



By Vehicle Systems, Inc.

Motor Coach Heating Specialists

Installation Manual

MODEL NUMBERS

HHE-200-07E

HHE-500-07M

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SECTION 1: HYDRONIC HEATING SYSTEM OVERVIEW

Introduction

1.0 Heating System Overview

The Hydro-Hot Hydronic Heating System utilizes a heated solution of water and antifreeze as its heating medium. This heated solution is circulated, by two 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 then drawn off and delivered to each particular heating zone.

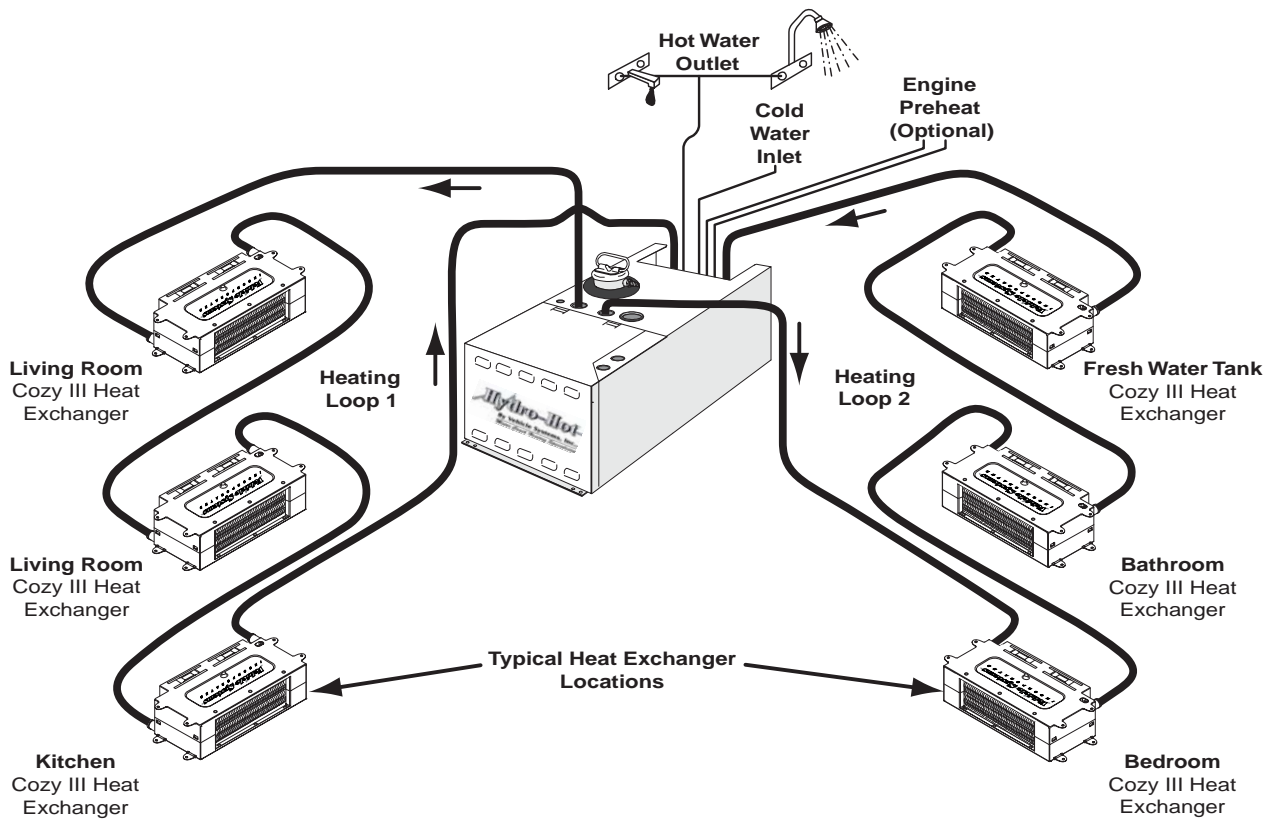


Figure 1

SECTION 2: HYDRO-HOT OVERVIEW

Hydro-Hot Overview

2.0 Hydro-Hot Overview

The Hydro-Hot hydronic heating system combines a continuous supply of domestic hot water, as well as interior heating, into one space-saving device. Both heating features are accomplished by a 12-VDC powered Diesel-Burner and a 120-VAC powered Electric Heating Element. These two heating sources maintain the temperature of the Hydro-Hot's solution of water and antifreeze. This solution stores the heat that provides both continuous domestic hot water and interior / fresh water tank heating. The Hydro-Hot has also been designed to preheat the vehicle's engine prior to starting. This feature, **available only on the HHE-200 models**, provides easy engine start-up when cool weather conditions exist.

NOTE: The Hydro-Hot is available in three versions / models. All three models come standard with the continuous domestic hot water and interior / fresh water tank heating features. The engine preheat and motoraid options are available on the HHE-200 and HHE-500 series, respectively. Be sure to identify the specific version / model of Hydro-Hot prior to installing the Heater. Do this by locating the I.D. Plate on the top side of the heater near the Access Cover, see Figures 2 and 2A.

Technical Data

2.1 Technical Data

Diesel Burner, Heat Output	50,000 BTU/hr
Diesel Burner, Fuel Consumption	0.50 gal/hr
Diesel Burner, Voltage / Power Consumption	12 VDC / 60 watts
Electric Heating Element specifications	120 VAC/1650 watts
Circulation Zone Pumps specifications	(2) 12 VDC/21 watts/ea
Number of Heating Zones	maximum of 5, plus optional Engine Preheat
Domestic Water Heating Capacity	continuous / on-demand
Dimensions	12"H X 18.5"W X 30"L
Dry Weight	approximately 105 lbs.

NOTE:

All Vehicle installations must comply with the requirements listed in the ANSI A119.2 Handbook (American National Standards Institute) NFPA 501C (National Fire Protection Association) Standard on Recreational Vehicles. 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

SECTION 2: HYDRO-HOT OVERVIEW

Hydro-Hot Overview

2.2 Hydro-Hot Reference Illustration

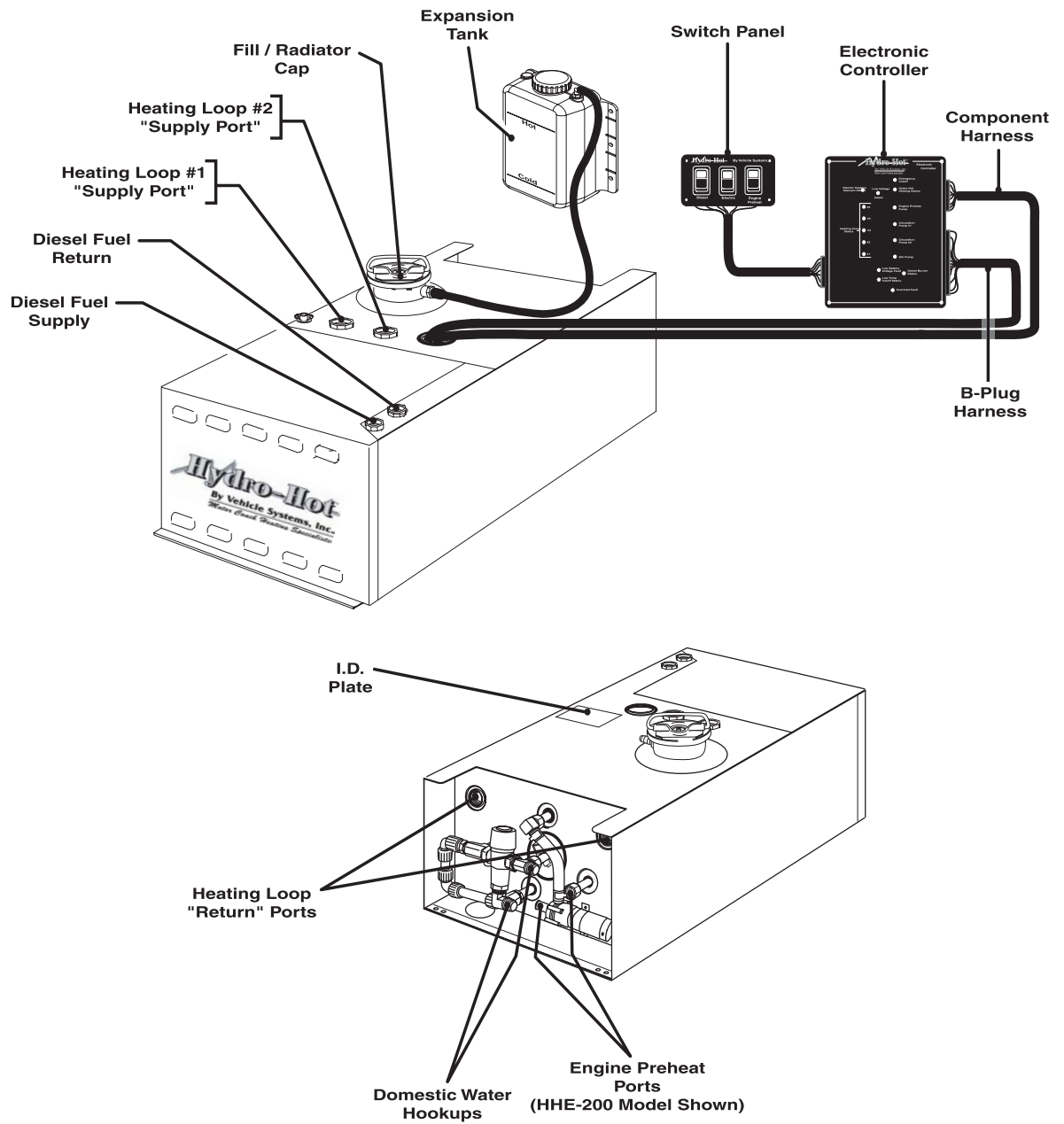


Figure 2

SECTION 3: INSTALLATION PROCEDURES

Hydro-Hot Identification Plate

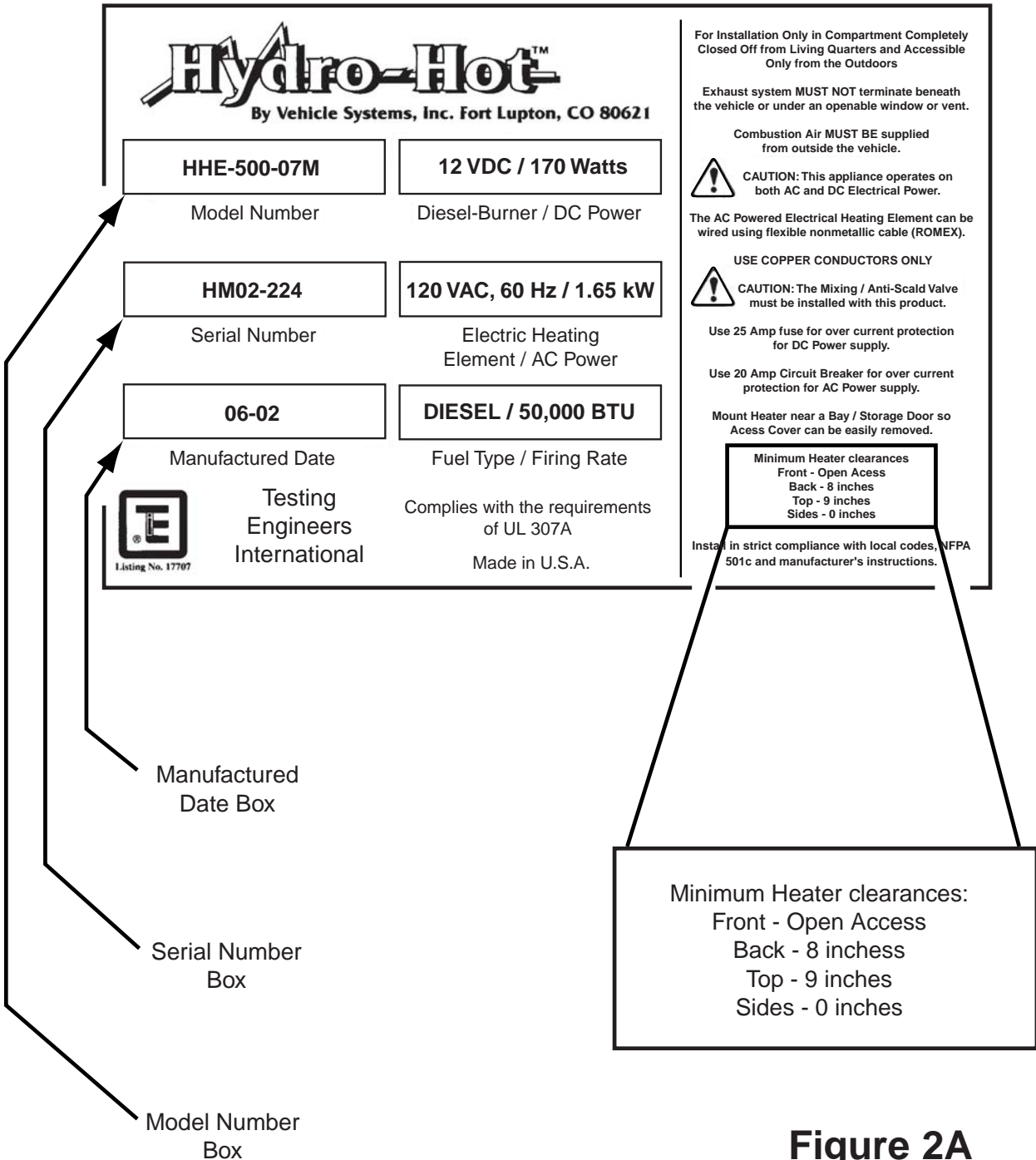


Figure 2A

SECTION 3: INSTALLATION PROCEDURES

Hydro-Hot Installation

Hydro-Hot Mounting Location



3.0 Installation Procedures

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

3.1 Mounting Location for the Hydro-Hot, Overview

Because Motorhome applications will vary, the Hydro-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 250 lbs.** Inspect the area beneath the mounting location to ensure no structural members will interfere with the Exhaust, Combustion Air-Tube, and Drain Holes.
- B. Because combustion-air must be drawn from outside the motorhome, the Hydro-Hot **cannot** be installed anywhere inside the passenger compartment or any living area.
- C. Centralize the Hydro-Hot nearest the area where Domestic Hot Water will be used most frequently (i.e. Bathroom and Kitchen Areas), see Figure 6A. This will ensure that the domestic hot water lines will be as short as possible.
- D. Mount the Hydro-Hot near a Storage Bay Door so that the Hydro-Hot's Access Cover can be easily removed and the Heater can be easily accessed from outside the Motorhome. Mounting the Hydro-Hot in this location will also ensure a minimal length of Exhaust Pipe (see Section 3.22 for details).
- E. The Hydro-Hot's Exhaust must be able to exit away freely 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 Hydro-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 which may contain combustible gases (i.e. Battery gases, Gasoline fumes, Propane fumes, etc. . . .).

- G. The permanent mounting location must allow for mounting of the Electronic Controller within the allowable wire harness length (i.e. 35 inches of wire harness maximum), reference Section 3.13 for specific mounting details.

SECTION 3: INSTALLATION PROCEDURES

Hydro-Hot Mounting

3.2 Mounting the Hydro-Hot

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

- Overall Hydro-Hot Dimensions, see Figure 3A.
 - Required size and location of the Combustion-Air Hole, Exhaust Hole, Heat Tank's Drain Hole, and the Pressure-Relief Valve Drain Hole, see Figure 4.
 - Required size and location of the Mounting Bracket Holes, see Figure 4.
 - Minimum Heater clearances, see Figure 2A.
1. Drill all the necessary Holes prior to mounting the Hydro-Hot permanently into place, see Figure 4.

NOTES:

- A. Be sure to drill the holes for the Exhaust System, Combustion-Air Hole, and the Heat Tank's Drain Hole prior to placing the Hydro-Hot into the permanent mounting position.
- B. Be sure to utilize all mounting holes to ensure that the Hydro-Hot does not move or shift under normal operating conditions.

2. Place the vibration / Rubber Shock-Mounts (adhesive side up) on all four corners of the Hydro-Hot underneath the Mounting Bracket Holes, see Figure 5.
3. Place the Hydro-Hot into the permanent mounting position.
4. Using 1/4" Bolts (total of eight required) fasten down the Hydro-Hot.
5. Once the Hydro-Hot has been permanently mounted, remove the Heater's Access Cover, see Figure 2.
6. Install and tighten the Combustion Air Intake Sleeve onto the Diesel-Burner's Combustion Air Intake Shutter using the Hose Clamp, see Figure 3.

NOTE: The Combustion Air Intake Sleeve **MUST BE INSTALLED** in order to comply with the UL 307A listing, see Figure 3.

