Service Manual for NEOTHERM®

Modulating Boiler
Model NTH
Sizes 399-850 MBTU/h

Water Heater
Model NTV
Sizes 399-850 MBTU/h

Every reference that you'll need, to service the ***Commercial NEOTHERM***

LAARS®
Heating Systems Company
A subsidiary of BRADFORD WHITE® Corporation

How to Use This Manual

How to Use the Troubleshooting Information

This manual is divided into five main sections:

Section A - Troubleshooting Instructions

Section B - Troubleshooting Procedures

Section C - Combustion

Section D - NeoTherm Control System

Appendix

Start the troubleshooting process using the charts in Section A. The instructions in Section A will lead you to more detailed procedures in Section B.

Section C covers possible combustion problems and the combustion setup procedure.

For details on the User Interface used on your unit, see Section D.

If the unit presents a Hold or Lockout message, you can get more information from the listing in the Appendix.

Contact Laars Technical Support if you can't diagnose the problem using the information in this manual:

LAARS Product Support

Phone: (800) 900-9276
(603) 335-6300

Fax: (800) 335-3355

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Safety Notes

Please read this section before beginning any troubleshooting procedures.

DANGER

If the information in this manual is not followed exactly, a fire or explosion may result, causing loss of life, personal injury, or property damage.

Necessary Training -

This product must be installed and serviced by a professional service technician, qualified and/or licensed in hot water boiler and heater installation and maintenance. Any changes to safety-related configuration parameters must only be done by qualified and/or licensed burner/boiler operators and mechanics.

Carbon Monoxide Hazard -

Improper installation and/or operation could create carbon monoxide gas in flue gases which could cause death, serious injury, or property damage. Improper installation and/or operation will void the warranty.

Fire or Explosion Hazard -

Improper configuration can cause fuel buildup and explosion. Improper user operation may result in death, severe physical injury, or property damage. Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

What to Do If You Smell Gas -

If any odor of gas is detected, or if the gas burner does not appear to be functioning in a normal manner, ***close the main gas shutoff valve***. The inlet gas pressure to the appliance must not exceed 13” w.c. (3.2 kPa).

- Do not try to light any appliance.
- Do not touch any electrical switch. Do not shut off the power switch. Do not use any phone in your building.
- Immediately call your gas supplier from a nearby phone. Follow the gas supplier’s instructions.
- If you cannot reach your gas supplier, call the fire department, your heating contractor, gas company, or factory representative.

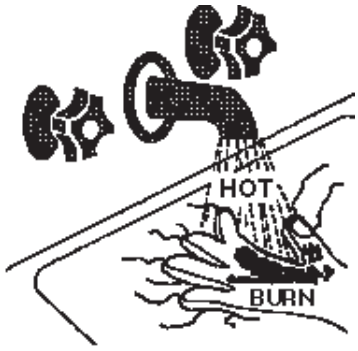
Electrical Shock Hazard

Electrical shock can cause severe injury, death or property damage. Only a professional technician, trained in electrical safety, should work on this unit. Whenever the troubleshooting procedures make this possible, turn off the power to the unit before working inside the cabinet. The only exceptions would be when it is necessary to test the voltages between the points listed in this manual. 120V AC is present in this unit behind the metal cover marked with the safety label. Be especially careful when working on the unit if this cover has been removed. Always replace the cover when the service procedure is complete. Before making any changes, disconnect the power supply to prevent electrical shock or damage to the equipment. It may be necessary to turn off more than one power supply disconnect.

All electrical wiring is to be done in accordance with local codes, or in the absence of local codes, with: 1) The National Electrical Code ANSI/NFPA No. 70 - latest Edition, or 2) CSA STD. C22.1 “Canadian Electrical Code - Part 1.” This appliance must be electrically grounded in accordance with these codes.

Hot Water -

This unit can produce water which is hotter than 125°F (52°C). This can cause severe burns instantly or death from scalding. Always shut off the system and allow it to cool for one hour before opening any pipe connections that may contain hot water.



Children, disabled and elderly persons are at the highest risk of being scalded. See the Installation and Operating manual for instructions before setting the temperature at the NeoTherm unit.

For NTV units - Adjust the outlet control (limit) or use temperature limiting valves to obtain a maximum water temperature of 125°F (52°C). Instruct all users to feel the water temperature before getting into the bath or shower.

The NeoTherm unit is protected against over-pressurization. A pressure relief valve is included with each NeoTherm unit.

Installation Codes -

All installations must be made in accordance with 1) American National Standard Z223.1/NFPA54-Latest Edition “National Fuel Gas Code” or 2) CSA B149.1 “Natural Gas and Propane Installation Code” and with the requirement of the local utility or other authorities having jurisdiction. Such applicable requirements take precedence over the general instructions contained in this manual.

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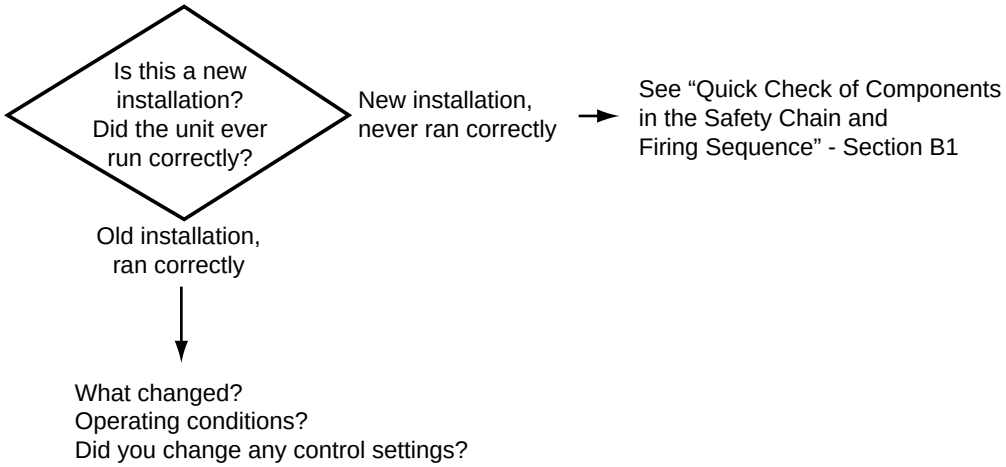
Troubleshooting - Start Here

A1



For troubleshooting instructions, see these sections:

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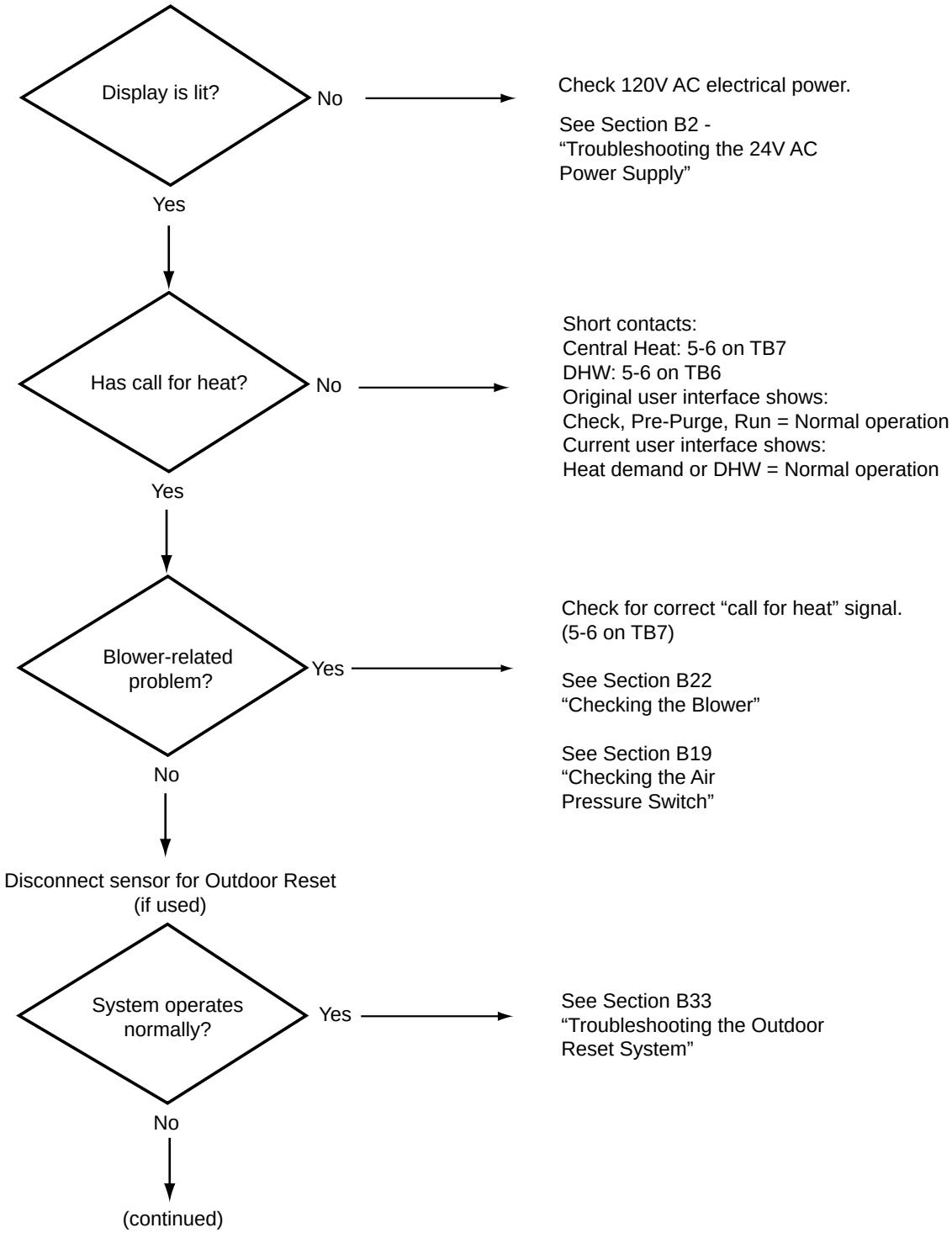
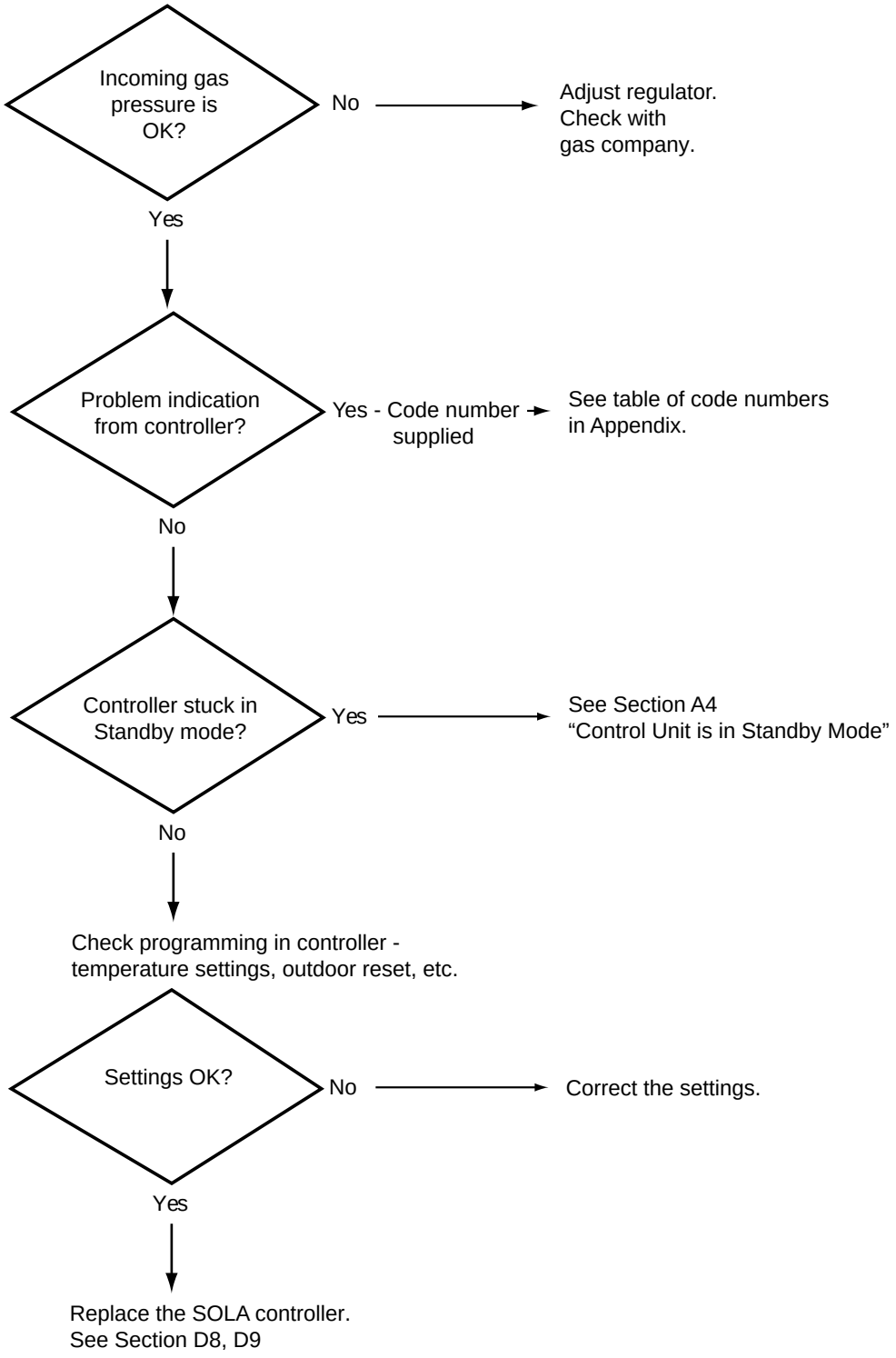
A2 Unit Will Not Fire - Blower is Not Running

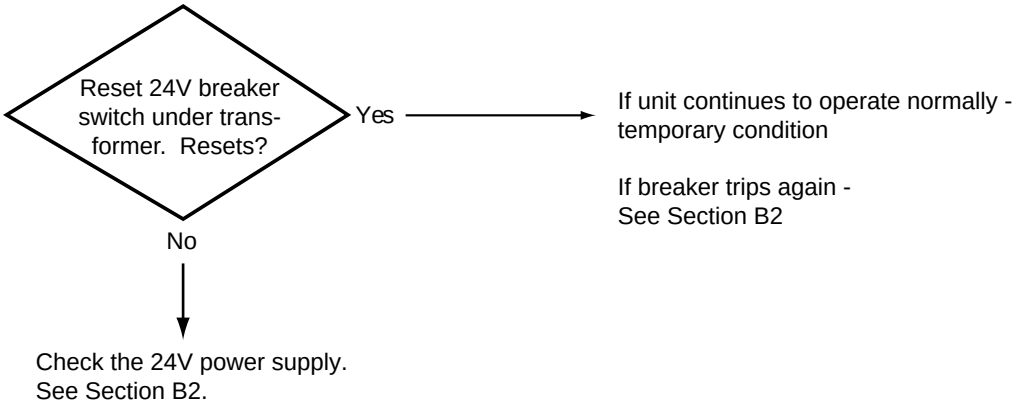


Unit Will Not Fire - Blower is Not Running



A3 Blower Runs Continuously, No Display

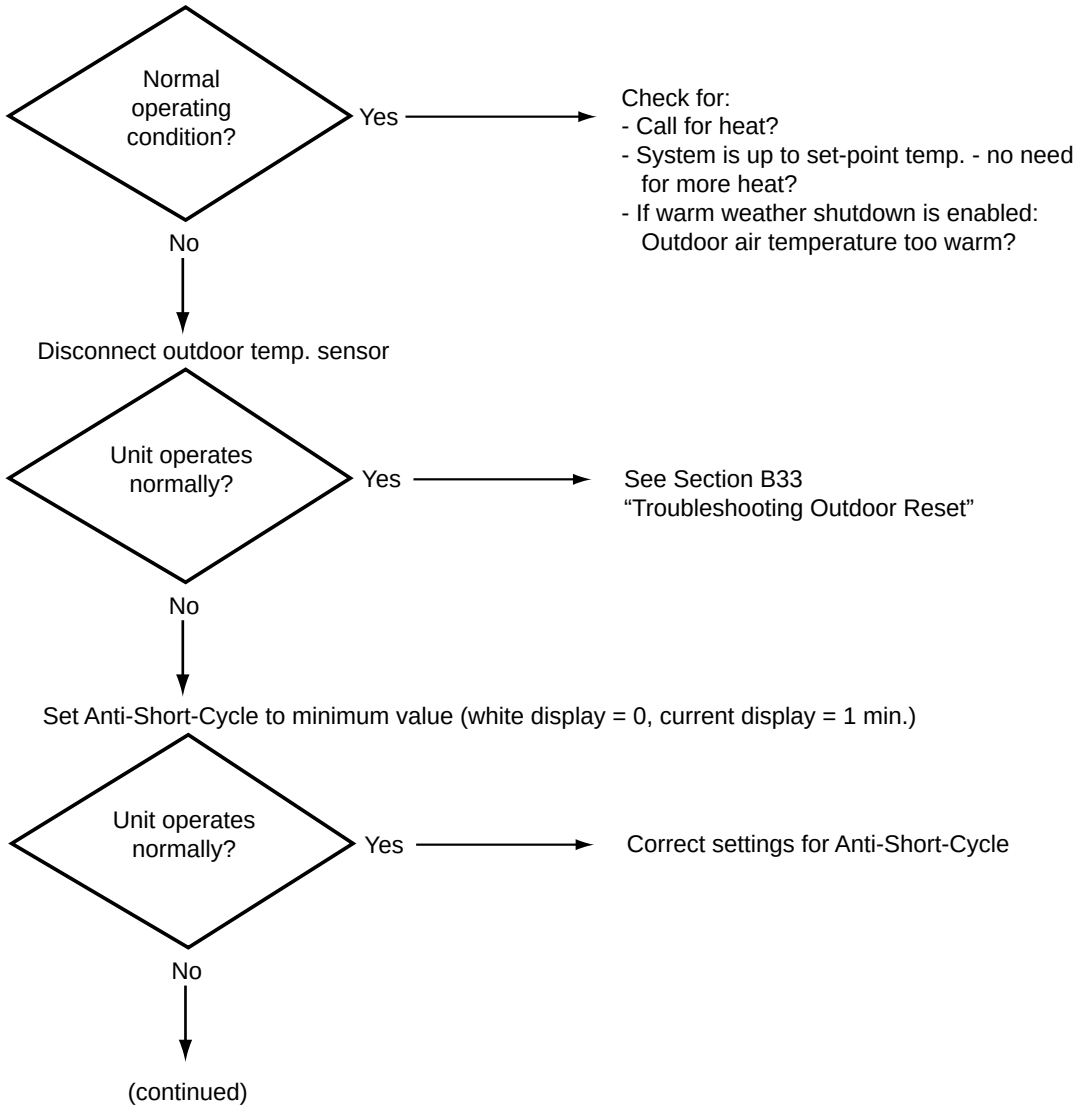
In this condition, the blower is running continuously, but the display is completely blank.



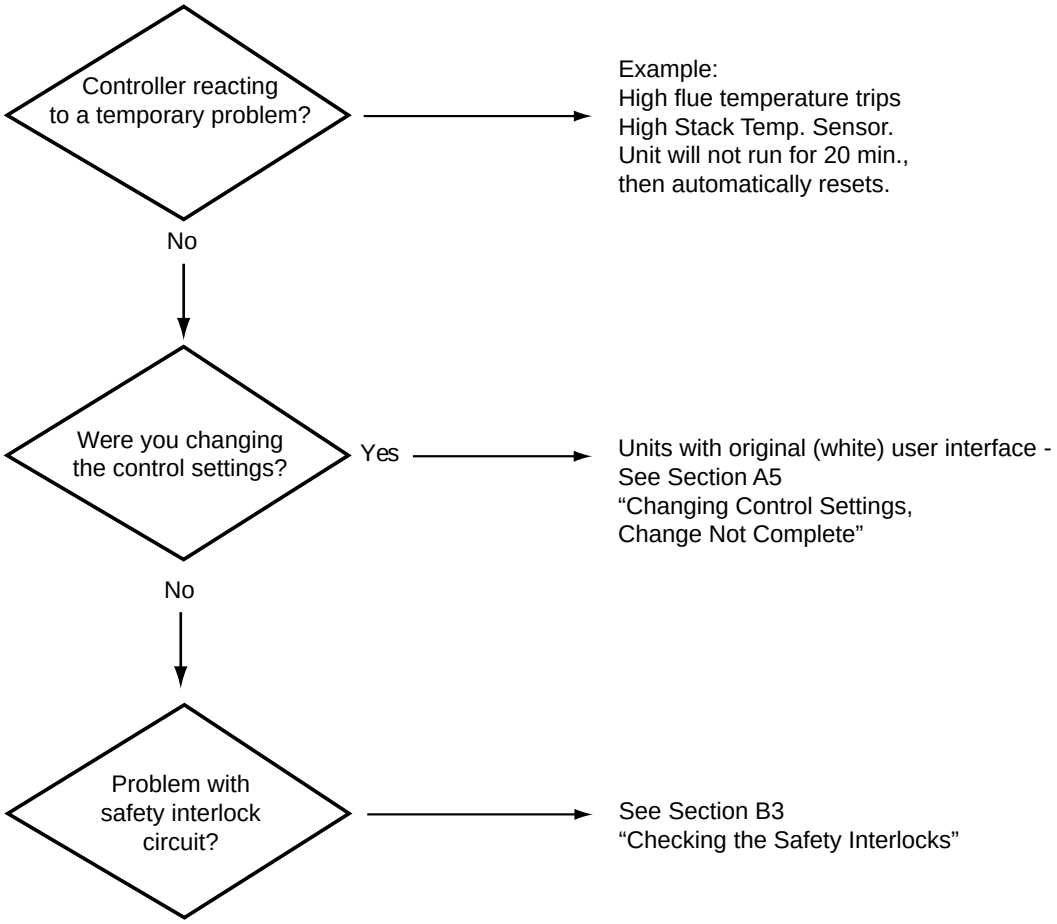
Control Unit is in “Standby” Mode

A4

In certain situations, the controller on this unit can go into “Standby” mode. The Boiler pump is running, so the unit sees a “Call for heat.” There is no lockout or hold, but something is preventing it from going to “Run” mode.



A4 cont. Control Unit is in “Standby” Mode (continued)



Changing Control Settings, Change Not Complete Original (White) Interface

A5

NeoTherm units were produced using two types of user interfaces. (See Section D1 to identify the kind of interface used on your unit.) These instructions apply to units with the original (white) user interface.

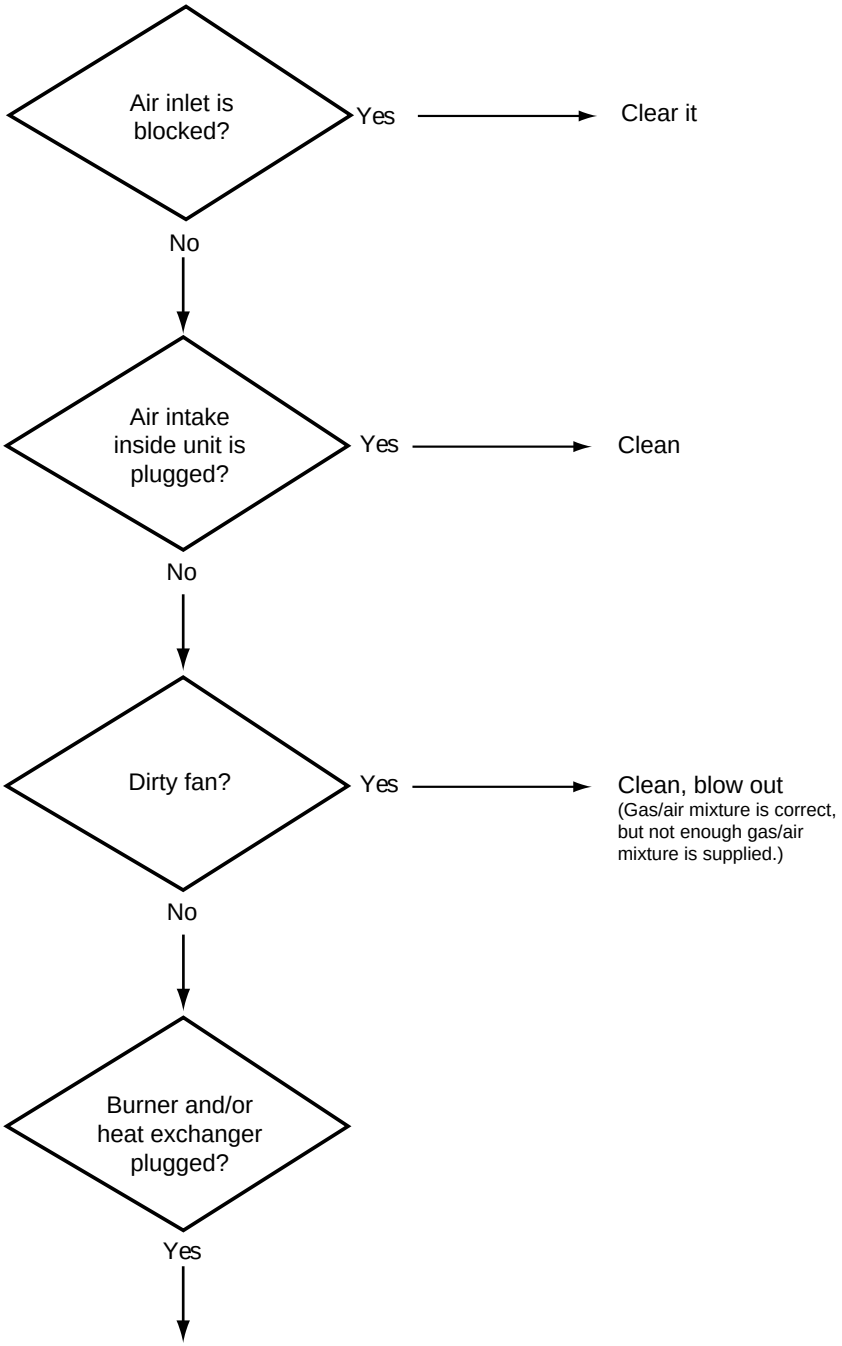
In certain situations, the controller used in this unit can go into a “Stand-by” mode. There is no lockout or hold, but the unit still will not run.

This can happen if you begin to change one of the control settings, but do not finish the process. For example, let’s say you want to change the DHW setpoint from 180° to 175°. You use the menus to go to the item for the DHW setpoint, then enter the new number – “175.” At this point, you are supposed to press the Done button to send the new setting to the controller. However, if you do not press Done or OK, the controller will go into the Standby mode. The setting for the DHW setpoint will remain at the old setting (180°), because at this point the controller still has not received the new setting. More importantly, the unit will not fire because it is still waiting for that new setting. There is no indication of this on the User Interface.

To recover from this, you need to return to the point where you were making the change, and enter the new setting again. In this case, you would step through the menus until you returned to the item for the DHW setpoint. Enter the new number again (175°), then press Done. At that point, the controller will leave the Standby mode, and the unit should begin operating normally.

In order to troubleshoot this kind of situation, ask yourself, “What was I just doing?” Were you trying to change a control setting? Which one? You probably need to return to that setting, enter the new value again, then remember to press Done.

A6 Unit is Running, But Building is Still Cold

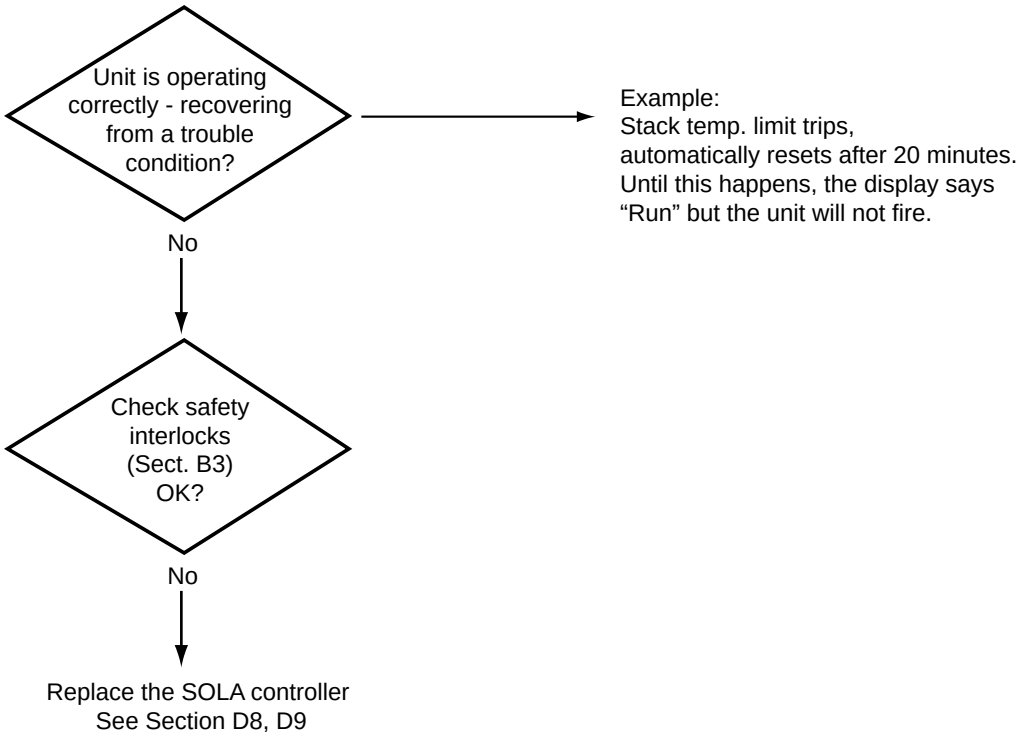


See “Cleaning the Burner and Heat Exchanger” Section C5

Control Unit Says “Run,” But Boiler is Not Firing

A7

In this condition, the panel is lighted, so you know the unit has power. The Boiler pump is running, so you know the unit is receiving the call for heat. The blower is running, the unit has spark, and the gas valve is operating correctly.



