



By Vehicle Systems, Inc.

Motorhome Heating Specialist

Installation Manual

Model Numbers

AHE-100-04S - 12 VDC

AHE-130-04X - 12 VDC

TABLE OF CONTENTS

Section 1	Hydronic Heating System Overview	Page
1.1	Heating System Overview.	2
Section 2	Aqua-Hot Overview	
2.1	Aqua-Hot Overview.	4
2.2	Aqua-Hot Model Differentiation.	4
Section 3	Installation Procedures	
3.1	Installation Procedure.	7
3.2	Mounting the Aqua-Hot Overview.	7
3.3	Mounting the Aqua-Hot.	8
3.4	Mounting the Interior Heat Exchangers Overview	12
3.5	Mounting the Interior Heat Exchangers	17
3.6	Mounting the Fresh Water Tank Heat Exchanger Overview.	17
3.7	Mounting the Fresh Water Tank Heat Exchanger.	20
3.8	Plumbing the Heat Exchangers Overview	20
3.9	Installing the Interior/Fresh Water Tank Plumbing Lines.	20
3.10	Plumbing the Engine Preheat System Overview	25
3.11	Attaching Plumbing Lines to the Vehicle's Engine	25
3.12	Domestic Hot Water Plumbing Overview	29
3.13	Attaching Plumbing Lines to the Domestic Hot Water System	30
3.14	Electronic Controller Overview	30
3.15	Wiring the Interior and Fresh Water Tank Heat Exchangers.	32
3.16	Mounting Locations for Interior Room Thermostats Overview	33
3.17	Wiring the Interior Room Thermostats	33
3.18	Mounting the Fresh Water Tank Thermostat Overview.	34
3.19	Wiring the Fresh Water Tank Thermostat	34
3.20	Installing and Wiring the Switch Panel	40
3.21	Diesel-Burner's Fuel System Overview	40
3.22	Installing the Diesel-Burner's Fuel System and Lines	42
3.23	Overview and Installation of the Aqua-Hot's Exhaust System	45
3.24	Installing the Aqua-Hot's Expansion Bottle	47
3.25	Connecting 12 Volt-DC Power to the Aqua-Hot	48
3.26	Bleeding the Interior/Fresh Water Tank Hydronic Heating System.	51
3.27	Bleeding the Domestic Water System.	52
3.28	Bleeding the Engine Preheat System.	54
3.29	Connecting 120 Volt-AC Power to the Aqua-Hot	54
3.30	Initial Activation of the Aqua-Hot.	57
Appendix A	Wiring Diagrams	
AHE-100-04S	Wiring Information	A1
AHE-130-04X	Wiring Information	A2
AHE-100-04S	Enlarged View of Switch Panel and Heating Zone Wiring	A3
AHE-130-04X	Enlarged View of Switch Panel and Heating Zone Wiring	A4
Appendix B	Wire Gauge Information	
Wire Gauge Chart	B1

TABLE OF CONTENTS (continued)

Referenced Illustrations	Page
Figure 1: Aqua-Hot and Inclusive Components	1
Figure 2: Heat Exchanger Heating Loops	3
Figure 3: Aqua-Hot Marking Plate	6
Figure 4: Aqua-Hot Combustion Air Overview	9
Figure 5: Aqua-Hot Dimensions	10
Figure 6: Aqua-Hot Mounting Template	11
Figure 7: Interior Heat Exchanger Mounting Locations	12
Figure 8: Interior Heat Exchanger Location Overview	14
Figure 9: Interior Heat Exchanger Dimensions, Wiring, and Mounting	15
Figure 10: Allowable Cozy III Heat Exchanger Mounting Configurations	16
Figure 11: Fresh Water Storage Tank's Heat Exchanger	17
Figure 12: Minimum Cozy III Heat Exchanger Clearance	18
Figure 13: Cozy III Heat Exchanger Mounting Template	19
Figure 14: Heat Exchanger Plumbing Overview	22
Figure 15: Installing the Heat Exchanger Plumbing	23
Figure 16A: "Supply" Heating Loop Ports and Plumbing	24
Figure 16B: "Return" Heating Loop Ports and Plumbing	24
Figure 17: Installing the Engine Preheat Plumbing on the Vehicle's Engine	26
Figure 18: Engine Coolant Supply and Return Port Locations	28
Figure 19: Attaching Plumbing Lines to the Domestic Hot Water System	30
Figure 20: Domestic Hot Water System Overview	31
Figure 21: Wiring the Fresh Water Tank Thermostat	34
Figure 22: Switch Panel Mounting Templates	35
Figure 23A: AHE-100-04S Switch Panel and Indicator Light Wiring	36
Figure 23B: AHE-100-04S Switch Panel Wiring Schematic	37
Figure 24A: AHE-130-04X Switch Panel and Indicator Light Wiring	38
Figure 24B: AHE-130-04X Switch Panel Wiring Schematic	39
Figure 25: Fuel System Specifications	41
Figure 26: Installing the Diesel-Burner's Fuel Lines	42
Figure 27: Diesel Fuel Supply and Return Port Locations	43
Figure 28A: Fuel Filter Overview	44
Figure 28B: Fuel Filter Overview	44
Figure 29: Exhaust System Overview	46
Figure 30: Installing the Expansion Bottle	47
Figure 31: VDC Power Overview	49
Figure 32: Low Voltage Reset Button	50
Figure 33: Air-Pressure Testing the Hydronic Heating System	53
Figure 34A: AHE-100-04S VAC Power Installation	55
Figure 34B: AHE-130-04X VAC Power Installation	56
Generalized Motorhome Heating System Floorplan	13

**Aqua-Hot
and Inclusive
Components**

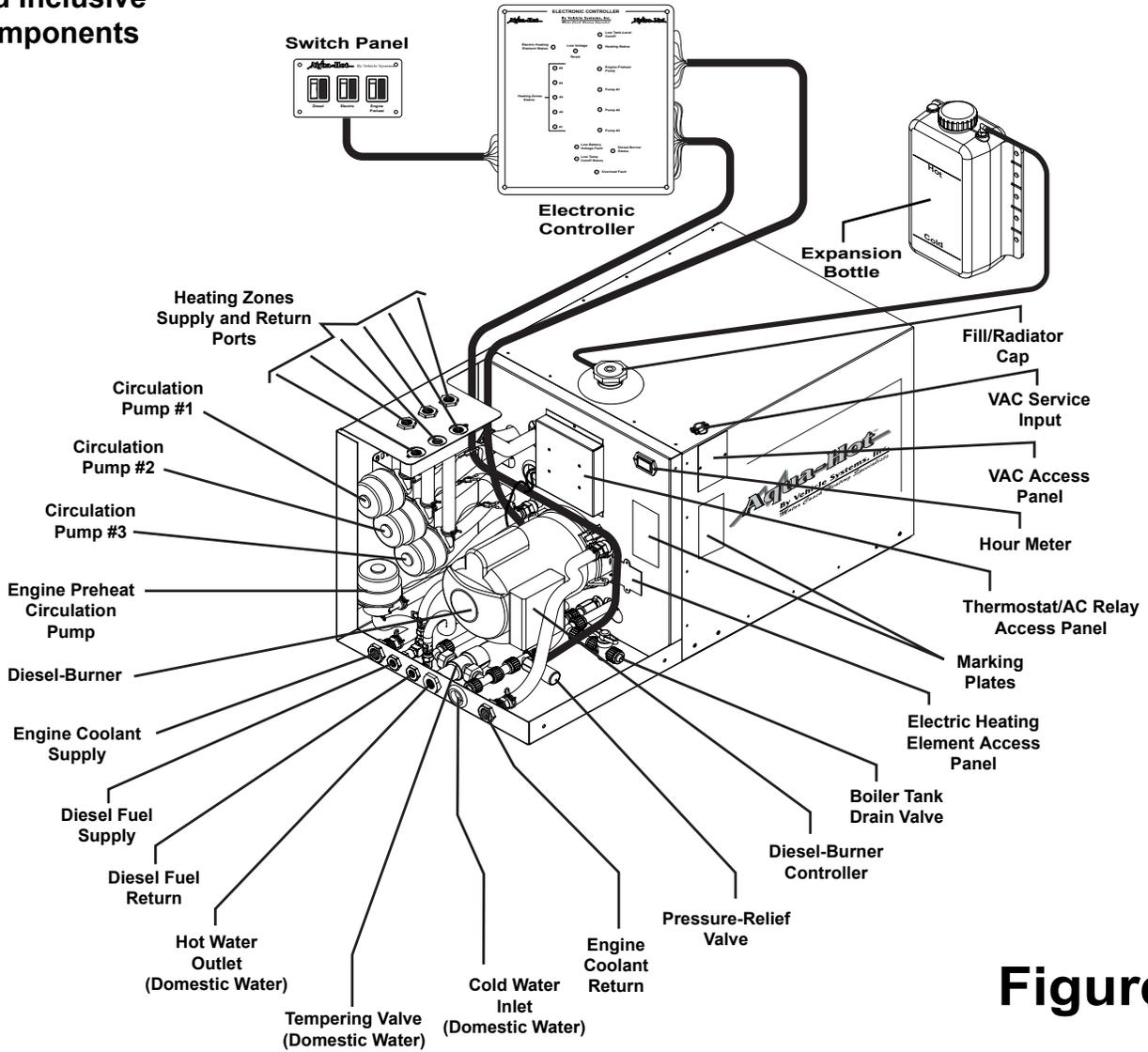


Figure 1

■ Introduction

1.1 Heating System Overview

The Aqua-Hot Hydronic Heating System utilizes an FDA approved “GRAS” (Generally Recognized as Safe) Propylene Glycol based antifreeze and water heating solution as its heating medium. This heated solution is circulated by three centrifugal Circulation Pumps to the heating system’s Heat Exchangers whenever a Room and/or Bay Thermostat “calls-for-heat.” As the heated solution is circulated through the Heat Exchangers, heat is transferred from the heating loop to the exchangers and delivered to each independent heating zone.

**Independent
(Heat Exchanger)
Heating Zones**

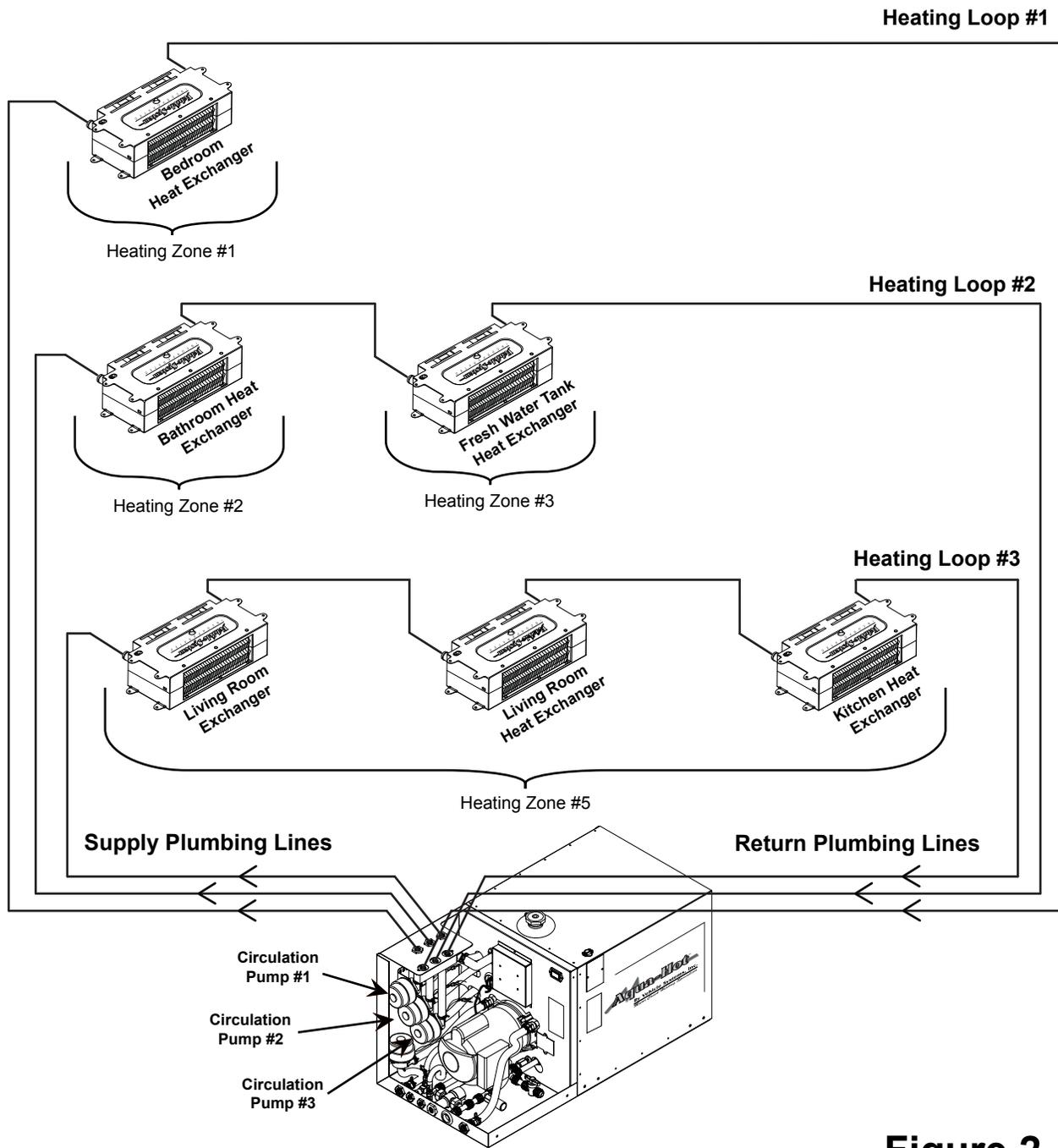
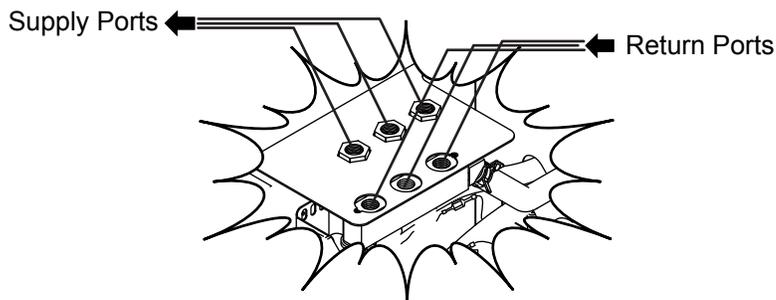


Figure 2



Aqua-Hot Overview

2.1 Aqua-Hot Overview

The Aqua-Hot Hydronic Heating System combines a continuous supply of domestic hot water and interior heating into one space-saving design. Both heating features are accomplished by a 12 Volt-DC powered Diesel-Burner and a minimum of one 120 Volt-AC Electric Heating Element. As Vehicle Systems manufactures two separate models of the Aqua-Hot, the number and wattage of the Electric Heating Element(s) may vary; reference Section 2.2 for model differentiation information. These two heating sources maintain the temperature of the Aqua-Hot's antifreeze and water heating solution. The antifreeze and water heating solution captures and stores the heat produced by the heating system, thereby providing continuous domestic hot water, as well as interior/fresh water tank heating. The Aqua-Hot has also been designed to preheat the vehicle's engine prior to starting, which provides easy engine start-up when cool weather conditions exist.

Aqua-Hot Model Differentiation

2.2 Aqua-Hot Model Differentiation

Vehicle Systems, Inc. manufactures two individual models of the Aqua-Hot Hydronic Heating System. The varying factor between these two models is the number of Electric Heating Elements featured, as well as the wattage employed by each Electric Heating Element. In order to determine which of the following Aqua-Hot models has been employed, locate the Marking Plate on the Heating System (reference Figures 1 and 3 for Marking Plate information) and view the Model Number Box.

AHE-100-04S

This model features a single 120 VAC/1650 Watt Electric Heating Element.

Diesel-Burner, Heat Input (Firing Rate)	50,000 BTU/hr
Diesel-Burner, Fuel Consumption (Continuous Operation)	0.40 gal/hr
Diesel-Burner, Voltage/Power Consumption	12 VDC/60 watts
Electric Heating Element specifications	120 VAC/1650 watts
Circulation Zone Pump specifications	(3) 12 VDC/21 watts/ea
Number of Heating Zones	maximum of 5, plus Engine Preheat
Domestic Water Heating Capacity	continuous/on-demand
Dimensions	18.5" H x 18.5" W x 36.75" L
Dry Weight	approximately 200 lbs.
<p>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.</p>	

**Aqua-Hot
Model
Differentiation,
continued**

AHE-130-04X

This model features two 120 VAC/2000 Watt Electric Heating Elements.

Diesel-Burner, Heat Input (Firing Rate)	50,000 BTU/hr
Diesel-Burner, Fuel Consumption (Continuous Operation)	0.40 gal/hr
Diesel-Burner, Voltage/Power Consumption	12 VDC/60 watts
Electric Heating Element specifications	(2) 120 VAC/2000 watts
Circulation Zone Pump specifications	(3) 12 VDC/21 watts/ea
Number of Heating Zones	maximum of 5, plus Engine Preheat
Domestic Water Heating Capacity	continuous/on-demand
Dimensions	18.5" H x 18.5" W x 36.75" L
Dry 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.

**Aqua-Hot
Marking Plate**

Model Number
Box

Serial Number
Box

Manufactured
Date Box

Aqua-Hot™
By Vehicle Systems, Inc. Ft. Lupton, CO 80621

AHE-100	04S	12 VDC / 184 Watts
Model Number		Diesel-Burner / DC Power
AH04-637		120 VAC, 60 Hz / 1.65 kW
Serial Number		Electric Heating Element / AC Power
06-04		DIESEL / 50,000 BTU
Manufactured Date		Fuel Type / Firing Rate
 Listing No. 02L01		Testing Engineers International Complies with the requirements of UL 307A Made in U.S.A.

For Installation Only in Compartment Completely Closed Off from Living Quarters and Accessible Only from the Outdoors.
 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 Electrical Power.
 The AC Powered Electrical Heating Element can be wired using flexible nonmetallic cable (ROMEX).
 USE COPPER CONDUCTORS ONLY
 Use 25 Amp fuse for over current protection for DC Power Supply.
 Use 20 Amp Circuit Breaker for over current protection for AC Power Supply.
 Mount Heater near a Bay / Storage Door so Access Cover can be easily removed

Minimum Heater clearances
 Front (Decal Sides) - Open Access
 Back (non-Decal sides) - 0 inches
 Top - 6 inches
 Install in strict compliance with local codes, NFPA 501c and manufacturer's instructions.
 For additional product installation information visit www.vehiclesys.com or call 1-800-685-4298

/ Storage Door so Acc removed
 Minimum Heater clearances
 Front (Decal Sides) - Open Access
 Back (non-Decal sides) - 0 inches
 Top - 6 inches
 compliance with local

Figure 3

**Reference Figure 1
for Marking Plate
Locations.**

SECTION 3: INSTALLATION PROCEDURES

Installation Procedure

3.1 Installation Procedure

All installations must be done in strict compliance with all applicable Codes, Laws, and Regulations having the force of Law.

Mounting the Aqua-Hot Overview

3.2 Mounting the Aqua-Hot Overview

Because Motorhome applications will vary, the Aqua-Hot's permanent mounting location should be chosen carefully. Adhering to the guidelines listed below will ensure maximum system performance and safe operation.

- A. The permanent mounting location must be **capable of supporting a minimum of 400 lbs.** Inspect the area beneath the mounting location to ensure no structural members will interfere with the Exhaust and Combustion-Air Intake Holes.
- B. Because combustion-air must be drawn from outside the motorhome, the Aqua-Hot **cannot** be installed anywhere inside the passenger compartment or any living area.
- C. Centralize the Aqua-Hot nearest the area where Domestic Hot Water will be used most frequently (i.e., Bathroom and Kitchen areas); reference Figure 7 and the "Generalized Motorhome Heating System Floorplan" in Section 3.4. This will ensure that the domestic hot water lines will be as short as possible.
- D. Mount the Aqua-Hot near a Storage Bay Door so the Aqua-Hot's Access Cover can be easily removed for product servicing, and the Heater can be easily accessed from outside the Motorhome. Mounting the Aqua-Hot in this location will also ensure a minimal length of Exhaust Pipe (reference Section 3.23, "Overview and Installation of the Aqua-Hot's Exhaust System," for details).
- E. The Aqua-Hot's Exhaust must be able to freely exit away from the Vehicle without any obstructions. In addition, the Exhaust Pipe is **hot** and must be kept away from any heat sensitive material.
- F. Adequate ventilation from underneath the Motorhome must be supplied to the Aqua-Hot at all times. This will ensure the Diesel-Burner receives a sufficient supply of combustion-air.

 **CAUTION:** The combustion air **cannot** be supplied from any compartment possibly containing combustible gases (e.g., Battery gases, Gasoline fumes, Propane fumes, etc.).

NOTE: Although preinstalled, the Combustion-Air Intake Sleeve **MUST BE UTILIZED** in order for the product to comply with the UL 307A listing; reference Figure 4.

- G. The permanent mounting location must allow for mounting of the Electronic Controller within the allowable wire harness length; reference Section 3.14 for specific mounting details.

Aqua-Hot Mounting

3.3 Mounting the Aqua-Hot

Once a mounting location for the Aqua-Hot has been selected, utilize the following illustrations for mounting information:

- Overall Aqua-Hot Dimensions; reference Figure 5.
 - Required size and locations of the Combustion-Air Hole and Exhaust Holes; reference Figure 6.
 - Required size and location of the Mounting Bracket Holes; reference Figure 6.
 - Minimum Heater clearances; reference the Aqua-Hot's Marking Plate (Figure 3).
1. Drill all the necessary holes prior to mounting the Aqua-Hot permanently into place; reference Figure 6.

NOTES:

- A. Be sure to drill the holes for the Exhaust System and Combustion-Air Intake prior to placing the Aqua-Hot into the permanent mounting position.
- B. Be sure to utilize all four Mounting Brackets to ensure that the Aqua-Hot does not move or shift under normal operating conditions.

2. Place the Aqua-Hot into the permanent mounting position.
3. Using 1/4 inch Bolts (total of eight required), fasten down the Aqua-Hot.

