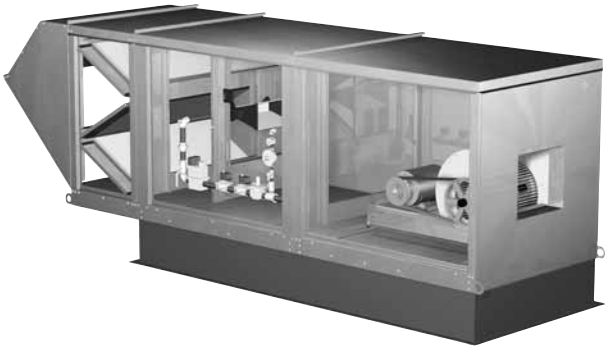
Part # 464044

GREENHEAT™ SYSTEM for INDUSTRIAL SPACE HEATING - MODEL DG / DGX

Installation, Operation and Maintenance Manual



FOR YOUR SAFETY

If you smell gas
1. **Open windows**
2. **Don't touch electrical switches**
3. **Extinguish any open flames**
4. **Immediately call your gas supplier**

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

WARNING

Disconnect and secure all electrical power to the "OFF" position prior to inspection or servicing. Failure to comply with this safety precaution could result in serious injury or death.

WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.

IMPORTANT

All factory provided lifting lugs must be used when lifting any unit. Failure to comply with this safety precaution could result in property damage, serious injury or death.

Report any damaged equipment to the shipper immediately!

All units are shipped on a skid or packaged to minimize damage during shipment. The transporting carrier has the responsibility of delivering all items in their original condition as received from Greenheck. The individual receiving the equipment is responsible for inspecting the unit for obvious or hidden damage, recording any damage on the bill of lading before acceptance and filing a claim (if required) with the final carrier. Some accessory items are stored inside the unit during shipping. Care must be taken during installation to prevent damage to units.

GREENHECK
Building Value in Air.

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STORAGE

When a unit is not going to be in service for an extended period of time, certain procedures should be followed to keep the unit in proper operating condition:

- Plug all piping
- Rotate fan wheel monthly and purge bearings once every one to three months (depending on environment).
- Energize fan motor once every three months
- Store belts flat to keep them from warping and stretching
- Store unit in location without vibration
- Cover unit with tarp to protect from dirt and moisture
- After storage period, purge grease before putting fan into service

NOTE!
Do not cover unit with a black tarp, as this will promote condensation.

NOTE!
Improper storage which results in damage to the unit will void the warranty.

Installation - Indoor

Step 1 Install Hangers

Install threaded hangers from ceiling supports. When locating hangers, allow enough room to open access panel(s). Be sure to allow for the recommended diffuser height outlined in the diffuser installation instructions. Two nuts must be used on the end of each threaded hanger. Ceiling supports are supplied by others. Refer to figure #1.

Step 2 Install Unit

Using sheet metal screws, attach the weatherhood/thru-wall/filter section to the blower/burner section. The flange on the weatherhood/thru-wall/filter section should overlap the flange on the blower/burner section.

Raise the assembled unit into place.

Using two nuts per hanger, fasten the unit supports to the hangers under the unit. Appropriate unit supports, such as the optional Greenheck hanging bracket kit or c-channel and angle iron (supplied by others) should be used. Refer to figure #1.

In order to prevent the unit from swinging and to provide a safe environment for service and maintenance, additional measures must be taken to secure the unit in all directions.

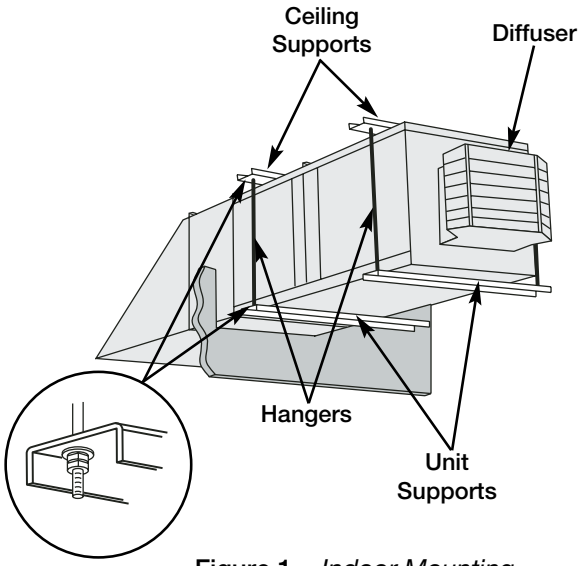

Figure 1. *Indoor Mounting*

NOTE!

