

SECTION 1. General Information

1A. Introduction

This manual provides installation and operation instructions for the Laars Lite, Model LLG and LLD pool and spa heaters. Read these installation and

operation instructions completely before proceeding with the installation. Consult the Teledyne Laars factory, or local factory representative, with any questions regarding this equipment. Experience has shown that most operating problems are caused by improper installation.

The Laars Lite heater is design certified by International Approval Services (formerly American

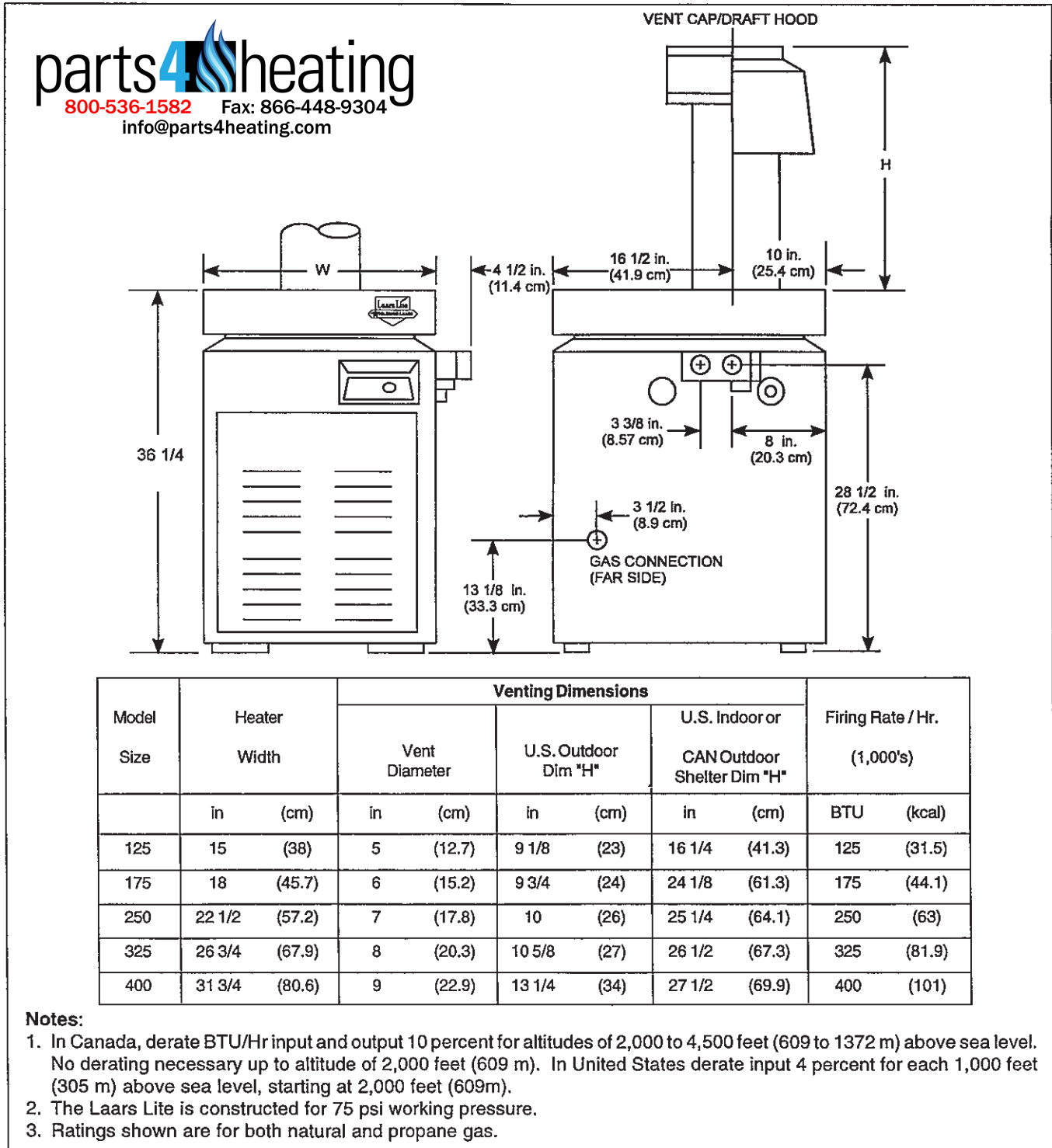


Figure 1. General Configuration.

Gas Association and Canadian Gas Association) as complying with the latest edition of the Standard for Gas-Fired Pool Heaters, ANSI Z21.56, and in Canada with CAN1-4.7-M85.

Certain sections of this manual are specific to either United States or Canadian installations, and are labeled as such.

1B. Description

The Laars Lite LLD heater gets electrical power from an external 120V / 240V (volt AC) source and provides a dual thermostat Flex-Temp control system for pool/spa combinations or pre-heat convenience. The Laars Lite LLD heater also meets the California, New York, Hawaii, and Oregon state energy requirements for intermittent ignition gas appliances. The Laars Lite LLG heater is a self contained standing pilot unit and requires no external power.

The Laars Lite heater is specifically designed for heating swimming pools and spas. Do not use it as a general service water heater or for heating salt water pools. Consult your dealer for the appropriate Teledyne Laars products for these applications.

1C. Warranty

The Laars Lite heater is sold with a limited factory warranty. Details are specified on the back cover of this manual. A copy of the warranty and a warranty registration card are included in the plastic bag shipped with the heater. Fill out and return the warranty registration card.

Make all warranty claims to an authorized Teledyne Laars representative or directly to the factory. Claims must include the heater serial number and model (this information can be found on the rating plate), installation date, and name of the installer. Shipping costs are not included in the warranty coverage.

Damage caused by improper installation or assembly, or to the heat exchanger by corrosive water, is NOT covered by the Warranty. See Section 3D for maintaining proper pool water chemistry.

NOTE: Keep this manual in a safe place for future reference when inspecting or servicing the heater.

1D. Technical Assistance

Consult Teledyne Laars or your local distributor with any questions or problems involving the specifications, installation, and operation of your Teledyne Laars equipment. An experienced technical support staff is ready to assist in assuring the proper performance and application of Teledyne Laars products.

SECTION 2. Installation Instructions

2A. General Information

Install the Laars Lite heaters in accordance with the procedures in this manual, local codes and ordinances, and in accordance with the latest edition of the National Fuel Gas Code, ANSI Z223.1. In Canada, the installation must be in accordance with CAN1-B149.1 or .2 and local codes. The authority having jurisdiction may require the installation conform to the Standard for Gas-Fired Heaters, ANSI Z21.56. Any changes to the heater, gas controls, gas orifices, wiring, draft diverter, or improper installation may void the warranty. If field conditions require change to any of the above, consult the factory.

All gas-fired products require correct installation to assure safe operation. The requirements for pool heaters include the following:

1. Field assembly (if required)
2. Appropriate site location (clearances) and flooring
3. Sufficient combustion and ventilation air
4. Properly sized gas meter and piping
5. Proper electrical wiring (if required)
6. Adequate water flow

This manual provides the information needed to meet these requirements. Review all application and installation procedures completely before continuing the installation.

2B. Field Assembly

The Laars Lite heater is shipped from the factory with the top assembly in the low-profile configuration for outdoor installation in the U.S. The Laars Lite heater is design certified for indoor installation when equipped with a draft hood, which must be installed without modification.

The Laars Lite heater is also certified for installation in an outdoor shelter in Canada when equipped with a draft hood. An outdoor shelter is an enclosure not normally occupied which does not communicate directly with occupied areas.

Check the rating plate on the heater for the correct Teledyne Laars part number. See instructions supplied with the draft hood for installation and attachment. When the draft hood is used, locate the heater so as to be in the same atmospheric pressure zone as the combustion air inlet to the heater.

If a draft hood is used, it must be connected to a vent pipe which stops at least 2 feet (0.61 meters [m]) above the highest point of the roof or other object that is within 10 feet (3.05 m) from the vent termination. The vent pipe must have a listed vent cap which allows a full equivalent opening for flue products (see Figure 2).

