EB2000G

"Field Assist Troubleshooting Guide"

Welcome to the Campo **"Field Assist Troubleshooting Guides".**
These guides were developed to assist the working technicians in the field. We've supplied issues and solutions to the most common problems encountered in the field. If you need assistance while troubleshooting on the job, they are easy to store in your smart phone, tablet or computer.

Getting Started is easy! Just click on Page # for the problem you are encountering

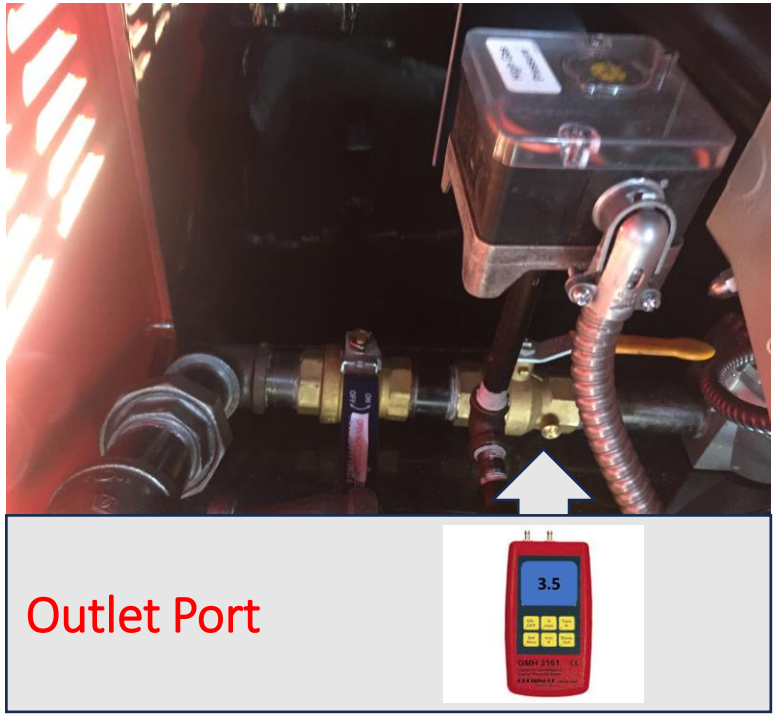
HOME

Resetting the Burner Control From Lock-out…

- Warning! Continuous resetting of the burner control may accumulate gases in the heatexchanger, which could lead to an Implosion of the heatexchanger or personal harm.
- Do not continuously reset the burner, troubleshoot the issue and solve the problem.
- Note: if the burner control is locked out on safety the Alarm light on the control will be flashing.

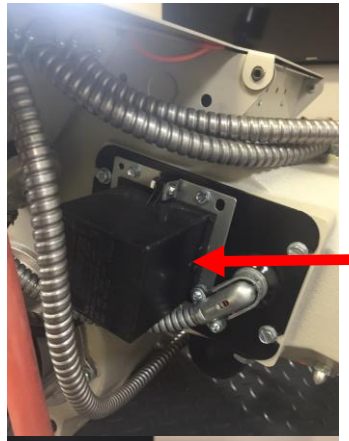
- You reset the control and…
- The Burner Starts , But Does Not Fire…Page 3
- The Burner motor Did Not Start…Page 11

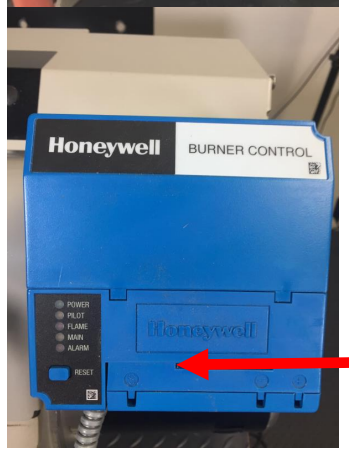
- Install your manometer in the outlet port of the manual valve between the gas valve and LP/NG switchover valve.
- Reset the burner control.
- After the 60 second purge, check to see if gas pressure is coming through the valves.
- Keep a close eye on the manometer, as the pressure will only register for 1 second after the 60 second pre-purge.



- If gas pressure is present… Page 4

- If gas pressure is NOT present… Page 9

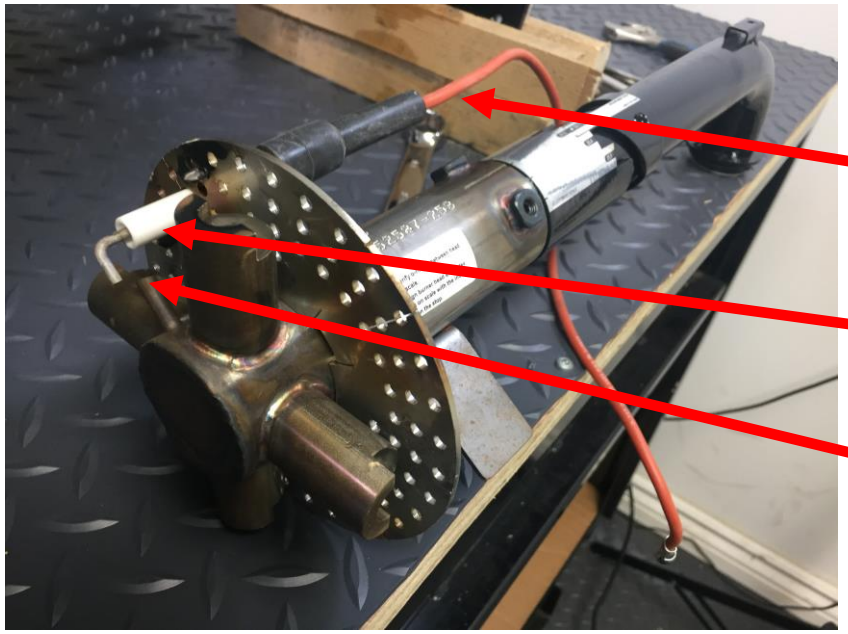




- ✓ Defective igniter
- ✓ Defective ignition cable 
- ✓ Broken ignition electrode 
- ✓ Defective burner control

➢ Test the components… Page 11

➢ SHUT OFF the gas supply to the burner before testing!



Remove the burner gun from the burner housing.

- Inspect the ignition cable for cracks.
- Inspect the ignition electrode porcelain for cracks.
- Inspect the electrode gap, ensuring the gap is 1/8".

✓ Replace damaged pieces as appropriate.

HOME

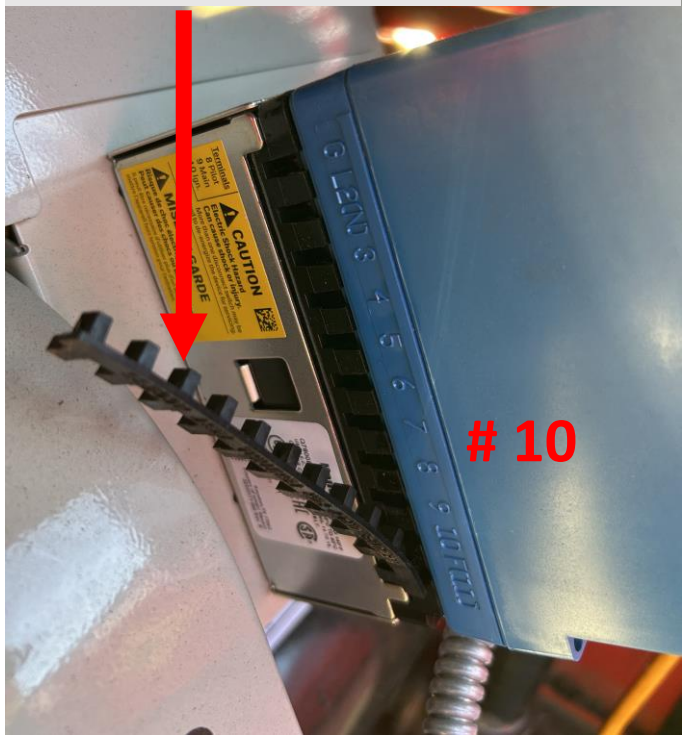
➢ If the burner gun is good, test the ignitor for spark…Page 6

- With the power and gas shut off and gun assembly still outside the burner housing, Re-connect the ignition cable to the igniter replace the housing door to block flame detector from sighting light and air escaping from housing. Careful not to pinch the electrode cable.
- Re-store power to the burner but leave the gas shut off.
- Ensure the gas gun is WELL GROUNDED to the burner housing using a jumper wire while testing for spark.
- Reset the burner control and check for spark after the purge.
- Keep a close eye on the electrode as the spark will only appear for 2 seconds AFTER the 60 second purge.

HOME

NO spark indicates, Defective burner control or Defective igniter…Page 7

Terminals are located behind plastic strip



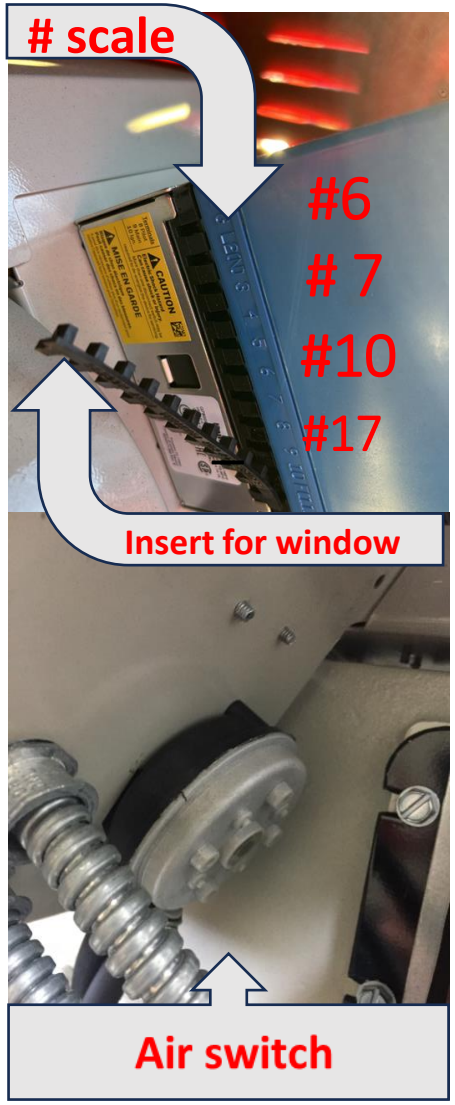
- Note: The control is mounted on a subbase that has windows and a plastic insert that can be removed to check for power with the control mounted.
- Reset burner control. After the 60 second purge, check for 120 volts on terminal # 10 and L2 (neutral) Keep a close eye on the voltmeter, as the voltage will only register for 1 or 2 seconds after the 60 second pre-purge.

✓ If 120 volts is NOT present after the 60 second purge, Defective burner control.

✓ If 120 volts is present and no spark, defective igniter

Problem Solved

You Reset The Control, The Burner Starts , But Does light…



- Note: Remove the black strip on the control subbase to be able to check voltage through window. The terminal # is on the side of the control in alignment with the terminal.
- Ensure the Hi pressure switch is not tripped off.

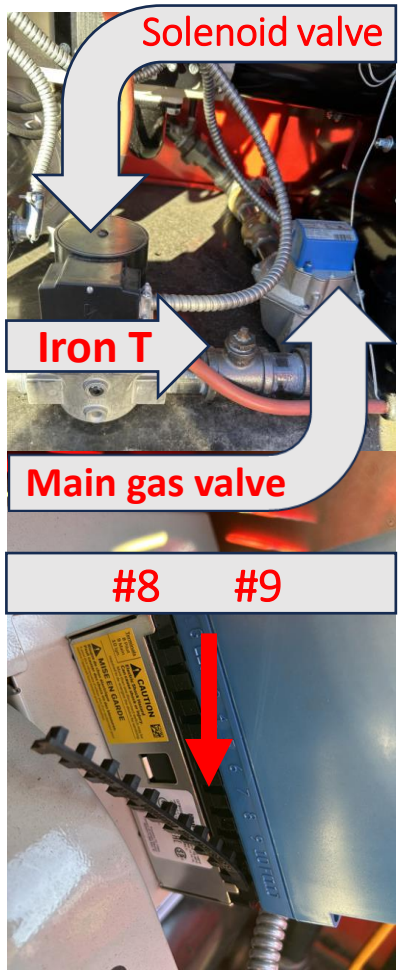
- Reset the control and if the motor starts check for 120 volts on terminal block # 20G located in heater control panel.
- If 120 volts is not present…Page 27
- If 120 volts is present, check for 120 volts on # 17 on burner control.
- If 120 volts is present, check for 120 volts on # 6 on burner control.