**Aqua-Hot
Combustion
Air Overview**

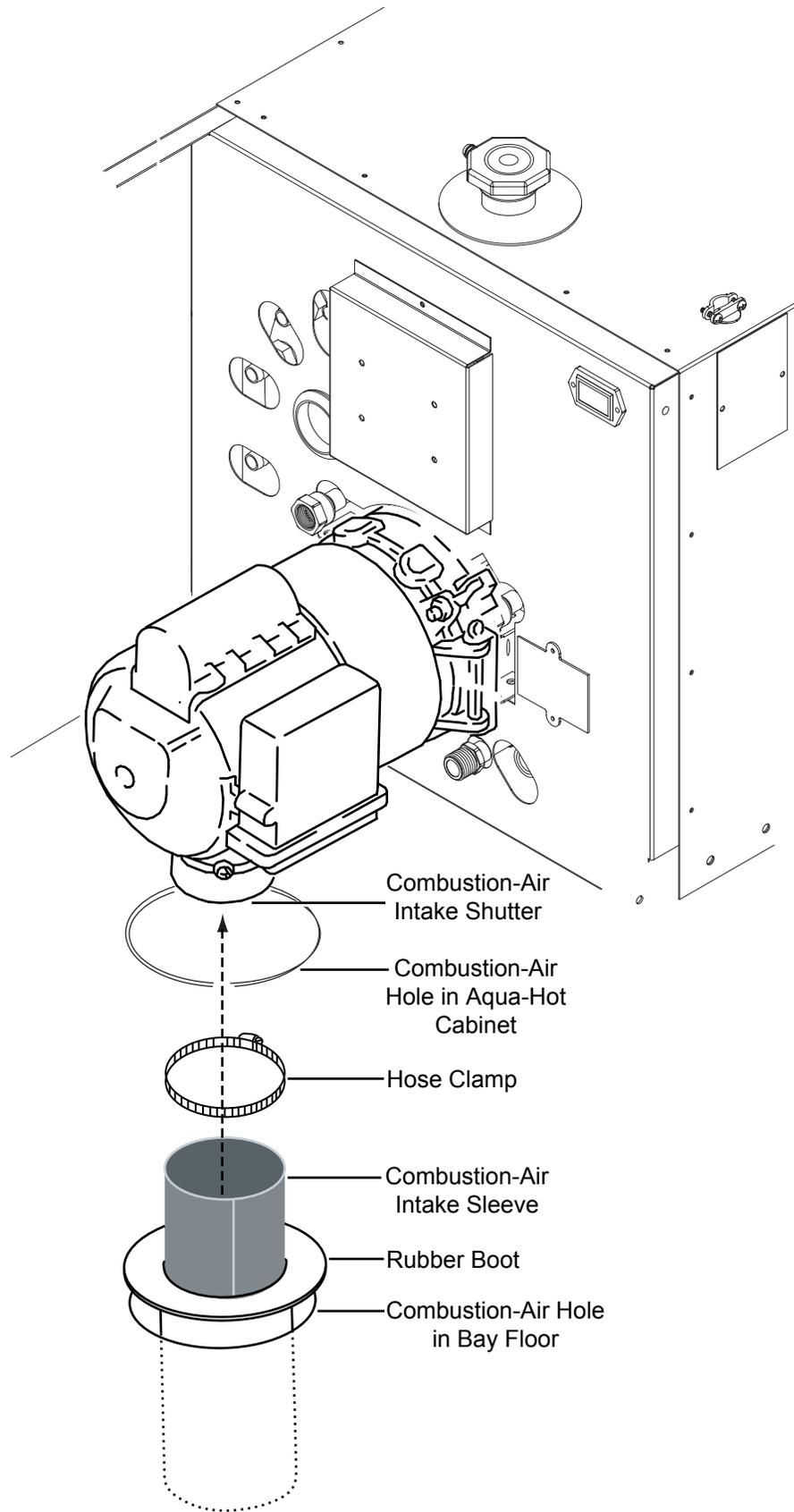


Figure 4

**Aqua-Hot
Dimensions**

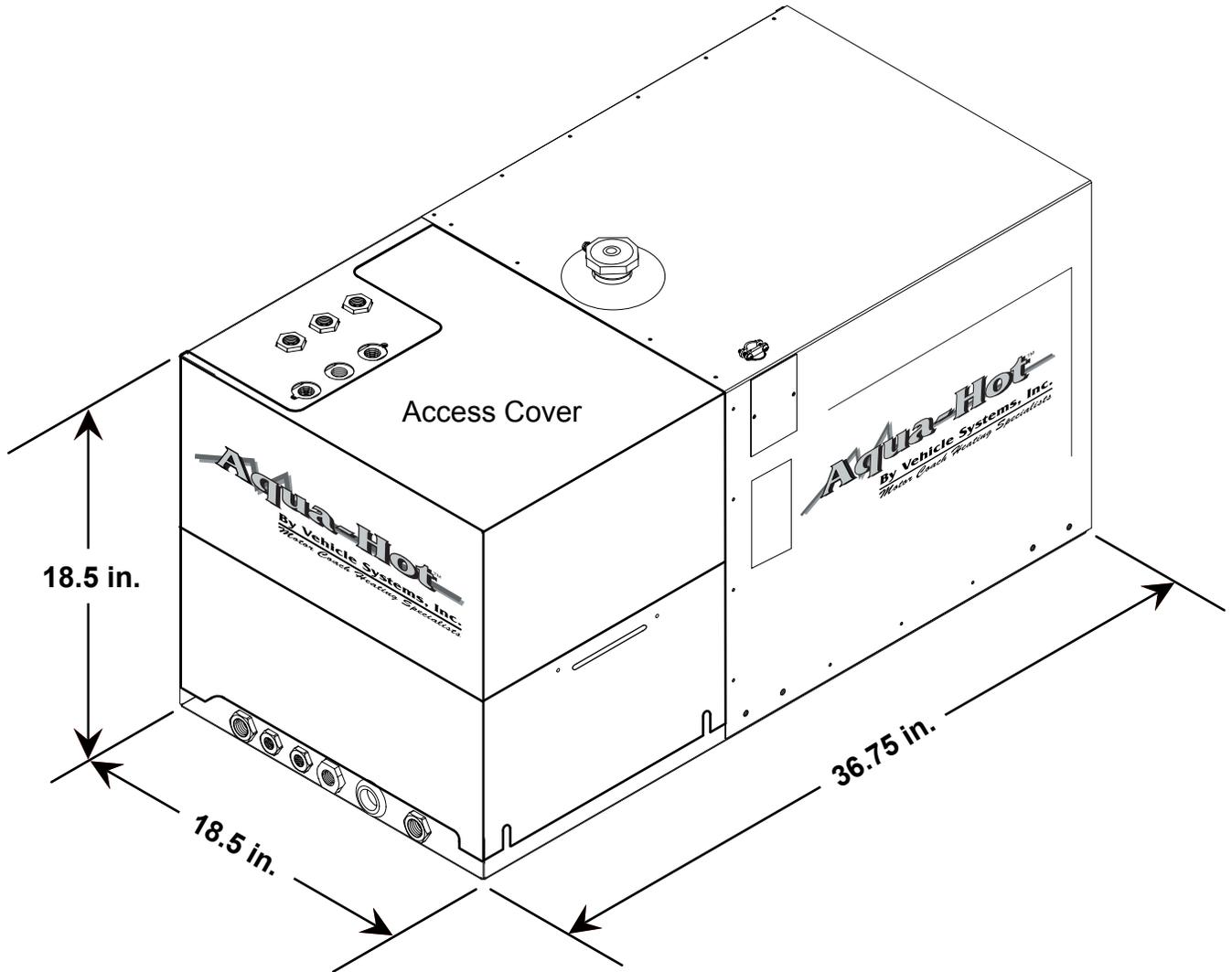


Figure 5

**Aqua-Hot
Mounting
Template**

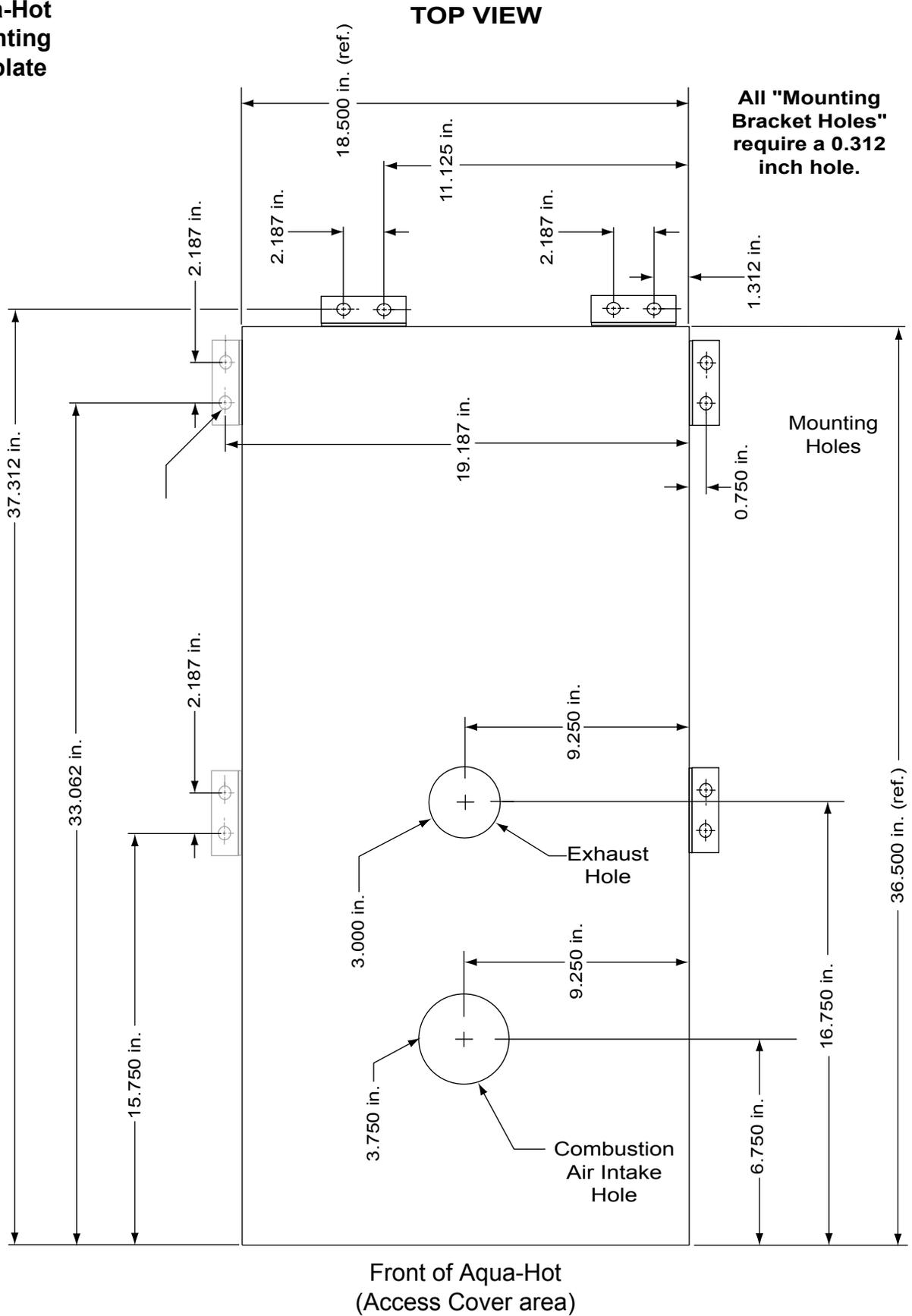


Figure 6

Mounting the Interior Heat Exchangers Overview

3.4 Mounting the Interior Heat Exchangers Overview

Adhering to the guidelines listed below will ensure maximum interior heating efficiency and even-heat distribution throughout each interior Heating Zone (i.e., Living Room, Kitchen, Bedroom, and Bathroom).

- A. Space the Heat Exchangers so that even-heat distribution will be felt throughout the interior; reference Figure 7 and the “Generalized Motorhome Heating System Floorplan” in this section of the manual.

NOTE: For “Slideout” configurations, it is simplest to place a Heat Exchanger(s) on the opposite side of the Motorhome pointing towards the Slideout.

- B. Sufficient ventilation (return-air) must be supplied to each interior Heat Exchanger; reference Figures 7 and 8.

NOTES:

1. Mounting Heat Exchangers without sufficient ventilation will severely reduce their overall heating performance (heat output).
2. In order to provide sufficient ventilation, the “return-air” registers must be the same size, or larger, than the outlet-air registers.
3. “Return-Air” must be supplied from the corresponding interior heating zones.

- C. Allow for easy access to all Heat Exchangers for potential servicing and cleaning (e.g., dust, etc.). Reference Figures 10 and 12 for allowable Cozy-III mounting configurations.

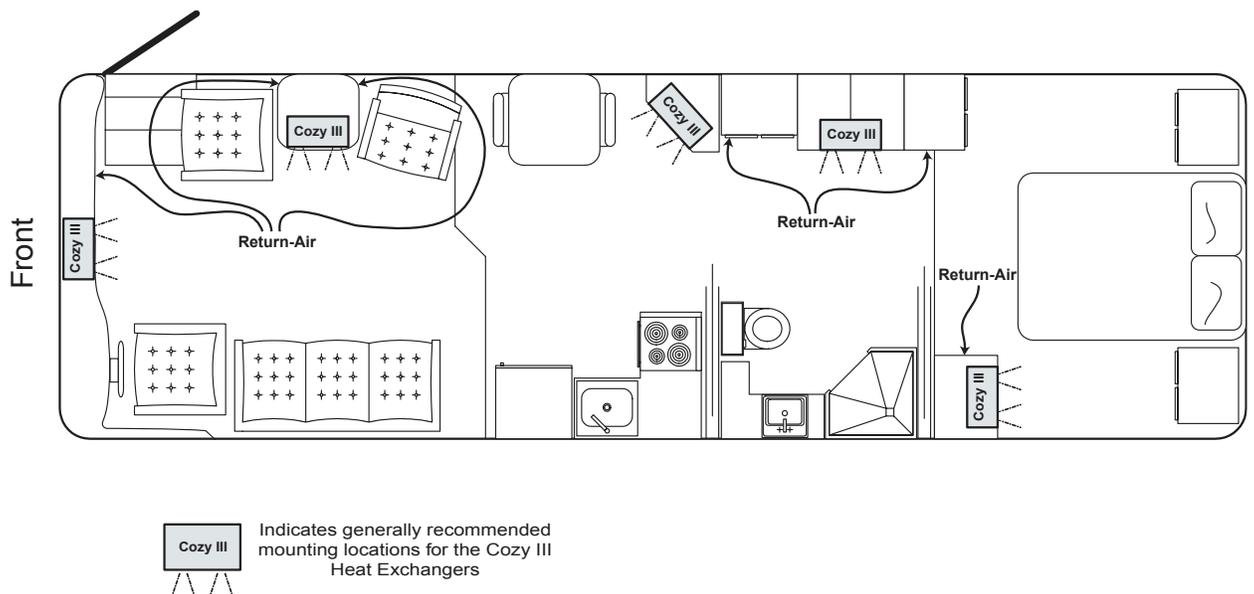
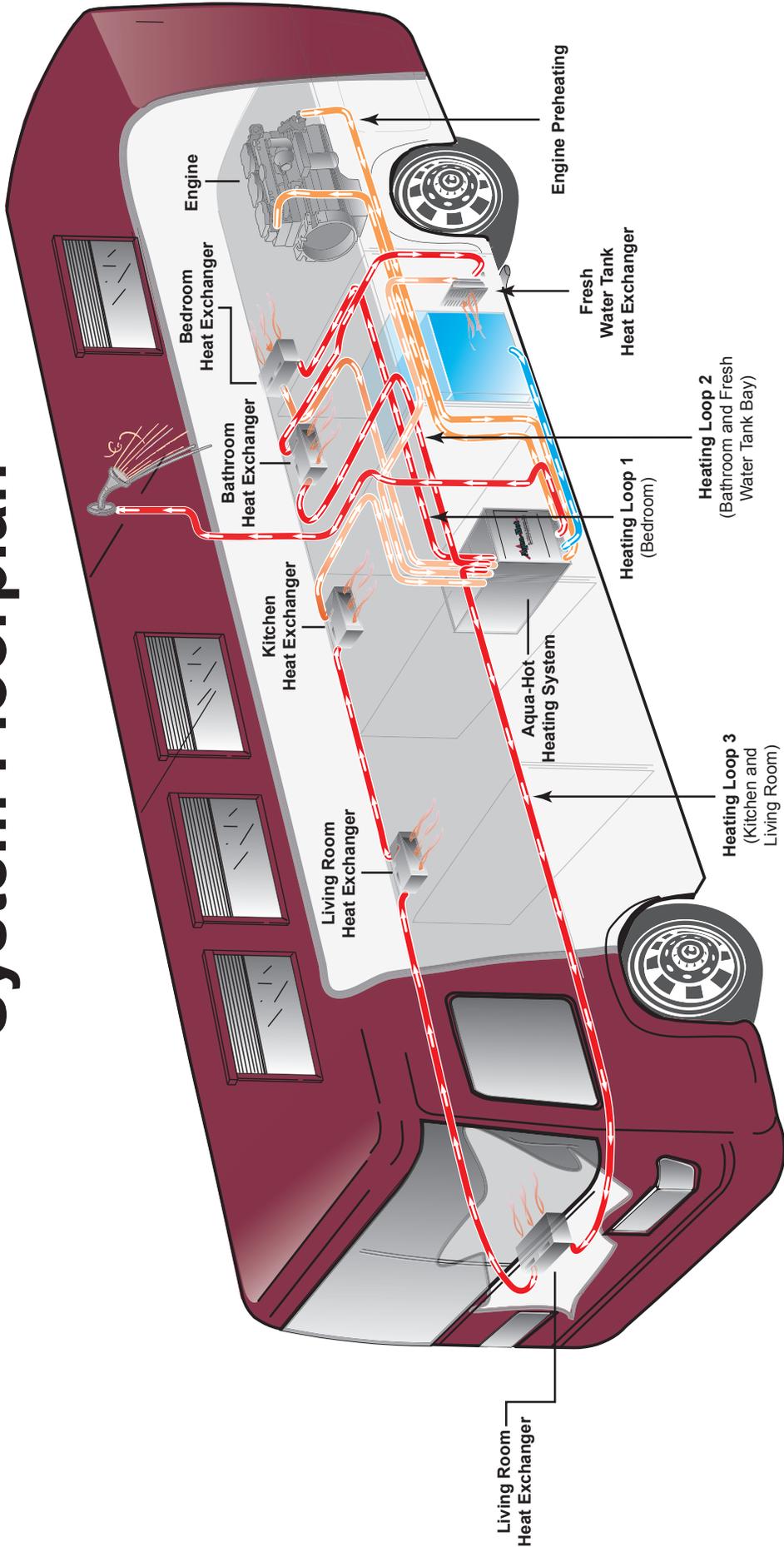


Figure 7

Generalized Motorhome Heating System Floorplan



**Interior Heat
Exchanger
Location
Overview**

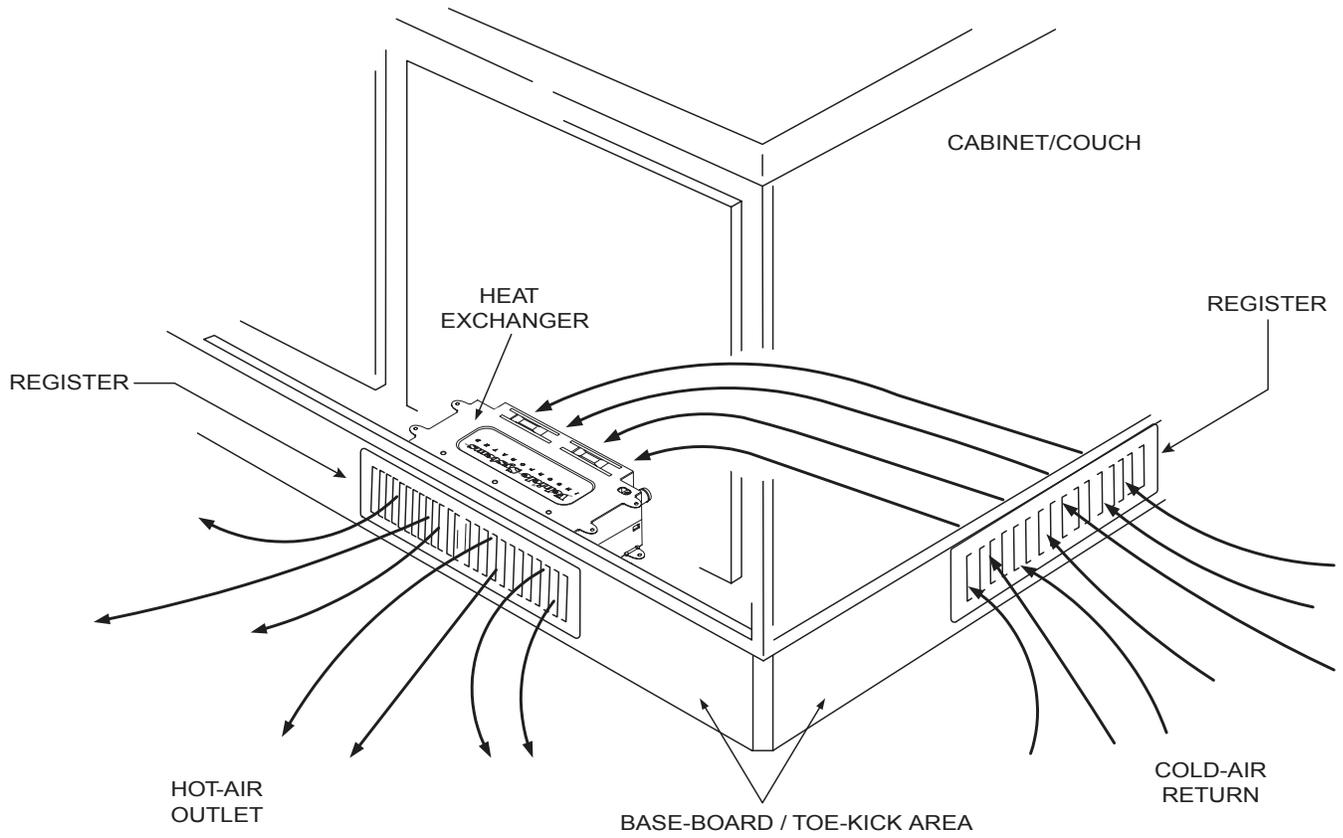


Figure 8

Interior Heat Exchanger Dimensions, Wiring, and Mounting Overview

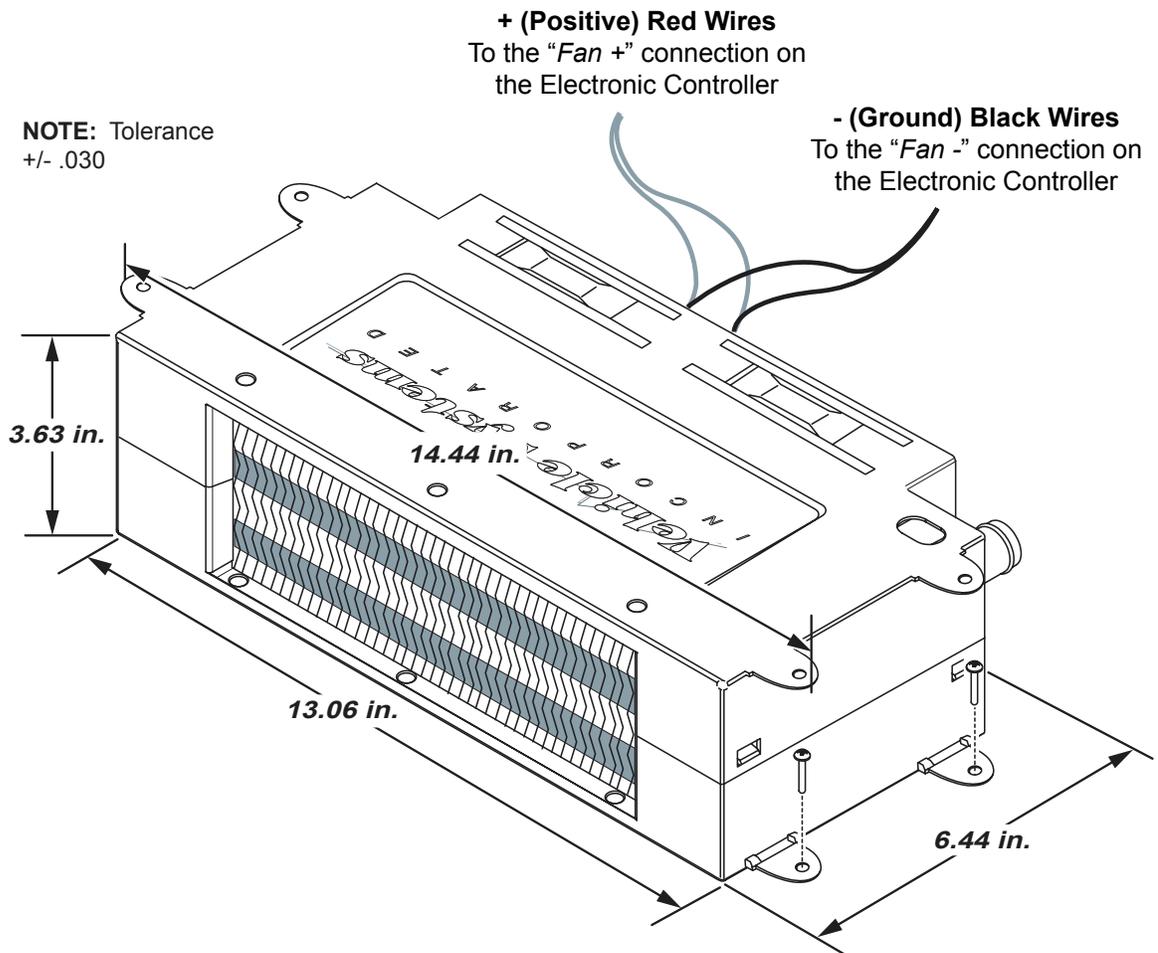


Figure 9

**Allowable Cozy III
Heat Exchanger
Mounting
Configurations**

Vertical Mount

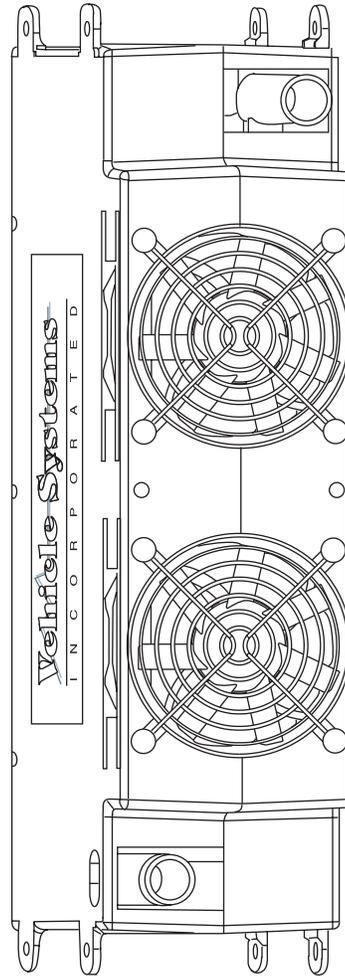
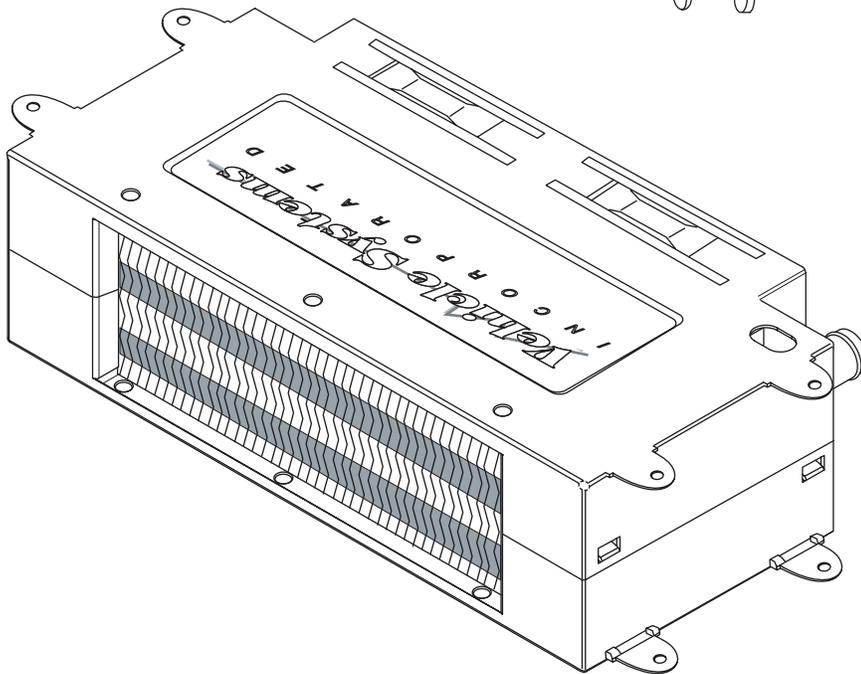


Figure 10

Horizontal Mount



Interior Heat Exchanger Mounting

3.5 Mounting the Interior Heat Exchangers

Once all permanent mounting locations have been selected, cut out the opening for each hot-air and cold-air register and fasten each Heat Exchanger permanently in place. Please reference Figure 8 for suggested Heat Exchanger mounting locations.