SECTION 3: INSTALLATION PROCEDURES

Hydro-Hot Combustion Air Overview

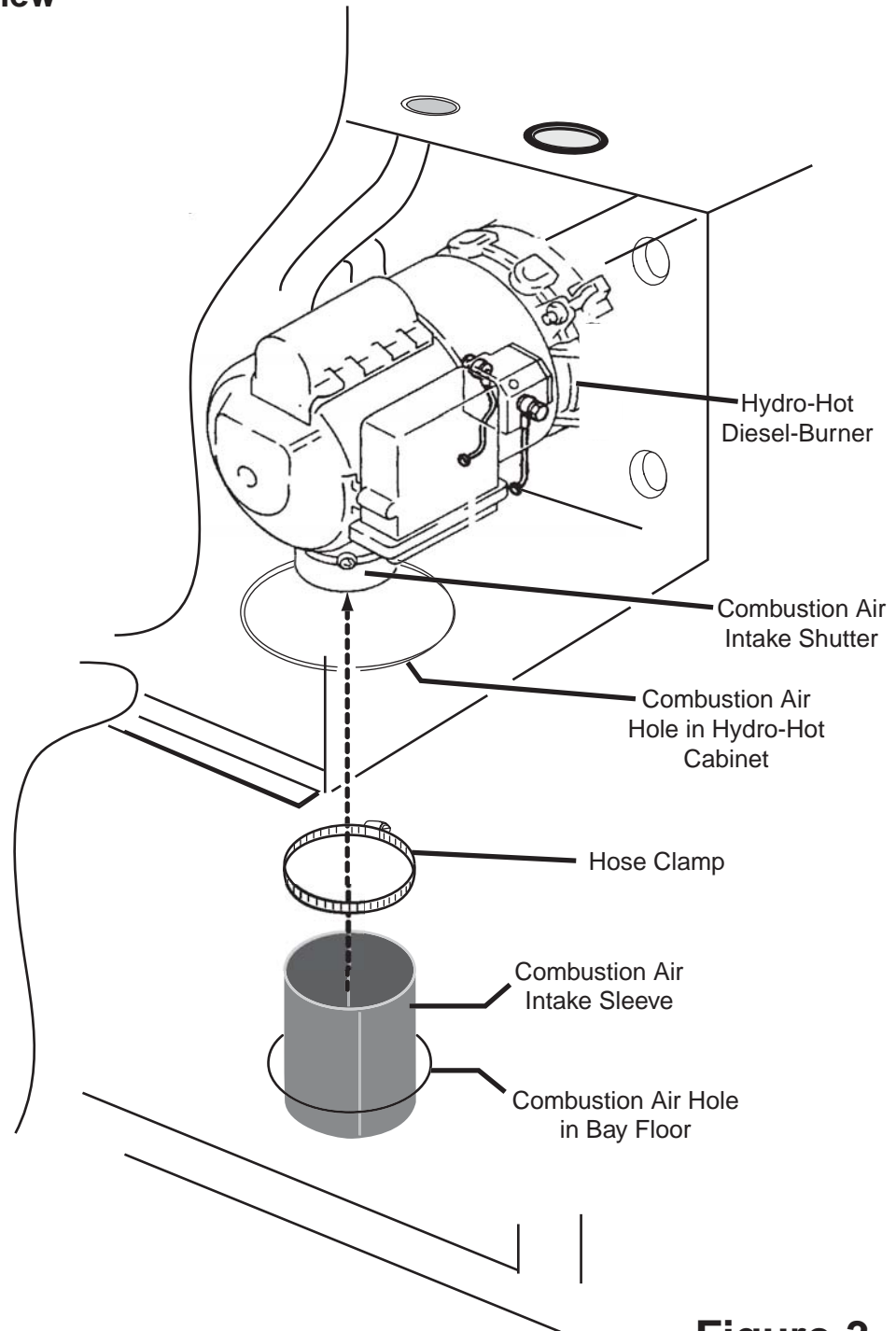
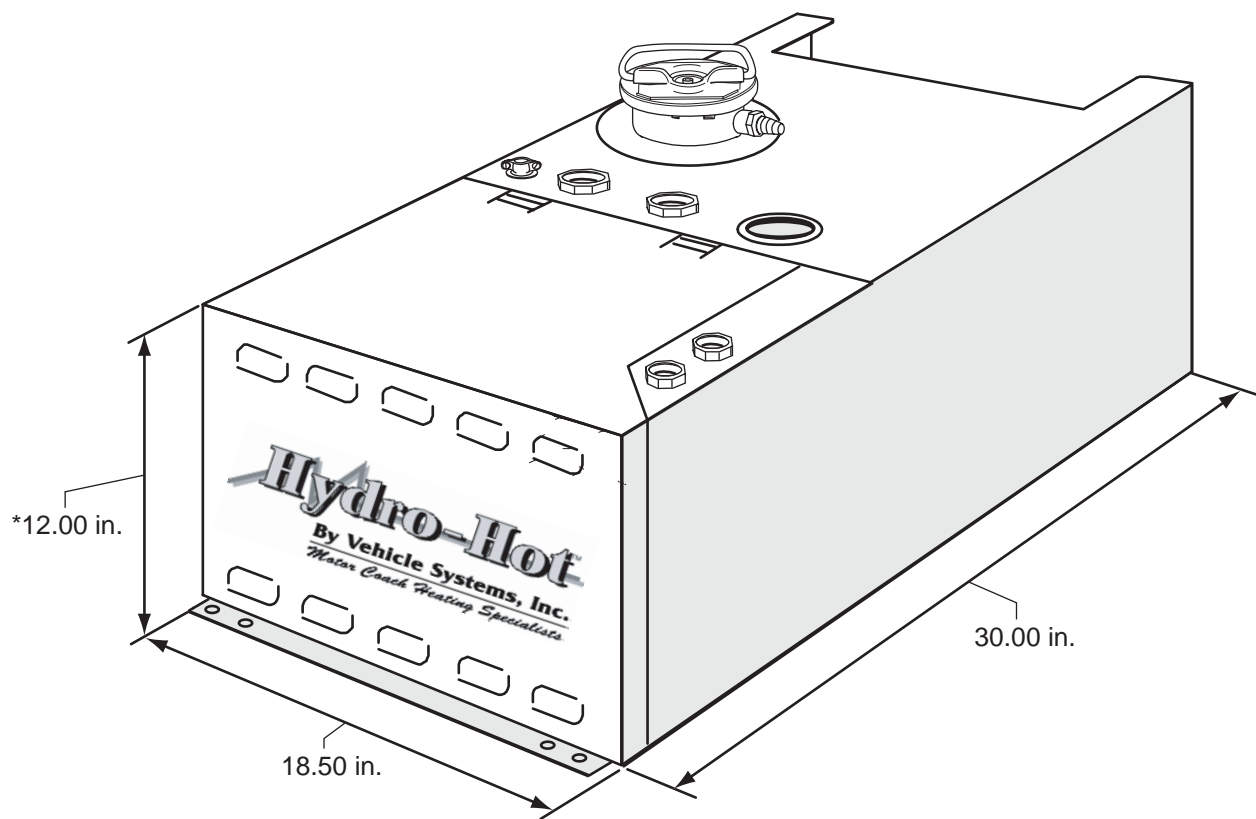


Figure 3

SECTION 3: INSTALLATION PROCEDURES

Hydro-Hot Dimensions



* Measurement excludes
Radiator Cap height

Figure 3A

SECTION 3: INSTALLATION PROCEDURES

Hydro-Hot Mounting Template

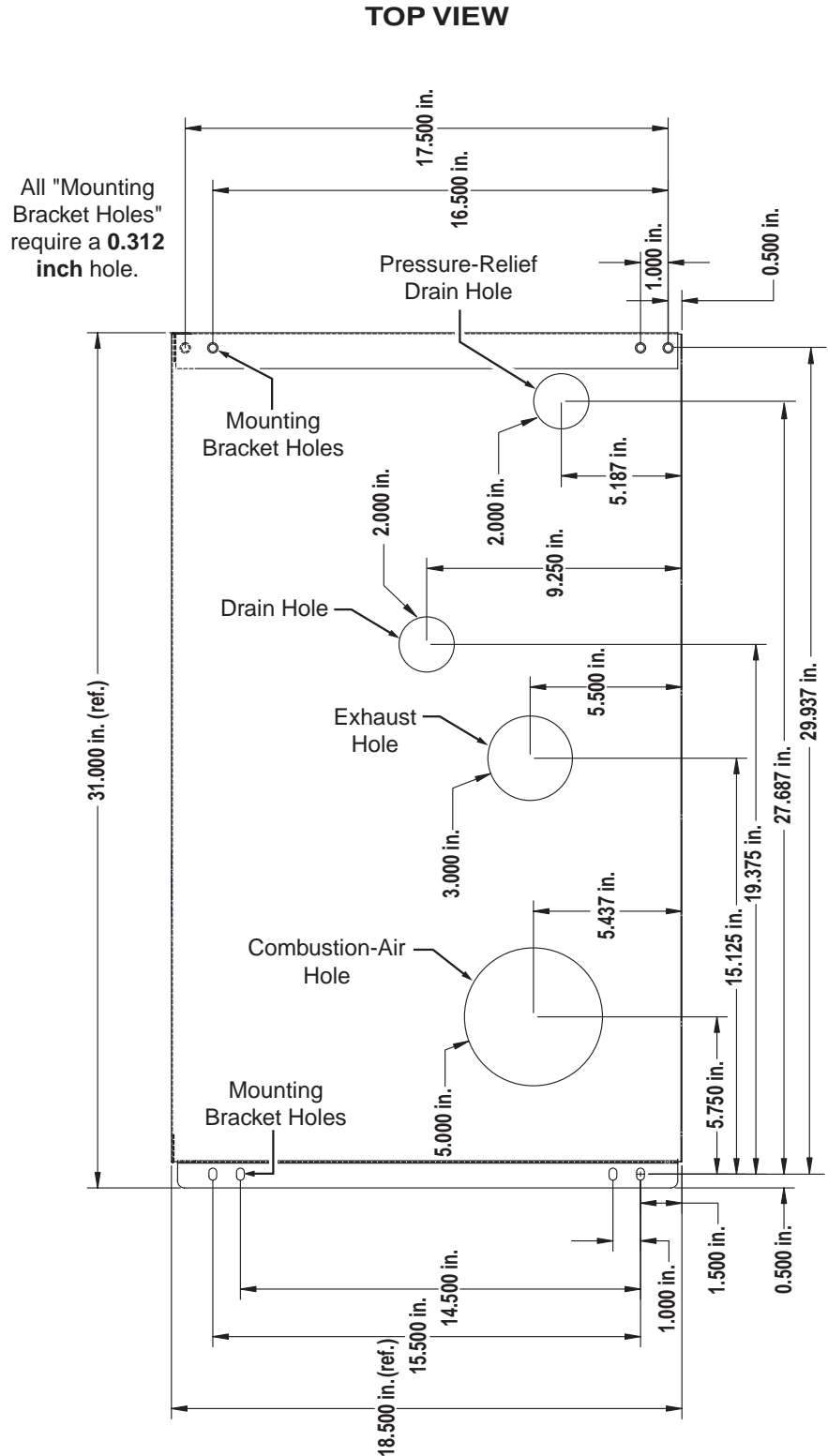


Figure 4

SECTION 3: INSTALLATION PROCEDURES

Hydro-Hot Mounting

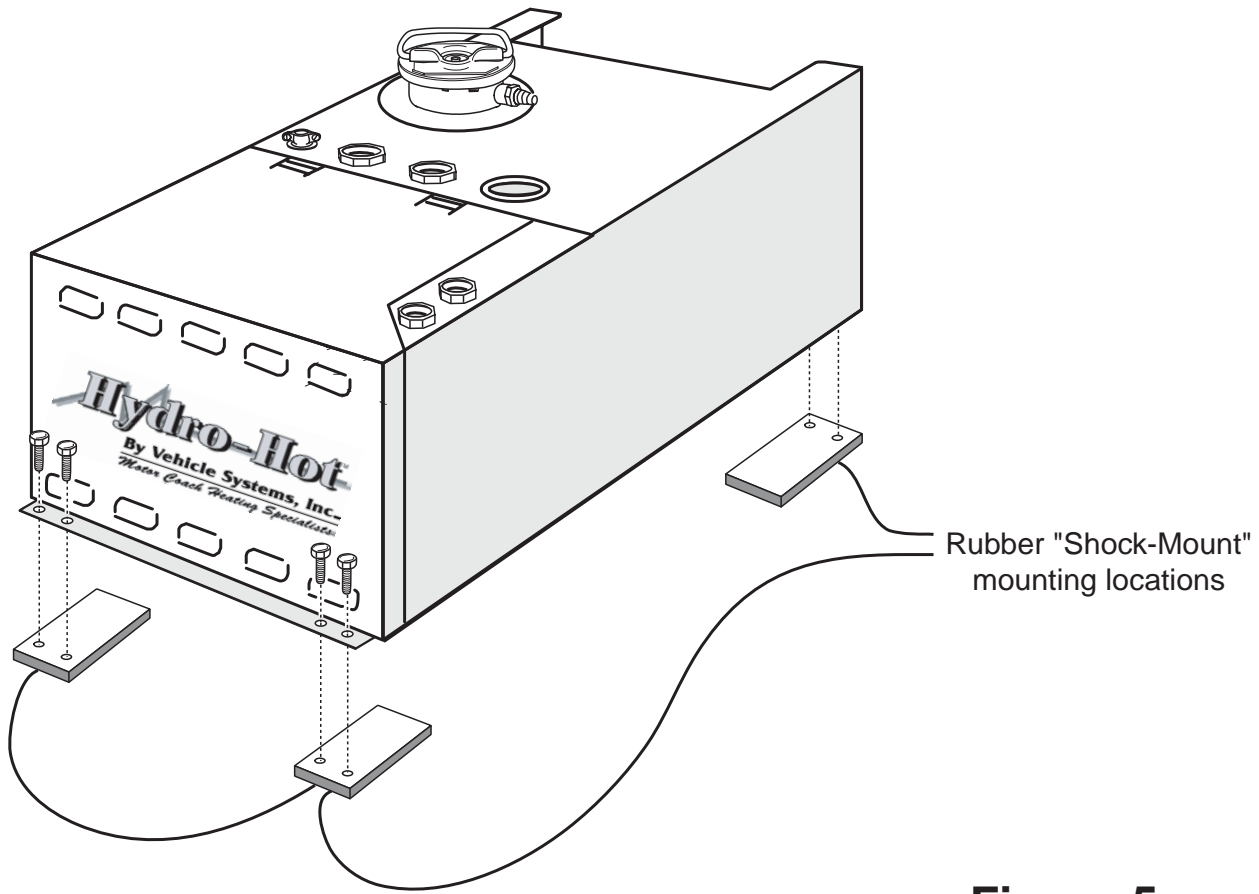


Figure 5

SECTION 3: INSTALLATION PROCEDURES

Interior Heat Exchanger Mounting Locations

3.3 Mounting Locations for 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, Bathroom).

- A. Space the Heat Exchangers so that even-heat distribution will be felt throughout the interior, see Figures 6 and 6A.

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, see Figures 6 and 7.

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 interior heating zones.

- C. Allow for easy access to all Heat Exchangers for potential servicing and cleaning (i.e. dust, etc . . .). See Figures 9 and 11 for allowable Cozy-III mounting configurations.

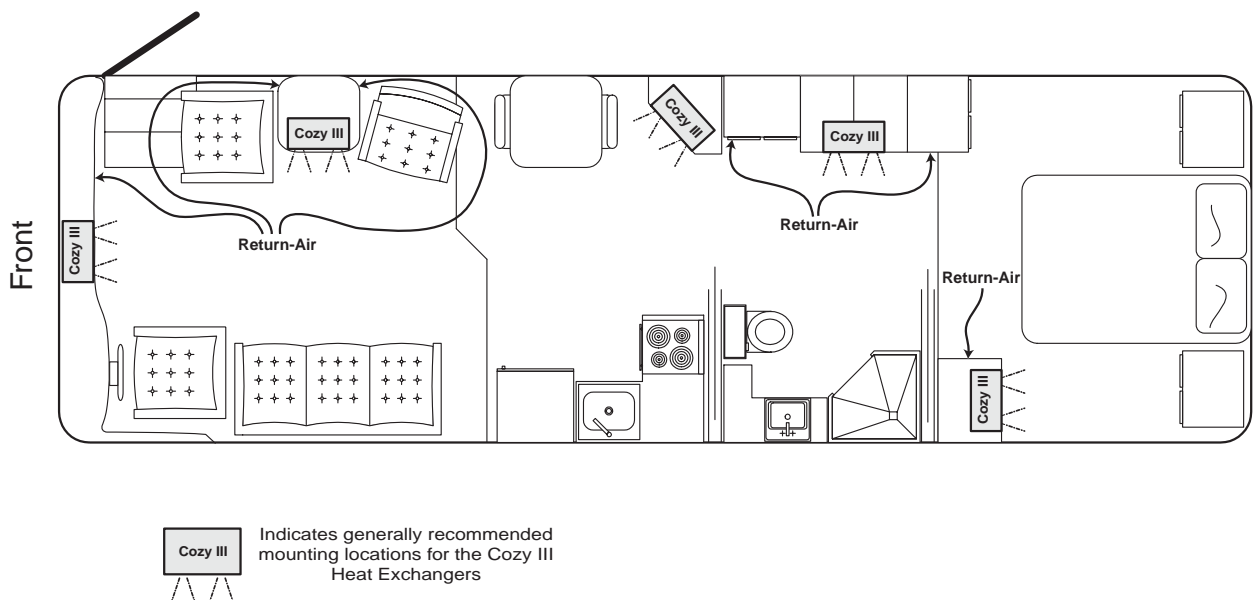
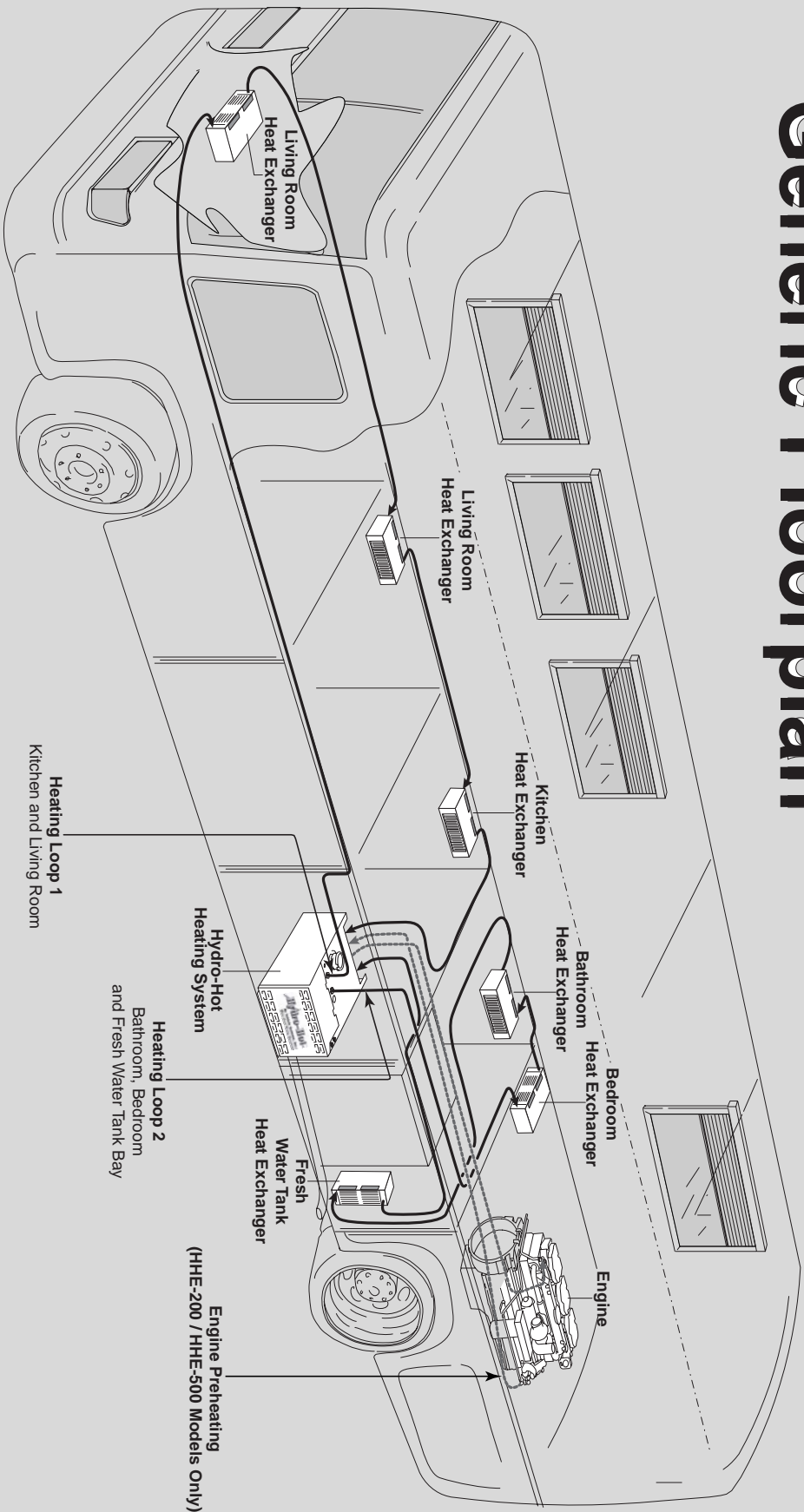