✓ If 120 volts is not present, defective Hi Pressure switch.

- If 120 volts is present, check for 120 volts on # 7.

✓ If 120 volts is not present, defective air proving switch.

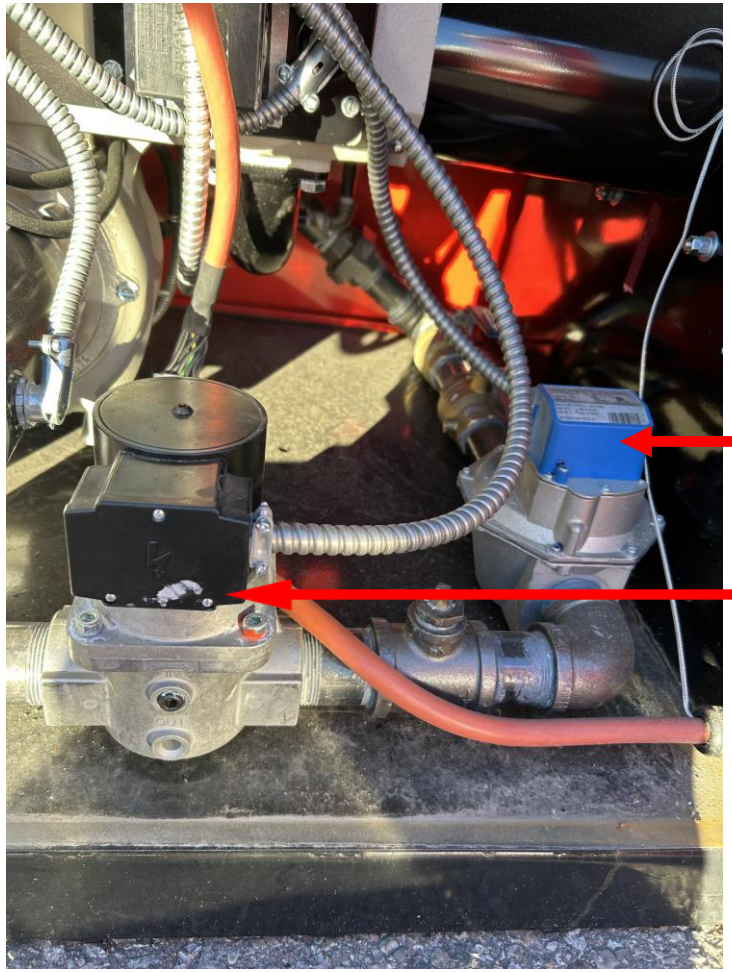
✓ continue…Page 15



- Reset the Burner Control. After the 60 second purge, check for 120 volts on #8 on burner control. Keep a close eye on your voltmeter, as the voltage will only register for 1 or 2 seconds after the 60 second pre-purge.
- ✓ If 120 volts is not present after the 60 second purge, control is defective.
- If 120 volts is present after the purge, Check for voltage on #9 You should see a slight increase in voltage for 1 or 2 seconds.
- ✓ If there is a slight voltage, one of the 2 two gas valves is defective.
- To check which gas valve is defective Install your manometer in the cast iron tee outlet located between the solenoid gas valve and the main gas valve.
- Reset the burner control and after the 60 second purge, check to see if gas pressure is coming through the gas solenoid valve.
- Keep a close eye on the manometer, as the pressure will only register for 1 or 2 seconds after the 60 second purge.

Continue...Page 10

You Reset The Control, The Burner Starts , But Does Not light…



- ✓ If gas is present after the 60 second purge, defective main gas valve.
- ✓ If gas is NOT present after the purge, the solenoid gas valve is defective.

Problem Solved

The burner motor did not start and locks-out on reset…

Motor reset.

Burner Control.

Motor Relay.

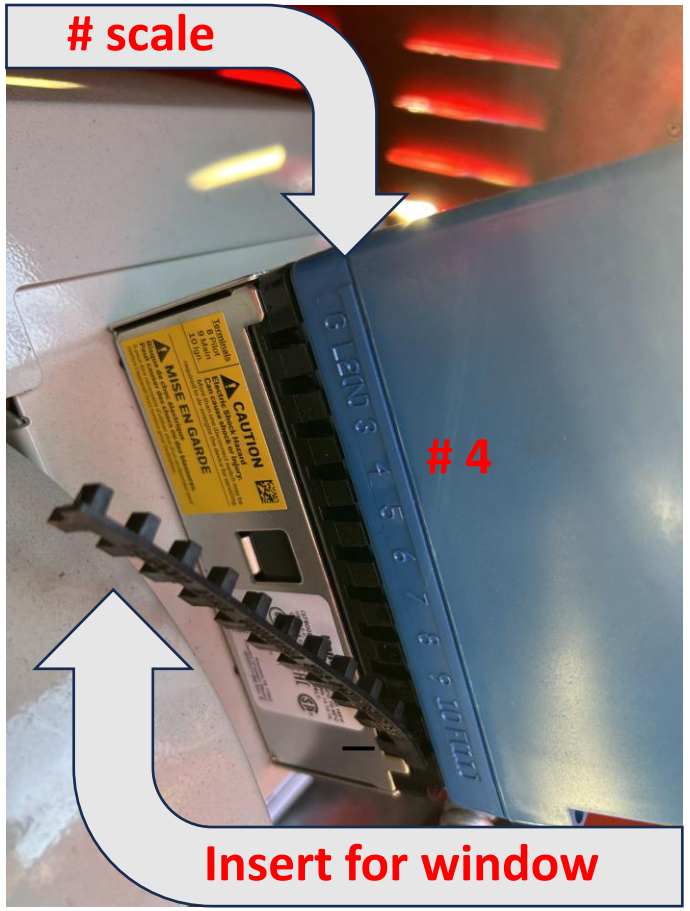
- Make sure the burner motor reset is not locked out.

- ✓ Defective burner motor.
- ✓ Defective Burner Control.
- ✓ Defective Motor Relay.

- Test the components… Page 12

HOME

The burner motor did not start and locks-out on reset…

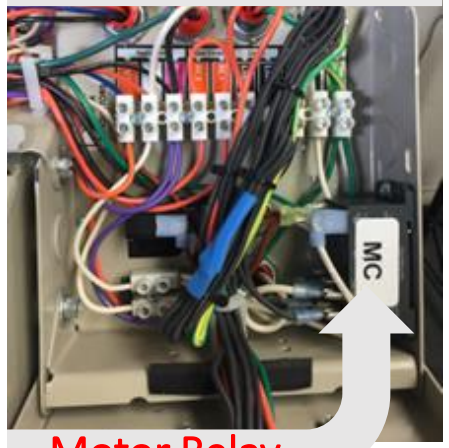


- ✓ Reset burner control, then check for 120 volts on burner control # 4 terminal. If 120 volts is NOT present, defective burner control.
- ✓ If 120 volts is present, check for 208 volts on MC relay contact to the burner motor.
- ✓ If 208 volts is present, defective burner motor.
- ✓ If 120 volts is NOT present, defective burner motor relay (MC)

➢ Note: Before replacing burner motor or relay…Page 13

Replacing burner motor or motor relay…

Motor 208 volts



Motor Relay

The burner motor is wired for 208 volts.

The motor can be wired for 120 volts or 208 volts. Ensure the replacement motor is wired for 208 volts.

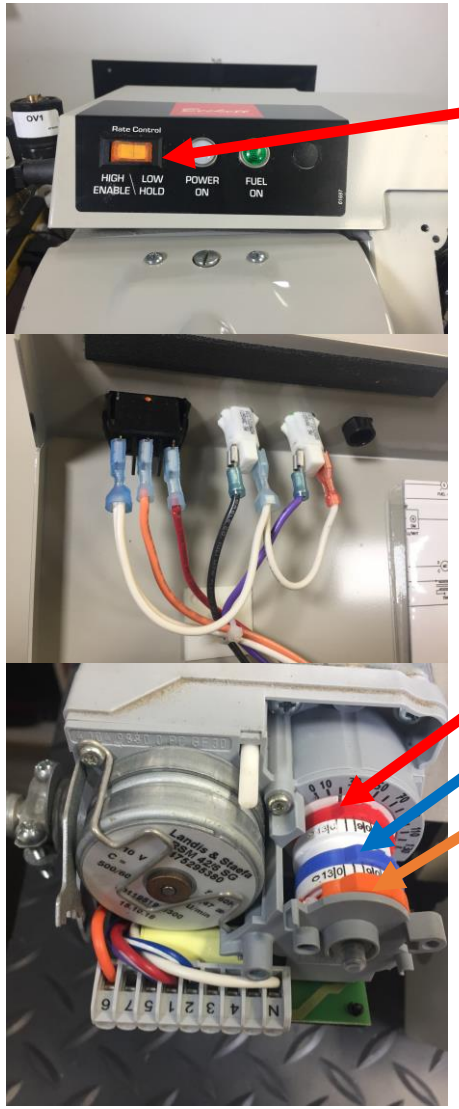
If replacing the MC relay, ensure the replacement relay has the same specifications as the original part.

Problem solved

The burner control is NOT locked out on reset…

Choose the issue you are encountering and click on the page

If the burner stays stuck on low fire…



- Make sure the rate control, high/low switch is in the high enable position.

- Make sure the air damper motor cam is set between the high fire setting and low fire setting.

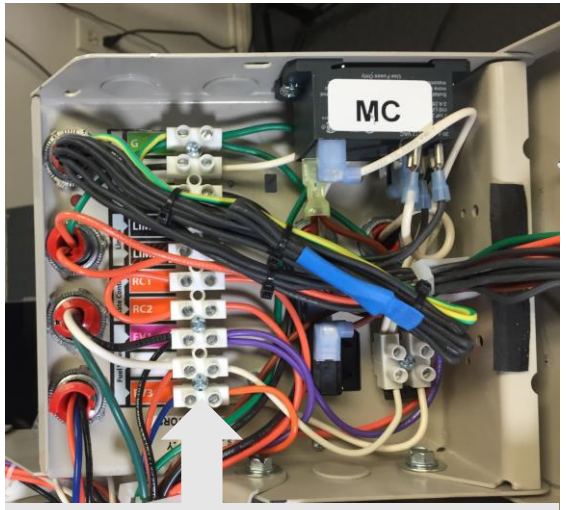
➢ Natural gas
- ➢ High fire air settings 32 red dial
- ➢ Low fire air setting 17 blue dial
- ➢ Cam adjustment set to 20 orange dial

➢ Propane
- ✓ High fire air settings 38 red dial
- ✓ Low fire air setting 26 blue dial
- ✓ Cam adjustment set to 30 orange dial

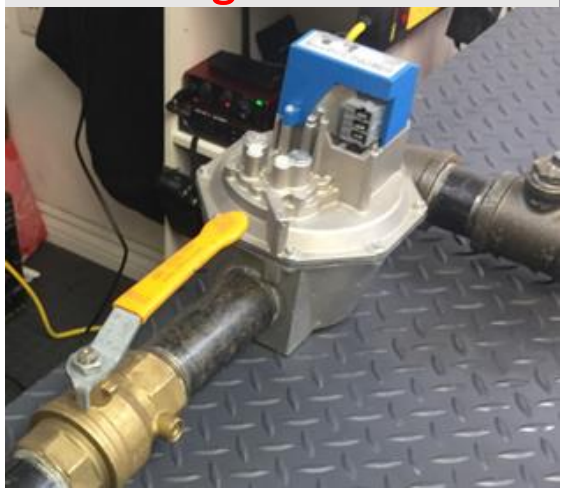
- Burner air settings are good continue…Page 16

HOME

If the burner stays stuck on low fire…



Orange wire FV3



Note: The EB2000G is equipped with a system that will modulate the burner from low fire to high fire automatically. This system conserves energy while maximizing heat output during operation.

