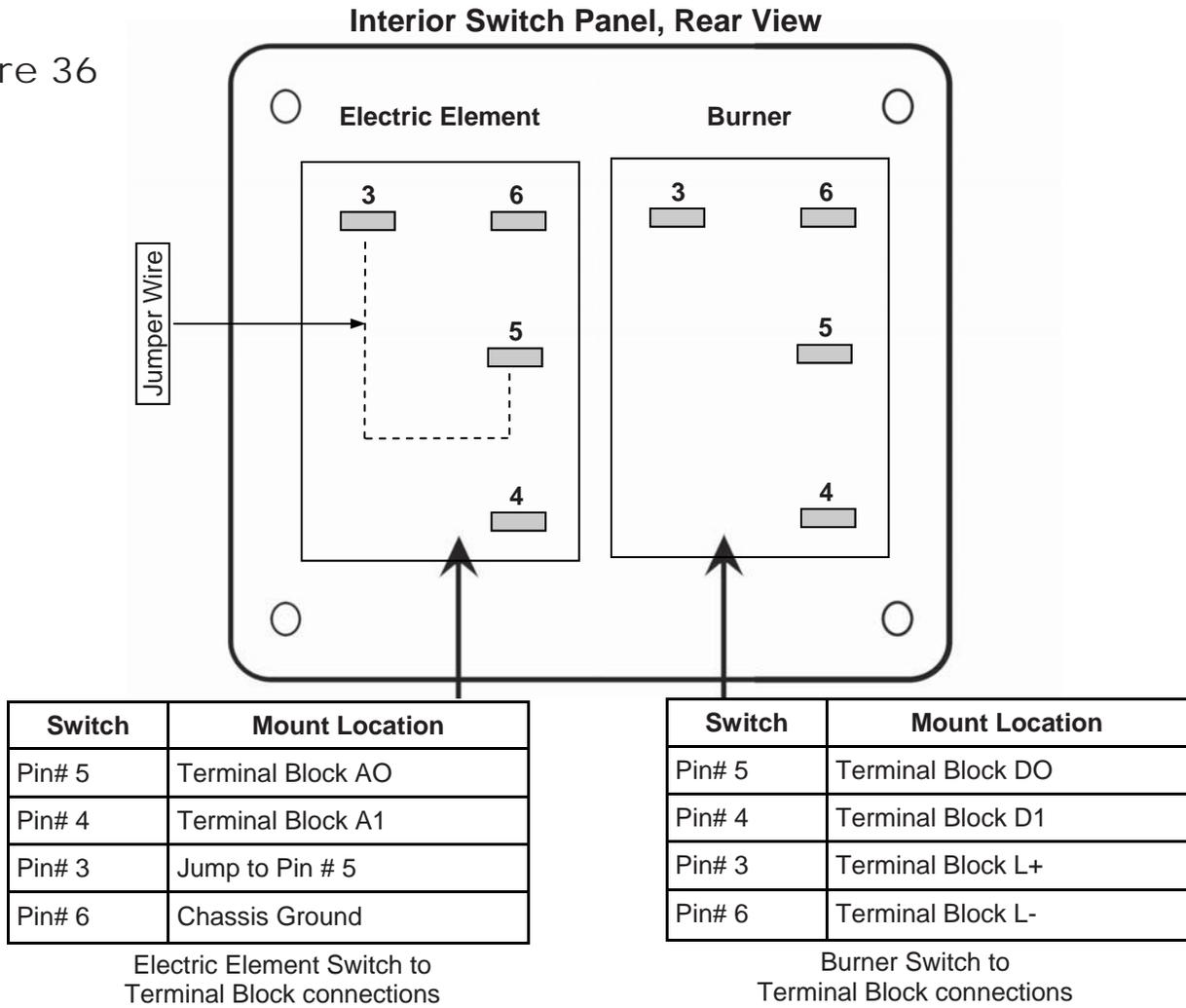
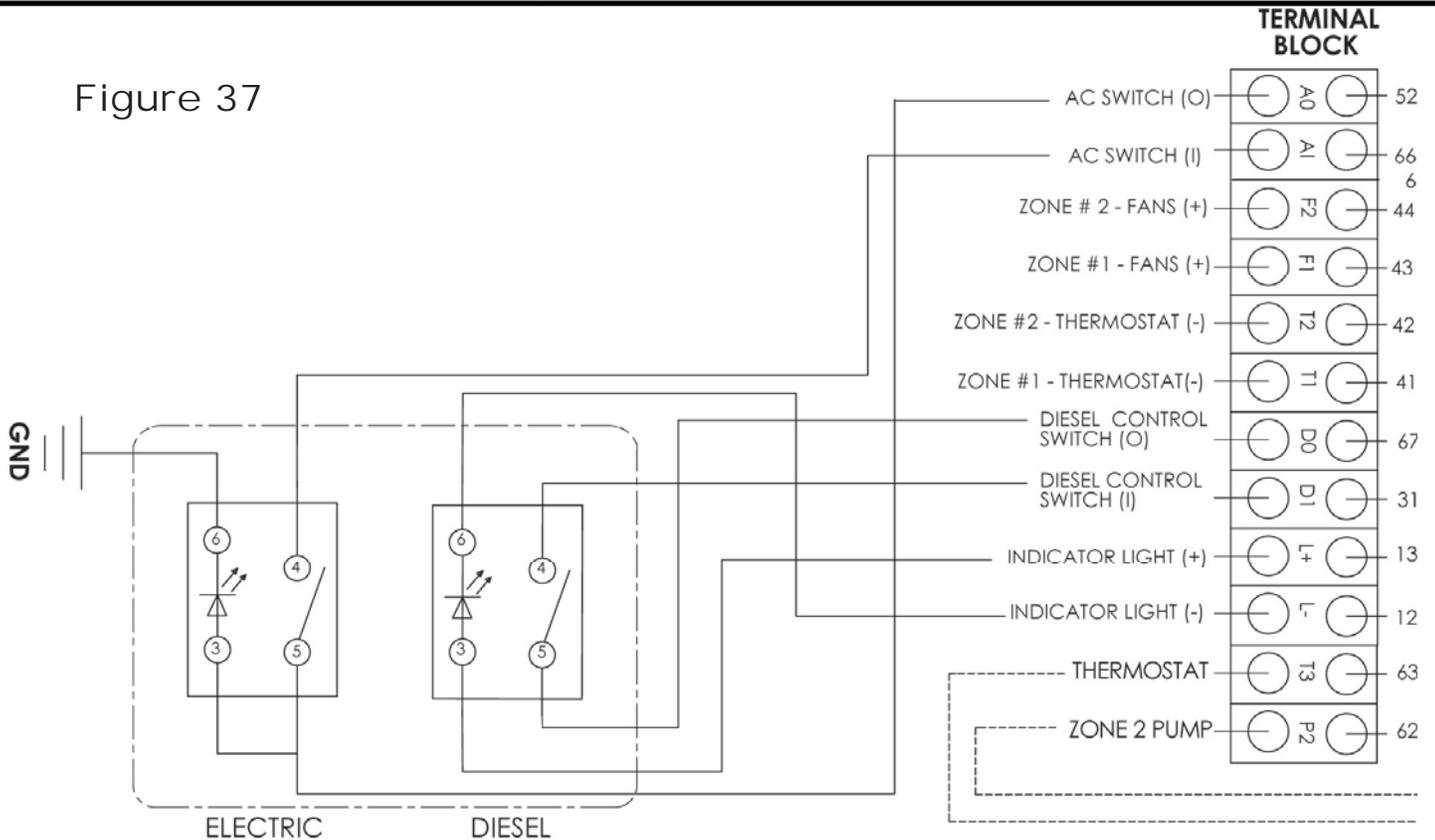


Figure 37



CAUTION

A kinked fuel line (return side) will increase the fuel pressure to hazardous levels and may cause a fuel line to rupture. A kinked fuel line could also severely damage the diesel-burner's internal fuel system.

Fuel Filter Location:

Mount the fuel filter assembly in a location that provides easy access for replacing the filter element and for catching any potential fuel spillage when servicing.

Fuel System Requirements:

- The diesel fuel supply should be drawn directly from the vehicle's main fuel tank or from a separate auxiliary fuel tank, if applicable.
- The fuel tank should be equipped with a dedicated fuel pick-up pipe (outlet port and inlet port). Reference Figure 38.

NOTE: If an auxiliary fuel tank is required, be sure to consult the ANSI/NFPA 1192 handbook concerning heating systems' diesel fuel system specifications.

Also, be sure to reference the ANSI/NFPA 1192 handbook for information regarding fuel distribution system specifications.

- Use 3/8 inch I.D. (Internal Diameter) fuel lines.
- The combined length of the supply and return fuel lines should not exceed 100 feet in total length. Reference Figures 39.

All fuel-fitting hardware (i.e., at the vehicle's fuel tank, fuel filter, and Aqua-Hot fuel parts) must be 1/4 inch NPT or greater with a 3/8 inch barbed fitting. Fuel fittings less than 1/4 inch NPT may restrict fuel flow, thereby compromising the diesel-burner's performance

Fuel System Installation:

1. Run two 3/8 inch fuel lines from the fuel tank inlet and outlet ports to the Aqua-Hot.

Both fuel lines should be laid as flat as possible and any extreme rises in height should be avoided in order to eliminate any potential air-traps.

Run both fuel lines in areas where they cannot be pinched, kinked, or damaged during normal operating conditions.

Run the fuel tank outlet fuel line past the fuel filter location in preparation for step 7.

2. Be sure to secure all fuel lines where necessary and apply protective shielding in areas where chafing may occur.
3. Label both fuel lines indicating whether they are an outgoing line or an incoming line.
4. Connect the Aqua-Hot's fuel lines to the vehicle's fuel tank. Reference Figure 38.
5. Install and tighten the appropriate fuel fittings onto the Aqua-Hot's fuel ports, as well as the two ports of the fuel filter. Reference Figures 39.
6. Connect the inlet and outlet fuel lines to the Aqua-Hot's fuel port connections. Reference Figure 41.
7. Cut the fuel line at the fuel filter mounting location and connect the fuel lines as illustrated in Figures 40.