Figure 6

Generic Floorplan



SECTION 3: INSTALLATION PROCEDURES

Interior Heat Exchanger Location Overview

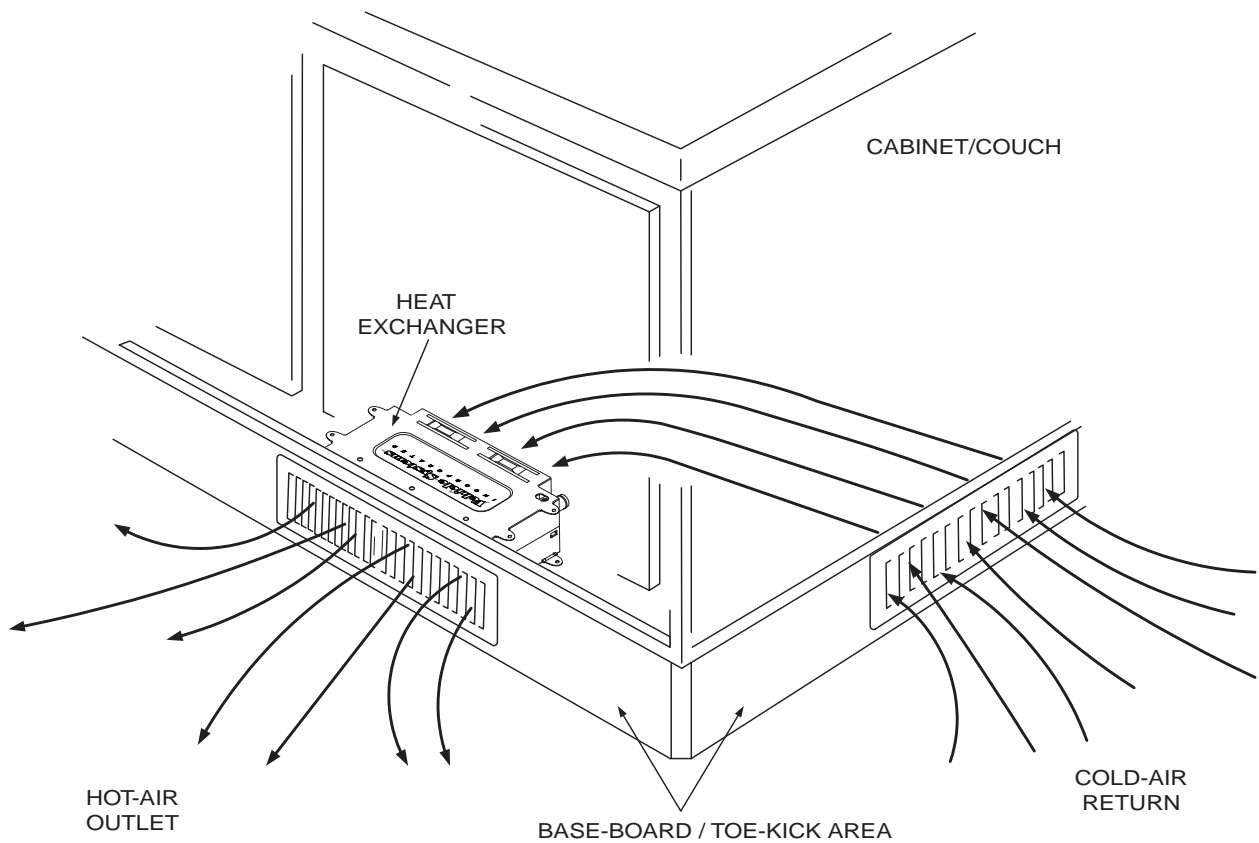


Figure 7

SECTION 3: INSTALLATION PROCEDURES

Interior Heat Exchanger Dimensions, Wiring, and Mounting Overview

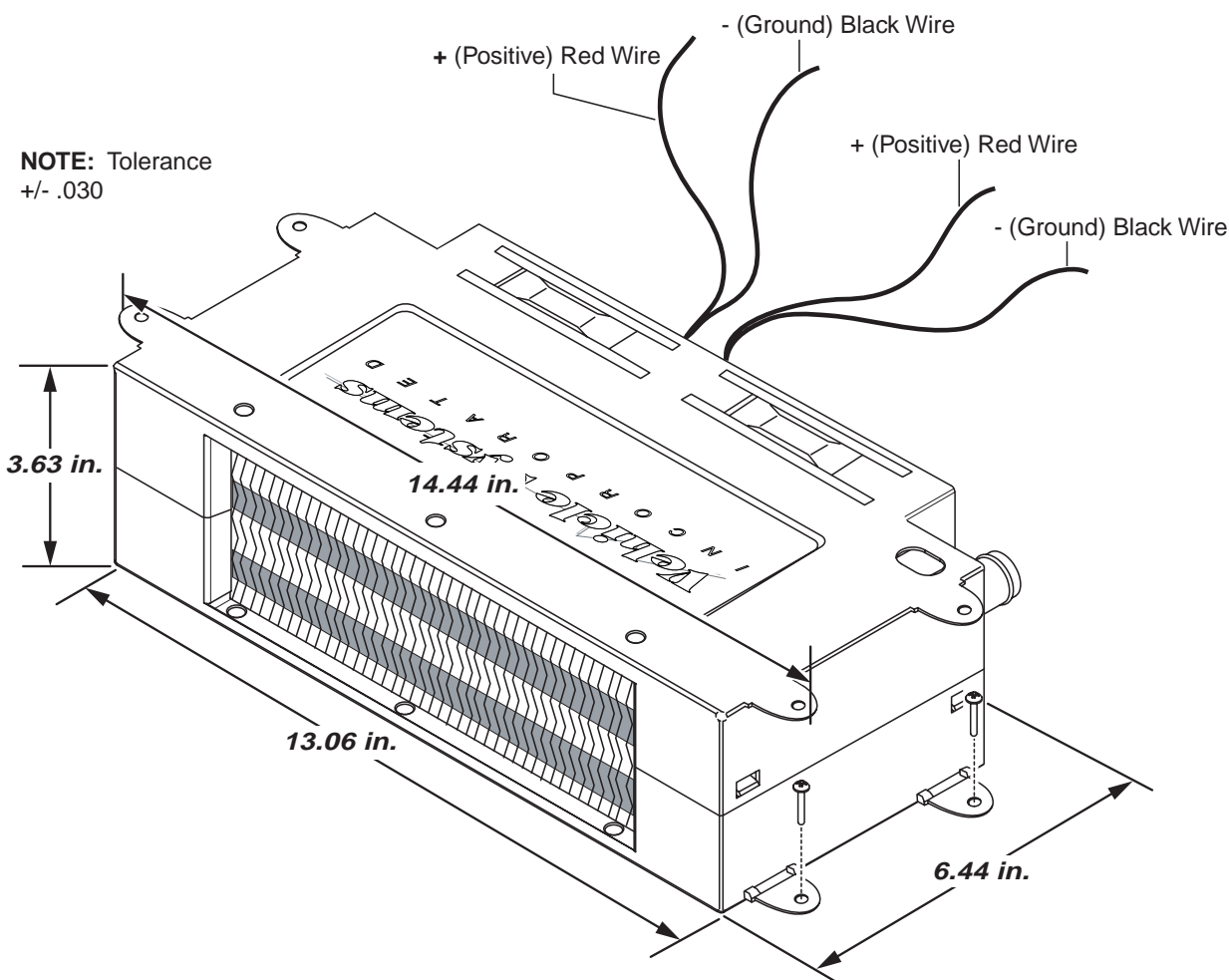
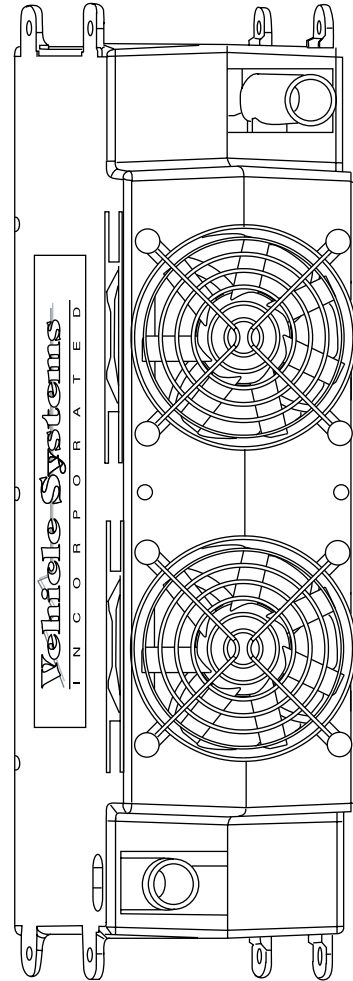


Figure 8

SECTION 3: INSTALLATION PROCEDURES

Allowable Cozy III Heat Exchanger Mounting Configurations

Vertical Mount



Horizontal Mount

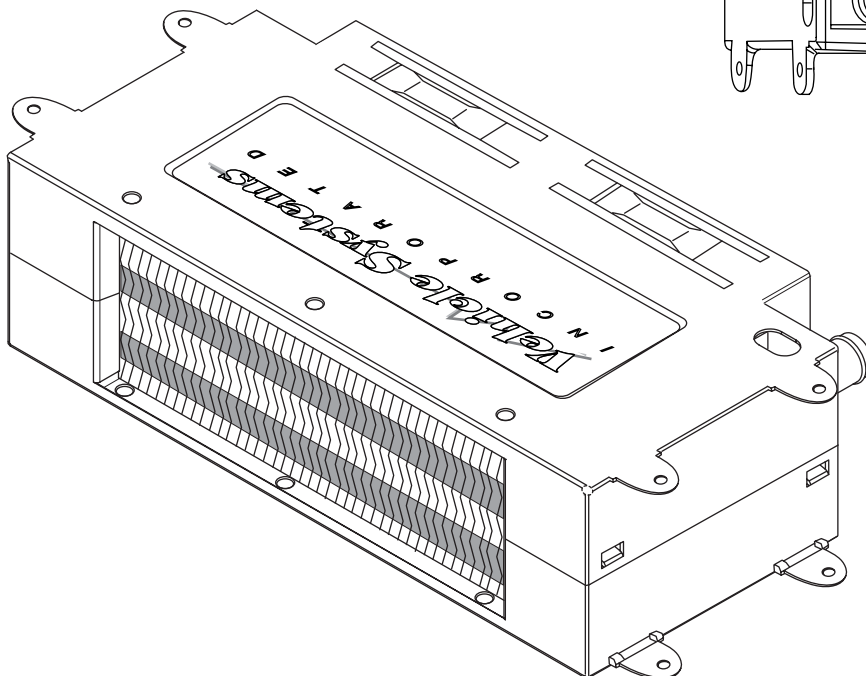


Figure 9

SECTION 3: INSTALLATION PROCEDURES

Interior Heat Exchanger Mounting

Bay Heat Exchanger Mounting

3.4 Mounting the Interior Heat Exchangers

Once all permanent mounting locations have been selected, cut out the opening for each outlet-air and return-air Register and fasten down each Heat Exchanger permanently into place. Please reference Figure 9 for allowable Heat Exchanger mounting configurations.

1. Cut out an opening of 2.5 in. x 10 in. for each Cozy-III hot-air outlet and cold-air return Register, see Figure 7
2. Mount each Heat Exchanger permanently into place, see Figures 8 and 12.
3. Install the hot-air outlet and cold-air return Registers, see Figure 7.

3.5 Mounting Location for the Fresh Water Tank Heat Exchanger, Overview

The Fresh Water Tank Heat Exchanger should be strategically placed in the domestic water plumbing area 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, see Figure 10.

NOTE: For 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, see Figure 10. Mounting the Heat Exchanger without sufficient ventilation will severely reduce its overall performance (heat output). Return-Air should be supplied from the same compartment as the Fresh Water Tank Heat Exchanger.