- Make sure the rate control, High/Low switch is in the high enable position.
- Check to ensure the temperature controller is under 235^{0} F.
- With the burner running on low fire for 4 seconds, check for 120 volts on orange wire FV3 located in burner junction box.

✓ If 120 volts is present, defective main gas valve.

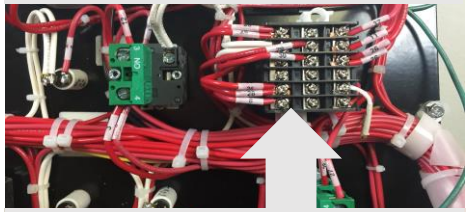
- If 120 volts is not present…

continue…Page 17

HOME

If the burner stays on low fire…

Heater panel



Temperature controller

Relay R5

Plastic strip

- Check for 120 volts on wire # 37 on temp. controller.

✓ If 120 volts is not present, defective temperature controller.

✓ If 120 volts is present, check for 120 volts on wire #35 in heater panel.

✓ If 120 volts is not present, defective R5 relay.

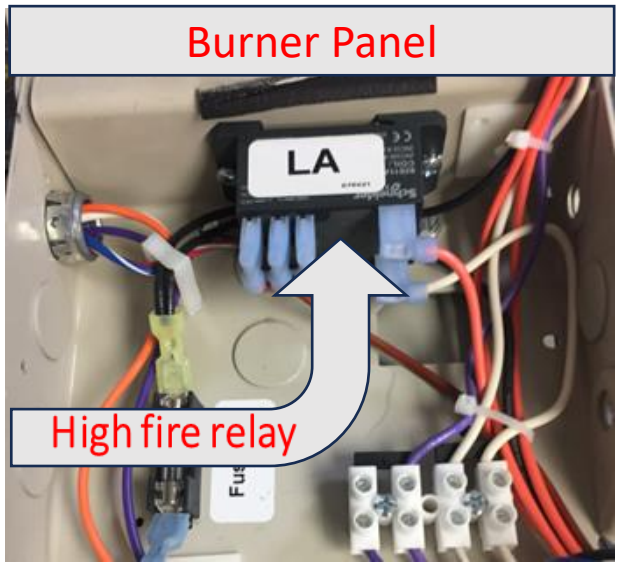
- If 120 volts is present, check for 120 volts on terminal #19 on burner control.
- If 120 volts is not present, defective wire or 15 pin plug.
- If 120 volts is present, check terminal #21 on burner control.
- If 120 volts is not present, check for 120 volts on wire #36 heater panel
- If 120 volts is present, defective wire or 15 pin plug.
- If 120 volts is present on terminal #21 continue…

continue… Page 18

➢ Note: terminals #19 and #20 are located on the right-hand side of the burner control base plate behind plastic strip.

HOME

If the burner stays on low or hi fire…



- If 120 volts is present on terminal #21 on burner control, check for 120 volts on RC2 in burner control panel.
- If 120 volts is not present, defective high/low switch.
- If 120 volts is present, check for 120 volts on LA relay Red/white wire.
- If 120 volts is not present, defective LA relay.
- If 120 volts is present, defective damper actuator.

Problem solved

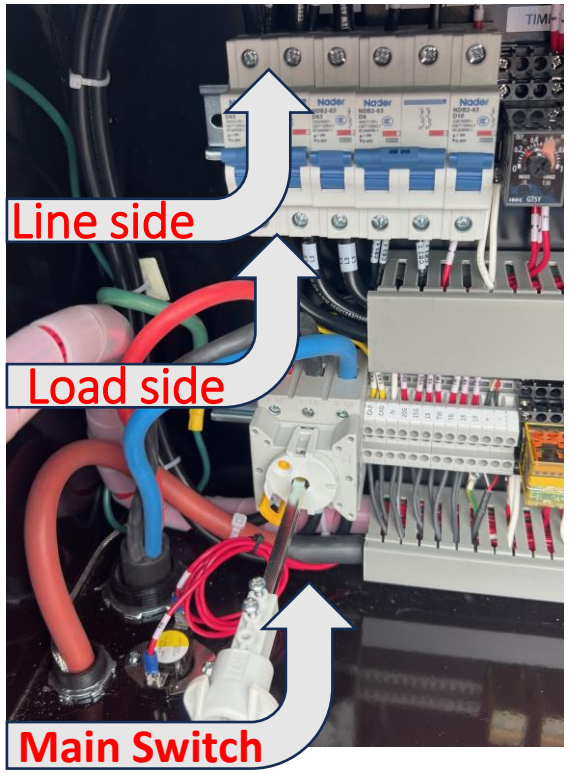
The burner control is NOT locked out on reset…

Before Proceeding, It is important to check voltage between Line L1 and L2, "Not" to ground. To start, please make sure…

- …the main power switch is in the on position
- …the 'gas/oil switch' is in the gas position
- …the 'controls' switch is in the on position
- …the bypass toggle switch is on.
- …the Heat/off/Fan switch is on heat
- …Fan tampered switch is in the off position
- …Check the Hi pressure gas switch to ensure it is not tripped off.

Proceed to…PAGE 20

Checking the Main Switch and Breakers



- Check for 240 volts on the load side of "Main Switch".

✓ If 240 volts is not present, supply power issue.

- If 240 volts is present, check for 240 volts on CB3 Line side.

✓ If 240 volts is not present, defective main switch.

- If 240 volts is present, check for 240 volts on CB3 Load side.

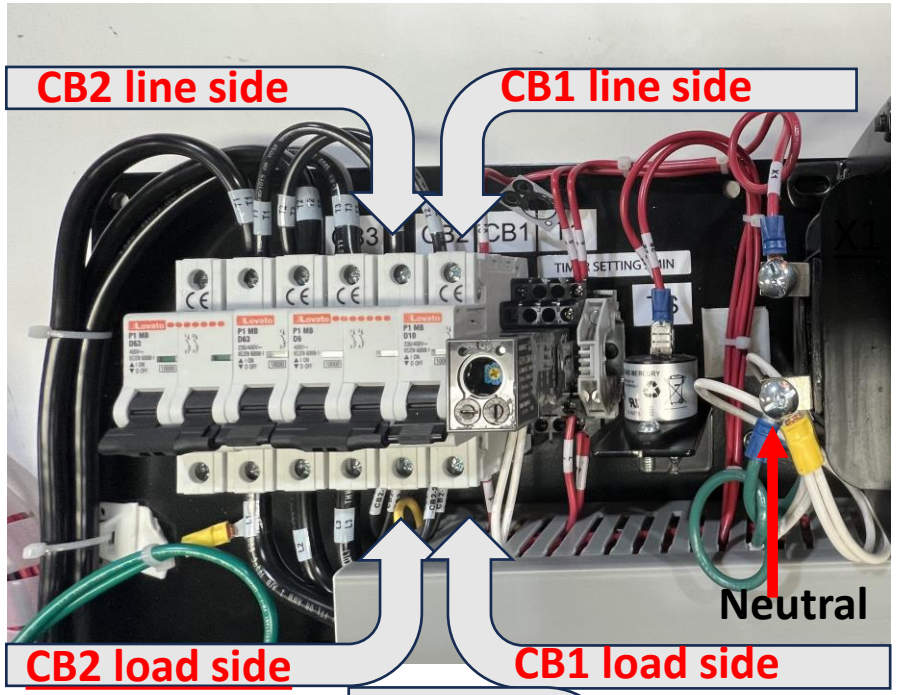
✓ If 240 volts is not present, the breaker is tripped off or defective.

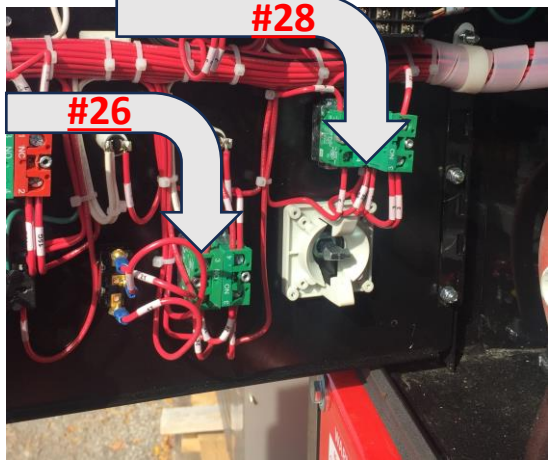
✓ If 240 volts is present, check for 240 volts on CB2 Load side.

- If 240 volts is not present, defective breaker or breaker off.
- If 240 volts is present…

➢ Continue to… Page 21

NOT locked out on reset and will not start…





- Check for 120 volts on CB1 line side and Neutral of transformer.

✓ If 120 volts is not present, defective transformer.

- If 120 volts is present, check for 120 volts on load side CB1.

✓ If 120 volts is not present, defective breaker of tripped off.

- If 120 volts is present, check for 120 volts at 'control switch' wire #26

✓ If 120 volts is not present, defective control switch.

- If 120 volts is present, check for 120 volts on 'Heat/Fan switch' wire #28

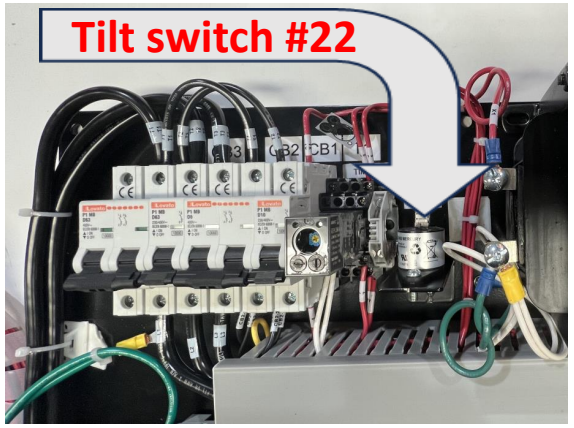
✓ If 120 volts is not present, defective 'Heat/Fan switch.

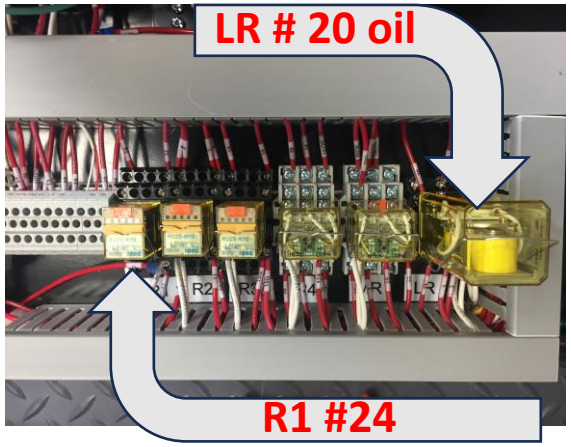
✓ If 120 volts is present, check for 120 volts on 'tilt switch' wire #22

Continue…Page 22

HOME

NOT locked out on reset and will not start…



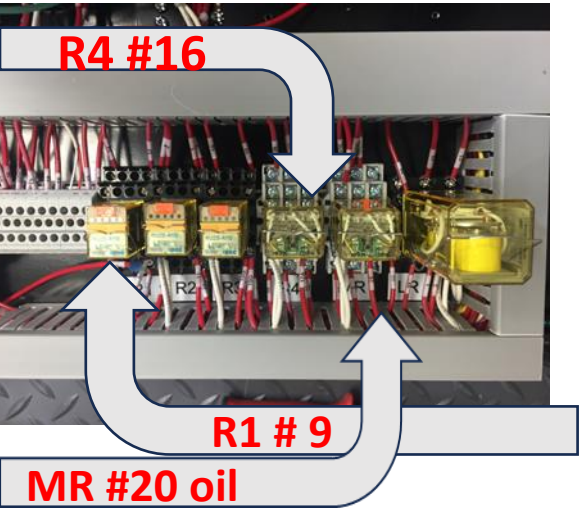


- ✓ If 120 volts is not present, defective 'tilt switch'
- If 120 volts is present, check for 120 volts at LR wire #20G
- If 120 volts is not present, defective LR relay
- If 120 volts is present, check for 120 volts at R1 wire #24.
- ✓ If 120 volts is not present, defective motor thermostat.