Two nuts must be used on each end of each threaded hanging rod for proper support.

NOTE!

Good duct practices should be followed for all ductwork. Ductwork should be installed in accordance with SMACNA and AMCA guidelines, NFPA 96 and any local codes. Reference the CAPS submittal for duct sizes.

Step 3 Seal Wall Opening

Apply sealant around the perimeter of the weatherhood to prevent water penetration and drafts into the building. Refer to figure #2.

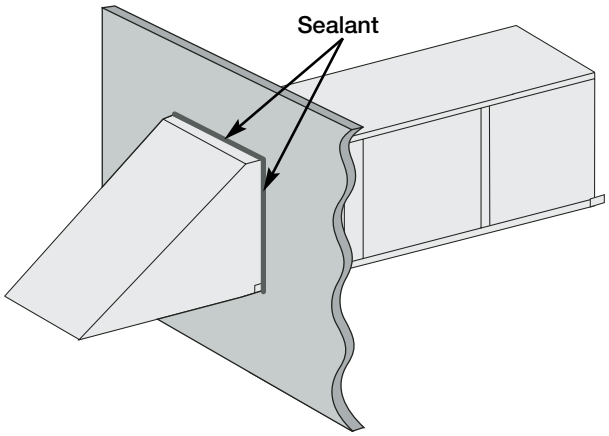

Figure 2. *Sealing Wall Opening*

Installation - Arrangement DB / HZ

Step 1 Install Curb

Position curb on the roof (reference the CAPS submittal for placement of curb in relation to the unit). Verify that the curb is level, shim if necessary. Attach curb to roof and flash into place. Refer to figure #3.

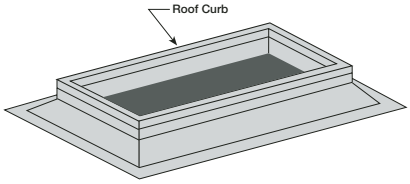

Figure 3. *Roof Curb*

Step 2 Install Ductwork

Good duct practices should be followed for all ductwork. All ductwork should be installed in accordance with SMACNA and AMCA guidelines, NFPA 96 and all local codes. Reference the CAPS submittal for ductwork sizes. Be sure to allow for the recommended diffuser height outlined in the diffuser installation instructions.

Apply an appropriate sealant around the perimeter of the curb and duct adapter to isolate fan vibration and prevent water penetration. Refer to figure #4.

NOTE!

The use of a duct adapter is recommended on a downblast (DB) arrangement to align the ductwork with the supply unit and is only a guide and is not to be used to support the ductwork.

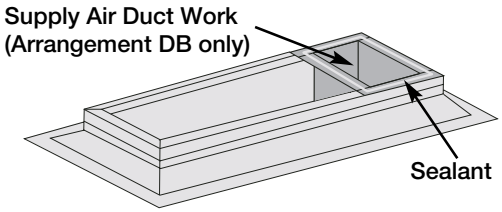

Figure 4. *Ductwork*

Step 3 Install Unit

Use a crane and a set of spreader bars hooked to the factory lifting lugs to lift and center the unit on the curb. Use self-tapping sheet metal screws to fasten the unit to the curb. See figure #5.

NOTE!

The use of all lifting lugs and a set of spreader bars is mandatory when lifting the unit.

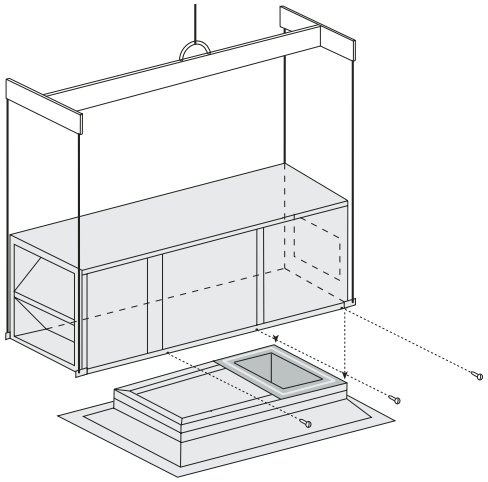

Figure 5. *Placing Unit*

Step 4 Assemble and Install Weatherhood

The weatherhood can now be assembled and attached to the unit. Detailed assembly instructions can be found with the weatherhood. Once the weatherhood is installed, use an appropriate sealant to seal the seam between the weatherhood and the unit.