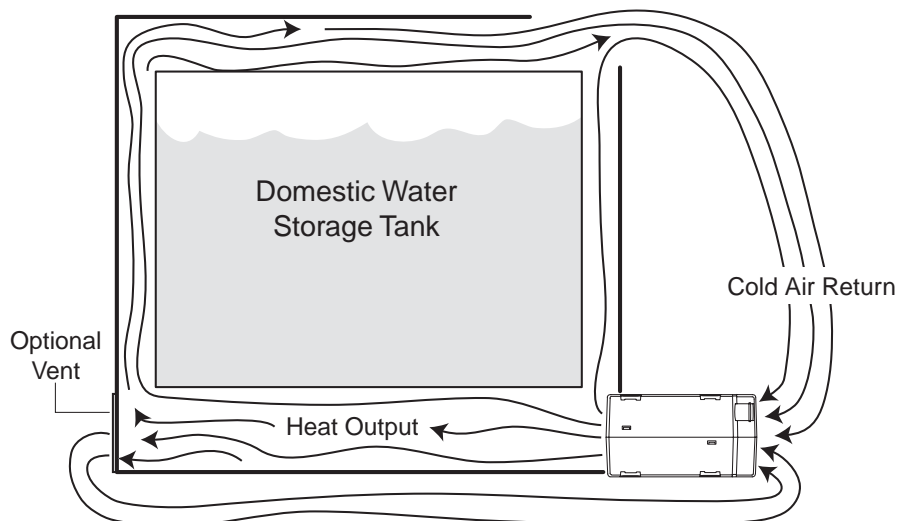


Figure 10

SECTION 3: INSTALLATION PROCEDURES

Minimum Cozy III Heat Exchanger Clearance

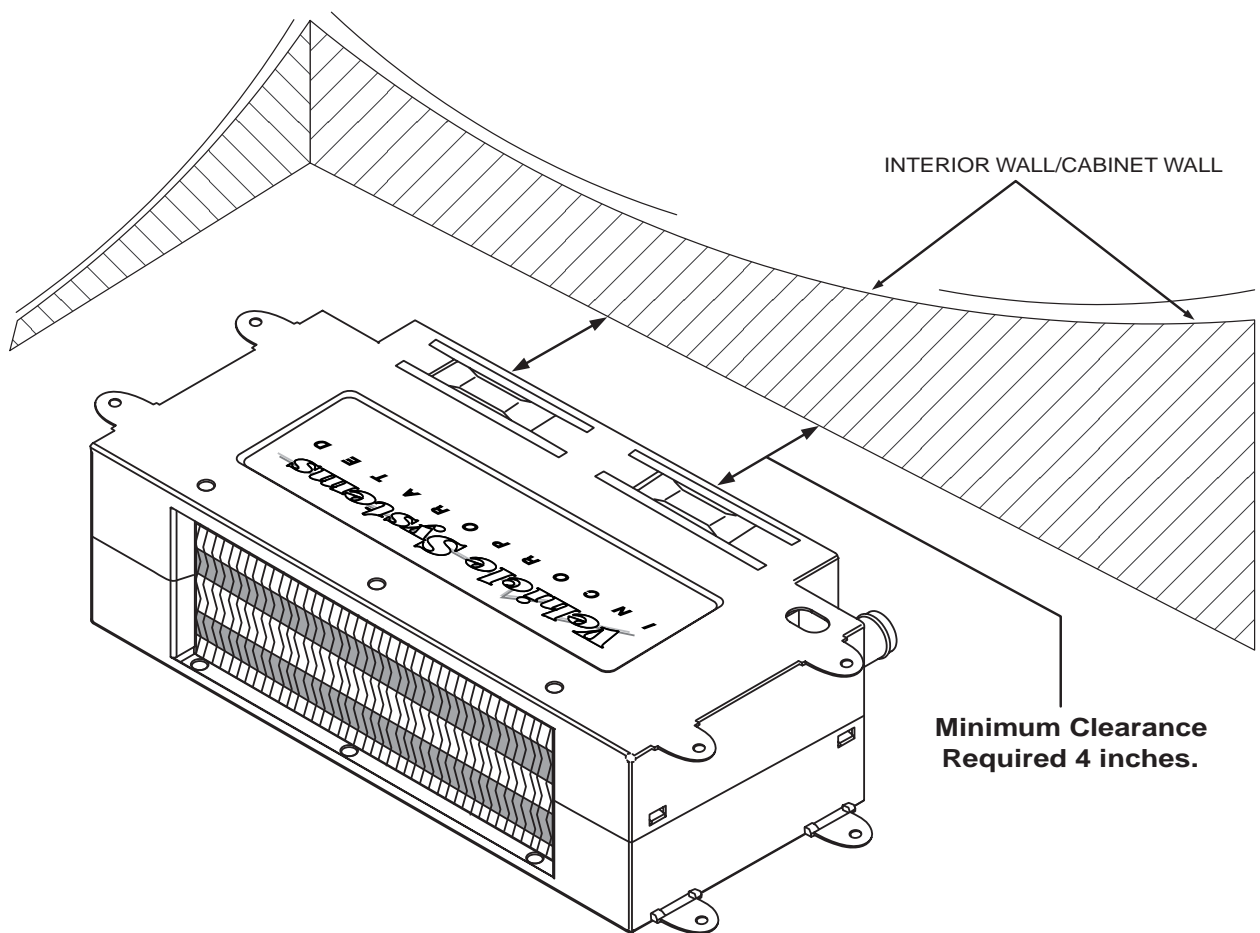


Figure 11

SECTION 3: INSTALLATION PROCEDURES

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

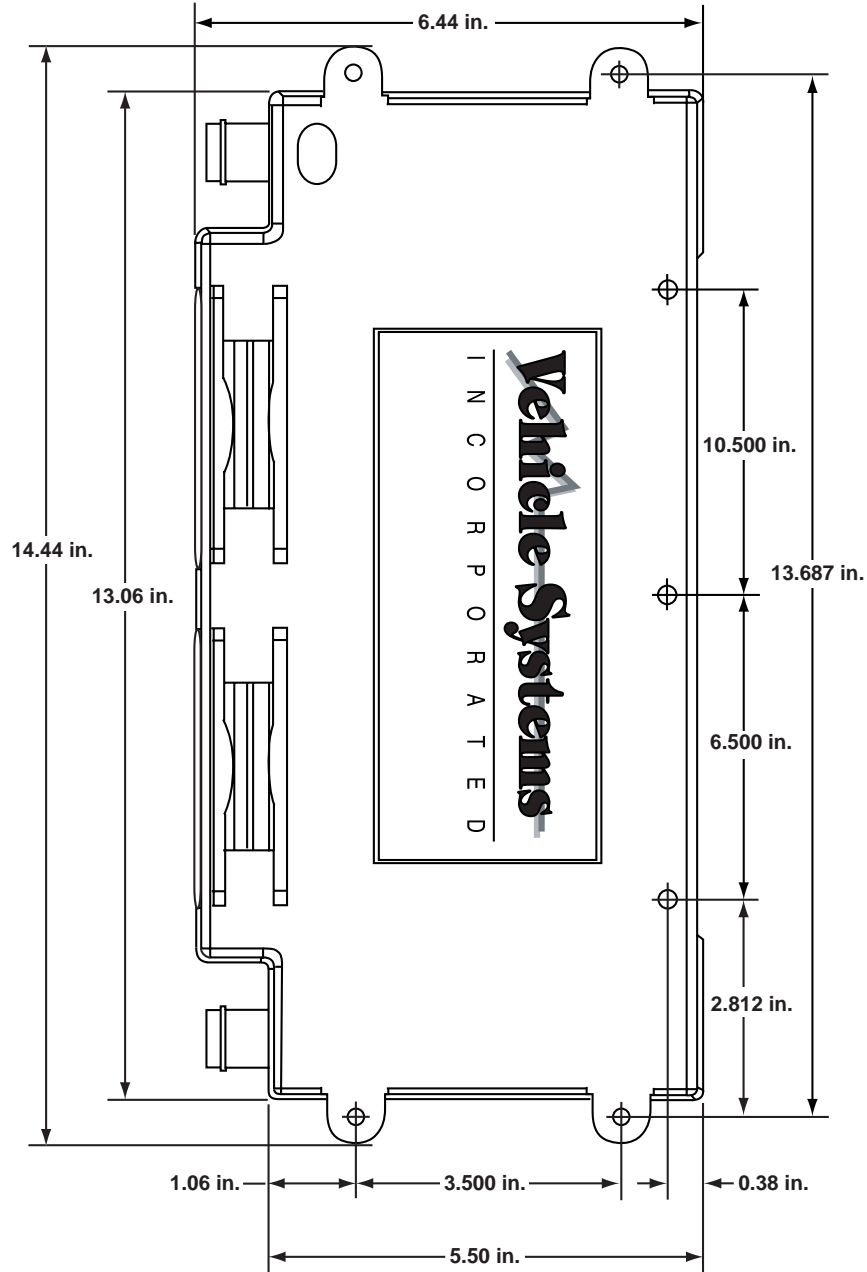


Figure 12

SECTION 3: INSTALLATION PROCEDURES

Bay Heat Exchanger Mounting

Planning The Heat Exchanger Plumbing

Installing The Heat Exchanger Plumbing

3.6 Mounting the Fresh Water Tank Heat Exchanger

Once a permanent mounting location for the Fresh Water Tank Heat Exchanger has been selected, fasten down the Heat Exchanger permanently into place. Please reference Section 3.4 and use Figures 7, 8, 9, 10, 11 and 12 for mounting information.

3.7 Plumbing the Heat Exchangers, Overview

Once all Heat Exchangers have been mounted, you will need to plan the routing of the Plumbing Lines from each heating zone to the Hydro-Hot. The Plumbing Lines are the roadways that carry the heated solution of water and antifreeze from the Hydro-Hot to the Heat Exchangers in each heating zone. 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 1", see Figures 1 and 6A.
- B. The Bedroom, Bathroom, and Bay Heat Exchangers **must** be plumbed together **in-series** on "Heating Loop 2", see Figures 1 and 6A.
- C. Use 5/8 in. I.D. Plumbing Lines for both "Heating Loops."
- D. Use wide-sweeping elbows or "Bend-Supports" wherever Plumbing Lines may be susceptible to kinking (i.e. 90° bends).

3.8 Installing the Interior / Fresh Water Tank Plumbing Lines

1. Install all Plumbing Lines and mark with **Arrows** and/or **Labels** at both ends. The Arrows should indicate which "Heating Loop" the Plumbing Lines pertain to (i.e. Heating Loop 1 or Heating Loop 2), and whether the Plumbing Line is a **Supply** or a **Return** line. Do this prior to running the Plumbing Lines or as they are being laid out.

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. We suggest using Rubber Coated / Closed Type Clamps when securing the Plumbing Lines.
- E. Be sure to install the supplied "Check Valves" to prevent thermal convection, see Figure 14.

2. Connect and clamp the **Supply** line to the lowest port on each Heat Exchanger in each heating zone, see Figures 1,13, and 15.
3. Connect and Clamp the **Return** Line to the highest port on each Heat Exchanger, see Figures 1,13, and 15.

SECTION 3: INSTALLATION PROCEDURES

Installing The Heat Exchanger Plumbing, continued

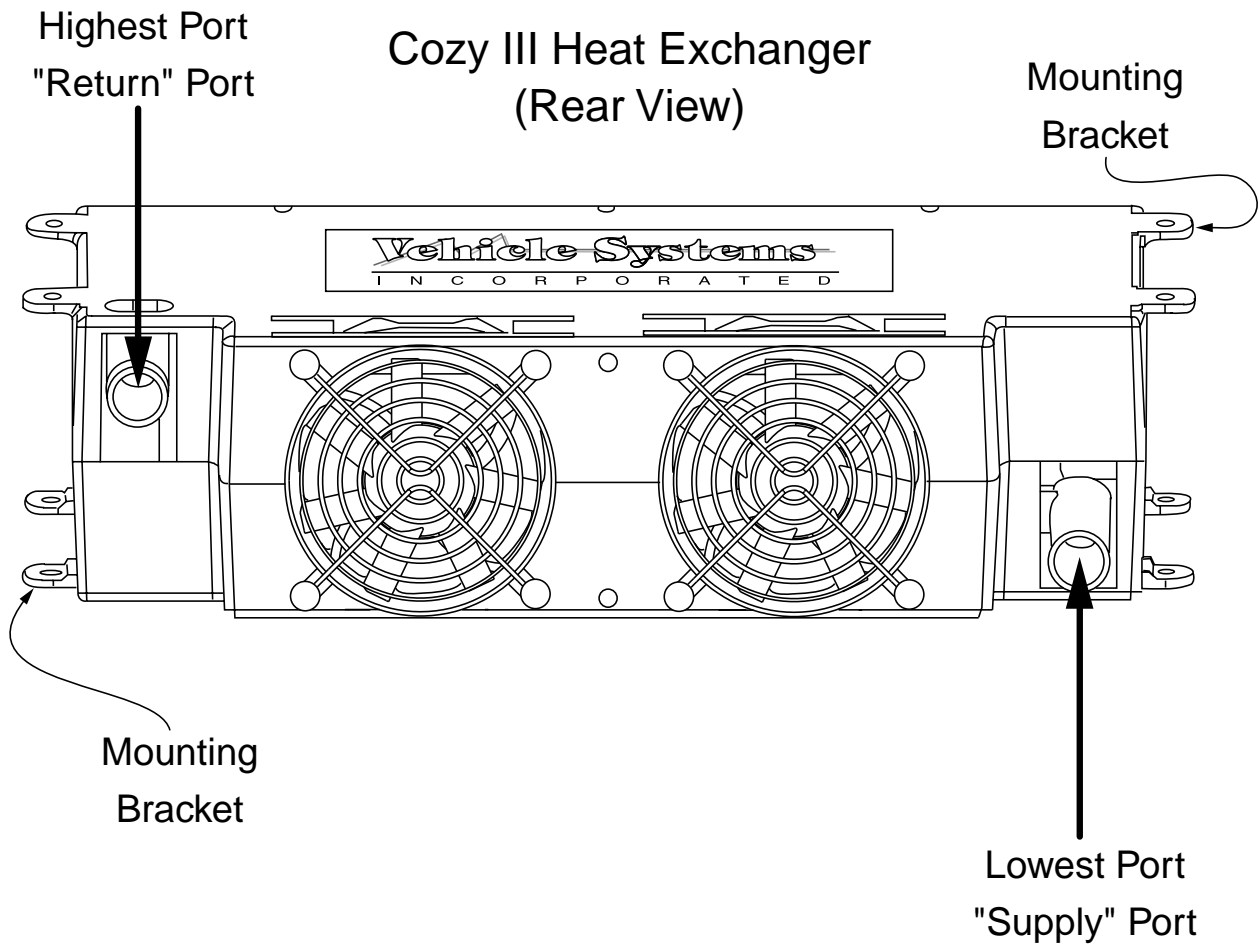


Figure 13

SECTION 3: INSTALLATION PROCEDURES

Installing The Heat Exchanger Plumbing, continued

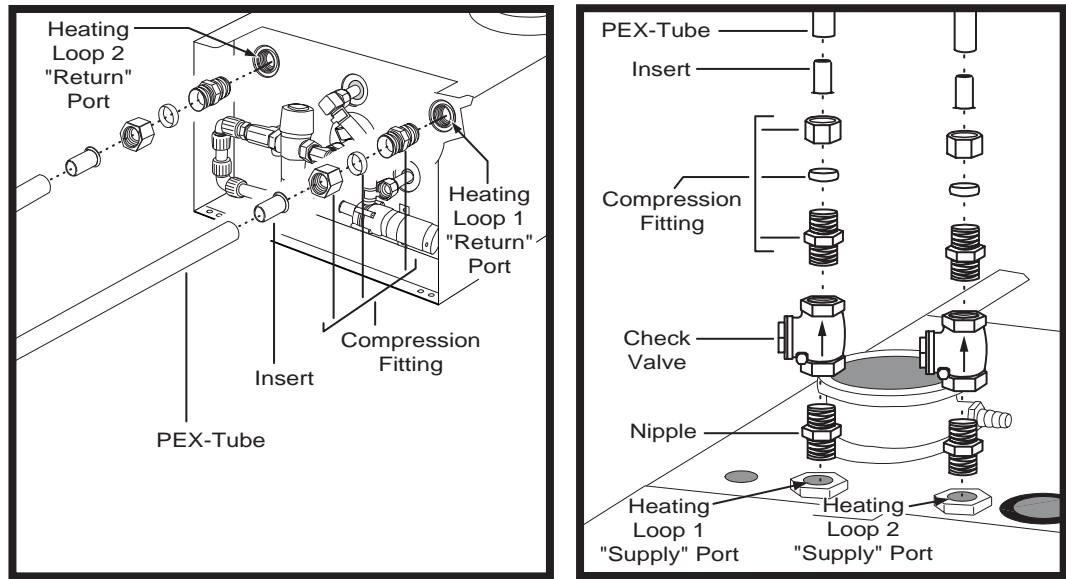


Figure 14

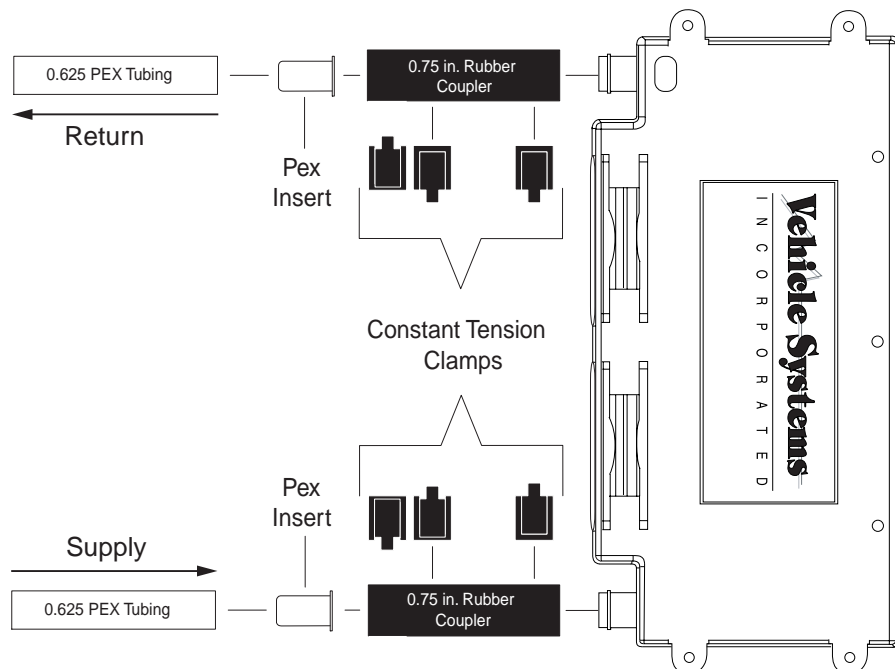


Figure 15

SECTION 3: INSTALLATION PROCEDURES

Installing The Heat Exchanger Plumbing, continued

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. Insert and tighten the Check Valves into the Hydro-Hot's **Supply** ports, see Figure 14.

NOTE: Be sure to install the Check Valves with the arrows pointing in the upward position.

5. Connect and tighten all interior Plumbing Lines, **Supply** and **Return**, to the Hydro-Hot's appropriate Heating Loop ports, see Figure 14.

Engine Preheat / MOTORAIDE Plumbing Overview

3.9 Plumbing the Engine Preheat / Motoraide System, Overview (HHE-200 and HHE-500 Models Only)

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

NOTE: Only the HHE-200 Model Hydro-Hot is equipped with an Engine Preheat Circulation Pump. However, the overall plumbing arrangement to the vehicle's engine is basically the same for both model heaters mentioned above.

- 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, see Figure 16. If you need assistance in determining the best **Supply** and **Return** ports for a specific engine, please contact us directly.

NOTES:

1. The engine's coolant should be allowed to flow as freely as possible to maximize the Hydro-Hot's engine preheating / motoraide system. Free flowing coolant will enhance the Hydro-Hot's motoraide feature while traveling down the road.
2. The engine's **Return** port receives the heated coolant back to the Engine Block from the Hydro-Hot. This port should be a **high** connection point on the Engine Block or a **suction port** on the engine's Water Pump, see Figure 16.
3. The engine's **Supply** port supplies the engine's coolant to the Hydro-Hot's Engine Preheat Circulation Pump (HHE-200 Models) or to the Hydro-Hot's Motoraide "IN" connection (HHE-500 Models). This port should be a **low** connection point on the Engine Block or a **pressure outlet port** on the Engine's Water Pump, see Figure 16.

- B. Use 3/4" I.D. Plumbing Lines / Heater Hose for the engine preheating / motoraide system.

SECTION 3: INSTALLATION PROCEDURES

Installing Engine Preheat / MOTORAIDE Plumbing

3.10 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 Hydro-Hot or whether it will be **returning** heated coolant to the Vehicle's engine, see Figures 2, 16, and 17.