NOTE: Be sure that the flow of fuel through the filter is in the correction direction as illustrated in Figure 40.

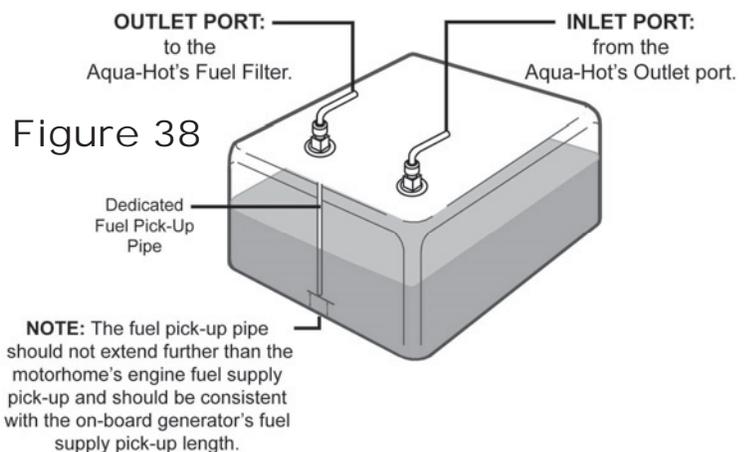
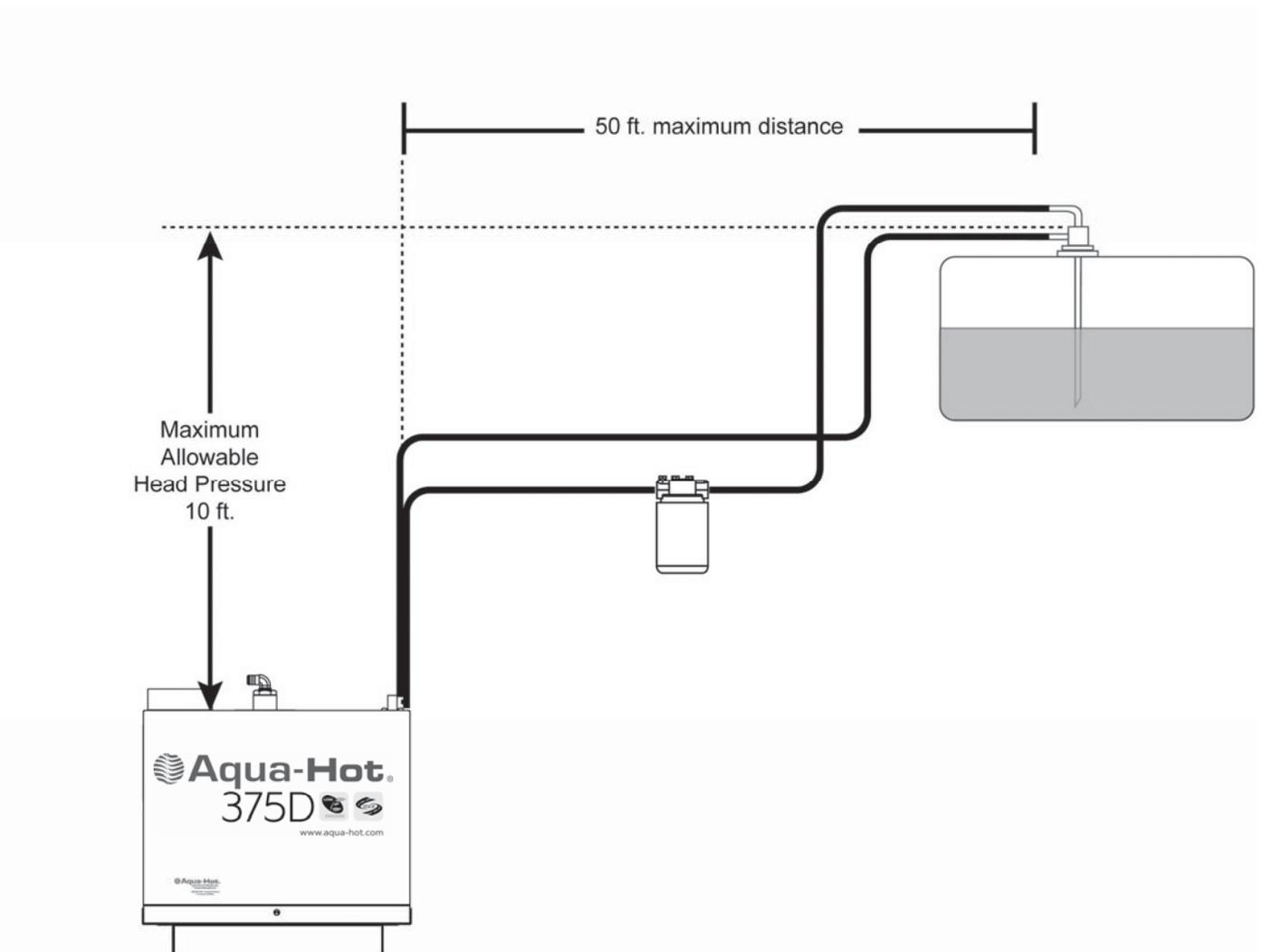
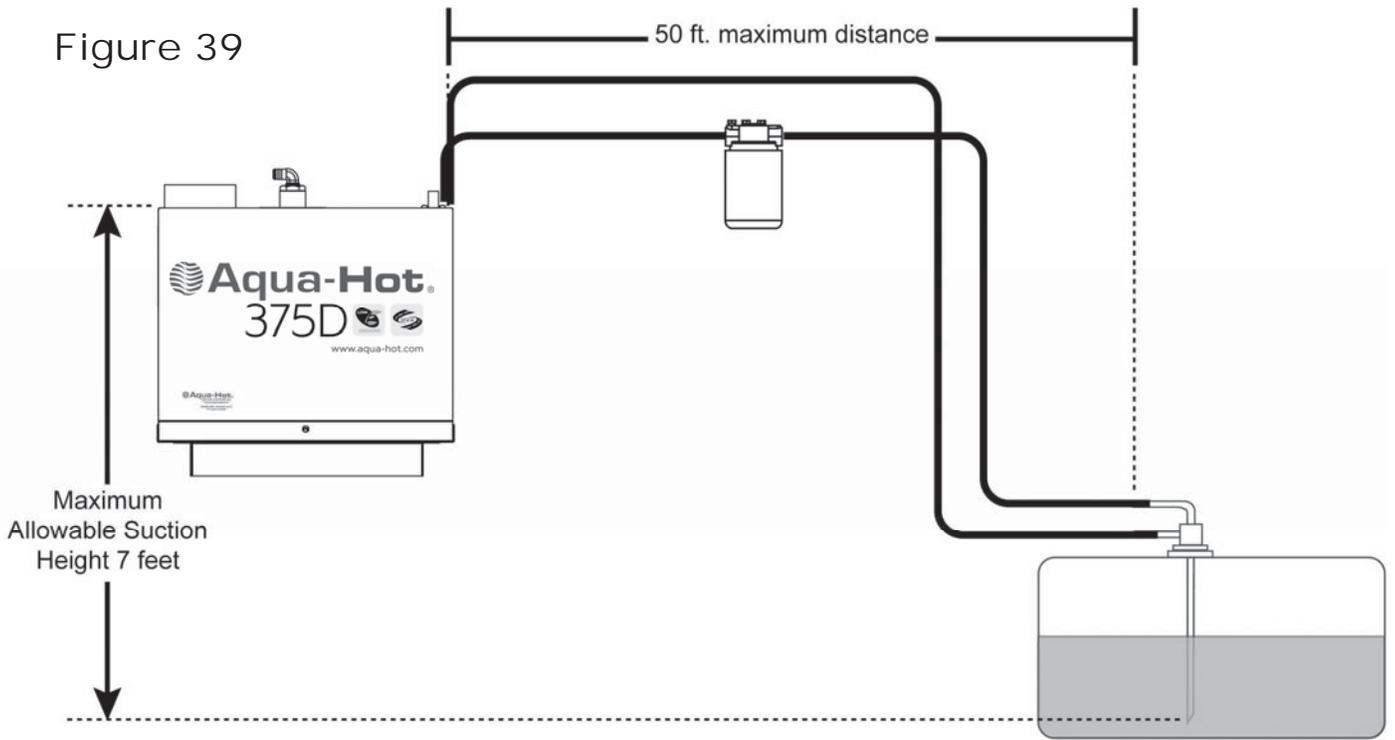


Figure 39



WARNING!

The Aqua-Hot's exhaust is hot and must be kept away from any heat-sensitive material.

DO NOT direct exhaust downward as a fire may result when parked in dry, grassy areas.

Exhaust must not terminate beneath the vehicle or beneath an openable window or vent.

DO NOT terminate the exhaust pipe within the awning area of the motorhome, if applicable. Be sure to keep the exhaust away from the slide-out areas.

CAUTION

All Aqua-Hot exhaust system installations **MUST** utilize the two black pipe nipples and the black pipe elbow, which are provided with the heating system, in the configuration best suited for the particular recreational vehicle application. Failure to conform could create a hazardous situation and will void the Aqua-Hot's ETL product listing.

NOTE: Refer to "Internal Combustion Engine Exhausts and Vehicle Wall Openings" in RVIA's ANSI/NFPA 1192 Handbook for the Recreational Vehicle Standards, as well as the National Fire Protection Association's (NFPA) 1192 Standard on Recreational Vehicles for additional information.

Exhaust System Requirements:

- The exhaust must be able to freely exit away from the vehicle without any obstructions.
- Angle the exhaust pipe towards the rear of the vehicle so that the exhaust fumes will naturally move away while the vehicle is in motion.
- Use standard 2.0 inch automotive-type exhaust piping and avoid bends, if possible. Reference Figure 42.
- A maximum of three 90° exhaust pipe bends are allowed.
- Do not use galvanized pipe or fittings; only black-iron pipe and fittings should be used.
- Exhaust should not exceed 27.5 feet.