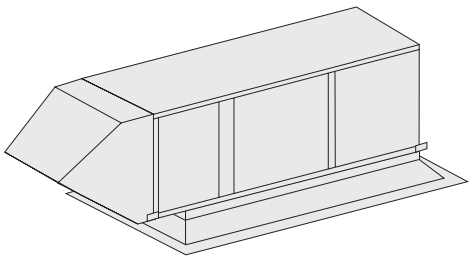

Figure 6. *Complete Rooftop Installation*

Installation - Diffuser and Remote Panel (TSCP)

IMPORTANT!

The location of the discharge diffuser and the TSCP are critical for optimum performance of the Greenheat space heat system.

Step 1 Install Diffuser

Using self-tapping screws, attach diffuser to the ductwork or unit. Be sure to maintain the recommended floor to diffuser height. Refer to the chart to the right for the recommended diffuser height. See figures #7 and #8.

Airflow (cfm)	Diffuser Height (ft.)		
	Minimum	Recommended	Maximum
4,000	15	20	25
6,000	15	20	25
8,000	20	20-25	30
10,000	20	25-30	35
13,000	25	30-35	40

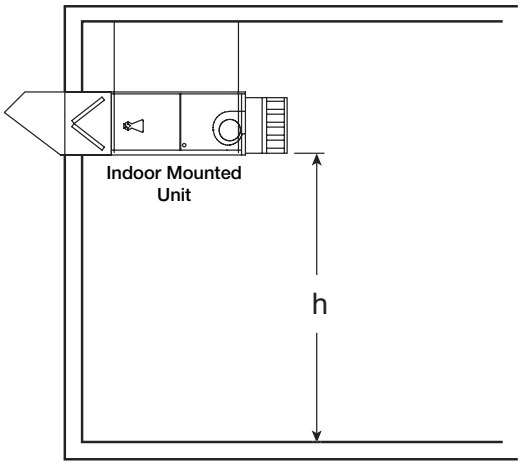

Figure 7. *Thru-wall Diffuser Height*

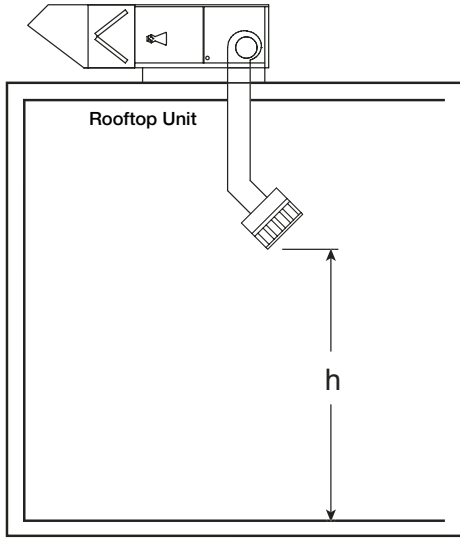

Figure 8. *Rooftop Diffuser Height*

Step 2 Install TSCP

When installing the TSCP, the locataion is critical to performance of the Greenheat space heat system. The TSCP should be installed 5-6 feet above the floor. It is recommended that the TSCP be installed on an outside wall, in the space, and close to any source of infiltration such as dock doors. DO NOT install the TSCP in the blast area of the heater or near any other source of heat. Refer to figure #9.

IMPORTANT!

DO NOT install the TSCP in the blast area of the space heater or near any other source of heat.