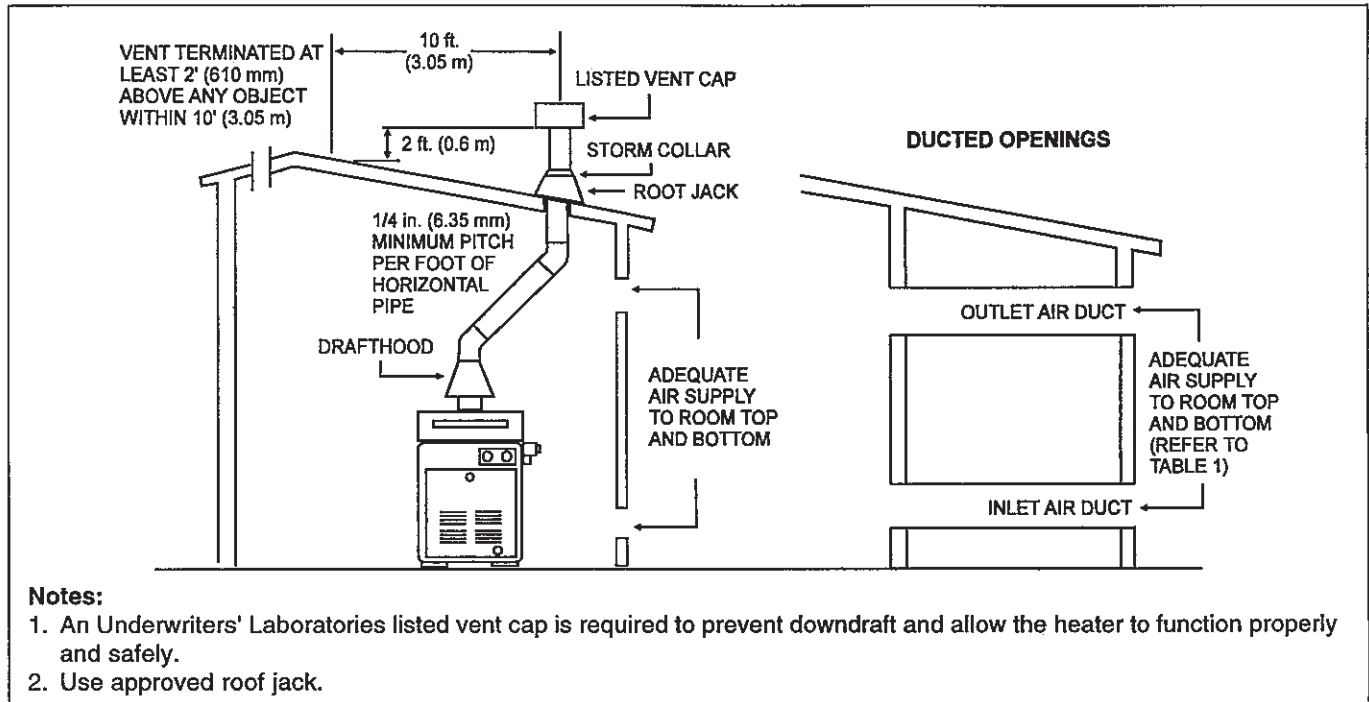


Figure 2. Indoor Installation Venting (USA), or Outdoor Shelter (Canada).

Table 1. Air Openings to Outside

Model	Required Net Free Open Area for Combustion Air Openings		Direct from outside		Duct from outside	
	in	(cm)	in	(cm)	in	(cm)
125	32	(206)	64	(413)		
175	44	(284)	88	(568)		
250	63	(406)	126	(813)		
325	82	(429)	164	(1058)		
400	100	(645)	200	(1290)		

Note: If using screens and/or louvers, compensate by adding 50% additional area to each opening.

2C. Site Location

⚠ WARNING
 Improper installation or maintenance can cause nausea or asphyxiation from carbon monoxide in flue gases which could result in severe injury, or death.

2C-1. Installation Information

Avoid placing the heater in locations where it can cause damage by water or condensate leakage. If this is not possible, provide a suitable drain pan to catch and divert any leakage. The pan must not block natural flow of air around the heater.

Locate the heater so the clearances from combustible surfaces shown in Table 2 are met.

2C-2. Outdoor Installation

Laars Lite heaters can be installed in the low-profile, grate top configuration (U.S.A. only) as received from the factory, or with an optional high wind vent cap/stack. Canadian units require a factory approved vent cap.

Locate the heater in an **open, unroofed area**. Do not install the heater under a deck. Do not locate the heater below or adjacent to any doors, glass openings, louvers, grills, etc., which connect in any way with an inhabited area of a building, even though the access might be through another structure (e.g., a garage or

Table 2. Minimum Heater Clearances From Combustible Surfaces

Side of Heater	Indoor (Outdoor Shelter) Installation				Outdoors Installation			
	U.S.		Canada		U.S.		Canada	
	inch	(cm)	inch	(cm)	inch	(cm)	inch	(cm)
Blank	6	(15.2)	6	(15.2)	6	(32)	6	(15.2)
Rear	6	(15.2)	6	(15.2)	6	(32)	6	(15.2)
Piping	12	(30.5)	18	(45.7)	12	(30.5)	18	(45.7)
Top	44	(111.7)	44	(111.7)	Open Unroofed Area			
Front	18	(45.7)	36	(91.4)				

utility room. In the United States there must be a minimum of 4 feet (1.22 m) horizontally or vertically between the heater and any door, glass opening, or gravity inlet to a building (see Figure 3).

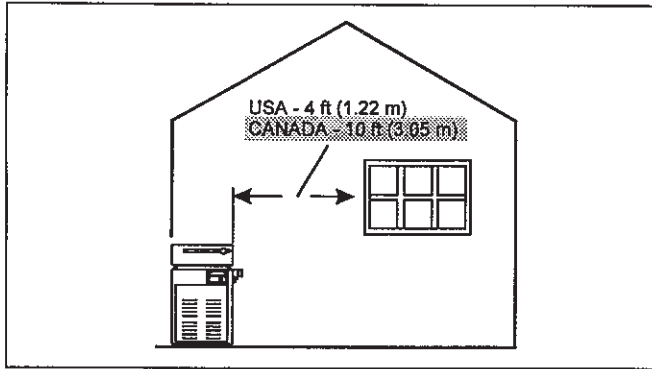


Figure 3. Outdoor Heater Installation.

⚠ WARNING
United States
 Do not install the heater with the top of the vent assembly within 4 feet (1.22 m) of any opening into a building.

Canada
 Do not install the heater with the top of the vent assembly within 10 feet (3.05 m) of any opening into a building.

If the heater is installed under an overhang, there must be a minimum clearance of 5 feet (1.5 m) above the top of the heater and the structure should not overhang the heater more than 12 inches (0.30 m). The area under the overhang must be open on three sides. This prevents combustion gases from being diverted into living areas through doors, windows, or gravity inlets.

If the heater is installed close to a structure, protect it from rain water runoff with rain gutters on the roof or other measures. Do not locate the heater near sprinkler systems that could spray water on it.

Avoid locations where wind deflection off nearby structures might cause wind loading and downdraft conditions. Where downdraft conditions exist, locate the heater at least 3 feet (0.91 m) from vertical surfaces (e.g., nearby buildings and walls). The addition of a vent cap may be necessary.

2C-3. Flooring - Typical Installation

Do not install the heater directly on a combustible wood or carpet floor without placing a non-combustible platform between the floor and the heater. In the United States, the National Fuel Gas Code allows a heater to be placed on a combustible surface when there is a platform under the heater

made of hollow masonry no less than 4 inches (102 millimeters [mm]) thick, covered with sheet metal at least 24 gauge thick and extending beyond the full width and depth of the heater by at least 6 inches (76.2 mm) in all directions. The masonry must be laid with ends unsealed, and joints matched to provide free circulation of air from side to side through the masonry (see Figure 4). If the heater is installed in a carpeted alcove, the entire floor of the alcove must be covered by a non-combustible panel. You can obtain a non-combustible base from Teledyne Laars, part number 10521701-05.

The diagram shows a rectangular heater unit sitting on a platform made of interlocking blocks. The platform has a grid of openings. On the side of the heater, there are two circular ports and a control panel with a gauge.

Notes:

1. Blocks must provide solid base and be braced so they cannot slip out of place.
2. Air openings in blocks must be arranged to provide unrestricted opening through entire width or length of base.

Figure 4. Non-Combustible Platform.

2D. Combustion and Ventilation Air Supply

All indoor installations must have openings to outside air for combustion, ventilation, and dilution of flue gases from inside the building (see Figure 2 and Table 1). Teledyne Laars does not recommend indoor installations that do not provide combustion air from outside the building.

All outdoor shelter installations (Canada only) must have uninterrupted openings to outside air for combustion and ventilation. The installation must be in accordance with the latest edition of CAN/CGA B149. Teledyne Laars does not recommend outdoor shelter installations that depend on combustion air for combustion.

If the heater is installed in a residential garage, or where flammable vapors will be present, the

burners must be 18 inches (457 mm) above the garage floor. Refer to the latest edition of the National Fuel Gas Code for more information. In Canada, refer to the latest edition of the Gas Installation Code, CAN/CGA B149.

⚠ Caution

Do not operate this heater outdoors at temperatures below 20 degrees Fahrenheit (°F) (-7 degrees Celsius [°C]).

2E. Gas Supply and Piping

2E-1. General Instructions

Review the following general instructions before continuing the installation.

⚠ WARNING

Do not convert this heater from natural gas to propane gas, or propane to natural. Field conversion could create carbon monoxide gas which can cause property damage, serious injury, or death.

1. Gas piping installation must be in accordance with the latest edition of ANSI Z223.1. In Canada, the installation must be in accordance with CAN- B149.1 or .2 and all local codes that apply.
2. Check the rating plate to make sure the heater is fitted for the type of gas being used. Teledyne Laars heaters shipped from the factory are certified to operate at an altitude of 0 to 2000 feet (0 to 609 m), or if so ordered, at higher altitudes. In the United States, the heater manifold is marked with a tag or sticker indicating one of the following high altitude operation codes:
 - a. High altitude (H) - 2,000 to 6,000 feet (609 to 1829 m)
 - b. High altitude (J) - 6,000 to 10,000 feet (609 to 3048 m)
3. In Canada, the heater rating plate is marked for specific altitude requirements: high altitude (H) is 2,000 to 4,500 feet (609 to 1372 m) above sea level.
4. Use the figures in Table 3 to size the gas inlet piping from the gas meter to the heater. Check all local codes for compliance before installing the heater.