Open Safety Chain - Fault #63

A8

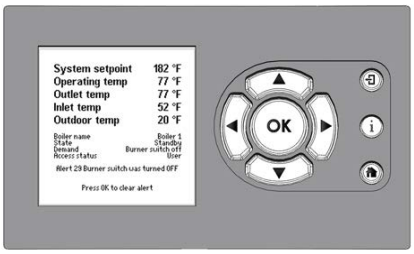
This fault indication can point to several different problems:

- Blocked condensate drain
- Blocked exhaust vent
- High or low gas pressure
- Low water in system
- Problem with circulator pump

Fault #63 is a bit like the “Check Engine” light in a car - it indicates a problem, but does not identify the problem. To identify the specific problem, see Section B3 - “Checking the Safety Interlocks.”

A9 Unit Runs in High or Low Fire Only

On systems using the Current user interface –



To see if the unit is locked into high fire or low fire -

From the Home screen, press “i” to go to the “Info/Install” screen. Highlight “Test” and press “OK.” In the Test menu, highlight “Manual Burner Operation” and press “OK.” Be sure “Firing Control” is set to “Auto.” If it is not, log in using the password “Int”, and change the setting to “Auto.”

A10 Unit is Noisy

On systems using anti-freeze –

This can occur if the concentration of anti-freeze is too high. At concentrations above 35%, localized boiling can occur, and this can produce noise.

Quick Check of Components in the Safety Chain

B1

This procedure gives you a quick way of checking the safety switches and some of the control functions in the unit. This will allow you to rule out some large sections of the control system, and find the part of the system that actually has the problem.

DANGER! - When the cover is opened, some of the areas carrying 120V AC voltage will not be covered. Do not perform the following tests unless you have been trained how to do this safely by Laars.

1. Remove the front panel assembly and front bezel.
2. Before you start troubleshooting, you should disconnect some parts of the system to make the troubleshooting simpler. If a sensor for the Outdoor Reset function is connected, disconnect it at terminals 1 and 2 on TB-7 on the control board. See Fig. B1-1. (Remember to re-connect the sensor when you are done.)

   If the unit operates with the Outdoor Reset sensor disconnected, go to Section B33 - "Troubleshooting the Outdoor Reset System."
3. Turn off the Anti Short Cycle function by setting it to the minimum value.
4. If you are working with a boiler which can produce both hydronic heat and domestic hot water, work with just one function at a time. This will make it clear whether the "call for heat" is coming from the hydronic side of the system or the DHW side.
5. Insert a jumper across terminals 5 and 6 on TB-7 on the control board. See Fig. B1-2. This will create a permanent "call for heat" signal. (Again, remember to remove this when you are through.)

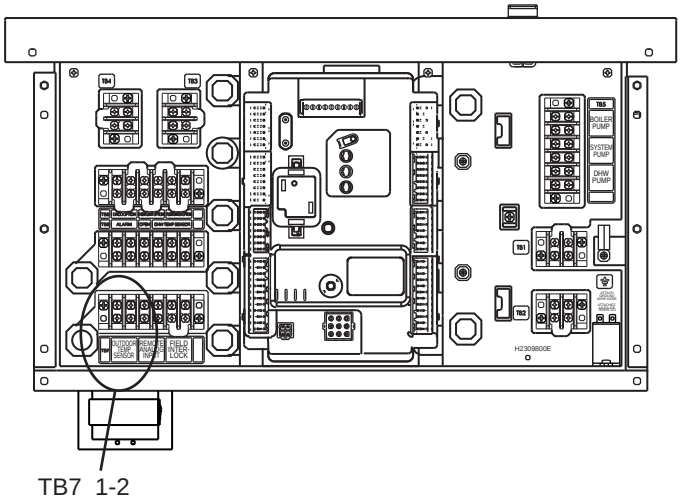


Fig. B1-1 - Terminals for outdoor reset

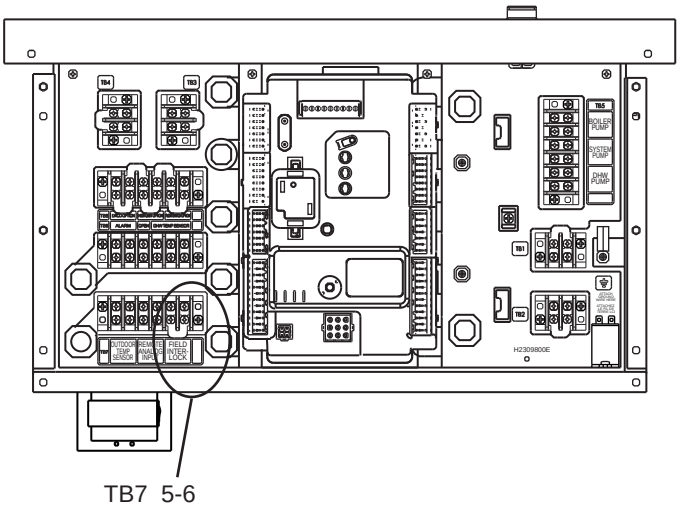


Fig. B1-2 - Simulating a "call for heat" input

Quick Check of Components in the Safety Chain - continued

6. If this unit is set up to use a separate DHW signal –

   Insert a jumper across terminals 5 and 6 on TB-6 on the control board. See Fig. B1-3. This will create a permanent “Call for DHW” signal. (Again, remember to remove this when you are through.)

7. Turn on power to the unit.

8. Check for 24V AC between terminal blocks TB-3 and TB-4. See Fig. B1-4. If 24V AC is present here, this means that the unit is getting line voltage, and the main power switch and transformer are working correctly.

   If 24V AC is not present, go to Section B2 - “Troubleshooting the 24V AC Power Supply.”

9. Connect a volt-meter between TB4-1 and TB8-1. See Fig. B1-5. If 24V AC is present here, this means that the safety interlocks are connected (or jumpered out), and the switches are closed, allowing the unit to fire when a “call for heat” arrives. If you see 24V AC here, this means that the following safety interlock switches are OK:
   - Low water cutoff switch
   - High water temperature limit switch
   - Flow switch

   If 24V AC is not present, go to Section B3 - “Checking the Safety Interlocks.”

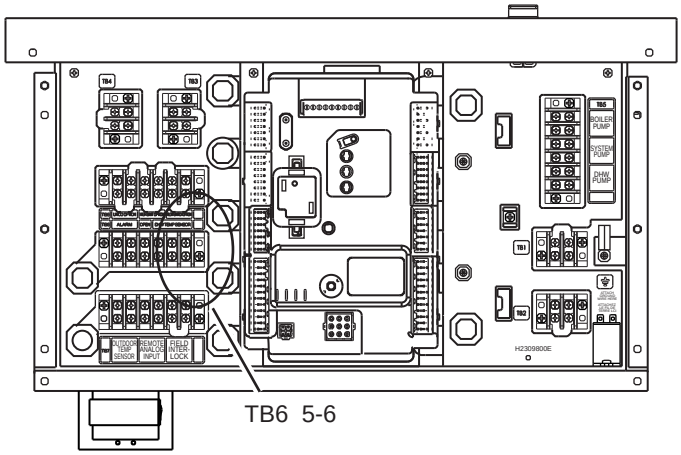


Fig. B1-3 - Simulating a “Call for DHW” input

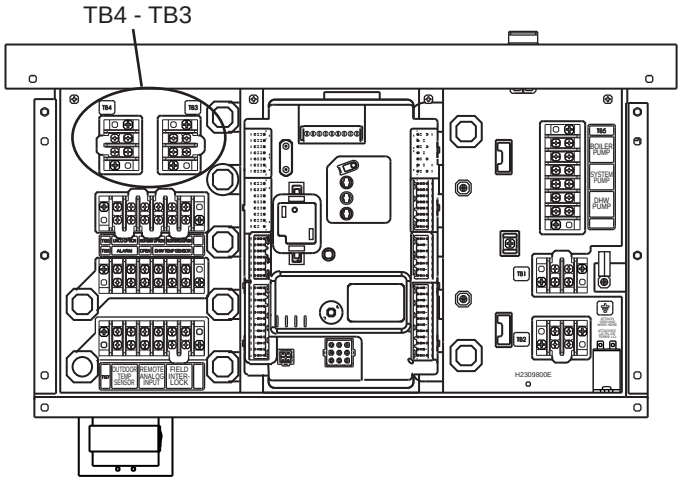


Fig. B1-4 - Check for 24V AC between TB4 and TB3

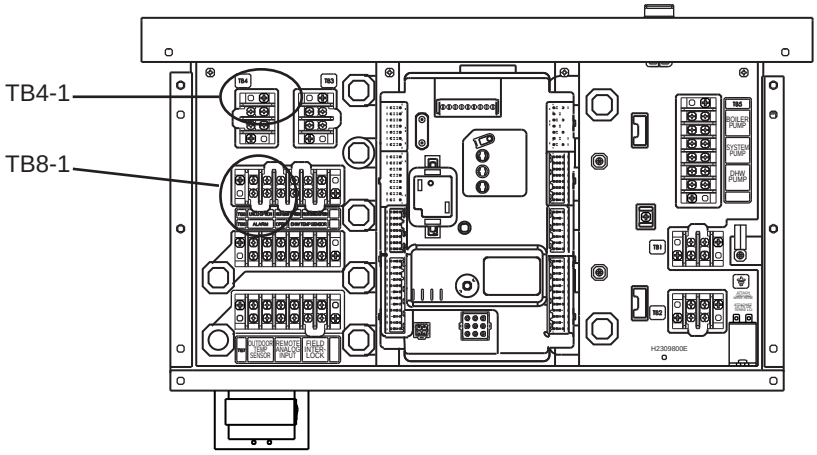


Fig. B1-5 - Check for 24V AC at TB8-1

10. Check for 24V AC between terminal J6-1 on the control module and any terminal on TB4. See Fig. B1-6. If 24V AC is present here, this means that the following safety switches are OK:
    - High gas pressure switch
    - Low gas pressure switch
    - Condensate trap level switch

    If 24V AC is not present, troubleshoot the three components:
    - Section B12 - High Gas Pressure Switch
    - Section B13 - Low Gas Pressure Switch
    - Section B16 - Condensate Trap Level Switch

11. If you see 24V AC at J6-1, this means that all of the switches in the safety chain are satisfied. The blower should run, and then the pressure switch should close, allowing the ignition sequence to start. To check the pressure switch, check for continuity (no resistance) between terminal 1 on J6 and terminal 1 on J5 on the control module. See Fig. B1-7.

    If the pressure switch remains open, go to Section B19, “Checking the Air Pressure Switch.”

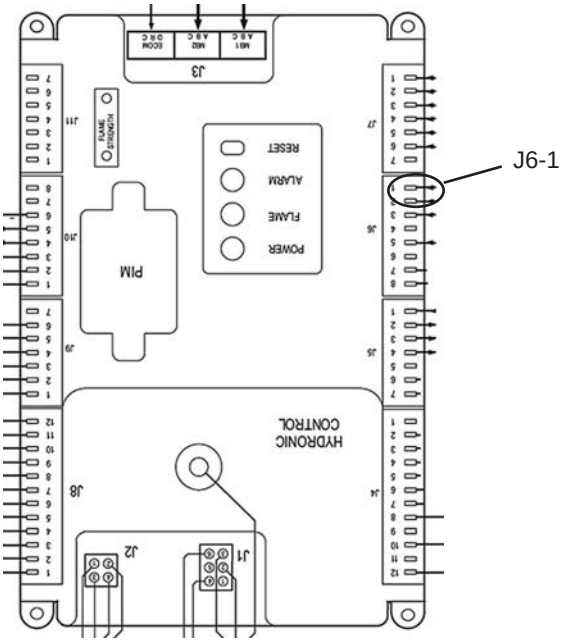


Fig. B1-6 - Checking the safety switches

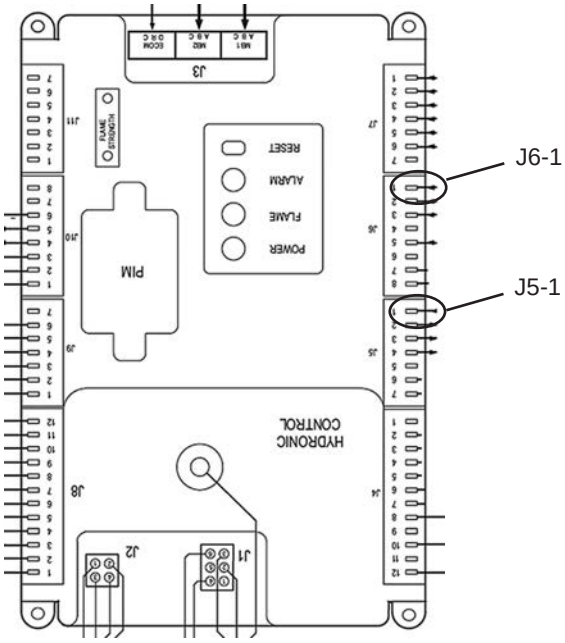


Fig. B1-7 - Checking the safety switches

Quick Check of Components in the Safety Chain - continued

12. If the unit is receiving a “call for heat,” and all of the safety switches are OK, the blower should be receiving control voltage through J2 on the control module. See Fig. B1-8.
    - If power is available at J2, but the blower is not running, go to Section B22 - “Checking the Blower.”
    - If the blower is running, and the unit does not fire, go to Section B32 - “Testing the Temperature Sensors.”

13. Replace all of the wiring you changed earlier:
    - Remove the jumper for the “call for heat” – TB7 5-6)
    - Reconnect the outdoor temperature sensor (TB7 1-2)
    - Reset the Anti-Short Cycle setting
    - If DHW is connected – Remove the DHW jumper (TB6 5-6)

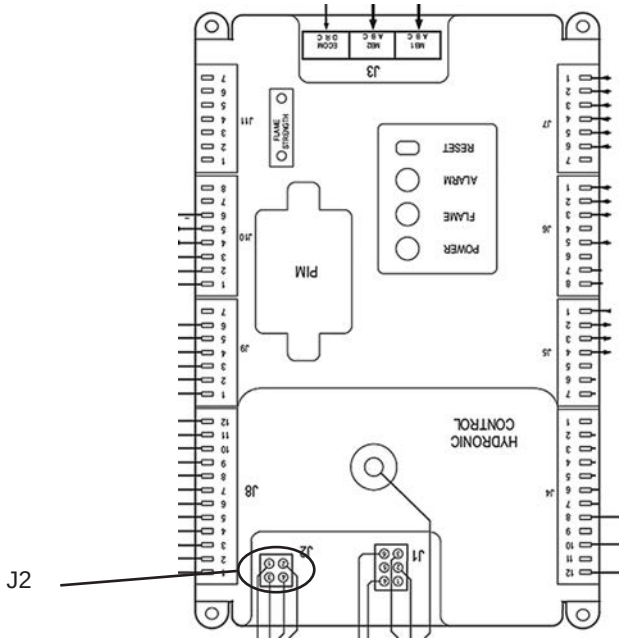
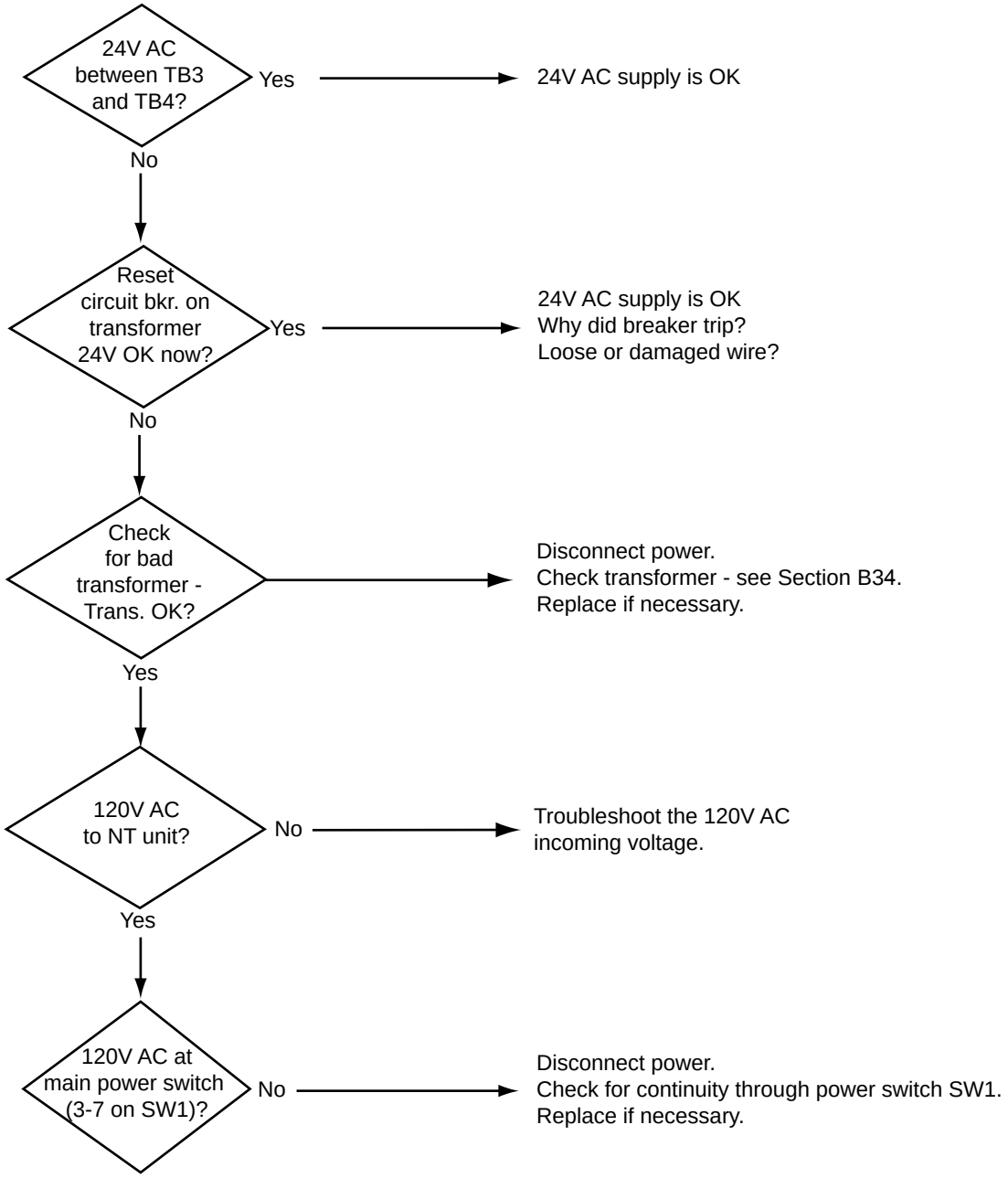
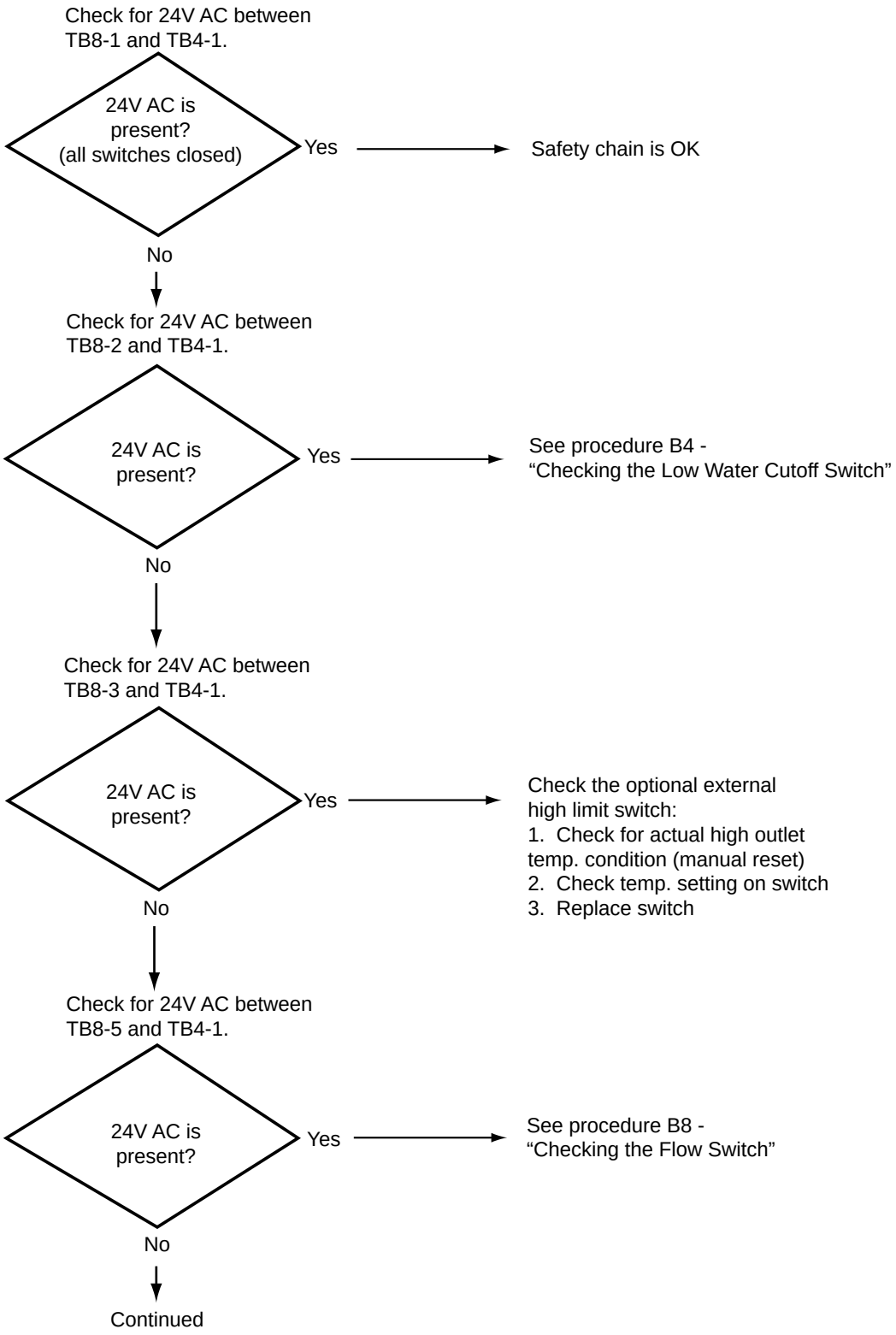


Fig. B1-8 - Control voltage for the blower

Troubleshooting the 24V AC Power Supply



B3 Checking the Safety Chain



Checking the Safety Chain - continued

Check for 24V AC at terminal J6-1.

24V AC is present? (other safety switches closed)

No → See procedure B16 - "Checking Condensate Trap Level Switch"

Yes ↓

With boiler attempting to run, check for 24V AC across two leads on air pressure switch.

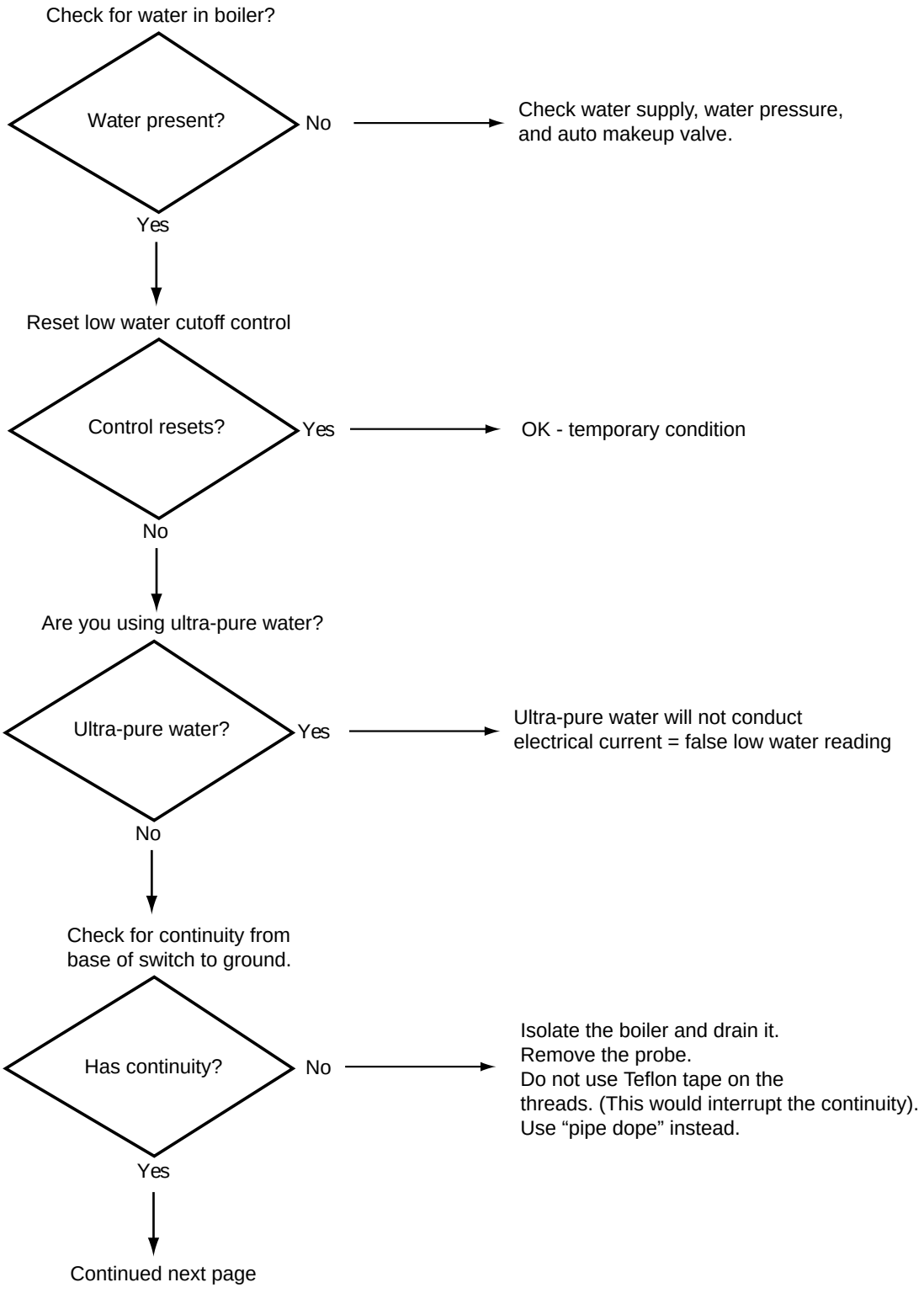
24V AC is present? (switch open)

Yes → See procedure B19 - "Checking the Air Pressure Switch"

No ↓

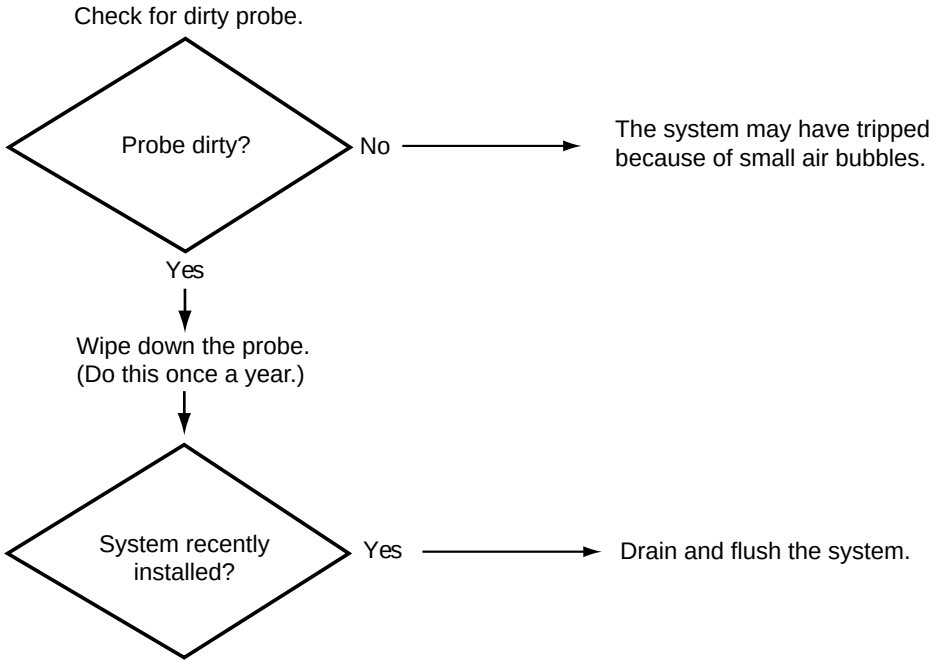
NT unit should be trying to fire. If not firing, control panel should be displaying an error code. See Error Codes in Appendix.