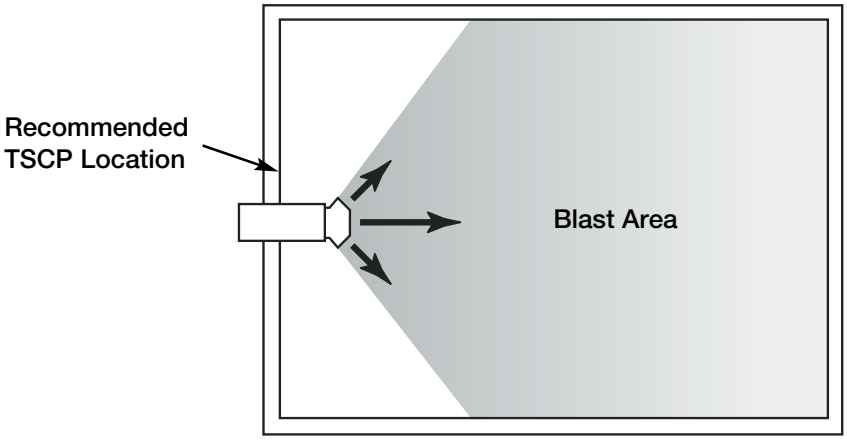

Figure 9. *TSCP Location*

Installation - Electrical Wiring

IMPORTANT!

Before connecting power to the unit, read and understand the following instructions and wiring diagrams. Complete wiring diagrams are attached on the inside of the control center door(s).

IMPORTANT!

All wiring should be done in accordance with the latest edition of the National Electrical Code ANSI/NFPA-70 and any local codes that may apply. In Canada, wiring should be done in accordance with the Canadian Electrical Code.

CAUTION!

If replacement wire is required, it must have a temperature rating of at least 105°C, except for energy cut-off or sensor lead wire which must be rated to 150°C.

IMPORTANT!

The equipment must be properly grounded. Any wiring running through the unit in the airstream must be protected by metal conduit, metal clad cable or raceways.

DANGER!

High voltage electrical input is needed for this equipment. This work should be performed by a qualified electrician.

CAUTION!

Any wiring deviations may result in personal injury or property damage. Greenheck is not responsible for any damage to, or failure of the unit caused by incorrect final wiring.

IMPORTANT!

Greenheck's standard control voltage is 24 VAC. Control wire resistance should not exceed 0.75 ohms (approximately 285 feet total length for 14 gauge wire; 455 feet total length for 12 gauge wire). If the resistance exceeds 0.75 ohms, an industrial-style, plug-in relay should be wired in place of the remote switch. The relay must be rated for at least 5 amps and have a 24 VAC coil. Failure to comply with these guidelines may cause motor starters to chatter or not pull in, resulting in contactor failures and/or motor failures.

Step 1 Determine the Size of the Main Power Lines

The unit's nameplate states the voltage and the unit's total amps. The main power lines to the unit should be sized accordingly. See figure #10.

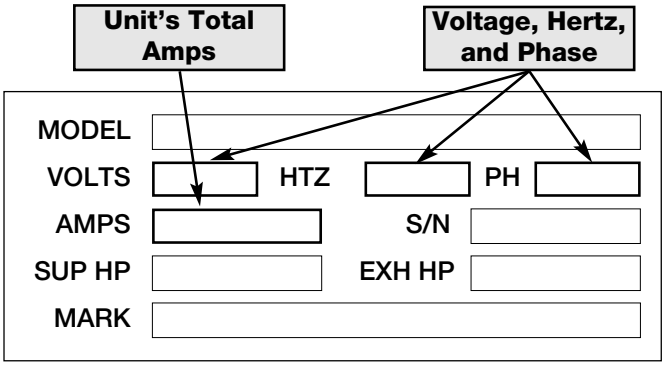

Figure 10. *Electrical Nameplate*

Step 2 Provide the Opening(s) for the Electrical Connections

Electrical openings vary by unit size and arrangement and are field supplied.

Step 3 Connect the Main Power

Connect the main power lines to the disconnect switch and main grounding lug(s). Torque field connections to 20 in-lbs. See the control center layout in the reference section for main disconnect and grounding lug(s) locations.

Step 4 Wire the Optional Convenience Outlet

The convenience outlet requires a separate 115V power supply circuit. The circuit must include short circuit protection which may need to be supplied by others.

Step 5 Wire the Remote Panel (TSCP)

Reference the ladder diagram on the inside of the control center door for correct wiring of the TSCP.

NOTE!

TSCP has number-to-number wiring to the control center in the unit.

Installation - Direct Gas Piping

IMPORTANT!