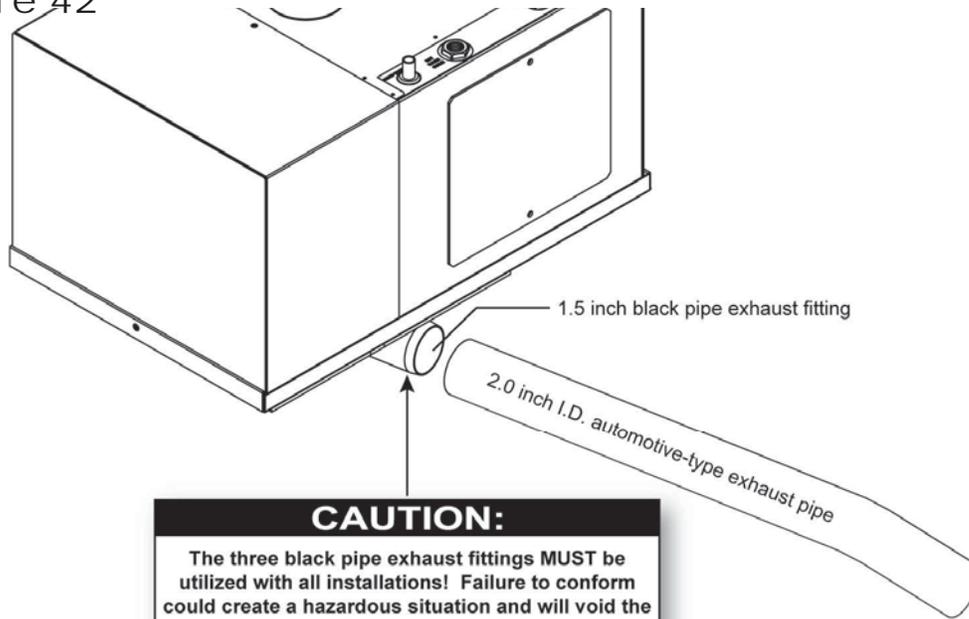
NOTE: Should the particular application require more than 27.5 feet of exhaust pipe, more than three 90° exhaust pipe bends, or less than 2.0 inch OD exhaust pipe, please contact the Aqua-Hot Heating Systems Product Application Department at 1-800-685-4298 for assistance.

Installing the Exhaust System:

The Aqua-Hot is supplied with a 3-inch and a 4-inch black pipe nipple (1.5 inch diameter) along with a 1.5 inch exhaust elbow. Reference Figure 44. These three exhaust system components **MUST BE** utilized with all product installations. Be sure to reference Figure 44 to determine which exhaust nipple should be connected directly to the Aqua-Hot's exhaust port (i.e., the 3-inch or the 4-inch black pipe nipple).

1. Run the exhaust pipe to the driver's side of the vehicle and ensure that the exhaust fumes cannot enter into the passenger compartment. Be sure to keep the exhaust away from the slide-out areas.
2. Be sure to secure the end of the exhaust pipe to the vehicle with the proper exhaust hanger/support hardware.

Figure 42



CAUTION:
The three black pipe exhaust fittings **MUST** be utilized with all installations! Failure to conform could create a hazardous situation and will void the Aqua-Hot's ETL product listing.

NOTE: A maximum of one 90° and one 45° bend is allowed for the exhaust pipe. Also, the exhaust pipe cannot exceed 11 feet.

Front of Aqua-Hot
View from underneath

Figure 43

NOTE: The exhaust elbow can be rotated 270° as shown in the illustration; however, the exhaust must not terminate beneath the vehicle or beneath an openable window or vent.

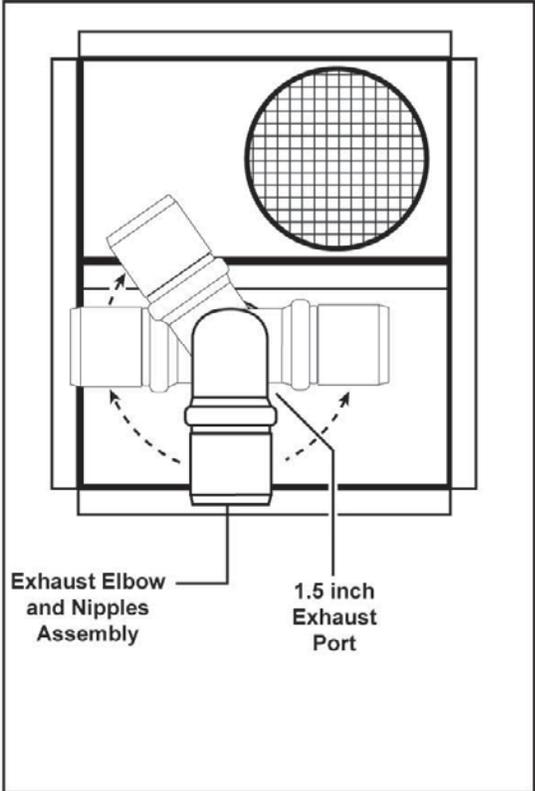
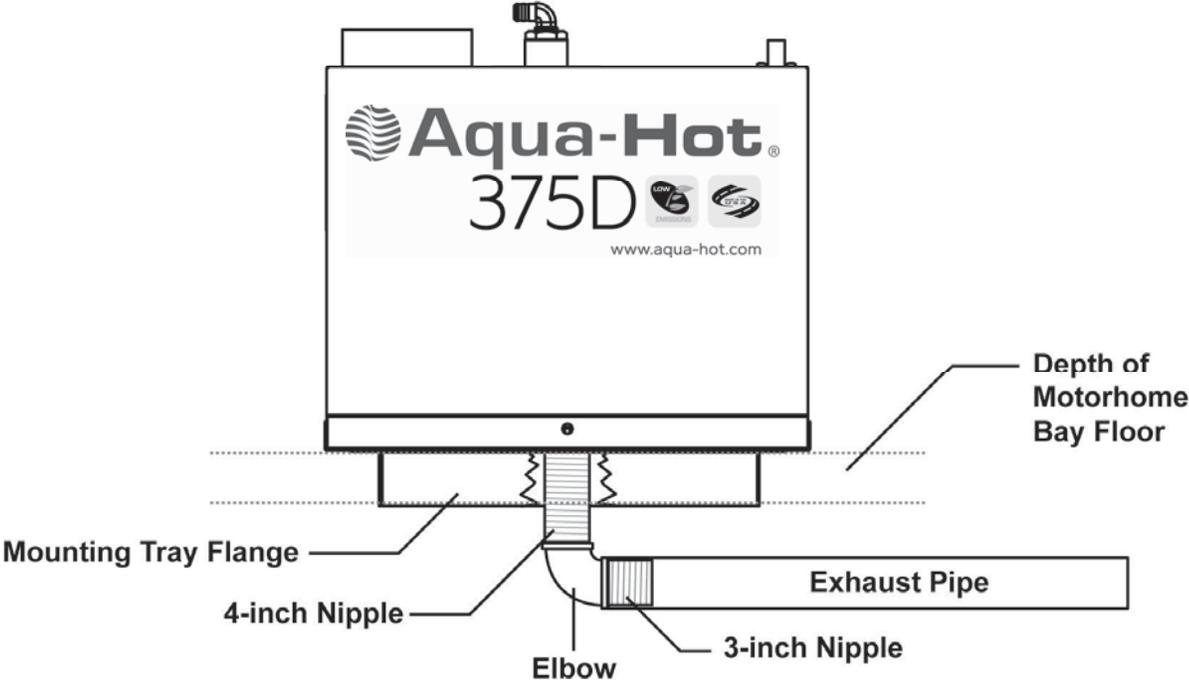
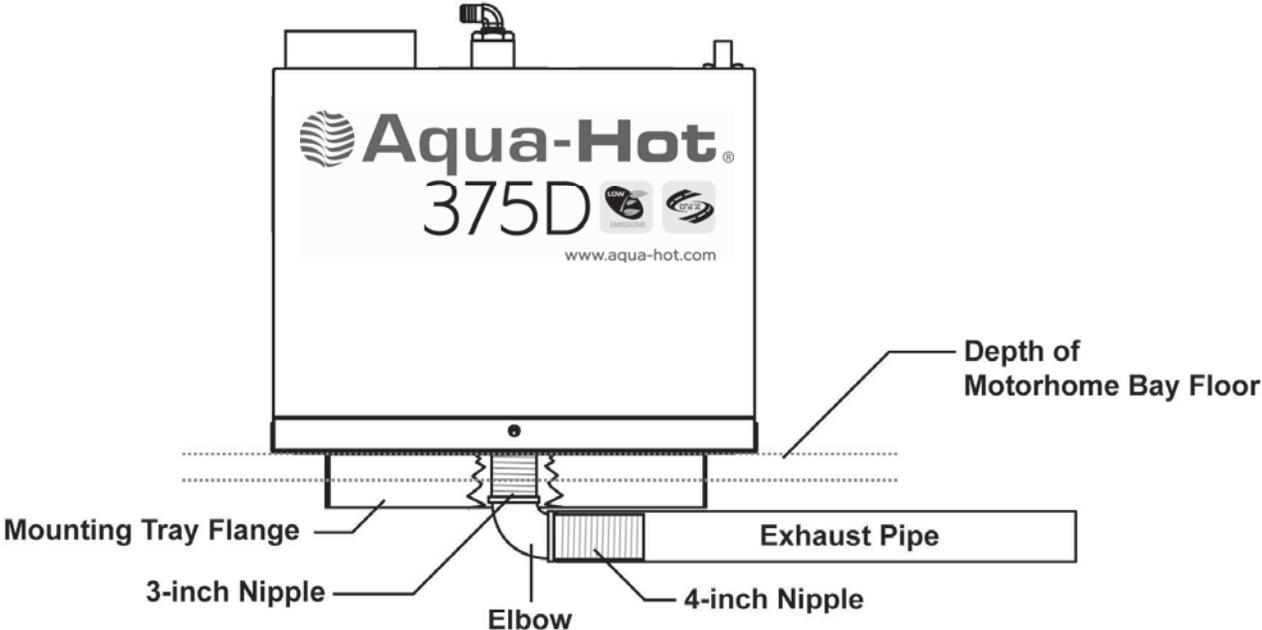