➢ Note:The 'Circulating Fan Motor' should be replaced, or motor taken to an electrical motor repair shop to have the motor thermostat replaced. Contact Campo Equipment for more details.

- If 120 volts is present continue…Page 23

NOT locked out on reset and will not start…



- If 120 volts is present, check for 120 volts at R1 wire #9.
- ✓ If 120 volts is not present, defective R1 relay

- If 120 volts is present, check for 120 volts at R4 relay wire #16
- ✓ If 120 volts is not present, defective R4 relay

- If 120 volts is present, check for 120 volts at MR wire #20G
- If 120 volts is not present, defective MR relay.

Problem Solved

If the circulating fan does not start…

R2 relay wire #11

- Check for 120 volts at R2 relay wire #11.

✓ If 120 volts is present, defective R2 relay

- If 120 volts is NOT present…

✓ Defective temperature controller.

✓ Defective thermocouple

✓ Defective timer

✓ Defective VFD

✓ Defective Fan speed switch.

➢ Check the components…Page 25

HOME

HOME

If the circulating fan does not start…

- Note: The heater is equipped with multiple switches to insure positive start of the circulating fan. It is very unlikely that all switches would be defective.

Testing temperature controller. When the display temperature reaches 90º F check for 120 volts on wire # 11 on temperature controller.

✓ If no voltage present, defective temperature controller.

Testing thermocouple. If the display reads odd numbers…Page 43

Testing the fan timer. After the burner has run for 2 minutes, place a jumper between #4 and #5 wires. If the fan starts, defective timer.

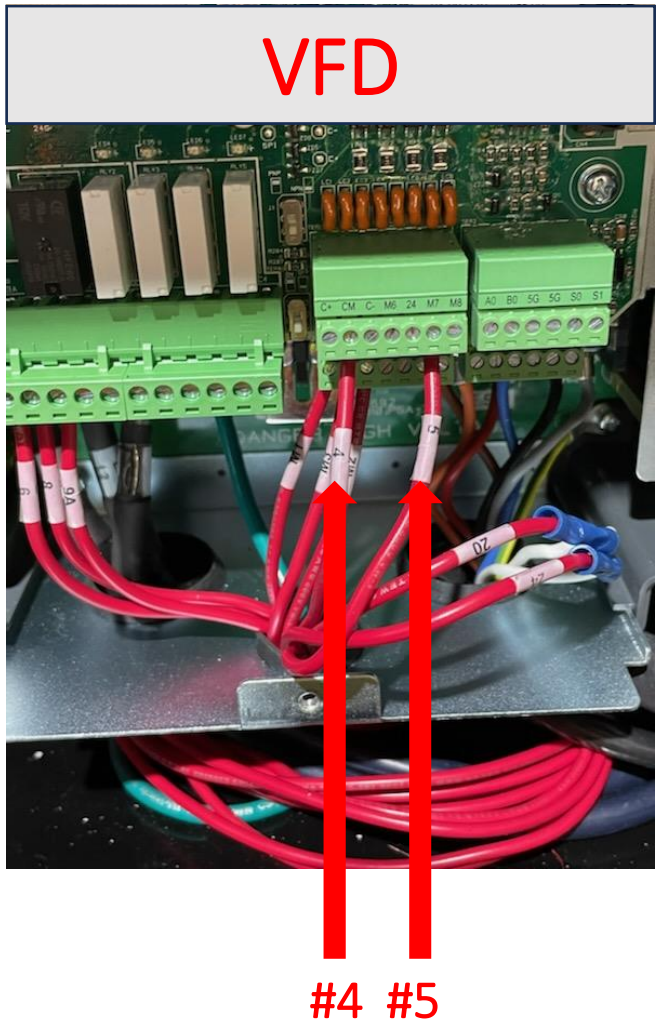
Testing the fan speed switch. Place a jumper between #M1 and #M3 wires on the back of the switch. If the fan starts, defective speed switch.

HOME

- If the fan doesn't start, check the VFD…Page 26

HOME

If the circulating fan fails to start or not stop…



- Turn the HEAT/OFF/FAN switch to the FAN on position. If the circulating fan does not start.

Make sure 208 to 240 volts is being supplied to the VFD.

1. Turn off power to the heater.
2. Remove the cover of the VFD.
3. Ensure that all wires are secured into the terminals.
4. Ensure the terminal blocks are secured properly into place.
5. Restore power to the heater.
6. Place a jumper between #4 wire and #5 wire.

✓ If the fan doesn't Start the VFD is defective

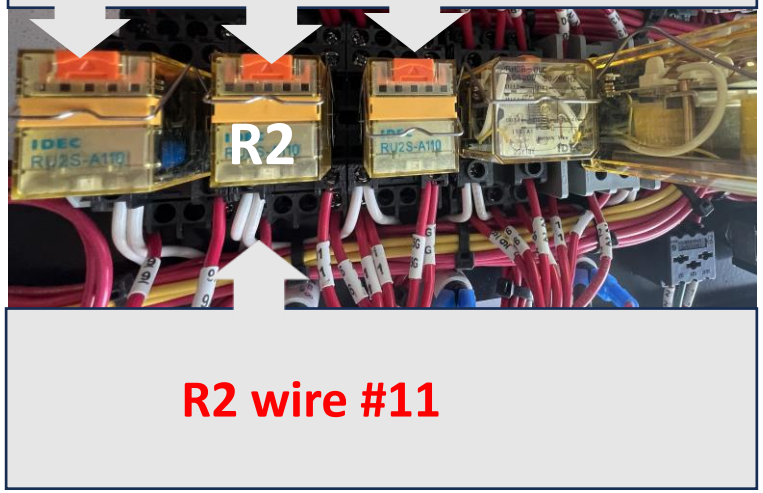
➢ Note: In the case the fan doesn't stop. If fan doesn't stop running, remove wire #4

✓ If the fan stops the VFD is defective.

Problem Solved

HOME

If the circulating fan does not shut off automatically…



➢ Note: Ensure all orange tabs on relays are in down position. Ensure the ambient temperature on the temperature controller is below 80° F.

- Check for 120 volts on wire # 11 on R2 relay.

✓ If 120 volts is present, defective temperature controller or thermocouple.

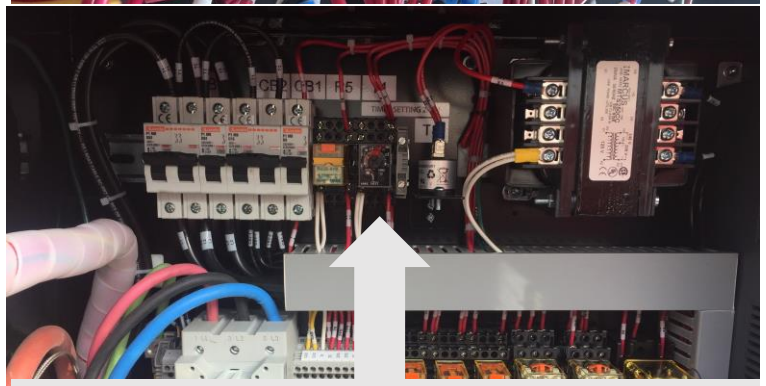
- If 120 volts is not present continue …Page 28

➢ Testing the thermocouple Page 43

HOME

If the circulating fan does not shut off automatically…

R2 relay, remove from base



Remove timer T1 from base

- If 120 volts is not present, unplug relay R2 from subbase
- If the fan stops, defective R2 relay.
- If the fan doesn't stop, remove the timer T1 from base,

✓ if the fan stops, defective timer.

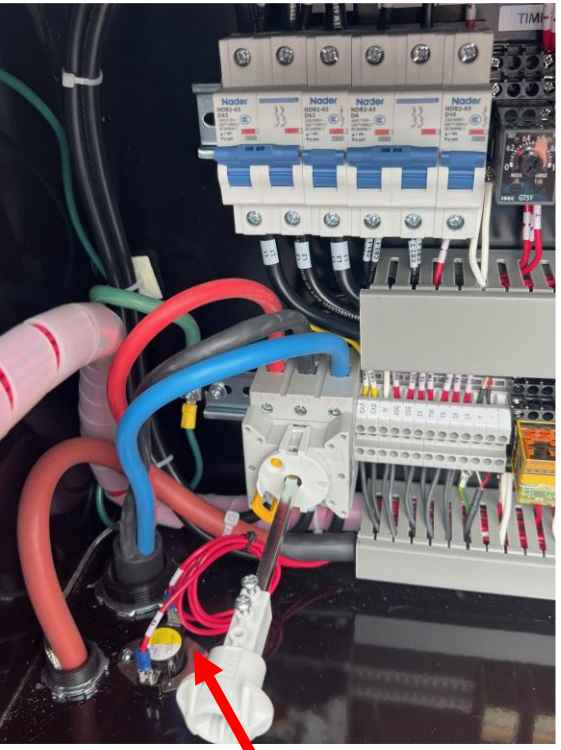
- If the fan doesn't stop, remove wire #M1 on the back of the
- Fan speed switch.

✓ If the fan stops, defective speed switch.

✓ If the fan doesn't stop, check the VFD…Page 26

Problem Solved

HOME



#10
150°F thermal limit disc

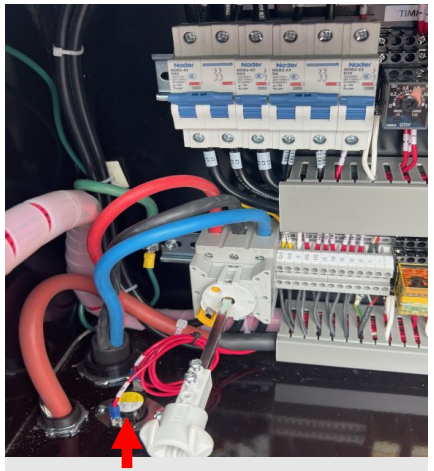
Check for 120 volts on wire #10 on the 150°F thermal limit disc
If 120 volts is present…

- ✓ Defective 150°F thermal limit disc 
- ✓ Defective LR Relay 
- ✓ Defective temperature controller 
- ✓ Defective thermocouple 

➢ Testing the components… Page 30

HOME

If the ‘overheat reset’ light is illuminated and will not reset…



150ºF disc #10

LR relay

- Turn off power to the heater. Remove wire #10 from the 150ºF thermal limit disc and restore power to the heater. Reset the ‘overheat reset’ button.

✓ If the burner starts, the 150ºF thermal limit disc is defective.

- If the overheat reset still stays illuminated. Turn off power to the heater. Remove the #10 wire from the temperature controller. Restore power to the heater. Reset the ‘overheat reset’ button.

✓ If the burner starts, the temperature controller is defective

✓ If the ‘overheat reset’ remains illuminated, the LR relay is defective.