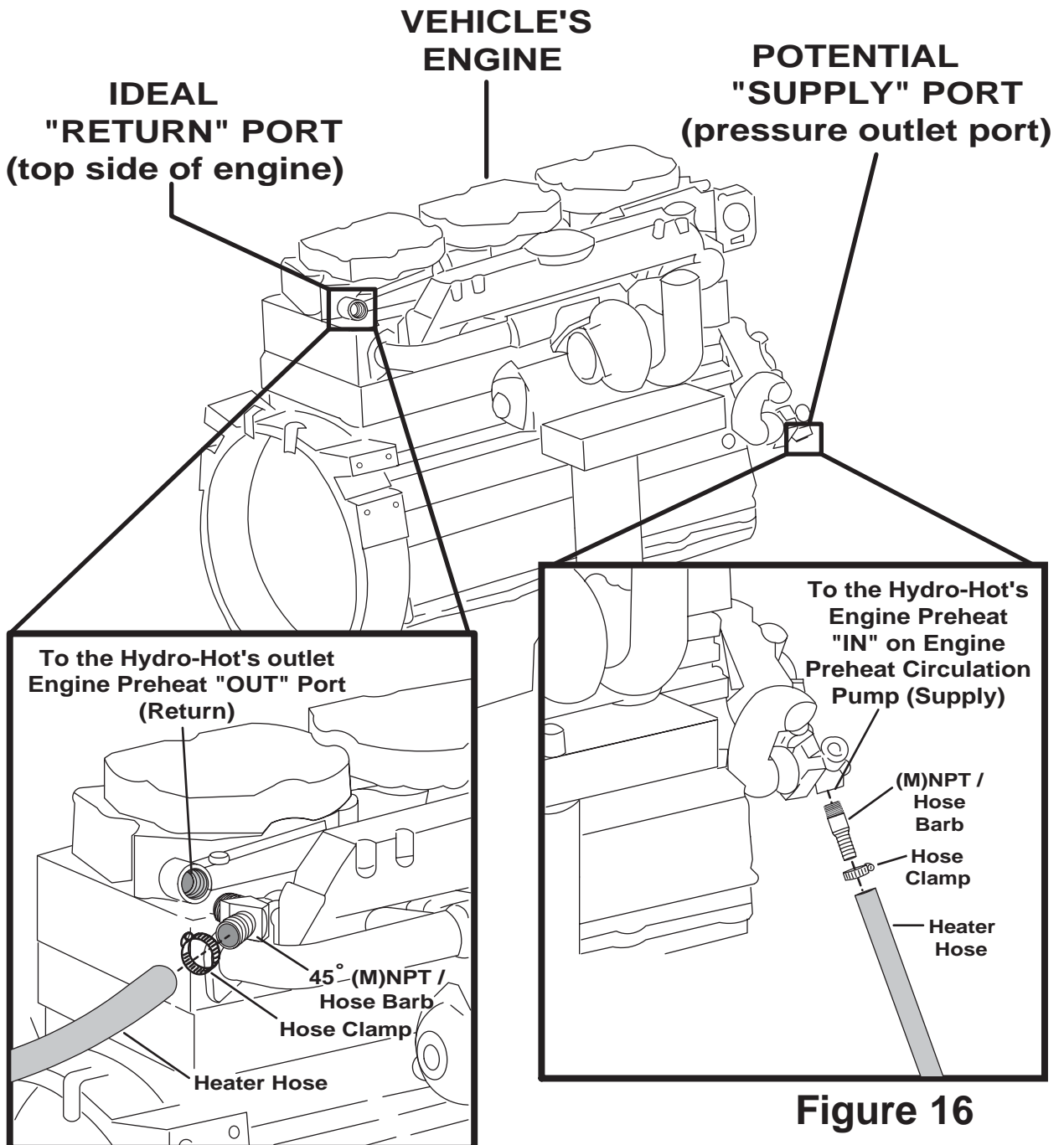


Figure 16

SECTION 3: INSTALLATION PROCEDURES

Installing Engine Preheat / MOTORAIDE Plumbing, continued

NOTES:

- A. Lay both Engine Plumbing 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. We suggest 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.

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 you need assistance for a specific engine, please contact us directly.

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

NOTE: Try to use one-piece Plumbing Fittings. This will reduce the potential for coolant leaks and we also suggest applying Pipe Thread Sealant to the Plumbing Fittings.

5. Install and clamp both the **Supply** and **Return** engine Plumbing Lines / Heater Hose to the Engine's Plumbing Fittings, see Figure 16.
6. Install and tighten the Plumbing Fittings into the "**IN**" and "**OUT**" ports on the Hydro-Hot's Engine Preheating / Motoraide System, see Figures 2 and 17. (Please note that Hydro-Hot model HHE-200 requires only one Plumbing Fitting in the "**OUT**" port).

CAUTION: Be sure to use two Wrenches when tightening these Plumbing Fittings. Failure to do so could result in **serious damage** to the Hydro-Hot's internal Engine Preheating / Motoraide System.

7. Attach and clamp the Engine's **Supply** Plumbing Line to the Hydro-Hot's "**IN**" connection, see Figure 17.
8. Attach and clamp the Engine's **Return** Plumbing Line to the Hydro-Hot's "**OUT**" connection, see Figure 17.
9. After all Plumbing Lines, Fittings, and connections have been tightened, refill the Engine's Coolant System.



SECTION 3: INSTALLATION PROCEDURES

Installing Engine Preheat / Motoraide Plumbing, continued

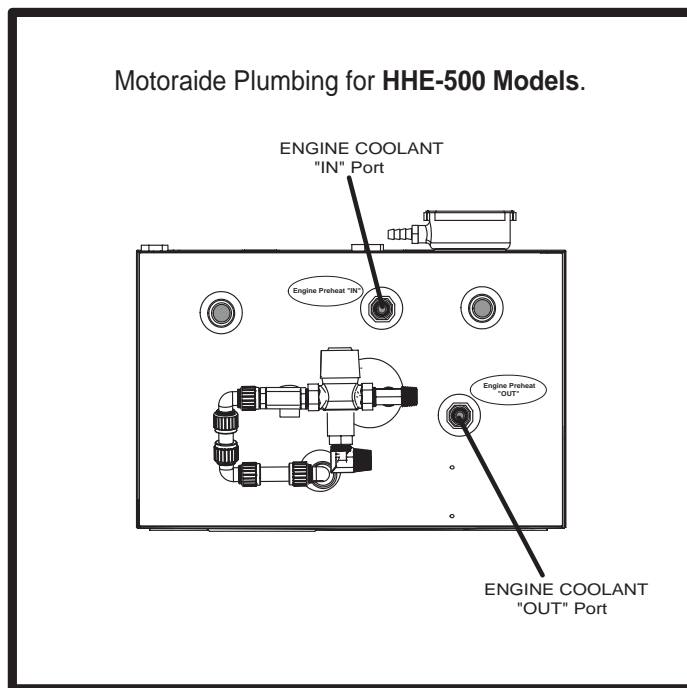
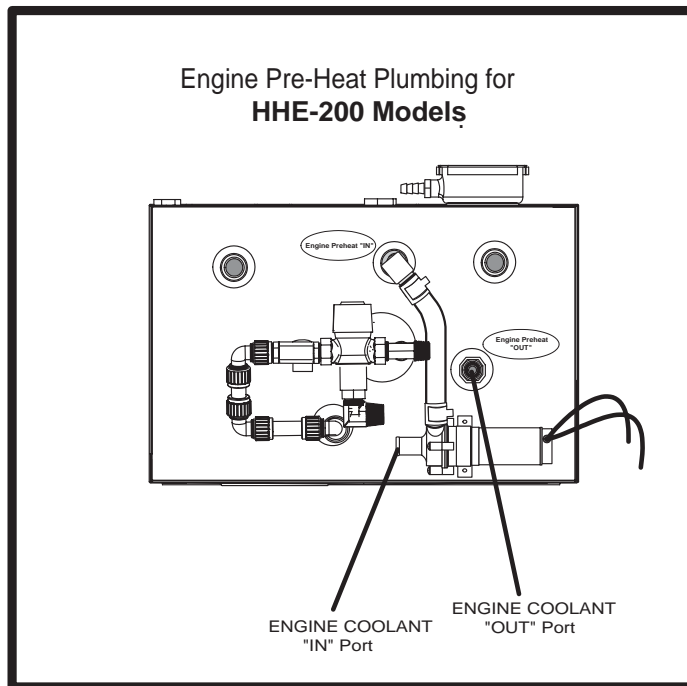


Figure 17

SECTION 3: INSTALLATION PROCEDURES

Domestic Hot Water System Overview

3.11 Domestic Hot Water Plumbing, Overview

A major feature of the Hydro-Hot is its ability to provide a continuous supply of domestic hot water. Because the Hydro-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.

- B. The Hydro-Hot is equipped with a Pressure-Relief Valve which releases excessive pressure in the domestic water system, if necessary. Be sure to provide a drain hole for this valve, see Figures 4 and 19.

SECTION 3: INSTALLATION PROCEDURES

Domestic Hot Water System Overview

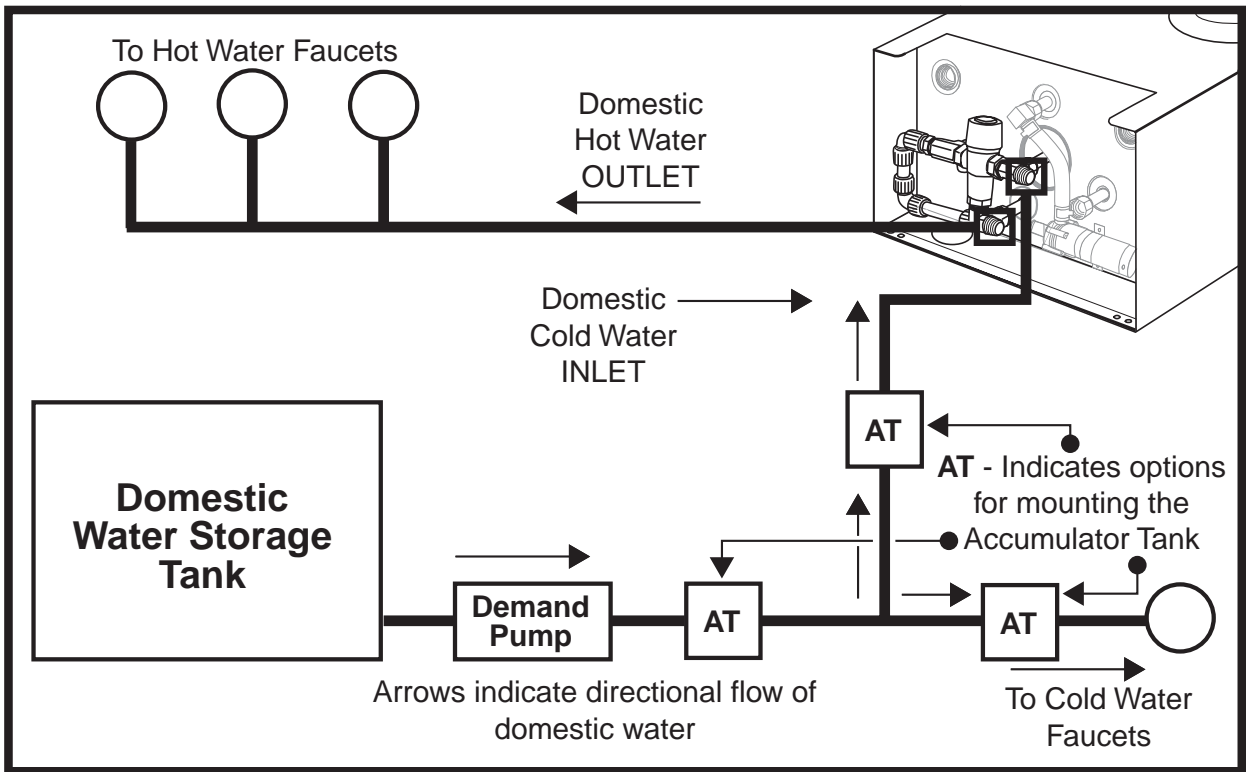


Figure 18

SECTION 3: INSTALLATION PROCEDURES

Installing Domestic Hot Water Plumbing

3.12 Attaching Plumbing Lines to the Domestic Hot Water System

The Hydro-Hot is equipped with a Mixer-Valve which regulates the temperature of the hot water, see Figures 18 and 19.

1. Connect a domestic water Plumbing Line from the Domestic Water Demand Pump / Water Manifold to the **Cold "Inlet" Port** on the Hydro-Hot's Mixer-Valve, see Figures 18 and 19.

NOTE:

- A. Be sure to install an Accumulator Tank in the domestic water system, see Figure 18. The Accumulator Tank will absorb the pressure increase due to the heating of the water in the domestic water heating system.
2. Connect a domestic water Plumbing Line from the Hydro-Hot's **Hot "Outlet" Port** to the hot water system's Distribution Lines / Water Manifold, see Figures 18 and 19.

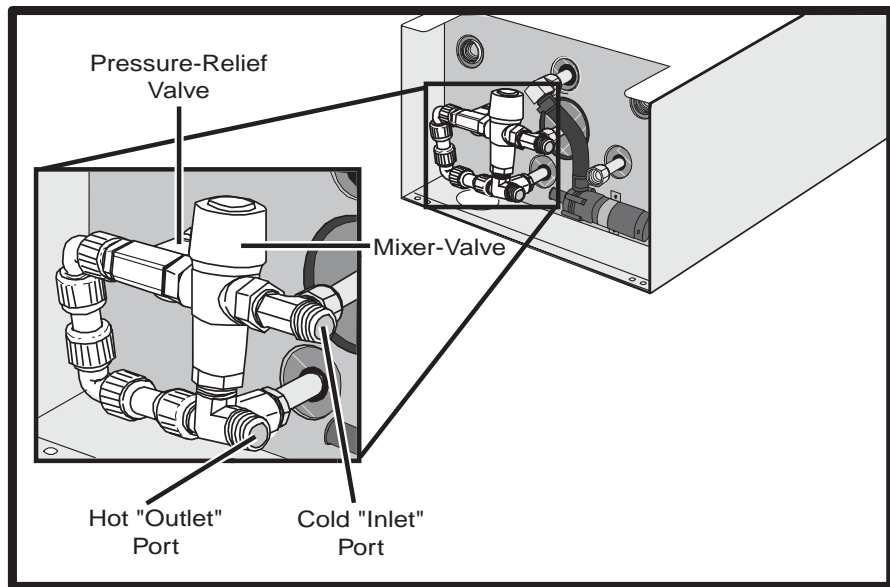


Figure 19

Electronic Controller Overview

3.13 Electronic Controller, Overview

The Hydro-Hot utilizes an Electronic Controller 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 and reference Figure 20 for specific details.

- A. The dashed lines of Figure 20 indicate **Polarity Sensitive** wiring and the solid lines indicate **NON-Polarity Sensitive** wiring.

SECTION 3: INSTALLATION PROCEDURES

Electronic Controller Wiring Overview

Wiring schematic and recommended wire Color-Codes

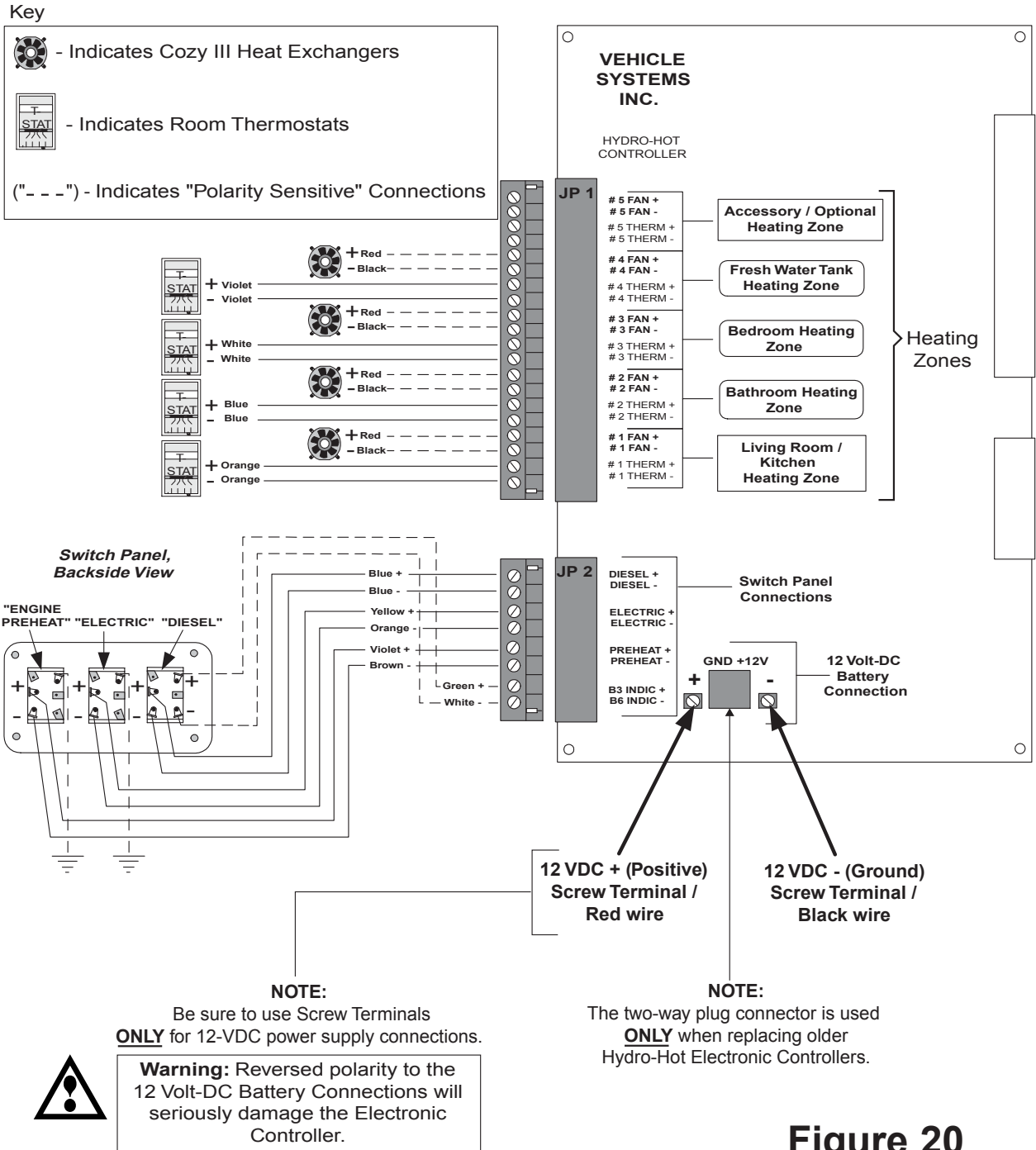


Figure 20

SECTION 3: INSTALLATION PROCEDURES

Electronic Controller Overview, continued

- B. All Electronic Controller Thermostat and Switch connections illustrate a "(+)" and "(-)" symbol with solid lines. The "(+)" symbol indicates a positive 12-VDC **output** to a particular Thermostat or Switch, while the "(-)" symbol indicates a positive 12-VDC **input** signal from a particular Thermostat or Switch. The 12-VDC **output** signal is always present as long as the Electronic Controller is powered by a 12-VDC Power Source while the 12-VDC **input** signal is only present whenever a Switch is activated or whenever a Thermostat is "calling-for-heat", see Figure 20.
- C. Each heating zone "FAN" circuit can supply up to 2.5 Amps of DC Current. This **output** signal allows for multiple Cozy III Heat Exchangers to be wired "in-parallel" (i.e. Heating Loop 1), see Figures 1, 6A, and 20.
- D. Heating Zones 1 and 5 are reserved electrically for the "Living Room / Kitchen Heating Zone" (Heating Loop 1) and the "Accessory / Optional Heating Zone" **ONLY!** Heating Zones 2 thru 4 are reserved electrically for the "Bathroom", "Bedroom", and "Fresh Water Tank Heating Zone" (Heating Loop 2), **ONLY!**
- E. All Switch connections are to be wired directly to the Hydro-Hot's "Switch Panel Connections", see Figure 20 and 23. Both the "B3 INDIC +" and the "B6 INDIC -" connections are reserved electrically for the "Diesel" Switch connections **ONLY!**
- F. The Hydro-Hot's Electronic Controller was designed to work with most Electronic Room Thermostats. However, the chosen Thermostat must produce a constant 12-VDC output signal and must receive its 12-VDC Power Supply from the Hydro-Hot's Electronic Controller (i.e. "THERM +"). This will ensure that the Thermostat / Electronic Controller is properly **fuse protected**.
- G. Be sure to use the wire colors illustrated in Figure 20. 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 7.50 in. x 10.25 in. for recessed mounting and be sure to utilize all four mounting tabs.