1. Cut out a 2.5 inch x 10 inch opening for each Cozy III hot-air outlet and cold-air return register; reference Figures 7 and 8.
2. Mount each Heat Exchanger permanently into place; reference Figures 9, 10, and 12.
3. Install the hot-air outlet and cold-air return registers; reference Figure 8.

Fresh Water Tank Heat Exchanger Mounting

3.6 Mounting the Fresh Water Tank Heat Exchanger Overview

The Fresh Water Tank Heat Exchanger should be strategically placed in the domestic water plumbing area in order to prevent freezing of the plumbing lines and storage tank.

- A. Centralize and position the Fresh Water Tank Heat Exchanger in the Domestic Water Storage Tank Plumbing Bay area so even-heat distribution will be achieved; reference Figure 11.

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).

- B. Sufficient ventilation (cold-air return) must be supplied to the Fresh Water Tank Heat Exchanger; reference Figure 11.

NOTES:

- A. Mounting the Heat Exchanger without sufficient ventilation will severely reduce its overall performance (heat output).
- B. Return-Air should be supplied from the same compartment as the Fresh Water Tank Heat Exchanger.

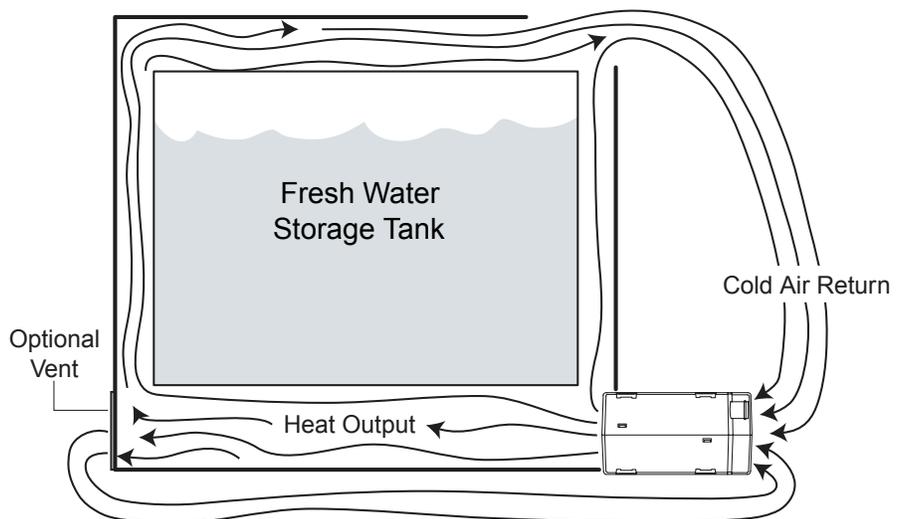


Figure 11

**Minimum
Cozy III Heat
Exchanger
Clearance**

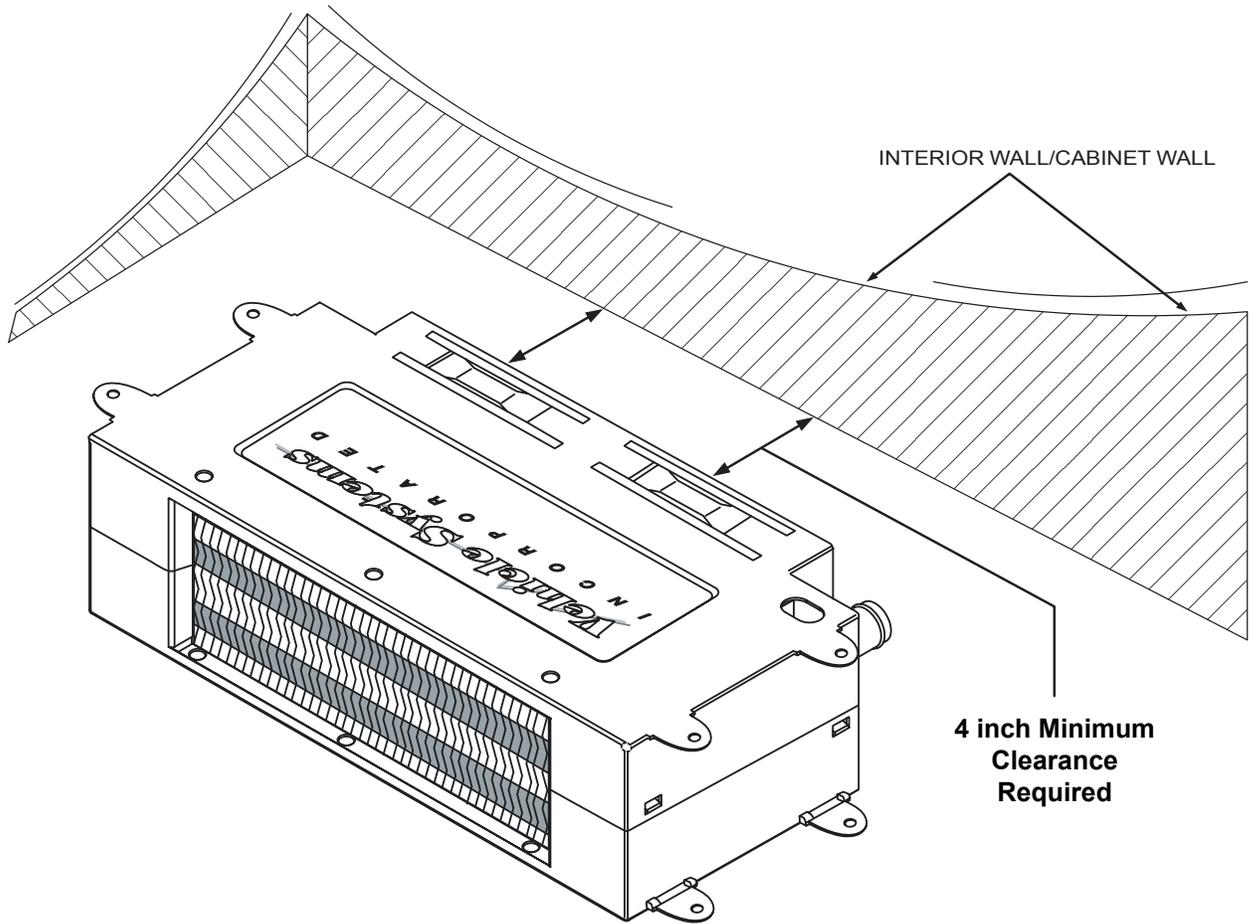


Figure 12

Cozy III Heat Exchanger Mounting Template

NOTE: Tolerances on the dimensions shown are as follows:
 .XX (i.e., 6.44 in.) = +/- .030
 .XXX (i.e., 6.500 in.) = +/- .015

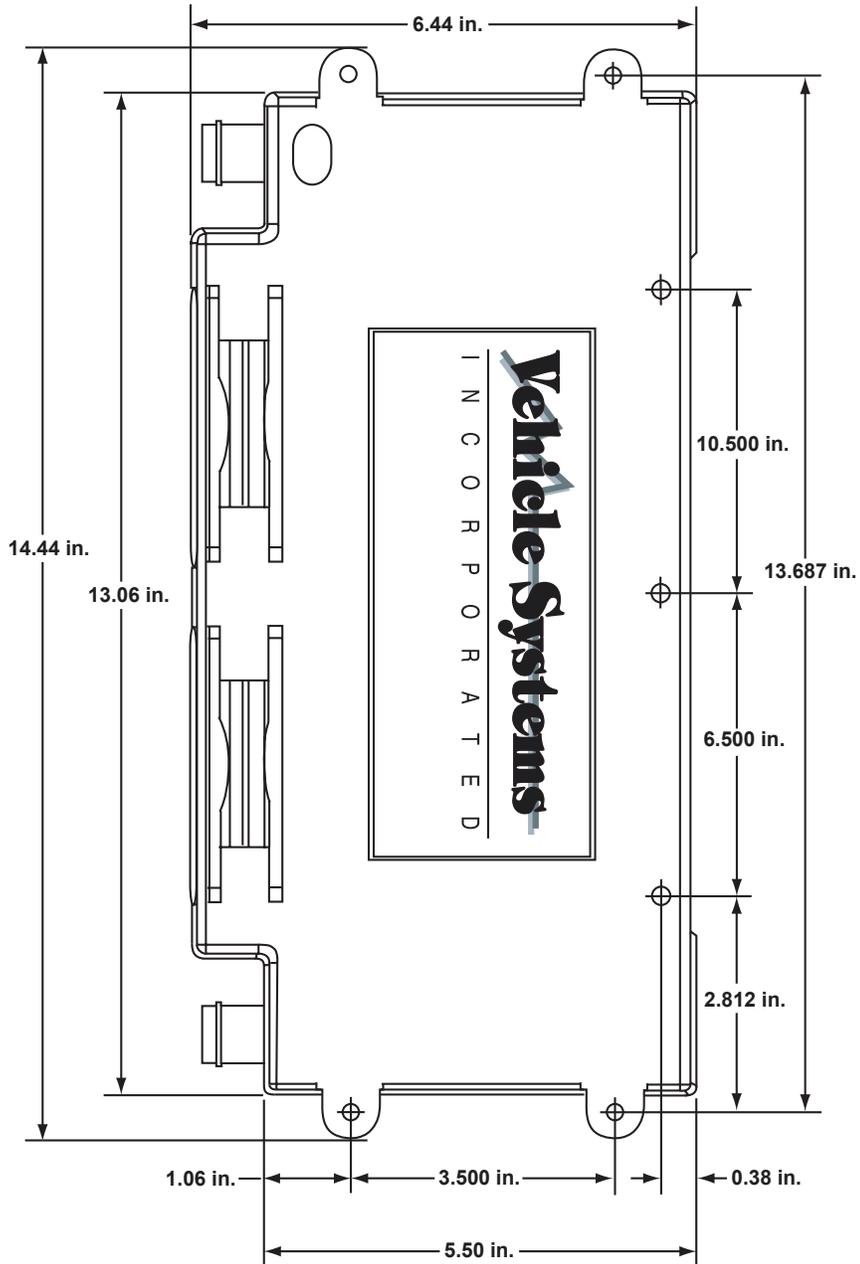


Figure 13

Fresh Water Tank Heat Exchanger

3.7 Mounting the Fresh Water Tank Heat Exchanger

Once a permanent mounting location for the Fresh Water Tank Heat Exchanger has been selected, fasten the Heat Exchanger permanently in place. Please reference Section 3.6 and use Figures 8, 10, 11, 12, and 13 for mounting information.

Plumbing the Heat Exchangers Overview

3.8 Plumbing the Heat Exchangers Overview

Once all Heat Exchangers have been mounted, a plan should be formulated for the routing of the Plumbing Lines from each heating zone to the Aqua-Hot. The Plumbing Lines are the roadways that carry the antifreeze and water heating solution from the Aqua-Hot to the Heat Exchangers in each heating zone; reference Figures 2 and 7. Adhering to the guidelines listed below will ensure maximum heating performance (heat output):

- A. The Kitchen and Living Room Heat Exchangers (typically three) **must** be plumbed together **in-series** on “Heating Loop #3.” Be sure to reference Figure 2 and the “Generalized Motorhome Heating System Floorplan” in Section 3.4 for additional information.
- B. The Fresh Water Tank and Bathroom Heat Exchangers (typically two) **must** be plumbed together **in-series** on “Heating Loop #2.” Be sure to reference Figure 2 and the “Generalized Motorhome Heating System Floorplan” in Section 3.4 for additional information.
- C. The Bedroom Heat Exchanger (typically one) is plumbed solely on “Heating Loop #1.”
- D. Use 5/8 in. I.D. (Inside Diameter) Plumbing Lines for all Heating Zones.
- E. Use wide-sweeping elbows or “Bend-Supports” whenever Plumbing Lines may be susceptible to kinking (i.e., 90° bends).

Installing the Interior/Fresh Water Tank Plumbing

3.9 Installing the Interior/Fresh Water Tank Plumbing Lines

1. Prior to installing the Plumbing Lines, mark each line with arrows and/or labels at both ends. This can be done while the lines are being laid out in order to indicate which Heating Loop the Plumbing Lines pertain to (i.e., Heating Loop 1, Heating Loop 2, or Heating Loop 3) and whether the Plumbing Line is a **Supply** or a **Return** line; reference Figures 2, 16A, and 16B.

NOTES:

- A. All Plumbing Lines should be laid as flat as possible, and any extreme rises in height should be avoided.
- B. Run all Plumbing Lines in areas where they cannot be pinched off or damaged under normal operating conditions.
- C. Be sure to secure all Lines where necessary and apply protective shielding in areas where chafing may occur.
- D. Vehicle Systems suggests using Rubber Coated/Closed-Type Clamps when securing the Plumbing Lines.

2. Connect and clamp the **Supply** line from the Heater to the lowest port on each Heat Exchanger in each heating zone; reference Figures 2 and 14.

**Installing
the Interior/
Fresh water
Tank Plumbing,**
continued

3. Connect and clamp the **Return** line from the Heater to the highest port on each Heat Exchanger; reference Figures 2 and 14.

NOTE: Reference Figure 15 for visual instructions on how to properly connect PEX type tubing to each Heat Exchanger.

NOTE: 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).

4. Connect and tighten all interior Plumbing Lines, **Supply** and **Return**, to the Aqua-Hot's appropriate Heating Zone ports; reference Figures 16A and 16B.

**Installing
the Heat
Exchanger
Plumbing**

**Cozy III Heat Exchanger
(Rear View)**

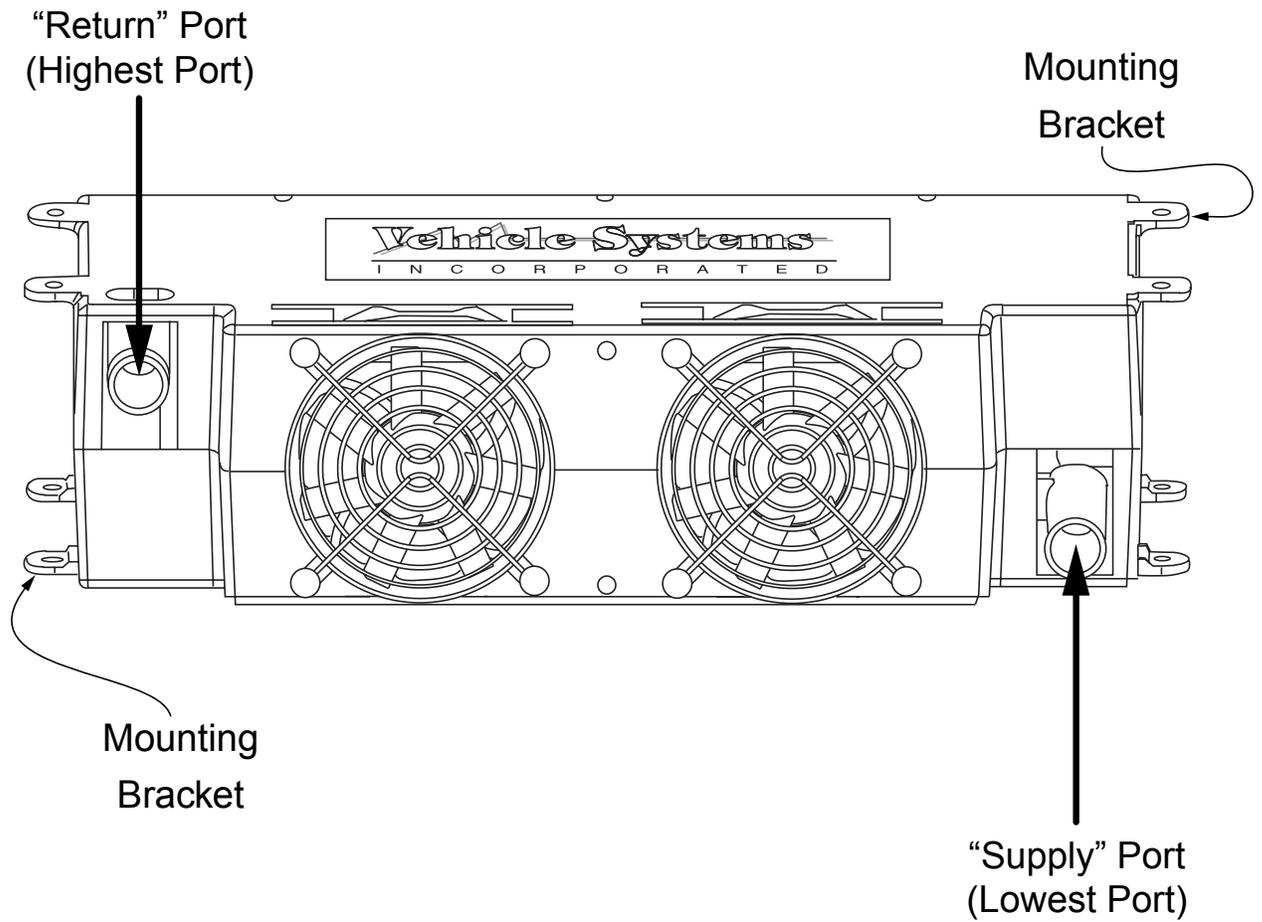


Figure 14

**Installing
the Heat
Exchanger
Plumbing,
continued**

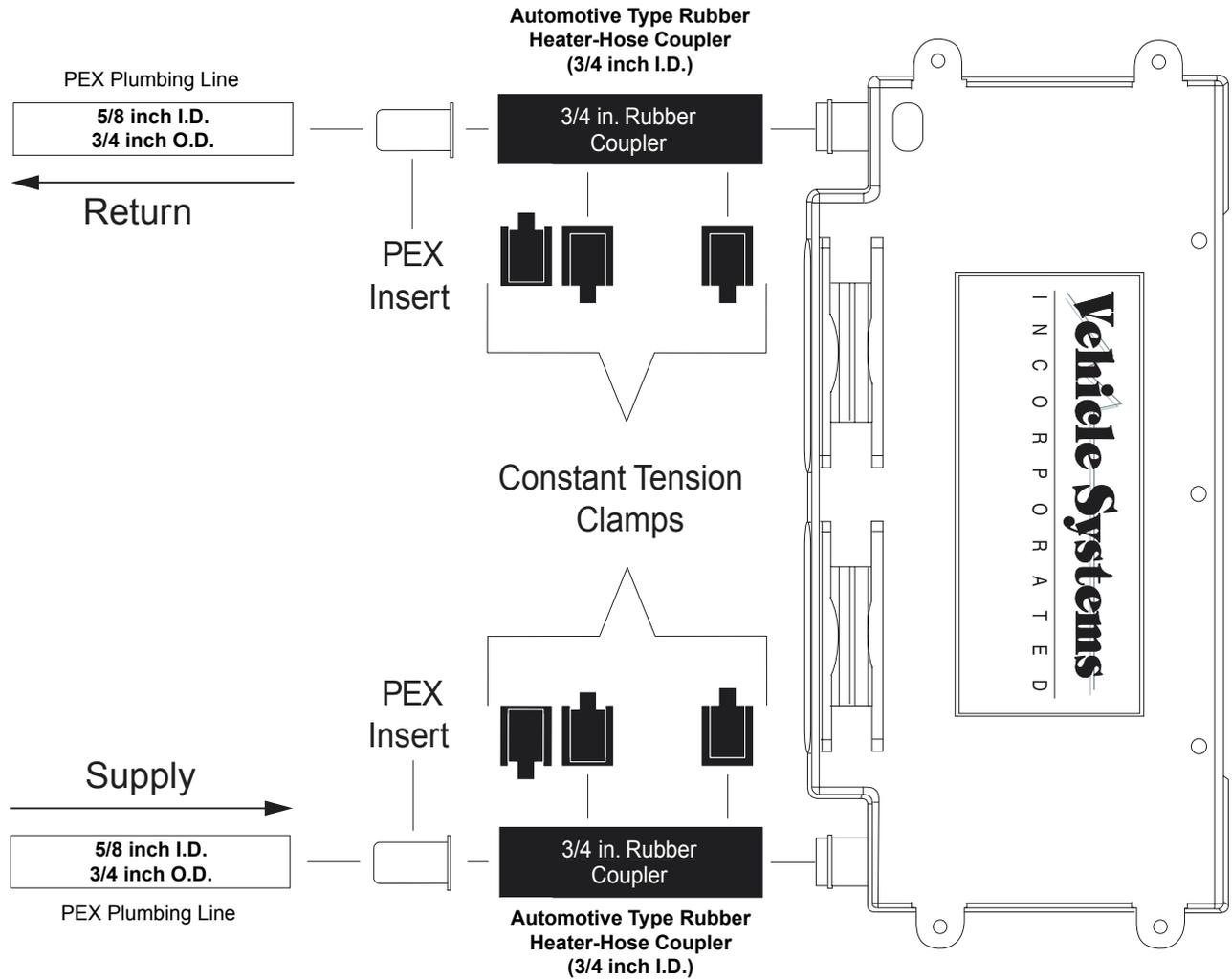


Figure 15

**Installing
the Heat
Exchanger
Plumbing,
continued**

“Supply” Heating Zone Ports

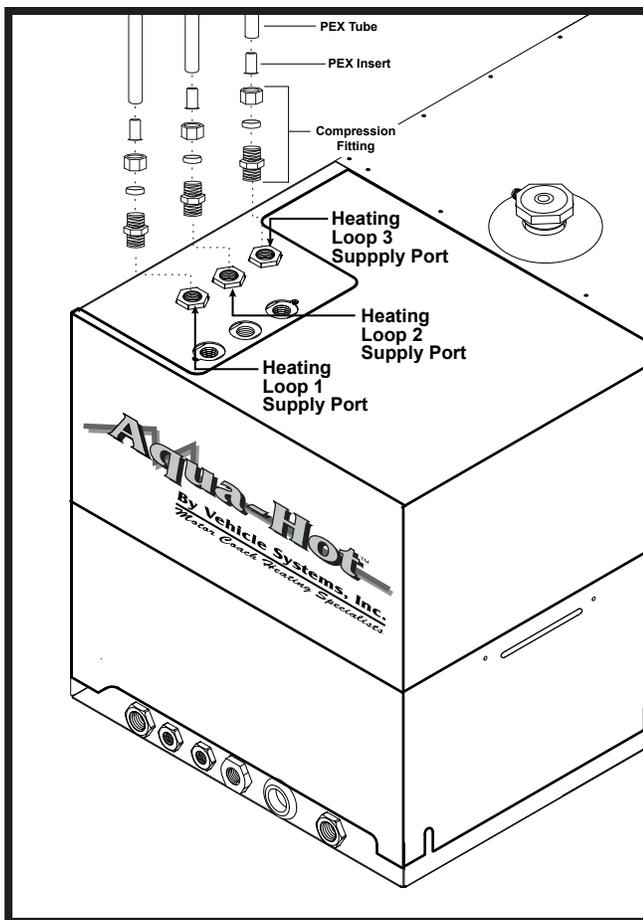


Figure 16A

“Return” Heating Zone Ports

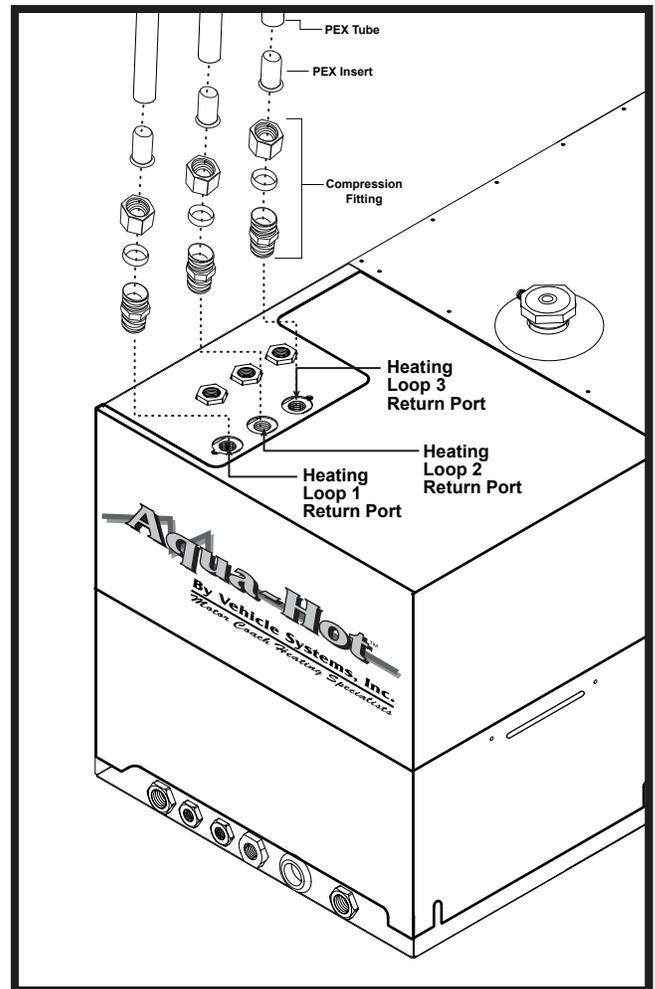


Figure 16B

Engine Preheat Plumbing Overview

3.10 Plumbing the Engine Preheat System Overview

Engine preheating is accomplished by a “Water-to-Water” Heat Exchanger that is an integral part of the Aqua-Hot’s Heat-Tank. Adhering to the guidelines listed below will ensure maximum engine preheating efficiency.