Problem Solved

HOME

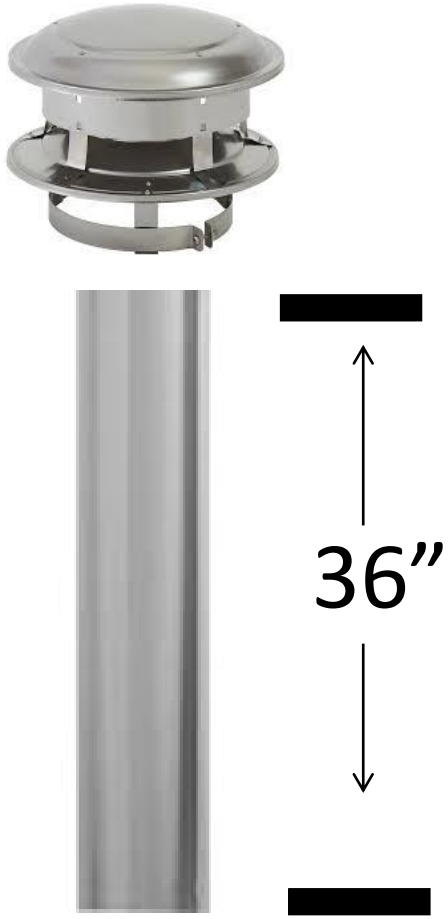
Heater set-up guide.

- ✓ The heater should be installed level and on solid ground or base.
- ✓ The heater should be installed on a noncombustible base (material).
- ✓ The heater should not be installed in an area where combustible gases are circulating.
- ✓ The heater must be equipped with vent (flue) pipes installed. See venting…Page 33
- ✓ The heater should have the proper size wiring for voltage and amperage demand…Page 35
- ✓ All wiring cables should be routed so they are protected from water or traffic.
- ✓ All gas lines should be routed so they are protected from water or traffic.
- ✓ Ensure all piping and fittings are free from gas leaks.
- ✓ Ensure proper ducting of heater respecting limitations…Page 36

Back to information menu…Page 31

HOME

Venting outside a building.



- ✓ Make sure to install a stack minimum 36" on the flue.
- ✓ Make sure to install a rain cap on the flue pipe.
- ✓ Make sure that flue gases are not being circulated into by the cooling fan and pushed into the space you are heating.

WARNING: The appropriate measures must be taken to ensure there will be no positive pressures on the exhaust flue of the heater.

- ✓ All connections of the venting should be fastened securely.

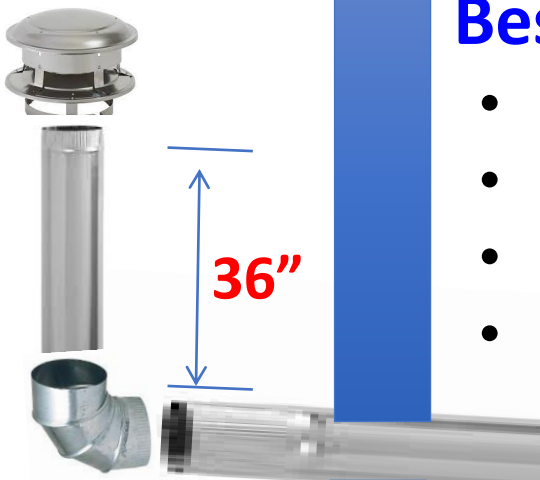
➢ Venting from inside a building…Page 34

➢ Return to previous…Page 32

➢ Back to information menu…Page 31

Best practices for venting when heater is located inside a building

- Avoid using as many 90-degree elbows as possible
- Venting runs should be as short as possible
- Vertical rise minimum 3 feet, 5 feet is better outside the building.
- Always install a rain cap.



- Never decrease diameter of flue piping.
- Horizontal runs ¼” per foot rise.
- Make sure all piping is properly secured.
- Make sure there is no negative pressure inside the building where the heater is placed.

➢ Note: where the vent pipe passes through a combustible wall a fireproof thimble must be used. Ensure there are no negative pressures inside the building.

➢ Return to previous…Page 32 ➢ Back to information menu…Page 31

HOME

Wire sizing and connections.

- All wiring and connections to the heater should be calculated by a qualified electrician and approved by the local authorities having jurisdiction.

- Note: The proper voltage and amperage draw is specified on the rating plate of the heater, failure to comply with electrical standards for wiring and amperage draw of the heater may cause damage to the heater. Consult a qualified electrician for assistance in wire sizing. Voltage should be maintained between 208 and 240 volts while operating.

- Return to previous…Page 32
- Back to information menu…Page 31

HOME

The EB1000G can be used in most applications with ductwork.
The maximum outlet (supply air) is 400 feet. The maximum inlet (return air) is 50 feet.
Total ducting, Outlet plus Inlet not to exceed 400 feet.

- Best practices…
- ✓ Never exceed the 400 feet of total ducting and 50 feet of air inlet ducting.
- ✓ If flexible ducting is used, there should be no kinks in ductwork.
- ✓ Weather flexible or solid ducting is used, try to avoid sharp 90^{θ} turns.
- ✓ If ducting is split into 2 locations, use a TY not a T. and a maximum of 200 feet total ducting.
- ✓ If ducting is split into 2 locations, ensure the volume of air passing through is equal to or greater than the single outlet of the heater.
- ✓ Ensure all ducting is properly protected from water, traffic, and other obstructions.
- Note: Improper ducting will cause overheating and short cycling which will damage the heater and void all warranty.

HOME
Return to previous…Page 38
Back to information menu…Page 31

EB2000G air setting/Gas pressure settings…

- Propane
- ✓ High fire air settings 38 red dial
- ✓ Low fire air setting 26 blue dial
- ✓ Cam adjustment set to 30 orange dial
- ✓ Low fire gas pressure Propane 2" WC
- ✓ High fire gas pressure Propane 4.7" WC

- Natural gas
- ✓ High fire air settings 32 red dial
- ✓ Low fire air setting 17 blue dial
- ✓ Cam adjustment set to 20 orange dial
- ✓ Low fire gas pressure natural gas 1" WC
- ✓ High fire gas pressure natural gas 3.7" WC

- Note: Pressure to be taken on the manual valve located before NG/LP switchover valve.

- How to set air adjustments…Page 50
- Back to information menu…Page 31

Piping charts gas 0.6 specific gravity… "Field Assist Troubleshooting Guide"

1	2	3	4
.05 PSIG. Or less… Page 45	1 PSIG. With less than 10 % pressure drop… Page 46	2 PSIG. With less than 10 % pressure drop… Page 47	5 PSIG. With less than 10 % pressure drop… Page 48

- **Note**: All gas piping should be calculated and installed by a qualified Gas fitter and approved by the local authorities having jurisdiction. Gas fitters have charts for sizing gas pipes and proper regulators for different pressures and installations. Different States and Provinces have different regulations.

HOME
- Back to Start-up…Page 39
- Back to information menu…Page 31

HOME

Start-up procedure gas continued.

- With the switch for the burner in the off position, plug in the heater, turn the fan manual override switch to ON position and ensure voltage remains steady between 208 and 240 volts Return fan manual override switch to OFF position.

- Place the toggle switch in bypass position to start the burner.
- Once the burner is running make sure that incoming pressure is between 7" and 14" of WC .
- If the pressure drops out when running, it means that there is not enough volume of gas or not enough pressure.
- If the gas pressure drops, make sure the gas regulators and piping are correct and gas supply is adequate.
- If there is more than 1 heater or appliance on the same piping all units should be running during testing for pressure drop.
- Once the heater is running ensure proper operating gas pressure…Page 37

➢ Continue start up procedure…Page 40

HOME

Clean & Reliable Combustion

Getting the most reliable performance out of a gas burner comes down to ensuring that it is properly set up. This can require some fine tuning, but the following steps should help you achieve the reliable combustion you are looking for.

- **No installation** is complete until the combustion of the heater has been performed.
- While the flue-stack is still cold pre-drill ¼" hole in the flue-pipe 18" above the flue collar.
- Using a combustion analyzer adjust the air settings… Page 41
- Return to information menu…Page 31

Clean & Reliable Combustion.

➢ **Note**: Be sure to set your analyzer for Propane or Natural Gas and adjust both Low and Hi fire combustion

Set the air settings to manufacture's recommendations, start the burner and let it operate for 10 minutes. Adjust the air settings on Hi fire and then on Low fire to achieve between 11.5% to 12% CO_2 . Check the CO (Carbon Monoxide) level, it should not be higher than 50 PPM.

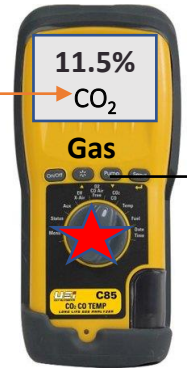
Carbon, smoke, cold flame
High C0 PPM
= blocked heatexchanger
Low efficiency

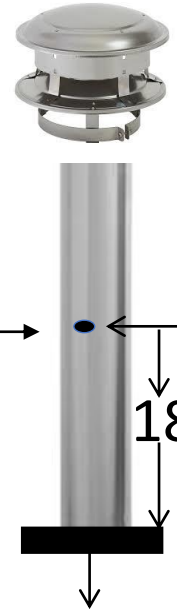
What happens when you don't use a Combustion Analyzer

Combustion

No Carbon, no smoke, hot flame
no C0 PPM
= clean heatexchanger
High efficiency

What happens When you use a Combustion Analyzer





Start up complete

➢ Continue combustion…Page 42

Set High-fire Air and Combustion.

Place the low-fire hold to low fire hold and allow the burner to run at low fire until the appliance has warmed sufficiently.

Once the appliance has warmed, the high-fire setting can be checked and adjusted.

Place the low-fire hold switch in the high-fire position. The damper motor will begin to rotate, after four seconds.

Use combustion test instruments to adjust the burner. Adjust the air by moving the red cam to a lower number to increase C02 or higher number to decrease C02 to achieve 11.5 to 12% CO2 level and less than 50 PPM C0.

Set Low-fire Air and Combustion

Move the **low-fire hold** switch from the **"High Fire position"** to the **"Low Fire Hold"** position. The damper will return to the **low-fire** air setting. Check CO2 level. The CO2 should be between 11.5 to 12%. If the CO2 is less than 11% decrease the blue cam number and if the C02 is higher than 12% increase the blue cam number. Operate the burner from **low fire** to **high fire** and back to verify operation.

Note: The orange cam must be halfway between the red cam number and the blue cam number.

Refer to…Page 50 for air adjustments and how to set. ➢ Back to information menu…Page 31

Startup complete

Testing a thermocouple

- Note: Usually when the thermocouple if defective, the Temperature Controller will indicate odd readings in the display window.
  Example.. 0000 or high numbers, 700 or 800
  In this case….

Testing the thermocouple…

Remove the (small) red and white thermocouple wires from the terminal block located in the control panel on #11 white and #12 red. Place a jumper wire between the two terminals #11 And #12. on the temperature controller

- ✓ if now the display reads the ambient temperature, defective thermocouple
- ✓ If the display continues to read odd numbers, defective temperature controller
- ✓ Tip on replacing a thermocouple…Page 44

HOME

Tech Tip

With the side panels removed.

1. Remove thermocouple wire from the bottom of the terminal block in the panel.
2. Attach a string to the end of the wires using electrical tape insuring the knot is not too large.
3. Locate the chase that the thermocouple passes through in the heater casing.
4. Using a box cutter cut a 4 inch slit in the chase casing. (be careful not to cut into wires inside).
5. Locate the thermocouple wire through the slit.
6. Pull the thermocouple wire through the slit while someone else pushes it from panel.
7. Once the string reaches the slit have someone pull the thermocouple from the burner end of the heater while someone pushes it through the slit.
8. With the old thermocouple removed, attach the string onto the new thermocouple wires ensuring electrical tape knot is not too large.
9. Now reverse the procedure and reinstall the wires to the terminal block, white to white, red to red.