NOTE: 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

3.14 Wiring the Interior and Fresh Water Tank Heat Exchangers

The Hydro-Hot's Electronic Controller is designed to supply 12-VDC Electrical Power as well as a ground source (negative), to all Interior and Fresh Water Tank Heat Exchangers. Whenever a particular heating zone Thermostat "calls-for-heat," the Hydro-Hot's Electronic Controller will output a 12-VDC power supply, and ground, to each Heat Exchanger(s) in that heating zone.

1. Run two 18 Gage Wires, Red for (+) and Black for (-), from each particular Heating Zone's Heat Exchanger(s) to the Hydro-Hot's Electronic Controller.

SECTION 3: INSTALLATION PROCEDURES

Wiring Interior / Bay Heat Exchangers, continued

NOTE: For heating zones with multiple Heat Exchangers (i.e. Living Room / Kitchen / Heating Loop 1), run two wires from the closest Heat Exchanger to the Hydro-Hot's Electronic Controller and then wire the other Heat Exchangers in-parallel, see Figures 8 and 20.

2. Label the wires indicating the heating zone they pertain to (i.e. 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. " # 4 FAN + / # 4 FAN -", for the Fresh Water Tank Heating Zone, etc. . .), see Figure 20.
4. Connect all Electronic Controller wires to the positive and negative leads of each Heat Exchanger, see Figures 8 and 20.

Mounting Locations For Interior Thermostats

3.15 Mounting Locations for the Interior Room Thermostats, Overview

The mounting locations for the Interior Thermostats, or Temperature Sensors of a Electronic Thermostat, 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 thermostat

Wiring Interior Thermostats

3.16 Wiring the Interior Room Thermostats

1. Run two 18 Gage wires from each interior Room Thermostat mounting location to the Hydro-Hot's Electronic Controller.

NOTE: Be sure to use the wire colors illustrated in Figure 20. 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 locations on the Electronic Controller, see Figure 20.
3. Connect all wires to the appropriate leads of each Room Thermostat.

NOTE: If utilizing an Electronic Room Thermostat, be sure to reference note F. of Section 3.13 for important installation / fuse protection information.

4. Permanently mount all interior Room Thermostats in place.
5. Be sure to turn **OFF** all Interior Room Thermostats at this time.

SECTION 3: INSTALLATION PROCEDURES

Mounting Location For Bay Thermostat

3.17 Mounting Location for 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. Our "Low-Temp" Thermostat is specifically designed to keep the domestic water from freezing **ONLY**, and has a maximum temperature setting of 50 ° F.

- A. Centralize the Low-Temp Thermostat in the domestic water storage compartment.

NOTES:

1. Only the "Bulb" of the Low-Temp Thermostat needs to be physically mounted in the area requiring heat. The Thermostat body can be mounted remotely for easy operator access, see 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.

Wiring Bay Thermostat

3.18 Wiring the Fresh Water Tank Thermostat

1. Run two 18 Gage wires from the Bay Thermostat's mounting location to the Hydro-Hot's Electronic Controller.

NOTE: Be sure to use the wire colors illustrated in Figure 20. 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 locations on the Electronic Controller, see Figure 20.
3. Connect both wires to the appropriate leads of the Low-Temp Thermostat, see Figure 21.
4. Permanently mount the Low-Temp Thermostat in place, see Figure 21.

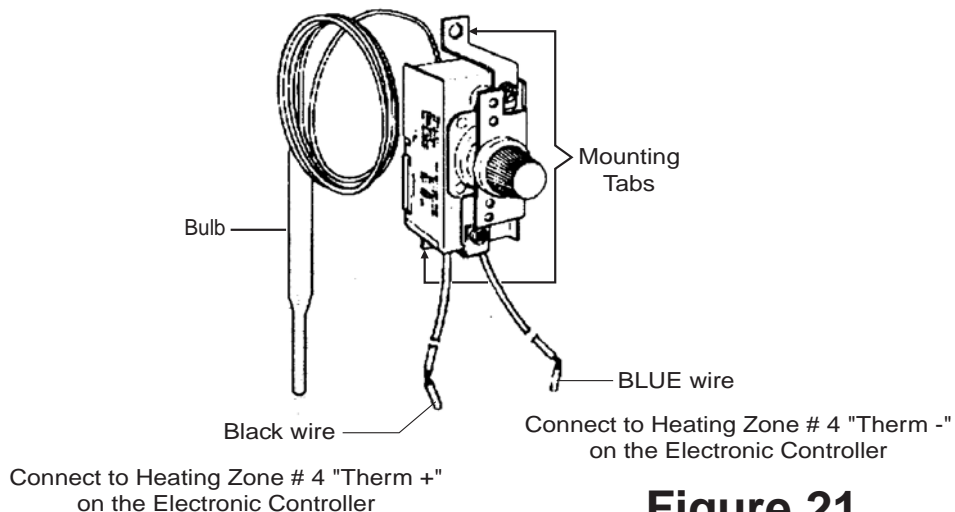


Figure 21

SECTION 3: INSTALLATION PROCEDURES

Switch Panel
Mounting
Template

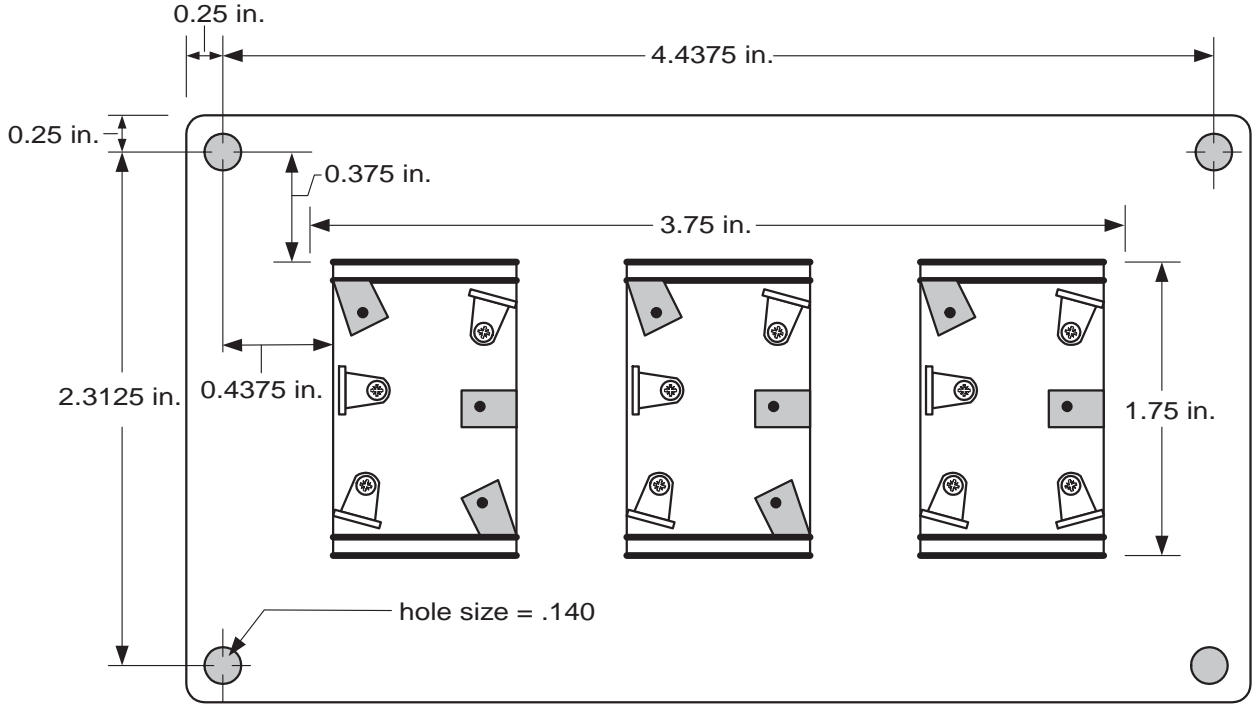
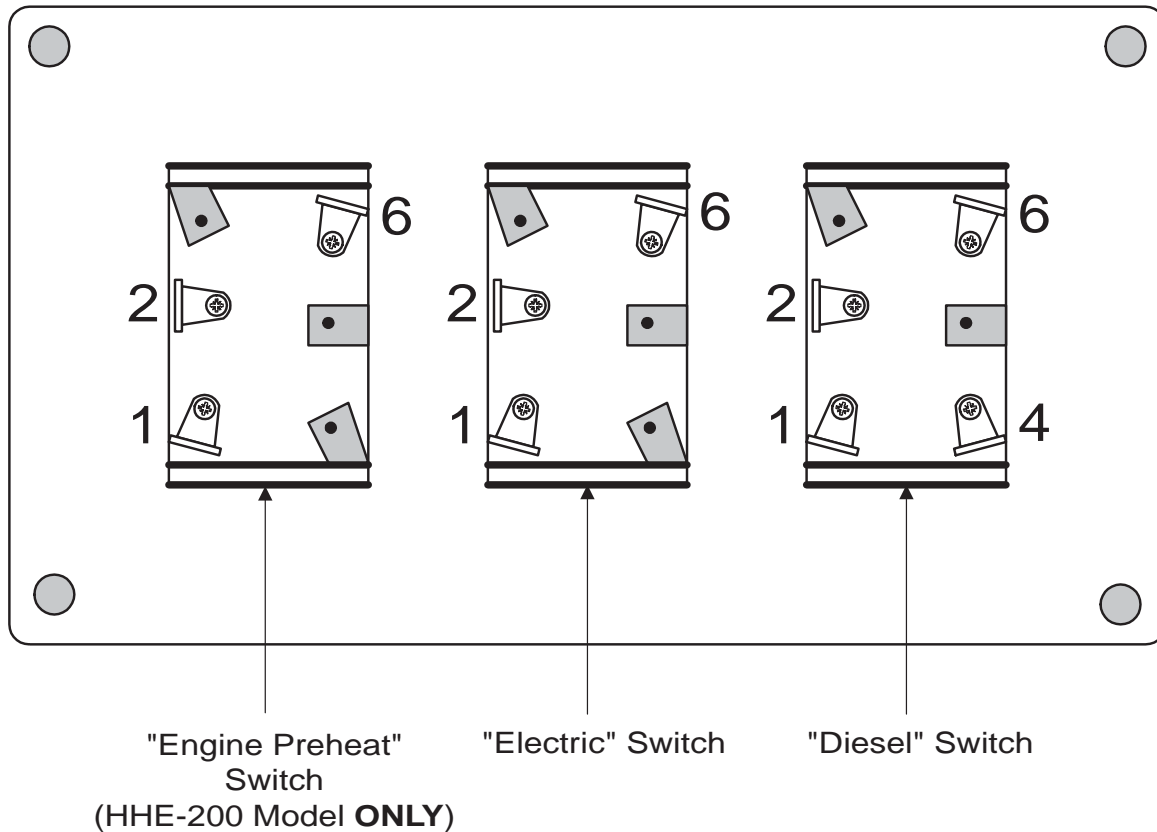


Figure 22

SECTION 3: INSTALLATION PROCEDURES

Switch Panel and Indicator Light Wiring Overview

Switch Panel Back Side View



Switch to Electronic Controller connections

Switch	Elec. Controller
Pin # 1 →	to "PREHEAT -".
Pin # 2 →	to "PREHEAT +".
Pin # 6 →	to Chassis Ground.

Switch to Electronic Controller connections

Switch	Elec. Controller
Pin # 1 →	to "ELECTRIC -".
Pin # 2 →	to "ELECTRIC +".
Pin # 6 →	to Chassis Ground.

Switch to Electronic Controller connections

Switch	Elec. Controller
Pin # 1 →	to "DIESEL -".
Pin # 2 →	to "DIESEL +".
Pin # 4 →	to "B3 INDIC +".
Pin # 6 →	to "B6 INDIC -".

Figure 23

SECTION 3: INSTALLATION PROCEDURES

Installing / Wiring The Switch Panel

3.19 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 Diesel-Burner malfunctions, the Switch Panel should be easily visible to the operator.

1. Cut out an opening of 3.75"W x 1.75"H for the Switch Panel Plate, see Figure 22.
2. Run eight 16 Gage wires from the Switch Panel to the Electronic Controller.

NOTE: Be sure to use the wire colors illustrated in Figure 20. This will ensure installation consistency, differentiate each separate Switch and assist Service Personnel with troubleshooting.

3. Strip and crimp insulated female terminals onto each wire at the Switch Panel location.
4. Connect all Switch wires as illustrated in Figure 23. Be sure to connect the two chassis Ground wires to the "Electric" and "Engine Preheat" Switches. (HHE-200 Model ONLY).
5. Insert all Switch wires into the appropriate terminal / "Switch Panel Connections" on the Electronic Controller, see Figure 20.
6. Permanently mount the Switch Panel in place.
7. Be sure to turn all three Switches to their **Off** position by pressing them in the downward position.

Planning The Fuel System

3.20 Diesel-Burner's Fuel System, Overview

The Diesel Burner is the Hydro-Hot's primary heat source so 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), see Figure 25.

NOTES:

1. If an auxiliary fuel tank is required, be sure to reference the ANSI A119.2 NFPA 501C Standards Manual regarding Fuel Systems and Equipment.
2. Be sure to reference the ANSI A119.2 NFPA 501C Standards Manual for information regarding the Fuel Distribution System (i.e., the Fuel Lines that will be used to supply and return Diesel Fuel to and from the Hydro-Hot's Diesel-Burner).

- B. Fuel head pressure should not exceed 2 feet, see Figure 24.
- C. Use 1/4" I.D. Fuel Lines.
- D. The combined length of the supply and return Fuel Lines should not exceed 66 feet in total length.

SECTION 3: INSTALLATION PROCEDURES

Fuel System Specifications

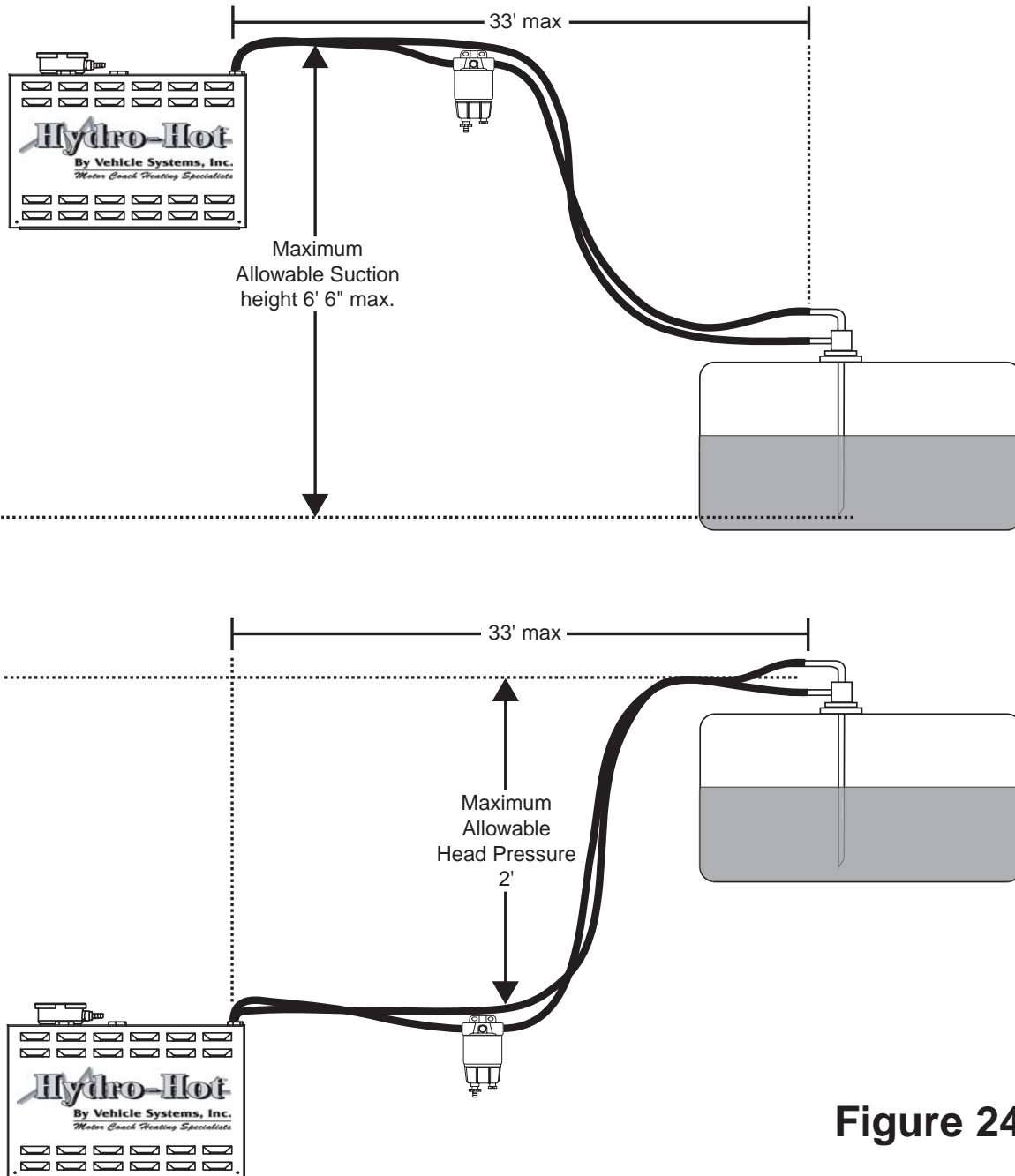


Figure 24

SECTION 3: INSTALLATION PROCEDURES

Planning The Fuel System, continued

Installing The Diesel Burner's Fuel Lines



- 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 the Hydro-Hot.
- 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.