- A. The **Supply** and **Return** ports on the vehicle’s engine should be kept as far apart as possible. This will ensure that the entire engine is thoroughly preheated; reference Figure 17. If assistance is needed in determining the best **Supply** and **Return** ports for a specific engine, please contact Vehicle Systems’ Product Application Support Department at 1-800-685-4298 or contact the specific Engine’s Manufacturer.

NOTES:

1. The engine’s coolant should be allowed to flow as freely as possible to maximize the Aqua-Hot’s engine preheating system.
2. The engine’s **Return** port returns the heated coolant to the Engine Block from the Aqua-Hot. This port should be a **high** connection point on the Engine Block or a suction port on the engine’s Water Pump; reference Figure 17.
3. The engine’s **Supply** port supplies the engine’s coolant to the Aqua-Hot’s Engine Preheat Circulation Pump. This port should be a **low** connection point on the Engine Block or a **pressure outlet port** on the Engine’s Water Pump; reference Figure 17.

- B. Use 3/4 in. I.D. (Inside Diameter) Plumbing Lines/Automotive type Heater-Hose for the engine preheating system.

3.11 Attaching Plumbing Lines to the Vehicle’s Engine

1. Install both engine preheat Plumbing Lines and mark with **Arrows** and/or **Labels** at both ends. The labels should indicate whether the Plumbing Line is **supplying** coolant to the Aqua-Hot or whether it will be **returning** heated coolant to the vehicle’s engine; reference Figures 1, 17, and 18.

NOTES:

- A. Lay both Engine Preheat Lines as flat as possible and avoid any extreme rises in height. This will eliminate the potential for air traps.
- B. Run both Plumbing Lines in areas where they cannot be pinched off or damaged during normal operating conditions.
- C. Be sure to secure both Plumbing Lines where necessary and apply protective shielding in areas where chafing may occur.
- D. Vehicle Systems suggests using Rubber Coated/Closed-Type Clamps when securing the Plumbing Lines.

2. Drain the Engine’s Coolant.
3. Remove the selected **Supply** and **Return** port “Plugs” from the engine.

Installing Engine Preheat Plumbing

Installing
Engine
Preheat
Plumbing,
continued

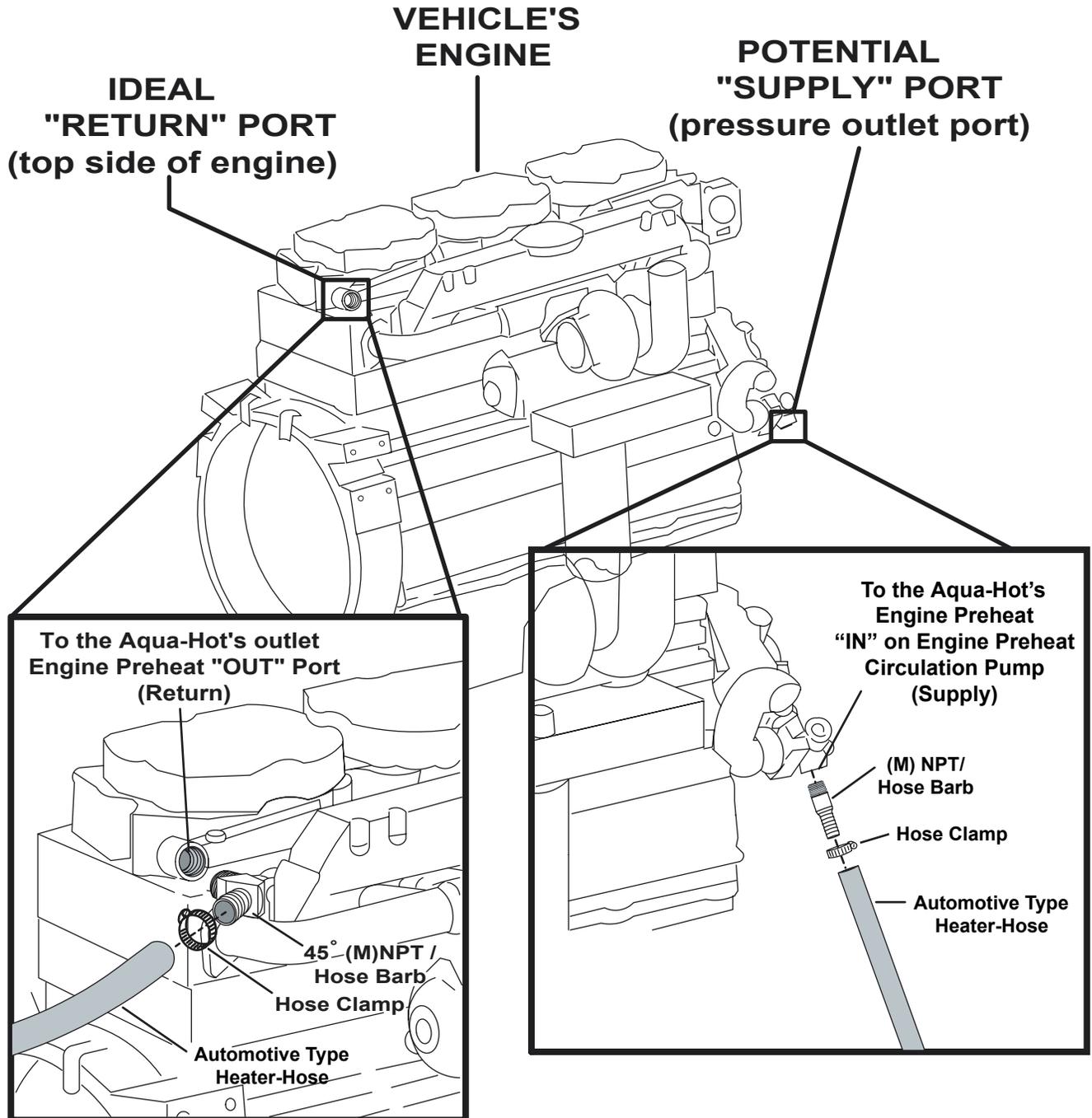


Figure 17

Installing Engine Preheat Plumbing, continued

NOTE: Should one or both of the selected engine ports already have Plumbing Fittings attached to them, it may be necessary to “tee” into those existing Plumbing Fittings. If assistance is needed for a specific engine, please contact Vehicle Systems’ Product Application Support Department at 1-800-685-4298.

4. Install and tighten the Plumbing Fittings into the **Supply** and **Return** ports on the Vehicle’s Engine.

NOTE: One-piece Plumbing Fittings are recommended in order to reduce the potential for coolant leaks. It is also suggested that Pipe Thread Sealant be used on all Plumbing Fittings.

5. Install and clamp both the **Supply** and **Return** engine Plumbing Lines/Automotive Type Heater-Hoses to the Engine’s Plumbing Fittings; reference Figure 17.
6. Install and tighten the Plumbing Fittings into the “**IN**” and “**OUT**” ports on the Aqua-Hot’s Engine Preheating System; reference Figures 1 and 18.

CAUTION: Be sure to use two wrenches when tightening these Plumbing Fittings. Failure to do so could result in **serious damage** to the Aqua-Hot’s internal Engine Preheating System.



7. Attach and clamp the Engine’s **Supply** Plumbing Line to the Aqua-Hot’s “**IN**” connection; reference Figure 18.
8. Attach and clamp the Engine’s **Return** Plumbing Line to the Aqua-Hot’s “**OUT**” connection; reference Figure 18.
9. After all Plumbing Lines, Fittings, and Connections have been tightened, refill the Engine’s Coolant System.

**Installing
Engine
Preheat
Plumbing,**
continued

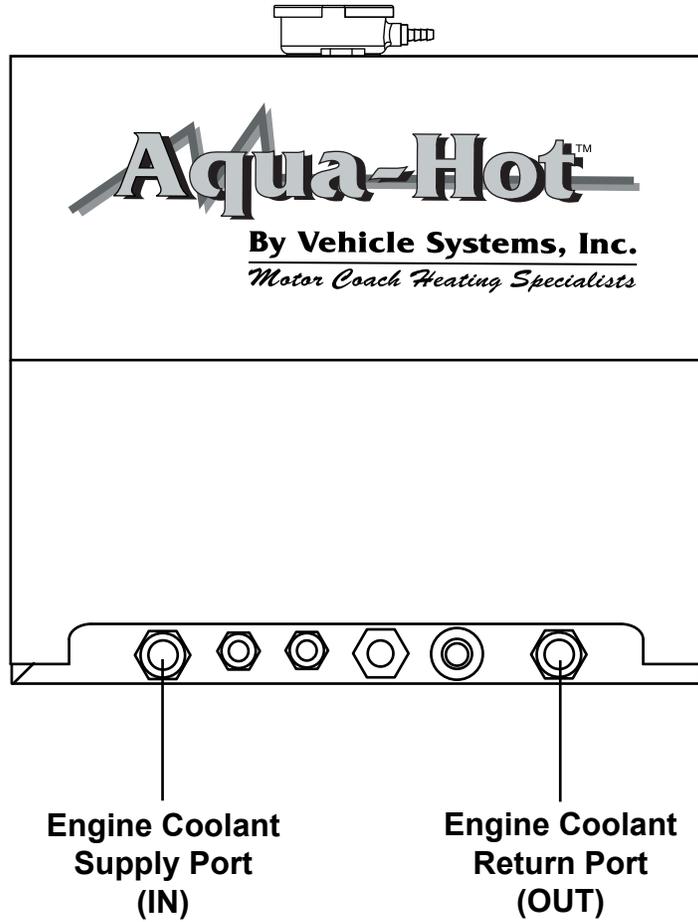


Figure 18

Domestic Hot Water Plumbing Overview

3.12 Domestic Hot Water Plumbing Overview

One major feature of the Aqua-Hot is that it possesses the ability to provide a continuous supply of domestic hot water. Because the Aqua-Hot heats the domestic water **on-demand**, there is no need for a separate Storage Type Water Heater. Adhering to the following guidelines will ensure maximum domestic hot water efficiency.

- A. The following information concerning the sizing of Water Supply Piping was taken directly from the ANSI A119.2/NFPA 501C Standard on Recreation Vehicles, 1993 Edition. This information should be used as a general guideline:

“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 size of Water Supply Piping and Branch Line shall not be less than shown in Table 4-6.5.1.

NOTE: A Water Heater or Ice Maker shall not be counted as a Water-Using Fixture when computing pipe sizes.

Table 4-6.5.1 Minimum Size Tubing and Pipe for Water Distribution Systems*

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.

NOTE: The Aqua-Hot is equipped with a Pressure-Relief Valve, which releases excessive pressure in the domestic water system, if necessary.

Installing Domestic Hot Water Plumbing

3.13 Attaching Plumbing Lines to the Domestic Hot Water System

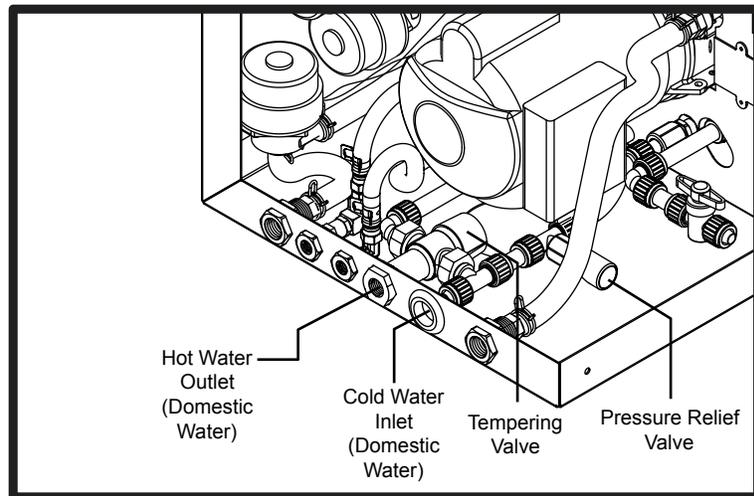
The Aqua-Hot is equipped with a Tempering Valve, which regulates the temperature of the hot water; reference Figure 19.

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 19 and 20.

NOTE: Please note that it may be necessary to utilize an Accumulator Tank within the Domestic Water System; reference Figure 20. Although the Aqua-Hot is equipped with a Pressure-Relief Valve, the utilization of an Accumulator Tank will help prevent excessive “weeping” of the aforementioned valve, if applicable. 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.

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 19 and 20.

Figure 19



Electronic Controller Overview

3.14 Electronic Controller Overview

The Aqua-Hot utilizes an Electronic Controller (E.C.) to monitor specific heater activities, supply electrical power to specific internal and external components, and control the overall operation of the heater. The following are important installation details regarding the Electronic Controller. Please read this section thoroughly for specific details.

NOTE: Please reference Appendix A for specific wiring information pertaining to the precise model of Aqua-Hot being installed.

- A. All Electronic Controller Fan Power connections (and two switch connections) possess a “(+)” or a “(-)” symbol, which indicates that they are Polarity Sensitive. Therefore, be sure to use care when wiring these particular components to the Electronic Controller.

**Domestic Hot
Water System
Overview**

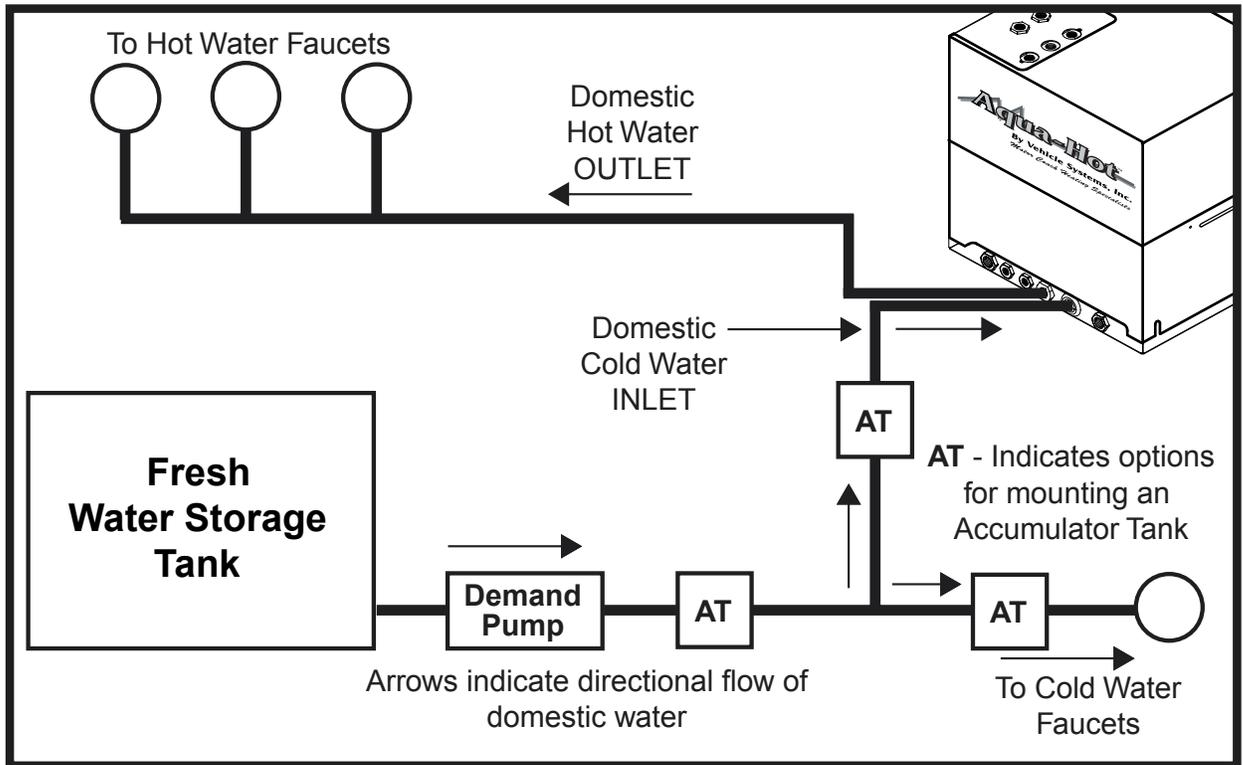


Figure 20

Electronic Controller Overview, continued

- B. All Electronic Controller Thermostat and Switch connections (excluding two) possess an “(I)” or an “(O)” symbol. The “(O)” symbol indicates a positive 12 Volt-DC **output** to a particular Thermostat or Switch, while the “(I)” symbol indicates a positive 12 Volt-DC **input** signal from a particular Thermostat or Switch. The 12 Volt-DC **output** signal is always present as long as the Electronic Controller is powered by a 12 Volt-DC Power Source, while the 12 Volt-DC **input** signal is only present whenever a Switch is activated or whenever a Thermostat is “calling for heat”; reference Appendix A.
- C. Each heating zone “FAN” circuit can supply up to 2.0 Amps of Direct Current. This 12 Volt-DC allows for multiple Cozy III Heat Exchangers to be wired “in-parallel” (e.g., Heating Zone 5); reference Figure 2, Appendix A, and the “Generalized Motorhome Heating System Floorplan” in Section 3.4.
- D. Heating Zone 5 is reserved electrically for the “Living Room/Kitchen Heating Zone” (Heating Loop 3) **ONLY**; Heating Zones 2, 3, and 4 are reserved electrically for the “Bathroom, Fresh Water, and Optional Heating Zone” Tank Heating Zone” (Heating Loop 2) **ONLY**. Heating Zone 1 is reserved electrically for the “Bedroom Heating Zone” (Heating Loop 1) **ONLY**. Reference Figure 2.
- E. All Switch connections are to be wired directly to the Aqua-Hot’s “Switch Panel Connections”; reference Figures 23A, 23B, 24A, and 24B and Appendix A. Both the “IND-LT(+)B3” and the “IND-LT(-)B6” connections are reserved electrically **ONLY** for the “Diesel” Switch connections.
- F. The Aqua-Hot’s Electronic Controller is designed to work with most Electronic Room Thermostats; however, the chosen Thermostat must produce a constant 12 Volt-DC output signal and must receive its 12 Volt-DC Power Supply from the Aqua-Hot’s Electronic Controller (i.e., “THERM O”). This will ensure that the Thermostat/Electronic Controller is properly **fuse protected**.
- G. Be sure to use the wire colors illustrated in Appendix A. This will ensure installation consistency, differentiate the separate Heating Zones, and assist Service Personnel with troubleshooting.
- H. The Electronic Controller can be either recessed or surface mounted. Cut out an opening of 7.25 inches x 10.25 inches for recessed mounting and be sure to utilize all four mounting tabs.

NOTES:

- A. Be sure to fasten the wire harness connections to the Electronic Controller by securing the screw-type fasteners on the Terminal Strip/Plug of the Wiring Harness to the Header on the Electronic Controller.
- B. Be sure to secure the wire harness connections at the Electronic Controller by clamping the wire harness permanently into place.

Wiring Interior/Bay Heat Exchangers

3.15 Wiring the Interior and Fresh Water Tank Heat Exchangers

The Aqua-Hot’s Electronic Controller is designed to supply 12 Volt-DC Electrical Power, as well as a ground source (negative), to all Interior and Fresh Water Tank Heat Exchangers. Therefore, whenever a particular heating zone Thermostat “calls for heat,” the Aqua-Hot’s Electronic Controller will output a 12 Volt-DC power supply and provide ground to each Heat Exchanger in that heating zone.

NOTE: DO NOT use a “chassis ground” as a ground source for any of the Heat Exchangers. Ground **MUST BE** supplied by the Aqua-Hot’s Electronic Controller.

Wiring Interior/ Bay Heat Exchangers, continued

1. Run two 16 Gauge Wires, Red for (+) and Black for (-), from each particular Heating Zone's Heat Exchanger(s) to the Aqua-Hot's Electronic Controller.

NOTE: For heating zones with multiple Heat Exchangers (e.g., Living Room/Kitchen/Heating Loop 1, etc.), run two wires from the closest Heat Exchanger to the Aqua-Hot's Electronic Controller and then wire the other Heat Exchangers in-parallel; reference Figure 9 and Appendix A.

2. Label the wires indicating the heating zone they pertain to (e.g., Living Room/ Kitchen, Bedroom, Fresh Water Tank, etc.)
3. Insert all Heat Exchanger wires into the appropriate terminal/heating zone location on the Electronic Controller (e.g., "#3 FAN +/#3 FAN -," for the Fresh Water Tank Heating Zone, etc.); reference Appendix A.
4. Connect all Electronic Controller "FAN" wires to the positive and negative leads of each Heat Exchanger; reference Figure 9 and Appendix A.

Mounting Locations for Interior Thermostats

3.16 Mounting Locations for Interior Room Thermostats Overview

The mounting locations for the Interior Thermostats and/or the Electronic Thermostat's Temperature Sensors should be selected carefully to ensure even-heat distribution throughout each heating zone.

- A. Locate each Thermostat at approximately chest level, if applicable.

NOTE: Do not mount the thermostat where it can be 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 (uncooled) areas such as an outside wall behind the thermostat

Wiring Interior Thermostats

3.17 Wiring the Interior Room Thermostats

1. Run two 16 Gauge wires from each interior room thermostat mounting location to the Aqua-Hot's Electronic Controller.

NOTE: Be sure to use the wire colors illustrated in Appendix A. This will ensure installation consistency, differentiate the separate Heating Zones, and assist Service Personnel with troubleshooting.

2. Insert all interior room thermostat wires into the appropriate terminal/heating zone location on the Electronic Controller; reference Appendix A.
3. Connect all wires to the appropriate leads of each room thermostat.

NOTE: The Aqua-Hot's Electronic Controller is designed to work with most Electronic Room Thermostats; however, the chosen Thermostat must produce a constant 12 Volt-DC output signal and must receive its 12 Volt-DC Power Supply from the Aqua-Hot's Electronic Controller (i.e., THERM O"). This will ensure that the Thermostat/Electronic Controller is properly **fuse protected**.