Figure 44



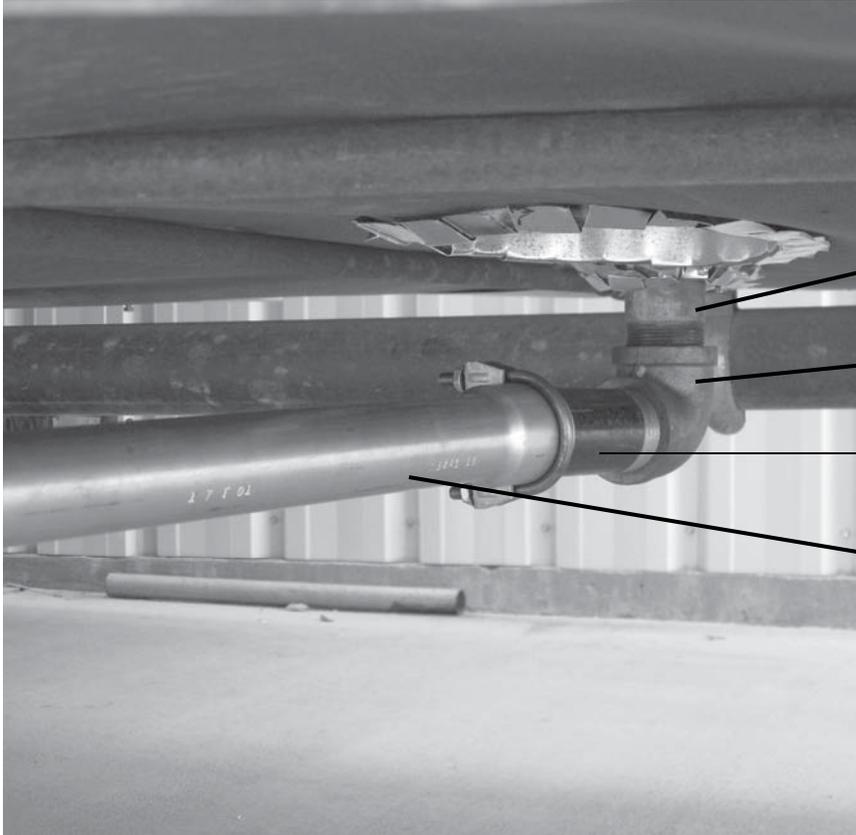


Figure 45

3" Black Pipe
Nipple Installed

Black Pipe Elbow

4" Black Pipe
Nipple Installed

2" Automotive
Type Exhaust Pipe

NOTE: All electric installations, systems, and equipment shall comply with Article 551, Parts I and III through VI of NFPA 70, as well as the regulation of authorities having jurisdiction and CSA Standard B139.

Electrical connections for the Aqua-Hot 375-D heater are made in the terminal block access area on top of the heater. Access ports exist on either side of the access area to better accommodate all installations. Please note, however, that in order for the required access cover to be installed, all ports must be used on the same side. One port should be used for the wiring for each terminal block (i.e., one port should contain the 120 Volt-AC wires, one port should contain the 12 Volt-DC wires, and one port should contain the switch panel and thermostat wires. Reference Appendix A). Three cable-clamp fittings have been included in the shipping kit and will be used to support the incoming wires to the terminal blocks.

Connecting the 12 Volt-DC Power:

CAUTION

DO NOT connect the 12 Volt-DC power to the Aqua-Hot if the vehicle requires welding. Electrical welding will cause serious damage to the burner controller.

NOTE: Because the Aqua-Hot is designed to shut down in the event that the DC voltage level drops too low to properly operate, it is imperative that the proper wire gauge be determined and utilized.

Be sure to protect against accidental shorting (i.e., chassis shorting) by incorporating a 25-Amp rated in-line fuse into the power wire at the battery location. Reference Figure 48.

1. Calculate the necessary wire gauge for the 12 Volt-DC power and ground wires.
 - A. Determine the total maximum amperage draw of the Aqua-Hot heating system by adding the total maximum amps of the installed heat exchangers (consult the heat exchanger manufacturer for amp-draw information) to the Aqua-Hot 375-D's twenty-six amps.

NOTE: Each Aqua-Hot Cozy heat exchanger draws .23 amps of direct current.

For example, an Aqua-Hot 375-D heater with six Aqua-Hot Cozy heat exchangers draws a total of 27.38 amps ((6 x .23) + 26).

- B. Determine the total length of wire required to connect the terminal block to the vehicle's main battery disconnect.
- C. Reference Appendix B with the total amps and length of wire to determine the necessary wire gauge. For example, an Aqua-Hot 375-D heater with six

Aqua-Hot Cozy heat exchangers ten feet from the vehicle's battery would require an 6-gauge wire.

NOTE: The distance for the length of wire must be doubled when referencing the chart in Appendix B as the lengths given are from the source to the device and back to the source.

2. Run and connect two wires — one red (+) wire and one black (-) wire (power and ground), from the vehicle's main battery disconnect to the Aqua-Hot's 12 Volt-DC terminal block through the corresponding cable-clamp fitting. Reference Appendix A and Figures 47 and 48.
3. Follow the instructions in this section for "Installing the Wires into the Terminal Blocks" for each 12 Volt-DC wire.

Connecting the 120 Volt-AC Power:

1. Follow the instructions in this section for "Installing the Wires into the Terminal Blocks" for the 120 Volt-AC wires.

WARNING!

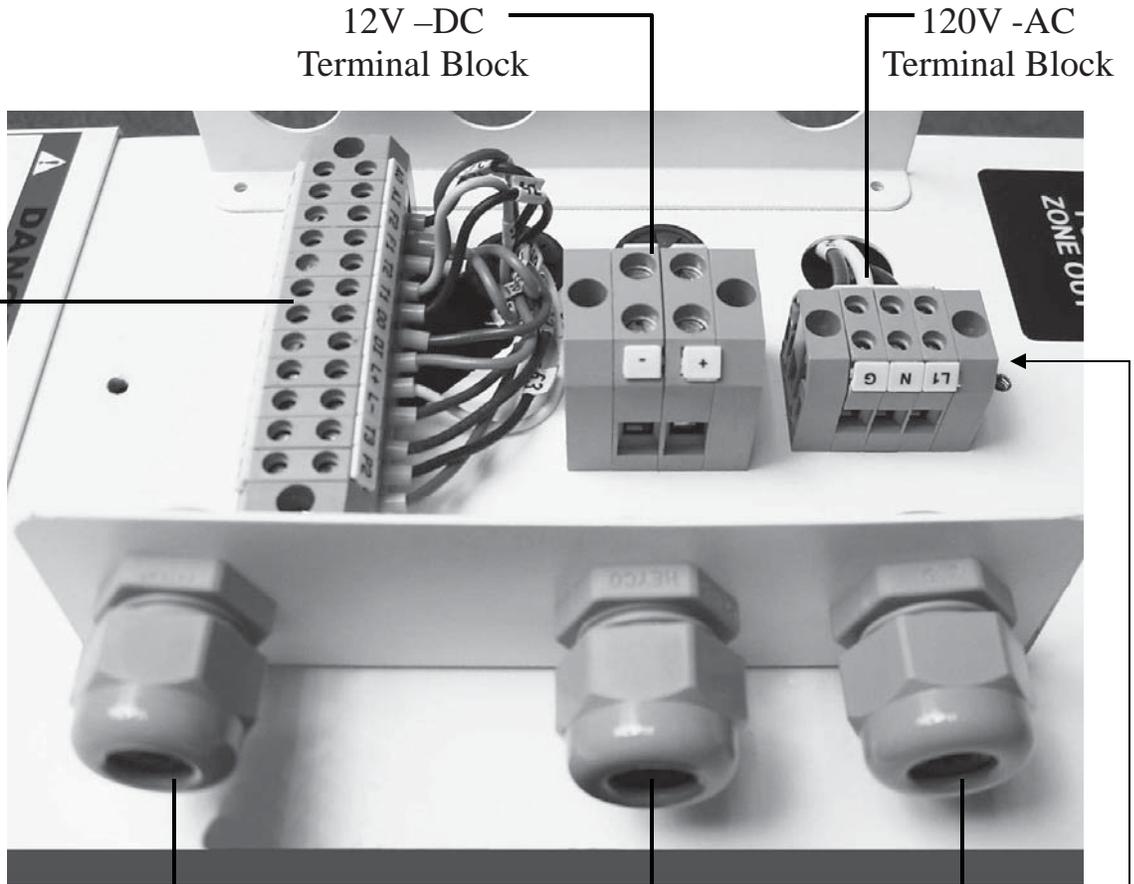
DO NOT activate the burner until the antifreeze and water heating solution has been added to the boiler tank and the heating system has been completely bled of air. Operating the Aqua-Hot without the antifreeze and water heating solution will cause serious damage to the Aqua-Hot's boiler tank.

Installing the Wires into the Terminal Blocks:

1. Loosen the cable clamps on the installed cable clamp fittings. Reference Figure 47.
2. Insert the wires into the terminal block access area through the appropriate port's cable clamp fitting and into the proper terminal. A ferrule is required if stranded wire is being used to connect to the terminal block. Tighten the terminal screws to 5 inch-pounds using a slotted blade no wider than 1/8". Reference Figure 47.
3. Secure the wires into their terminals by tightening the corresponding screw on the terminal block.
4. Hand-tighten the cable clamps on each of the cable-clamp fittings.
5. Re-install the terminal block access cover and tighten the screws securing the cover to the Aqua-Hot.