B4 Checking the Low Water Cutoff Switch (option)



Checking the Low Water Cutoff Switch (continued)

B4 cont.



Controller for Low Water Cutoff

B5

The low water cutoff switch operates by passing a slight electrical current between from a probe to ground when water is surrounding the probe. If there is no water, there is no current, and the controller knows that the water level has dropped.

The low water cutoff controller is shown in Fig. B5-1 The controller has two LED indicators:

- Power (red) – When lighted, the control box has power.
- Tripped (yellow) – When lighted, the controller has detected a low water condition.

The controller also has two switches:

- Reset – Use this to cancel the “trip” condition.
- Test – This simulates a “low water” condition.

See “Removing and Replacing the Low Water Cutoff Switch,” Section B6.

Fig. B5-1 - Controller for low water cutoff

B6 Removing and Replacing the Low Water Cutoff Controls

The low water cutoff (LWCO) is designed to shut down the unit if there is a low water condition. The control includes two parts: a control box, and a probe which reaches into the water piping.

Tools and equipment required:

- Small Phillips-head screwdriver (#1)
- Two medium-sized pipe wrenches or adjustable wrenches
- 5/16” socket

Fig. B6-1 - Removing the probe for the low water cutoff

Procedure - Removing or replacing the probe

1. Turn off power to the system. Use the main disconnect switch on the front panel.
2. Isolate the boiler. Turn off the water shutoff valves located upstream and downstream of the unit.
3. Drain the boiler.
4. Unlock and open the front panels on the unit. Turn the two wingnuts and swing out the center electrical panel. Now you will have easy access to the probe, as shown in Fig. B6-1.
5. Disconnect the probe wire and the ground wire.
6. Use two pipe wrenches to unscrew the probe assembly. Turn the probe assembly counter-clockwise to loosen it.
7. To reassemble, reverse the procedure we have just described. Keep these points in mind as you do this:
   - Use pipe dope on the threads on the probe assembly.
   - Be sure the wiring connections are tight.

Procedure - Replacing the control box

1. To remove the cover, remove the two sheet metal screws on the sides.
2. Disconnect the three wires on the terminal strip, and the violet wire that runs to the connector above the terminal strip. See Fig. B6-2.
3. The control box is attached to the backing plate by two sheet-metal screws with large heads. See Fig. B6-3. One of these holds the green ground wire. Use the 5/16” socket to loosen both of these. Remove the green ground wire from the left-hand screw. Twist the box slightly and pull it away from the backing plate.
4. To reassemble, reverse the procedure we have just described. Remember to attach the green ground wire to the inner sheet metal screw (5/16” head).

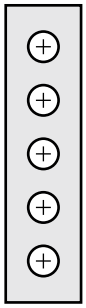


Fig. B6-2 - Connections to low water cutoff control

Fig. B6-3 - Control for low water cutoff with cover removed

B7 High Water Temperature Limit Switch (optional)

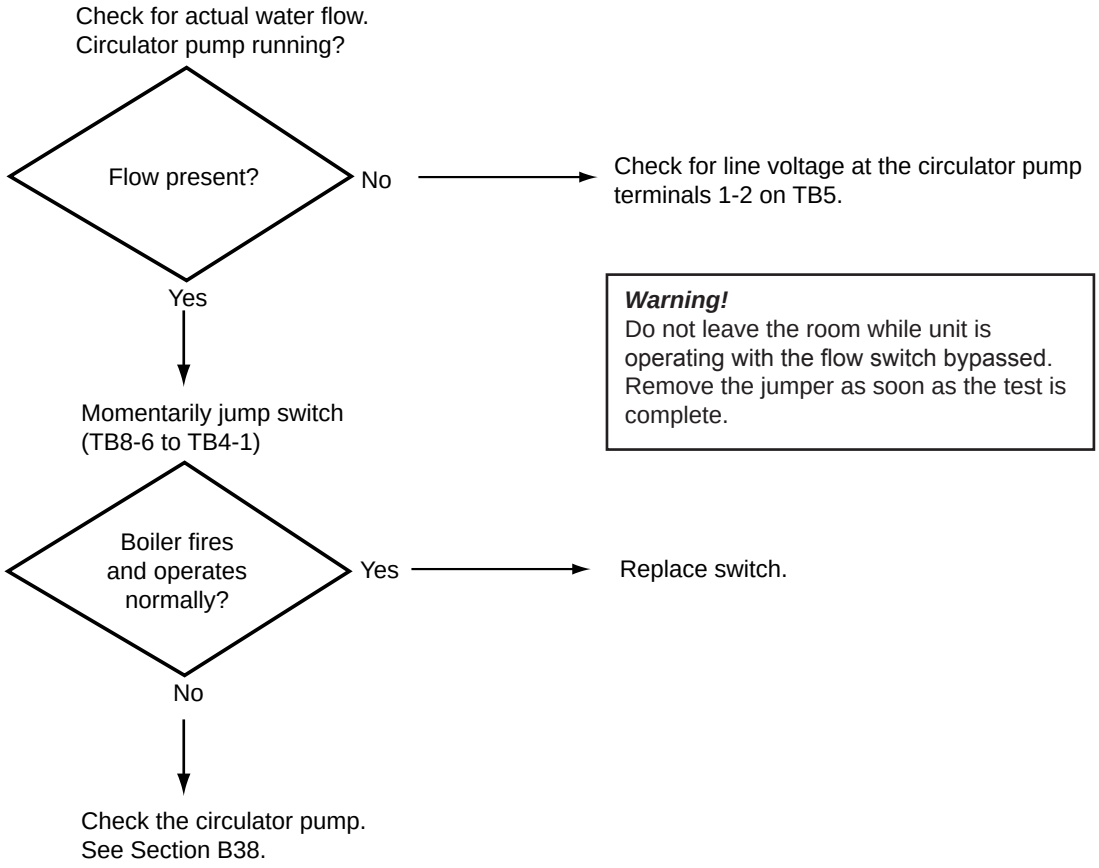
Laars does not provide this switch. It is installed only where required.

This is a normally-closed (NC) switch. If the water temperature rises above the pre-set limit, the switch opens.

Some types of switches must be reset manually. To reset this type of switch, press the button on the control. Other switches will reset automatically.

Correct the cause of the problem and/or replace the switch.

B8 Checking the Flow Switch (optional)



Testing the Flow Switch

The flow switch uses a set of paddles to sense water flowing through the system. See Fig. B9-2. When water is flowing, the switch is normally closed (N.C.). If the water flow stops, the switch opens. After a “no flow” condition, the switch resets itself immediately and automatically.

Shut off power to the boiler, and remove the cover on the switch. Use a volt-ohmmeter to test the continuity through the switch. With no water flow and the paddles in the “relaxed” position (standing upright), the switch should be open.

Note - There is a seal at the base of the paddle assembly. If this seal fails, it can allow water to leak into the connection box. From there, the water can flow through conduits to other parts of the control system in the Magna-Therm unit.

If it is necessary to replace the flow switch, see Section B10 for instructions.

Fig. B9-1 – Typical flow switch installation

Fig. B9-2 - Metal paddles used to detect water flow (typical)

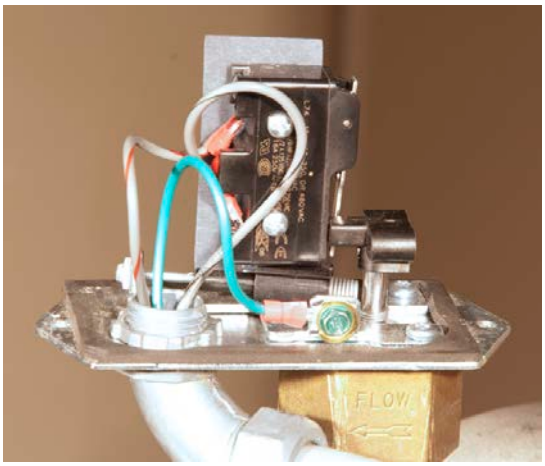


Fig. B9-3 – Flow switch with cover removed

B10 Removing and Replacing the Flow Switch

The switch assembly includes two parts: a set of paddles that extend into the water pipe, and a control box. See Fig. B9-1.

Figure B9-2 shows the paddles that extend into the piping to detect the water flow.

The paddles are sized to match the amount of water flowing through the system, so a flow switch installed in a smaller system, with a smaller pipe, will have smaller paddles, and a switch in a larger system will have larger paddles. Keep this in mind if you need to replace one of these switches.

Tools and equipment required:

- Medium-sized pipe wrench
- Sheet-metal shears - use a type that can make a curved cut
- 100-grit sandpaper
- Pipe dope or Teflon® tape

Procedure:

1. Turn off power to the system. Use the main disconnect switch mounted above the front panel.
2. Isolate the boiler. Turn off the water shutoff valves located upstream and downstream of the unit.
3. Drain the boiler. The drain valve is located xx.
4. Remove the cover from the control box for the switch. Note the positions of the wiring connections, then disconnect the wires.
5. Now you can use the pipe wrench to remove the whole switch assembly.
6. When you receive the new switch, it will include four paddles. These will be longer than necessary for your installation, so you will need to trim these paddles to the correct sizes. The best way to do this is to copy the sizes of the paddles in the old switch. Make a smooth curve at the end of each paddle, as shown in Fig. B9-2. Remove any burrs from the cut end of the paddle using 100-grit sandpaper.

Removing and Replacing the Flow Switch (continued)

7. Once you have trimmed the paddles, install them on the switch. See Fig. B10-1. Insert the pin to attach the paddles to the center post.

8. Important! When the switch is installed, the ends of the paddles must sit in the correct orientation inside the pipe. The paddles must be placed so they can sense the water flow, and they can bend with the direction of the water flow.

   - The wide sections of the paddles must sit across the line of the water flow, partially blocking the flow.
   - The flowing water should hit the longer paddle first. See Fig. B10-1.

9. Note the arrow and the word “Flow” on the large mounting nut. This will help you to install the paddles in the correct orientation.

10. Coat the threads with pipe dope or Teflon® tape and install the part.

    Important! With the pipe wrench, tighten so the paddles sit in the orientation shown above. Be sure the arrow on the large mounting nut points in the direction of water flow.

11. Re-connect the wires as shown in Fig. B9-3.

12. Open the water isolation valves and check for a leak where the switch is threaded into the pipe.

13. Turn on power to the unit.

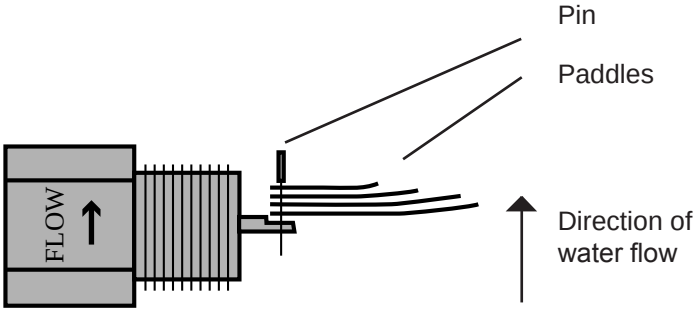


Fig. B10-1 - Attaching the paddles

B11 Removing and Replacing the Gas Valve

The modulating gas valve consists of a valve body that controls the on/off gas flow and a negative pressure regulator. It provides the air/gas ratio control in combination with the Venturi to the unit.

The easiest way to remove the gas valve is to remove a section of the gas input piping, including the gas valve and the high gas pressure switch. Once you have done this, you can separate the gas valve from the rest of the assembly. Figure B11-1 shows how the parts are arranged.

Tools and equipment required:

- Small Phillips-head screwdriver (#1)
- 3/8” and 5/16” sockets
- 4 mm Allen wrench
- Two medium-sized pipe wrenches
- Gas-resistant pipe dope or Teflon® tape
- Gas leak detection solution (“bubble spray”)
- Container for removed parts

Procedure:

1. Turn off power to the machine. Use the main disconnect switch on the front of the machine, just above the control panel.
2. Remove the front and right side panels.
3. Shut off the gas at the gas shutoff valve on the right side of the machine (yellow handle). See Fig. B11-1.
4. Unplug the wires running to the gas valve. (The connector is keyed, and can only be plugged in one way.) See Fig. B11-2.

Fig. B11-1 - Gas shutoff valve (typical)

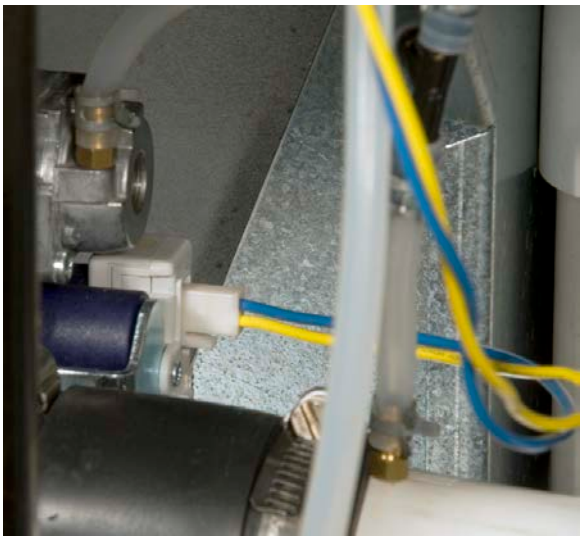


Fig. B11-2 - Wiring connector for gas valve (typical)

Removing and Replacing the Gas Valve (continued)

5. Disconnect the small vacuum hose running to the top of the gas valve.
6. Disconnect the wires to the high gas pressure switch only. (On the unit, this is the pressure switch on the left, on the side closest to the blower. See Fig. B11-3.) Remove the front cover on the gas switch by removing the two screws. Before disconnecting the wires, note the way they are connected to the switch. Mark the wire on the left using a piece of electrical tape. When the switch is re-connected, this wire will go to the "N.C." connection.
7. On the left end of the assembly, remove the four bolts which attach the gas assembly to the blower. See Fig. B11-4. The 5/16" socket will fit the head of each bolt. Use the 3/8" socket on the nut on the other end.
8. On the right end of the assembly, remove the four socket-head cap screws which attach the gas inlet pipe to the assembly. See Fig. B11-5. Use the 4mm Allen wrench. Notice that the two screws on the bottom of the assembly are shorter.

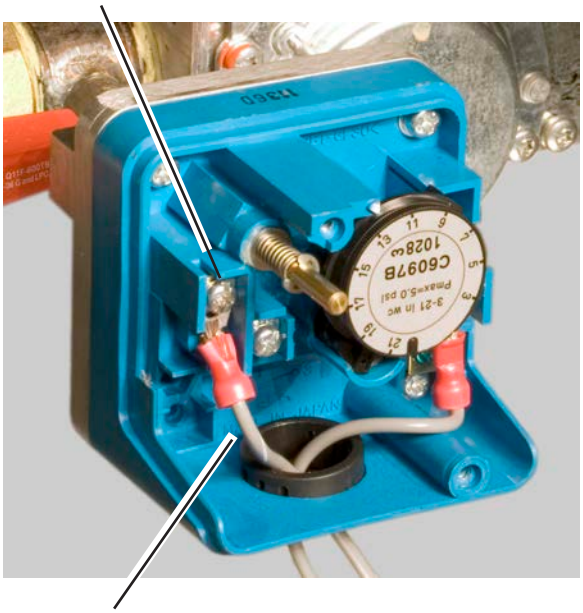


Fig. B11-3 - High gas pressure switch - cover removed

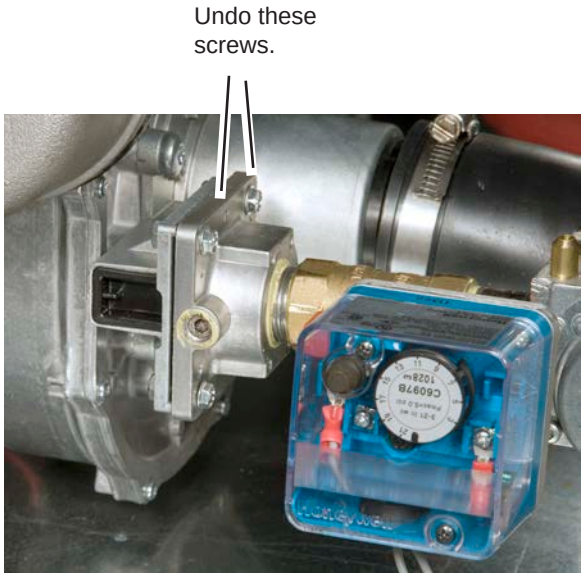


Fig. B11-4 - Undo the four screws at the left end of the assembly

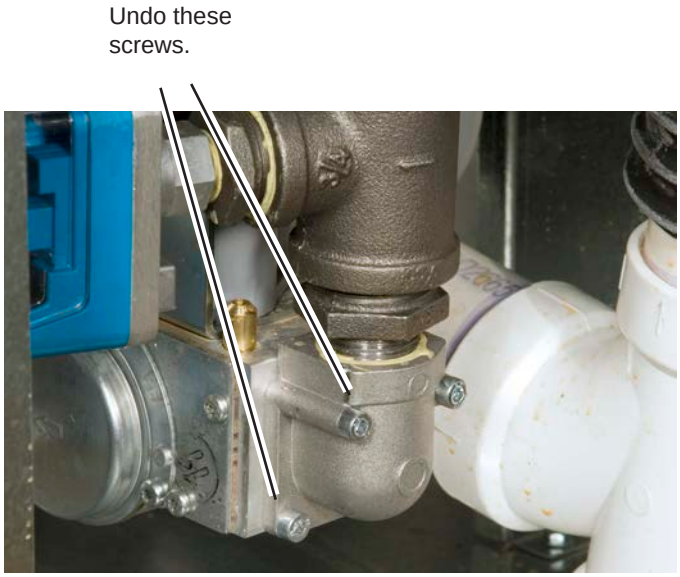


Fig. B11-5 - Undo the four screws at the right end of the assembly

Removing and Replacing the Gas Valve (continued)

9. Now you can remove the whole assembly from the machine. Figure B11-6 shows the complete assembly.

10. The next step is to remove the high gas pressure switch. Turn the red handle on the gas valve to the Off position (handle up and down). This will give you better access to the base of the high gas pressure switch. Use two wrenches to remove the high gas pressure switch.

CAUTION - *Be very careful how you use the pipe wrench to grip the body of the gas valve. The covers on the sides of the valve are made of sheet metal, and can be crushed easily. Be sure the jaws of the pipe wrench grip the solid square body of the valve.*

---

11. Now you can separate the gas valve itself. Again, use two wrenches to unscrew the large T-nipple from the gas valve.

12. Figure B11-7 shows the gas valve after it has been removed. Notice the rubber washer - be careful to install this correctly when mounting the new valve.

13. To reassemble, reverse the procedure listed above. Keep the following points in mind during reassembly:

    - We already mentioned the rubber washer on the gas valve.
    - When re-attaching any parts which have pipe threads and will be exposed to the gas, be sure to use gas-resistant pipe dope or Teflon® tape.
    - When re-attaching the wires to the high gas pressure valve, be careful not to reverse the connections. Connect the wire on the left (marked with tape) to the contacts labeled “N.C.” (Normally Closed).

14. After reassembly, check for gas leaks using a leak detection solution (i.e. Hercules Megabubble® Leak Detector or equivalent).

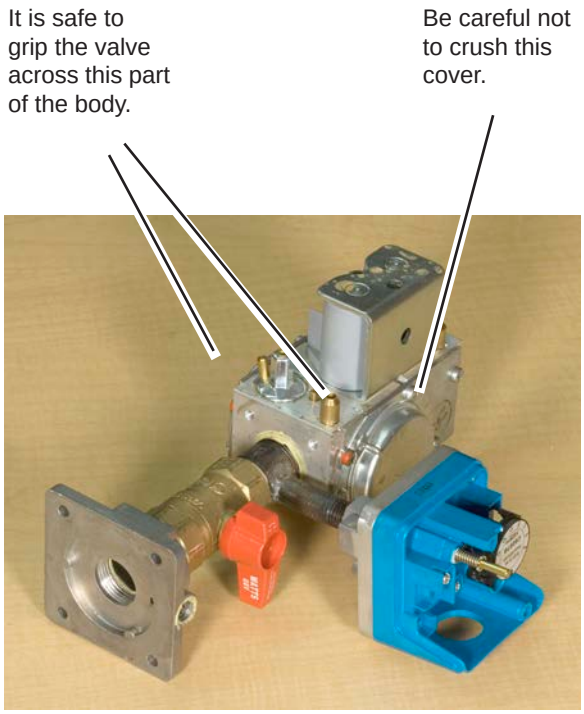


Fig. B11-6 - The gas assembly after removal

Fig. B11-7 - Gas valve

Checking the High Gas Pressure Switch

B12

The high gas pressure switch is a 24V manual reset switch that acts to cut power to the gas valve if the gas pressure is too high for proper operation. The type of switch used is integrally vent limited, and does not require venting to the atmosphere.

Check for 24V AC across the switch.

24V AC present? (switch open)

Yes

Reset the switch manually by pressing the button.

(If the switch was tripped, you will feel a resistance. The voltage should return at the switch terminals.)

Switch resets?

Yes → Temporary drop in gas pressure. Switch is OK.

No

Check gas supply. Call gas company. Gas pressure should be lower than 13” w.c.

Gas supply OK?

No → Call the gas company and correct the problem.

Yes

Replace if necessary. See Section B15.

WARNING - Never jump this switch!

B13 Checking the Low Gas Pressure Switch

The low gas pressure switch is a 24V manual reset switch that acts to cut power to the gas valve if the gas pressure is too low for proper operation. The type of switch used is integrally vent limited, and does not require venting to the atmosphere.

Check for 24V AC across the switch.

24V AC present? (switch open)

Yes

Reset the switch manually by pressing the button.

(If the switch was tripped, you will feel a resistance. The voltage should return at the switch terminals.)

Switch resets?

Yes → Temporary drop in gas pressure. Switch is OK.

No

Check gas supply. Call gas company. Gas pressure should be greater than 3” w.c.

Gas supply OK?

No → Call the gas company and correct the problem.

Yes

Test the switch. See Section B14
Replace if necessary.
See Section B15

WARNING - Never jump this switch!

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Testing the Low Gas Pressure Switch

In the gas train, this switch is located before the gas control valve. Gas will reach this switch whenever the gas shutoff valve to the unit is open.

Figure B14-1 shows the gas train. Connect a test gauge to the inlet gas pressure tap.

The low pressure switch (Honeywell p/n C6097A) is wired N.O. (normally open), and requires a manual re-set. (You will need to reset this switch if you disconnect an old switch or install a new switch.) The low pressure switch is set to trip below 3” W.C. (water column).

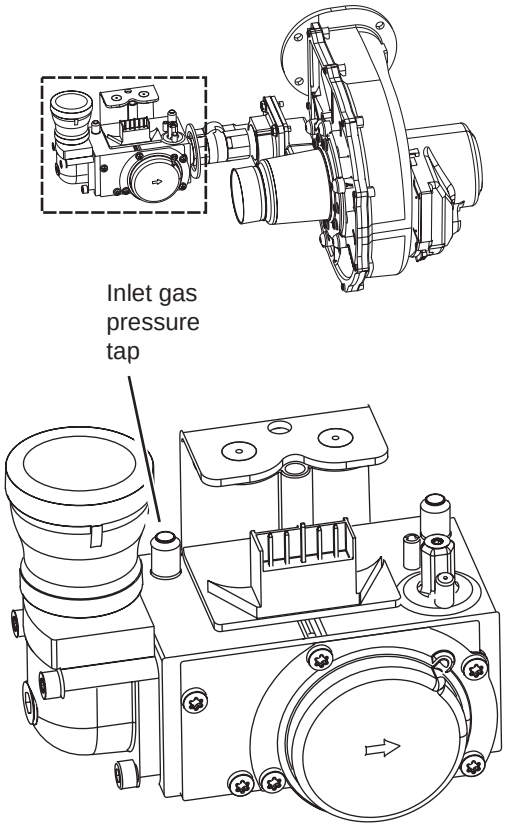


Fig. B14-1 - Inlet gas pressure tap

B15 Removing and Replacing the High and Low Gas Pressure Switches

Each NT unit includes two switches which sense gas pressure:

- The low gas pressure switch is located *before* the gas valve. It will prevent the unit from firing if there is not enough gas pressure to operate correctly.
- The high gas pressure switch is placed *after* the gas valve. It will shut down the unit if excess gas pressure gets past the gas valve.

Note that these two switches are similar, but not identical.

- The low pressure switch (Honeywell p/n C6097A) is wired N.O. (normally open), and has a manual reset switch. (You will need to reset this switch if you disconnect an old switch or install a new switch.) The low pressure switch is set to trip below 3” w.c. (water column).
- The high pressure switch (Honeywell p/n C6097B) is wired N.C. (normally closed). The high pressure switch is set to trip above 3” w.c. (water column).

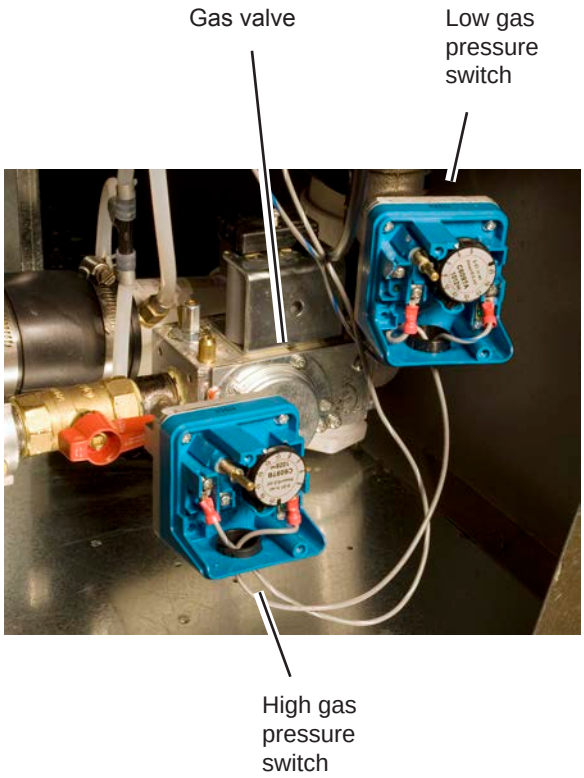


Fig. B15-1 - High and low gas pressure switches (typical)

Tools and equipment required:

- Small Phillips-head screwdriver (#1)
- Two medium-sized pipe wrenches or adjustable wrenches
- Gas-resistant pipe dope or Teflon® tape
- Gas leak detection solution (“Hercules Mega-bubble® or equivalent)
- Container for removed parts

Removing and Replacing the High and Low Gas Pressure Switches (continued)

Procedure - Removing or replacing either switch

1. Turn off power to the machine. Use the main disconnect switch on the front of the machine, just above the control panel.
2. Remove the front panel.
3. Shut off the gas at the gas shutoff valve on the right side of the machine (yellow handle).
4. Disconnect the wires to the gas pressure switch. Remove the front cover on the gas switch by removing the two screws. Before disconnecting the wires, note the way they are connected to the switch.

Fig. B15-2 - Gas shutoff valve (typical)

For the high gas pressure switch only -

Mark the wire on the left using a piece of electrical tape. When the switch is assembled, this wire will go to the “N.C.” connection.

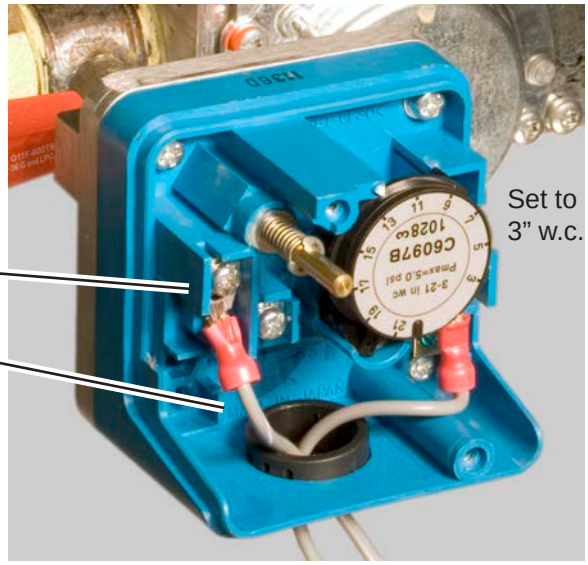


Fig. B15-3 - High gas pressure switch - cover removed

Removing and Replacing the High and Low Gas Pressure Switches (continued)

For the low gas pressure switch only -

Mark the wire on the left using a piece of electrical tape. When the switch is assembled, this wire will go to the “N.O.” connection.