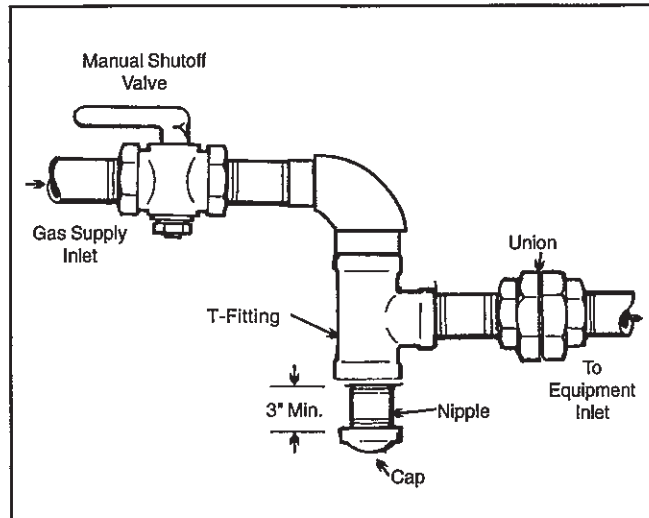


Figure 5. The proper design for a sediment trap / drip leg.

5. Install a sediment trap (drip leg) ahead of the gas controls (see Figure 5). Fit the trap with a threaded cap which can be removed for cleaning.
6. Install a manual gas shutoff valve for service and safety. Do not use a restrictive gas cock. **DO NOT USE GAS FLEXIBLE PIPING.**
7. Disconnect the heater and its individual shutoff valve from the gas supply system during pressure testing of the system at pressures higher than 1/2 pounds per square inch (psi) (3.45 kilopascals [kPa]). If the test pressure is equal to or less than 1/2 psi (3.45 kPa), close the manual shutoff valve on the heater during the piping pressure test.

Table 3. Natural Gas Pipe Size Requirements

Heater Size	Distance from Gas Meter					
	0-50 feet (0-15 m)		50-100 feet (15-30 m)		100-200 feet (30-60 m)	
	in.	(mm)	in.	(mm)	in.	(mm)
125	3/4	(19)	1	(25.4)	1	(25.4)
175	1	(25.4)	1	(25.4)	1-1/4	(31.75)
250	1	(25.4)	1-1/4	(31.75)	1-1/4	(31.75)
325	1-1/4	(31.75)	1-1/4	(31.75)	1-1/2	(38)
400	1-1/4	(31.75)	1-1/2	(38)	1-1/2	(38)

Notes:

1. These numbers are for natural gas (0.65 Sp. Gr.) and are based on 1/2 inch (13 mm) water column pressure drop. Check supply pressure with a manometer, and local code requirements for variations. For liquefied petroleum gas, reduce pipe diameter one size, but maintain a 3/4 inch (13 mm) minimum diameter.
2. Check supply pressure and local code requirements before proceeding with work.
3. Pipe fittings must be considered when determining gas pipe sizing.

⚠ Caution

Permanent damage to the gas valve will occur if the following procedures are not followed.

8. If the gas supply pressure is less than required, check for under-sized pipe between the meter and the heater, a restrictive fitting, or an under-sized gas meter. Gas supply pressures to the heater are listed in Table 4.

NOTE: The maximum inlet gas pressure must not exceed the specified value. The minimum value listed is for the purpose of input adjustment. Refer to Table 4.

Table 4. Gas Supply Pressure Requirements

Supply Pressure Water Column	Natural Gas	Propane Gas
	in. (mm)	in. (mm)
Minimum	6 (152)	10 (254)
Maximum	14 (356)	14 (356)

9. Before operating the heater, test the complete gas supply system and all connections for leaks using a soap solution. Do not use an open flame.

⚠ Caution

Some leak test solutions (including soap and water) may cause corrosion or stress cracking. Rinse the piping with water after testing.

2E-2. Special Precautions for Propane Gas

Liquefied petroleum (LP) gas is heavier than air. Therefore, do not install pool heaters using LP gas in pits or locations where gas might collect. Locate heaters a safe distance from LP gas storage and filling equipment. Consult local codes and fire protection authorities about specific installation restrictions.

2F. Electrical Wiring

2F-1. General Information (LLD Only)

Wiring connections must be made exactly as shown in the wiring diagram found on the inside of the heater (see Figures 6 and 7 for typical examples) and must include a definite means of grounding. There is a bonding lug on the right side of the heater, where a bond wire must be attached.

Electrical wiring must be in accordance with the latest edition of the National Electric Code (NEC),

ANSI/National Fire Protection Association (NFPA) 70, unless local code requirements indicate otherwise.

To wire the Laars Lite heater:

1. Wire the heater to a 120V or 240V /60 Hertz (Hz) electrical source.
2. Connect the wires from the source to the leads on the right side of the heater in the space behind the ignition control (see Figure 8).
3. Remove the screw located to the lower right of the transformer and open the hinged cover.

NOTE: No external junction box is required.

2F-2. Auxiliary Time Clock Wiring (LLD or LLG)

If you install a time clock to control the filter pump operation, it is recommended that the time clock have its own low voltage (Fireman's) switch to turn off the heater before turning off the pump. The switch should shut off the heater about 15 minutes before the filter pump shuts off. This will allow for a more efficient operation by removing any residual heat contained in the heat exchanger back to the pool.

To install a time clock auxiliary switch into the heater wires (see Figure 9):

1. Remove heater door.
2. Remove the factory installed wire between terminals 1 and 2 on the terminal strip (see Figure 9).
3. Connect the wires from the time clock auxiliary switch to the two terminals. Use American Wire Gage (AWG) No. 14 gauge stranded copper wire with a temperature rating of 221°F (105°C) or greater.

The length of the wire between the heater and the time clock should not exceed 10-15 feet (4.57 m). The contact points of the time clock switch should be silver, or a low resistance alloy.

2F-3. Remote Operation (Model LLD Only)

The Laars Lite pool/spa heater controls can be wired for remote operation. The CS-02 remote control permits switching from one temperature controller to the other and turning the heater on and off from a remote location. The CS-04 includes the same features as the CS-02 plus a remote temperature controller. Contact Teledyne Laars for further information. Reference part numbers CS-02 and CS-04.

An interrupt (on/off) type remote can be connected by removing the jumper wire on the

terminal block located in the control compartment (see Figure 6) and connecting the two wires from the remote to the two terminals on the terminal block. This type of remote control will turn the heater on or off, but will not switch between the two temperature controllers on the Flex-Temp control panel.

To connect a 3-wire remote (not supplied by Teledyne Laars), order a wire harness assembly (part

No. E0120000) which connects to the flex-temp control panel. Installation instructions are included with the wire harness assembly.

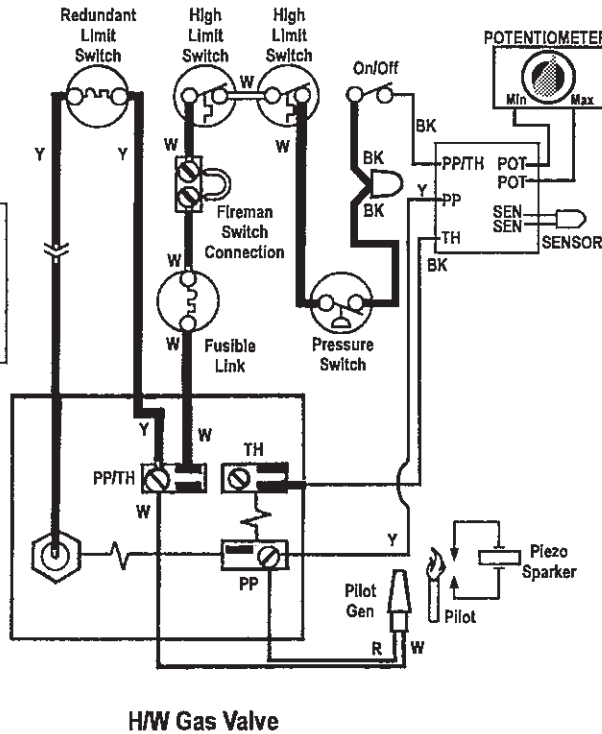
Consult with Teledyne Laars Service Department with questions about installing remotes other than Teledyne Laars.

MODEL LLG HEATER ELECTRICAL DIAGRAM

Connection Diagram

BK - BLACK
W - White
Y - Yellow
R - Red

IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE HEATER MUST BE REPLACED, APPLIANCE WIRING MATERIAL RATED FOR 105°C MUST BE USED. WHERE MARKED THUS **————** APPLIANCE WIRING MATERIAL FOR 200°C MUST BE USED.