➢ Back to information menu…Page 31

HOME

Maximum Capacity of Pipe in Cubic Feet of Gas per Hour for Gas Pressures of 0.5 Psig or Less and a Pressure Drop of 0.3 Inch Water Column

Back to charts...Page 38

(Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size, Inches	Internal Diameter, Inches	Length of Pipe, Feet													
		10	20	30	40	50	60	70	80	90	100	125	150	175	200
¼	.364	32	22	18	15	14	12	11	11	10	9	8	8	7	6
⅜	.493	72	49	40	34	30	27	25	23	22	21	18	17	15	14
½	.622	132	92	73	63	56	50	46	43	40	38	34	31	28	26
¾	.824	278	190	152	130	115	105	96	90	84	79	72	64	59	55
1	1.049	520	350	285	245	215	195	180	170	160	150	130	120	110	100
1¼	1.380	1,050	730	590	500	440	400	370	350	320	305	275	250	225	210
1½	1.610	1,600	1,100	890	760	670	610	560	530	490	460	410	380	350	320
2	2.067	3,050	2,100	1,650	1,450	1,270	1,150	1,050	990	930	870	780	710	650	610
2½	2.469	4,800	3,300	2,700	2,300	2,000	1,850	1,700	1,600	1,500	1,400	1,250	1,130	1,050	980
3	3.068	8,500	5,900	4,700	4,100	3,600	3,250	3,000	2,800	2,600	2,500	2,200	2,000	1,850	1,700
4	4.026	17,500	12,000	9,700	8,300	7,400	6,800	6,200	5,800	5,400	5,100	4,500	4,100	3,800	3,500

Back to charts…Page 38

Pipe Sizing Table for 1 Pound Pressure

Capacity of Pipes of Different Diameters and Lengths in Cubic Feet per Hour for an Initial Pressure of 1.0 Psig With a 10 Percent Pressure Drop and a Gas of 0.6 Specific Gravity

Pipe Size of Schedule 40 Standard Pipe (Inches)	Internal Diameter (Inches)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	717	493	396	338	300	272	233	206	142	114	97
1.25	1.380	1471	1011	812	695	616	558	478	423	291	234	200
1.50	1.610	2204	1515	1217	1041	923	836	716	634	436	350	300
2.00	2.067	4245	2918	2343	2005	1777	1610	1378	1222	840	674	577
2.50	2.469	6766	4651	3735	3196	2833	2567	2197	1947	1338	1075	920
3.00	3.068	11962	8221	6602	5650	5008	4538	3884	3442	2366	1900	1626
3.50	3.548	17514	12037	9666	8273	7332	6644	5686	5039	3464	2781	2381
4.00	4.026	24398	16769	13466	11525	10214	9255	7921	7020	4825	3875	3316
5.00	5.047	44140	30337	24362	20851	18479	16744	14330	12701	8729	7010	6000
6.00	6.065	71473	49123	39447	33762	29923	27112	23204	20566	14135	11351	9715
8.00	7.981	146849	100929	81049	69368	61479	55705	47676	42254	29041	23321	19960
10.00	10.020	266718	183314	147207	125990	111663	101175	86592	76745	52747	42357	36252
12.00	11.938	422248	290209	233048	199459	176777	160172	137087	121498	83505	67057	57392

HOME

Back to charts...Page 38

Pipe Sizing Table for 2 Pounds Pressure

Capacity of Pipes of Different Diameters and Lengths in Cubic Feet per Hour for an Initial Pressure of 2.0 Psig With a 10 Percent Pressure Drop and a Gas of 0.6 Specific Gravity

Pipe Size of Schedule 40 Standard Pipe (Inches)	Internal Diameter (Inches)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	1112	764	614	525	466	422	361	320	220	177	151
1.25	1.380	2283	1569	1260	1079	956	866	741	657	452	363	310
1.50	1.610	3421	2351	1888	1616	1432	1298	1111	984	677	543	465
2.00	2.067	6589	4528	3636	3112	2758	2499	2139	1896	1303	1046	896
2.50	2.469	10501	7217	5796	4961	4396	3983	3409	3022	2077	1668	1427
3.00	3.068	18564	12759	10246	8769	7772	7042	6027	5342	3671	2948	2523
3.50	3.548	27181	18681	15002	12840	11379	10311	8825	7821	5375	4317	3694
4.00	4.026	37865	26025	20899	17887	15853	14364	12293	10895	7488	6013	5147
5.00	5.047	68504	47082	37809	32359	28680	25986	22240	19711	13547	10879	9311
6.00	6.065	110924	76237	61221	52397	46439	42077	36012	31917	21936	17616	15077
8.00	7.981	227906	156638	125786	107657	95414	86452	73992	65578	45071	36194	30977
10.00	10.020	413937	284497	228461	195533	173297	157020	134389	119106	81861	65737	56263
12.00	11.938	655315	450394	361682	309553	274351	248582	212754	188560	129596	104070	89071

Back to charts…Page 38

Pipe Sizing Table for 5 Pounds Pressure

Capacity of Pipes of Different Diameters and Lengths in Cubic Feet per Hour for an Initial Pressure of 5.0 Psig With a 10 Percent Pressure Drop and a Gas of 0.6 Specific Gravity

Pipe Size of Schedule 40 Standard Pipe (Inches)	Internal Diameter (Inches)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	1989	1367	1098	940	833	755	646	572	393	316	270
1.25	1.380	4084	2807	2254	1929	1710	1549	1326	1175	808	649	555
1.50	1.610	6120	4206	3378	2891	2562	2321	1987	1761	1210	972	832
2.00	2.067	11786	8101	6505	5567	4934	4471	3827	3391	2331	1872	1602
2.50	2.469	18785	12911	10368	8874	7865	7126	6099	5405	3715	2983	2553
3.00	3.068	33209	22824	18329	15687	13903	12597	10782	9556	6568	5274	4514
3.50	3.548	48623	33418	26836	22968	20356	18444	15786	13991	9616	7722	6609
4.00	4.026	67736	46555	37385	31997	28358	25694	21991	19490	13396	10757	9207
5.00	5.047	122544	84224	67635	57887	51304	46485	39785	35261	24235	19461	16656
6.00	6.065	198427	136378	109516	93732	83073	75270	64421	57095	39241	31512	26970
8.00	7.981	407692	280204	225014	192583	170683	154651	132361	117309	80626	64745	55414
10.00	10.020	740477	508926	408686	349782	310005	280887	240403	213065	146438	117595	100646
12.00	11.938	1172269	805694	647001	553749	490777	444680	380588	337309	231830	186168	159336

What you need to commission the heater!

Combustion Analyzer

Voltmeter

Manometer

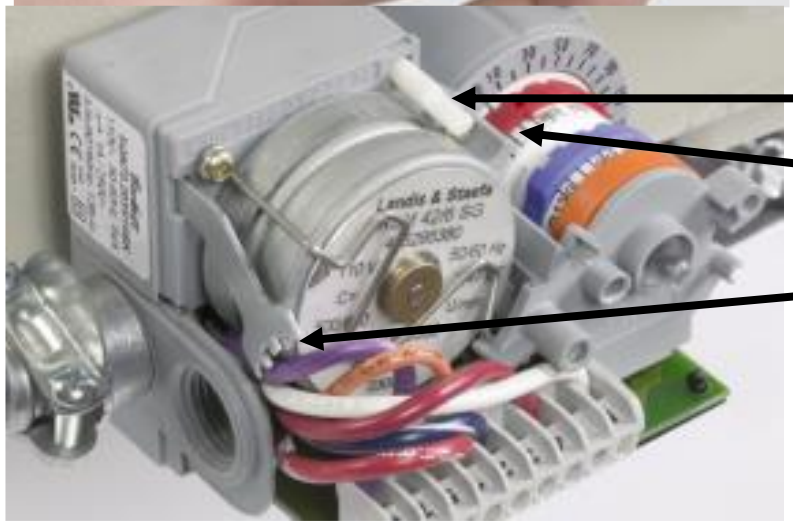
➢ Back to start-up…Page 39

➢ Back to information menu…Page 31

HOME

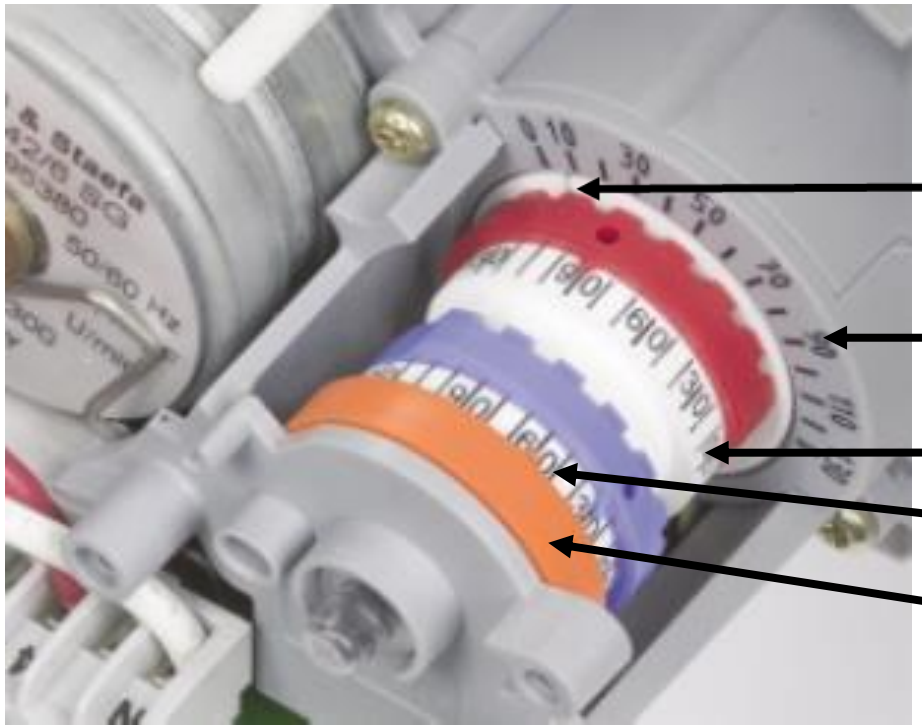
Adjustment Instructions
Printed on Cover

The **Disengaging Pin** allows the Damper and Cam Stack to be rotated by hand
The **Disengaging Pin** must be out when the burner is operating



- Disengaging Pin push in to disengage
- Cam Stack
- Adjustment Wrench

Continue...Page 57



Damper Position Indicator
(Black mark on white ring)

Damper Position Scale

Red High Fire Cam with
White adjustment Scale

Blue Low Fire Cam with
White adjustment scale

Transition Cam shares the
same white adjustment scale

Continue...Page 58

Setting the High Fire Air andLow Fire Air

Low Fire Air Set with Blue Cam

Adjustment Wrench

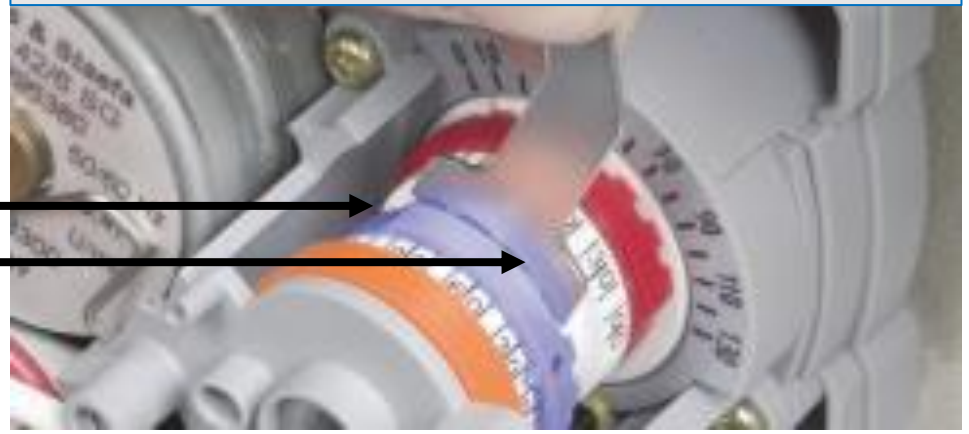
If adjusting the air settings while the burner is operating, it is necessary to cycle the burner from High to Low Fire or Low to High by using the lighted low fire hold switch.