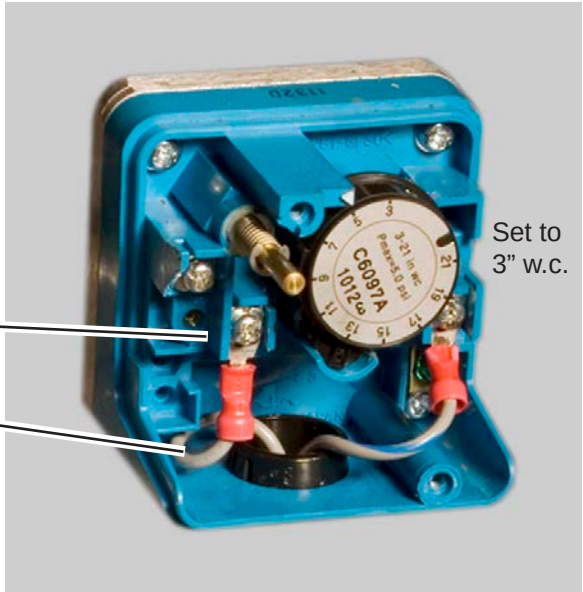


Fig. B15-4 - Low gas pressure switch - cover removed

5. Remove the switch using the two wrenches.

   For the high gas pressure switch only -

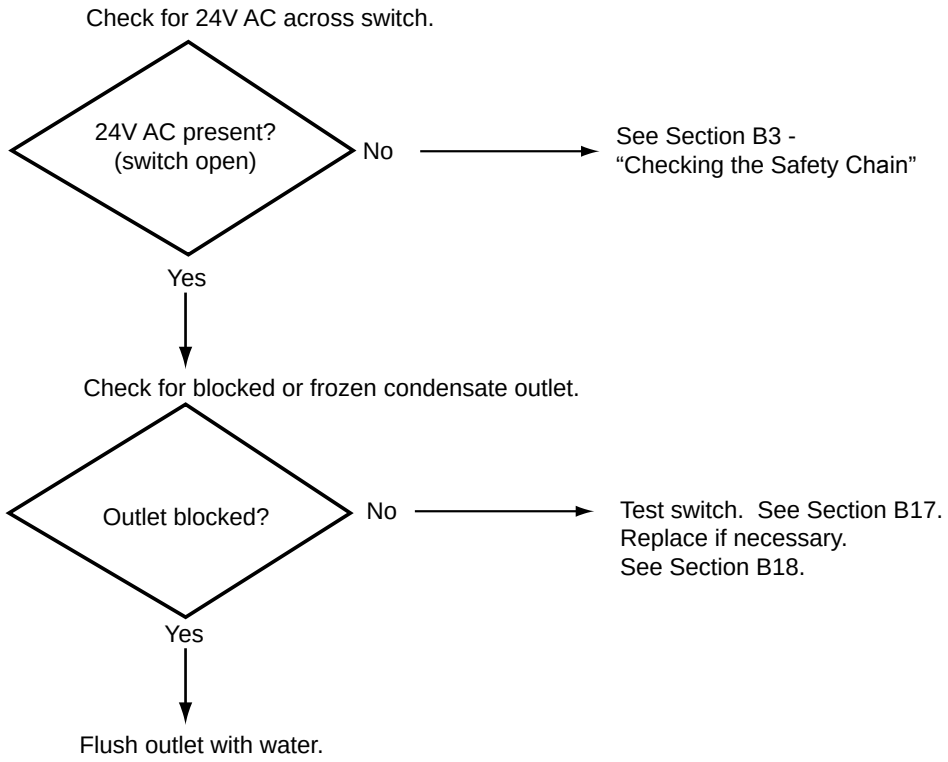
   Turn the red knob on the gas valve so it is in a vertical position. This will give you more room to use the wrenches.

6. To reassemble, reverse the procedure we have just described. Use gas-resistant pipe dope or Teflon® tape on the threaded joints. For both the high gas pressure and low gas pressure switches, check the setting on the adjusting knob. Both switches should be set to 3” w.c..

   Important! Remember to reset the low-pressure switch before you place the NT unit in operation. (Every low pressure switch will need to be reset when it arrives from the factory.) To reset, press the black rubber-booted button to the left of the adjusting knob.

7. After reassembly, check for gas leaks using leak detection solution (i.e. Hercules Megabubble® or equivalent).

Checking the Condensate Trap Level Switch



B17 Testing the Condensate Trap Level Switch

Some operating conditions can cause small particles of mineral material to be formed in the heat exchanger and collect in the condensate trap. The drain can also be blocked if it is frozen or plugged with debris. If the water cannot drain freely, it can back up into the heat exchanger. The level switch is designed to prevent this by shutting off the unit before the water can reach the heat exchanger.

This assembly uses a float-type switch. To test, plug the outlet (the higher fitting on the assembly). Measure the resistance across the switch contacts when the assembly is empty. At this point, the contacts should be closed (no resistance). Next, add water at the inlet (the lower fitting). As the water level rises inside the assembly, you should see the contacts open (infinite resistance).

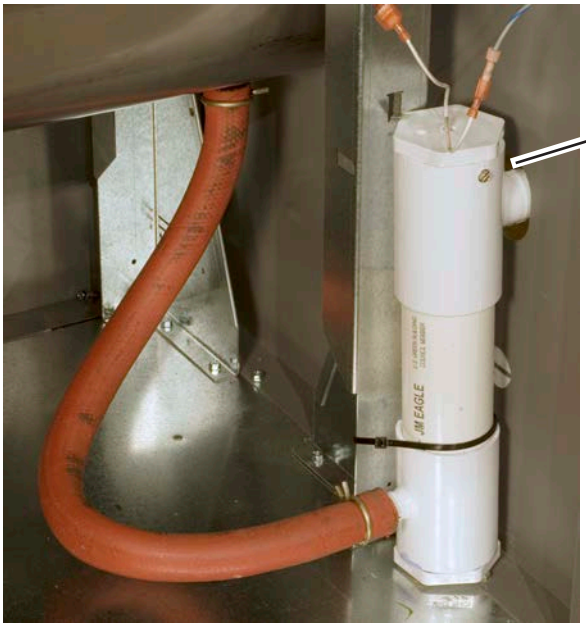


Fig. B17-1 - Small condensate trap assembly (typical)

B18 Removing and Replacing the Condensate Trap

The Magna-Therm unit is designed to operate in the “condensing” mode. The combustion of natural gas produces a lot of water vapor. In the NT unit, this water vapor is condensed out of the exhaust gas inside the heat exchanger. The water is collected from the bottom of the heat exchanger, and sent to the condensate trap. The trap includes a float valve. If the condensate drain is plugged or blocked for some reason, the float rises inside the trap. If the water rises high enough, the float trips a switch and prevents the NT unit from firing. This prevents the condensate water from backing up into the heat exchanger.

Note that the condensate water can be hot. The water is also acidic, and can damage metal pipes.

Figure B17-1 shows a condensate trap from a smaller NT unit. The water enters through the hose at the bottom of the unit, and exits through the top. At the top of the unit you can see the two wires for the float switch.

The cap on the PVC assembly is held in place by a set-screw. Once you remove this screw, you can remove the cap and unscrew the switch.

Removing and Replacing the Condensate Trap (continued)

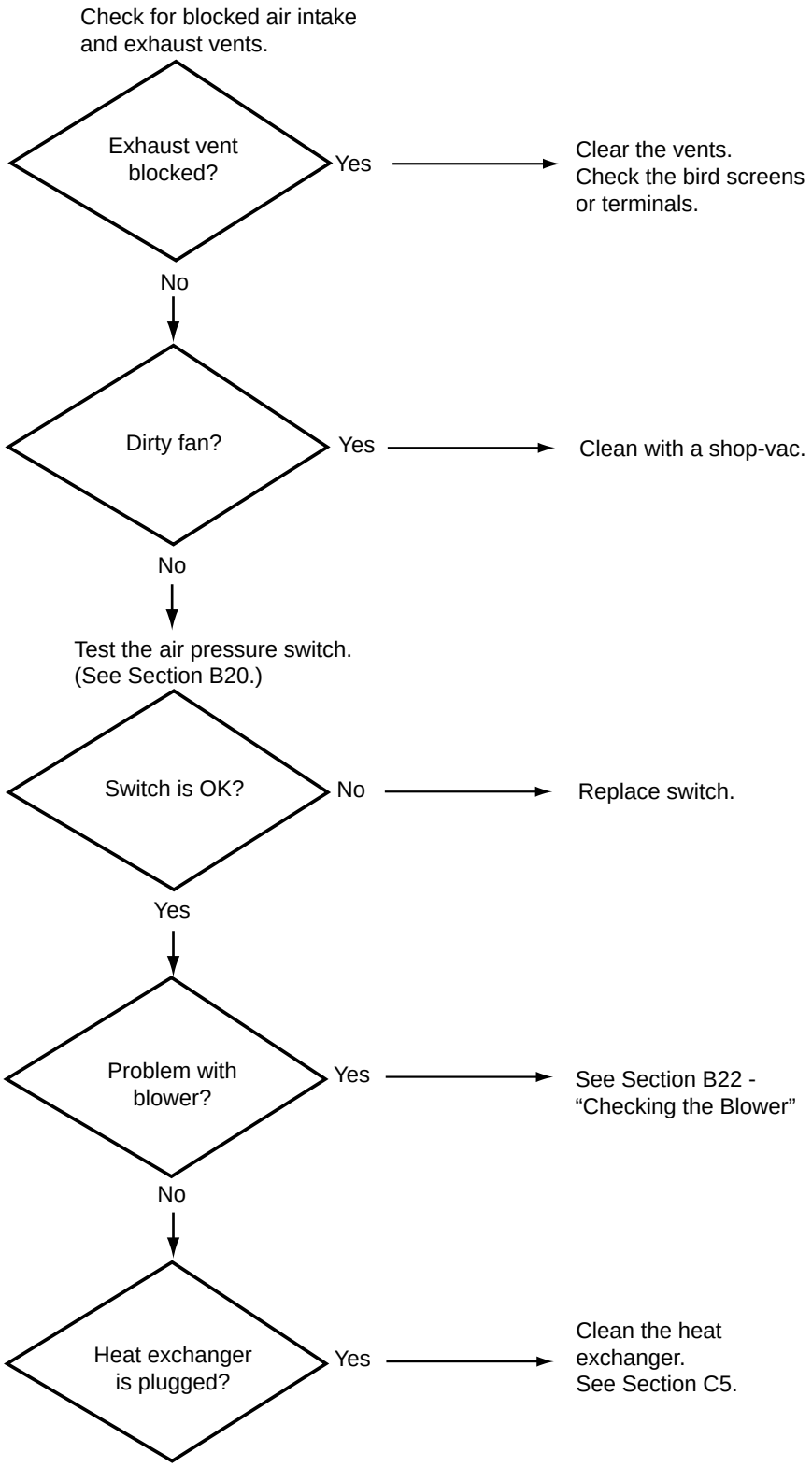
Tools and equipment required:

* 1/4” socket
- Small diagonal cutters or knife
- Water-pump pliers
- 11” Ty-wrap

Procedure

1. Turn off power to the system. Use the main disconnect switch mounted above the front panel.
2. Remove the front panel from the unit.
3. You won’t be able to do this procedure unless you also remove the panel on the right side of the unit. Remove the mounting screws, then remove the right side panel.
4. Disconnect the two wires from the top of the trap assembly.
5. Notice the position of the Ty-wrap, then cut it.
6. Use the water-pump pliers to remove the clip holding the inlet hose (lower end of the trap assembly). Pull the end of the hose away from the trap assembly.
7. Once the assembly is free, flush it out with water to remove any collected sediment.
8. To replace the assembly, reverse the steps we have just described. It does not matter which way the wires are connected.

B19 Checking the Air Pressure Switch - Blower Proving Switch



Test Procedure for Air Pressure Switch

B20

1. The switch is located behind the front panel. Disconnect the two leads, and connect a Volt-Ohmmeter set to check for continuity (reading Ohms).
2. Insert a hose “T” in the clear plastic hose that runs to the positive pressure port (closest to the electrical connections). Attach a length of hose to the branch of the “T.”
3. Blow on the end of the hose.

   With pressure –
   You should see continuity (low Ohms - switch closed)

   Without pressure –
   You should not see continuity (high Ohms – switch open)
4. Disconnect the “T.” Attach a manometer to the negative port on the blower. When the fan starts, you should see a vacuum of about ½” w.c.

Removing and Replacing the Air Pressure Switch

B21

The air pressure switch acts as a “blower proving switch” to ensure that the blower is running before the unit will fire.

Tools and equipment required

- Small Phillips-head screwdriver (#1) or 5/16” socket
- Small standard pliers
- Electrical tape

Fig. B21-1 - Air pressure switch (typical)

Removing and Replacing the Air Pressure Switch (continued)

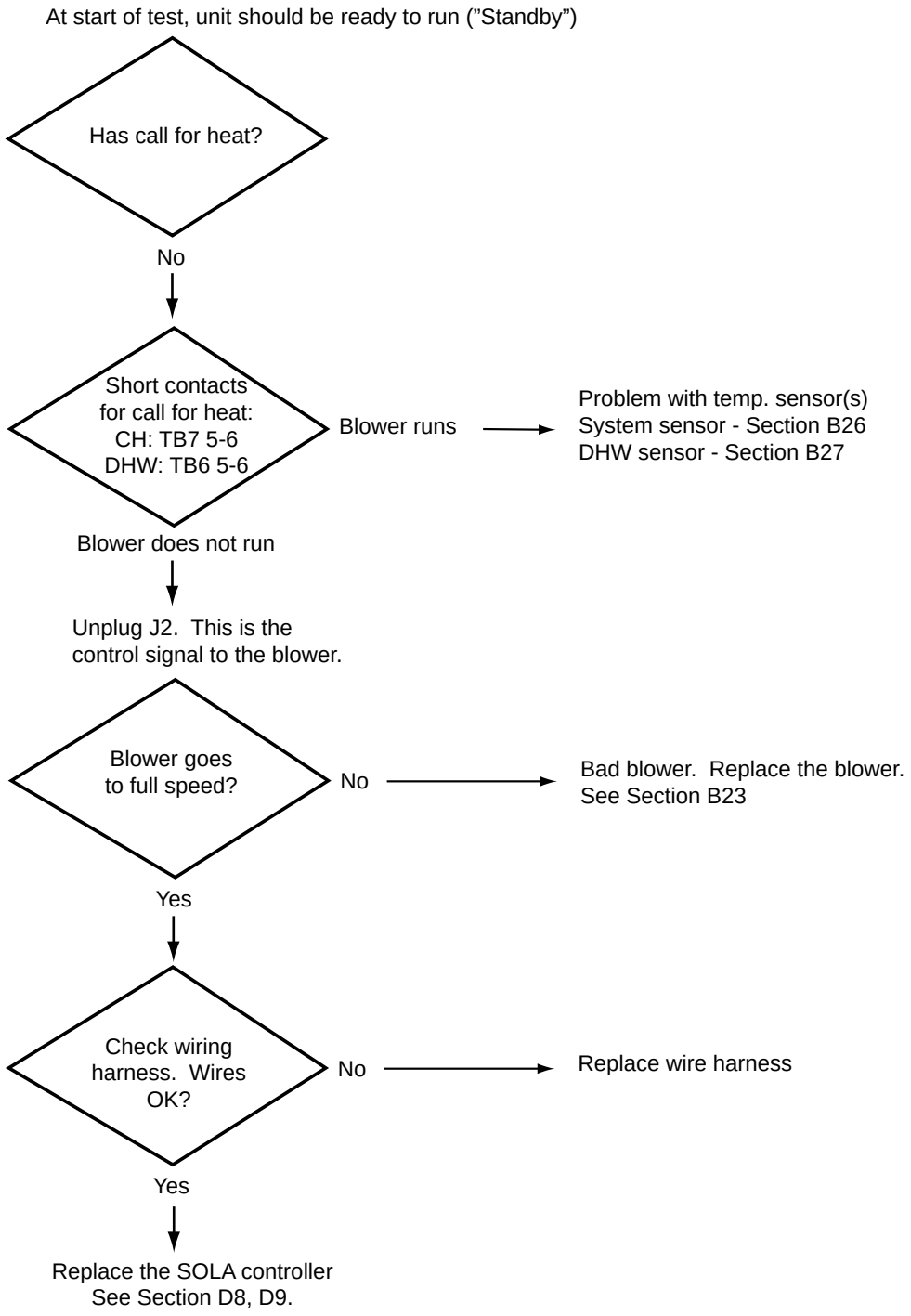
Procedure - Removing or replacing the switch

1. Turn off power to the machine. Use the main disconnect switch located above the top of the control panel.
2. Remove the covers on top of the unit so you can reach the air pressure switch.
3. Remove the mounting screws on both sides of the switch. Use the screwdriver or the 5/16” socket.
4. Use the pliers to release the hose clamps and remove the air hoses from the bottom of the switch.

   Important! During reassembly, the hoses must be connected to the correct barbs on the switch. Do not reverse the connections.

   To prevent this, you should mark one of the hoses. Remove the front hose first. Mark the rear hose with a piece of electrical tape, then remove the rear hose.
5. To reassemble, reverse the procedure we have just described. Be sure to connect the two air hoses in the correct locations.

Checking the Blower



B23 Removing and Replacing the Blower

The easiest way to remove the blower is to remove it as part of an assembly, including the air/gas channel, front panel of the combustion chamber, and the burner. Once you have done this, you can separate the burner from the rest of the assembly.

Tools and equipment required:

- Small Phillips-head screwdriver (#1)
- 3/8” and 5/16” sockets
- 4 mm Allen wrench
- #25 Torx® driver
- Flat-blade screwdriver
- Gas leak detection solution (Hercules “Megabubble” or equivalent)
- Replacement gasket for front plate of heat exchanger
- Container for removed parts

Procedure:

1. Turn off power to the machine. Use the main disconnect switch on the front of the machine, just above the control panel.
2. Remove the front and right side panels.
3. Shut off the gas at the gas shutoff valve on the right side of the machine (yellow handle). See Fig. B23-1.
4. On the left end of the gas valve assembly, remove the four bolts which attach the gas valve assembly to the blower. See Fig. B23-2. The 5/16” socket will fit the head of each bolt. Use the 3/8” socket on the nut on the other end.

Fig. B23-1 - Gas shutoff valve (typical)

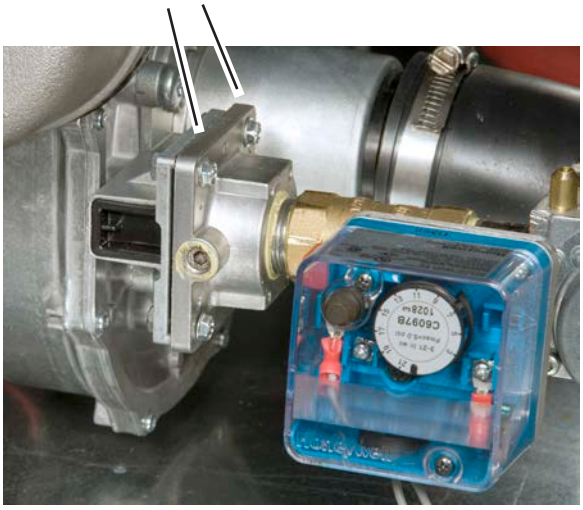
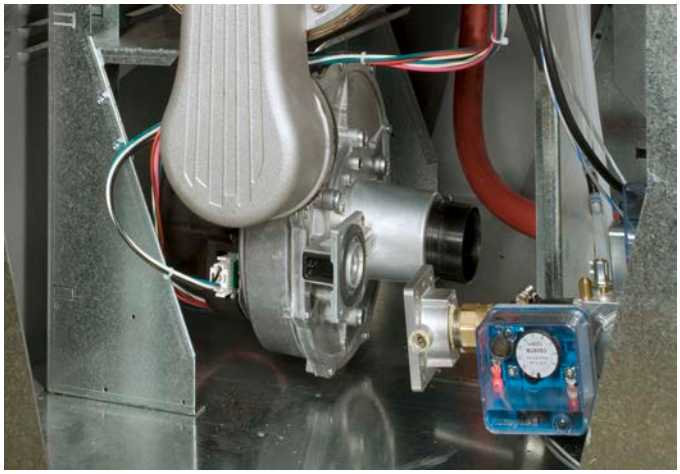


Fig. B23-2 - Undo the four screws at the left end of the assembly

5. Behind the gas valve, locate the black rubber air intake hose. Loosen the hose clamp on the left end of this hose, and pull the end of the hose away from the end of the Venturi. When you have finished this step, the unit will look like Fig. B23-3.
6. Disconnect the wires to the blower. There are two connectors. See Fig. B23-4. The power wires run to the rear connector, and the control wires connect to the front.
7. The next job is to separate the front plate on the heat exchanger from the rest of the unit. See Fig. B23-5.

   Note the two large wires running to this assembly. The spark wire and the flame sense wire look alike. ***The unit will not run if you reverse these wires.*** Before removing the wires, mark the spark wire with a piece of electrical tape. Also disconnect the green ground wire.



B23-3 - Gas and air intakes disconnected

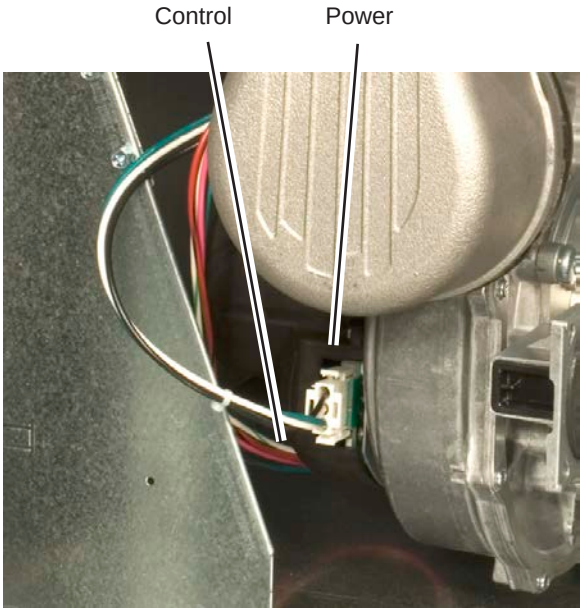


Fig. B23-4 - Wiring connectors for blower

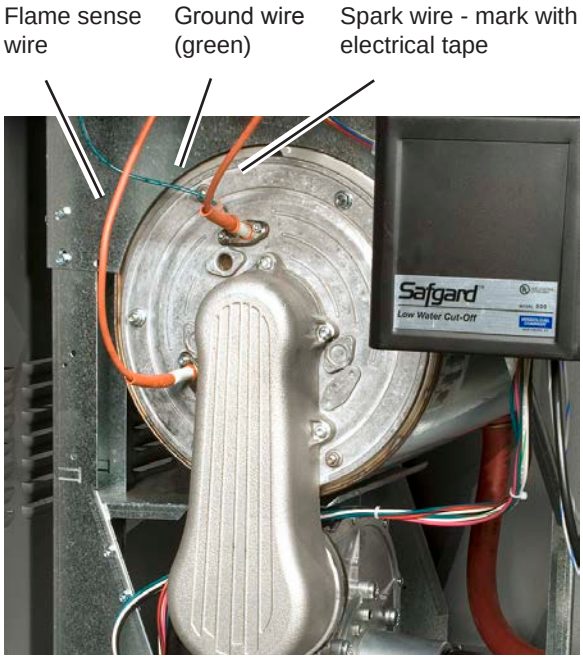
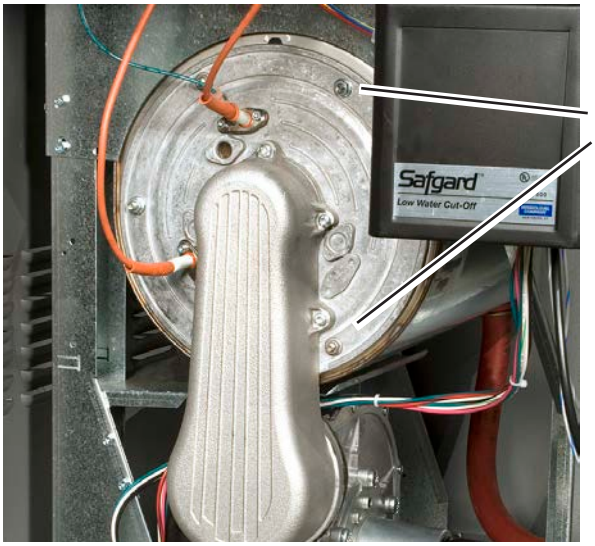


Fig. B23-5 - Disconnect the wires on the front plate of the heat exchanger

Removing and Replacing the Blower (continued)

8. Now you can remove the front of the heat exchanger, with the blower and burner still attached. Undo the six 10mm nuts around the outside of the front plate of the heat exchanger. See Fig. B23-6. As you remove the part, note the position of the large black gasket. This gasket must be replaced every time you clean the unit or remove the front cover of the heat exchanger.
9. Once the assembly has been removed, it looks like Fig. B23-7. Remove the four 13mm screws that attach the blower to the assembly.
10. Next, separate the Venturi from the blower. Remove the six #25 Torx® screws. See Fig. B23-8.



B23-6 - Removing the front of the heat exchanger

B23-7 - Blower, front plate, and burner assembly

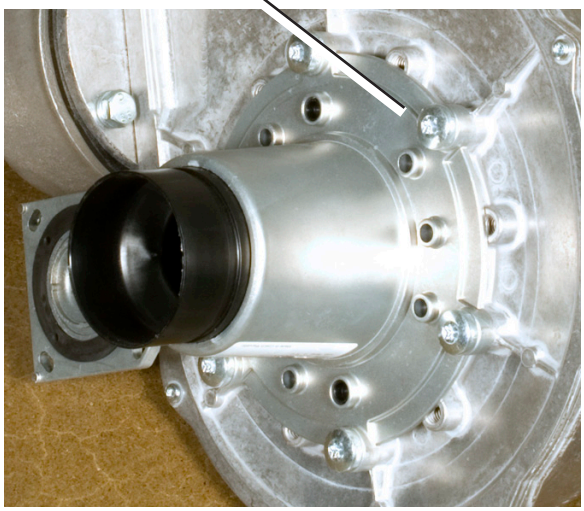


Fig. B23-8 - Separate the Venturi from the blower

Removing and Replacing the Blower (continued)

11. The location where you removed the Venturi is the air intake for the blower. To clean the blower, blow compressed air through the intake and spin the impeller.
12. To reassemble, reverse the procedure listed above.
13. Replace the gasket on the inner surface of the cover for the heat exchanger. The gasket should sit in its slot as shown in Fig. B23-9.
14. When attaching the front cover of the heat exchanger, tighten the nuts in a cross-pattern. See Fig. B23-10. (If you tighten all of the nuts on one side first, this might bend or distort the cover.)
15. Check for gas leaks using a leak detection solution.
16. Finish reassembling the unit and turn on the power and gas. Check for proper venting and combustion air. Fire the boiler and check the combustion using a combustion analyzer.

Fig. B23-9 - Gasket in correct position

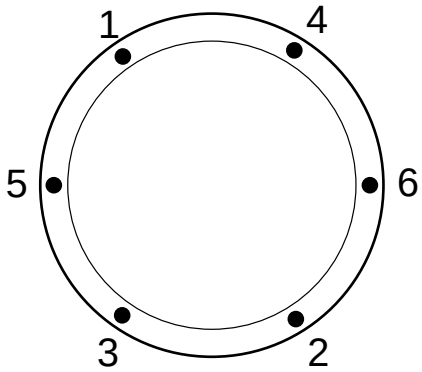
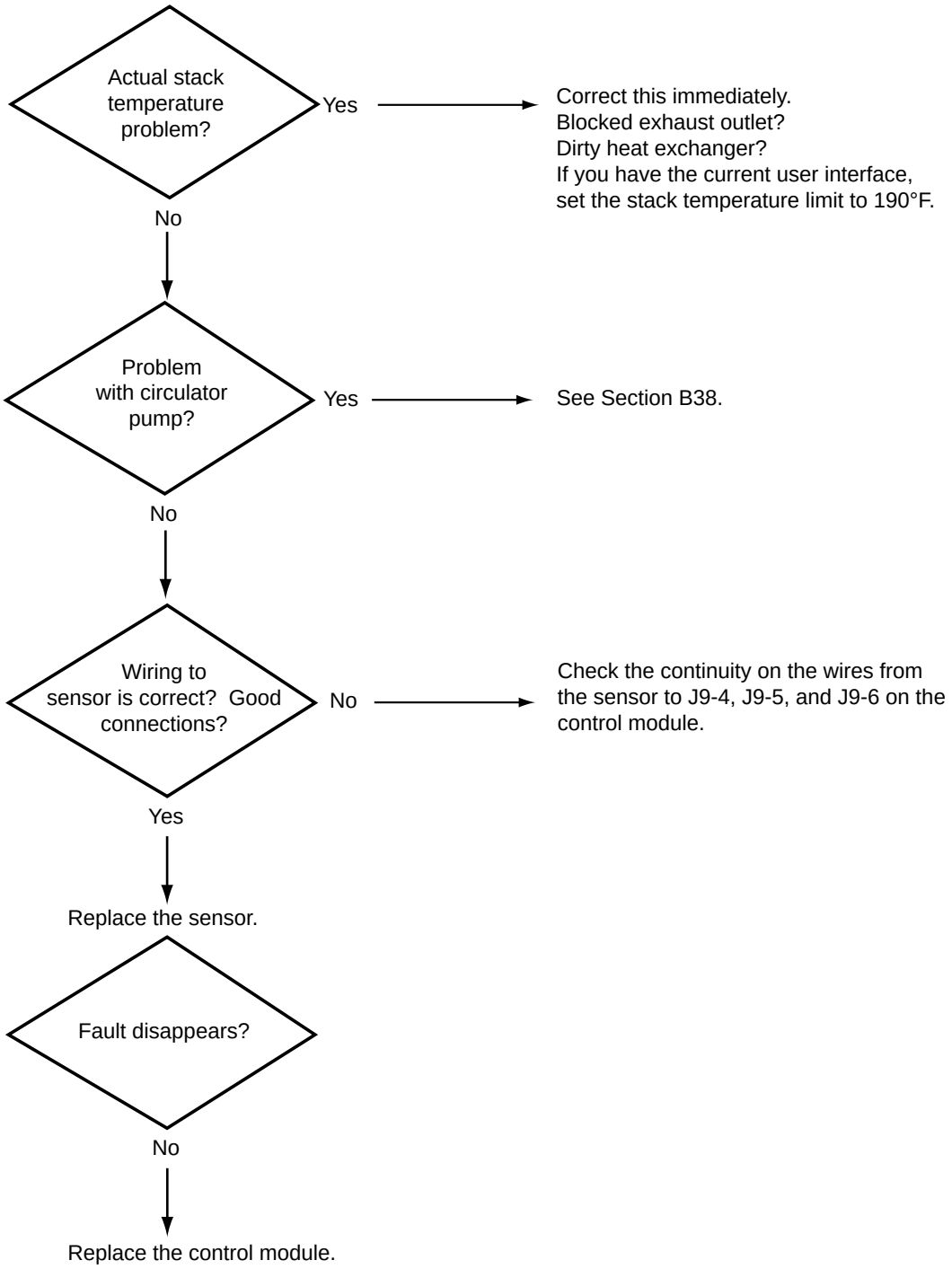


Fig. B23-10 - Tightening sequence for nuts on front cover

B24 High Stack Temperature Fault



Removing and Replacing the Stack Temperature Limit Switch

B25

The stack temperature limit switch will shut down the NT unit if the stack temperature rises above 195°F. This is a “duplex” sensor - it actually includes two separate thermistors. The control system constantly compares the readings from the thermistors. If there is a large difference between the readings, or if one of the thermistors is “open” or “shorted,” the control system will shut down the NT unit, and display a “Hold 95” error message.