All gas piping must be installed in accordance with the latest edition of the National Fuel Gas Code ANSI/Z223.1 and any local codes that may apply. In Canada, the equipment shall be installed in accordance with the Installation Code for Gas Burning Appliances and Equipment (CGA B149) and Provincial Regulations for the class. Authorities having jurisdiction should be consulted before installations are made.

WARNING!

All components of this or any other gas fired heating unit must be leak tested prior to placing the unit into operation. A soap and water solution should be used to perform this test. NEVER test for gas leaks with an open flame.

WARNING!

If pressure testing in excess of 1/2 psig (3.5 kPa), the heater and manual shutoff valve must be disconnected from the supply gas line.

WARNING!

If pressure testing at or below 1/2 psig (3.5 kPa), the heater must be isolated from the supply gas line by closing its manual shutoff valve.

IMPORTANT!

All piping should be clean and free of any foreign matter. Foreign material entering the gas train can damage the valves, regulators and burner.

IMPORTANT!

Do NOT connect the unit to gas types other than what is specified and do NOT connect the unit to gas pressures that are outside of the pressure range shown on the label.

Step 1 Determine the Supply Gas Requirements

The unit's direct gas nameplate states the requirements for the gas being supplied to the unit. See figure #11.

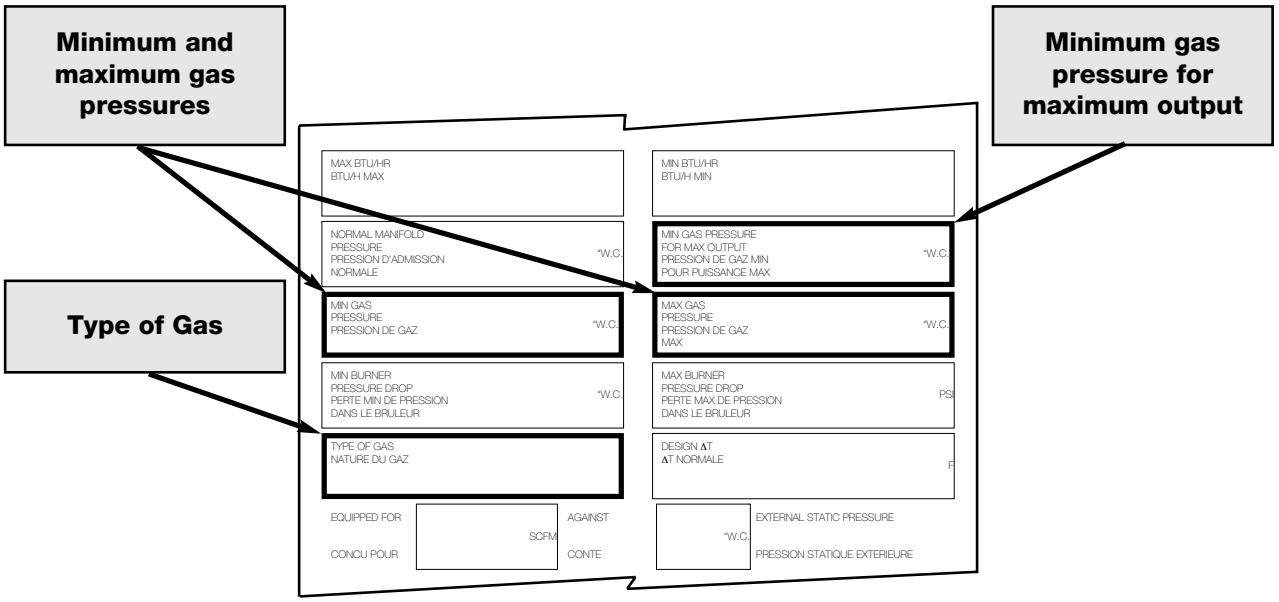

Figure 11. *Direct Gas Nameplate*

Installation - Direct Gas Piping

Step 2 Install Additional Regulator if Required

When the supply gas pressure exceeds the maximum gas pressure shown on the direct gas nameplate (see figure #11), an additional regulator (by others) is required to reduce the pressure. The regulator must have a listed leak limiting device or it must be vented to the outdoors.

NOTE!
The regulator located inside the unit is used to adjust the unit's maximum output temperature.