High Fire Air is set with the Red Cam

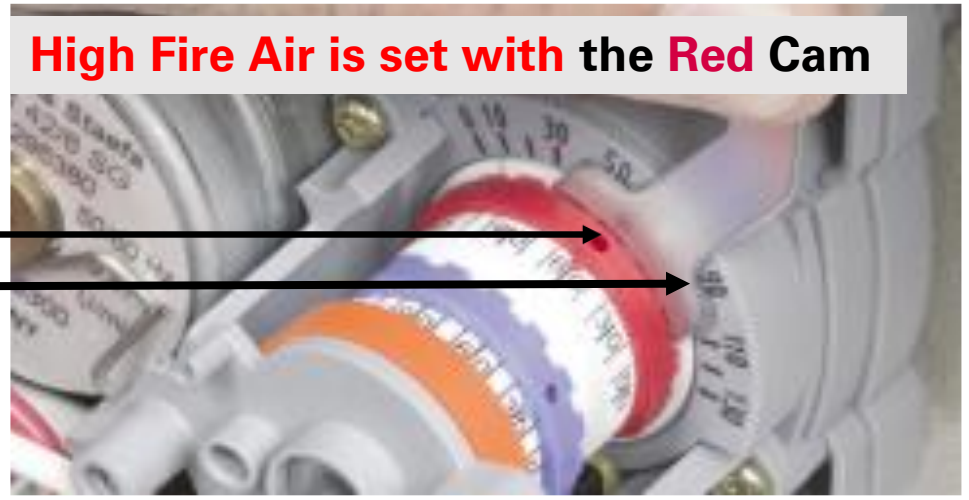
Adjustment Wrench

Continue...Page 59

Low Fire Air Set with Blue Cam



High Fire Air is set with the Red Cam



Setting the Transition

Cam is disengaged (pushed in).
The ORANGE CAM sets the transition point between Low Fire and High Fire transition.

It should be set halfway between the settings of the RED Cam and the BLUE Cam.
Example: Red setting 50 Blue setting 30 cam would be orange 40.

- Note: After you complete your adjustments make certain the disengaging pin has been reengaged with the damper position set between the high fire and low fire limits. Replace the actuator cover, making sure it is correctly seated, and test the burner for proper firing at low fire, high fire and in transition between low and high.

Transition Cam is set with Screwdriver

➢ Back to start-up...Page 31

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Return to main menu…Page 1

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Return to main menu…Page 1

Natural Gas and Propane Burner	
Preform and Record combustion results:	**Check**
O2 PERCENTAGE (oxygen) Low fire and Hi fire	✓ done
CO parts per million (ppm carbon monoxide) Low fire and Hi fire	✓ done
Remove gas gun assembly adjust electrodes check for cracks and clean	✓ done
Lubricate o ring on gun assembly	✓ done
Clean flame rod	✓ done
Check ignition cable	✓ done
Start burner and check control safety lock-out	✓ done
Check and adjust gas pressure Hi fire and Low fire	✓ done
Clean blower wheel (remove dust)	✓ done
Check air switch hose for cracks	✓ done
Check gas train fittings for leaks	✓ done
Start heater and check operation of thermostat /bypass	✓ done

Continue… Page 57 Return to information menu…Page 31

Heater controls	Check
Test temperature controller. Fan on at 90F / Fan off at 80F Burner off 30 F above set high limit / Burner back on at high set temp	✓ Done
Check circulating fan,(Fan timer, Fan relay, 110F disk)	✓ Done
Check wiring terminals inside control panel, tighten if lose	✓ Done
Clean heater casing and check for dents	✓ Done

- Note: Pre-season annual maintenance will save you time, money and service calls every time you rent the unit.

Return to main menu…Page 31

- **Note**: All gas piping should be calculated and installed by a qualified Gas fitter.

Gas fitters have charts for sizing gas pipes and proper regulators for different pressures and installations.

It is important to use the right sizing piping charts for your area. Code regulations vary from different States and Provinces.

As we work our way through this, if there is something you don't understand, there are many tutorials on You Tube you can visit that explains this method.

Next… Page 59

Natural Gas and Propane Regulator Examples…

1. Obtain the specifications included with the operational instructions for gas heaters.
2. Size the gas regulator according to the gas inlet pressure available to the heater.
3. Read the outlet pressure required for the heater on the heater specification sheet.
4. Size the regulator according to both the inlet and outlet gas pipe diameter of the gas train.

Size the gas regulator and piping according to the gas Outlet pressure available

Outlet diameter → **Gas Train 1 ¼"**

Outlet pressure

Size the gas regulator according to the gas inlet pressure required for the heater →

7" to 14"

➢ Note: The supplied pressure regulator with the heater on the gas train is used only to adjust the burner operating pressure. The only time a secondary regulator is not used is when the gas supplied on site from the meter is less than 14" WC.

Job sizing example…Page 60

Pipe sizing the job site…

- **WHAT YOU NEED TO KNOW**

Where the heater will be placed

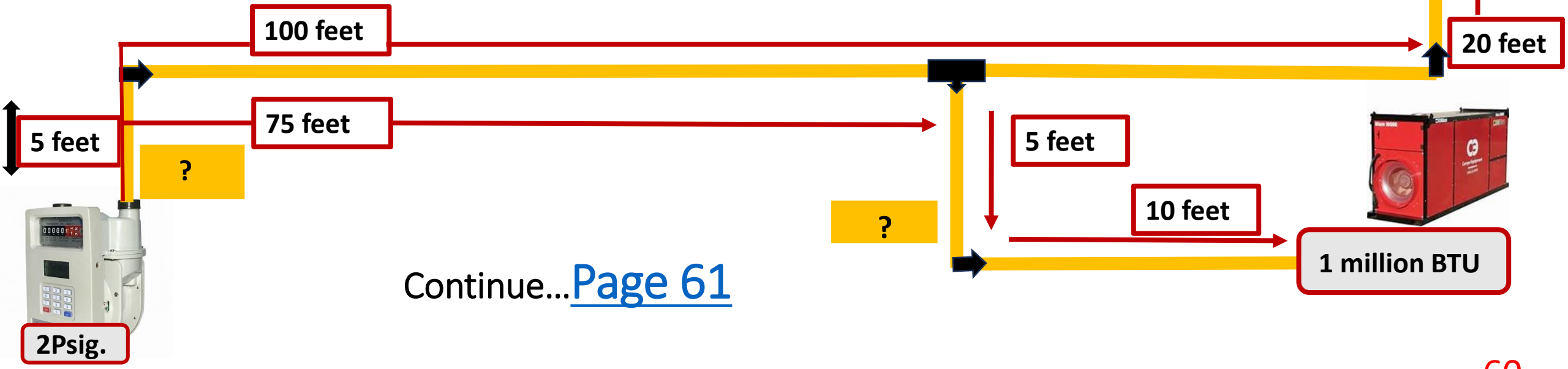
What Pressure is available 2 Psig

Gas type Natural Gas

Total BTUs of all units connected to gas piping 3 million

Length of longest run. 125 feet

- Steve's Job site requiring 1 heater - 1 million BTUs and 1 - heater 2 million BTUs.



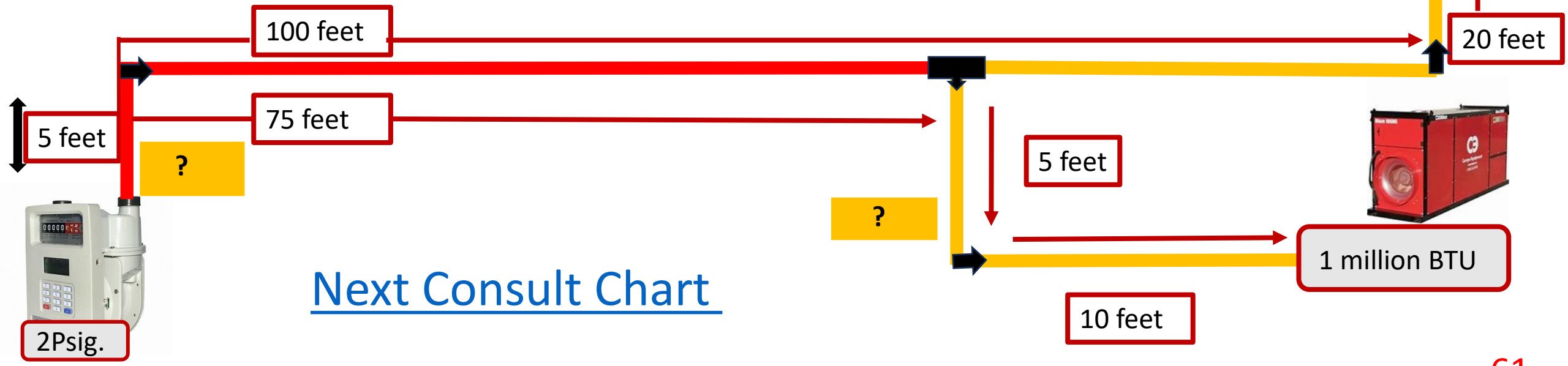
Continue…Page 61

Pipe sizing…

Find size of pipe to the first branch using your 2 Psig chart for NG. and Longest length. 125-foot run and consult your chart

Natural Gas

GAS: NATURAL														
INLET PRESSURE: LESS THAN 2 psi														
PRESSURE DROP: 0.5 in. w.c.														
SPECIFIC GRAVITY: 0.60														
PIPE SIZE (inch)														
NOMINAL:	½	¾	1	1¼	1½	2	2½	3	4	5	6	8	10	12
ACTUAL ID:	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026	5.047	6.065	7.981	10.020	11.938
LENGTH (feet)	CAPACITY IN CUBIC FEET OF GAS PER HOUR													
10	172	360	678	1390	2090	4020	6400	11 300	23 100	41 800	67 600	139 000	252 000	399 000
20	118	247	466	957	1430	2760	4400	7780	15 900	28 700	46 500	95 500	173 000	275 000
30	95	199	374	768	1150	2220	3530	6250	12 700	23 000	37 300	76 700	139 000	220 000
40	81	170	320	657	985	1900	3020	5350	10 900	19 700	31 900	65 600	119 000	189 000
50	72	151	284	583	873	1680	2680	4740	9660	17 500	28 300	58 200	106 000	167 000
60	65	137	257	528	791	1520	2430	4290	8760	15 800	25 600	52 700	95 700	152 000
70	60	126	237	486	728	1400	2230	3950	8050	14 600	23 600	48 500	88 100	139 000
80	56	117	220	452	677	1300	2080	3670	7490	13 600	22 000	45 100	81 900	130 000
90	52	110	207	424	635	1220	1950	3450	7030	12 700	20 600	42 300	76 900	122 000
100	50	104	195	400	600	1160	1840	3260	6640	12 000	19 500	40 000	72 600	115 000
125	44	92	173	355	532	1020	1630	2890	5890	10 600	17 200	35 400	64 300	102 000
150	40	83	157	322	482	928	1480	2610	5330	9650	15 600	32 100	58 300	92 300
175	37	77	144	296	443	854	1360	2410	4910	8880	14 400	29 500	53 600	84 900
200	34	71	134	275	412	794	1270	2240	4560	8260	13 400	27 500	49 900	79 000
250	30	63	119	244	366	704	1120	1980	4050	7320	11 900	24 300	44 200	70 000
300	27	57	108	221	331	638	1020	1800	3670	6630	10 700	22 100	40 100	63 400