Figure 47

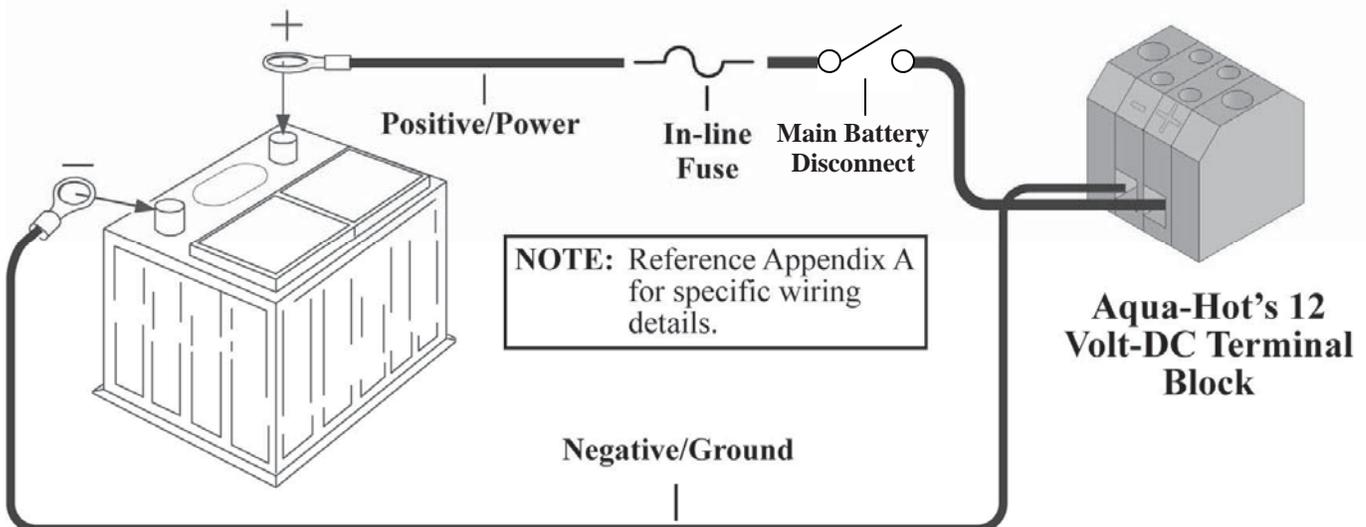
Terminal Block for Switches, Heat Exchanger Fans and Thermostats



Cable-Clamp Fittings (Placement Optional)

WARNING!

Tighten the terminal block screws to 5 inch-pounds using a slotted blade, no larger than 1/8", when attaching the 120V AC wires to the terminal block.



WARNING!

Only propylene glycol based “boiler” type antifreeze deemed “GRAS” (Generally Recognized as Safe) by the FDA shall be used in the Aqua-Hot’s hydronic heating system. Failure to use the above specified antifreeze type could result in serious injury or death.

CAUTION

Ensure that the overflow tube is connected from the Aqua-Hot’s expansion tank connection to the expansion tank’s bottom connection and from the expansion tank’s top connection through the overflow tube hole in the motorhome’s bay floor prior to beginning this antifreeze and water heating solution fill procedure. Failure to do so could result in an antifreeze spill in the motorhome’s bay. Reference Figure 12.

Purging the Hydronic Heating System:

In order to provide the best freeze protection, boil-over protection, and anti-corrosion and rust protection, a mixture of “GRAS” approved propylene glycol antifreeze and water is recommended.

Aqua-Hot recommends the antifreeze solution in the Aqua-Hot system contain 35% to 50% propylene glycol.

You must refer to the information and chart in Appendix E and determine the level of protection required for your operating conditions.

Reference Appendices C through E for additional information regarding the antifreeze and water heating solution. Be sure to use a “GRAS” boiler-type propylene glycol based antifreeze rather than an RV and Marine antifreeze or an automotive antifreeze/coolant.

If assistance is needed in selecting an appropriate antifreeze, please contact the Aqua-Hot Heating Systems Product Application Department at 1-800-685-4298.

Figure 49

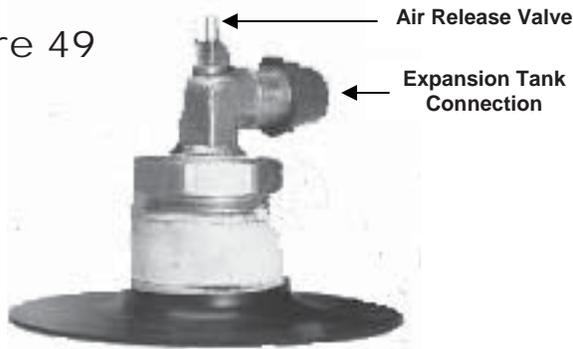
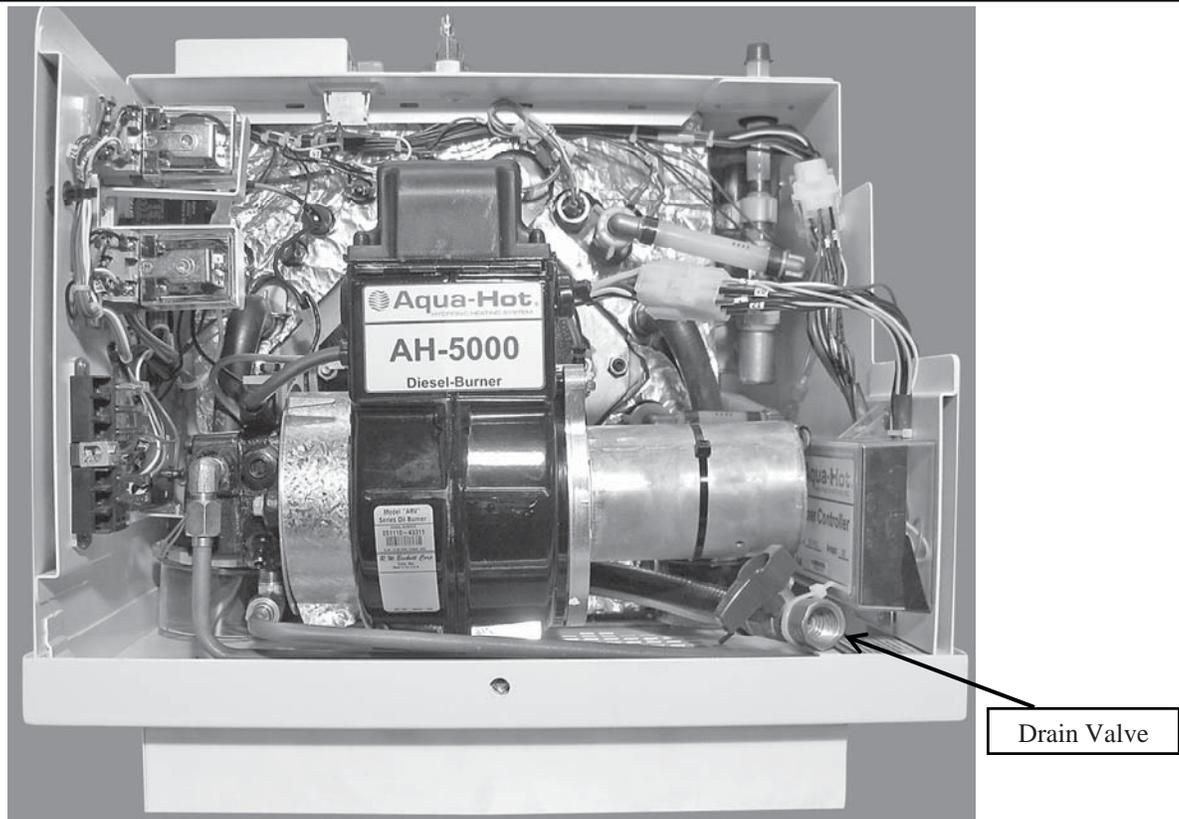


Figure 50



SECTION 10: PURGING THE SYSTEMS

Purging the Hydronic Heating System (Continued):

1. Refer to the information and chart in Appendix E and determine the level of protection required for your operating conditions.
2. Mix propylene glycol based antifreeze and water to meet the level of protection you require.

NOTE: See Appendix D for water quality recommendations and Appendix E Antifreeze mixture information and ratios.

CAUTION

Propylene glycol based antifreeze solution is not 100% propylene glycol. Some propylene glycol based antifreeze solution is premixed with water.

3. **Measure the level of propylene glycol in the antifreeze solution to ensure it is mixed to the proper level of protection.**

NOTE: Use a refractometer to properly measure the percent of propylene glycol in the antifreeze solution. Ball-type hydrometers typically used for measuring the percentage of ethylene glycol in automotive applications will not properly measure the level of propylene glycol. See Appendix F on Page 52.

4. Open the Aqua-Hot's drain valve located at the front of the heater. Reference Figure 50.
5. Connect a piece of 1/2 inch PEX-type tubing to the drain valve. This piece should be long enough to transport the antifreeze and water heating solution from its source to the Aqua-Hot.
6. Fill the Aqua-Hot completely with the proper mixture of antifreeze solution. This will take approximately five gallons; look for the solution to enter the overflow tube attached to the expansion tank connection on top of the Aqua-Hot.
7. When refilling, open the air-release valve located on the expansion tank connection to release air pockets. Reference Figure 47. Hold the valve open until all air is released. Be sure the valve is closed when finished by hand-tightening. Look for the solution to enter the overflow tube attached to the expansion tank connection on top of the Aqua-Hot.
8. Close the drain valve.

Purging the System by Grounding the Zone

Thermostat Connection:

1. Ensure that the boiler tank has been filled with the appropriate mixture of antifreeze and water heating solution.
2. Locate Terminal Block for switches, heat exchangers, fans and thermostats. Reference Figure 51.
3. Locate the thermostat connection terminals T1 and T2. Reference Figure 52.
4. Connect a wire to the desired zone terminal and connect the opposite end of the cable to a ground source. Reference Figure 52.

NOTE: The circulation pump will activate as soon as the terminal is connected to a ground source; therefore, disconnect the wire from the ground source during the antifreeze and water heating solution filling procedure.

5. Allow the circulation pump to operate for approximately 1-3 minutes in order to purge the corresponding heating loop, then remove the wire from the ground source.
6. Open the drain valve and completely fill the Aqua-Hot's boiler tank with additional antifreeze and water heating solution.
7. Repeat steps 5 and 6 for both heating loops until all air has been completely bled from the entire heating system.

NOTE: All air is bled from the heating system when the antifreeze solution enters the overflow tube attached to the expansion tank connection.