3.21 Installing the Diesel Burner's Fuel System / Lines

1. Run two 1/4" ID Fuel Lines from the Fuel Tank / fuel pick-up to the Hydro-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 create a hazardous fuel pressure and may cause a Fuel Line to rupture or could 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, see Figure 25.

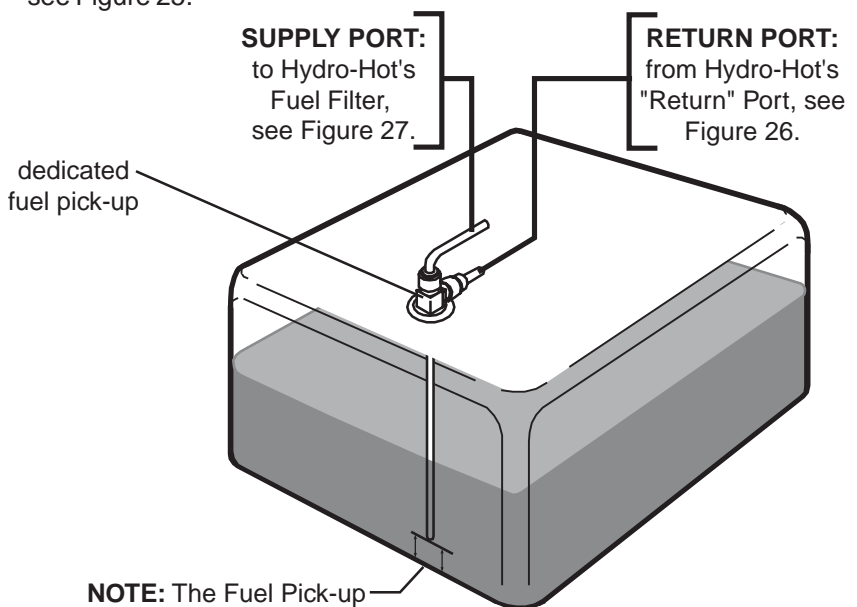


Figure 25

SECTION 3: INSTALLATION PROCEDURES

Fuel System Overview

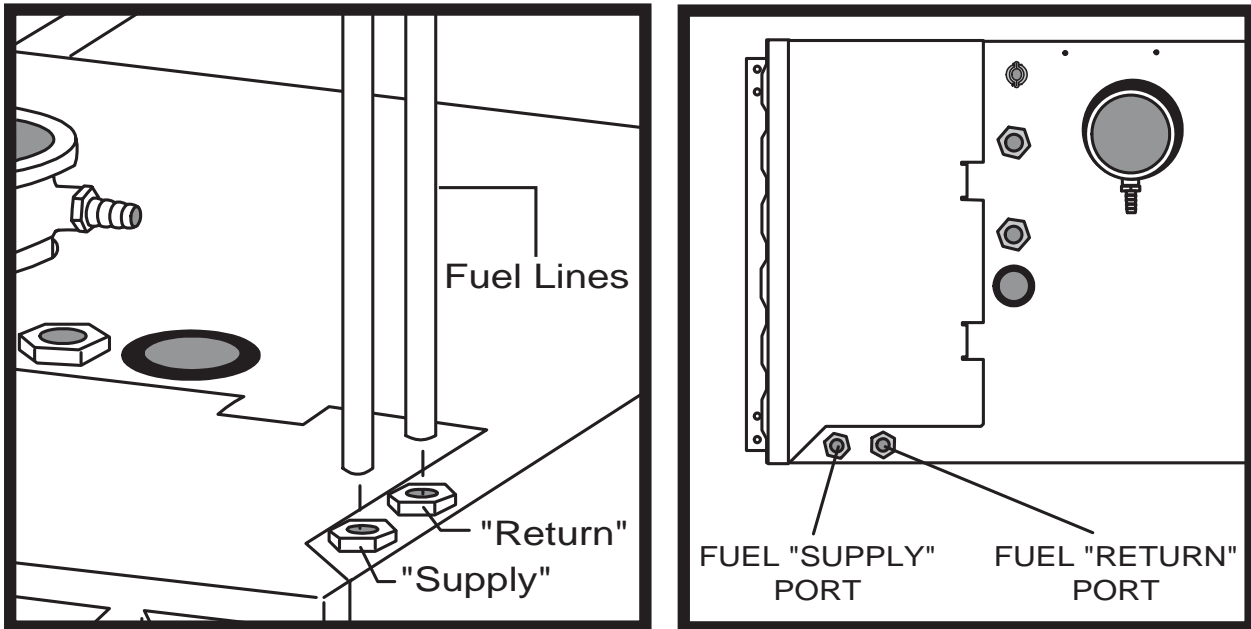
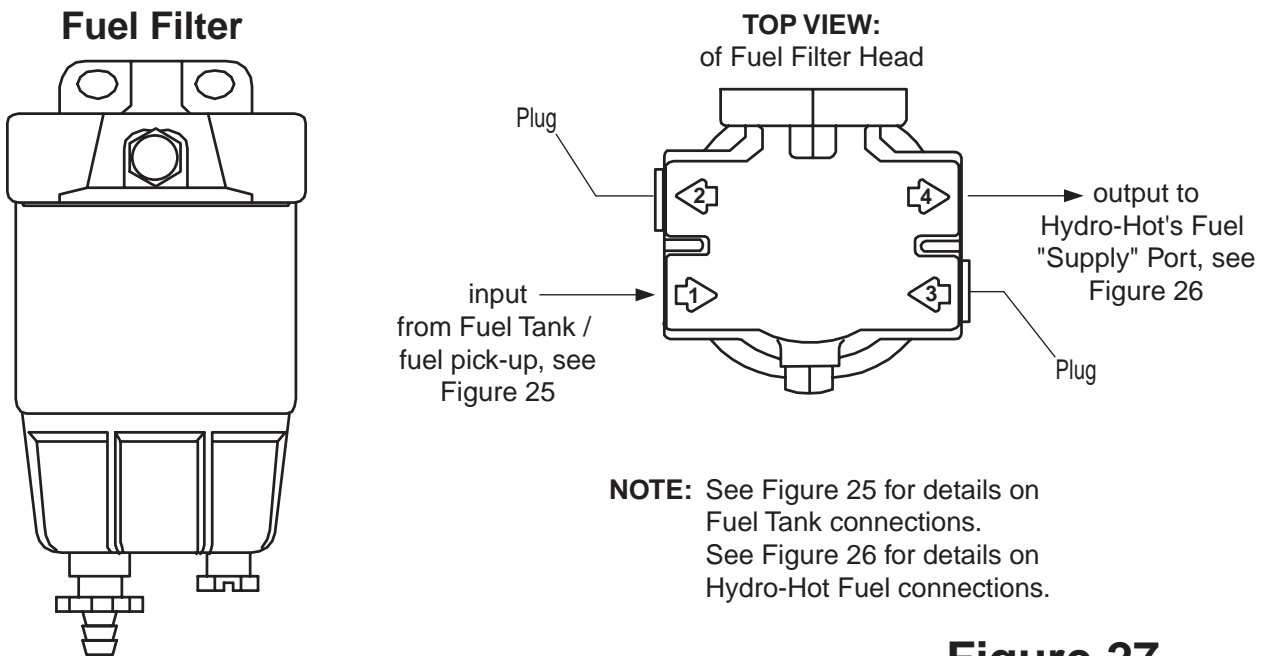


Figure 26



NOTE: See Figure 25 for details on Fuel Tank connections.
See Figure 26 for details on Hydro-Hot Fuel connections.

Figure 27

SECTION 3: INSTALLATION PROCEDURES

Installing The Diesel Burner's Fuel Lines, continued

4. Install and tighten appropriate fuel fittings into the Hydro-Hot's Fuel Ports as well as the two selected ports of the Fuel Filter, see Figures 26 and 27.
5. Connect the **Supply** and **Return** lines to the Hydro-Hot's fuel port connections, see Figures 2 and 26.
6. Cut the **Supply** line, at the Fuel Filter mounting location, and connect the Fuel Lines as illustrated in Figure 27.

Exhaust System Overview / Installation



3.22 The Hydro-Hot's Exhaust System, Overview and Installation

WARNING: The Hydro-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 exit away freely from the vehicle without any obstructions.
- B. Run the Exhaust Pipe to the driver's side of the vehicle and ensure that 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 Hydro-Hot's UL listing.
 2. Angle the Exhaust Pipe towards the rear of the vehicle so that 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 Section 3-4.3 in the RVIA "Handbook for Recreational Vehicle Standards" for additional information.
 - D. From the Hydro-Hot's 1-1/2 in. (F)NPT Exhaust Port, use 1-3/4 in. I.D. Exhaust Pipe, see Figure 28.

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 us directly for assistance.
 3. A maximum of two 90° 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" diameter) at the Exhaust Pipe's lowest point or by simply sloping the Exhaust Pipe away from the Hydro-Hot, see Figure 28.
 - F. Be sure to secure the end of the Exhaust Pipe to the vehicle with the proper Exhaust Hanger / support hardware.

SECTION 3: INSTALLATION PROCEDURES

Exhaust System Overview

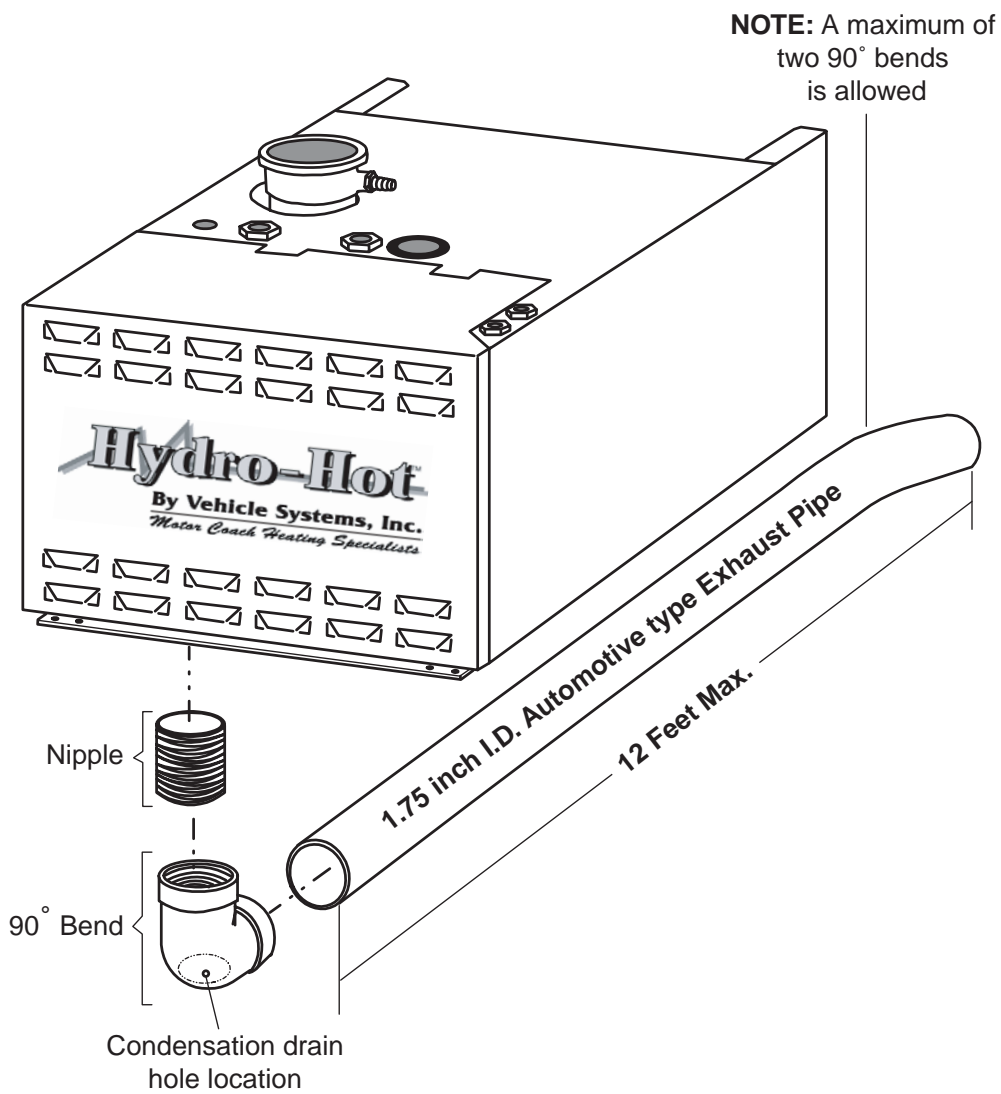


Figure 28

SECTION 3: INSTALLATION PROCEDURES

Installing The Expansion Tank

3.23 Installing the Hydro-Hot's Expansion Tank

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

1. Mount the Expansion Tank as illustrated in Figure 29.
2. Connect and clamp the Expansion Tubing from the Expansion Tank to the Hydro-Hot's Filler Neck Expansion Connection, see Figure 29.

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

3. Drill hole in the Bay Floor and connect and clamp the Overflow Tube from the top connection of the Expansion Tank through the Bay Floor.