Step 3 Connect the Supply Gas Line

A manual shut off valve (gas cock), 1/8 inch plugged test port and 6 inch drip leg must be installed prior to the gas train (see figure #12). The valve and the test port must be accessible for the connection of a test gauge. Supply gas connections must be made by a qualified installer and are not furnished by Greenheck

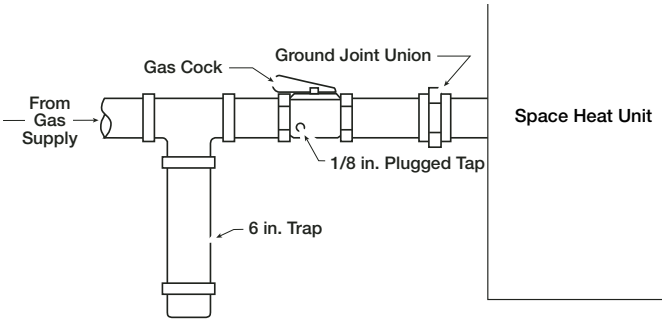

Figure 12. *Supply Gas Line*

Step 4 Pipe the Optional Vent Line

If an optional vent line is located between the safety shutoff valves it must be piped to the outdoors. Refer to figure #13.

NOTE!
Reference the National Fuel Gas Code for additional vent line requirements.

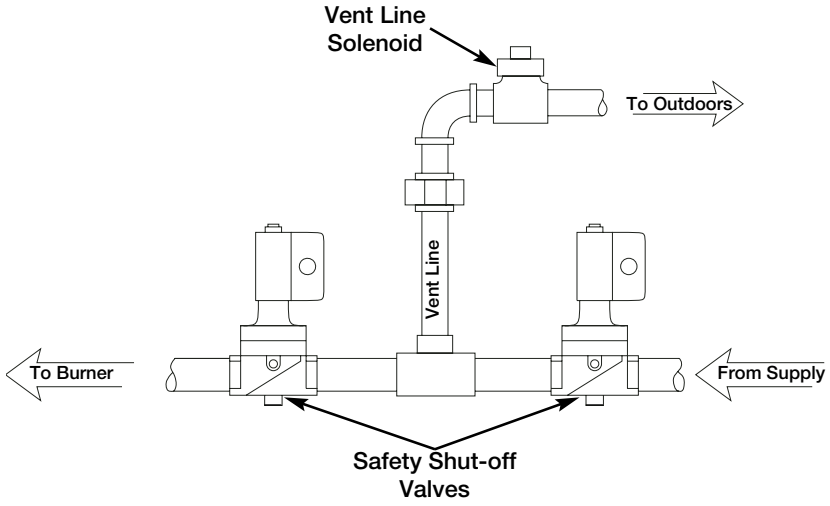

Figure 13. *Vent Line*

Step 5 Test the System for Leaks

Check both the supply lines and the factory piping for leaks. Apply a soap and water solution to all piping and watch for bubbling which indicates a leak.

WARNING!
NEVER test for a gas leak with an open flame.

WARNING!
The factory piping has been checked for leaks, but should be rechecked due to shipping and installation.

Start-Up - Blower

Pre Start-Up Check

Rotate the fan wheel by hand and make sure no parts are rubbing. Check the V-belt drive for proper alignment and tension (a guide for proper belt tension and alignment is provided in the belt maintenance section). Check fasteners, set screws and locking collars on the fan, bearings, drive, motor base and accessories for tightness. Remove any shipping fasteners from the blower's vibration isolators.

WARNING!

Disconnect and lock-out all power and gas before performing any maintenance or service to the unit. Failure to due so could result in serious injury or death and damage to equipment.

WARNING!

Check the housing, blower, weatherhood, filter section and ductwork for foreign objects and debris before the blower is run.

SPECIAL EQUIPMENT REQUIRED

Below is a list of special tools that are required. A recommended model is shown, but equivalent products may be used.

Description	Manufacturer-Model	Phone	Website
Voltage Meter	Fluke-23	1-800-44-FLUKE	www.fluke.com
Amperage Meter	Fluke-23	1-800-44-FLUKE	www.fluke.com
Thermometer	Fluke-50	1-800-44-FLUKE	www.fluke.com
U-Tube manometer	Dwyer-Slack Tube	1-219-897-8000	www.dwyer-inst.com
Tachometer	Monarch-Pocket Tach 100	1-800-999-3390	www.monarchinstruments.com

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Step 1 Check the Voltage

Before starting the unit, compare the supplied voltage, hertz, and phase with the unit and motor's nameplate information. See figure #14.