H/W Gas Valve

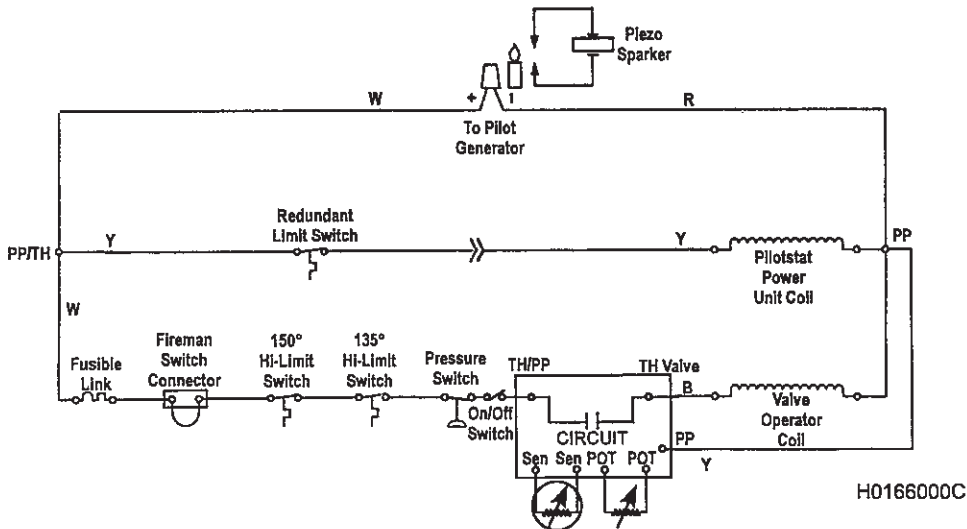


Figure 7. LLG Connection/Schematic Wiring Diagram

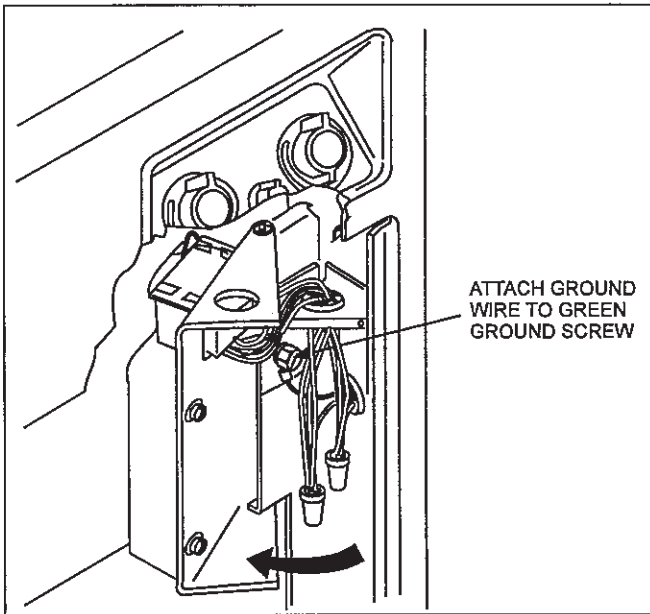


Figure 8. Field Wiring Connections (LLD).

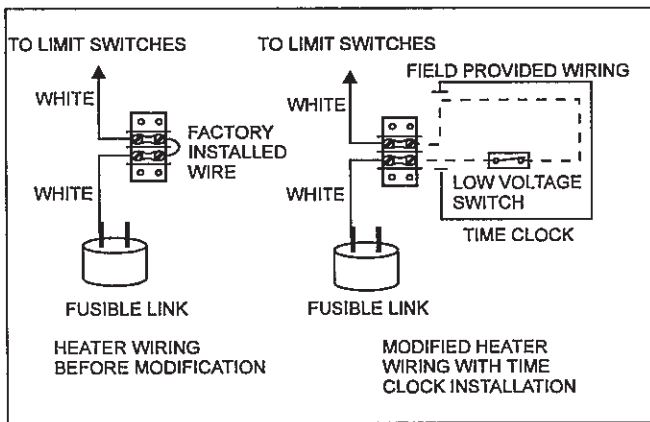


Figure 9. Time Clock Wiring.

2G. Water Flow System

2G-1. Flange Installation

The heater has 2" universal header couplings. You can connect threaded 2" iron pipe, unthreaded 1-1/2" iron pipe, 1-1/2" or 2" copper pipe without an adapter (see Figure 10).

Plastic piping (PVC Schedule 40) can be connected to the heater if local codes allow it, by using the CPVC nipples included with your heater.

To install plastic piping (see Figure 11):

1. Remove CPVC nipples from plastic bag.
2. Screw CPVC nipples into metal flange until tight, using teflon tape on plastic threads.
3. Attach PVC plumbing to CPVC pipes using PVC to CPVC cement only.

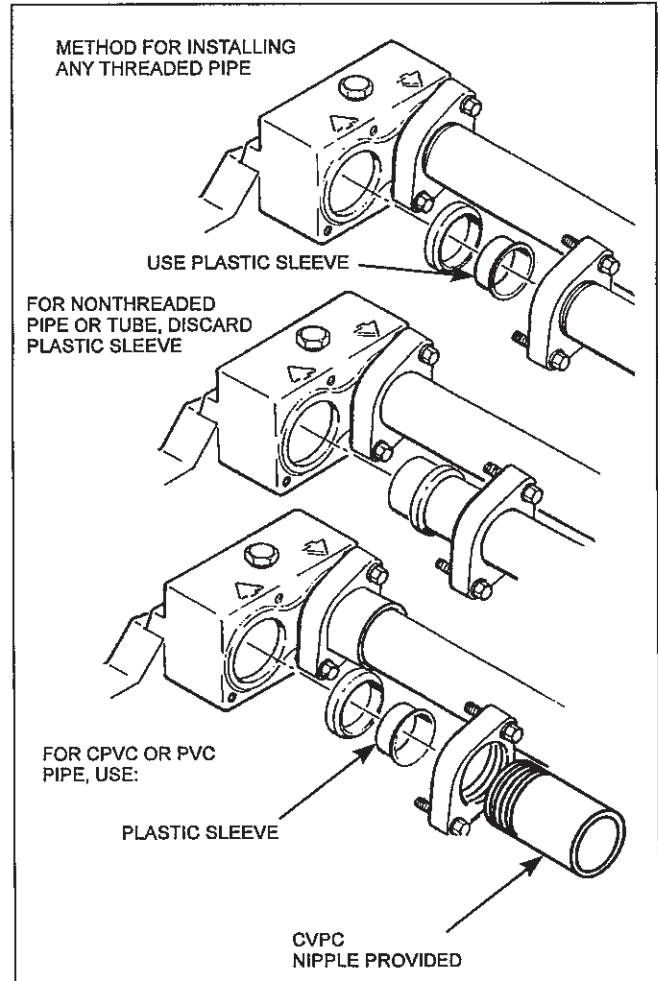


Figure 10. Piping installation.

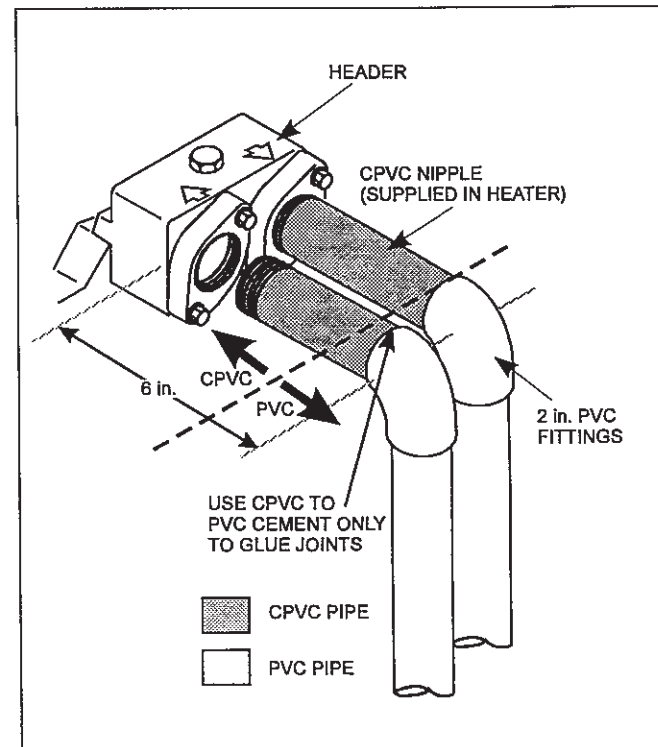


Figure 11. Plastic piping connections.

2G-2. Reversible Water Connections

Teledyne Laars ships the Laars Lite heater with the water connections on the right side. The Laars Lite heater can be installed with the water connections on either side. It could be necessary, or helpful, to switch the connections to the left side to improve access for installation service. Perform this modification before installing the heater using the following procedures:

1. Remove heater door.

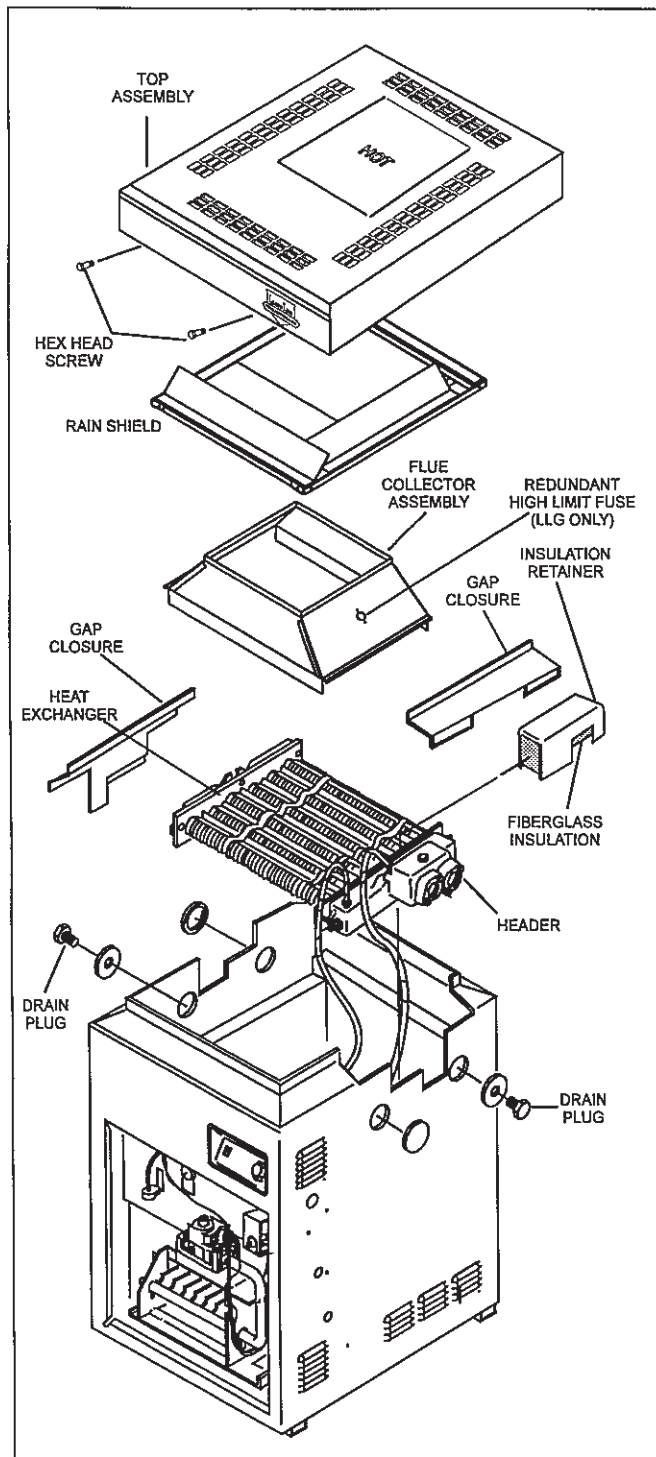


Figure 12. Heat exchanger reversal.

2. If there is a vent cap or draft hood (indoor) on top of the heater, remove it.
3. Remove all hex-head screws fastening the top and lift the top assembly straight up (see Figure 12).
4. Remove rainshield assembly and set it aside.
5. Remove screws that fasten the gap closures and put them aside. Remove gap closures.
6. Remove the fiberglass insulation and insulation retainer covering header sensors (see Figure 14).
7. Disconnect the two yellow leads (Model LLG only) from the redundant limit fuse located on the flue collector (see Figure 12).
8. Remove the screws securing the two flue collector holddown clamps and remove the clamps (see Figure 13). Remove flue collector.
9. Remove the three jacket/plug grommets and drain plugs (see Figure 12). One set is located under the water connections on the right side. The other is on the left side toward the front of the heater.
10. Tag and disconnect the white wire on the pressure switch (PS) and the white wire on the Fireman's switch terminal (see Figure 6 or 7) which leads to the high limit switch.
11. Remove plastic tie wraps and pull the white wires out of the front compartment through the vestibule cover and coil them on the heat exchanger.
12. Unscrew the brass compression fitting securing the pressure switch. Remove tube from header and gently bend it out of the way.
13. Loosen the screw securing the temperature sensing bulb retainer bracket. Slide the retainer bracket off

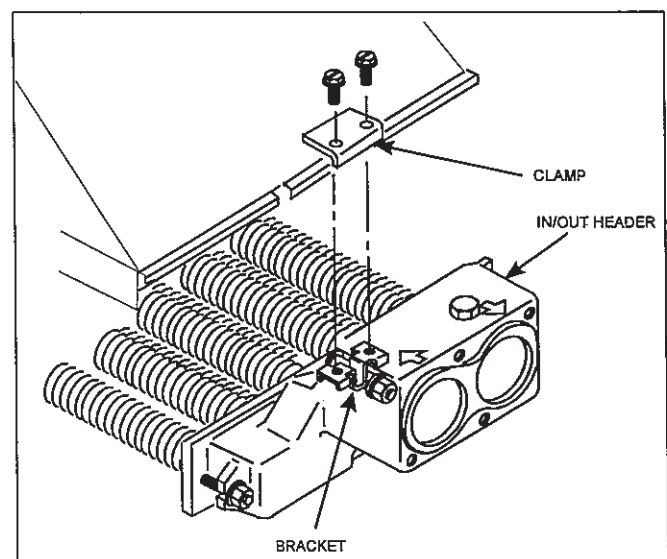


Figure 13. Flue collector holddown brackets.

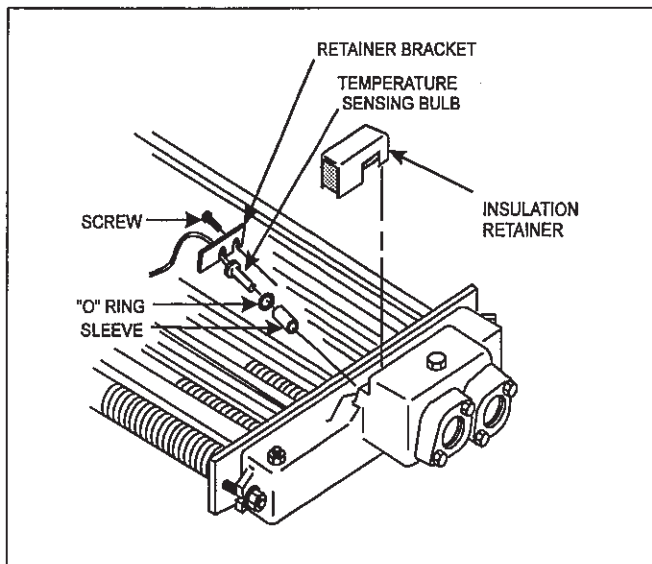


Figure 14. Temperature sensing bulb.

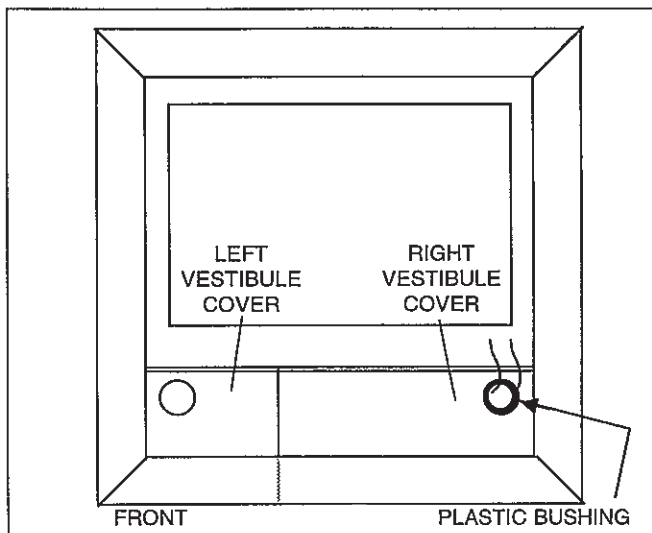


Figure 15. Vestibule covers.

the bulb flange and remove the bulb from the header (see Figure 14). Pull pressure switch tube through vestibule cover hole first, then pull thermostat bulb assembly through same hole.

⚠ Caution

It may be necessary to have help lifting the heat exchanger out and replacing it.

14. Lift out the heat exchanger assembly and set it aside. Re-install heat exchanger 180 degrees from it's original position (header left).
15. Remove the plastic bushing from the hole on the right side of vestibule cover. Re-install it in the hole on the left vestibule cover.
16. Re-route pressure switch tube and thermostat bulb assembly through hole in left side of (vestibule) cover in reverse order.

17. Remove pressure switch retainer from vestibule panel (allow pressure switch to float).
18. Re-install the temperature sensing bulb in the header, and fasten it with the retainer bracket and screw.
19. Re-install the compression fitting at end of pressure switch line into header.
20. Route the white wiring beside the heat exchanger and down to the original location. Be careful to keep the wires away from the flue collector. Secure white wires to the pressure switch tube with tie straps.
21. Connect the white wire labeled PS to the pressure switch and the other white wire to its original location on the Fireman's switch.
22. Replace jacket/plugs grommets, and re-install the drain plugs. Tighten securely.
23. Install the flue collector assembly. Be sure the bottom lips are inside the grooves on the front and rear tile covers and are not pinching any wires.
24. Reconnect yellow wires (Model LLG only) to redundant limit fuse on the flue collector.
25. Attach the flue collector holddown clamps to the clips located under the two center header bolts.
26. Replace the gap closures and tighten the screws securely.
27. Re-cover the header sensors with fiberglass insulation, and replace the insulation retainer.
28. Double-check to make sure the wiring is not pinched against sharp edges, or resting on the flue collector assembly.
29. Re-install rainshield assembly.
30. Replace the top assembly. Make sure the tabs are outside the heater jacket. Fasten the top assembly with the hex-head screws.
31. Install plastic tie wraps on wiring.
32. Install heater door.
33. Reinstall the vent cap or drafthood, if one was removed.

2G-3. Check Valve Installation

Install a check valve if there is any chance of back-siphoning when the pump stops. Do not install any other valve in the piping between the heater outlet and the pool, unless it is being used as a diverter valve.

2G-4. Chlorinators, Ozone Generators, and Sanitizing Chemicals

The Teledyne Laars Lite heater is manufactured with materials that are not compatible with high concentrations of ozone, chlorine, bromine, or other sanitizing chemicals. Heater damage caused by excessive chemicals or improper ozonation is not covered by the Teledyne Laars warranty. Be sure to adhere to the following:

- When ozone is injected upstream of the heater, install an offgas mixing chamber, or an ozone bypass system between the heater and the ozone injector to prevent ozone and air from entering the heater.
- When chemical feeders are used, plumb the feeder downstream of the heater and install an inline check valve between the heater and the feeder (a minimum of 18" is required between the heater and the check valve).
- Never deposit chemicals directly in the pool skimmer.