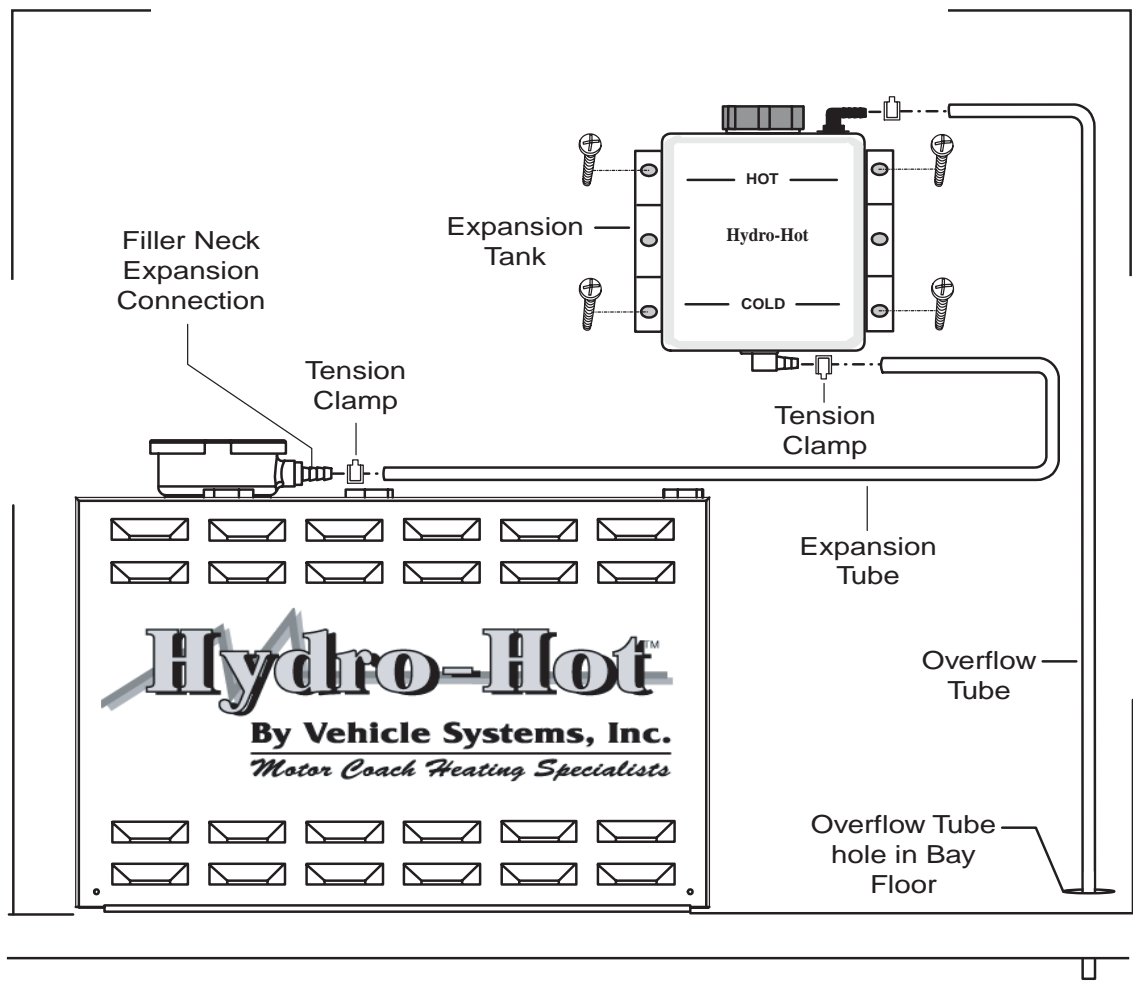


Figure 29

SECTION 3: INSTALLATION PROCEDURES

VDC Power Overview

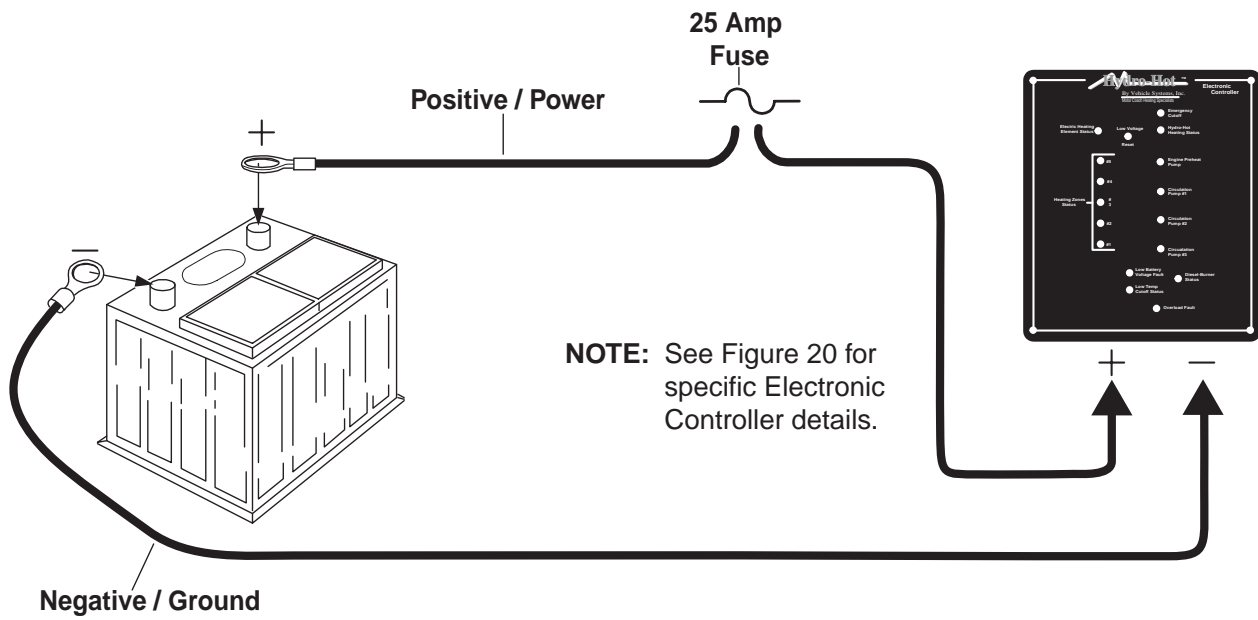


Figure 30

SECTION 3: INSTALLATION PROCEDURES

VDC Power Installation



3.24 Connecting 12-VDC Power to the Hydro-Hot

WARNINGS:

- A. **Do not** activate the Hydro-Hot's Diesel-Burner until the solution of water and antifreeze has been added to the Hydro-Hot's Heat Tank and the heating system has been completely bled of air. Operating the Hydro-Hot without the solution of water and antifreeze will cause **serious damage** to the Hydro-Hot's Heat Tank.
- B. **Do not** connect 12-VDC Power to the Hydro-Hot if the Vehicle requires welding. Electrical welding will cause **serious damage** to the Diesel-Burner's Control Unit and the Hydro-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 Gage wires, Red for (+) and Black for (-), from the Vehicle's Batteries to the Hydro-Hot's Electronic Controller, see Figures 20 and 30.

NOTE:

1. If the combined length of the two 10 Gage wires is in excess of 20 feet, reference Chart 1 in the back of this Manual for proper wire gage sizing. Please note that under full load conditions the Hydro-Hot can draw as much as 13.5 Amps of VDC current. **Because the Hydro-Hot is designed to shut down whenever the VDC Voltage Level is too low to properly operate, it is imperative that the proper gage wire be used.**
2. The maximum allowable **voltage drop** to the 12-VDC Hydro-Hot is 0.5VDC. Please use Chart 1 in the back of this Manual to ensure proper wire sizing.

NOTE: Be sure to use the wire colors illustrated in Figure 20. This will ensure installation consistency, differentiate the two Power Wires, and assist Service Personnel with troubleshooting.

2. Label the wires indicating whether they are a Power or a Ground wire.
3. Attach the VDC Power wires onto the appropriate terminal / battery connections on the Electronic Controller, see Figure 20.
4. 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 an In-Line Fuse, 25 Amp rating, into the Power wire at the Battery location, see Figure 30.

NOTE: The Hydro-Hot's Electronic Controller must be reset anytime VDC Power is disconnected and then reconnected to the heater. To reset the Electronic Controller, simply depress the "Low Voltage Reset" Button, see Figure 31.

SECTION 3: INSTALLATION PROCEDURES

Low Voltage Reset Button

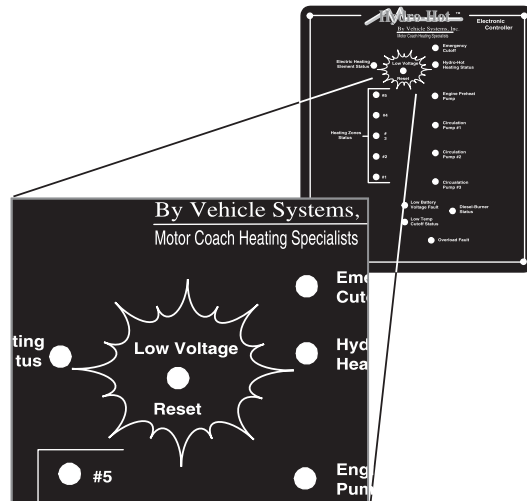


Figure 31

System Bleeding

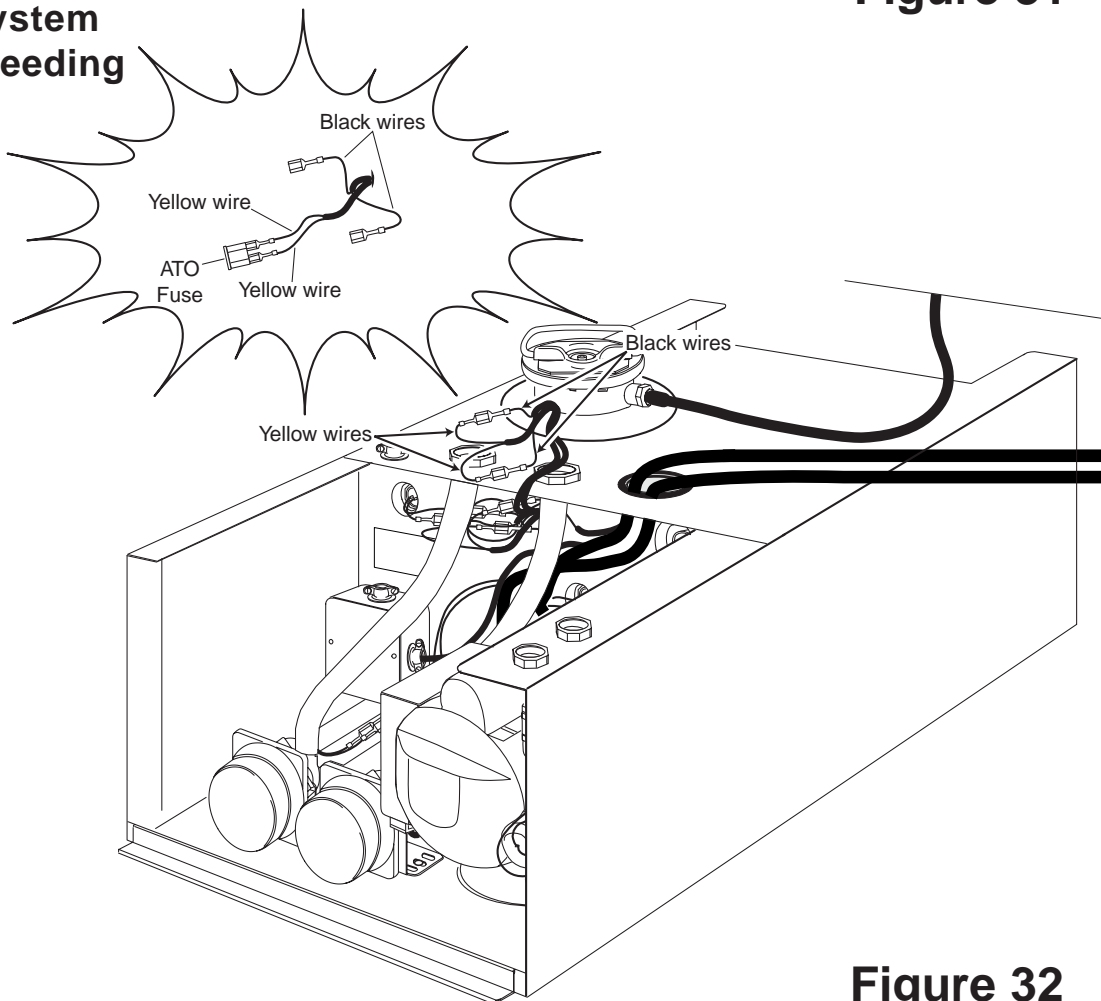


Figure 32

SECTION 3: INSTALLATION PROCEDURES

System Bleeding

3.25 Bleeding the Interior / Fresh Water Tank Heating System

NOTES:

- A. It is recommended to use either an Ethylene-Glycol or Propylene-Glycol based Antifreeze for all Hydro-Hot installations.
- B. Be sure to remove the Hydro-Hot's "Access Cover" before beginning this procedure, see Figure 2.

1. Remove the Hydro-Hot's Pressure Cap and completely fill the Heat Tank by pouring in 4 Gallons of a 2/3-thirds Water and 1/3-third Antifreeze Solution, see Figure 2.
2. Replace and tighten the Hydro-Hot's Pressure Cap.
3. Locate and disconnect the two Yellow colored wires located inside the Access Cover Area, see Figure 32 for wire details.
4. Connect the two Yellow colored wires together by utilizing an ATO type automotive fuse, or similar, see Figure 32.
5. Switch **ON** any Interior Zone Thermostat to its maximum temperature setting. Allow the Circulation Pump to operate for approximately one minute and then switch it **OFF**. This will activate one of the Hydro-Hot's Circulation Pumps which will fill the heating system's plumbing lines.
6. Again, remove the Hydro Hot's Pressure Cap and completely fill the Heat Tank with additional water / antifreeze solution.
7. Repeat steps 5 and 6 for both Heating Loops until all air has been completely bled from the entire heating system.
8. Remove the fuse, or similar, from the two Yellow wires and reconnect the wires back to their original wiring configuration, see Figure 32.

NOTE: The Yellow wires **are not polarity sensitive**, so either Yellow wire can connect to either Black wire.

SECTION 3: INSTALLATION PROCEDURES

Bleeding The Engine Preheat / Matoraide System

3.26 Bleeding the Engine Preheat / Matoraide System (HHE-200 and HHE-500 Models Only)

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 engine coolant level and top off, if necessary.
5. Activate the "Preheat" switch located on the Switch Panel (Model HHE-200 only). During this procedure, check for leaks in the Engine Preheat / Matoraide plumbing system and connections.
6. Switch the "Preheat" switch to the **OFF** position by pressing it in the downward position.

VAC Power Installation



3.27 Connecting 120-VAC Power to the Hydro-Hot

WARNING: Do not activate the Hydro-Hot's Electric Heating Element until the solution of water and antifreeze has been added to the Hydro-Hot's Heat Tank and the heating system has been completely bled of air. Operating the Hydro-Hot without the solution of water and antifreeze will cause **serious damage** to the Hydro-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. Run a 12-2 ROMEX wire with Ground, from an over-current protected (20-Amp Circuit Breaker required) 120-VAC Power supply, to the Hydro-Hot's ROMEX Clamp, see Figures 2 and 33.
2. Insert the wire through the Hydro-Hot's ROMEX Clamp and connect the 120-VAC Power supply to the Hydro-Hot's Electric Heating Element wires as illustrated in Figure 33.

SECTION 3: INSTALLATION PROCEDURES

VAC Power Installation, continued

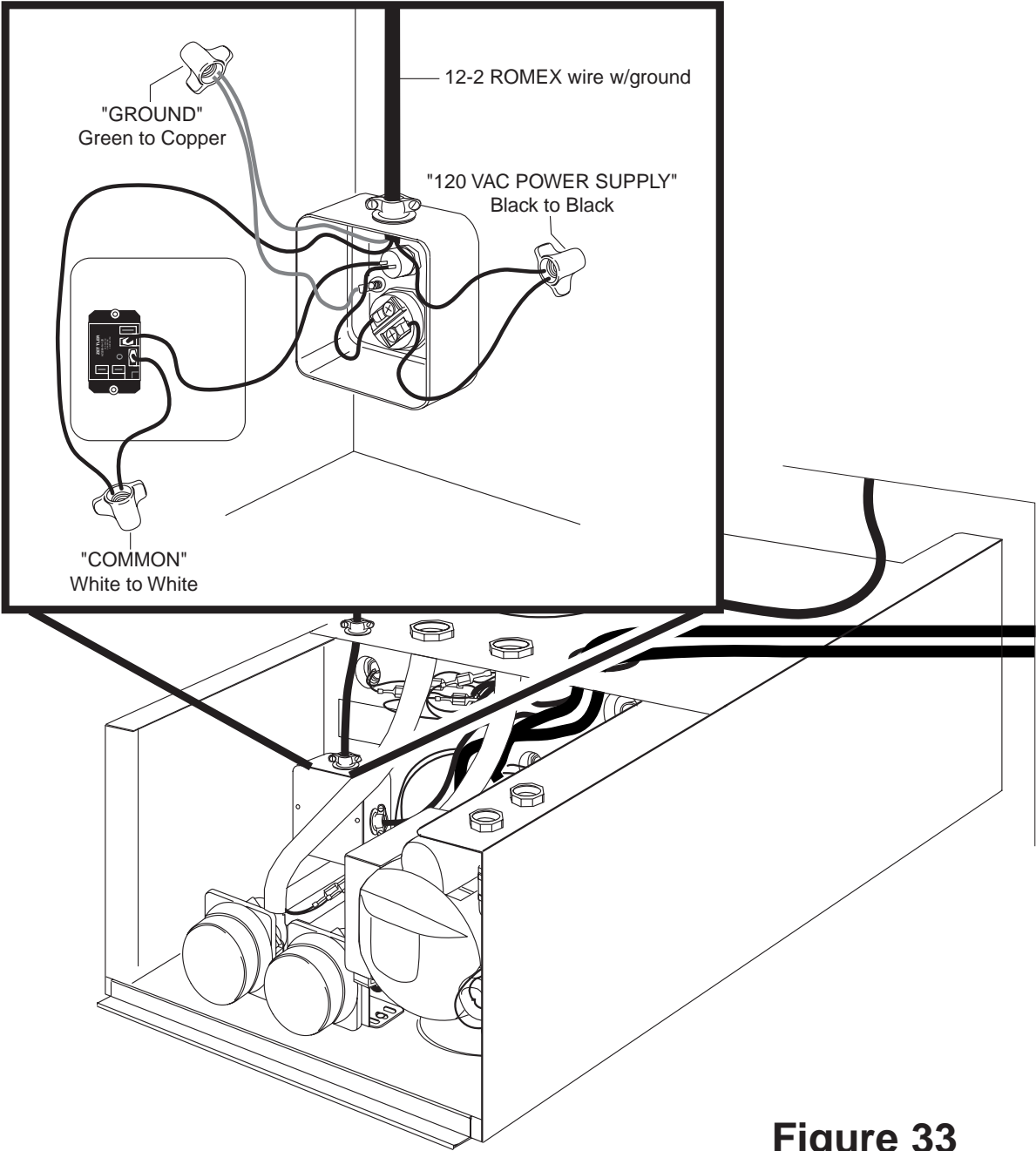


Figure 33

SECTION 3: INSTALLATION PROCEDURES

Activating The Hydro- Hot

3.28 Initial Activation of the Hydro-Hot

1. Switch the Hydro-Hot's "Diesel" switch to the **ON** position. Do this by pressing the switch in the upward position.

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. Switch the Hydro-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 ignites and exhaust can be heard exiting the heater.
- B. Allow approximately 10-20 minutes for the Hydro-Hot to reach normal operating temperature (approximately 195° F).

3. Switch the Hydro-Hot's "Electric" switch to the **ON** position. This will supply 120-VAC Power to the Hydro-Hot's Electric Heating Element.

NOTE: Both the 12-VDC powered Diesel-Burner and the 120-VAC powered Electric Heating Element are thermostatically controlled. Either or both heating sources will automatically maintain the temperature of the Hydro-Hot's solution of water and antifreeze.

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

INSTALLATION PROCEDURES

Chart 1

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																		
10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
5	18	16	14	12	12	10	10	10	8	8	8	6	6	6	6	6	6	6
10	14	12	10	10	10	8	6	6	6	6	4	4	4	4	2	2	2	2
15	12	10	10	8	8	6	6	6	4	4	2	2	2	2	2	1	1	1
20	10	10	8	6	6	6	4	4	2	2	2	2	1	1	1	0	0	2/0
25	10	8	6	6	6	4	4	2	2	2	1	1	0	0	0	2/0	2/0	3/0
30	10	8	6	6	4	4	2	2	1	1	0	0	0	2/0	2/0	3/0	3/0	3/0
40	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
50	6	6	4	4	2	2	1	0	2/0	2/0	3/0	3/0	4/0	4/0	4/0			
60	6	4	4	2	2	1	0	2/0	3/0	3/0	4/0	4/0	4/0					
70	6	4	2	2	1	0	2/0	3/0	3/0	4/0	4/0							
80	6	4	2	2	1	0	3/0	3/0	4/0	4/0								
90	4	2	2	1	0	2/0	3/0	4/0	4/0									
100	4	2	2	1	0	2/0	3/0	4/0										

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

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