Tools and equipment required:

- Crescent wrench or 17 mm socket

Procedure:

1. Turn off power to the system. Use the main disconnect switch mounted above the front panel.
2. The stack temperature limit switch is mounted in the “far” end of the heat exchanger assembly (the end which is farthest from the operator control panel.) You should be able to reach this switch from the top of the unit. Remove the top panels so you can see the switch.
3. Unplug the wiring connector (four wires). The connector is locked in place by a “squeeze tab.” Press on the tab to release the connector.
4. Unscrew the sensor using the 17 mm socket or a crescent wrench. Turn counter-clockwise to unscrew the part.
5. To reassemble, reverse the process we have just described. There is no need to use pipe dope or Teflon® tape on the threaded part of the sensor.

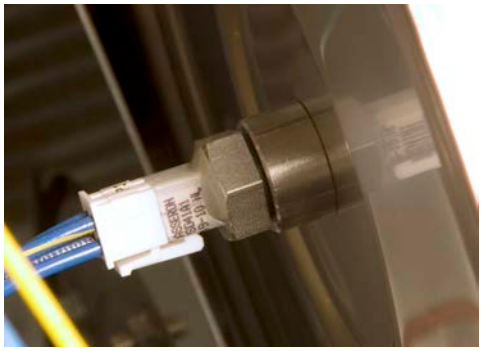


Fig. B25-1 - Stack temperature limit switch (typical)

B26 Checking the System Sensor

The System sensor is mounted in the circulating loop, and provides the input for the CH (Central Heating) function. This type of sensor can fail in either an “open” or “shorted” condition, or may become inaccurate.

On a unit with the current user interface -

Check the line on the display for “LL OPER TEMP.” If the sensor is operating normally, the unit will display a temperature on this line. The display will indicate an open sensor as “OPEN”, and a shorted sensor will be shown as “SHORT.”

On a unit with the original user interface -

Check the line on the display for “LL.” If the sensor is operating normally, the unit will display a temperature on this line. If the sensor is not working, or is disconnected, the display will present three dashes: “- - - .”

To check the sensor for accuracy, see Section B32.

B27 Checking the DHW Sensor

The DHW sensor is mounted in the indirect hot water tank, and provides the input for the DHW (Domestic Hot Water) function. This type of sensor can fail in either an “open” or “shorted” condition, or may become inaccurate.

On a unit with the current user interface -

Check the line on the display for “DHW TEMP.” If the sensor is operating normally, the unit will display a temperature on this line. The display will indicate an open sensor as “OPEN”, and a shorted sensor will be shown as “SHORT.”

On a unit with the original user interface -

Check the line on the display for “DHW.” If the sensor is operating normally, the unit will display a temperature on this line. If the sensor is not working, or is disconnected, the display will present three dashes: “- - - .”

To check the sensor for accuracy, see Section B32.

Inlet Water Temperature Sensor

B28

A typical installation for the inlet water temperature sensor is shown in Fig. B28-1. The sensor is connected to J8 4-5 on the control module. This sensor uses an electronic device called a “thermistor.” For instructions on testing the sensor, see Section B32.

To reset the control system after the inlet sensor trips:

- On a unit with the original (white) user interface -

  Press the Reset button near the lower left-hand corner of the display. This will reset the lockout, and the lockout code will disappear.

- On a unit with current user interface -

  Reset by pressing the OK button.

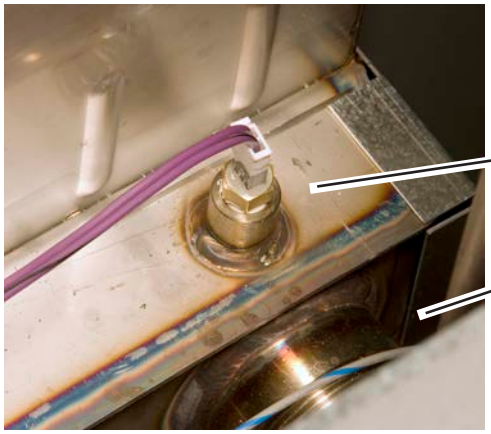


Fig. B28-1 - Inlet water temperature sensor (typical)

Removing and Replacing the Inlet Water Temperature Sensor

B29

The inlet water temperature sensor allows the control system to monitor the temperature of the water as it returns to the NT unit.

Tools and equipment required:

- Crescent wrench or 14 mm socket
- Pipe dope or Teflon® tape

Procedure:

1. Turn off power to the system. Use the main disconnect switch mounted above the front panel.
2. Isolate the boiler. Turn off the water shutoff valves located upstream and downstream of the unit.
3. Drain the boiler. The drain valve is located near the lower end of the heat exchanger.
4. The inlet water temperature sensor is mounted in the shoulder of the heat exchanger assembly, just above the point where the water inlet pipe is attached to the heat exchanger. (The inlet pipe is marked with a label on top of the unit.) Remove the top panels on the unit so you can reach the temperature sensor.
5. Unplug the wiring connector (two wires). The connector is locked in place by a “squeeze tab.” Press on the tab to release the connector.
6. Unscrew the sensor using the 14 mm socket or a crescent wrench. Turn counter-clockwise to unscrew the part.
7. To reassemble, reverse the process we have just described. Be sure to use pipe dope or Teflon® tape on the threaded part of the sensor.

B30 Outlet Water Temperature Sensor

The outlet water temperature switch allows the control system to monitor the temperature of the water as it leaves the NT unit. A typical installation for the outlet water temperature sensor is shown in Fig. B30-1. The sensor is connected to J8 8-9-10 on the control module.

This sensor assembly includes two electronic devices called “thermistors.” As long as the resistance readings from both sensors agree, the Magna-Therm will continue to operate. If there is a large difference between the readings, or if one of the thermistors is “open” or “shorted,” the control system will shut down the NT unit and display a “Hold 92” error message.

For instructions on testing the assembly, see Section B32.

To reset the control system after the outlet sensor trips:

- On a unit with the original (white) user interface - Press the Reset button near the lower left-hand corner of the display. This will reset the lockout, and the lockout code will disappear.
- On a unit with current user interface - Reset by pressing the OK button.

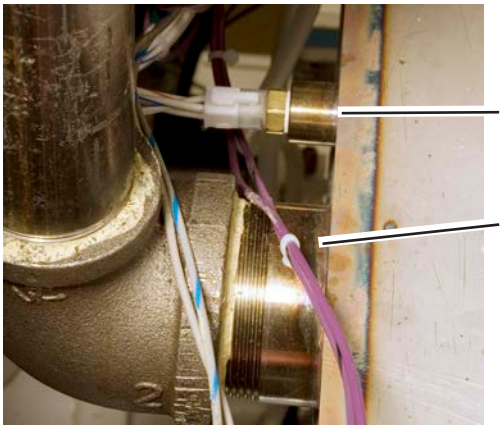


Fig. B30-1 - Outlet water temperature sensor (typical)

B31 Removing and Replacing the Outlet Water Temperature Sensor

See Fig. B30-1 for a typical installation.

Tools and equipment required:

- Crescent wrench or 14 mm socket
- Pipe dope or Teflon® tape

Procedure:

1. Turn off power to the system. Use the main disconnect switch mounted above the front panel.
2. Isolate the boiler. Turn off the water shutoff valves located upstream and downstream of the unit.
3. Drain the boiler. The drain valve is located near the lower end of the heat exchanger.

Removing and Replacing the Outlet Water Temperature Sensor (continued)

B31 cont.

4. The outlet water temperature sensor is mounted in the shoulder of the heat exchanger assembly, just above the point where the water outlet pipe is attached to the heat exchanger. (The outlet pipe is marked with a label on top of the unit.) Remove the top panels on the unit so you can reach the temperature sensor.
5. Unplug the wiring connector (four wires). The connector is locked in place by a "squeeze tab." Press on the tab to release the connector.
6. Unscrew the sensor using the 14 mm socket or a crescent wrench. Turn counter-clockwise to unscrew the part.
7. To reassemble, reverse the process we have just described. Be sure to use pipe dope or Teflon® tape on the threaded part of the sensor.

Testing the Temperature Sensors

B32

The temperature sensors used in this unit are devices called "thermistors." The electrical resistance across a thermistor drops as the temperature rises. The table below shows some typical resistance readings at different temperatures.

There are three temperature sensors mounted directly on the NT unit:

- Inlet water temperature sensor
- Combined outlet water temperature sensor and water temperature high limit (duplex sensor)
- Stack sensor (duplex sensor)

There are up to three more sensors mounted at remote locations:

- System sensor
- DHW sensor (if installed)
- Sensor for Outdoor Reset function (if installed)

Each "duplex" sensor assembly actually uses two thermistors. The control module compares the readings of the two. If the difference becomes greater than allowed, the controller declares a lockout and prevents the Magna-Therm unit from firing.

To check a thermistor, unplug the sensor wires and check the resistance through the thermistor using a volt-ohmmeter. Note the temperature of the part, and check the resistance against the table. If there is an open-circuit or no resistance at all, replace the part.

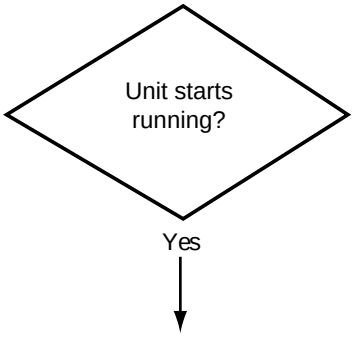
The connector for a "duplex" sensor will include four pins. Two of these run to one thermistor, and two go to the other. You should see the same resistance reading on both of the thermistors in the assembly.

°F	±°F	Ohms
-22	1.6	176.1 kΩ
-4	1.6	96.7 kΩ
14	1.6	55.2 kΩ
32	1.6	32.6 kΩ
50	1.6	19.9 kΩ
68	1.6	12.5 kΩ
77	1.6	10.0 kΩ
86	1.6	8.0 kΩ
104	1.4	5.3 kΩ
122	1.4	3.6 kΩ
140	1.4	2.4 kΩ
158	1.6	1.7 kΩ
176	1.8	1.2 kΩ
194	2.0	912 Ω
212	2.2	674 Ω
230	2.5	506 Ω
248	2.7	384 Ω
266	2.9	296 Ω
284	3.1	230 Ω
302	3.2	181 Ω

Table B33-1 - Thermistor Resistance Chart

B33 Troubleshooting the Outdoor Reset System

Disconnect one lead from
outdoor temperature sensor



Reconnect the sensor lead

Is Outdoor Reset enabled on the controller?

Check programming -

Example - Low boiler temp. set to 130°, heat setpoint set to 120°, so unit never fires.

Example - High and low boiler temps. set the same, so unit never fires.

The high temp. setting must always be higher than the low temp. setting.

Note -

On units with the current interface produced before October 2012 -
If the sensor for outdoor reset is disconnected, the unit will operate at the highest setpoint, as if the outdoor reset function was inoperative.

On units with the current interface produced after October 2012 -
The unit will operate at 140°F.

B34 Servicing the Transformer

The transformer changes the 120V AC input power into 24V AC for use by the controls in the NT unit. The transformer includes an integral 4 Amp circuit breaker, and is mounted on the machine frame, near the top of the unit. A reset switch on the bottom of the unit can be used to reset the circuit breaker.

The transformer is sized for the appliance load only, and should not be used to supply power to additional field devices. Additional loads may cause the circuit breaker to trip.

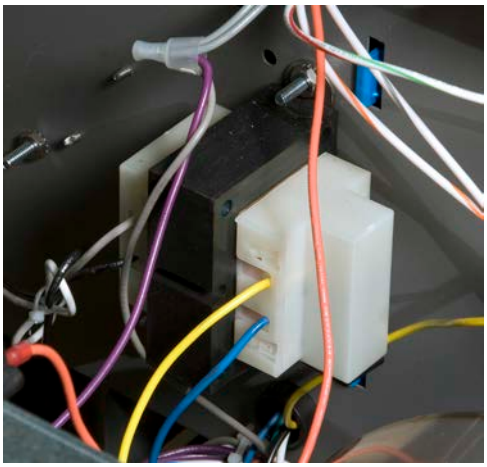


Fig. B34-1 - Transformer installation (typical)

Servicing the Transformer (continued)

Tools and equipment required:

- Volt-Ohmmeter
- Phillips head screwdriver (size #1)
- Deep socket for transformer mounting nuts

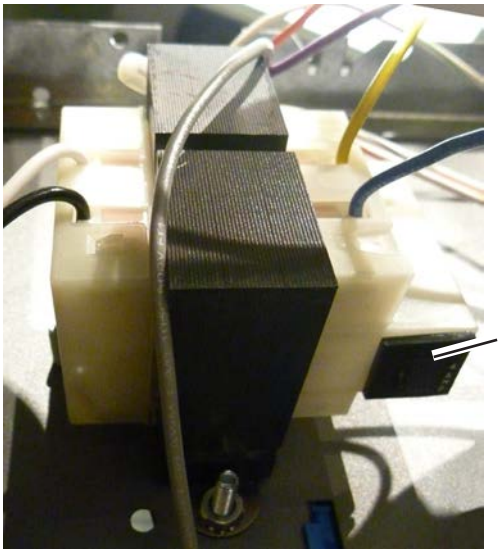


Fig. B34-2 - Reset switch on bottom of transformer (viewed from below)

Test Procedure:

It is simplest to test the transformer by checking the voltages at other points on the NT unit.

1. Turn on power to the unit.

   Warning! You will be working with sections of the machine that will carry 120V AC. Do not attempt this procedure unless you have been trained in safe techniques when working around "live" electrical parts.

2. Remove the top covers on the NT unit so you can reach the transformer.
3. Try resetting the Reset switch. If the Reset switch trips again, there is a short-circuit in the 24V AC circuitry or inside the transformer itself.
4. If the power remains on (Reset switch does not trip), you can check for normal voltages:

   120V AC input:
   Black wire on TB1 (120V hot) to white wire on TB2 (neutral)

   24V AC output:
   Blue wire on TB3 (24V hot) to yellow wire on TB4 (common)

   If the meter indicates 120V input, but there is no 24V output, this indicates a bad transformer. If there is no 24V AC output, the operator display will not light up.

Replacement Procedure:

1. Turn off the power to the NT unit. Use the power switch located above the center of the control panel.
2. Disconnect the four wires which run to the transformer. Before removing each wire, carefully note the way it is threaded through the NT unit.
   - black wire to TB1
   - white wire to TB2
   - blue wire to TB3
   - yellow wire to TB4
3. Remove the two bolts which attach the transformer to the frame of the machine.
4. To install the new transformer, reverse the procedure we have just described. Once the power has been turned on again, you may need to press the Reset switch on the bottom of the transformer.

B35 Removing and Replacing the Pressure Relief Valve

If the system pressure exceeds the relief valve setting, the pressure relief valve is designed to open and release the excess pressure and water. Note - This type of valve is designed to relieve a limited number of times during its life cycle, so it is not a good idea to "test" the valve by tripping the small metal handle on top. Sometimes when this type of valve is opened, it will not re-seat correctly, causing a slow leak. If this happens, and the valve cannot be cleared, it must be replaced.

Note -
Normally a drain pipe would run from here to within 6" of the floor.

Fig. B35-1 - Pressure relief valve (typical)

Tools and equipment required:

* Plumber's torch, solder, and flux
- Two pipe wrenches
- Pipe dope or Teflon® tape

Procedure:

1. Turn off power to the system. Use the main disconnect switch mounted above the front panel.
2. Isolate the boiler from the system. To relieve the pressure, open the boiler drain to the right of the heat exchanger.
3. The pressure relief valve is mounted on a pipe that extends up a few inches above the top panel of the NT unit.
4. Disassemble and remove the drain pipe.
5. Unscrew the valve from the vertical pipe using the two pipe wrenches.
6. The replacement valve must be the correct size and capacity to match the size of the NT unit. Check the old valve for two important numbers:
   - The capacity of the old valve, listed in BTU
   - The relief pressure of the old valve, listed in p.s.i.

   These numbers will be marked on the body of the valve. Check for this before you get a replacement. The replacement valve must have ratings for both BTU and psi which ***are the same as or higher*** than the ratings on the old valve
7. Wrap a piece of Teflon® tape around the threads on the end of the vertical pipe. Install the new valve using the two pipe wrenches.
8. Reassemble the drain pipe.

   WARNING! Always re-install the drain pipe. If the pressure relief valve were to open without the drain pipe in place, the boiling water could shoot out, causing personal injury or property damage. Most plumbing codes call for the drain pipe to extend straight down to a point about 6" above the floor. Check your local code.

Ignitor Assembly

The ignitor assembly is a two-rod system that consists of a ground rod and a spark rod.

Adjustment Procedure:

1. Shut off the 120V power supply to the unit.
2. Turn off all manual gas valves connecting the unit to the main gas supply line.
3. Remove the front door of the unit to gain access to the ignitor assembly.
4. The end of each spark rod should be 1/4” away from the burner.
5. Set the gap between the spark rods at 3/16” ± 1/16.”

Replacement Procedure:

1. Shut off the 120V power supply to the unit.
2. Turn off all manual gas valves connecting the unit to the main gas supply line.
3. Remove the front door of the unit to gain access to the ignitor assembly.
4. Remove the two wires connected to the assembly.
5. Remove the two bolts connecting the ignitor assembly to the burner door. Remove the old ignitor assembly.
6. Install a new assembly by reversing the instructions listed above. Replace the ignitor assembly gasket if it is damaged.

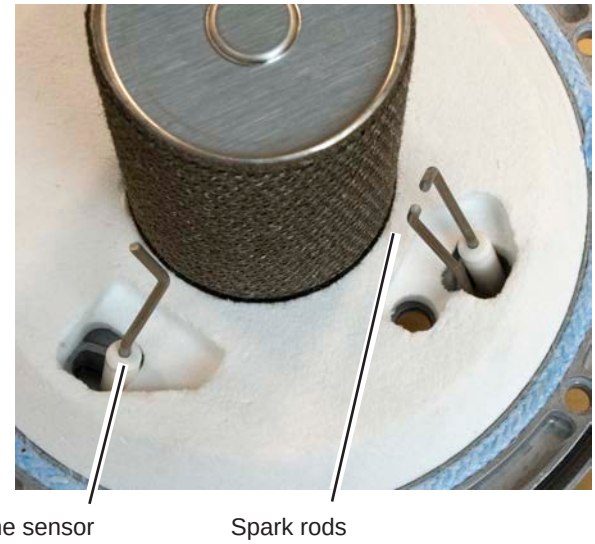


Fig. B36-1 - Spark rods and flame sensor

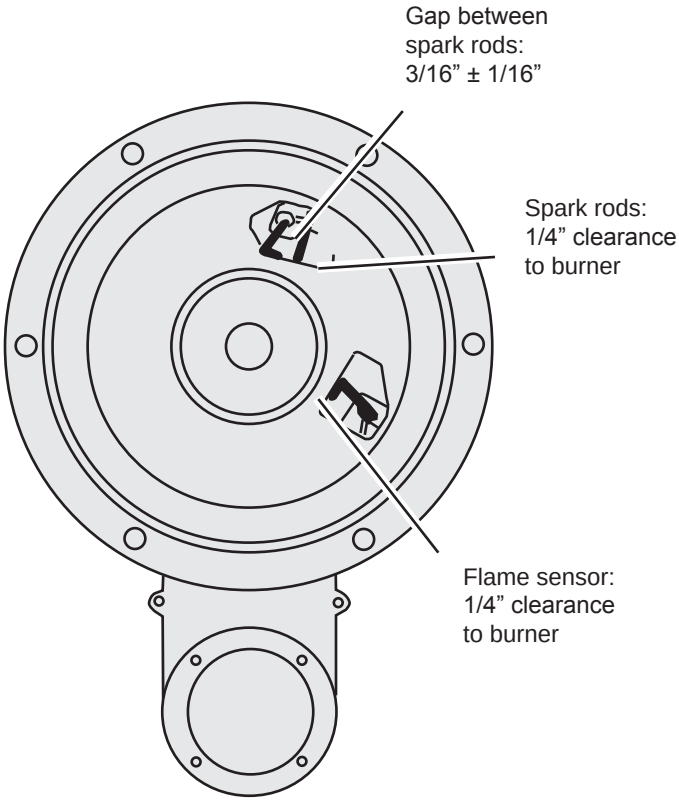


Fig. B36-2 - Correct setting for spark gap

B37 Flame Sensor

The flame sensor is a single-rod system, and is mounted in the front cover of the heat exchanger. Over time, this sensor can become tarnished or coated. (This will happen more quickly if the NT unit has been operating often at a low firing rate.) The flame sensor has a protective coating.

Important! Do not use sandpaper, steel wool, or emery board to clean the flame sensor. These materials will clean the sensor, but they will also remove the protective coating. The sensor will work, but only for a short time.

Fig. B37-1 - Correct way to clean the flame sensor

Adjustment Procedure:

1. Shut off the 120V power supply to the unit.
2. Turn off all manual gas valves connecting the unit to the main gas supply line.
3. Remove the front door of the unit to gain access to the flame sensor electrode.
4. The end of the flame rod should be 1/4” away from the burner. See Fig. B36-2.

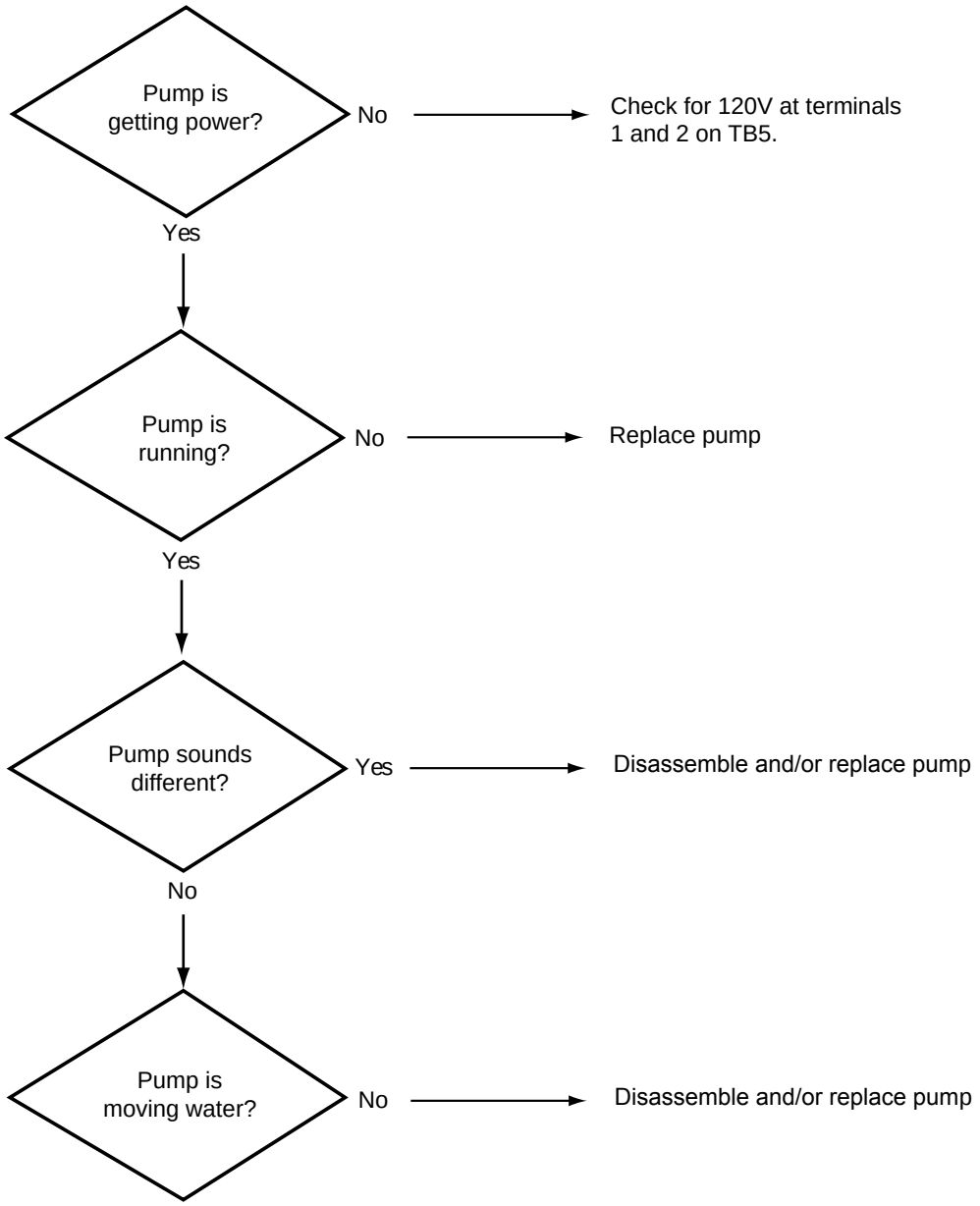
Cleaning or Replacement Procedure:

1. Shut off the 120V power supply to the unit.
2. Turn off all manual gas valves connecting the unit to the main gas supply line.
3. Remove the front door of the unit to gain access to the flame sensor electrode.
4. The best way to clean the flame sensor is to use a dollar bill, as shown in Fig. B37-1. The paper used in the bill is just abrasive enough to clean the sensor correctly, without removing the protective coating.
5. If you need to replace the part, remove the flame sensor wire from the electrode.
6. Remove the two bolts fastening the electrode to the burner door. Remove the old flame sensor.
7. Install a new assembly by reversing the instructions listed above. The end of the flame rod should be 1/4” away from the burner. See Fig. B36-2. Replace the flame sensor gasket if it is damaged.

Pump Fault

B38

A problem with the circulator pump could appear as a #79 error (Outlet High Limit). It could also appear as a #63 error (LCI - Limit Control Input) if the safety chain includes a flow switch. The SOLA controller also can display error #51 - Pump Fault.



About Correct Combustion

When the unit is firing, the gas valve must always supply the correct amount of gas to match the amount of air going through the burner. The ratio of gas to air remains constant, but the control module adjusts the blower speed to adjust for changes in heat load. If the ratio of gas to air is not correct, this will cause poor combustion, and this can cause several different problems:

- Poor combustion can cause the unit to produce carbon monoxide, and this may lead to personal injury or death.
- Poor combustion will make the unit run less efficiently, and cause it to use more gas than necessary.
- Poor combustion can cause maintenance problems, including sooty exhaust and a fouled heat exchanger. Eventually this can reduce the life of the unit.

Before the unit leaves the factory, it is test-fired and the combustion settings are adjusted. However, once the unit is installed, the airflows (air inlet and exhaust) will be different, because of the different arrangements of the inlet and exhaust piping. This is why the combustion settings must be re-set after installation. (For the setup procedure, see the instructions in the following sections.)

Depending on the gas/air mixture, the burner can operate in three different ways:

- When the burner is burning correctly (correct gas and air mixture), enough air is available to combine with the gas, and the flame produces CO_2 ("carbon di-oxide") and H_2O (water). ("Carbon di-oxide" includes two oxygen atoms attached to every carbon atom.)
- When the burner cannot get enough air, the flame is "starved" for air. The flame continues to burn, but since enough oxygen is not available the result is CO ("carbon mon-oxide"). ("Carbon mon-oxide includes just one oxygen atom attached to each carbon atom.) This is dangerous because carbon mon-oxide can replace the oxygen in the air you are trying to breathe. This is the reason for the warnings we have included in this manual.
- Another kind of problem can happen if the flame has too much air for the amount of gas supplied. In this case, the extra air cools the flame temperature. The flame lifts off the burner surface, and begins to produce too much CO.