2G-5. Pressure Relief Valve

A pressure relief valve is not furnished with the Laars Lite heater, except in Canada, however, it is recommended and may be required by local codes.

To install a pressure relief valve, remove the 3/4 inch (19 mm) brass plug on the in/out header with the valve (see Figure 16). The setting of the valve should be at or below the lowest working pressure of filter system components.

2G-6. Adjusting the Pressure Switch

⚠ Caution

The pressure switch should be adjusted to turn the heater off when the pump is off. Setting the switch to close at too low of a flow can damage the appliance. Adjust the switch to turn the heater off, not on.

The pressure switch is preset at the factory for activation at 2 psi (14 kPa). Adjust the pressure switch only if any part of the filter system piping is 3 feet (0.91 m) or more above the top of the heater jacket.

Do not adjust the pressure switch if the heater is installed more than 15 feet (4.57 m) below or 6 feet (1.83 m) above the pool surface. Consult your local Teledyne Laars representative for recommendations.

On some installations, the piping from the heater to the pool is very short. The back pressure could be too low to trigger the pressure switch. If this happens, it may be necessary to install a directional fitting or elbows where the return line enters the pool. This will increase back pressure enough for the heater to operate properly.

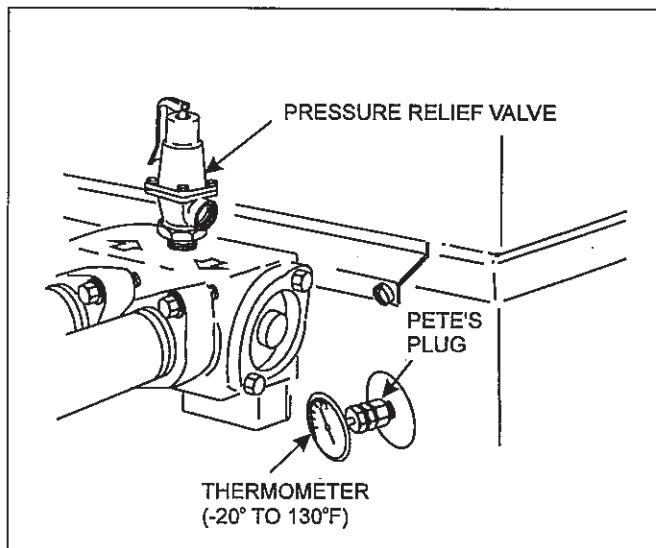


Figure 16. Thermometer and pressure relief valve.

Make sure the pool filter is clean before making any pressure switch adjustment: A dirty filter will restrict the water flow and the pressure switch cannot be adjusted properly. To adjust the pressure switch:

1. Turn the control panel rotary switch to OFF (see Figure 17).
2. Turn filter pump on. If a two-speed pump is used, make sure it is at high speed. (NOTE: Heater should not be allowed to fire on low speed).
3. Turn rotary switch to ON. Heater should start.
4. Pry out the top rubber dirt plug.
5. Use a 7/32 inch (5.55 mm) Allen wrench to turn the adjustment screw very slowly clockwise until the heater goes off (see Figure 18).
6. Slowly turn the pressure switch adjustment screw **counter-clockwise** one-quarter turn. The heater should come back on.
7. Check the adjustment by turning the filter pump OFF. The heater should shut off immediately. If it does not, restart the filter pump and repeat Steps 6 and 7. Check the adjustment again.
8. Return the pool temperature control to the desired temperature.

2G-7. Automatic Flow Control Valve

The automatic flow control valve maintains the proper flow through the heater at rates up to approximately 125 Gallons Per Minute (GPM) (474 liters per minute [LPM]). If the system filter-flow rate is higher than approximately 125 GPM (474 LPM), install a manual bypass valve (see Figure 18), then perform a temperature rise test (see Section 2G-8) and adjust the flow with the bypass valve until the proper temperature rise is obtained.

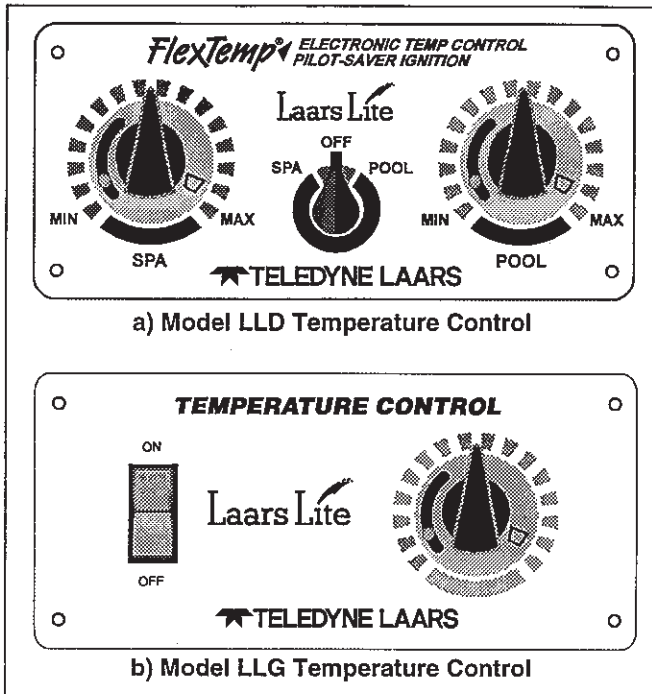


Figure 17. Temperature controls.

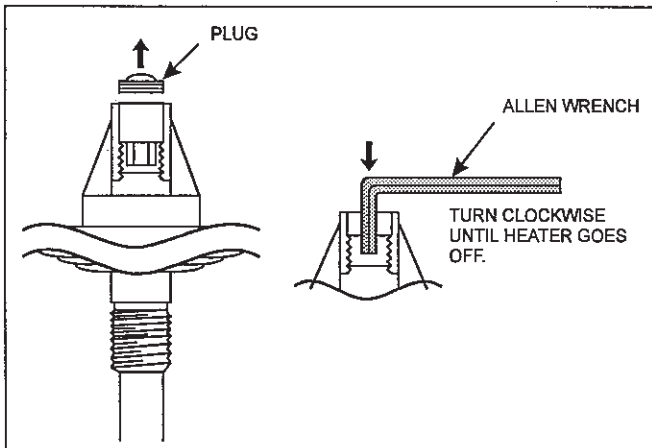


Figure 18. Pressure switch adjustment.

2G-8. Temperature Rise

A temperature rise test confirms proper water flow through the heater. The temperature rise is the difference between the temperature of the pool or spa water before and after heating, as measured in the header. Perform the following temperature rise test when the installation is complete:

1. Make sure the pool filter is clean.
2. Set the rotary switch on the temperature control panel (see Figure 17) to OFF.
3. Turn the filter pump off.
4. Remove the drain plug located on the right-hand side of the heater and replace it with a Pete's plug (see Figure 16).

5. Insert a pocket thermometer (see Figure 16) through the Pete's plug into the header.
6. Turn the filter pump on and wait 3 minutes. The heater is turned off.
7. Record the temperature indicated by the thermometer (cold water).
8. Turn the heater ON following the lighting instructions found on the inside of the heater.
9. Allow the heater to run for about 3 minutes. Record the new temperature reading (heated water).
10. Subtract the first temperature reading (cold water) from the second temperature reading (heated water). The difference between the two readings is the *temperature rise*. The temperature rise should be within the range shown in Table 6.

Table 6. Temperature Rise and Minimum Flow Rates

Size	Minimum		Minimum		Maximum	
	GPM	(LPM)	°F	(°C)	°F	(°C)
125	20	(76)	27	(15)	36	(20)
175	20	(76)	33	(19)	42	(24)
250	25	(95)	33	(19)	42	(24)
325	30	(114)	28	(16)	38	(21)
400	30	(114)	30	(17)	39	(22)

11. If the temperature rise is below the minimum range indicated, two possibilities arise:
 - a. The supply gas volume is too low.
 - b. The system's water flow exceeds 125 GPM (474 LPM), and requires a manual bypass valve for proper operation (see Figure 19).
12. If the temperature rise is above the maximum, there is not enough water flowing through the heater. Check for clogging in the water filter or restriction in the water pipes.

⚠ Caution

Operation with the temperature rise above maximum or below the minimum can damage the heater and may void the warranty.

13. If the temperature rise is within the correct range, complete the procedure as follows:
 - a. Turn heater off.
 - b. Wait 3 minutes, turn filter pump off.
 - c. Remove thermometer and Pete's plug.
 - d. Replace the drain plug.