Next Consult Chart

Pipe sizing Table for 2 pounds Pressure with a 10% Pressure drop and a gas of…

0.6 Specific Gravity

NO 125-foot then always use next highest ➘

Pipe Size of Schedule 40 Standard Pipe (Inches)	Internal Diameter (Inches)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	1112	764	614								
1.25	1.380	2283	1569	1260								
1.50	1.610	3421	2351	1888								
2.00	2.067	6589	4528	3636								
2.50	2.469	10501	7217	5796								
3.00	3.068	18564	12759	10246								
3.50	3.548	27181	18681	15002								
4.00	4.026	37865	26025	20899								
5.00	5.047	68504	47082	37809								
6.00	6.065	110924	76237	61221								
				786	10							
				161	19							
				682	309553	274351	248582	212754	188560	129596	104070	89071

➢ **WHAT YOU NEED TO KNOW**

What Pressure is available 2 Psig

Gas type, Natural Gas

Total BTUs of all units connected to gas piping 3 million

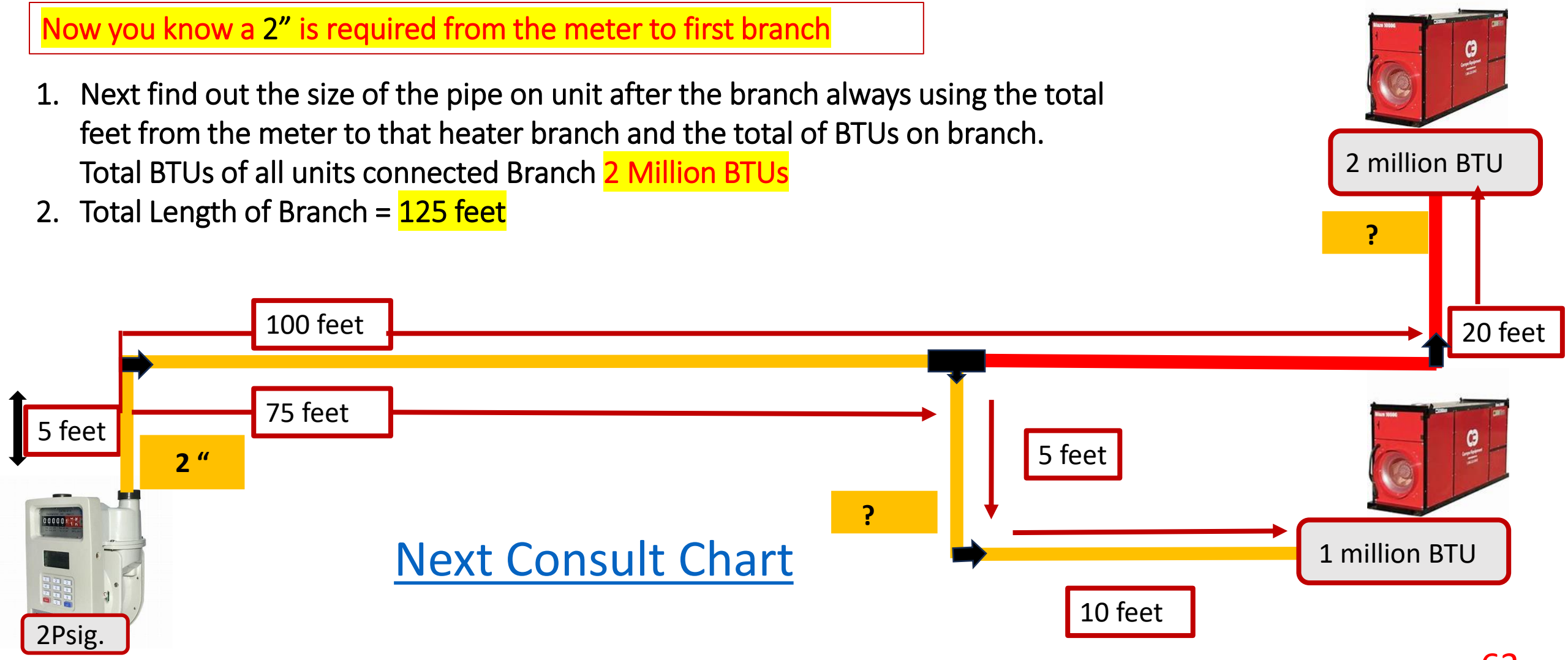
Length of longest run. 125 feet

150 feet-3636 million BTU's = 2" pipe.

Continue…Page 63

Now you know a 2" is required from the meter to first branch

1. Next find out the size of the pipe on unit after the branch always using the total feet from the meter to that heater branch and the total of BTUs on branch.
   Total BTUs of all units connected Branch 2 Million BTUs
2. Total Length of Branch = 125 feet



Pipe sizing Table for 2 pounds Pressure with a 10% Pressure drop and a gas of…
0.6 Specific Gravity

Pipe Size of Schedule 40 Standard Pipe (Inches)	Internal Diameter (Inches)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	1112	764	614	525	466	422	361	320	220	177	151
1.25	1.380	2283	1569	1260	1079							
1.50	1.610	3421	2351	1888	1616							
2.00	2.067	6589	4528	3636	3112							
2.50	2.469	10501	7217	5796	4961							
3.00	3.068	18564	12759	10246	8769							
3.50	3.548	27181	18681	15002	12840							
4.00	4.026	37865	26025	20899	17887							
5.00	5.047	68504	47082	37809	32359							
6.00	6.065	110924	76237	61221	52397							
				88 125786	107657							
				97 228461	195533							
				94 361682	309553	274351	248582	212754	188560	129596	104070	89071

Total BTUs on branch = 2000,000

Total length of run = 125 feet

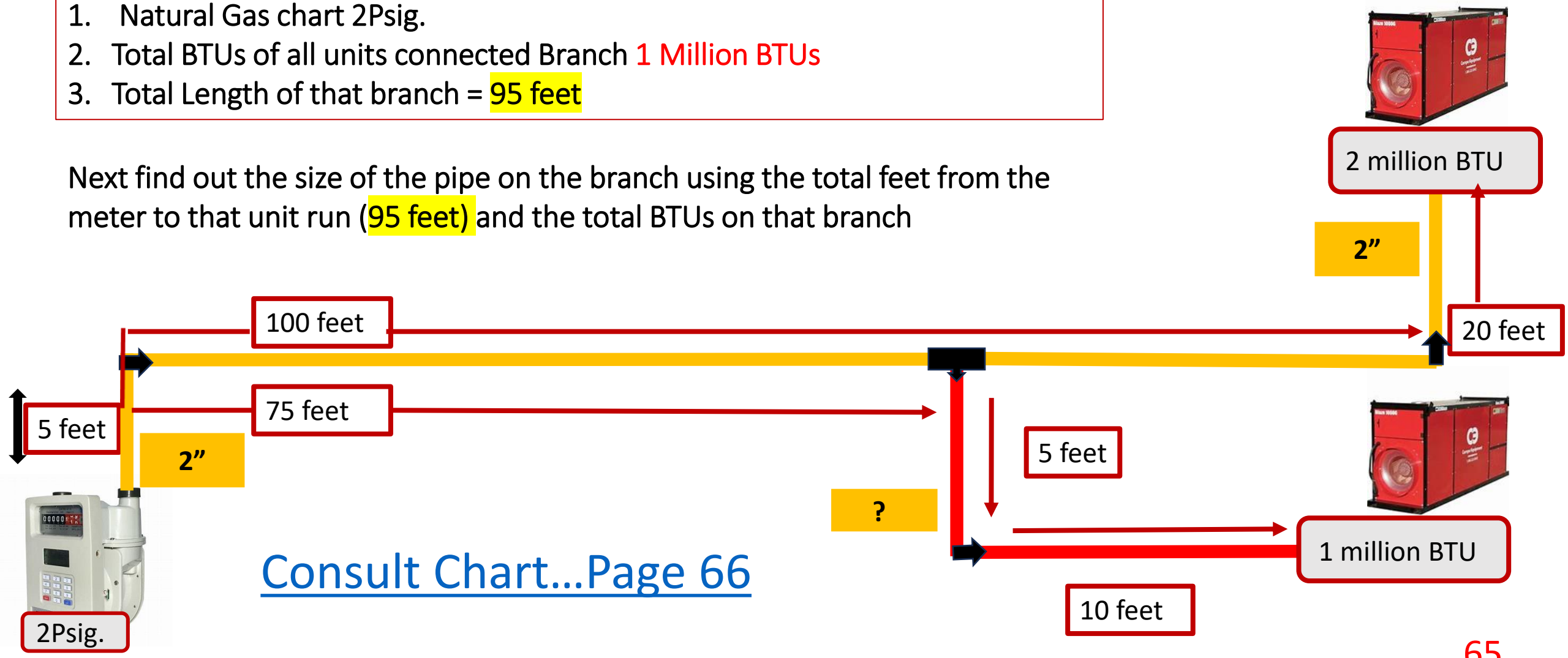
150 feet-3636 million BTU's = 2" pipe.

No 125 foot on chart must use next highest footage.

Continue…Page 65

1. Natural Gas chart 2Psig.
2. Total BTUs of all units connected Branch 1 Million BTUs
3. Total Length of that branch = 95 feet

Next find out the size of the pipe on the branch using the total feet from the meter to that unit run (95 feet) and the total BTUs on that branch



Consult Chart…Page 66

Pipe sizing Table for 2 pounds Pressure with a 10% Pressure drop and a gas of…
0.6 Specific Gravity.

NO 95-foot then always use next highest

Pipe Size of Schedule 40 Standard Pipe (Inches)	Internal Diameter (Inches)	Total Equivalent Length of Pipe in Feet										
		50	100	150	200	250	300	400	500	1000	1500	2000
1.00	1.049	1112	764	614	525	466	422	361	320	220	177	151
1.25	1.380	2283	1569	1260								
1.50	1.610	3421	2351	1888								
2.00	2.067	6589	4528	3636								
2.50	2.469	10501	7217	5796								
3.00	3.068	18564	12759	10246								
3.50	3.548	27181	18681	15002								
4.00	4.026	37865	26025	20899								
5.00	5.047	68504	47082	37809								
6.00	6.065	110924	76237	61221	52397	46439	42077	36012	31917	21936	17616	15077
				125786	107657	95414	86452	73992	65578	45071	36194	30977
				228461	195533	173297	157020	134389	119106	81861	65737	56263
				361682	309553	274351	248582	212754	188560	129596	104070	89071

1. Natural Gas chart 2Psig.
2. Total BTUs of all units connected Branch 1 Million BTUs
3. Total Length of Branch from meter = 95 feet

100 feet-1569 BTU's = 1 ¼"

Continue… Page 67

Piping for job complete

2 million BTU

2"

100 feet

20 feet

5 feet

75 feet

2"

5 feet

1 ¼"

1 million BTU

10 feet

2Psig.

Click Multiple units on a header

Pipe sizing multiple heaters one header…

Note: any other appliances operating off the same meter would have to be calculated in to piping.

400,000 BTU

650,000 BTU

2 million BTU

20 feet

1" PIPE

20 feet

1" PIPE

20 feet

2" PIPE

2 1/2" PIPE

30 feet

50 feet

100 feet

2 feet

2Psig.

40 feet

10 feet

1 1/4" PIPE

2 million BTU

Click Multiple units on 2 branches…Page 69

Available pressure 2Psig.
Total BTU = 5.050 million
Longest length 122 feet

Pipe sizing multiple heaters one Main Line and multiple drops…

"Field Assist Troubleshooting Guide"

Available pressure 2Psig.

Total BTU = 4250,000

Longest length 165 feet

Note: any other appliances operating off the same meter would have to be calculated in to piping.

400,000 BTU

20 feet

1"

30 feet

30 feet

650,000 BTU

20 feet

1"

50 feet

2 million BTU

20 feet

2"

Branch A - 135 feet

3 feet

2 feet

2 ½"

2Psig.

Home

50 feet

1 ½"

1 million BTU

20 feet

1 ¼"

50 feet

50 feet

10 feet

200,000 BTU

1"

Branch B

165 feet

Questions notes

1. What about the low voltage indicator
2. What about fan tampered switch