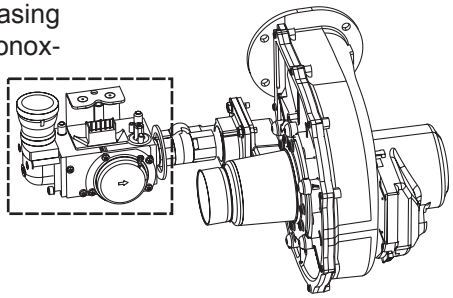
Of course, the main concern is that bad combustion is potentially dangerous, but bad combustion can also cause maintenance problems in the unit. A "sooty" flame can eventually create enough soot to plug up the heat exchanger. So the goal is to set up the burner so that it is always producing the correct amount of CO_2, and the minimum amount of CO. To do this, you use two adjustments on the gas valve: the high- and low-fire CO_2 adjustment screws.

As you adjust the combustion, you will need to set the control system to the High Fire and Low Fire conditions. NeoTherm units have been produced using two different types of user interfaces. In the following section we have listed instructions for both types of interfaces. Please check Section D1 at the end of this manual to identify the type of interface used on your unit.

C2 Combustion Adjustment Procedure - Units with Original (White) User Interface

WARNING

Improper adjustment may lead to poor combustion quality, increasing the amount of carbon monoxide produced. Excessive carbon monoxide levels may lead to personal injury or death.



Equipment required:

- Combustion analyzer
- 2 mm Allen wrench

Procedure:

1. Measure the CO_2 and O_2 in the flue products at High Fire. The NeoTherm must be forced to High Fire to obtain accurate results.

   How to get there: From the "Home" screen, press and hold the Next button for 3 seconds to go to Diagnostic mode. Press the Next button several times until you see "Rate" and "100%." Press the Up arrow. The NT unit is now forced into high fire for 5 minutes.

   The CO_2 readings should be between the values shown in Table C2-1. If the CO_2 is not within the range shown, adjustments may be made. To adjust the high fire CO_2, locate the high fire adjuster screw as shown in Fig. C2-1. Slowly make adjustments in 1/16 of a revolution increments until the CO_2 is within the range identified. For the high fire adjustment, turning the screw counter-clockwise (CCW) makes the mixture richer.

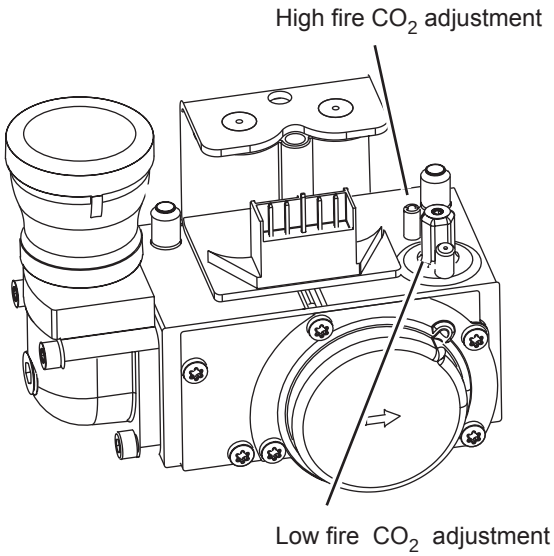


Fig. C2-1 - High- and low-fire adjustments on gas valve

Gas Type	High Fire CO_2	Low Fire CO_2
Natural	8.8% to 9.0%	0.5% lower than high fire CO_2
Propane	9.8% to 10.0%	0.5% lower than high fire CO_2

Table C2-1 - CO_2 Range

Combustion Adjustment Procedure - Units with Original (White) User Interface - continued

2. Once you have completed the high fire combustion test, measure the CO_2/O_2 in the flue products at Low Fire.

   How to get there: Use the Down arrow to set the "Rate" to "20%." The NT unit is now forced to low fire for 5 minutes.

   The CO_2 readings should be between the values shown in Table C2-1. If the CO_2 is not within the range shown, adjustments may be made. To adjust the low fire CO_2, locate the low fire adjuster screw as shown in Fig. C2-1. Slowly make adjustments in 1/16 of a revolution increments until the CO_2 is within the range identified. For the low fire adjustment, turning the screw clockwise (CW) makes the mixture richer.

3. Repeat steps 2 and 3 to confirm that the CO_2 readings are within the required ranges. Adjust each setting again if necessary.

4. Confirm that the differential pressure is still within the appropriate range.

5. If any of the measurements cannot be adjusted to the specified ranges or the CO levels are above 150 ppm when adjusted, see Section C4, "Troubleshooting Combustion Problems."

6. Remove the differential pressure gauge from the air and gas pressure taps making sure to close all ports after the gauge has been removed.

C3 Combustion Adjustment Procedure - Units with Current User Interface

⚠ WARNING

Improper adjustment of the high fire and low fire settings may lead to poor combustion, increasing the amount of carbon monoxide produced. Excessive carbon monoxide levels may lead to personal injury or death.

Equipment required:

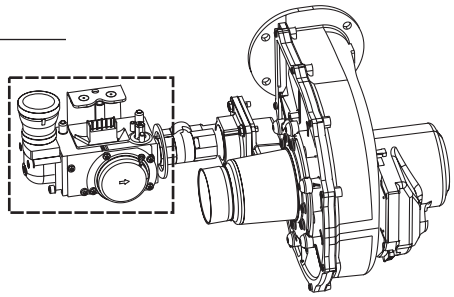
- Combustion analyzer
- 2 mm Allen wrench

Procedure:

1. Start by measuring the CO_2 and O_2 in the flue products at high fire. The controller has a feature that makes it easy to go directly to the high fire condition. The unit will operate at high fire for 5 minutes, then return to normal operation.

   How to get there: From the "Home" screen, press "I" to go to "Info/ Install." Choose "Test," then go to "Forced Rate." Select "Set High Fire," then select "Start Test."

   The CO_2 readings should be between the values shown in Table C3-1. If the CO_2 is not within the correct range, adjust the high fire setting. See Fig. C3-1 to locate the high fire adjuster screw. Slowly make adjustments (1/16 of a turn at a time) until the CO_2 is within the range shown in the table. For the high fire adjustment, turning the screw counter-clockwise (CCW) makes the mixture richer.



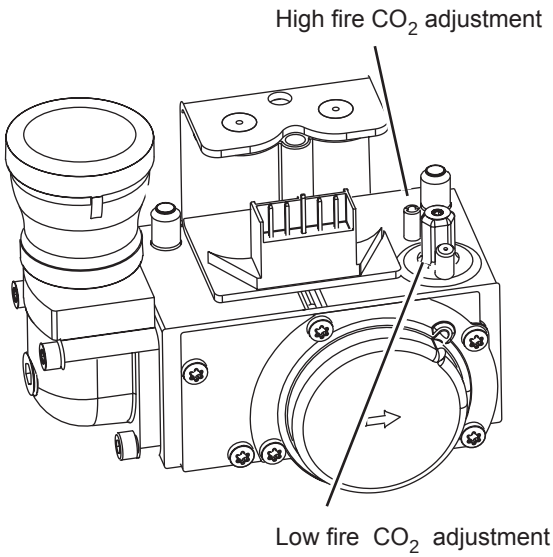


Fig. C3-1 - High- and low-fire adjustments on gas valve

Gas Type	High Fire CO_2	Low Fire CO_2
Natural	8.8% to 9.0%	0.5% lower than high fire CO_2
Propane	9.8% to 10.0%	0.5% lower than high fire CO_2

Table C3-1 - CO_2 Range and Pressure Differential

Combustion Adjustment Procedure - Units with Current User Interface (continued)

2. Next, measure the CO_2 and O_2 in the flue products at low fire. The NeoTherm can be forced to remain in low fire during the setup.

   How to get there: From the "Home" screen, press "I" to go to "Info/ Install." Choose "Test," then go to "Forced Rate." Select "Set Low Fire," then select "Start Test."

   Again, the CO_2 readings should be between the values shown in Table C3-1. See Fig. C3-1 to locate the low fire adjuster screw for your unit. For the low fire adjustment, turning the screw clockwise (CW) makes the mixture richer.

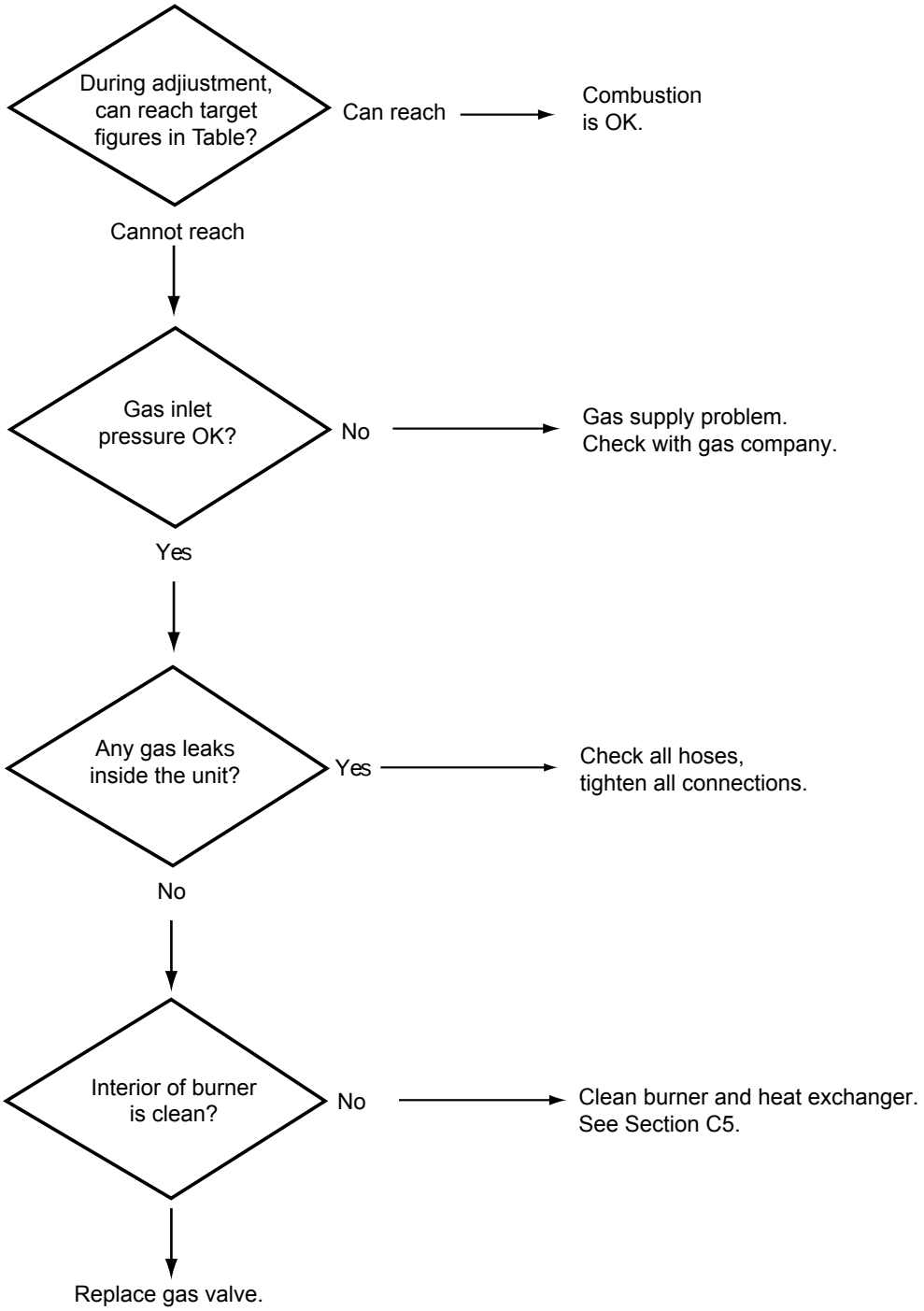
3. You might have to go back and forth between high fire and low fire several times before the CO_2 readings are correct in both cases. Repeat steps 2 and 3 and continue to adjust until the CO_2 readings are stable.

4. Check to see that the differential pressure is still within the correct range.

5. If any of the measurements cannot be adjusted to the specified ranges or the CO levels are above 150ppm when adjusted, see Section C4, "Troubleshooting Combustion Problems."

6. Remove the differential pressure gauge from the air and gas pressure taps. Be sure to close all ports after you remove the gauge.

Troubleshooting Combustion Problems



Cleaning the Burner and Heat Exchanger

C5

The buildup of black carbon soot on the external surfaces of the heat exchanger can be caused by one or more of the following: incomplete combustion, combustion air problems, venting problems, and short-cycling. Soot buildup or other debris on the heat exchanger may restrict the flue passages.

Laars recommends the unit be inspected once a year, and cleaned if necessary. If a condensing boiler is operated consistently at high temperatures, it may need to be cleaned more often.

In order to clean the unit, it is necessary to remove the front of the heat exchanger. Because of the way the air-gas channel is attached to the blower, the simplest way to do this is to remove the whole air-gas channel/ blower/ gas valve assembly. This will require you to disconnect the gas inlet first.

Figure C5-1 shows how the parts are arranged.

Tools and equipment required:

Disassembly/ Reassembly:

- Socket wrench with 10 mm and 13 mm sockets and 4” extension
- 5/16” and 3/8” sockets or combination wrenches
- #25 Torx® driver
- Flat-blade screwdriver
- Gas leak detection solution (i.e. Hercules Megabubble®)
- Electrical tape
- Replacement gasket for front of heat exchanger
- Container for removed parts

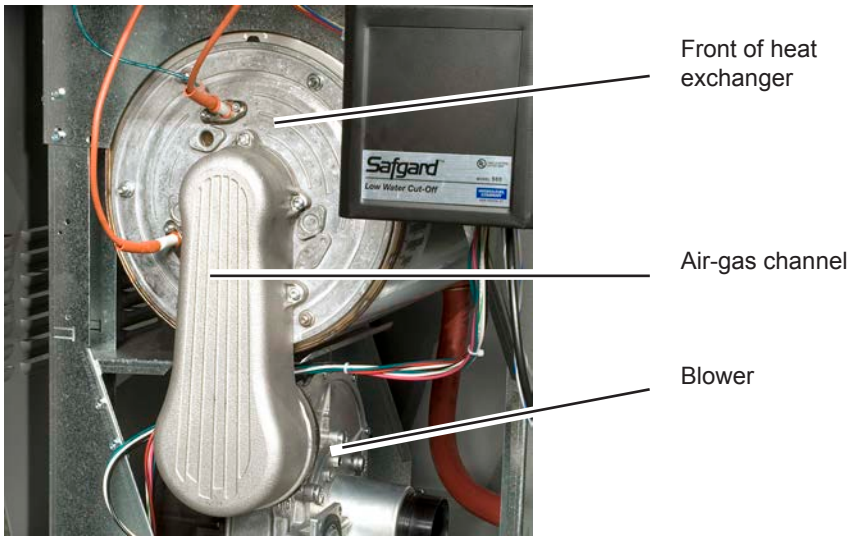


Fig. C5-1 - Front of heat exchanger and other part

Cleaning:

- Long-handled toilet brush or other soft brush
- Furnace vacuum (i.e. SootMaster ®)
- Drain hose (approx. 6’)
- White vinegar

Cleaning the Burner and Heat Exchanger (continued)

Disassembly Procedure:

1. Turn off power to the machine. Use the main disconnect switch on the front of the machine, just above the control panel.
2. Remove the front panel.
3. Shut off the gas at the gas shutoff valve on the right side of the machine (yellow handle).
4. On the left end of the gas valve assembly, remove the four bolts which attach the gas valve assembly to the blower. See Fig. C5-3. The 5/16” socket will fit the head of each bolt. Use the 3/8” socket on the nut on the other end.
5. Behind the gas valve, locate the black rubber air intake hose. Loosen the hose clamp on the left end of this hose, and pull the end of the hose away from the end of the Venturi. Fig. C5-4 shows how the unit will look when you have finished this step.

Fig. C5-2 - Gas shutoff valve (typical)

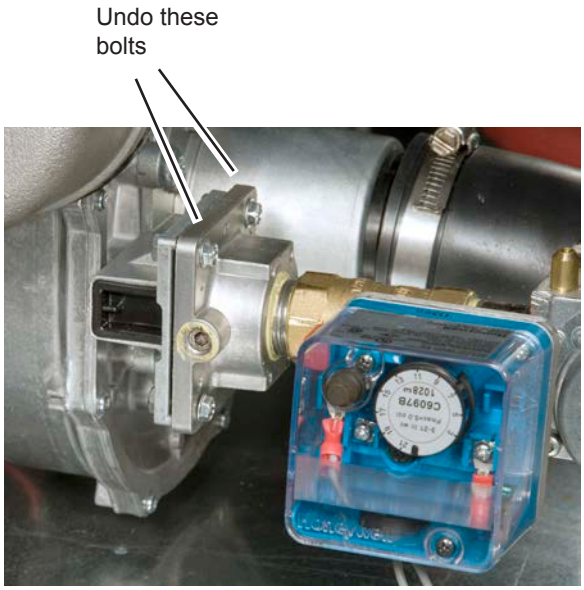


Fig. C5-3 - Undo the four bolts at the left end of the assembly

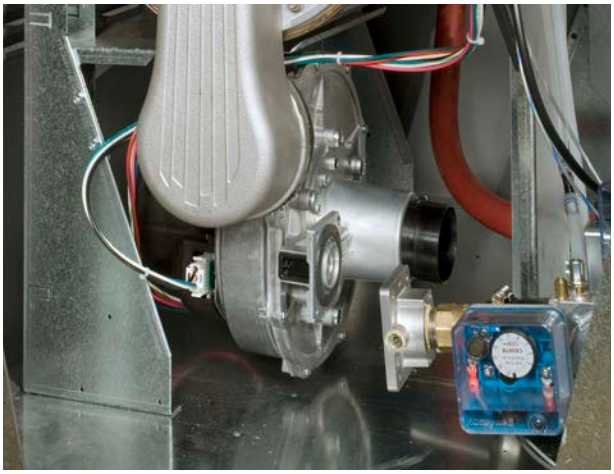


Fig. C5-4 - Gas and air intakes disconnected

6. Disconnect the wires to the blower. See Fig. C5-5. There are two connectors. The power wires run to the front connector, and the control wires connect to the rear.

7. The next job is to separate the front plate on the heat exchanger from the rest of the unit. See Fig. C5-6. Note the two large wires running to this assembly. The spark wire and the flame sense wire look alike. ***The unit will not run if you reverse these wires.*** Before removing the wires, mark the spark wire with a piece of electrical tape. Also disconnect the green ground wire.

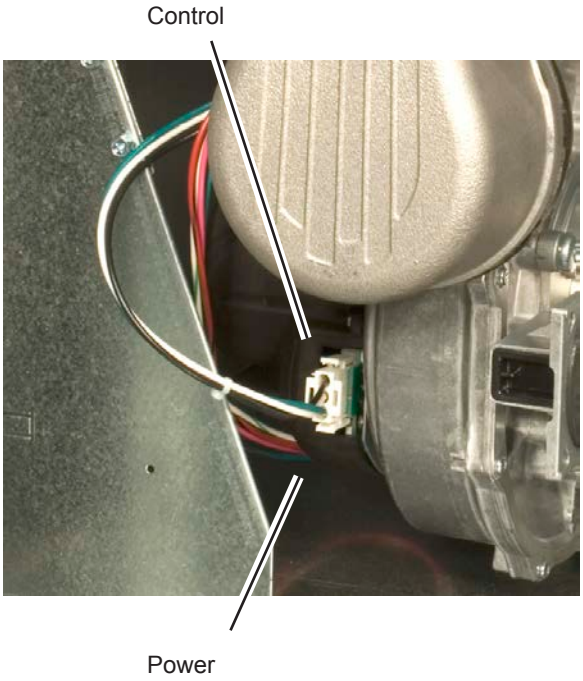


Fig. C5-5 - Wiring connectors for blower

Fig. C5-6 - Disconnect the wires on the front plate of the heat exchanger

Cleaning the Burner and Heat Exchanger (continued)

8. Now you can remove the front of the heat exchanger, with the blower and burner still attached. Undo the six 10mm nuts around the outside of the front plate of the heat exchanger. See Fig. C5-7. As you remove the part, note the position of the large black gasket. This gasket must be replaced every time you clean the unit or remove the front cover of the heat exchanger.

9. Fig. C5-8 shows how the assembly looks after it has been removed.

   Note - The white ceramic refractory material on the inside of the heat exchanger front plate is brittle, and can be damaged easily. Handle the heat exchanger front plate carefully.

Fig. C5-7 - Removing the front of the heat exchanger

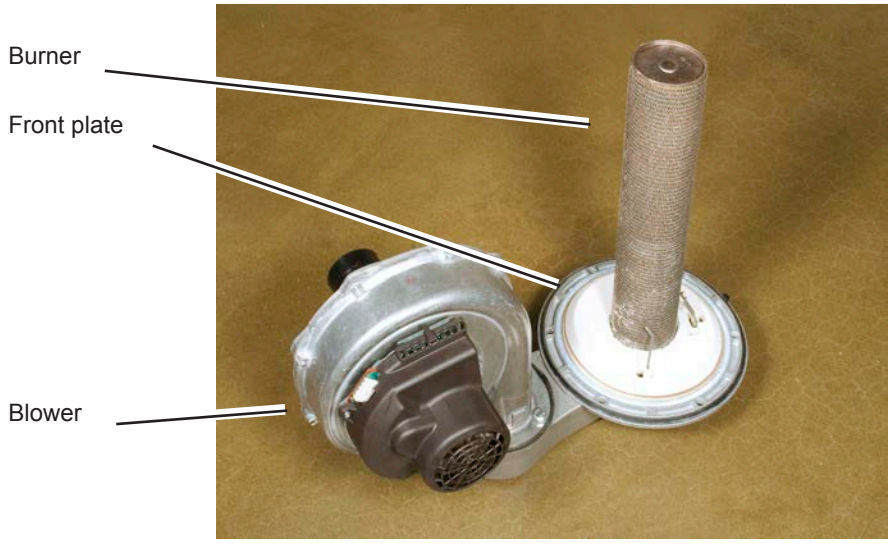


Fig. C5-8 - Blower, front plate, and burner assembled

Cleaning the Burner and Heat Exchanger (continued)

10. Separate the blower from the assembly by removing the four 13mm screws. As you disassemble the parts, note the position of the black gasket.

11. Separate the air-gas channel from the front plate for the heat exchanger. Remove the five #25 Torx® screws.

12. Now you can pull the burner out of the hole in the front plate for the heat exchanger. Normally you will see some soot or dust on the thin metal vanes on the outside of the can. Blow any soot or dust off of the vanes using compressed air (50 psi max.). Wipe out the inside of the can with a non-detergent cleaner like Windex®.

    Note - Be careful when handling the burner. The thin metal vanes are delicate, and can be damaged easily.

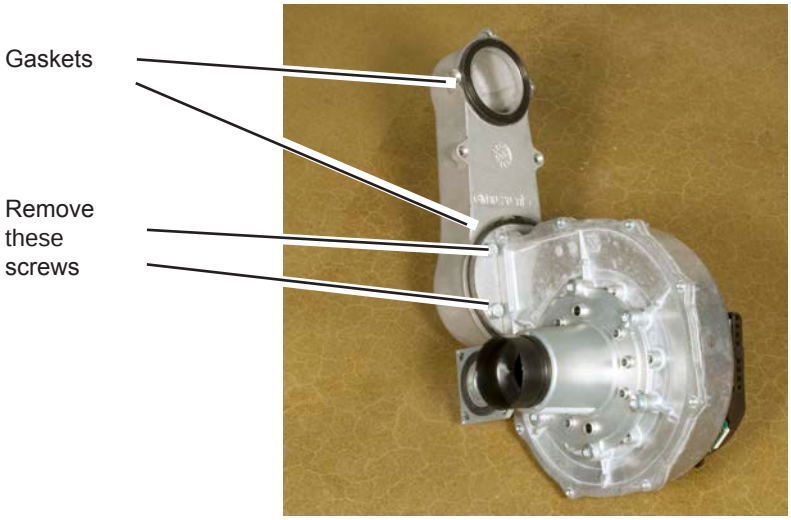


Fig. C5-9 - Separating the blower
(Shown with front cover for heat exchanger removed)

Cleaning the Burner and Heat Exchanger (continued)

Cleaning Procedure:

1. The flame sensor is mounted in the front cover of the heat exchanger. Over time, this sensor can become tarnished or coated. (This will happen more quickly if the NT unit has been operating often at a low firing rate.) The flame sensor has a protective coating.

   Important! Do not use sandpaper, steel wool, or emery board to clean the flame sensor. These materials will clean the sensor, but they will also remove the protective coating. The sensor will work, but only for a short time.

   The best way to clean the flame sensor is to use a dollar bill, as shown in Fig. C5-10. The paper used in the bill is just abrasive enough to clean the sensor correctly, without removing the protective coating.

Fig. C5-10 - Correct way to clean the flame sensor

2. Figure C5-11 shows the inside of the heat exchanger.
   - Black carbon soot can build up on the coils as a result of poor combustion, combustion air problems, venting problems, or short-cycling.
   - If the unit is operated in a non-condensing mode, this can cause mineral granules or “coffee grounds” to build up on the coils. You may also notice a green build-up.

   Any of these conditions can reduce the efficiency of the unit or plug up the flue passages. Your job is to get all of this extra material out of the heat exchanger so that it can operate properly.

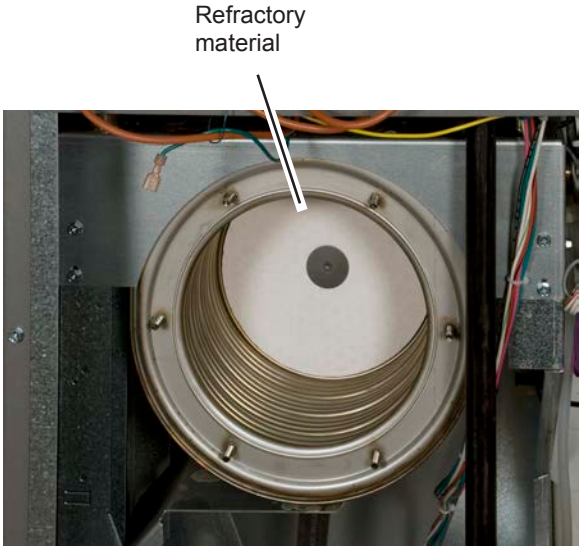


Fig. C5-11 - Inside of heat exchanger (new unit)

The heat exchanger in Fig. C5-11 is new, so it is clean. Figure C5-12 is a photo of a dirty heat exchanger. Normally you will find a heat exchanger that looks like this. However, sometimes a heat exchanger can be really dirty, as shown in Fig. C5-13.

3. Attach one end of the drain hose to the condensate drain located under the heat exchanger. Run the other end of the hose to a bucket or drain.

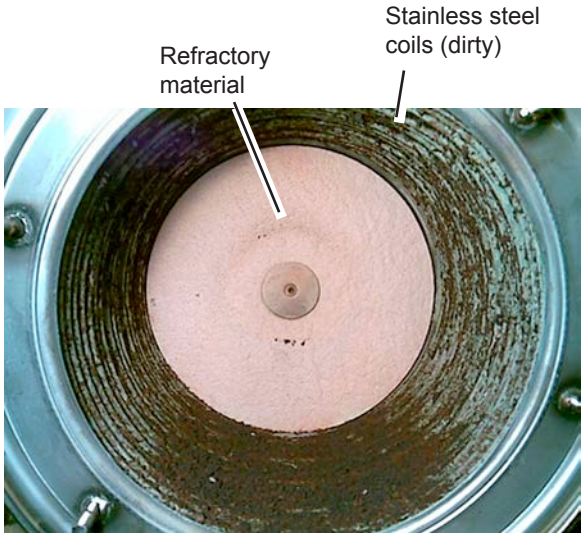


Fig. C5-12 - Dirty heat exchanger

Fig. C5-13 - Very dirty heat exchanger

Fig. C5-14 - Drain hose connected under the heat exchanger

Cleaning the Burner and Heat Exchanger (continued)

4. Clean the heat exchanger by brushing away any soot with the toilet brush, and collecting the dust using a vacuum cleaner. Use the vacuum to remove any mineral granules.

   Caution! Do not use a stiff brush with wire bristles. This can scratch the tubes on the heat exchanger.

   Note - It is not necessary to remove the refractory material at the far end of the heat exchanger.

5. Once the tubes are clean, rinse them with white vinegar. You do not need a lot of vinegar to do this - just enough to flush any remaining dust out of the spaces between the coils.

Reassembly Procedure:

1. To reassemble, reverse the procedure we have just listed.
2. Replace the gasket on the inner surface of the cover for the heat exchanger. Figure C5-15 shows how the gasket should sit in its slot. Replace the gasket (p/n R2069400) if it is damaged.
3. When attaching the front cover of the heat exchanger, tighten the nuts in a cross-pattern. See Fig. C5-16. (If you tighten all of the nuts on one side first, this might bend or distort the cover.)
4. The gas valve includes a rubber washer. See Fig. C5-17. Be sure to insert this in the correct position when replacing the valve.
5. The gas valve has an On/Off switch. When replacing the valve, be sure this is set to On.
6. When re-attaching the gas inlet, remember to position the O-ring correctly. Replace the O-ring if it is damaged. To connect the gas inlet pipe, start by inserting the right rear screw, but do not tighten it completely. This will make it easier to line up the right front screw.
7. Check for gas leaks using a leak detection solution.
8. Finish reassembling the unit and turn on the power and gas. Check for proper venting and combustion air. Fire the boiler and check the combustion using a combustion analyzer.