8. Once the systems have been purged, disconnect the wire from the ground source and the terminal block.
9. Check the Aqua-Hot's expansion tank and top it off to the cold level mark with the antifreeze and water solution, if necessary.
10. Ensure that each thermostat's connection wiring is still in its original configuration. Reference Appendix A.

Purging the Domestic Water System:

CAUTION

Verify that the domestic water tank contains fresh water prior to bleeding the fresh water system.

1. Ensure that the vehicle's domestic water pump has 12 Volt-DC power, then activate it by opening each hot water faucet, one at a time, and running the water until all air is purged from the domestic water system.
2. Once the domestic water system is completely bled, check for leaks in the domestic water system.

Figure 51

Terminal Block for Switches, Heat Exchanger Fans and Thermostats

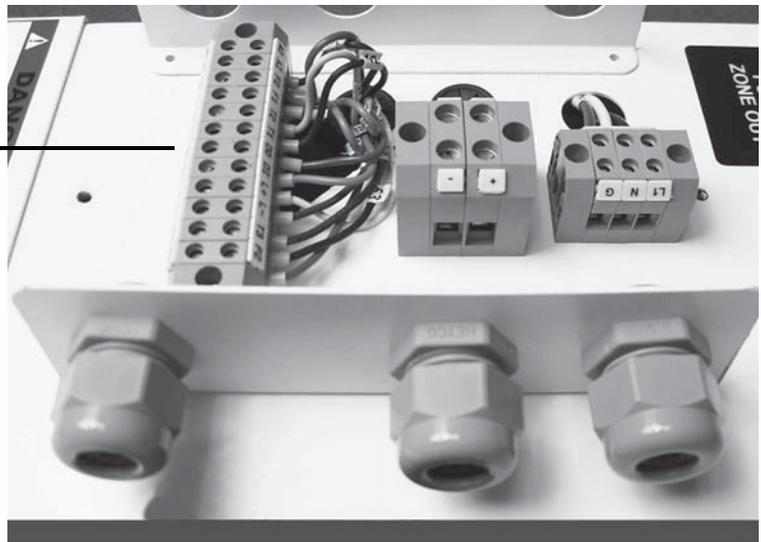
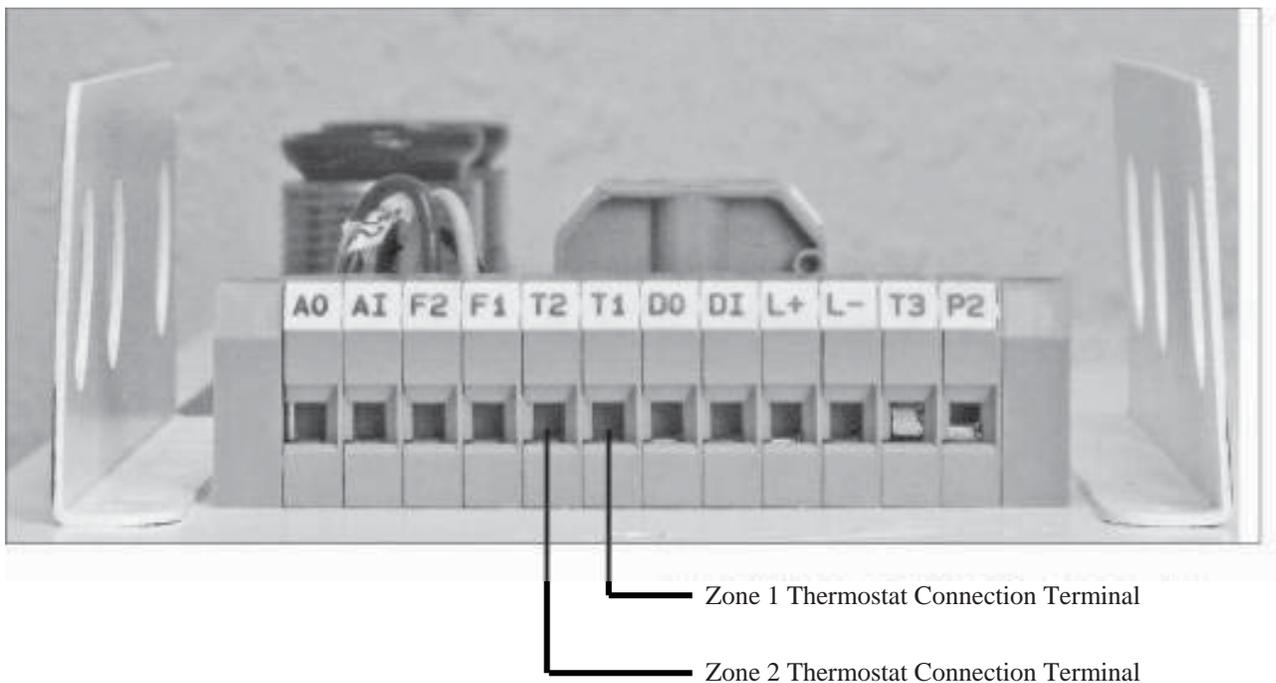


Figure 52



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Activating the Aqua-Hot:

1. Reinstall the Aqua-Hot's main access cover and the fastener, which secures the front of the Aqua-Hot's access cover to the mounting tray.

NOTE: The main access cover must be installed prior to operation; a safety switch exists, which will prevent the Aqua-Hot from operating whenever the main access cover is not properly installed.

2. Move the diesel burner switch to the **ON** position for approximately ten seconds **ONLY**, then switch it **OFF**.

NOTE: This procedure will purge the diesel-burner's fuel system by allowing the heater's fuel pump to complete its normal 30-150 second shutdown/purge cycle.

3. After the purge cycle has ended, repeat once more.
4. Move the diesel-burner switch to the **ON** position and leave it on in order to activate the diesel-burner.

NOTE: It will take approximately 10 seconds before the diesel-burner will ignite and exhaust can be heard exiting the heater.

Allow approximately 10-20 minutes for the Aqua-Hot to reach normal operating temperature (approximately 190°F).

5. Move the Aqua-Hot's electric element switch to the **ON** position in order to supply 120 Volt-AC power to the electric heating element.

NOTE: Both the 12 Volt-DC powered diesel-burner and the electric heating element are thermostatically controlled. Either or both heating sources will automatically maintain the temperature of the boiler tank's antifreeze and water heating solution.

The Aqua-Hot is now ready for normal operation and use.

Activating the Aqua-Hot when it has been turned off for long periods of time in cold temperatures:

NOTE: These procedures for "Cold Starting" are only necessary when:

- Starting the Aqua-Hot in cold climates for the first time
- Taking the coach from storage in cold climates when the Aqua-Hot has been completely shut down.

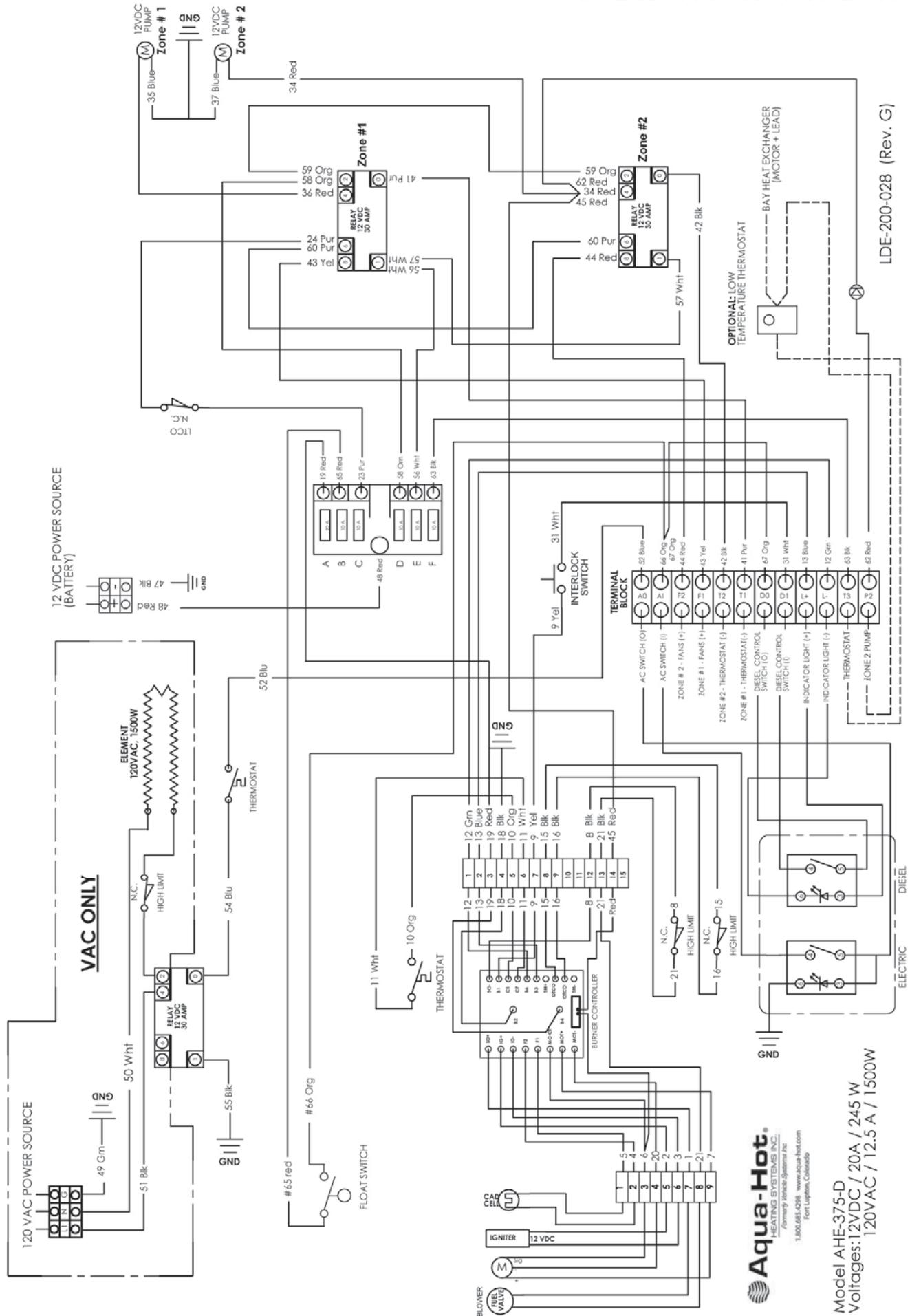
To initially start the Aqua-Hot 375D in cold climates, It may be necessary to preheat the Aqua-Hot 375D with the Aqua-Hot system's electric element before the Aqua-Hot system's diesel burner will operate.