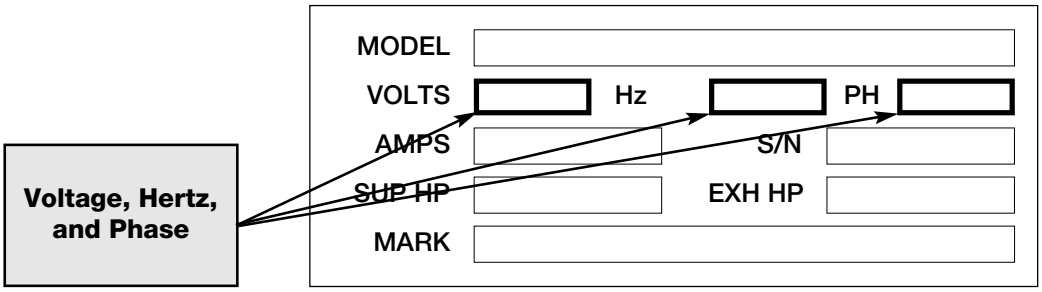

Figure 14. *Electrical Nameplate*

Step 2 Check the Blower Rotation

Open the blower access door and run the blower momentarily to determine the rotation. Arrows are placed on the blower scroll to indicate the proper direction or reference figure #15.

NOTE!

To reverse the rotation on three phase units, disconnect and lock-out the power, then interchange any two power leads.

NOTE!

To reverse the rotation on single phase units, disconnect and lock-out the power, then rewire the motor per the manufacturer's instructions.

IMPORTANT!

If the blower is rotating in the wrong direction, the unit will move some air, but will not perform as designed. Be sure to perform a visual inspection to guarantee the correct blower rotation.

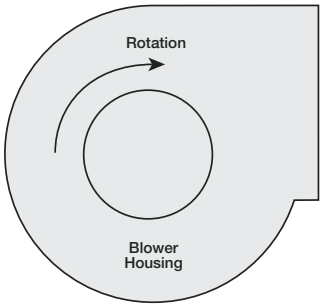

Figure 15. *Blower Rotation*

Start-Up - Blower

Step 3 Check for Vibration

Check for unusual noise, vibration or overheating of the bearings. Reference the troubleshooting section for corrective actions.

IMPORTANT!

Excessive vibration may be experienced during the initial start-up. Left unchecked, it can cause a multitude of problems including structural and/or component failure.

IMPORTANT!

Generally, fan vibration and noise is transmitted to other parts of the building by the ductwork. To minimize this undesirable effect, the use of heavy canvas duct connectors is recommended.

Step 4 Motor Check

Measure the motor voltage, amps and RPM, and compare to the specifications on the motor's nameplate.

Step 5 Air Volume Measurement and Check

Measure the unit's air volume (CFM) and compare it with its rated air volume. If the air volume is off, adjust the fan RPM by changing the drive.

NOTE!

The most accurate way to measure the air volume is by using a pilot traverse method downstream of the blower. Other methods can be used but should be proven and accurate.

IMPORTANT!

Changing the air volume can significantly increase the motor's amps. If the air volume is changed, the motor's amps must be checked to prevent overloading the motor.

Step 6 Set-up Optional Components

Adjust the settings on the optional components. See the control center layout in the reference section for location of optional components.

- Building Freeze Protection (typical setting: 5 min at 45ºF)
- Dirty Filter Gauge (typical setting: settings vary greatly for each unit)

Start-Up - Direct Gas

IMPORTANT!
For proper unit function and safety, follow the start-up procedure in the exact order that it is presented.

IMPORTANT!
This start-up should begin after all of the installation procedures and the Electrical start-up have been completed.

Step 1 Check the Supply Gas Pressure

Check the supply gas pressure and compare it with the unit's nameplate pressure requirements (see figure #16). Adjust the supply regulator as needed until the supply gas pressure is within the specified range.