Fig. C5-15 - Gasket in correct position

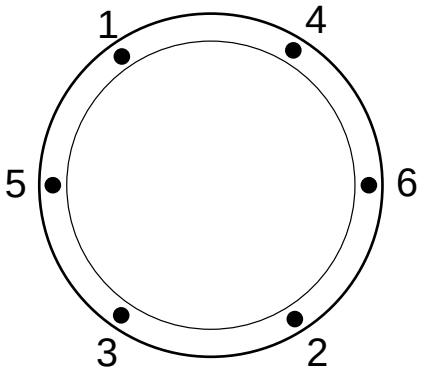


Fig. C5-16 - Tightening sequence for nuts on front cover

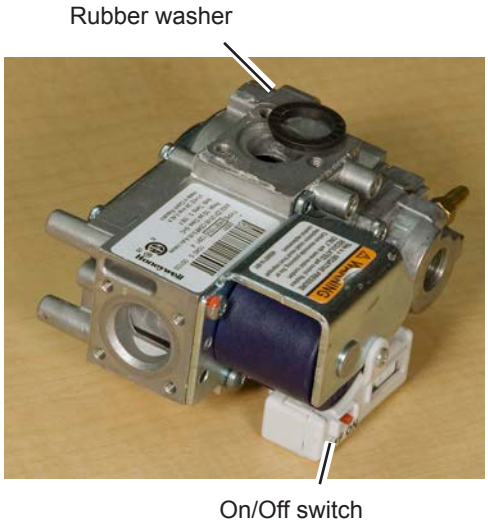


Fig. C5-17 - Gas valve and rubber washer

Identifying the User Interface on Your Unit

D1

There are two main parts to the control system on a NeoTherm unit:

- The “controller” - This is the control module that contains the computer that actually operates the unit. The controller is located inside the cabinet of the unit.
- The “user interface” - This is the control panel that allows the operator to change control settings and get readings from the unit. The user interface is mounted on the front of the unit.

NeoTherm units have been produced with two different types of user interfaces, as shown below. Notice that Laars has been using the same *control module* throughout (the SOLA controller), but the *user interfaces* were changed in 2012. (There were actually two versions of the current user interface, issued before and after October 2012. There are slight differences in the way these two versions operate.)

The type of interface used on your unit will affect the way you navigate between the different control functions. In the following sections, we will include quick summaries of the instructions for the two types of interfaces.

Fig. D1-1
Original (“white”) user interface - 2012 and earlier

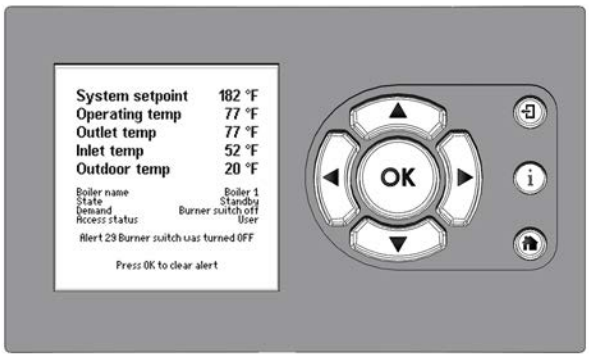


Fig. D1-2
Current user interface - production after 2012

D2 Using the Original (White) User Interface

This interface was used on all NeoTherm models produced through 2012.

There are a few features on this interface that you should know about -

- When the NeoTherm unit is first turned on, the interface will go through a self-test routine for 90 seconds. During this time, none of the buttons will work. Just wait for the self-test to be completed before you try to use the interface.
- The interface records the last lockout and alert codes, but these are erased if the interface is reset or power to the NeoTherm unit is turned off. (We will explain how to handle lockouts on this interface in Section D3.)
- Whenever you change a setpoint or value, you must press the Done button. If you do not do this, the interface will continue to use the old setpoint or value, and the unit may remain in "standby."

The display navigation is divided into three operating modes: User, Setup, and Diagnostic.

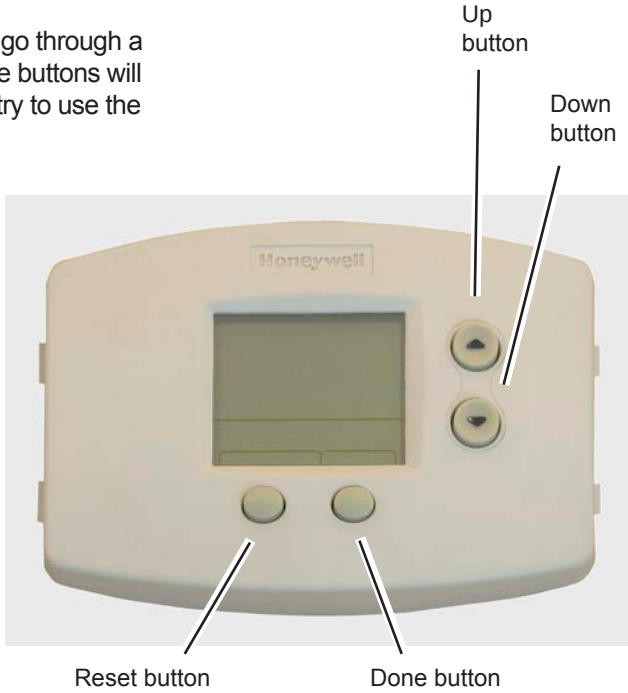


Figure D2-1 -Typical display on original (white) user interface

User Menu

Normally the unit will display the User mode screen shown to the right. Notice the entry for Outlet in the upper left-hand corner. This means the interface is displaying the current outlet temperature.

To check the setpoint for Central Heat, press the Up button. Use the Up or Down buttons to change the setpoint. ***Important*** - You must press the Done button to save the new setpoint, or the interface will use the old setpoint.

To go to the next item in this menu, press the Next button. The interface will show the inlet water temperature. Use the Next button to step through the other items in this menu. See the table to the right.

If you want to change the DHW (domestic hot water) setpoint, use the same procedure we have just described - use the Up and Down buttons to set the new value, then press Done.

MENU ITEM	FUNCTION	RANGE	DEFAULT
Outlet	Displays the current outlet water temperature and allows the setpoint to be adjusted	55-190°F	120°F
Inlet	Displays the current inlet water temperature	—	—
Delta T	Displays the current temperature rise across the heat exchanger	—	—
DHW water temperature	Displays the current DHW temperature and allows the setpoint to be adjusted	60-182°F	120°F
Stack temperature	Displays the current stack temperature	—	—
Outdoor temperature	Displays the current outdoor air temperature	—	—
Firing Rate	Displays the current firing rate based on fan RPM.	—	—
LL	Displays the current system temperature for Lead/Lag operation and allows the setpoint to be adjusted	60-190°F	120°F

Table D2-1 - User Mode Menu Structure

Setup Menu

To go to the Setup Mode, press and hold the Up and Down buttons at the same time for about three seconds. The interface will indicate "°F."

Press Next to go to the setup for Outdoor Reset (shown as "LBT HOD LOD"). Use the Up button to turn on the Outdoor Reset feature, if desired. Once this is enabled, press Next to go to the lines for Low Boiler Setpoint (LBT), High Outdoor Temperature (HOD), and Low Outdoor Temperature (LOD). To change any of these, use the Up and Down buttons. (You do not need to press Done yet.)

Use the Next button to step through the other items in this menu. To see the current setpoint for an item, press the Next button. Then use the Up and Down buttons to change the setpoint.

Important - When you want to leave the Setup Mode, press the Done button to save any changes you have made. If you do not do this, the system will use the old setpoints.

MENU ITEM	DEFINITION
F or C	Selects temperature units
LBTHODLOD	Outdoor reset enable/disable - enables following menu items
LBT	Low boiler setpoint during outdoor reset
HOD	High outdoor temperature setpoint
LOD	Low outdoor temperature setpoint
RMT Add	Remote address - used for Lead/Lag setup
LL	Lead/Lag enable/disable - enables menu items
HS	Hysteresis - temp range between on/off cycles
bL	Base Load % - input rate before next boiler fires
Sd	Warm weather shut-down temperature
ASC	Anti short cycle - minutes of delay between startups

Table D2-2 - Setup Mode Parameters

Diagnostic Menu

Diagnostic Mode allows you to see any alerts or lockouts. This mode is also used to set up the "high fire" and "low fire" conditions so you can do the gas valve/CO_2 adjustment.

To go to the Diagnostic Mode, press and hold the Next button for three seconds. The display will indicate a value, followed by "µA." This is the signal from the flame sensor.

Press Next again to see the last alert (since the unit was last turned on), and press Next again to see the last lockout. (There is a list of the lockout codes in the Appendix at the end of this manual.) The table below shows the other functions in the Diagnostic Mode. Use the Next button to step through these functions.

For combustion testing, forced high and low fire are accessed from this menu. See Section C2 for instructions.

MENU ITEM	DESCRIPTION
µA	Displays the flame sense signal
Alert codes	Displays the current alert code
Lockout code	Displays the current lockout code
Outlet Limit	Displays the outlet temperature limit
DHW limit	Displays the Domestic Hot Water limit setting
Stack Limit	Displays the Stack limit setting
Min. firing rate	Displays the minimum firing rate allowed
Min. forced firing rate	Allows the user to force the boiler to fire at the minimum firing rate
Max forced firing rate	Allows the user to force the boiler to fire at the maximum firing rate
Rate indicator	Displays the current firing rate based on the fan RPM.

Table D2-3 - Diagnostic Mode Menu Structure

D3 Reacting to Lockouts on the Original (White) User Interface

The system responds to three kinds of trouble indications:

- A ”lockout” is caused by a serious problem that might involve a safety issue. Once the controller enters a lockout, the burner will shut down, and will not be allowed to run again until the cause of the problem is corrected, and you reset the control system.
- The system may enter a “hold” for a period of time before locking out. This allows the controller to see if the error is corrected before it goes to a hard lockout.
- An “alert” indicates that some feature of the control system’s operation was not correct, delayed, or waiting for a response. This does not necessarily indicate a problem.

Here is the procedure used to recover from a Lockout.

- The “Lockout” indication will appear in the lower left-hand corner of the display, and the lockout code will flash in the center.
- Write down the lockout code, and look it up in the Appendix at the end of this manual.
- Press the Reset button near the lower left-hand corner of the display. This will reset the lockout, and the lockout code will disappear. (This is why we told you to write it down.)

If the problem condition is still present, the unit will lockout again. See Section A for troubleshooting instructions.

You can also check the last lockout or alert code using the Diagnostic mode of the display:

Press and hold the Next button until the display shows the flame signal followed by “µA.” This tells you the display is in the Diagnostic mode.

Press Next again to see the last alert. Press Next one more time to see the last lockout.

Removing and Replacing the Original (White) User Interface

D4

Please check the troubleshooting instructions in Section A before replacing the user interface. Here is the removal/ replacement procedure:

1. Turn off all power to the NeoTherm unit, and shut off all manual gas valves.
2. Remove the front door on the NeoTherm, and remove the plastic bezel from the control panel.
3. Disconnect all of the wiring connections to the control module. (The connectors are keyed so that they can only be inserted one way. Be careful not to bend the wires sharply or pull them out of the connectors.)
4. To remove the user interface, push in on the two tabs on the left side of the board to unlatch the clips from the control panel. Rotate the board around the fastening points on the right side to separate the hooks from the board.
5. To replace the part, repeat the steps listed above in the reverse order. Be sure to re-connect all of the wiring connectors in their proper locations.

D5 Using the Current User Interface

This interface is used on all NeoTherm models produced since 2012.

The table below lists the functions of the various parts of the user interface. In a moment, we will explain how to use the buttons to reach the different sections of the control system.

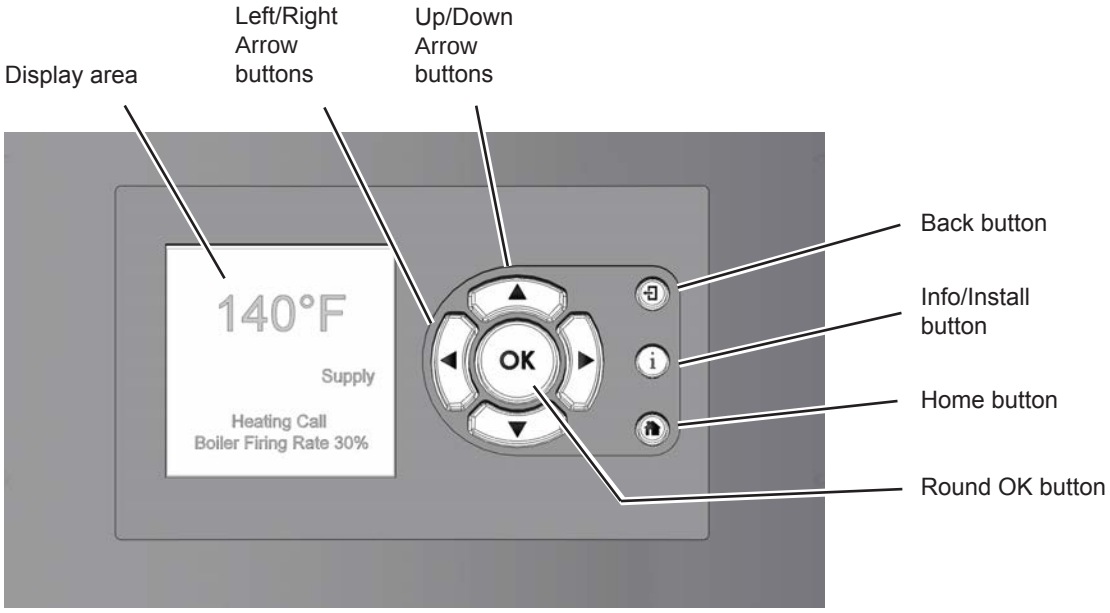


Fig. D5-1 - Control buttons on current user interface

Display area	This area displays several different kinds of information, including current operating information, setup parameters, and messages from the SOLA controller.
Up/ Down Arrow buttons	Use these to go to the choice you want to select in the display area, then press the round OK button.
Left/ Right Arrow buttons	Use these to go to the choice you want to select in the display area, then press the round OK button.
Back button	Use this to go back to the previous display.
Info/ Install button	Press this button at any time to go to the sub-menus that allow you to set up and monitor the controller.
Home button	Press this button at any time to go back to the Home display. (See the section on “Home Display.”)
Round OK button	Use the round OK button to confirm a value or action. Note – Sometimes the system will present the Keyboard display screen, which also includes a separate “OK” area. This is not the same as the round OK button – the two have different functions.)

Table D5-1 - Button Functions on Current User Interface

Home Display

When the boiler is operating normally, the controller will display the Home display. See Fig. D5-2.

The screen display area has three sections:

- The upper section of this screen displays the most important operating information for the unit. In the example shown here, the display is showing the system setpoint, the operating temperature, the outlet and inlet temperatures for the water entering and leaving the boiler, and the outdoor temperature.

  (Note that the five lines at the top of the screen are customizable, and may be arranged differently on your system.)

- The central section shows some additional operating and setup information. In this case, this area lists the boiler name, boiler state, current demand, and the current password level (the "access status").

- The lower section shows any current lockouts, holds, or alerts.

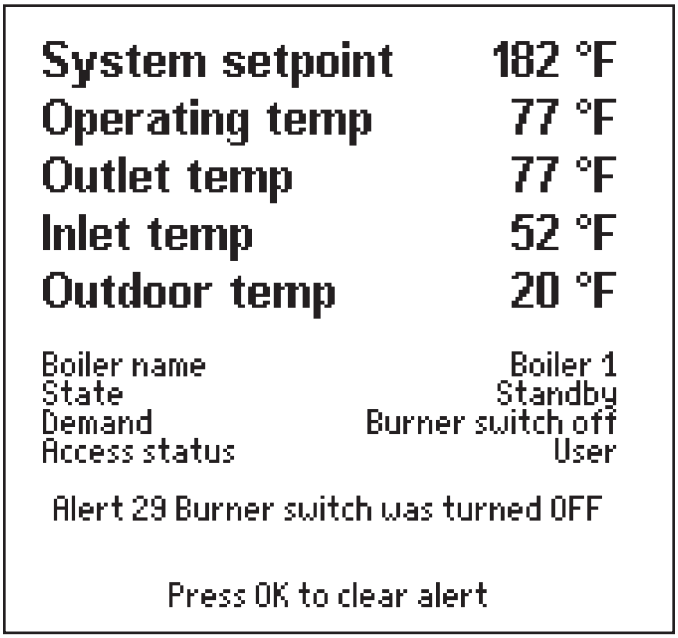


Fig. D5-2 - Home display

Info/Install Display

From the Home display shown in Fig. D5-2, press the "I" button ("Info/ Install"). The display will change to show the six sub-menus available. See Fig. D5-3.

- To move from one choice to another, use the Left- and Right-Arrow buttons or the Up- and Down-Arrow buttons.
- Once you have highlighted the choice you want, press the round OK button.

Table D5-2 shows the functions listed under each of the sub-menus.

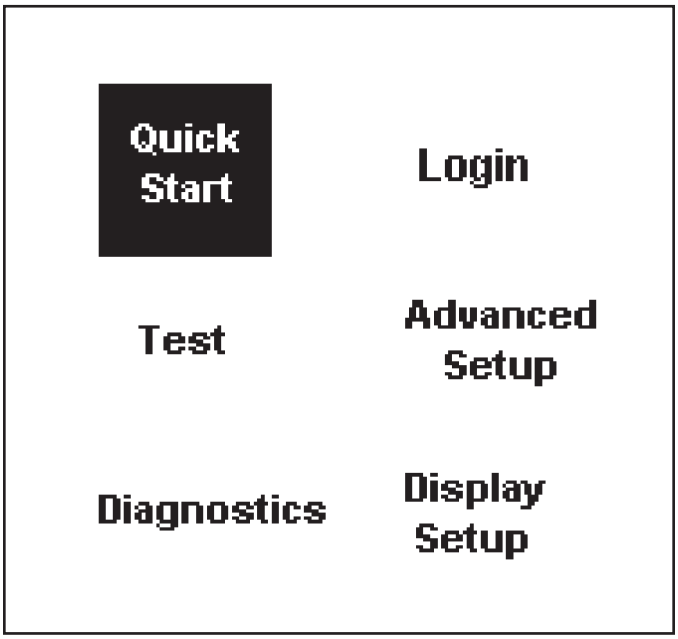


Fig. D5-3 - Info/ install display

Using the Current User Interface - continued

Quick Start	This menu gives you an easy way to check or change the most common settings on the unit: • CH setpoint • DHW setpoint • Outdoor reset (Note - On some units you cannot disable this function) • Low water temperature • Maximum outdoor temperature • Minimum outdoor temperature • Adjustable high limit • Adjustable low limit
Login	If you want to change a setup value or function, and the system requires a password, you can enter it here.
Test	These parameters let you set the burner operation for combustion testing, and control pump operation.
Advanced Setup	The sub-menus listed here allow you to set up most of the functions on the controller. (For many of these functions, the system will require a password before it will allow you to make changes.)
Diagnostics	Use the Diagnostics to check the status of the sensors and the digital inputs and outputs. The system also records a history of lockouts and alarms.
Display Setup	You can use this option to adjust the contrast of the display or change the items which appear at the top of the Home display.

Table D5-2 - Functions on Info/ Install Menu

Changing a Value

The procedure for changing a control value used by the system is listed below. (In this example, we will use the screen for the CH Setpoint.)

- Use the Up- and Down-Arrow buttons to step down through the list until you have highlighted the correct line on the display.
- Press the round OK button to select that line. Figure D5-4 shows a typical screen for this type of setting.
- The current setting for the setpoint appears in the box at the top of the screen. In this example, this is 182°F.
- The numbers near the left edge of the screen show the allowable range for this value. In this case, the setpoint can be set anywhere between 190°F and 55°F.
- Press the Up- and Down-Arrow buttons to scroll the setpoint until you see the correct value in the box.
- When the value is correct, press the round OK button.

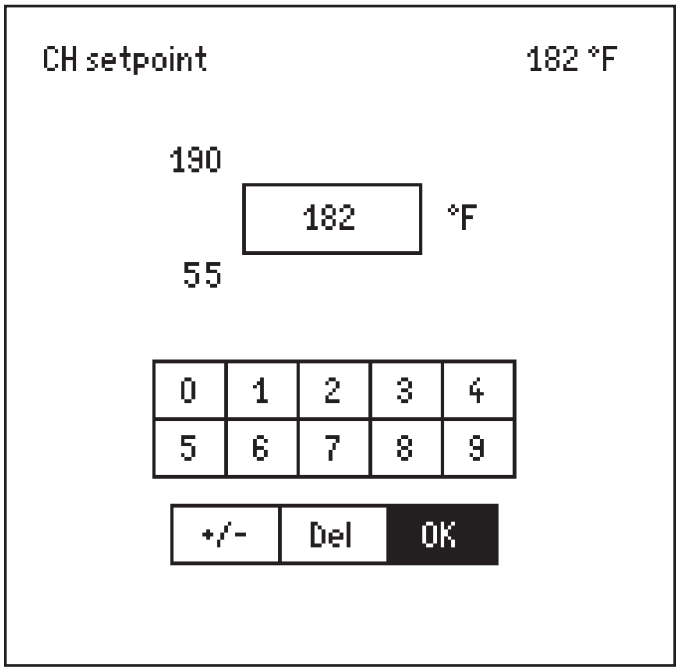


Fig. D5-4 – Changing a value

You will notice that the system did not ask you for a password, so this is one of the values that can be changed by anyone.

Entering a Time

The controller uses several different timing functions, and you can change some of these. (In the example shown in Fig. D5-5, we will use the screen for the Anti Short-Cycle Time.

- The current setting appears in the upper right-hand corner of the screen. In this example, this is 1 minute.
- The numbers near the left edge of the screen show the allowable range for this value. In this case, the time can be set anywhere between 1 minute and 15 minutes.

In this example we will change the time delay to 5 minutes.

- Press the Left- and Right-Arrow buttons to move to the box you want. In this case, we want to change the middle box - the box for Minutes.
- Use the Up- and Down-Arrow buttons to change the value in that box.
- You can change the numbers in the other boxes in the same way.
- When the new setting is correct, press the round OK button.

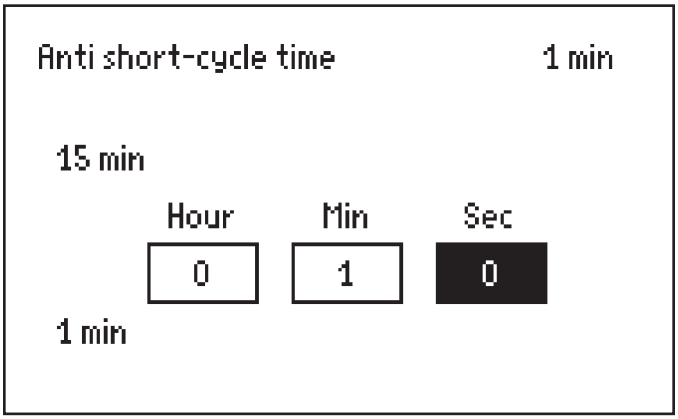


Fig. D5-5 - Changing a timing function

Using the Current User Interface - continued

Entering a Password or Name

The system uses a different type of screen to enter a password or name. If you want to change a setup value or function, and the system requires a password, you can enter it using the Login screen.

There are two ways you can reach this screen:

- From the Info/ Install screen, select Login.
- If you try to change a function that requires a password, the unit will prompt you to log in. See Fig. D5-6.

The controller for this unit uses three levels of password protection:

User Level - Some of the settings can be changed or read by anyone, without a password. These non-critical adjustments and functions include setting the Central Heat and Domestic Hot Water setpoints, monitoring the input and output variables, reading parameters from the controller, and reading the error log.

Installer Level - Settings that might affect the safe operation of the unit can only be changed by a trained technician who enters a password. These include setup and parameter changes made when the system is installed, and some diagnostic and troubleshooting functions. The installer level password is "lnt" (lower case "LNT").

OEM Level - Some of the settings can only be changed at the Laars factory.

Once you enter a password, the password access remains valid until you exit to the normal no-password state. If you do not make any edits for 10 minutes, the password access will be cancelled.

The areas on the Login display are arranged a bit like a computer keyboard.

- To enter a letter or number, use the Up-, Down, Left- and Right-Arrow buttons to highlight the character you want to use, then press the round OK button. You will see the character appear in the line at the top of the screen.
- When the characters in the line at the top of the screen are correct, move to the OK space at the bottom of the screen, and press the round OK button. This will send the new "string" of characters to the controller.

Fig. D5-6 – Password required

Fig. D5-7 – Login screen

Turning a Function On and Off

Some of the values can be enabled or disabled. Figure D5-8 shows one example.

- Use the Up- and Down-Arrows to highlight the line you want, then press the round OK button.

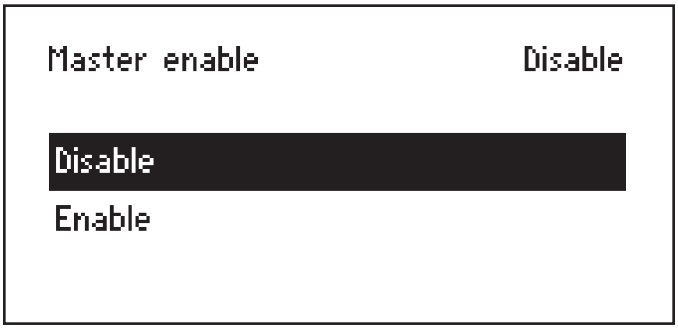


Fig. D5-8 - Enable/ disable screen

Changing a Value Using a "Slider"

There is another type of control screen you may see. This type of screen uses a "slider" to set the value. This system is used on the LCD Contrast screen (available under Display Setup.) See Fig. D5-9.

- Use the Left- and Right-Arrow buttons to move the bar and adjust the contrast.
- When the setting is correct, press the round OK button.

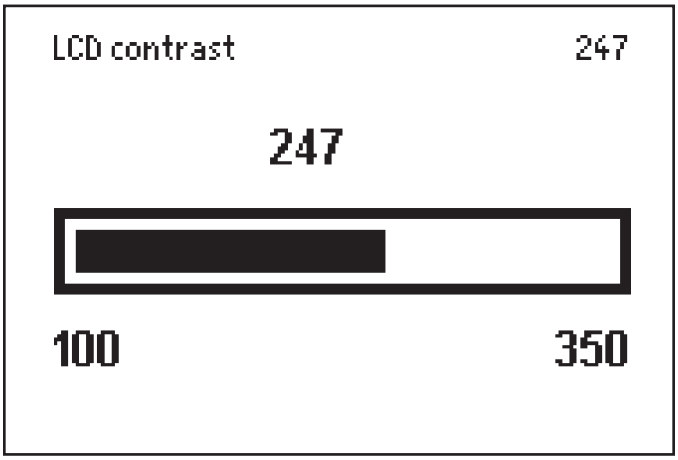


Fig. D5-9 – Changing LCD contrast

Using the Diagnostics -

Use the Diagnostics to check the status of the sensors and the digital inputs and outputs. The system also records a history of lockouts and alarms.

Analog Sensors -You can use this display to check on operating temperatures, fan speed, firing rate, etc. (The word "analog" refers to values that can change continuously between zero and a higher value.) The values shown here are "Read Only" – you can't change them from this display.

Digital Input/Output -This display shows whether different functions, inputs and outputs are either on or off. The functions listed here include pumps, valves, alarms, etc. The values shown here are "Read Only" – you can't change them from this display.

History - The system records the most recent lockouts or alerts. (If there is a current lockout or alert, a note about this will also appear at the bottom of the Home screen.)

D6 Reacting to Lockouts on the Current User Interface

The system responds to three kinds of trouble indications:

- A"lockout" is caused by a serious problem that might involve a safety issue. Once the controller enters a lockout, the burner will shut down, and will not be allowed to run again until the cause of the problem is corrected, and you reset the control system.
- The system may enter a "hold" for a period of time before locking out. This allows the controller to see if the error becomes resolved prior to the hard lockout.
- An "alert" indicates that some feature of the control system's operation was not correct, delayed, or waiting for a response. This does not necessarily indicate a problem.

If a problem occurs while the system is starting up, the system will declare a Hold. A brief explanation of the cause of the Hold will appear in a line across the bottom of the screen.

If a serious problem continues, the system will declare a Lockout. A brief explanation of the cause of the Lockout will appear in a line across the bottom of the screen. Correct this by pressing the OK button. You can also press the Reset button on the SOLA controller. See Fig. D6-1.

If an Alert occurs while the system is running, the system will present a note in a line across the bottom of the screen.

Each error message includes a number. For a more detailed description of each message, see the Appendix at the end of this manual.

Fig. D6-1 – Resetting the SOLA controller

Removing and Replacing the Current User Interface

Tools and equipment required:

* Soft cloth (clean towel, etc.)
- Small Phillips-head screwdriver (size #1)

Procedure

1. Turn off power to the system. Use the main disconnect switch mounted above the front panel.
2. Place the soft cloth on top of the NT unit.
3. Pull the upper front panel outward. Grip the two handles, and pull straight out. Once the panel is free, handle it carefully, because the wires will still be connected. Swing the panel up and place it, face down, on the cloth.