4. Permanently mount all interior room thermostats in place.
5. Be sure to turn **OFF** all interior room thermostats at this time.

Mounting Location for Fresh Water Tank Thermostat

3.18 Mounting the Fresh Water Tank Thermostat Overview

The mounting location of the Bay Thermostat should be selected carefully to ensure even-heat distribution throughout the Bay compartment. The Low-Temp Thermostat is specifically designed as a means of preventing the domestic hot water from freezing; therefore, it has a maximum temperature setting of 50°F.

A. Centralize the Low-Temp Thermostat in the Fresh Water Tank storage compartment.

NOTES:

1. Only the “Bulb” of the Low-Temp Thermostat needs to be physically mounted in the area requiring heat; reference Figure 21.
2. Do not mount the Thermostat “Bulb” in a drafty area.
3. The selected Thermostat body mounting location should allow for easy operator access; reference Figure 21.

Wiring the Fresh Water Tank Thermostat

3.19 Wiring the Fresh Water Tank Thermostat

1. Run two 16 Gauge wires from the Bay Thermostat’s mounting location to the Aqua-Hot’s Electronic Controller.

NOTE: Be sure to use the wire colors illustrated in Appendix A. This will ensure installation consistency, differentiate the separate Heating Zones, and assist Service Personnel with troubleshooting.

2. Insert both Thermostat wires into the appropriate terminal/heating zone location on the Electronic Controller; reference Appendix A.
3. Connect both wires to the appropriate leads of the Low-Temp Thermostat; reference Figure 21.
4. Permanently mount the Low-Temp Thermostat in place; reference Figure 21.

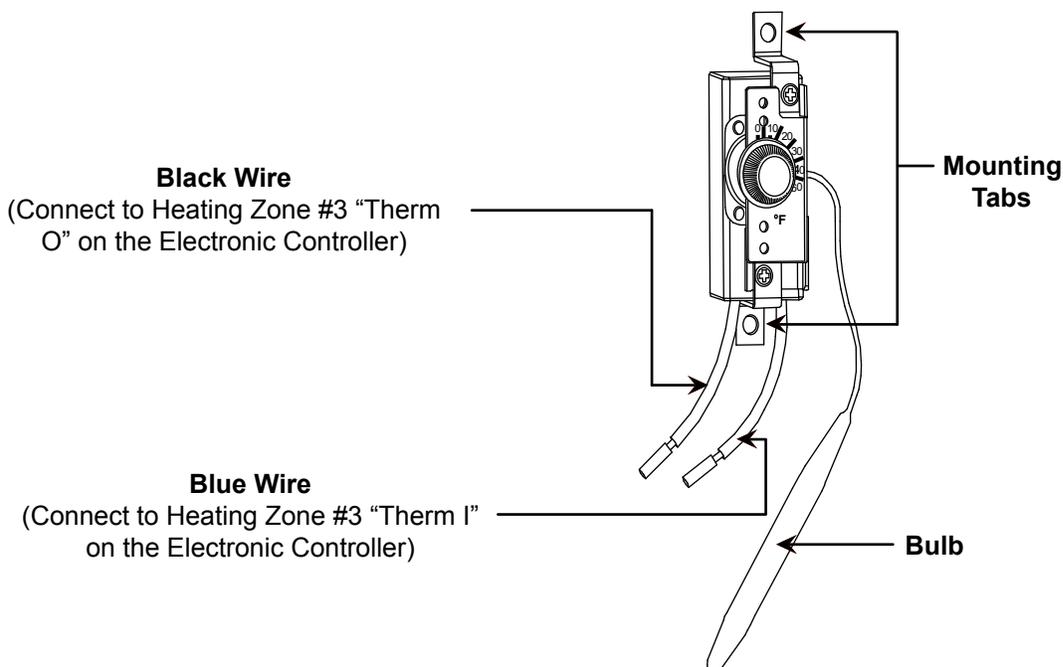


Figure 21

**Switch Panel
Mounting
Template**

AHE-100-04S Interior Switch Panel

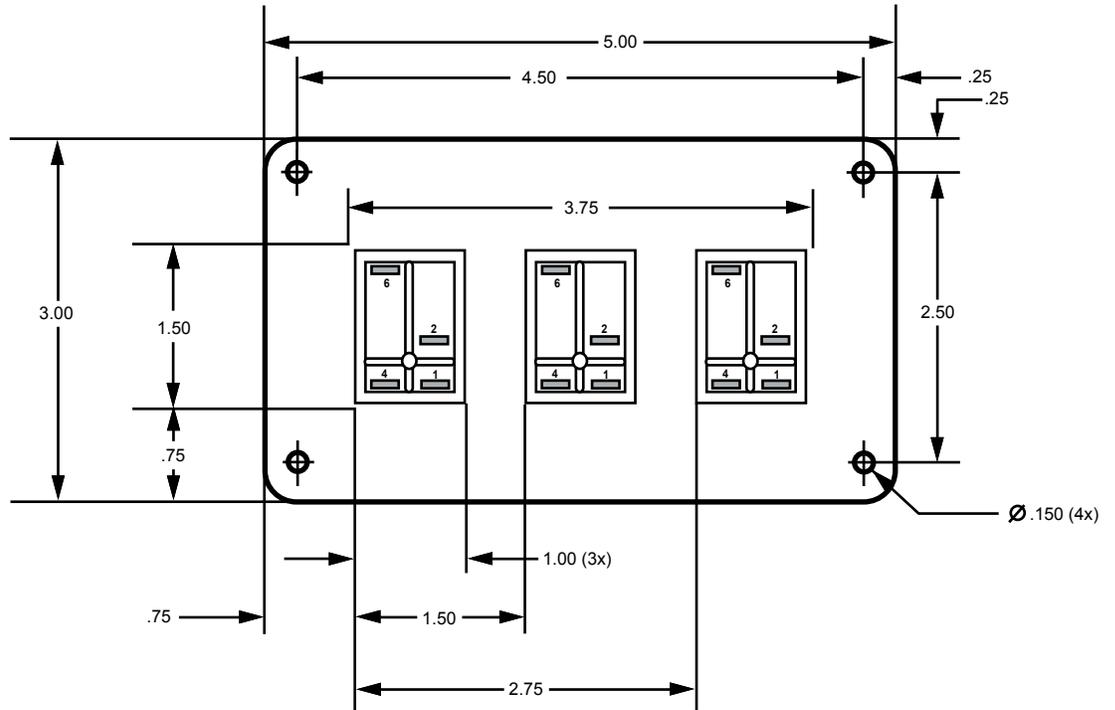
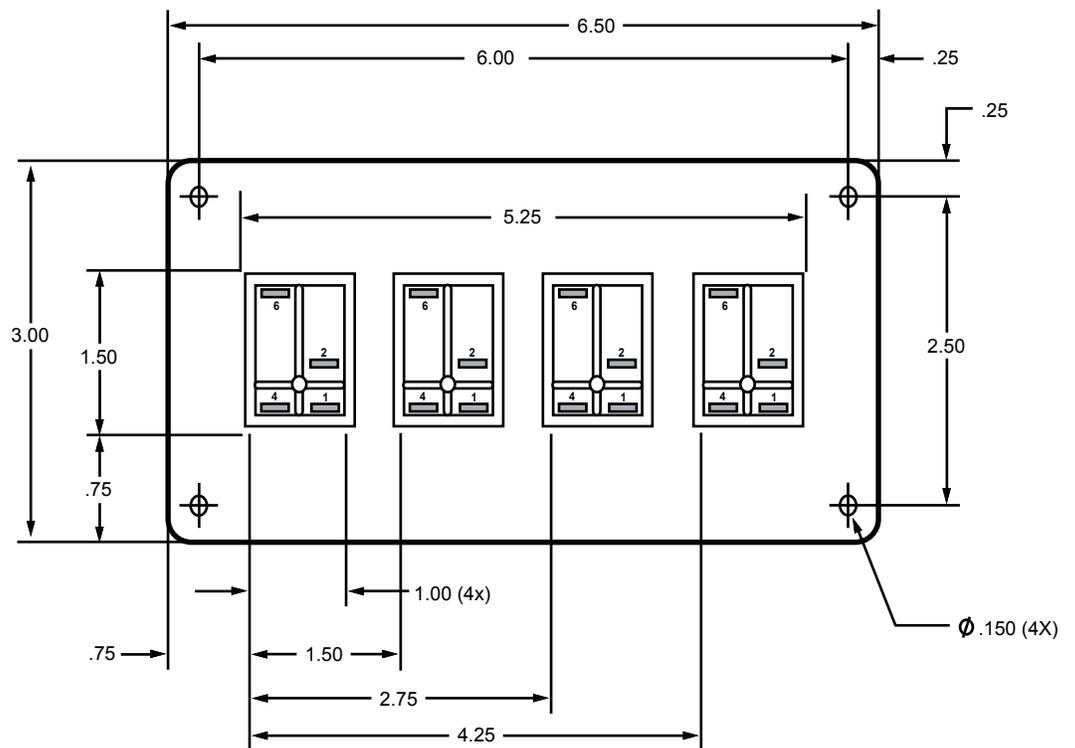


Figure 22

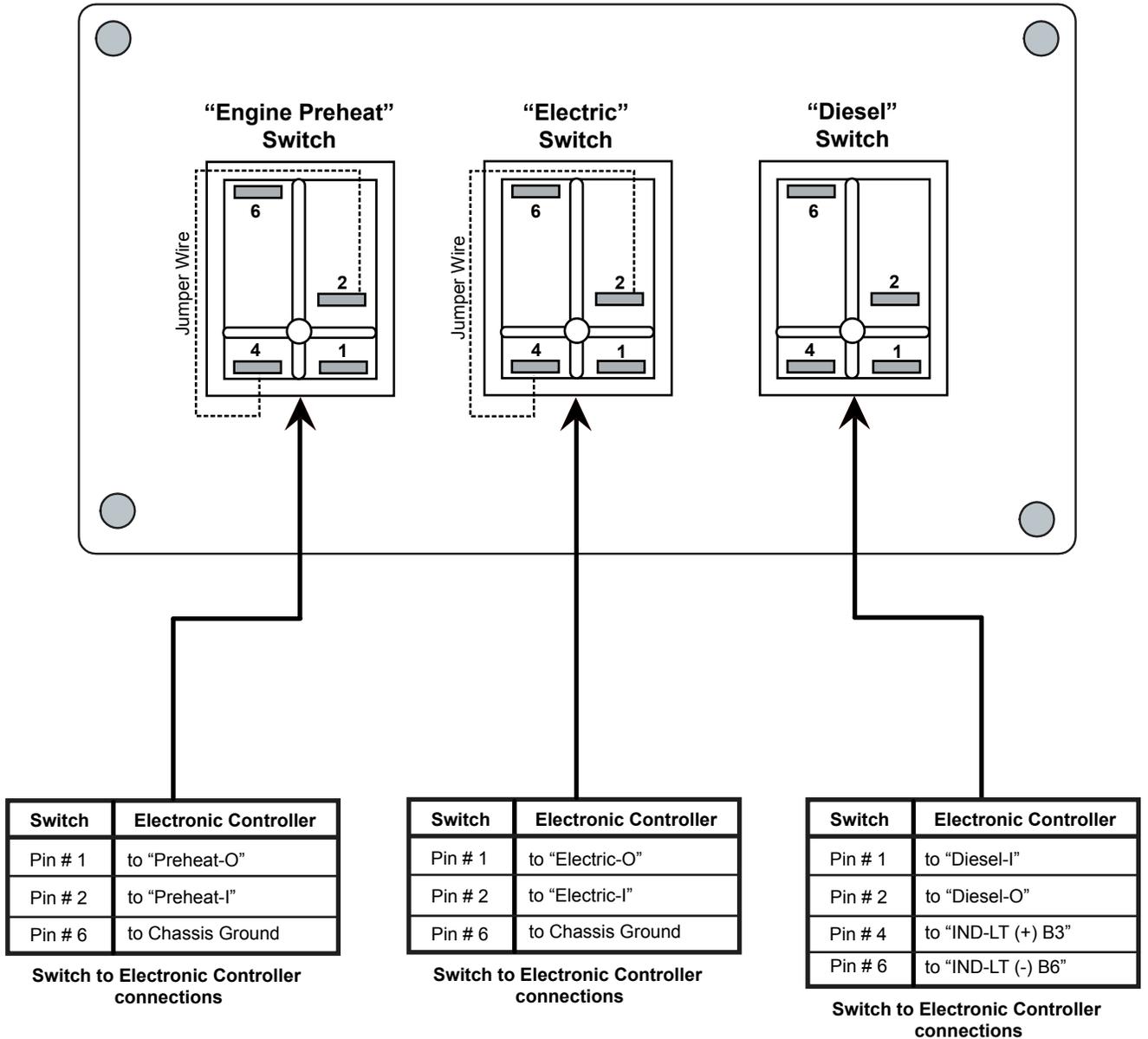
AHE-130-04X Interior Switch Panel



* All dimensions listed are in inches

**Switch Panel
and Indicator
Light Wiring
Overview
AHE-100-04S
Model ONLY**

Switch Panel
Back Side View



NOTE: The "Engine Preheat" and "Electric" switches require a Jumper Wire, which connects Terminal 2 to Terminal 4.

Figure 23A

**Switch Panel
and Indicator
Light Wiring
Overview
AHE-100-04S
Model ONLY**

AHE-100-04S Switch Panel

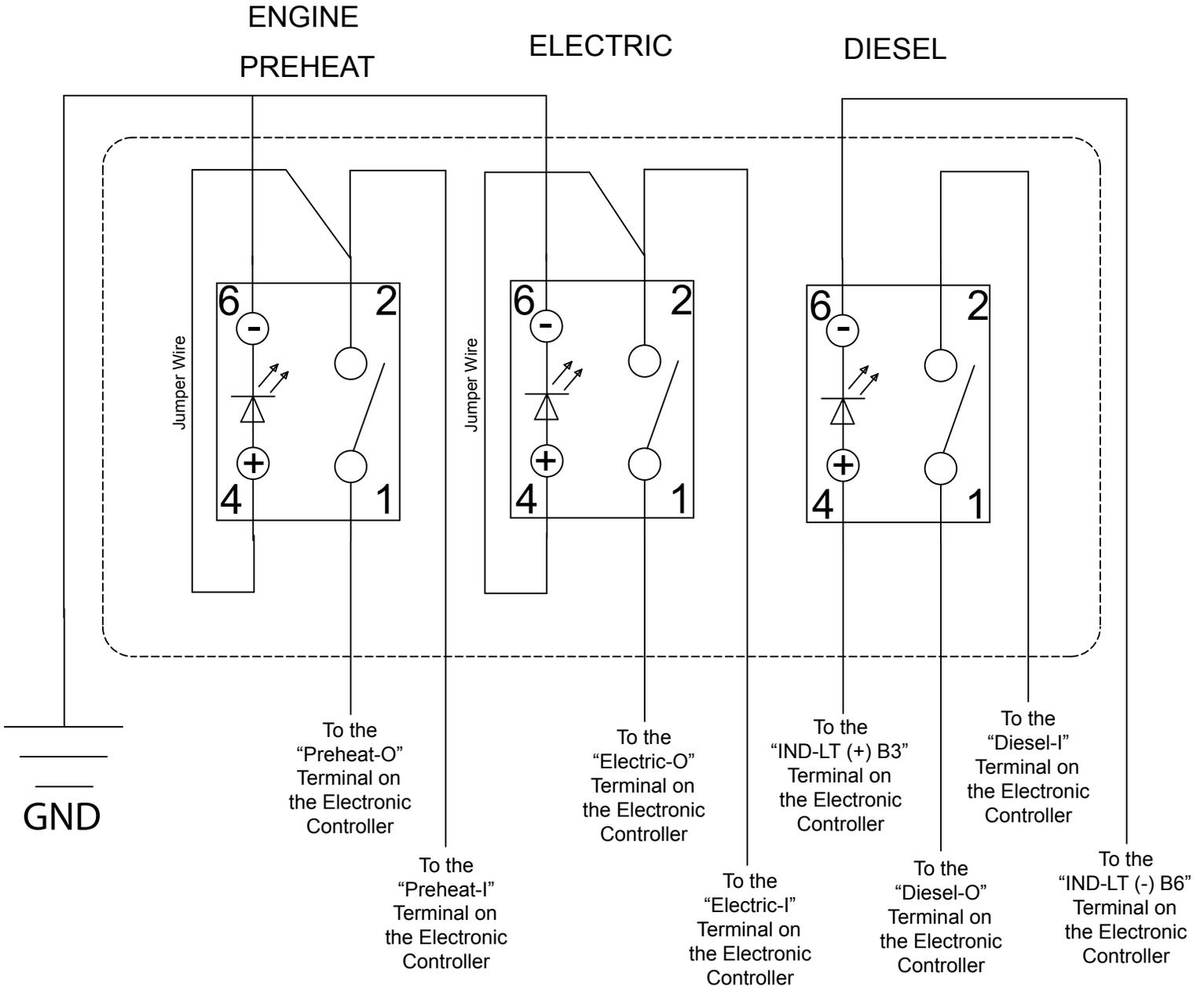


Figure 23B

**Switch Panel
and Indicator
Light Wiring
Overview
AHE-130-04X
Model ONLY**

Switch Panel
Back Side View

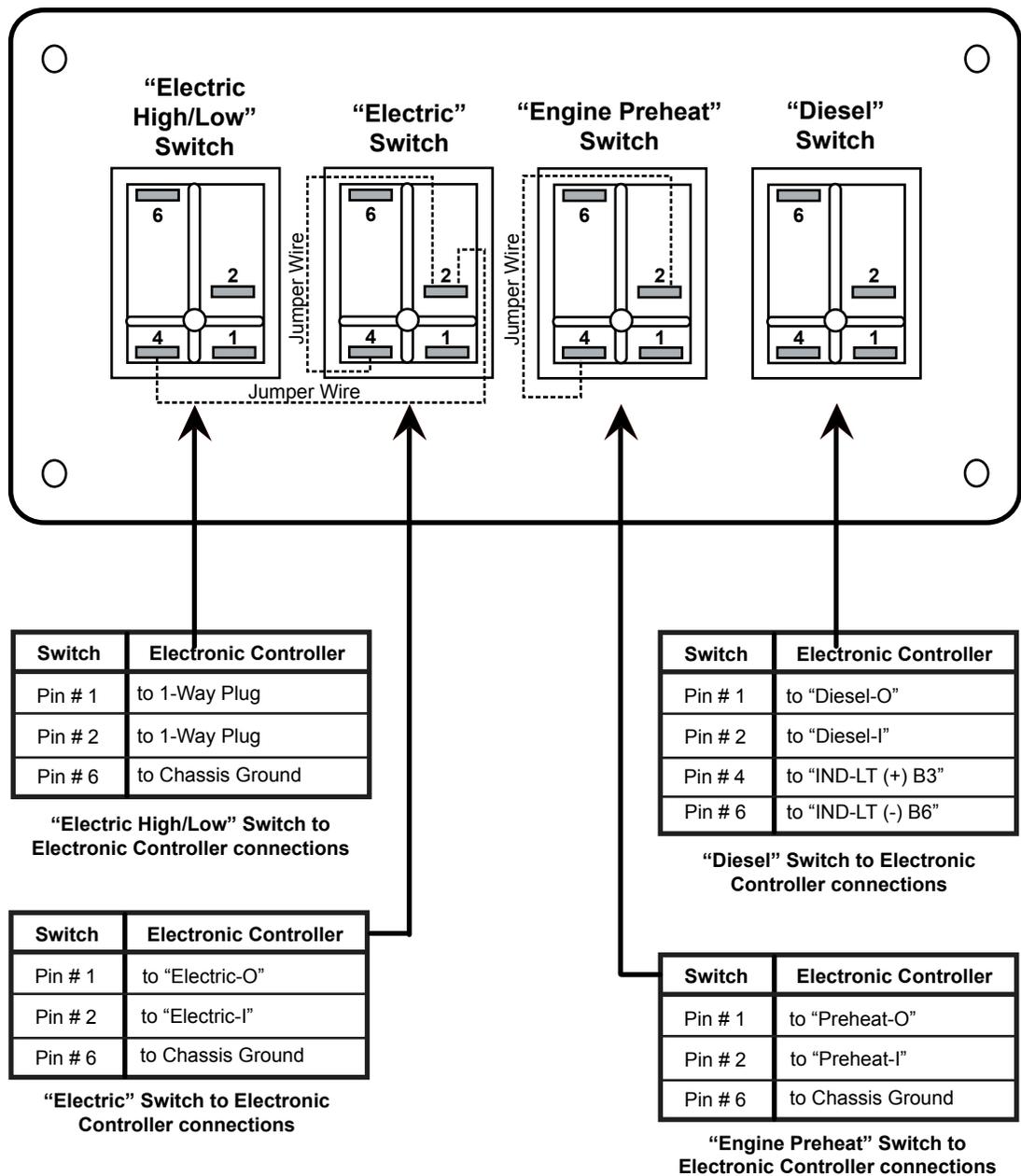


Figure 24A

NOTE: The "Engine Preheat" and "Electric" switches require a Jumper Wire, which connects Terminal #2 to Terminal #4. The "Electric High/Low" switch also requires a Jumper Wire, which connects its Terminal #4 to Terminal #2 on the "Electric" switch.

Installing/ Wiring the Switch Panel

3.20 Installing and Wiring the Switch Panel

The chosen location for the Switch Panel should allow for easy operator access. Also, because the “Diesel” switch incorporates a fault light, which indicates a Diesel-Burner malfunction, the Switch Panel should be easily visible to the operator.

1. Cut out an opening for the Switch Panel Plate; reference Figure 22.
AHE-100-04S: 3.75 in. W x 1.50 in. H
AHE-130-04X: 5.25 in. W x 1.50 in. H
2. Run eight 16 Gauge wires from the Switch Panel to the Electronic Controller.

NOTE: Be sure to use the wire colors illustrated in Appendix A. This will ensure installation consistency, differentiate between the separate switches and assist Service Personnel with troubleshooting.

3. Strip and crimp insulated female terminals onto each wire at the Switch Panel location. Also, be sure to prepare the necessary Jumper Wires.
4. Connect all switch wires as illustrated in Figure 23A and 23B for the AHE-100-04S Model and Figure 24A and 24B for the AHE-130-04X Model. Reference Appendix A for additional wiring information.
5. Insert all switch wires into the appropriate terminal/switch panel connection on the Electronic Controller; reference Appendix A.
6. Permanently mount the Switch Panel in place.
7. Be sure to move all three switches to their **OFF** position by pressing them in a downward motion.

Diesel- Burner’s Fuel System

3.21 Diesel-Burner’s Fuel System Overview

The Diesel-Burner is the Aqua-Hot’s primary heat source; therefore, care should be taken when installing the fuel system.

- A. 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 (“Supply” port and “Return” port); reference Figure 26.

NOTES:

1. If an auxiliary Fuel Tank is required, be sure to consult the ANSI/NFPA 1192 Handbook concerning Diesel Fuel System specifications.
2. These particular Aqua-Hot Hydronic Heating System models utilized two unique Fuel Filters; therefore, please reference Figures 28A and 28B in order to determine the Fuel Filter utilized in the particular model being installed.

- B. Fuel head pressure should not exceed 2 feet; reference Figure 25.
- C. Use 1/4 inch I.D. (Inside Diameter) Fuel Lines.
- D. The combined length of the supply and return Fuel Lines should not exceed 66 feet in total length; reference Figure 25.