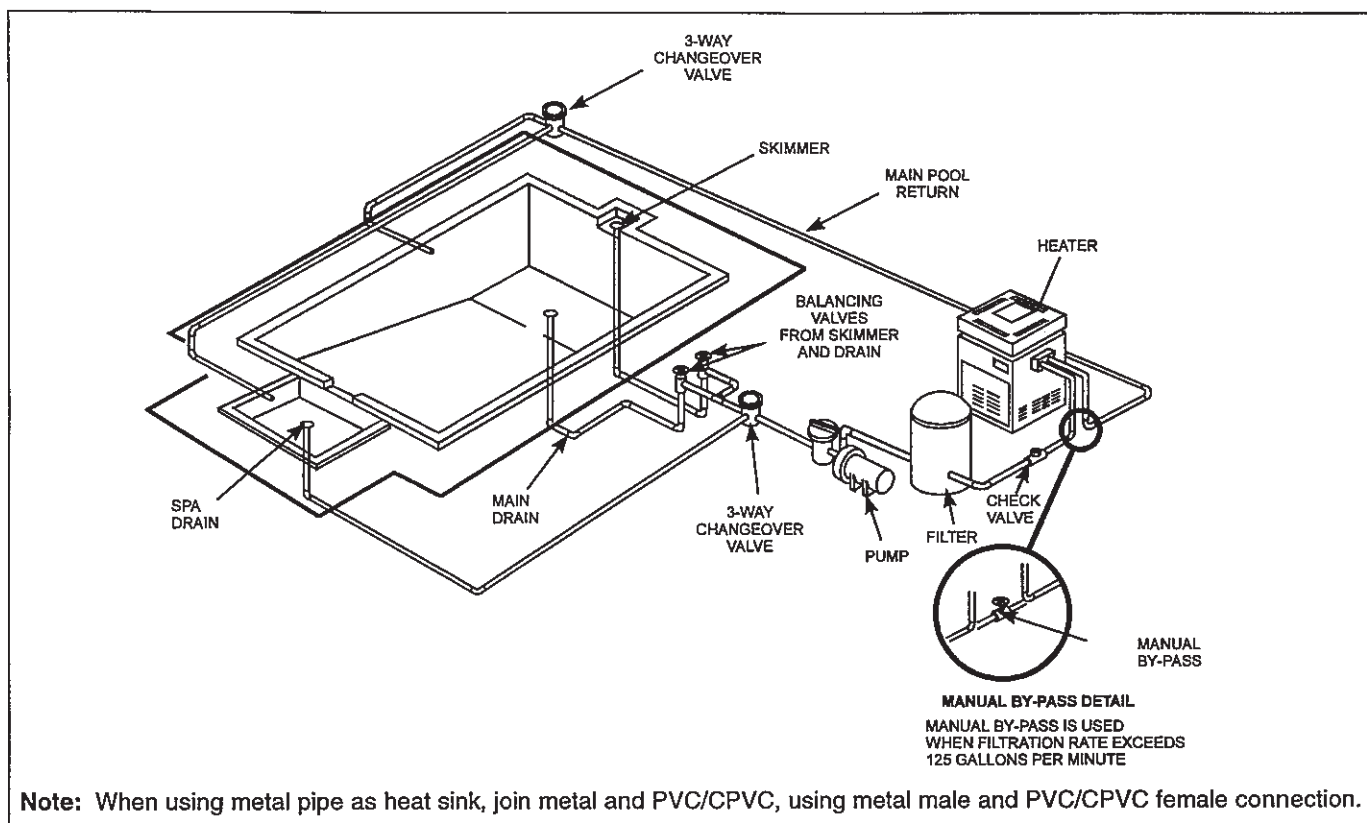


Figure 19. Typical installation.

2G-9. Adjusting the Manual Bypass Valve

After the manual bypass valve is installed, use the following procedures to adjust the bypass valve:

1. Clean pool filter.
2. Remove drain plug located on right-hand side of heater and replace it with a Pete's plug.
3. Insert a pocket thermometer (see Figure 16) through the Pete's plug into the header.
4. Close manual bypass valve.
5. Turn rotary switch to OFF position.
6. Repeat steps 6 through 12 of the temperature rise test (see Section 2G-8).
7. Open manual bypass valve until temp rise falls between the min. and max. range.
8. Once the temperature is within the correct range, safety wire handle of the manual bypass valve in place and tag valve to prevent change in the water low.

SECTION 3. Operating Instructions

3A. General Information

With any new pool or spa installation, operate the filter pump with the heater off long enough to com-

pletely clean the water. This will remove any installation residue from the water. Clean the filter at the end of this operation before starting the heater. When raising the temperature of a cold pool, remove all time clock settings. This lets the filter system and heater operate continuously until the water reaches the temperature setting on the temperature control. When that happens, the heater will automatically shut off, but the filter pump will keep running.

⚠ WARNINGS

Vent pipes, drafthoods, and heater tops get hot! These surfaces can cause serious burns. Do not touch these surfaces while the heater is in operation. Adding a vent cap reduces the temperature on the top.

For your safety, when starting the heater, keep your head and face well away from the lower firebox opening to prevent any risk of personal injury.

Keep all objects off the top of the heater. Blocking air flow could damage the heater, and may void the warranty.

3B. Lighting and Shutdown Procedures




3B-2. Model LLG (Standing Pilot)

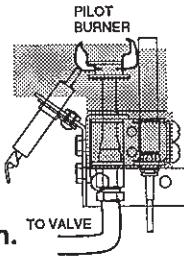
FOR YOUR SAFETY READ BEFORE OPERATING

⚠ WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

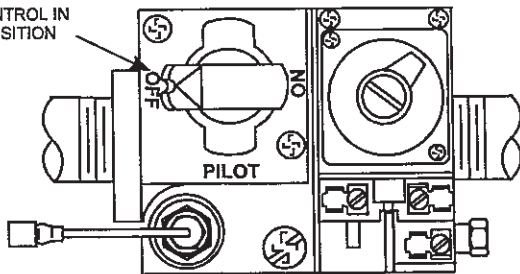
- A. This appliance has a pilot which must be lighted by a push button sparker. When lighting the pilot, follow these instructions exactly.
- B. **BEFORE LIGHTING**, smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.
- WHAT TO DO IF YOU SMELL GAS**
- Do not try to light any appliance.
 - Do not touch any electric switch; do not use any phone in your building.
 - Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not push in or turn by hand, don't try to repair it. Call a qualified service technician. Force or attempted repair may result in a fire or explosion.
- D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. **STOP!** Read the safety information above.
2. Set the thermostat to lowest setting and turn appliance ON/OFF switch to "OFF".
3. Turn gas control knob clockwise  until it stops at "OFF" position.
4. Wait five (5) minutes to clear out any gas. If you then smell gas, **STOP!** Follow "B" in the safety information above. If you don't smell gas go to the next step.
5. To find pilot—follow gas line from gas valve to pilot location.
6. Turn knob on gas valve counterclockwise  to "PILOT" then push control knob all the way and hold down.
7. Push the button of the sparker, repeating until confirming that pilot lights, by observing reflection on burner tray mirror.
8. Continue to hold the control knob down for about one (1) minute after the pilot is lit. If it goes out, repeat steps 3 through 8.
 - If knob does not pop out when released, stop and immediately call your service technician or gas supplier.
 - If the pilot will not stay lit after several tries, turn the gas control knob to "OFF" and call your service technician or gas supplier.
9. Turn gas control knob counterclockwise  to "ON".
10. After replacing control compartment access panel, set thermostat to desired setting and turn appliance ON/OFF switch to "ON". Valve has built-in delay before coming on.
11. If the appliance will not operate, check that the filter pump is on, that the filter is clean and water is flowing to the pool. Otherwise, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.




GAS CONTROL IN "OFF" POSITION



LLG Gas Valve

TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting and turn appliance ON/OFF switch to "OFF".
2. Turn gas control knob clockwise  until it stops at "PILOT". Then press down slightly on knob while turning clockwise  to "OFF". Do not force.

NOTE: If your LP tank runs out of fuel, turn off gas at the heater. After the tank is refilled, the heater must be re-lit following the instructions found on the inside of the heater. **DO NOT** attempt repairs on the gas control or heater. Tampering is dangerous and voids all warranties.

3C. Setting the Temperature Control

The temperature control (see Figure 17) is calibrated at the factory and covers a range from approximately 70 to 104°F (21 to 40°C). Use an accurate pool thermometer to determine the best water temperature for your uses.

The Laars Lite model LLD has dual temperature controls, which allows two different temperature settings, selected by the rotary switch in the middle of the panel. One control can be set for normal use and the other for standby; or one can be set for pool and the other for a spa. Placing the rotary switch in the middle turns off the heater (see Figure 17). The model LLG has only a single control and is set similar to the LLD above.

IMPORTANT: The temperature controls cannot be calibrated in the field. If the control is faulty, shut down the heater and have a qualified service technician replace the control. **DO NOT** use the thermostat switch to completely shut down the heater.

3D. Seasonal Care

3D-1. Spring and Fall Operation

During periods when the pool is only going to be used occasionally, turn the temperature control down to the MIN setting. This prevents the pool from becoming chilled, and minimizes the time required to raise the pool water back up to the desired temperature.

If the heater is not going to be used for a long period of time, shut it down completely. Follow the instructions found on the inside of the heater.

3D-2. Winterizing

In areas where freezing temperatures occur in winter, and the pool or spa will not be used, have your service technician perform the following steps:

1. Turn off the main gas supply valve to the heater, outside the heater jacket.
2. Remove heater door.
3. Shut down the heater following the shutdown instructions found on the inside of the heater.
4. Remove the drain plug from the return side (see Figure 20), loosen the drain plug from the inlet-outlet side, and completely drain the heater before the first frost.
5. After all water has drained from the heater, remove the drain plug from the inlet/outlet side. Check for mineral buildup in the openings.
6. Use compressed air to blow out any standing water remaining in the heat exchanger.
7. Grease the threads in the drain plugs and reinstall plugs, but do not tighten.
8. Disconnect the pressure switch copper tubing (see Figure 21).