When turning on the diesel burner switch inside the coach, if the Aqua-Hot fails to start and the light on the burner switch blinks 8 times (8 code), the following preheating process should be followed:

Preheating the Aqua-Hot 375D with the electric element:

1. Turn the burner switch to "off"
2. Plug in the coach to shore power **or** turn on the coach's generator
3. Turn on the Aqua-Hot's electric switch
4. Wait a maximum of 45 minutes before turning on the Aqua-Hot 375's diesel burner

APPENDIX A: WIRING DIAGRAM



Model AHE-375-D
 Voltages: 12VDC / 20A / 245 W
 120VAC / 12.5 A / 1500W

LDE-200-028 (Rev. G)

APPENDIX B: WIRE GAUGE INFORMATION

CONDUCTOR SIZING TABLE - MAXIMUM 10% VOLTAGE DROP - (12VDC)

CURRENT DRAW (AMPS)

	1	2	3	4	5	6	7	8	9	10	15	20	25	30	40	50	60	70	80	100	
GAGE	MAXIMUM LENGTH OF SAE CONDUCTOR (in feet) FROM SOURCE TO DEVICE																				
20	107	53	36	27	21	18	15	13	12	11	7										
18	172	86	57	43	34	29	25	21	19	17	11	9									
16	261	130	87	65	52	43	37	33	29	26	17	13	10								
14	413	207	138	103	83	69	59	52	46	41	28	21	17	14							
12	651	326	217	163	130	109	91	81	72	65	43	33	26	22	16						
10	1043	521	348	261	208	174	149	130	116	104	70	52	42	35	26	21	17				
8	1653	827	551	413	331	276	236	207	184	165	110	83	66	55	41	33	28	24	21		
6	2892	1446	954	723	578	482	413	362	321	289	193	145	116	96	72	58	48	41	36	29	
4	4170	2085	1390	1043	834	695	596	521	463	417	278	209	167	139	104	83	70	60	52	42	

MAXIMUM LENGTH OF AWG CONDUCTOR (in feet) FROM SOURCE TO DEVICE

20	115	57	38	29	23	19	16	14	13	11	8										
18	182	81	61	45	36	30	26	23	20	18	12	9									
16	288	144	96	72	58	48	41	36	32	29	19	14	12								
14	458	229	153	115	92	76	65	57	51	46	31	23	18	15							
12	729	364	243	182	146	121	104	91	81	73	49	36	29	23	19						
10	1159	579	386	290	232	193	166	145	129	116	77	58	46	39	29	23	19				
8	1738	869	579	435	348	290	248	217	193	174	116	87	70	58	43	35	29	25	22		
6	2930	1465	977	733	586	488	419	366	326	293	195	147	117	98	73	59	49	42	37	29	
4	4659	2330	1553	1165	932	777	666	582	518	466	311	232	186	155	116	93	78	67	58	47	

OVERCURRENT PROTECTION

AWG OR SAE Conductor Size Gage (Metric)	Maximum Ampacity at Conductor Insulation Temperature Rating of:		
	90° C	105° C	125° C
20 (.05)	10	10	15
18 (.08)	15	15	20
16 (1)	20	20	25
14 (2)	25	30	30
12 (3)	30	40	40
10 (5)	40	50	60
8 (8)	50	70	80
6 (13)	80	100	100
4 (19)	100	120	150
2 (32)	150	150	200

The following information addresses the necessary usage of a propylene glycol based “boiler” type antifreeze in the Aqua-Hot. Propylene glycol is a safer alternative to the more toxic ethylene glycol antifreeze; however, as mandated by IAPMO (International Association of Plumbing and Mechanical Officials), only those propylene glycol based “boiler” type antifreezes deemed “Generally Recognized as Safe” (GRAS) by the FDA should be utilized.

Because of the significant impact various types of antifreeze can have on a hydronic heating system, including the level of safety provided, it has been recognized that there is a need to provide an explanation regarding two additional prominent types of antifreeze/coolant available. The following information should be utilized as an educational means of ensuring that the proper type of propylene glycol based antifreeze is selected:

RV & Marine Antifreeze:

These types of propylene glycol based antifreeze products are formulated specifically for “winterizing” applications only. Although RV & Marine antifreeze is often “Generally Recognized as Safe” by the FDA, it should never be used in

the Aqua-Hot’s Hydronic Heating System. This type of antifreeze is not formulated to transfer heat, which is essential to the heating system’s functionality and does not contain rust inhibitors. Please note, however, that RV & Marine antifreeze can be utilized to winterize the Aqua-Hot’s Domestic Hot Water Heating System.

Automotive Antifreeze/Coolant:

These types of propylene glycol based antifreeze products are formulated specifically to protect automotive engines against corrosion, freezing temperatures, and overheating. They also have excellent heat transfer and thermal conductivity characteristics. Although these types of antifreeze products are considered less toxic and safer than ethylene glycol for people, pets, and the environment, they are not “Generally Recognized as Safe” (GRAS) rated by the FDA. Therefore, they must be marked with a “harmful if swallowed” warning. This additional warning is required because these types of antifreeze products contain high levels of chemical rust inhibitors. Due to their potentially hazardous properties, they should never be used in the Aqua-Hot’s Hydronic Heating System.

APPENDIX D: ANTIFREEZE MIXTURE WATER QUALITY RECOMMENDATIONS

In order to ensure maximum performance and longevity of an Aqua-Hot heating system’s boiler tank and associated components, it has been determined that there is a need to use distilled, de-ionized, or soft water in combination with concentrated propylene glycol for the Aqua-Hot’s antifreeze and water heating solution. Please note that this is only necessary when mixing concentrated propylene glycol antifreeze with water; suppliers of pre-mixed antifreeze are responsible for the use of high-quality (distilled, de-ionized, or soft) water when preparing their antifreeze for sale.

Hard water possesses a high-level of calcium and magnesium ions, which deplete the propylene glycol antifreeze’s corrosion inhibitors. This, in turn, causes the antifreeze and water heating solution to begin turning acidic, which can corrode the Aqua-Hot’s Boiler tank and associated components prematurely. Therefore, concentrated propylene glycol should be diluted with distilled, de-ionized, or soft water which is 80 ppm or less in total hardness. The local water agency should have up-to-date water quality reports which should indicate if the local tap water is within this guideline.

Propylene Glycol Based Antifreeze Solution:

The following information addresses the process of selecting a propylene glycol based antifreeze solution that provides adequate freeze, boiling, and rust/anti-corrosive protection.

A propylene glycol antifreeze solution that is 35% to 50% propylene glycol is recommended. Antifreeze solution with 50% propylene glycol will result in a freeze point of approximately -28°F and a boil point of approximately 222°F.

NOTE: As the installer of this Aqua-Hot system, you must refer to the information and chart in Appendix E to determine the percentage of propylene glycol your antifreeze solution should contain for the level of protection you require.

Aqua-Hot sells CAMCO propylene glycol based antifreeze solution in the following packages:

Part Number	Container Size	% Propylene Glycol
MSX-300-270	Gallon Bottle	68%
MSX-300-275	Quart Bottle	98%
MSX-300-280	55 Gallon Drum	68%

NOTE: Propylene glycol based antifreeze solution is not 100% propylene glycol. It is a mixture of propylene glycol, rust and anti-corrosive inhibitors, and water.

The following information should be utilized for the purpose of clarifying some terms commonly associated with anti-freeze.

Freeze Point and Burst Point:

Antifreeze solution lowers the freezing point of any liquid, to which it has been added, by preventing the formation of ice crystals; however, as the ambient temperature continues to decline, the water in the solution will attempt to attain a solid state. The point in which the water begins to solidify is termed the “Freeze Point.” Although the water in the solution has begun to freeze, producing a “slushy” consistency, the antifreeze in the solution will continue to combat the normal expansion of the solution as it freezes. The point in which the solution can begin to expand, due to colder temperatures, is called the “Burst Point.” Once the solution reaches the burst point, the potential is present for ruptured pipes to exist. The burst point of the antifreeze and water heating solution is dependent upon the brand of propylene glycol antifreeze employed.

Boiling Point:

The Aqua-Hot utilizes the propylene glycol based (PPG) antifreeze and water heating solution as a transportation means for the heat produced from the internal processes. The PPG antifreeze solution absorbs the heat created until its boiling point is reached; it is at this point that the liquid turns to a gas and is expelled to prevent the heating system from overheating. Each time the boiling point is reached, a loss of efficiency occurs because the heat produced is expelled rather than utilized for the function of the heating system. Therefore, a higher boiling point is desired in order to combat the loss of efficiency, which allows the antifreeze to transport the heat created from the internal process throughout the motorhome where it can be utilized productively rather than dissipating due to its change from a liquid to a gas.