Fuel System Specifications

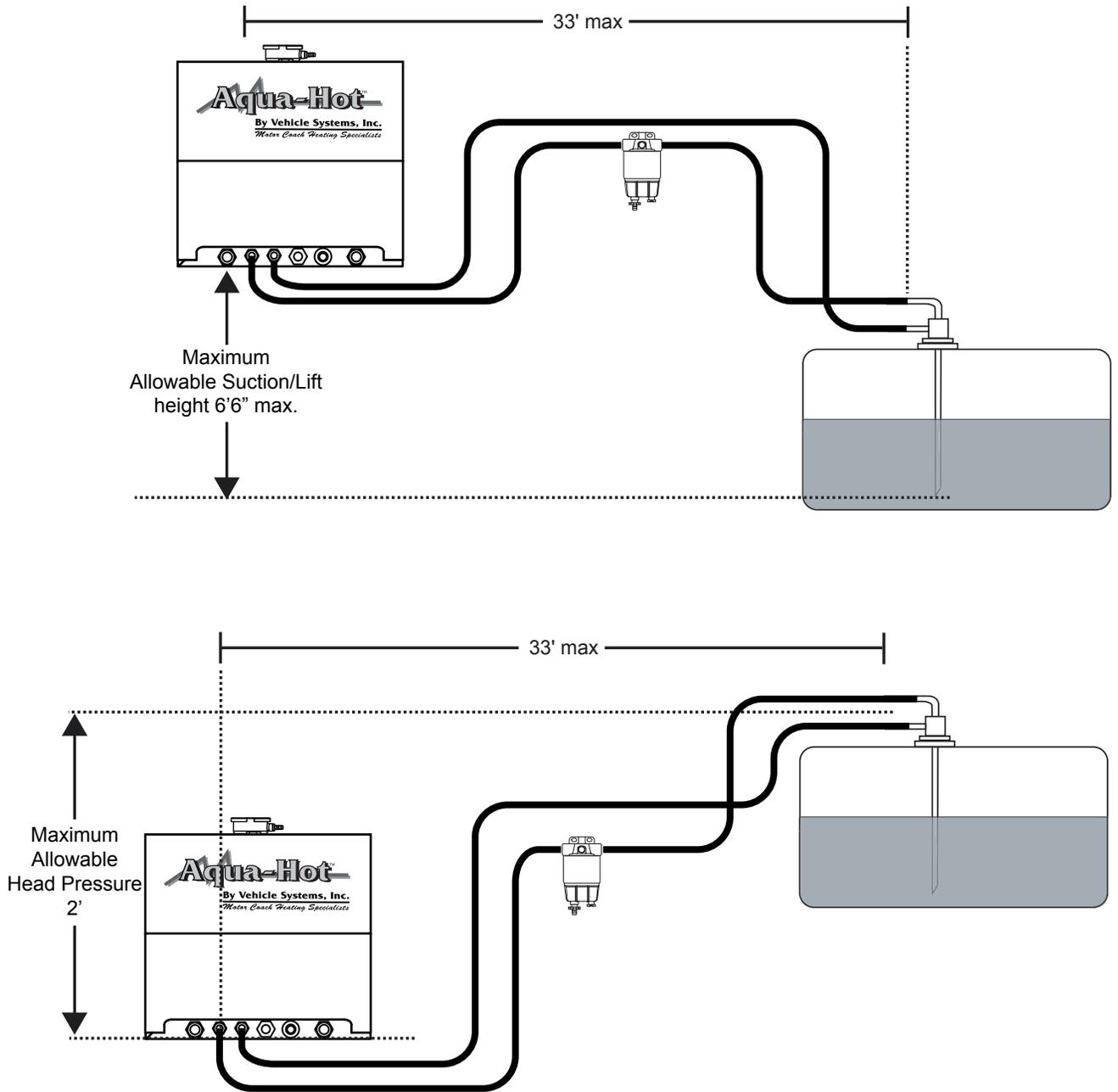


Figure 25

SECTION 3: INSTALLATION PROCEDURES

Diesel-Burner's Fuel System, continued

- E. Mount the Fuel Filter in a location that provides easy access for changing the Filter Element and for catching any potential fuel spillage when servicing.
- F. Be sure to securely tighten all fuel fittings so that **air** cannot enter into the fuel system. Air in the fuel system will cause excessive "White Smoke" emissions.

Installing the Diesel-Burner's Fuel Lines

3.22 Installing the Diesel-Burner's Fuel System and Lines

1. Run two 1/4 inch I.D. (Inside Diameter) Fuel Lines from the Fuel Tank/Fuel Pick-Up to the Aqua-Hot.

NOTES:

- A. Both Fuel Lines should be laid as flat as possible, and any extreme rises in height should be avoided. This procedure will eliminate any potential air-traps.
- B. Run both Fuel Lines in areas where they cannot be pinched off, kinked, or damaged during normal operating conditions.
- C. Be sure to secure all Fuel Lines where necessary and apply protective shielding in areas where chafing may occur.

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.



2. Label both Fuel Lines indicating whether they are a **Supply** line or a **Return** line.
3. Connect the **Supply** and **Return** lines to the Fuel Tank/Fuel Pick-Up; reference Figure 26.

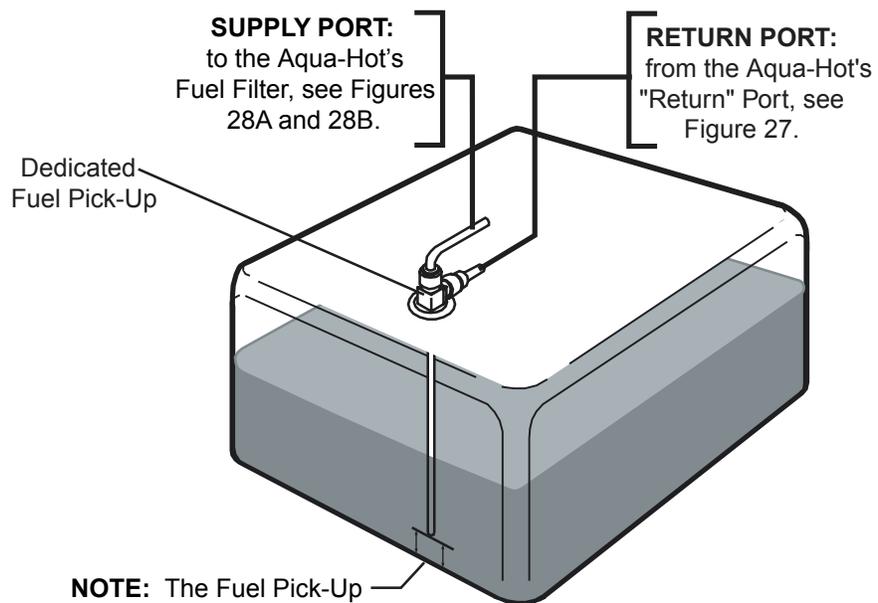


Figure 26

■ Diesel
Fuel Ports

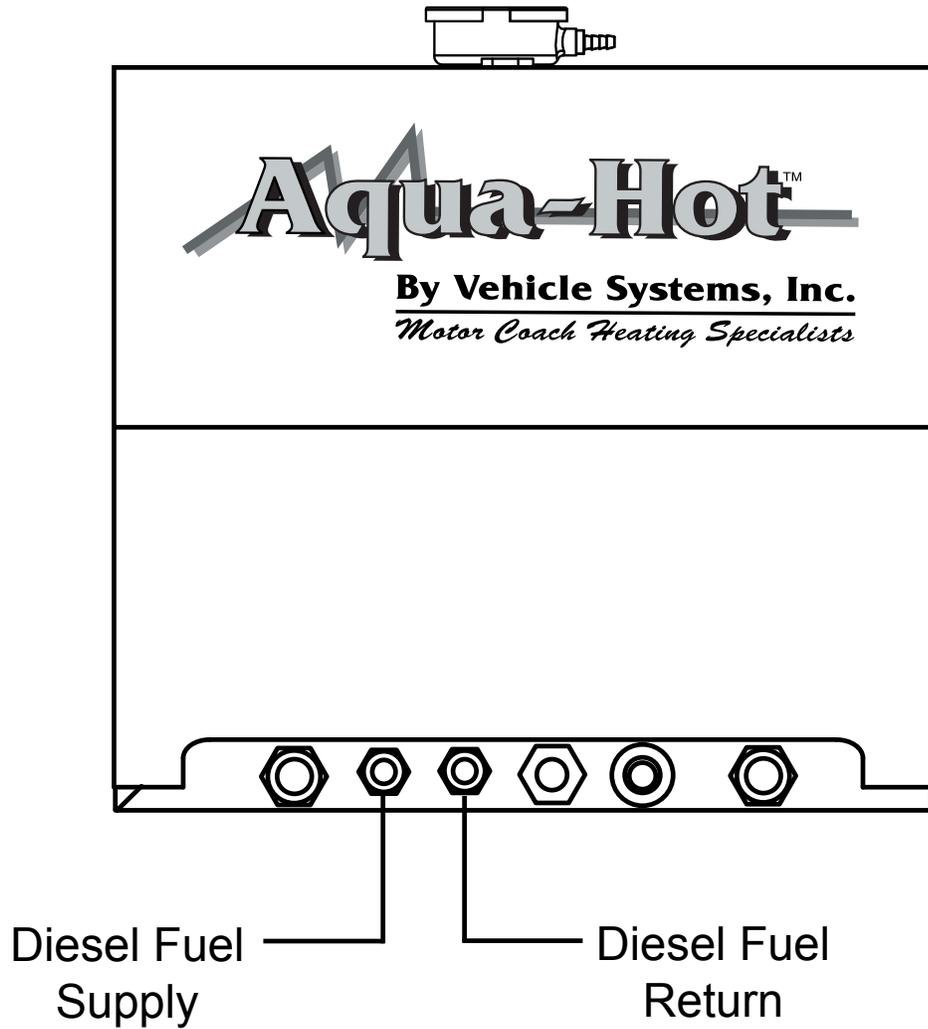
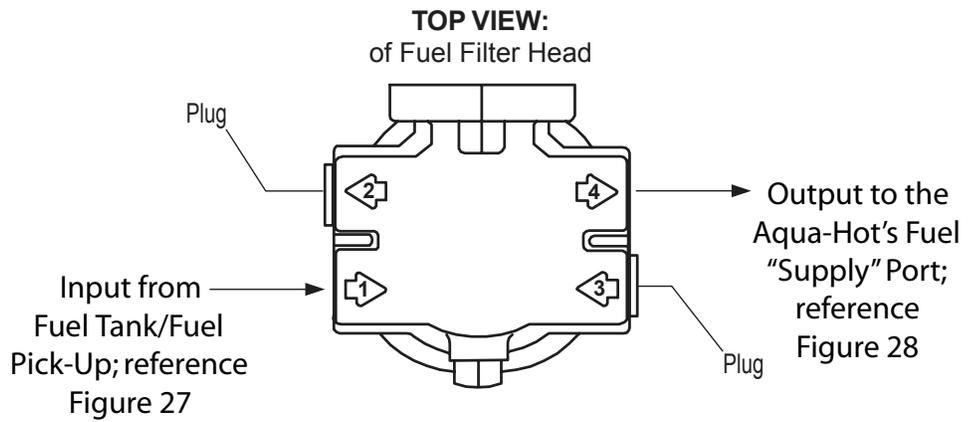
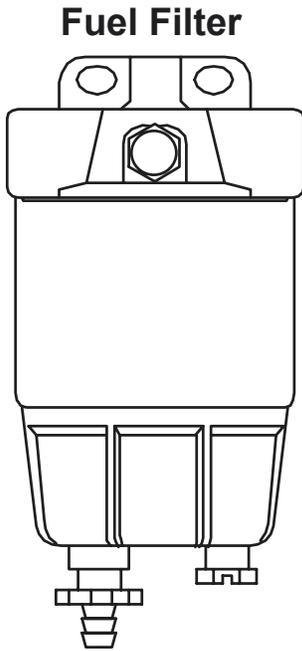


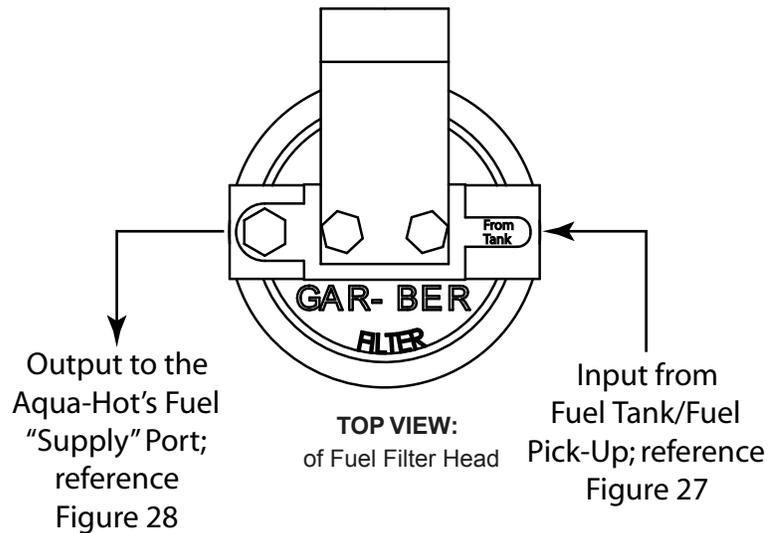
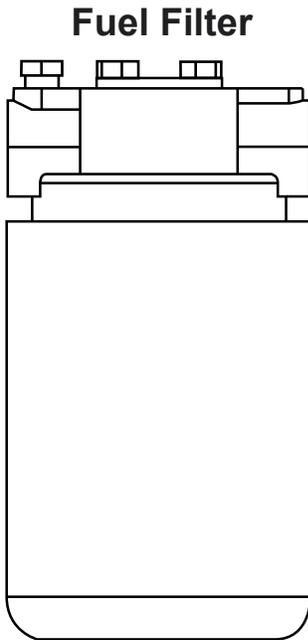
Figure 27

Fuel Filters



NOTE: Reference Figure 27 for details on the Fuel Tank connections. Reference Figure 28 for details on the Aqua-Hot's Fuel Connections.

Figure 28A



NOTE: Reference Figure 27 for details on the Fuel Tank connections. Reference Figure 28 for details on the Aqua-Hot's Fuel Connections.

Figure 28B

SECTION 3: INSTALLATION PROCEDURES

Installing the Diesel-Burner's Fuel Lines, continued

4. Install and tighten the appropriate fuel fittings into the Aqua-Hot's Fuel Ports, as well as the two selected ports of the Fuel Filter; reference Figures 27, 28A, and 28B.
5. Connect the **Supply** and **Return** lines to the Aqua-Hot's fuel port connections; reference Figures 1 and 27.
6. Cut the **Supply** line at the Fuel Filter mounting location and connect the Fuel Lines as illustrated in Figures 28A and 28B.

Exhaust System Overview/Installation

3.23 Overview and Installation of the Aqua-Hot's Exhaust System

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. In addition, the exhaust must not terminate beneath the vehicle or beneath an openable window or vent. Refer to "Internal Combustion Engine Exhaust Pipe Termination" Section 3-4.3 in the RVIA Standards Manual for additional exhaust system information.



- A. The exhaust must be able to freely exit away from the vehicle without any obstructions.
- B. Run the Exhaust Pipe to the driver's side of the vehicle and ensure that the exhaust fumes **cannot** enter into the passenger compartment.

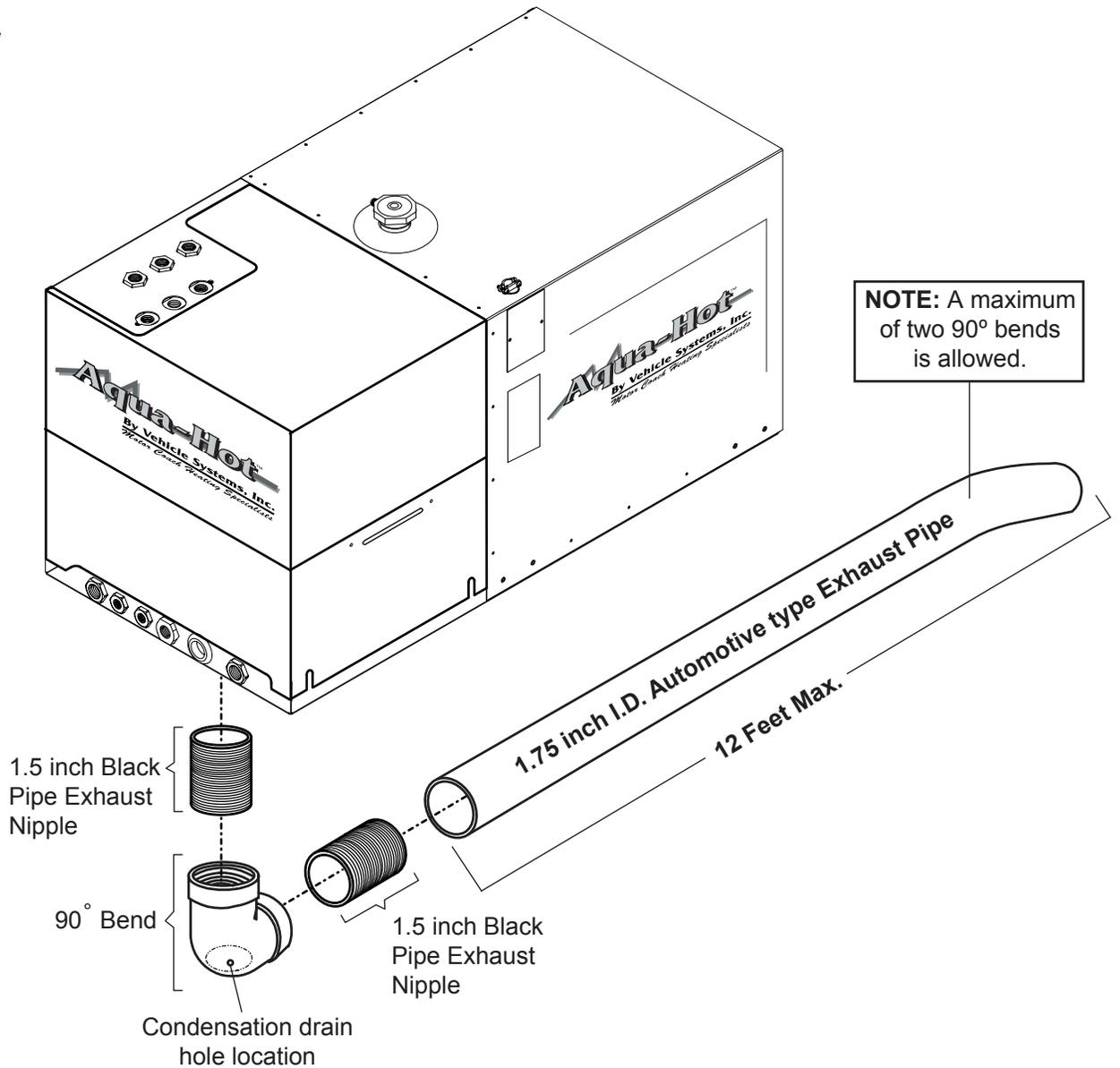
NOTES:

1. The Exhaust System **MUST NOT** terminate beneath the vehicle. Failure to conform will void the Aqua-Hot's UL listing.
 2. 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.
- C. **DO NOT** terminate the Exhaust Pipe within the awning area of the Motorhome, if applicable. Be sure to keep the exhaust away from the slideout areas. Reference RVIA's ANSI/NFPA 1192 Handbook for additional information.
 - D. From the Aqua-Hot's 1-1/2 inch (F) NPT Exhaust Port, use a 1-3/4 inch I.D. (Inside Diameter) Exhaust Pipe; reference Figure 29.

NOTES:

1. Be sure to use standard Automotive Type Exhaust piping and avoid bends, if possible.
 2. The total length of Exhaust Pipe should not exceed **12 feet**. Should your particular application require more than 12 feet of Exhaust Pipe, please contact Vehicle Systems' Product Application Support Department at 1-800-685-4298 for assistance.
 3. A maximum of two 90° Exhaust Pipe bends is allowed.
- E. A condensation drain must be provided in the exhaust system. This can be accomplished by drilling a small hole (approximately 1/8 inch diameter) at the Exhaust Pipe's lowest point (slightly sloping the Exhaust Pipe away from the Aqua-Hot will achieve the same results); reference Figure 29.
 - F. Be sure to secure the end of the Exhaust Pipe to the vehicle with the proper Exhaust Hanger/support hardware.

**Exhaust
System
Overview**



NOTE: A maximum of two 90° bends is allowed.

NOTE: A Condensation drain is not required if the Exhaust Pipe slopes away from the Heater.

Figure 29

Installing the Expansion Tank

3.24 Installing the Aqua-Hot's Expansion Bottle

The selected mounting location for the Expansion Bottle should allow for easy access (i.e., for filling) and clear visibility whenever the particular Storage Bay door is open.

1. Mount the Expansion Bottle, as illustrated in Figure 30.
2. Connect and clamp the Overflow Tubing from the Expansion Bottle to the Aqua-Hot's Filler Neck Overflow Connection; reference Figure 30.

NOTE: The Expansion Bottle can be mounted either above or below the top of the Aqua-Hot.

3. Drill a hole in the Bay floor and connect (secure with a clamp) a large enough piece of Overflow Tubing so that it can be connected to the top of the Expansion Bottle and extend through the Bay floor; reference Figure 30.

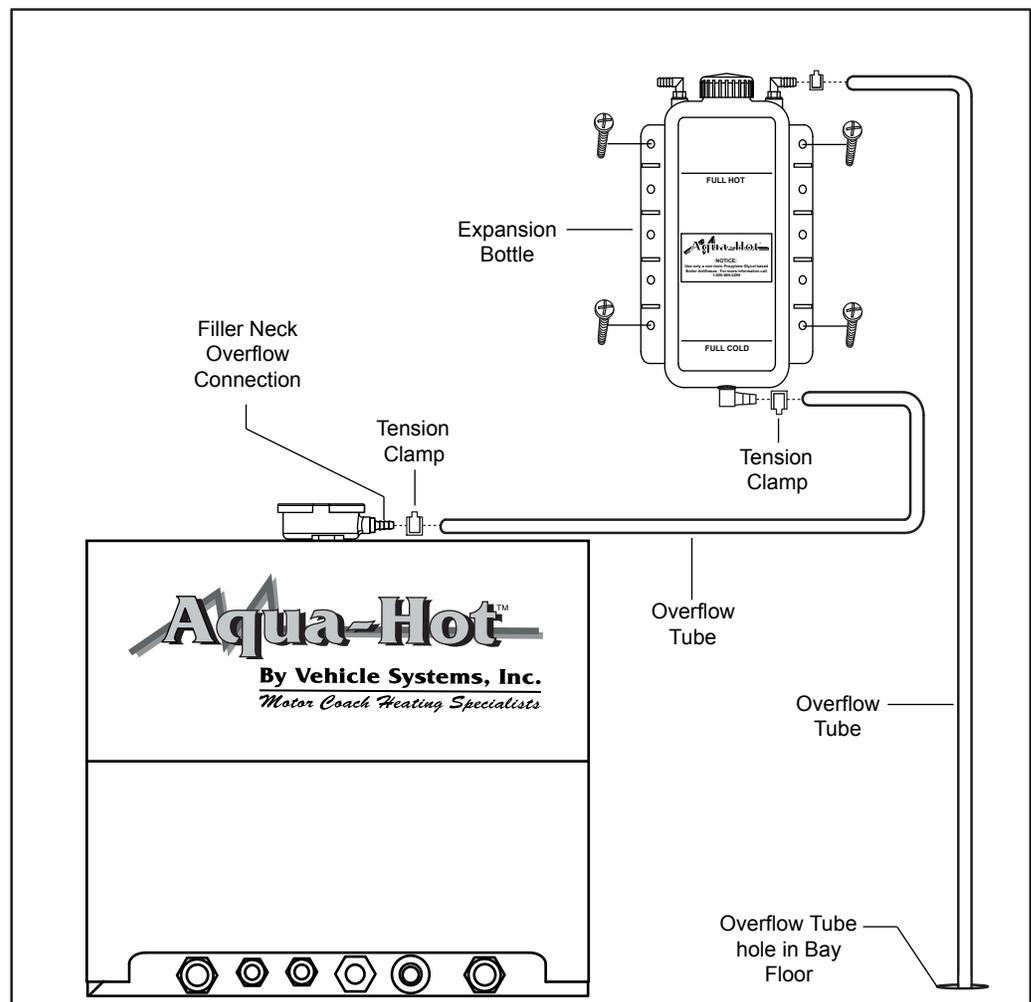


Figure 30

VDC Power Installation

3.25 Connecting 12 Volt-DC Power to the Aqua-Hot

WARNINGS:



- A. **Do not** activate the Aqua-Hot's Diesel-Burner until the antifreeze and water heating solution has been added to the Aqua-Hot's Heat 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 Heat Tank.
- B. **Do not** connect the 12 Volt-DC Power or the Ground Wires to the Aqua-Hot if the Vehicle requires welding. Electrical welding will cause **serious damage** to the Diesel-Burner's Controller and the Aqua-Hot's Electronic Controller.

NOTE: All Electric Installations, Systems, and Equipment must comply with Article 551, Part A and other Sections of NFPA 70, "National Electrical Code."

1. Run two 10 Gauge wires, Red for (+) and Black for (-), from the Vehicle's Batteries to the Aqua-Hot's Electronic Controller; reference Appendix A and Figure 31.

NOTES:

- A. If the combined length of the two 10 Gauge wires is in excess of 20 feet, reference Appendix B for proper wire gauge sizing. Please note that under full load conditions, the Aqua-Hot can draw as much as 15.33 Amps of VDC current. **Because the Aqua-Hot is designed to shut down in the event that the VDC Voltage Level drops too low to properly operate, it is imperative that the proper wire gauge be determined and utilized.**
- B. The maximum allowable **voltage drop**, for the 12 Volt-DC Aqua-Hot, is 0.75 Volts-DC. Please reference Appendix B to ensure proper wire gauge sizing is utilized.