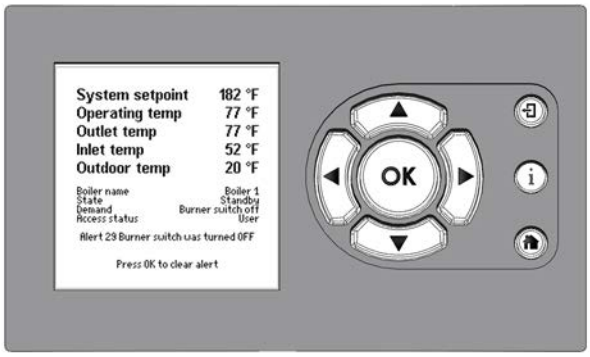


Fig. D7-1 - Current user interface

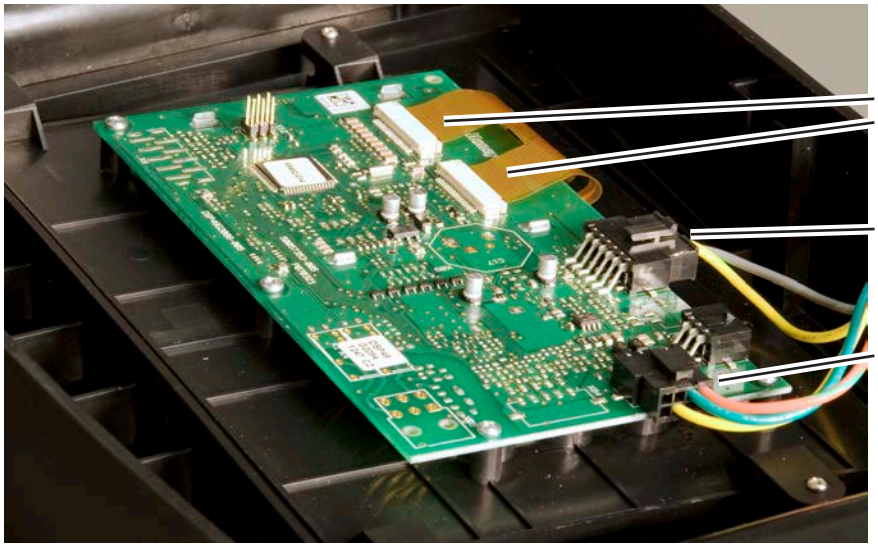


Fig. D7-2 - Removing the connectors

4. Disconnect the two wiring connectors:
   - 8-pin connector X07
   - 12-pin connector X01

   Each connector is held in place by a locking tab. To release the connector, push the tab down.
5. Disconnect the two ribbon-cable connectors.
6. Remove the four Phillips-head screws and separate the user interface board from the back of the front control panel.
7. Below the circuit board you will see the button actuator. This is a small soft plastic part that is part of the button assembly. Be sure this part remains in the position shown in the photo.

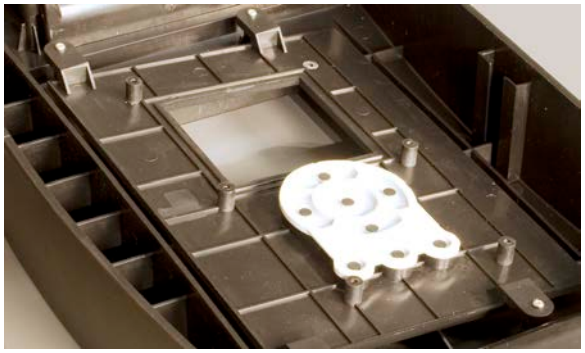


Fig. D7-3 - Placing the button actuator

D7 cont. Removing and Replacing the Current User Interface (continued)

7. Place the new circuit board in position and replace the screws.
8. Plug in the two ribbon cable connectors.
9. Plug in connectors X01 and X07.
10. Replace the front panel assembly.
11. Turn on power to the unit.

D8 When to Replace a SOLA Controller

When a technician is troubleshooting a problem with a NeoTherm unit, because the Honeywell SOLA controller is the most complicated part, it's tempting to assume that the controller is causing the problem. Usually the problem is caused by an input (a sensor or switch), or by a programming problem.

Don't automatically assume that every problem is caused by a bad controller.

Laars uses the same SOLA controller in many different NeoTherm models. The controllers are programmed differently for the different NeoTherm models. The replacement must be programmed at the factory for the specific model of the NeoTherm unit in which it will be used.

Removing and Replacing the SOLA Controller

D9

All of the NT units use the SOLA controller. This procedure explains how to remove and replace this controller.

Notice that, as installed in the NT unit, the SOLA controller is mounted "upside down." This does not affect the way the controller operates.

If you order a replacement, the SOLA controller will arrive with the EEPROM (programming software) already installed. The programming is different from one model of NT unit to the next. This means that the SOLA controllers are not interchangeable. When you order the replacement, you must specify the exact model of NT unit you have.

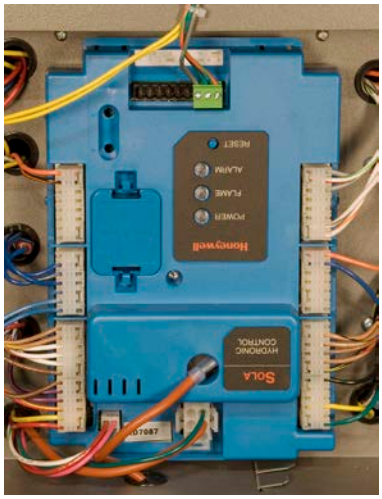


Fig. D9-1 - Honeywell SOLA controller

Tools and equipment required

- 1/4" socket

Procedure

1. Before you begin, record all of the existing control settings, if possible. This will allow you to re-enter the settings after you install the new controller. Record the current settings for temperature setpoints, outdoor reset, and lead/lag.
2. Turn off power to the system. Use the main disconnect switch mounted above the front panel.
3. Remove the front panel from the unit by pulling it straight out.
4. Disconnect the wires and cables leading to the unit:

   At the top of the controller:

   - Disconnect the green connector. (Notice that this is plugged into the right end of the socket. Be sure to replace it in the correct position.)

   On the left side of the controller (reading top to bottom):

   - Disconnect connector CP10 from J10
   - Disconnect connector CP9 from J9
   - Disconnect connector CP8A from J8 (upper part)
   - Disconnect connector CP8B from J8 (lower part)

   On the bottom of the controller:

   - Unplug connector J2
   - Unplug connector J1

Removing and Replacing the SOLA Controller (continued)

On the right side of the controller (reading top to bottom):

- Disconnect connector CP6 from J6
- Disconnect connector CP5 from J5
- Disconnect connector CP4A from J4 (upper part)
- Disconnect connector CP4B from J4 (lower part)

At the lower center of the controller:

- Disconnect the large orange spark cable

5. Now you can remove the controller itself. The controller is attached to the support plate by four clips. To remove the control, push the lower ends of the left side clips, and swing the left side of the control toward you.
6. Mount the new controller using the four clips.
7. Replace the wires and cables listed above. The cables and connectors are all labeled.
8. Replace the front cover and turn on the power to the unit.
9. You may need to reset the control on initial startup. Press the "OK" button to reset the control.

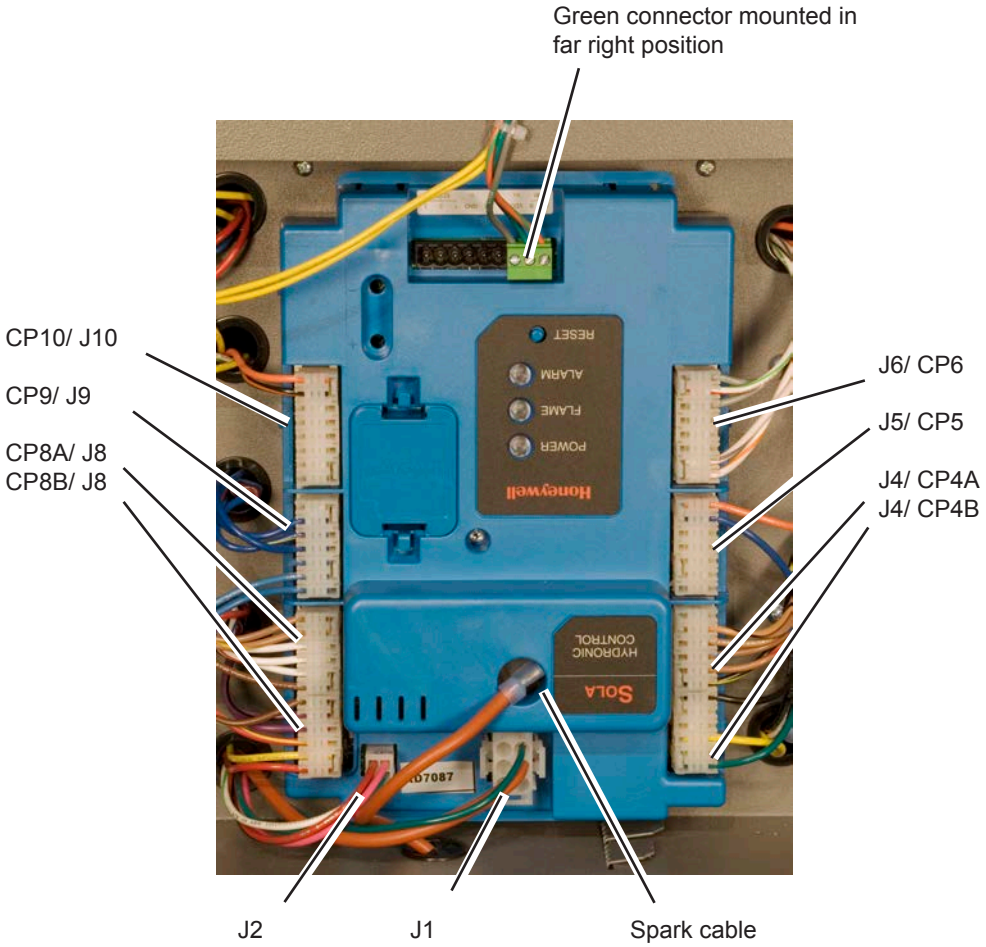


Fig. D9-2 - Connectors on the SOLA controller

Appendix 1 - Error Codes

This table includes a listing of the faults that might be generated by the controllers, and displayed on the Operator Interface. Some of these can be corrected by an installer changing a parameter, while other conditions are more complicated, and will require a service technician.

The first column lists the code number that will appear at the beginning of the Lockout or Hold message in the orange bar at the bottom of the screen. The second column lists the text as it will appear on the Operator Interface. The third column shows whether the condition will cause a Hold, or Lockout, or both. The fourth column lists some suggestions for corrective action.

Code	Description	L or H	Procedure
1	Unconfigured safety data	L	1. New device, complete device configuration and safety verification. 2. If fault repeats, replace module.
2	Waiting for safety data verification	L	1. Device in Configuration mode and safety parameters need verification and a device needs reset to complete verification. 2. Configuration ended without verification, re- enter configuration, verify safety parameters and reset device to complete verification. 3. If fault repeats, replace module.
3	Internal fault: Hardware fault	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
4	Internal fault: Safety relay key feedback error	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
5	Internal fault: Unstable power (DC) output	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
6	Internal fault: Invalid processor clock	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
7	Internal fault: Safety relay drive error	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
8	Internal fault: Zero crossing not detected	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
9	Internal fault: Flame bias out of range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
10	Internal fault: Invalid burner control state	L	Internal fault 1. Reset module 2. If fault repeats, replace module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
11	Internal fault: Invalid burner control state flag	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
12	Internal fault: Safety relay drive cap short	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
13	Internal fault: PII (Pre-Ignition Interlock) shorted to ILK (Interlock)	H or L	Internal fault 1. Reset module 2. If fault repeats, replace module.
15	Internal fault: Safety relay test failed due to feedback on	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
16	Internal fault: Safety relay test failed due to safety relay off	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
17	Internal fault: Safety relay test failed due to safety relay not off	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
18	Internal fault: Safety relay test failed due to feedback not on	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
19	Internal fault: Safety RAM write	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
20	Internal fault: Flame ripple and overflow	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
21	Internal fault: Flame number of sample mismatch	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
22	Internal fault: Flame bias out of range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
23	Internal fault: Bias changed since heating cycle starts	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
24	Internal fault: Spark voltage stuck low or high	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
25	Internal fault: Spark voltage changed too much during flame sensing time	H	Internal fault 1. Reset module 2. If fault repeats, replace module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
26	Internal fault: Static flame ripple	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
27	Internal fault: Flame rod short to ground detected	H	Check flame rod - See Section B37. Internal fault in SOLA controller: 1. Reset module 2. If fault repeats, replace module.
28	Internal fault: A/D linearity test fails	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
29	Internal fault: Flame bias cannot be set in range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
30	Internal fault: Flame bias shorted to adjacent pin	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
31	Internal fault: SOLA electronics unknown error	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
32-46	Internal fault: Safety key 0 through 14	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
47	Flame rod to ground leakage	H	Check flame rod - See Section B37. Internal fault in SOLA controller: Internal fault 1. Reset module 2. If fault repeats, replace module.
48	Static flame (not flickering)	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
49	24 VAC voltage low/high	H	1. Check the module and display connections. 2. Check the module power supply and make sure that frequency, voltage and VA meet the specifications. See Section B2.
50	Modulation fault	H	Internal sub-system fault. 1. Review alert messages for possible trends. 2. Correct possible problems.
51	Pump fault	H	Internal sub-system fault. 1. Review alert messages for possible trends. 2. Correct possible problems.
52	Motor tachometer fault	H	Check the blower. See Section B22. Internal sub-system fault in SOLA controller: 1. Review alert messages for possible trends. 2. Correct possible problems.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
53	AC input phases reversed	L	1. Check the module and display connections. 2. Check the module power supply and make sure that both frequency and voltage meet the specifications. 3. On 24 VAC applications, assure that J4 terminal 10 and J8 terminal 2 are connected together.
59	Internal fault: Mux pin shorted	L	Internal fault. 1. Reset module. 2. If fault repeats, replace module.
61	Anti short cycle	H	Will not be a lockout fault. Hold only. See Section A9.
62	Fan speed not proved	H	Will not be a lockout fault. Hold only. It is normal to see this during startup only.
63	LCI (Limit Control Input) off Problem with safety interlock chain	H	1. See Section A8 . Check wiring and correct any faults. Check Interlocks connected to the LCI to assure proper function. 2. Reset and sequence the module; monitor the LCI status. 3. If code persists, replace the module
64	PII (Pre-Ignition Interlock) off	H or L	1. Check wiring and correct any faults. 2. Check preignition interlock switches to assure proper functioning. 3. Check the valve operation. 4. Reset and sequence the module; monitor the PII status. 5. If code persists, replace the module.
67	ILK (Interlock) off	H or L	1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.
68	ILK (Interlock) on	H or L	1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.
70	Wait for leakage test completion	H	1. Internal fault. Reset module. 2. If fault repeats, replace module.
78	Demand lost in run	H	1. Check wiring and correct any possible errors. 2. If previous steps are correct and fault persists, replace the module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
79	Outlet high limit	H or L	1. Check wiring and correct any possible errors. See Section B7. 2. Replace the outlet high limit. 3. If previous steps are correct and fault persists, replace the module.
80	DHW (Domestic Hot Water) high limit	H or L	1. Check wiring and correct any possible errors. 2. Replace the DHW high limit. 3. If previous steps are correct and fault persists, replace the module.
81	Delta T limit	H or L	1. Check inlet and outlet sensors and pump circuits for proper operation. 2. Recheck the Delta T Limit to confirm proper setting. 3. If previous steps are correct and fault persists, replace the module.
82	Stack limit	H or L	1. See Section B24. 2. Check wiring and correct any possible errors. 3. Replace the stack high limit switch. 4. If previous steps are correct and fault persists, replace the module.
91	Inlet sensor fault	H	1. Check wiring and correct any possible errors. See Section B28. 2. Replace the Inlet sensor. 3. If previous steps are correct and fault persists, replace the module.
92	Outlet sensor fault	H	1. Check wiring and correct any possible errors. See Section B30. 2. Replace the outlet sensor. 3. If previous steps are correct and fault persists, replace the module.
93	DHW (Domestic Hot Water) sensor fault	H	1. Check wiring and correct any possible errors. See Section B27. 2. Replace the DHW sensor. 3. If previous steps are correct and fault persists, replace the module.
94	Header sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the header sensor. 3. If previous steps are correct and fault persists, replace the module.
95	Stack sensor fault	H	1. Check wiring and correct any possible errors. See Section B24. 2. Replace the stack sensor. 3. If previous steps are correct and fault persists, replace the module.
96	Outdoor sensor fault	H	1. Check wiring and correct any possible errors. See Section B33. 2. Replace the outdoor sensor. 3. If previous steps are correct and fault persists, replace the module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
97	Internal fault: A2D mismatch.	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
98	Internal fault: Exceeded VSNSR voltage tolerance	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
99	Internal fault: Exceeded 28V voltage tolerance	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
100	Pressure sensor fault	H	1. Verify the pressure sensor is a 4-20 ma source. 2. Check wiring and correct any possible errors. 3. Test the pressure sensor for correct operation. 4. Replace the pressure sensor. 5. If previous steps are correct and fault persists, replace the module.
105	Flame detected out of sequence	H or L	1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the flame and ground wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.
106	Flame lost in MFEP (Main Flame Establishing Period)	L	1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting and flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
107	Flame lost early in run	L	1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
108	Flame lost in run	L	1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
109	Ignition failed	L	1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
110	Ignition failure occurred	H	Hold time of recycle and hold option. Will not be a lockout fault. Hold only. Internal hardware test. Not a lockout.
111	Flame current lower than weak threshold	H	Hold time of recycle and hold option. Will not be a lockout fault. Hold only. Internal hardware test. Not a lockout.
113	Flame circuit timeout	L	Flame sensed during initiate or off cycle, hold 240 seconds, if present after 240 seconds, system will lockout.
119	Control Interaction fault	H	Flap valve identifications configured incorrectly.
122	Lightoff rate proving failed	L	1. Check wiring and correct any potential wiring errors. 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
123	Purge rate proving failed	L	1. Check wiring and correct any potential wiring errors. 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
128	Fan speed failed during prepurge	H or L	1. Check wiring and correct any potential wiring errors. 2. Check the VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
129	Fan speed failed during preignition	H or L	1. Check wiring and correct any potential wiring errors. See Section B22. 2. Check the VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
130	Fan speed failed during ignition	H or L	1. Check wiring and correct any potential wiring errors. See Section B22. 2. Check the VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
131	Fan movement detected during standby	H	1. Check wiring and correct any potential wiring errors. See Section B22. 2. Check the VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
132	Fan speed failed during run	H	1. Check wiring and correct any potential wiring errors. See Section B22. 2. Check the VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
137	ILK (Interlock) failed to close	H	1. Check wiring and correct any possible shorts. 2. Check interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.
149	Flame detected	H or L	Holds if flame detected during safe start check up to flame establishing period.
150	Flame not detected	H	Sequence returns to standby and restarts sequence at the beginning of purge after the HF switch opens if flame detected during safe start check up to flame establishing period.
152	Combustion pressure on	H or L	1. Check wiring and correct any errors. 2. Inspect the combustion pressure switch to make sure it is working correctly. 3. Reset and sequence the relay module. 4. During standby and prepurge measure the voltage between J6 terminal 5 and L2 (N). Supply voltage should be present. If not, the lockout switch is defective and needs replacing. 5. If the fault persists, replace the relay module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
153	Combustion pressure off	H or L	1. Check wiring and correct any errors. 2. Inspect the combustion pressure switch to make sure it is working correctly. 3. Reset and sequence the relay module. 4. During standyby and prepurge, measure the voltage between J6 terminal 5 and L2 (N). Supply voltage should be present. If not, the lockout switch is defective and needs replacing. 5. If the fault persists, replace the relay module.
154	Purge fan switch on	H or L	1. Purge fan switch is on when it should be off. 2. Check wiring and correct any errors. 3. Inspect the purge fan switch J6 terminal 3 and its connections. Make sure the switch is working correctly and is not jumpered or welded. 4. Reset and sequence the relay module. 5. If the fault persists, replace the relay module.
155	Purge fan switch off	H or L	1. Purge fan switch is off when it should be on. 2. Check wiring and correct any errors. 3. Inspect the purge fan switch J6 terminal 3 and its connections. Make sure the switch is working correctly and is not jumpered or welded. 4. Reset and sequence the relay module. 5. If the fault persists, replace the relay module.
156	Combustion pressure and flame on	H or L	1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the flame and ground wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.
157	Combustion pressure and flame off	L	1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the flame and ground wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.
158	Main valve on	L	1. Check the main valve terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
159	Main valve off	L	1. Check the main valve terminal wiring and correct any errors. Be sure the On/Off switch on the bottom of the valve is On. See Fig. B11-7. 2. Reset and sequence the module. If fault persists, replace the module.
160	Ignition on	L	1. Check ignition terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.
161	Ignition off	L	1. Check ignition terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.
164	Block intake on	L	1. Check wiring and correct any errors. 2. Inspect the block intake switch to make sure it is working correctly. 3. Reset and sequence the module. 4. During standby and purge, measure the voltage across the switch. Supply voltage should be present. If not, the block intake switch is defective and needs replacing. 5. If the fault persists, replace the relay module.
165	Block intake off	L	1. Check wiring and correct any errors. 2. Inspect the block intake switch to make sure it is working correctly. 3. Reset and sequence the module. 4. During standby and purge, measure the voltage across the switch. Supply voltage should be present. If not, the block intake switch is defective and needs replacing. 5. If the fault persists, replace the relay module.
172	Main relay feedback incorrect	L	Internal fault. 1. Reset module. 2. If fault repeats, replace module.
174	Safety relay feedback incorrect	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
175	Safety relay open	L	Internal fault. 1. Reset module. 2. If fault repeats, replace module.
176	Main relay on at safe start check	L	Internal fault. 1. Reset Module. 2. If fault repeats, replace module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
178	Safety relay on at safe start check	L	Internal fault. 1. Reset module. 2. If fault repeats, replace module.
184	Invalid blower/ HSI output setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
185	Invalid Delta T limit enable setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
186	Invalid Delta T limit response setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
187	Invalid DHW (Domestic Hot Water) high limit enable setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
188	Invalid DHW (Domestic Hot Water) high limit response setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
189	Invalid flame sensor type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
192	Invalid igniter on during setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
193	Invalid ignite failure delay setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
194	Invalid ignite failure response setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
195	Invalid ignite failure retries setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
196	Invalid ignition source setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
197	Invalid interlock open response setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
198	Invalid interlock start check setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
199	Invalid LCI (Limit Control Input) enable setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
200	Invalid lightoff rate setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
201	Invalid lightoff rate proving setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
202	Invalid MFEP (Main Flame Establishing Period) time setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
203	Invalid MFEP (Main Flame Establishing Period) flame failure response setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
204	Invalid NTC sensor type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
205	Invalid outlet high limit response setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
207	Invalid PII (Pre-Ignition Interlock) enable setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
210	Invalid postpurge time setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
211	Invalid power up with lockout setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
212	Invalid preignition time setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
213	Invalid prepurge rate setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
214	Invalid prepurge time setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
215	Invalid purge rate proving setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
216	Invalid run flame failure response setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
217	Invalid run stabilization time setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
218	Invalid stack limit enable setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
219	Invalid stack limit response setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
220	Unconfigured Delta T limit setpoint setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
221	Unconfigured DHW (Domestic Hot Water) high limit setpoint setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
222	Unconfigured outlet high limit setpoint setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
223	Unconfigured stack limit setpoint setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
224	Invalid DHW (Domestic Hot Water) demand source setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
225	Invalid flame threshold setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
226	Invalid outlet high limit setpoint setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
227	Invalid DHW (Domestic Hot Water) high limit setpoint setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
228	Invalid stack limit setpoint setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
229	Invalid modulation output setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
230	Invalid CH (Central Heat) demand source setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
231	Invalid Delta T limit delay setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

Appendix 1 - Error Codes (continued)

Code	Description	L or H	Procedure
232	Invalid pressure sensor type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
234	Invalid outlet high limit enable setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
235	Invalid outlet connector type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
236	Invalid inlet connector type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
237	Invalid DHW (Domestic Hot Water) connector type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
238	Invalid stack connector type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
239	Invalid header connector type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
240	Invalid outdoor connector type setting	L	1. Return to configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

App2 Appendix 2 - Ignition and Firing Sequence

This is the basic operating sequence of the appliance whether there is a DHW, or hydronic call for heat.

1. The unit receives a call for heat.
2. The controller does a check of the safety chain.
3. The blower starts and the controller waits until it achieves prepurge RPM.
4. The prepurge timer is started once the prepurge RPM is achieved.
5. The controller waits through a pre-ignition time of two seconds to check the flame sensor operation and status. During this period an intermittent spark can be seen.
6. The controller waits through a trial for ignition period of four seconds. The direct spark ignition switches to constant spark for three seconds, during which time the gas valve is open. For the last second of the ignition period, direct spark is de-energized and the flame sensor checks for established flame. If a flame is sensed, the control enters “Run” to satisfy the demand. If flame is not established, the control enters a retry, starting from step 2. If the flame has not been established in the appropriate number of retries, the control will lockout with a 109 error code.
7. The call for heat input disappears.
8. The gas valve shuts off.
9. The blower and pump continue to run through the overrun times to purge the system.

Appendix 3 - Wiring Diagram

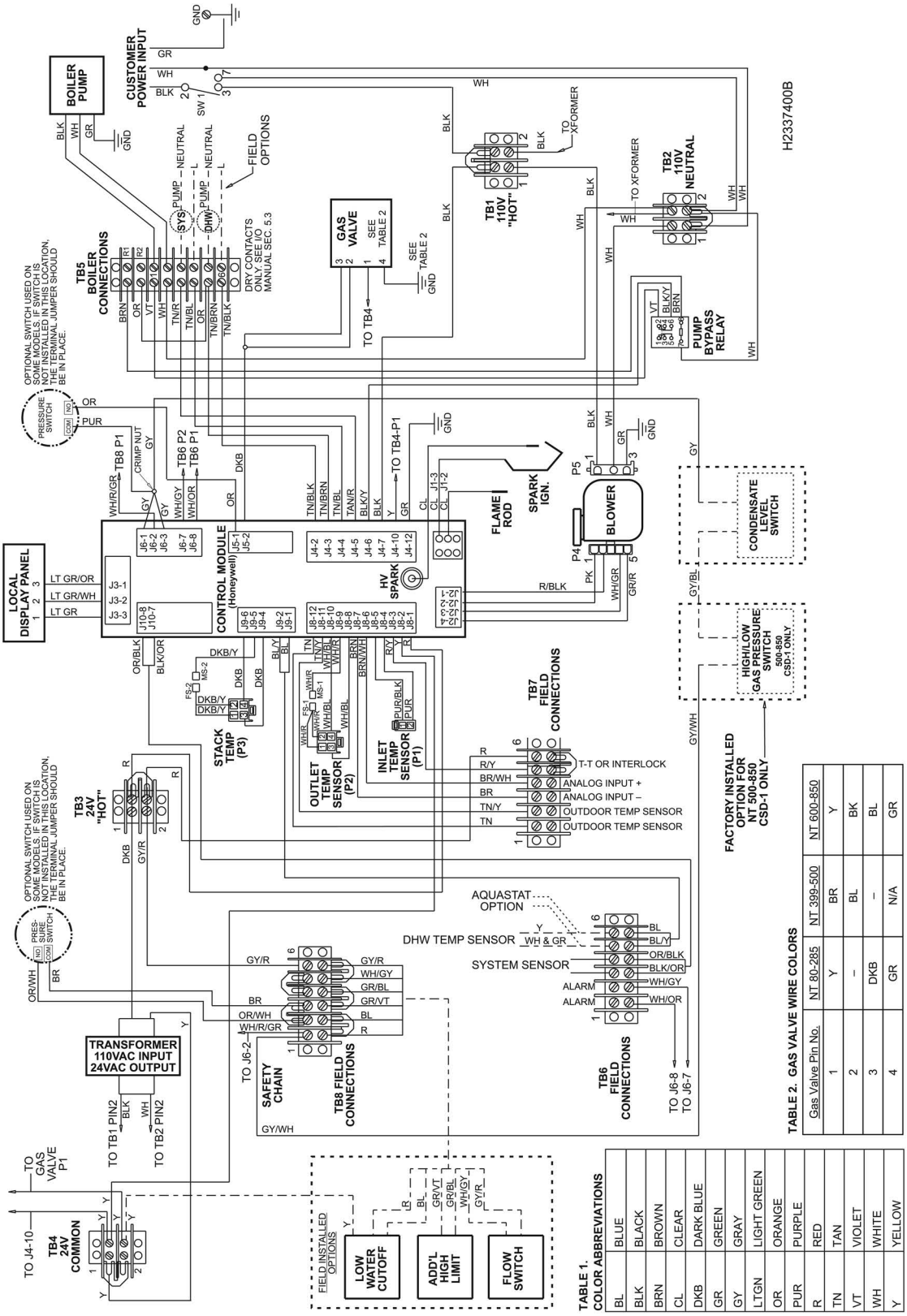


TABLE 1. COLOR ABBREVIATIONS

BL	BLUE
BLK	BLACK
BRN	BROWN
CL	CLEAR
DKB	DARK BLUE
GR	GREEN
GY	GRAY
LTGN	LIGHT GREEN
OR	ORANGE
PUR	PURPLE
R	RED
TN	TAN
VT	VIOLET
WH	WHITE
Y	YELLOW

TABLE 2. GAS VALVE WIRE COLORS

Gas Valve Pin No.	NT 80-285	NT 399-500	NT 600-850
1	Y	BR	Y
2	–	BL	BK
3	DKB	–	BL
4	GR	N/A	GR

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