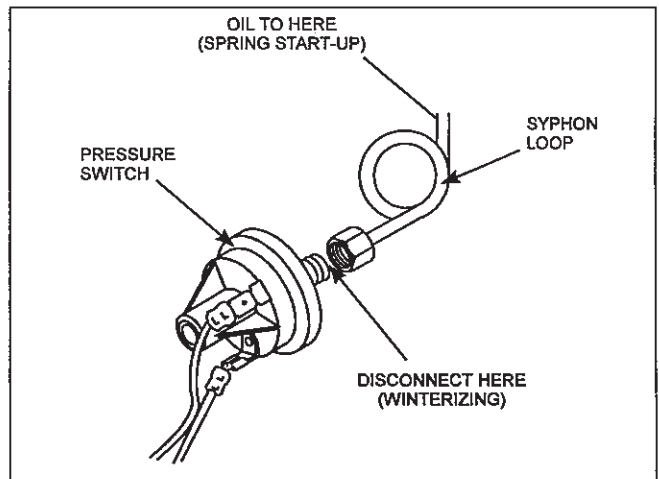


Figure 21. Pressure switch copper tubing.

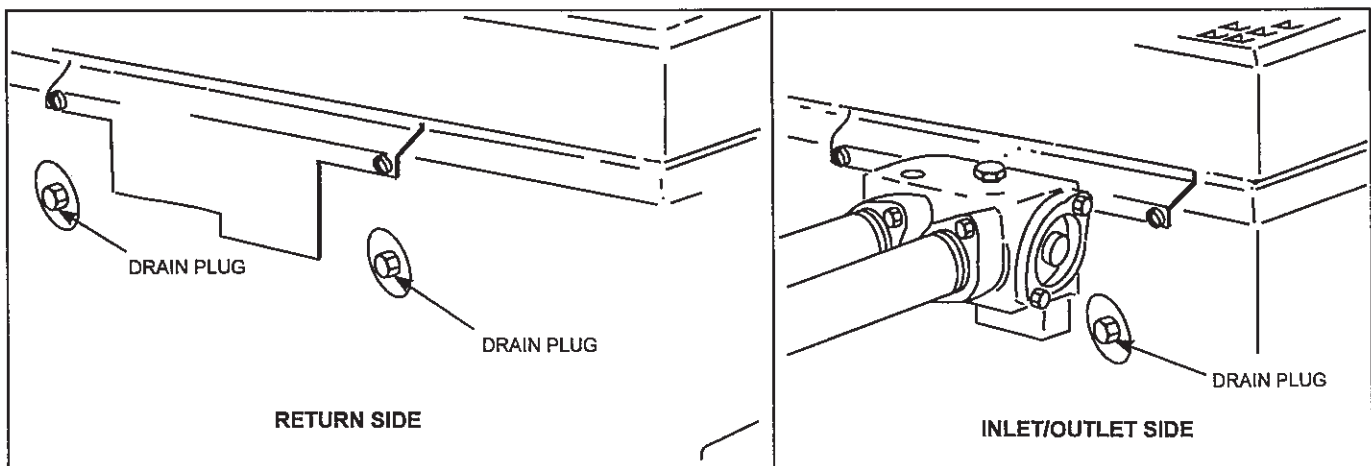


Figure 20. Heater drain locations.

3D-3. Spring Start-up

To restart the heater in the Spring, have a professional service technician reassemble the heater as follows:

1. Attach the copper tubing to the pressure switch and fill the loop with SAE 50, non-detergent oil (see Figure 21).
2. Tighten the drain plugs.
3. Turn on the main gas supply valve to the heater, outside the heater jacket.
4. Turn on the heater following the lighting instructions found on the inside of the heater.

3E. Water Chemistry

Proper chemical balances are necessary for sanitary bathing conditions as well as ensuring your heater's long life. Be sure to keep your chemical levels within the values indicated in Table 7. Teledyne Laars does not warrant heat exchangers damaged by corrosive chemical levels or excess dissolved solids in pool or spa water.

For spas, it is also necessary to perform water changes in addition to chemical treatment. It is recommended to change the spa water every 60 days for light usage and every 30 days if usage is heavy.

Table 7. Mineral Concentration Levels

Test	Recommended Level
Free chlorine	1.0 to 3.0 ppm
Bromine	3.0 to 5.0 ppm
pH	7.2 to 7.8
Total alkalinity (TA)	80 to 120 ppm
Calcium hardness (CH)	200 to 400 ppm
Langelier saturation index (LSI)	-0.5 to +0.5
Total dissolved solids (TDS)	Less than 2000 ppm
Cyanuric acid	30 to 150 ppm
Copper	0 ppm

3F. Spa/Hot Tub Safety Rules

WARNING

The following "Safety Rules for Hot Tubs," recommended by the U.S. Consumer Product Safety Commission, should be observed when using the spa.

1. Spa or hot tube water temperature should never exceed 104°F (40°C). One hundred degrees Fahrenheit (100°F [38°C]) is considered safe for a healthy adult. Special caution is recommended for young children.

2. The drinking of alcoholic beverages before or during spa or hot tub use can cause drowsiness which could lead to unconsciousness, and subsequently result in drowning.
3. **Pregnant women take note!** Soaking in water above 102°F (38.5°C) can cause fetal damage during the first three months of pregnancy (which could result in the birth of a brain-damaged or deformed child). If pregnant women are going to use a spa or hot tub, they should make sure the water temperature is below 100°F (38°C) maximum.
4. The water temperature should always be checked with an accurate thermometer before entering a spa or hot tub. Temperature controls may vary by as much as 4°F (-16°C).
5. Persons with a medical history of heart disease, diabetes, circulatory or blood pressure problems should consult their physician before using a hot tub or spa.
6. Persons taking any medication which induces drowsiness (e.g., tranquilizers, antihistamines, or anticoagulants) should not use spas or hot tubs.
7. Prolonged immersion in hot water can induce hyperthermia.

Hyperthermia occurs when the internal body temperature reaches a level several degrees above the normal body temperature of 98.6°F (37°C). Symptoms include dizziness, fainting, drowsiness, lethargy, and an increase in the internal body temperature. The effects of hyperthermia include:

- Lack of awareness of impending hazard
- Failure to perceive heat
- Failure to recognize need to leave spa
- Physical inability to leave spa
- Fetal damage in pregnant women
- Unconsciousness resulting in a danger of drowning

3G. Swimming Pool Energy Saving Tips

Teledyne Laars offers the following recommendations to help conserve fuel and minimize the cost of operating your pool heater without sacrificing comfort.

1. The American Red Cross recommends a maximum water temperature of 78°F (25°C). Use an accurate pool thermometer. A difference of 4 degrees, from 78 to 82°F (25 to 28°C), will use as much as 40% more gas.

2. Carefully monitor the water temperature of your pool in the summertime. You can reduce heater usage due to warmer air temperatures.
3. Find the proper setting on the pool heater temperature control and use the TEMP-LOK to discourage further adjustments.
4. Set the filter time clock to start the pump no earlier than 6:00 AM during the pool heating season. This is the time when nightly heat loss balances.
5. If the pool is only going to be used on weekends, reduce the heater temperature control setting by 8 or 10 degrees during the week. Reset it to the 78°F (25°C) level a day or so before you plan to use the pool.
6. During the winter or when on vacation for longer than a week, shut down the heater by following the shut-down instructions found on the inside of the heater.
7. Where possible, shelter the pool from prevailing winds with well-trimmed hedges or other landscaping, cabanas, or fencing.
8. Always use a pool cover when practical. Besides providing a valuable safety feature, a pool cover will reduce heat loss, conserve chemicals, and reduce the load on filter systems.
4. If the heater is equipped with a pressure relief valve, check for corrosion and make sure that water runs freely through it. If corrosion is found, replace the pressure relief valve.
5. Be sure all combustion air and ventilation openings are not blocked.

3H-2. Professional Inspection

In addition, annual inspections by a qualified professional technician are recommended to keep the heater operating safely and efficiently through the years. The following basic checks should be performed.

1. Check for loose or broken wires and terminal connections.
2. Verify pressure switch operation by cycling the spa pump on and off a few times. The heater should go off immediately after the pump stops.
3. Inspect the electrical controls, specifically the following:
 - a. High limit controls.
 - b. Pressure switch.
 - c. Temperature control.
 - d. Automatic gas valve.
4. Inspect the venting system for blockage, leakage, and corrosion.
5. Check for spider webs in the pilot and main burner orifices — especially at Spring startup.
6. Conduct a normal operating cycle and observe that the sequence proceeds as intended.
7. Inspect the external surfaces of the heat exchanger tubes for black carbon soot buildup by placing a mirror between and under the burners when the heater is firing. Remove any soot that has collected on the tubes, and correct the cause.

NOTE: After installation and first startup, check the heat exchanger for black carbon soot buildup after the following periods of operation: 24 hours, 7 days, 30 days, 90 days, and once every 6 months thereafter.

Proper flames appear:

- a. Blue in color.
- b. 1 to 4 inches (25 to 102mm) high above burner surface.

3H. Periodic Inspection

WARNING

Improper installation or maintenance can cause nausea or asphyxiation from carbon monoxide in flue gases which could result in severe injury, or death.

3H-1. Owner Inspection

Teledyne Laars designs and constructs the Laars Lite heater to provide long performance life when installed and operated properly under normal conditions. The following basic guidelines are suggested for your inspection:

1. Keep the top and surrounding area of the heater clear of all debris.
2. Keep the heater area clean and free of all combustible materials, flammable liquids and vapors, as well as sanitization chemicals.
3. Do not use the heater if any part has been under water. Immediately call a qualified professional technician to inspect the heater and replace any part of the control system which has been submerged.