NOTE: Be sure to use the wire colors illustrated in Appendix A. This will ensure installation consistency, differentiate between the two Power Wires, and assist Service Personnel with troubleshooting.

2. Attach the VDC Power wires onto the appropriate terminal/battery connection on the Electronic Controller; reference Appendix A.
3. Connect both Power and Ground wires **directly** to the Vehicle's batteries.

NOTE: 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 31.

NOTE: **The Aqua-Hot's Electronic Controller must be reset anytime VDC Power is disconnected and then reconnected to the heater.** The Electronic Controller can be reset either by depressing the "Low Voltage Reset" button located on the Electronic Controller (use a thin, straight object to access the reset button through the small hole in the faceplate) or by turning **OFF** the "Diesel" switch on the Heater's Interior Switch Panel for approximately 30 seconds, then turning the switch back **ON**. Reference Figure 32 for the location of the "Low Voltage Reset" button on the Electronic Controller.

VDC Power Overview

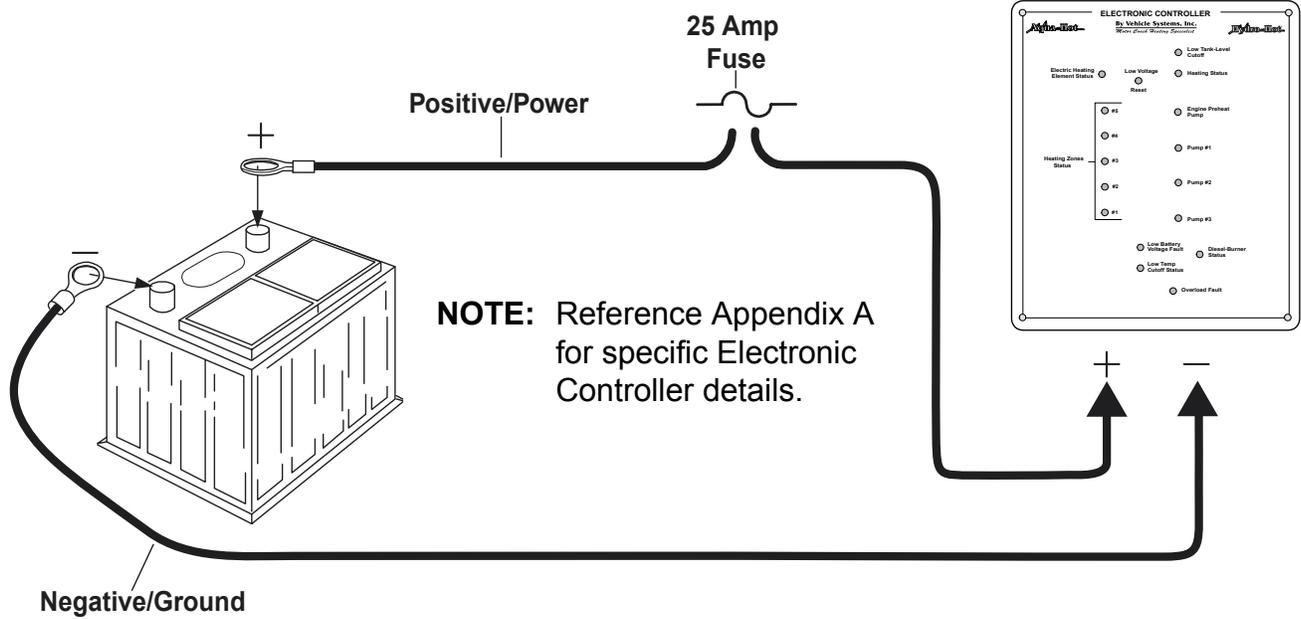


Figure 31

**Low Voltage
Reset Button**

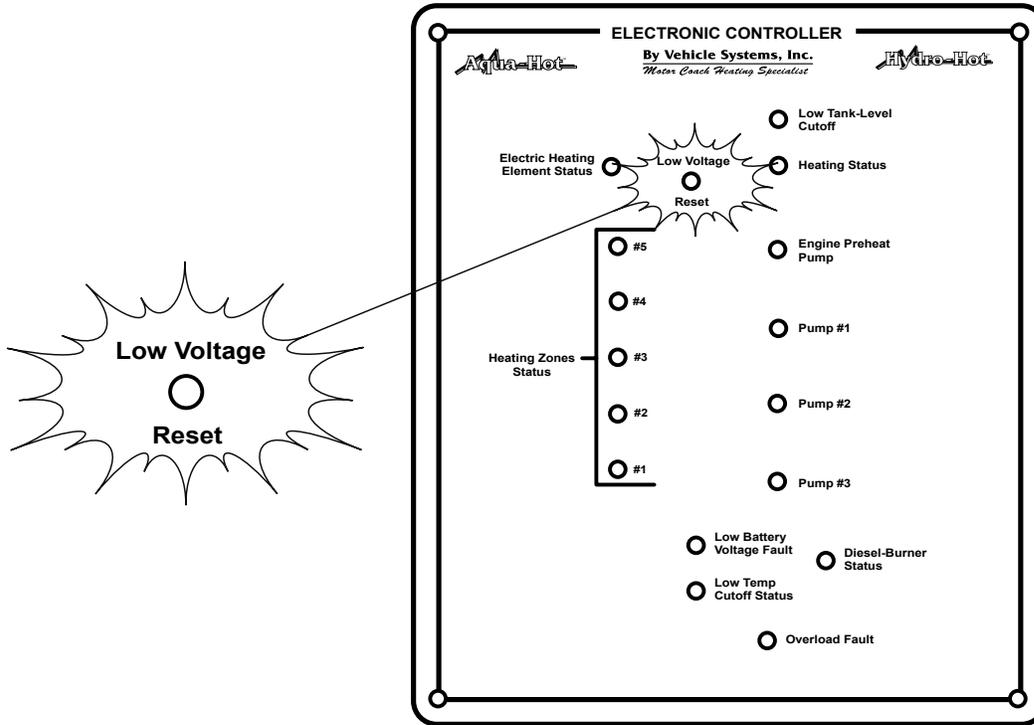


Figure 32

System Bleeding

3.26 Bleeding the Interior/Fresh Water Tank Hydronic Heating System

It is necessary to utilize a propylene glycol based “boiler” type antifreeze in the Aqua-Hot Hydronic Heating Systems. 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 can be utilized.

NOTE: Because of the significant impact various types of antifreeze can have on a Hydronic Heating System - including the level of safety provided, Vehicle Systems, Inc. has recognized 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.

Automotive Antifreeze/Coolant: These type 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 “GRAS” (Generally Recognized as Safe) 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.

Prior to bleeding the Aqua-Hot Hydronic Heating System with the proper solution of antifreeze and water, it is recommended that the plumbing system be tested for potential leaks. The following instructions detail how to properly perform a plumbing system pressure test:

- A. Remove the Aqua-Hot’s Radiator Cap and replace it with a “Cooling System Pressure Tester”; reference Figure 33. Please note that these types of Pressure Testing products can typically be obtained from a local Automotive Parts Supplier.
- B. Apply 15 pounds (PSI) of air pressure to the Aqua-Hot’s Hydronic Heating System.

NOTE: DO NOT exceed 15 PSI of air pressure, as this could cause damage to the internal plumbing components of the Aqua-Hot.

- C. Allow the air pressure to remain in the plumbing system for a minimum of 30 minutes.
- D. After the minimum 30 minute interval has expired, check the “Cooling System Pressure Tester’s” gauge for any loss of pressure.

System Bleeding, continued

NOTE: Should it be discovered that a loss of pressure has occurred, be sure to check all plumbing system connections for leaks (air leaks, in the form of bubbles, can be visually detected by applying a solution of soapy water to each plumbing system connection).

E. If applicable, repair all plumbing leaks.

1. Remove the Aqua-Hot's Fill/Radiator Cap and completely fill the Heat Tank by pouring in 16 gallons of a 50/50 antifreeze and water heating solution.

NOTE: As antifreeze itself does not possess acceptable heat transfer characteristics, water is added to the antifreeze due to its excellent heat conduction properties. In order to provide the best freeze protection, boil-over protection, and anti-corrosion and rust protection, a 50/50 mixture ratio of propylene glycol antifreeze and water 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 Hydronic Heating System from providing adequate domestic hot water and interior heating. Also, if there is a shortage of antifreeze, the Aqua-Hot Hydronic Heating System is not as well protected in terms of freeze protection and anti-rust/anti-corrosion protection.

2. Replace the Aqua-Hot's Fill/Radiator Cap, but do not tighten completely.

NOTE: The Fill Radiator Cap should remain loose during the Bleeding and Filling Procedure in order to allow air to escape from the top portion of the Aqua-Hot's Heat Tank.

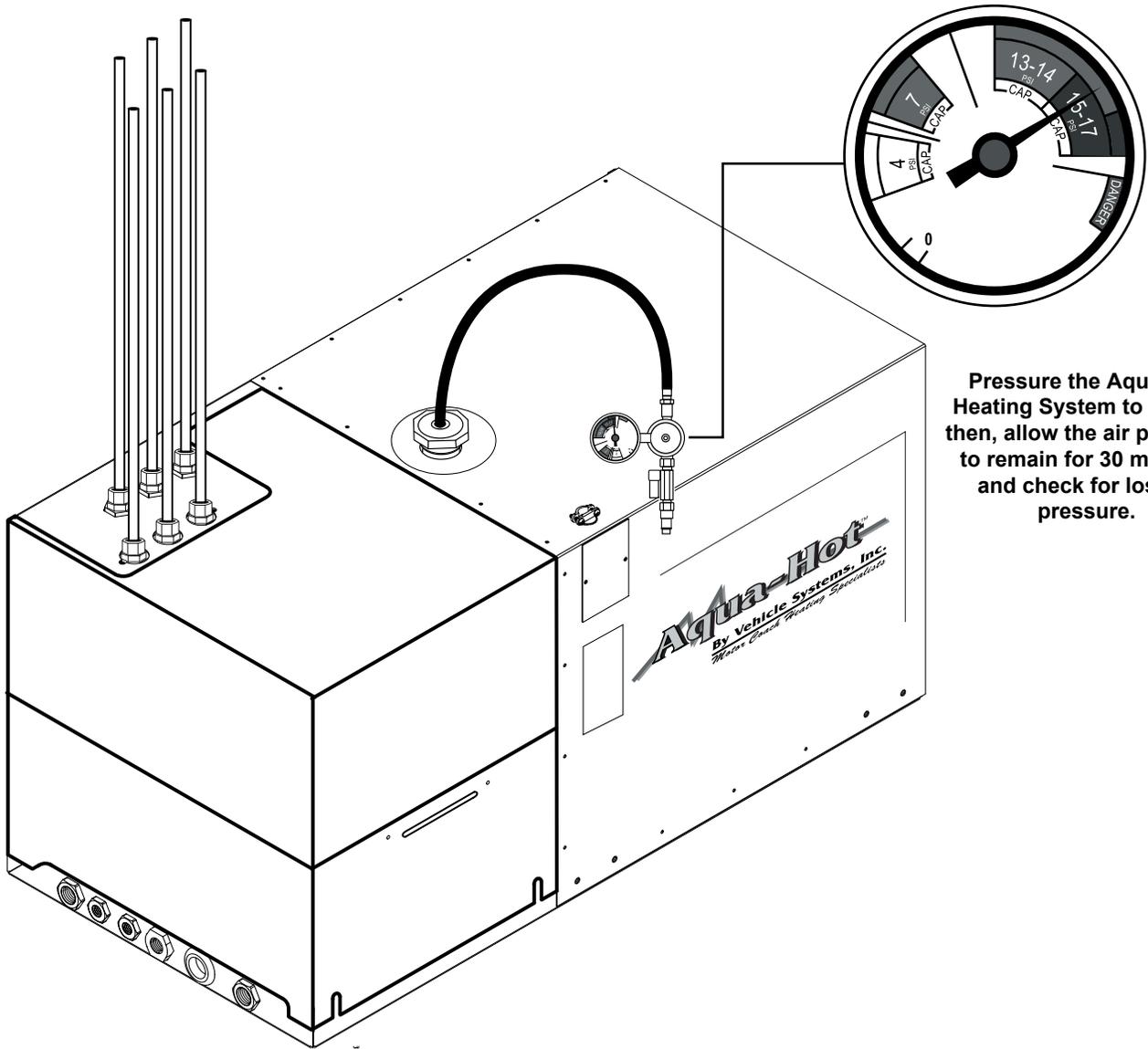
3. To activate one of the Aqua-Hot's Circulation Pumps, switch **ON** any Interior Zone Thermostat to its maximum temperature setting. Allow the Circulation Pump to operate for approximately one minute, then switch it **OFF**. This will fill the Heating System's plumbing lines.
4. Again, remove the Aqua-Hot's Fill/Radiator Cap and completely fill the Heat Tank with additional antifreeze and water heating solution.
5. Repeat steps 3 and 4 for all Heating Loops until all air has been completely bled from the entire Hydronic Heating System.
6. Once all air has been bled from the Hydronic Heating System and the Aqua-Hot's Heat Tank has been completely filled, completely tighten the Fill/Radiator Cap.

3.27 Bleeding the Domestic Water System

NOTE: Verify that the Domestic Water Tank is full prior to bleeding the Fresh Water System.

1. Ensure that the Domestic Water Pump has 12 Volt-DC power, then activate the Domestic Water Pump by opening all water faucets separately.
2. Once the Domestic Water System is completely bled, check for leaks.

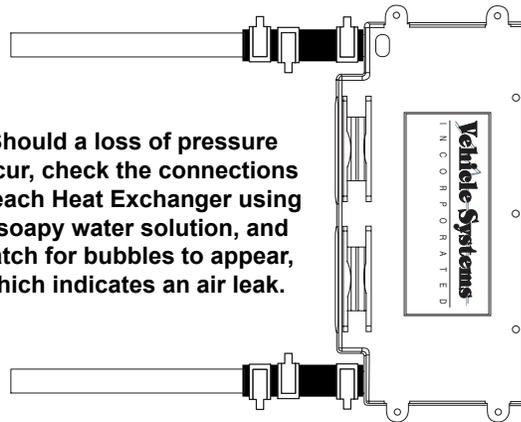
Domestic Water System Bleeding



Pressure the Aqua-Hot Heating System to 15 PSI, then, allow the air pressure to remain for 30 minutes and check for loss of pressure.

Figure 33

Should a loss of pressure occur, check the connections at each Heat Exchanger using a soapy water solution, and watch for bubbles to appear, which indicates an air leak.



Bleeding the Engine Preheat System

3.28 Bleeding the Engine Preheat System

1. Ensure that the Engine's Coolant System has been completely refilled.
2. Start and run the Engine until it reaches normal operating temperatures.
3. Turn the Engine **OFF**.
4. Check the engine coolant level and top off, if necessary.
5. Turn **ON** the "Preheat" switch located on the Switch Panel. During this procedure, check for leaks in the Engine Preheat plumbing system and connections.
6. Move the "Preheat" switch to the **OFF** position by pressing it in a downward motion.

VAC Power Installation

3.29 Connecting 120 Volt-AC Power to the Aqua-Hot

WARNING: **Do not** activate the Aqua-Hot's Electric Heating Element until the antifreeze and water heating solution has been added to the Aqua-Hot's Heat 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 Heat Tank.

NOTE: All Electric Installations, Systems, and Equipment must comply with Article 551, Part A and other Sections of NFPA 70, "National Electrical Code."

1. For Aqua-Hot Model AHE-100-04S:

Run one 12-2 ROMEX wire, with Ground, from an over-current protected (20 Amp Circuit Breaker required) 120 Volt-AC power supply to the Aqua-Hot's VAC Service Input; reference Figure 34A.

For Aqua-Hot Model AHE-130-04X:

Run two 12-2 ROMEX wires, with Ground, from two over-current protected (25-Amp Circuit Breaker required) 120 Volt-AC power supplies to the Aqua-Hot's VAC Service Input; reference Figure 34B.

2. Insert the wire(s) through the Aqua-Hot's ROMEX Clamp and connect the 120 Volt-AC Power supply to the Aqua-Hot's Electric Heating Element wires as illustrated in Figure 34A for the AHE-100-04S Model or Figure 34B for the AHE-130-04X Model.

SECTION 3: INSTALLATION PROCEDURES

**VAC Power
Installation
AHE-100-04S
Model ONLY**

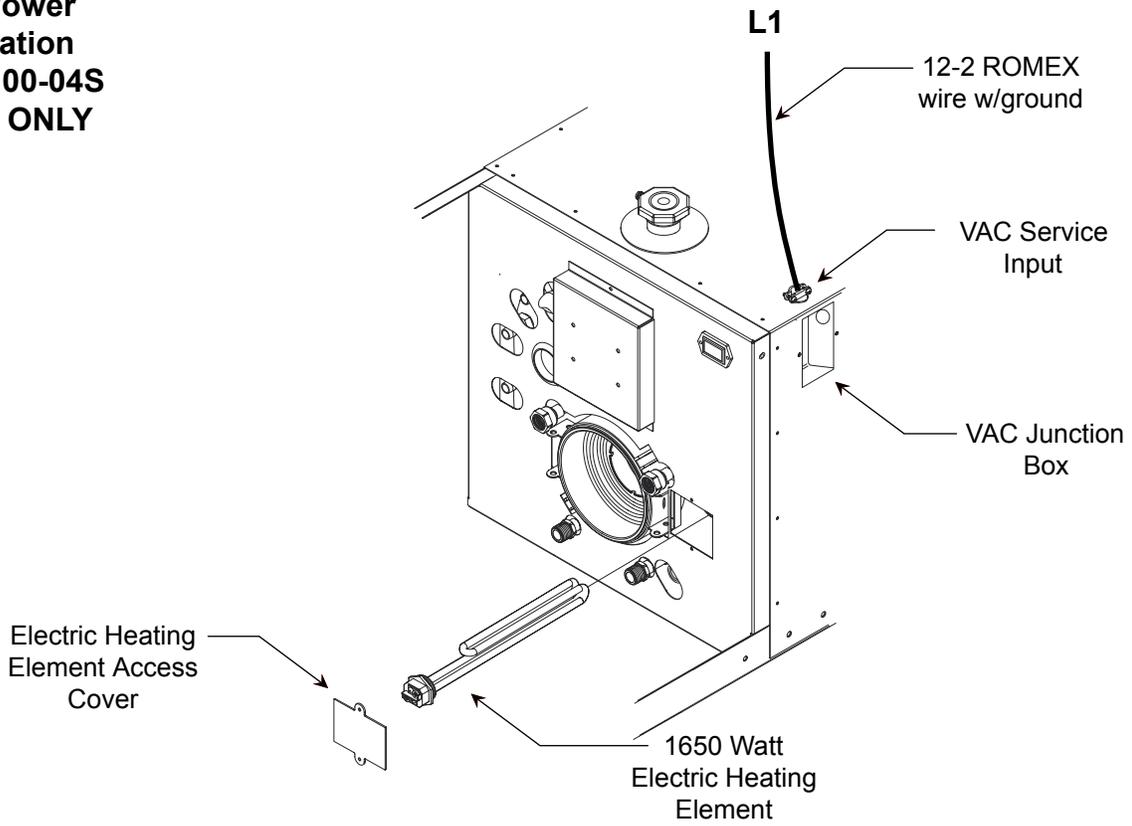
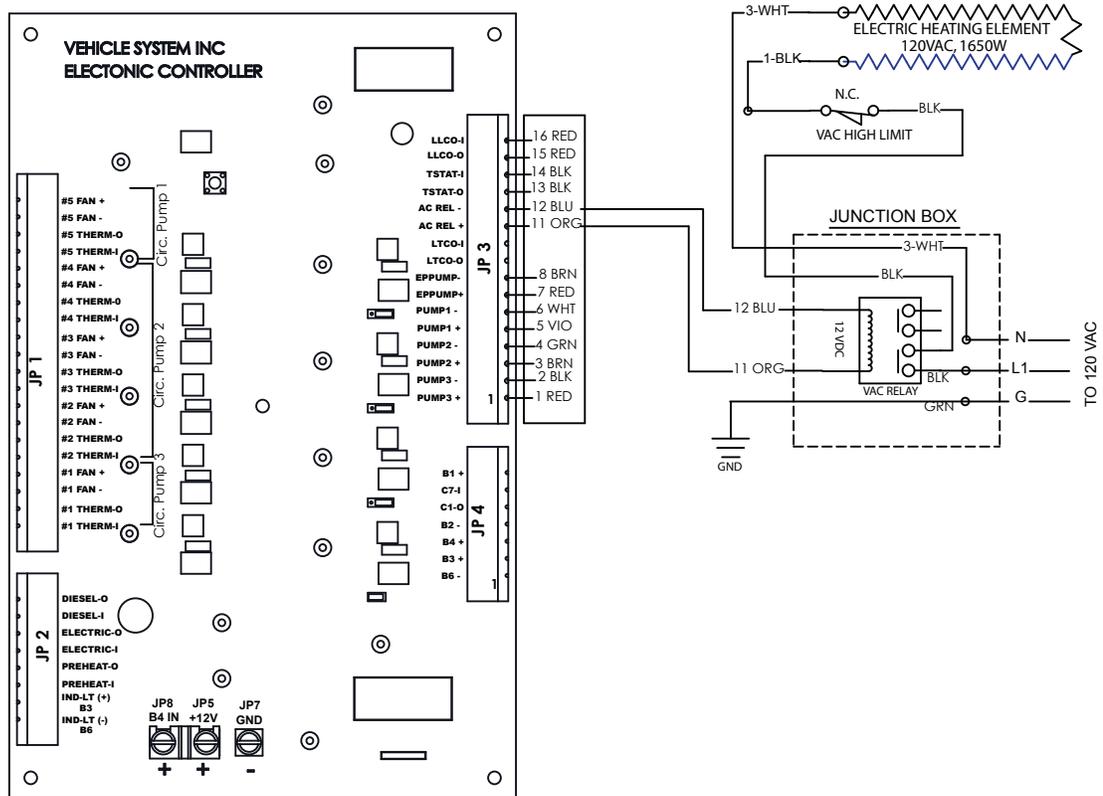