Rust and Anti-Corrosive Inhibitors:

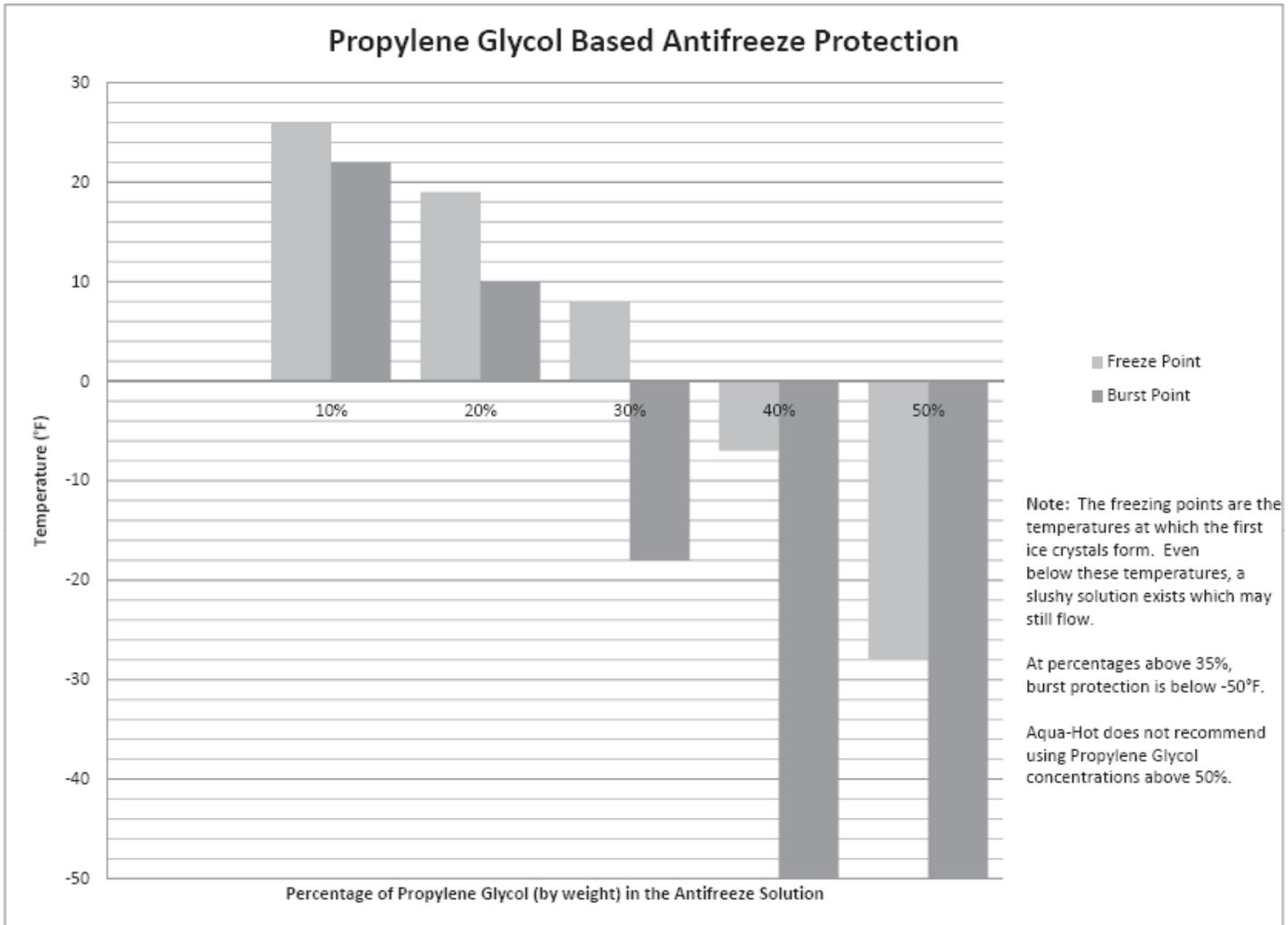
Another major function of antifreeze solution is to provide protection to the internal metal components of the Aqua-Hot hydronic heating system from corrosion and rust. Antifreeze is able to perform this function by the addition of rust and anti-corrosive inhibitors, which are designed specifically to activate in a water solution.

Summary:

Antifreeze solution has three basic functions: freeze protection, boil-over protection, and anti-corrosion and rust protection.

PPG Antifreeze solution is also primarily responsible for heat transfer; however, propylene glycol itself does not possess acceptable heat transfer characteristics. Therefore, as water is an excellent heat conductor, it is added to the mixture. PPG antifreeze solution, mixed with water, that is 35% to 50% propylene glycol is recommended to provide the best performance combination of the aforementioned functions. If excess propylene glycol exists within an antifreeze and water heating solution, the water’s heat absorption properties are compromised, which could ultimately inhibit the Aqua-Hot from providing adequate domestic hot water and interior heating.

Additionally, if the antifreeze and water heating solution contains over 70 percent propylene glycol, the freezing point is actually raised, resulting in less freeze protection. Please reference the attached graphical representation regarding the percentage of antifreeze to water and how it directly affects the solution’s freezing point.

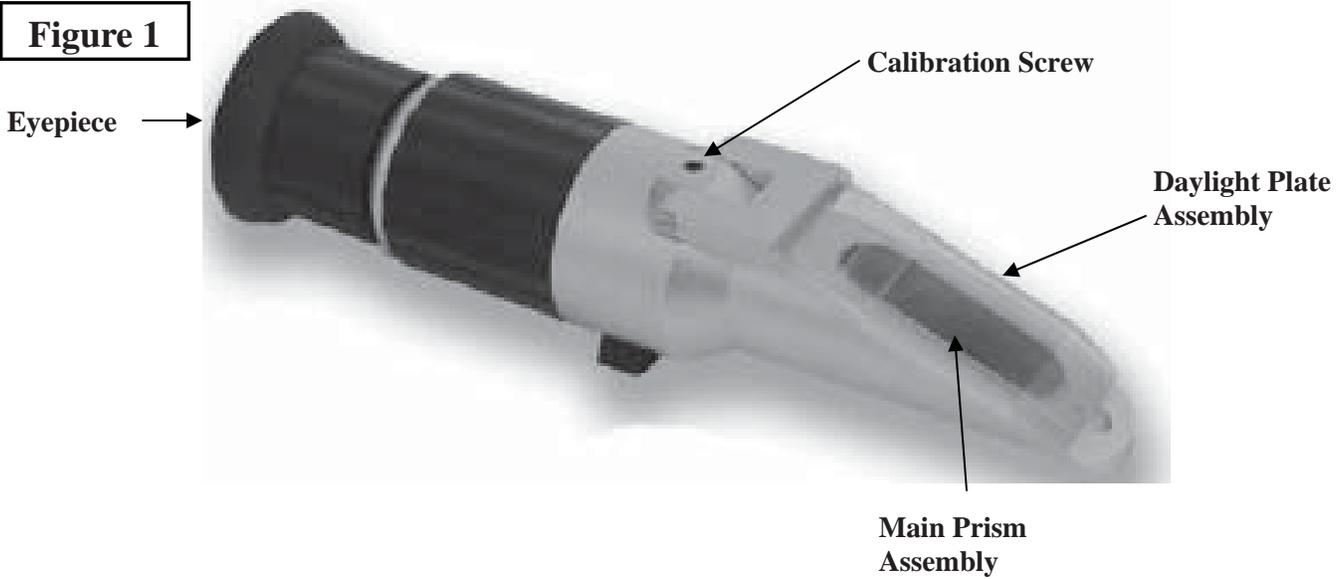


APPENDIX F: MEASURING PROPYLENE GLYCOL USING A REFRACTOMETER

CALIBRATE THE REFRACTOMETER

Aqua-Hot Part Number MSX-907-162

Figure 1



Calibration Procedure

Poor Poor Good

As seen when looking into the instrument

Upper Blue Field

Lower White Field

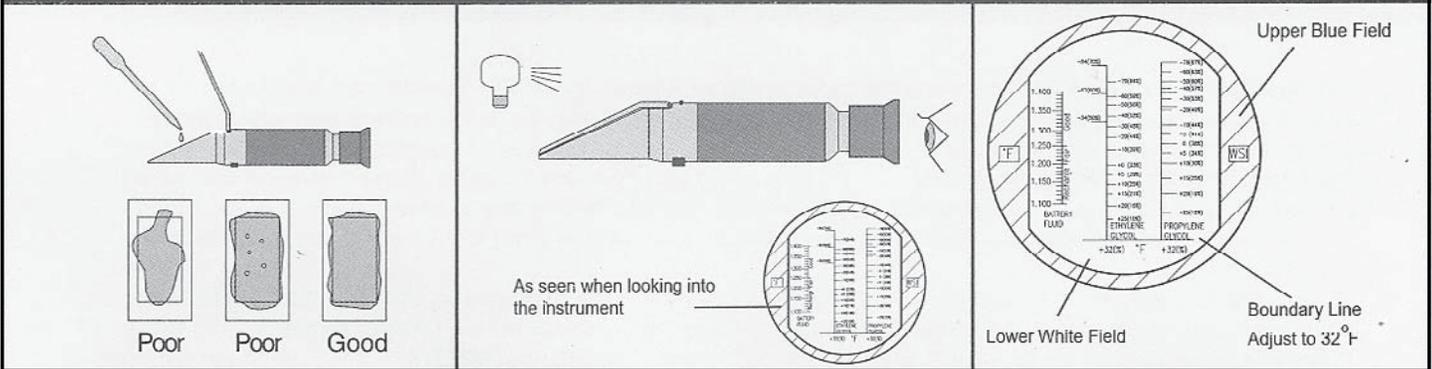
Boundary Line Adjust to 32°F

USING THE REFRACTOMETER TO TEST ANTIFREEZE SAMPLE

Warning

1. Use extreme caution in gathering your antifreeze sample. When draining the Aqua-Hot heating system, extremely hot liquid may be in the Boiler Tank and could cause personal injury.

Basic Operation



1. Open daylight plate, and place 2-3 drops of the sample on the main prism. Close the daylight plate so the liquid sample spreads across the entire surface of the prism without air bubbles or dry spots. Allow the sample to rest on the prism for approximately 30 seconds before going to step #2. (This allows the sample to adjust to the ambient temperature of the refractometer).
2. Hold daylight plate in the direction of a light source and look into the eyepiece. You will see a circular field with graduations down the center (you may have to focus the eyepiece to clearly see the graduations). The upper portion of the field should be blue, while the lower portion should be white.
3. Take the reading where the boundary line of blue and white cross the graduated scale. The scale will provide a reading of the freezing point of antifreeze solution and the propylene glycol concentration. Clean the prism carefully using a damp soft cloth. Do NOT immerse in water.

NOTE: Refractometers may have more than one scale. Make sure you are reading the scale marked "Propylene" for measuring the antifreeze solution in the Aqua-Hot system.



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