Figure 34A



SECTION 3: INSTALLATION PROCEDURES

VAC Power Installation AHE-130-04X Model ONLY

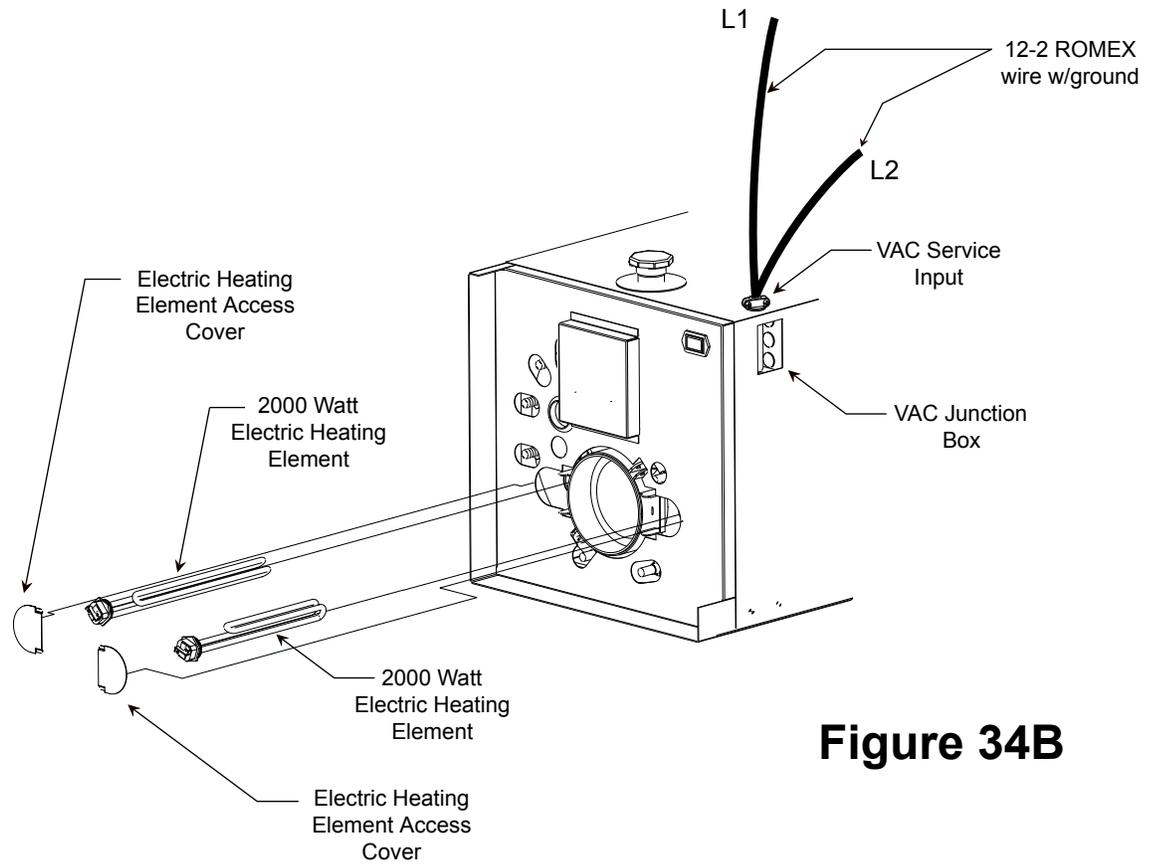
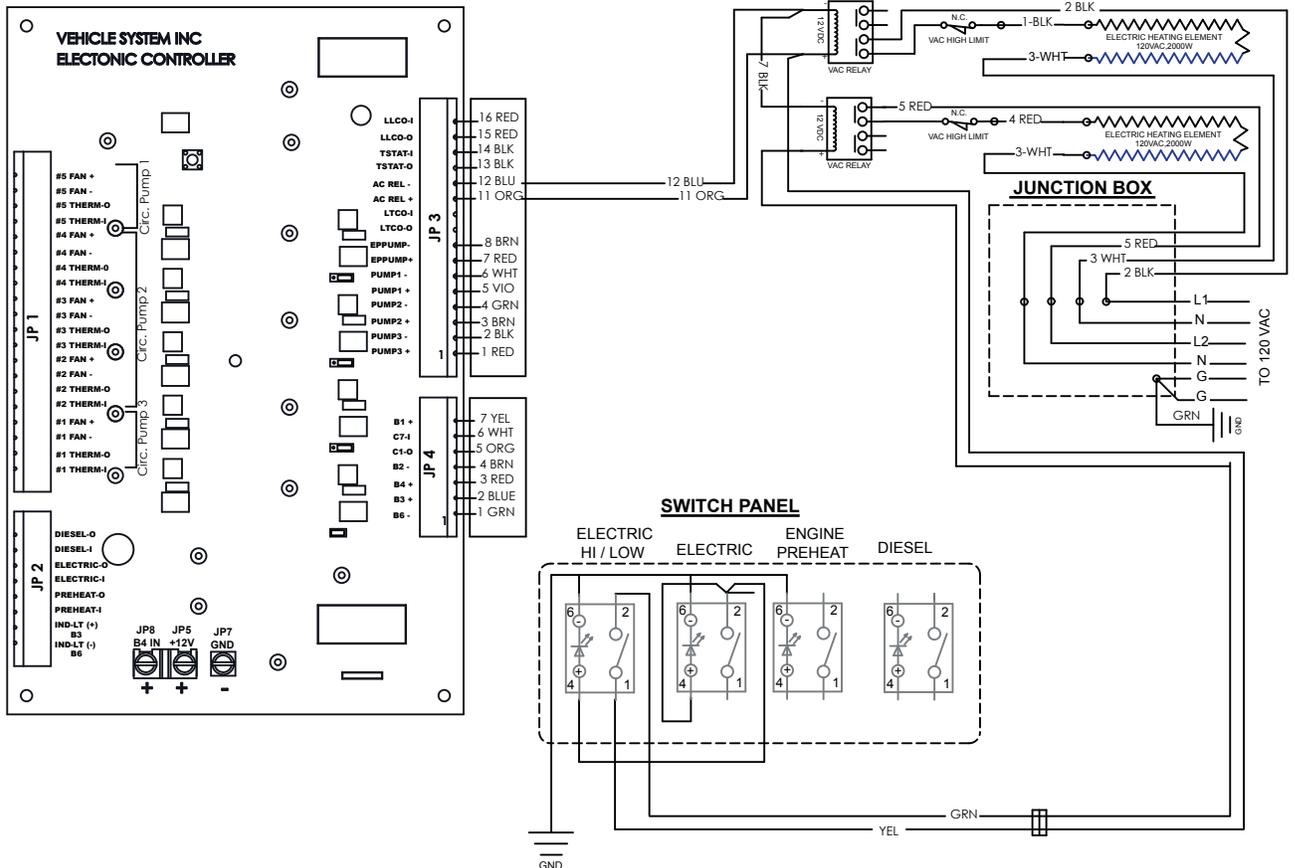


Figure 34B



Activating the Aqua-Hot

3.30 Initial Activation of the Aqua-Hot

1. Move the Aqua-Hot's "Diesel" switch to the **ON** position. Do this by pressing the switch in an upward motion.

NOTE: Activate the "Diesel" switch for approximately **five seconds ONLY and then switch it OFF**. This procedure will purge the Diesel-Burner's fuel system by allowing the Heater's Fuel-Pump to operate for approximately three minutes during its normal shutdown/purge cycle. After the three minute purge cycle has ended, repeat this procedure once more.

2. Move the Aqua-Hot's "Diesel" switch to the **ON** position and leave it on. This procedure will activate the Diesel-Burner and the Indicator Light circuit of the switch.

NOTES:

- A. It will take approximately **30 seconds** before the Diesel-Burner will ignite and exhaust can be heard exiting the heater.
- B. Allow approximately 10-20 minutes for the Aqua-Hot to reach normal operating temperature (approximately 195°F).

3. Because the number and voltage of the Electric Elements vary by model, locate the Marking Plate on the Aqua-Hot (reference Figure 1 for the Marking Plate locations, as well as Figure 3 for additional information) to determine which model is employed. Follow the Electric Element activation instructions below.

AHE-100-04S

Move the Aqua-Hot's "Electric" switch to the **ON** position. This will supply 120 Volt-AC Power to the Aqua-Hot's Electric Heating Element.

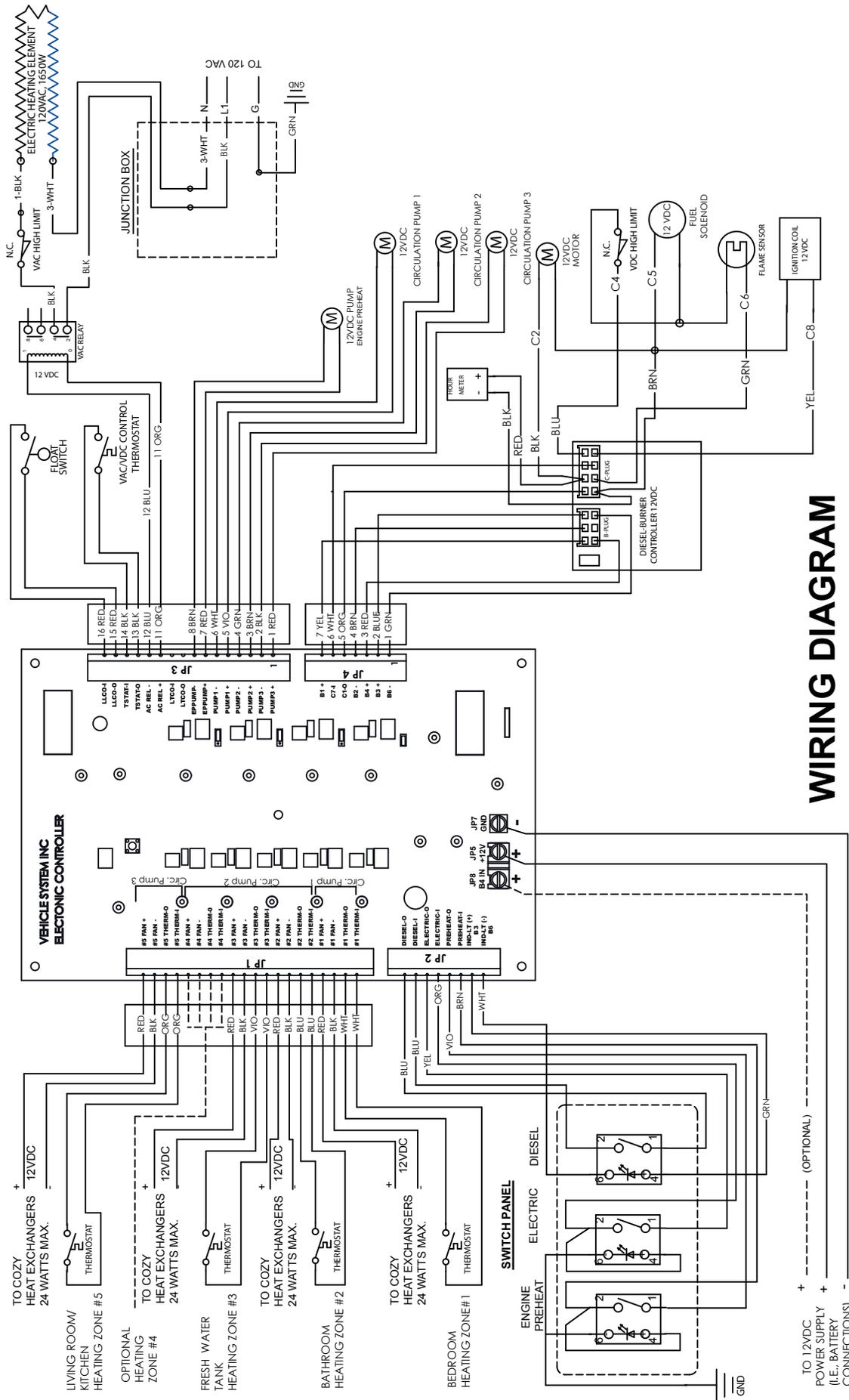
AHE-130-04X

Move the Aqua-Hot's "Electric" switch to the **ON** position and move the "High/Low" switch to the "High" position. This will supply 120 Volt-AC power to both Electric Heating Elements.

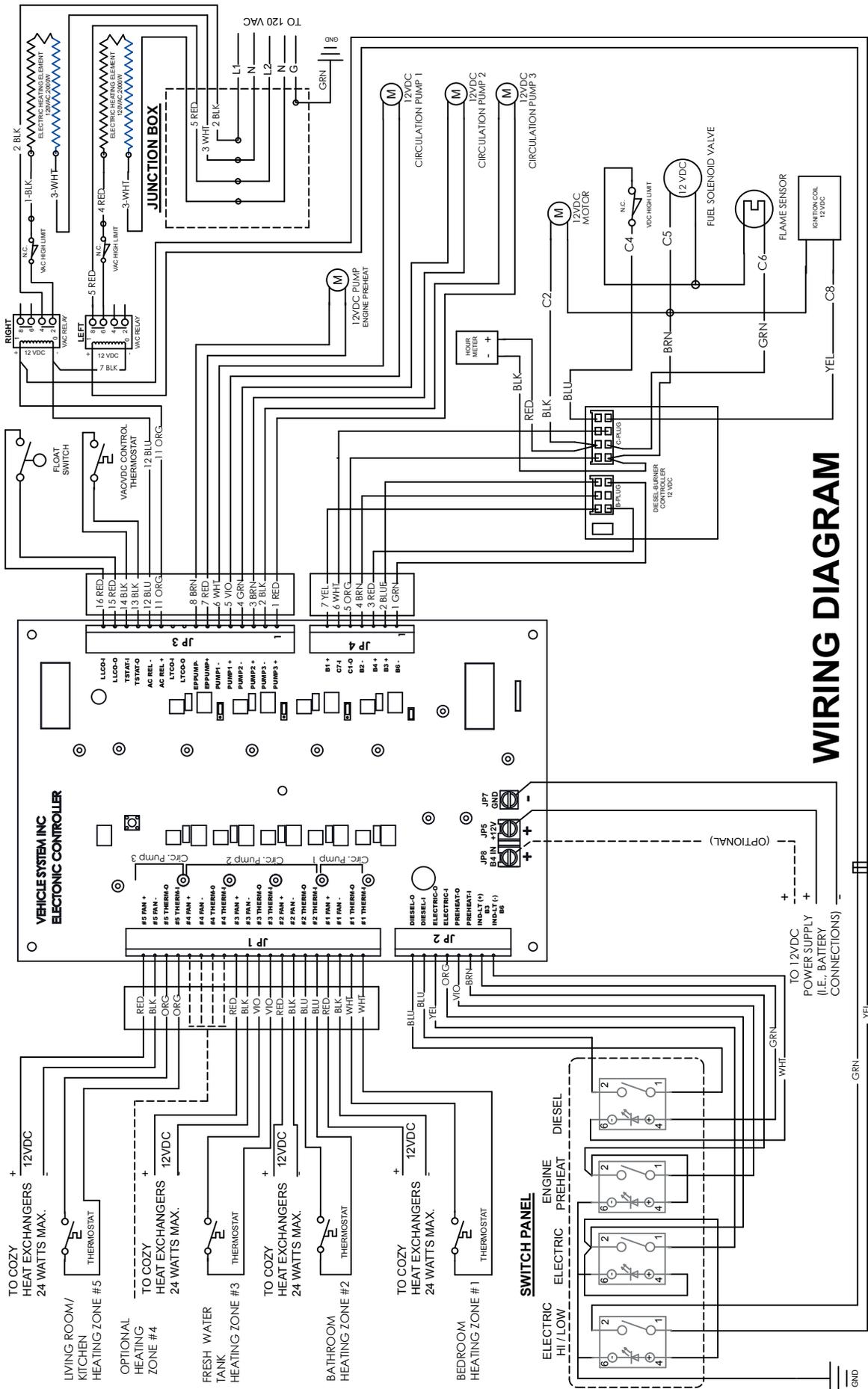
NOTE: Both the 12 Volt-DC powered Diesel-Burner and all Electrical Heating Elements are thermostatically controlled. Either or both heating sources will automatically maintain the temperature of the Aqua-Hot's antifreeze and water heating solution.

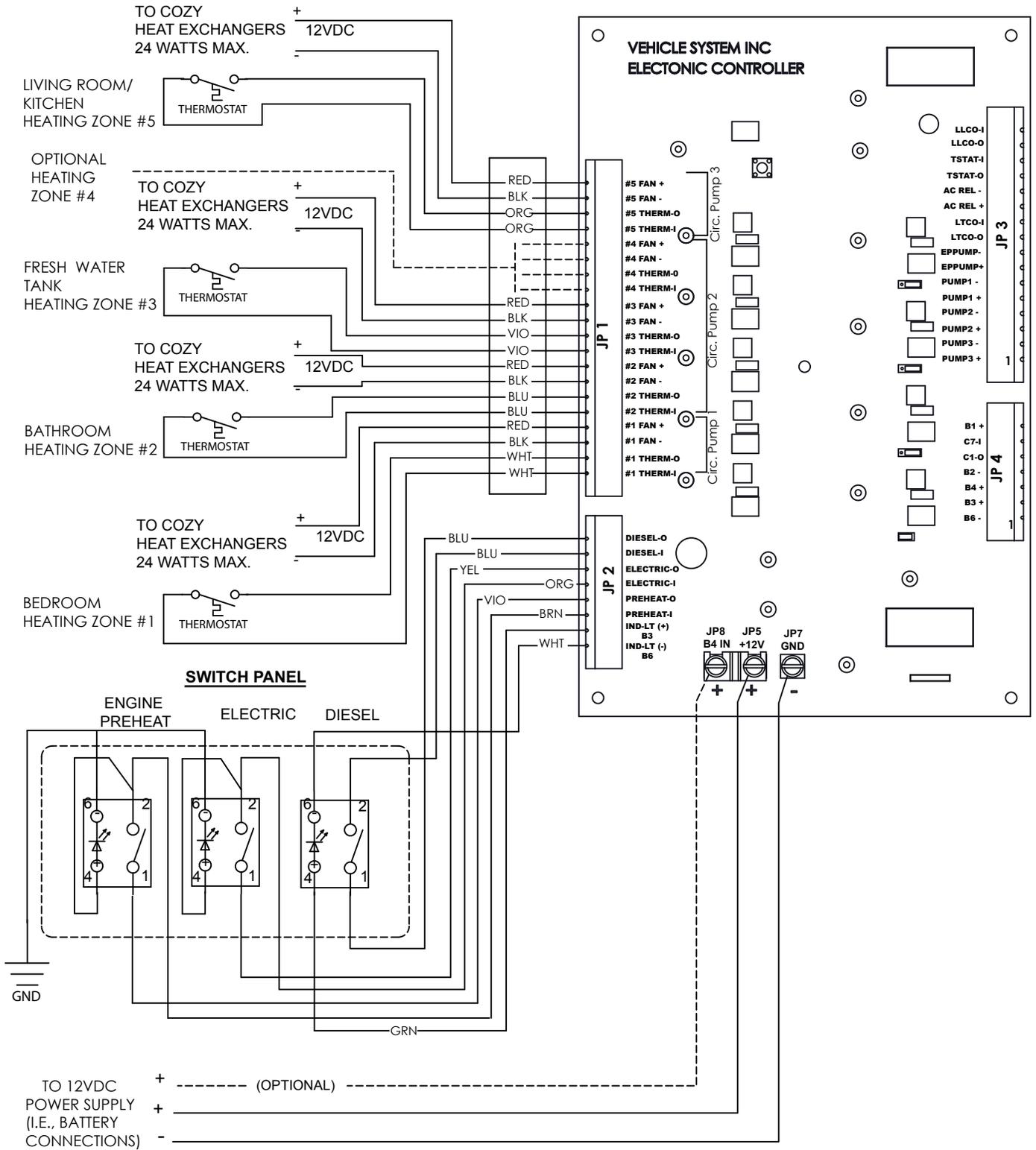
4. Once the Aqua-Hot has reached its normal operating temperature of approximately 195°F, switch **ON** each Interior and Fresh Water Tank Thermostat to their maximum temperature settings. This procedure will activate all Interior and Fresh Water Tank Heat Exchangers in each particular heating zone.
5. The Aqua-Hot is now ready for normal operation and use.

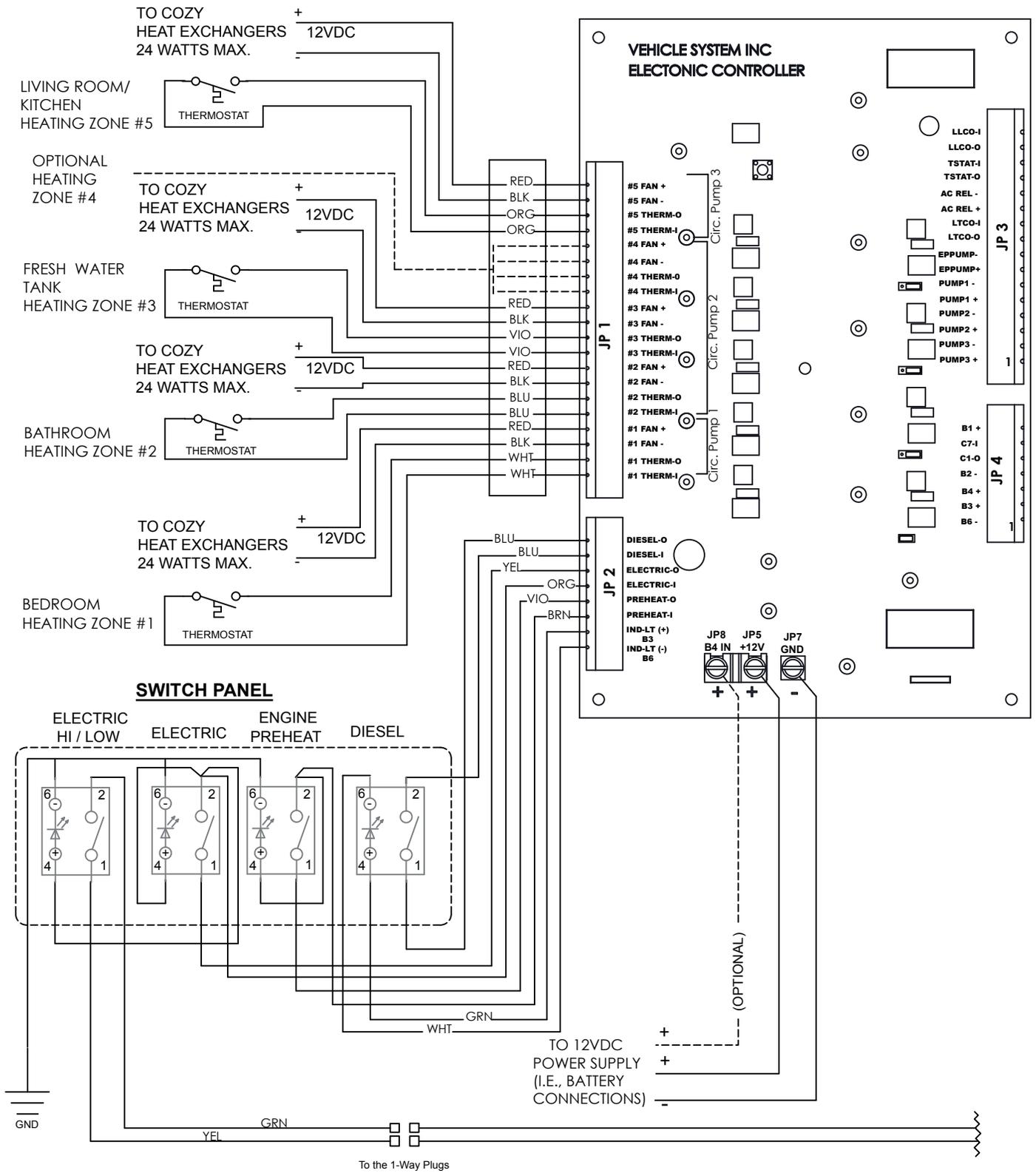
Wiring Diagrams



WIRING DIAGRAM







Wire Gauge Information

AMERICAN BOAT AND YACHT COUNCIL RECOMMENDATIONS
CONDUCTORS SIZES FOR 3% DROP IN VOLTAGE

TOTAL CURRENT ON CIRCUIT IN AMPS. Length of Conductor from Source of Current to Device and back to Source —Feet

12 Volts - 3% Drop Wire Sizes (gage) - Based on Minimum CM Area																			
5	10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
18	16	14	12	12	10	10	10	8	8	8	6	6	6	6	6	6	6	6	6
14	12	10	10	10	8	6	6	6	6	4	4	4	4	2	2	2	2	2	2
12	10	10	8	8	6	6	4	4	2	2	2	2	2	2	1	1	1	1	1
10	10	8	6	6	6	4	4	2	2	2	1	1	0	0	0	0	2/0	2/0	2/0
10	8	6	6	6	4	4	2	2	1	1	0	0	0	2/0	2/0	3/0	3/0	3/0	3/0
8	6	6	4	4	2	2	1	0	0	2/0	2/0	3/0	3/0	3/0	3/0	4/0	4/0	4/0	4/0
6	6	4	4	2	2	1	0	2/0	2/0	3/0	3/0	4/0	4/0	4/0					
6	4	4	2	2	1	0	2/0	3/0	3/0	4/0	4/0	4/0							
6	4	2	2	1	0	2/0	3/0	3/0	4/0	4/0									
4	2	2	1	0	2/0	3/0	4/0	4/0											
4	2	2	1	0	2/0	3/0	4/0												

24 Volts - 3% Drop Wire Sizes (gage) - Based on Minimum CM Area																			
5	10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
18	18	18	16	16	14	12	12	12	10	10	10	10	10	8	8	8	8	8	8
18	16	14	12	12	10	10	10	8	8	8	6	6	6	6	6	6	6	6	6
16	14	12	12	10	10	8	8	6	6	6	6	6	4	4	4	4	4	4	2
14	12	10	10	10	8	6	6	6	4	4	4	4	4	2	2	2	2	2	2
12	12	10	10	8	6	6	6	4	4	4	4	2	2	2	2	2	2	2	1
12	10	10	8	8	6	6	4	4	4	2	2	2	2	2	2	1	1	1	1
10	10	8	6	6	6	4	4	2	2	2	2	1	1	1	0	0	0	0	2/0
10	8	6	6	6	4	4	2	2	1	1	0	0	0	2/0	2/0	3/0	3/0	3/0	3/0
8	6	6	4	4	2	2	1	1	0	0	2/0	2/0	3/0	3/0	3/0	3/0	3/0	4/0	4/0
8	6	6	4	4	2	2	1	0	0	2/0	2/0	3/0	3/0	3/0	4/0	4/0	4/0	4/0	4/0
8	6	4	4	2	2	1	0	0	2/0	2/0	3/0	3/0	4/0	4/0	4/0	4/0	4/0		
6	6	4	4	2	2	1	0	2/0	2/0	3/0	3/0	4/0	4/0	4/0					

Vehicle Systems

I N C O R P O R A T E D

Motor Coach Heating Specialist • Manufacturer and Distributor

15549 East Highway 52 • Fort Lupton, Colorado 80621 • 1-800-685-4298 • Fax: 303-857-9000

© Copyright 2005 Vehicle Systems, Inc. All rights reserved.

www.vehiclesys.com

LTE-VHS-229