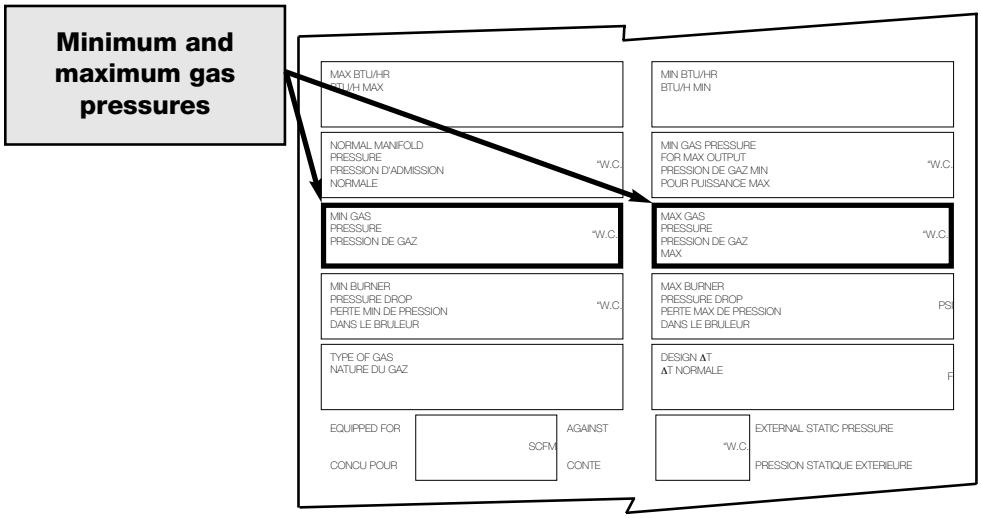

Figure 16. *Direct Gas Nameplate*

Step 2 Check the Pilot Gas Pressure

Check the pilot gas pressure. The recommended gas pressure is 3 inches wc. Adjust the pilot regulator as needed. See the gas train layout in the reference section for the location of the pilot pressure test port and pilot regulator.

Step 3 Check the Optional High and Low Gas Pressure Switches

Check the settings on the high and low gas pressure switches. The high pressure setting is typically 8 inches wc and the low pressure is setting is typically 3 inches wc. The switches are set at the factory and should not need adjustment. Adjust the setting if needed. See the gas train layout diagram in the reference section for the high and low pressure switch location.

NOTE!
The purpose of the high and low gas pressure switches is to automatically shutdown the burner if the inlet gas pressure is too low for the burner to safely light, or if the manifold pressure is too high for the burner to operate safely.

Start-Up - Direct Gas

IMPORTANT!
Proper air velocity over the burner is critical on direct fired gas units. If the air velocity is not within the unit specifications, the unit will not operate efficiently, may have sporadic shutdowns and may produce excessive carbon monoxide (CO) or other gases.

Step 4 Set the Burner Air Pressure Differential

With the fan running and discharging 70°F air, connect a U-Tube manometer to the outer sensing probes (see figure #18) and measure the static pressure across the burner.

The proper static pressure should be between 0.625 and 0.675 inches wc. If needed, evenly adjust the baffles above and below the burner, keeping the burner centered in the opening until the required pressure is obtained. See figure #17.

NOTE!
When required pressure is obtained, be sure to reconnect the outer sensing probes.

IMPORTANT!
This process may need to be repeated until the proper pressure is achieved. This adjustment will change the air quantity delivered by the unit and therefore the air quantity delivered should be rechecked. Refer to the blower start-up section.

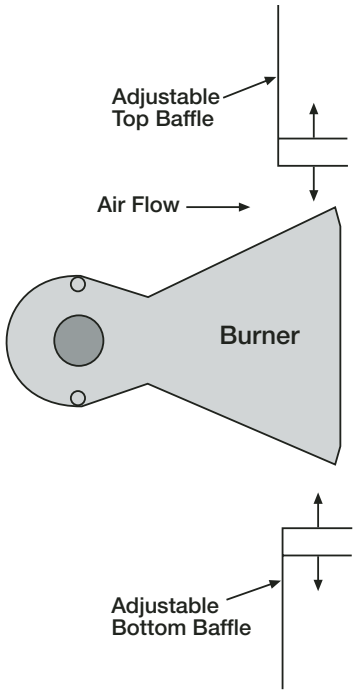

Figure 17. *Burner and Baffles*

NOTE!
To increase the static pressure decrease the opening. To decrease the static pressure increase the opening.

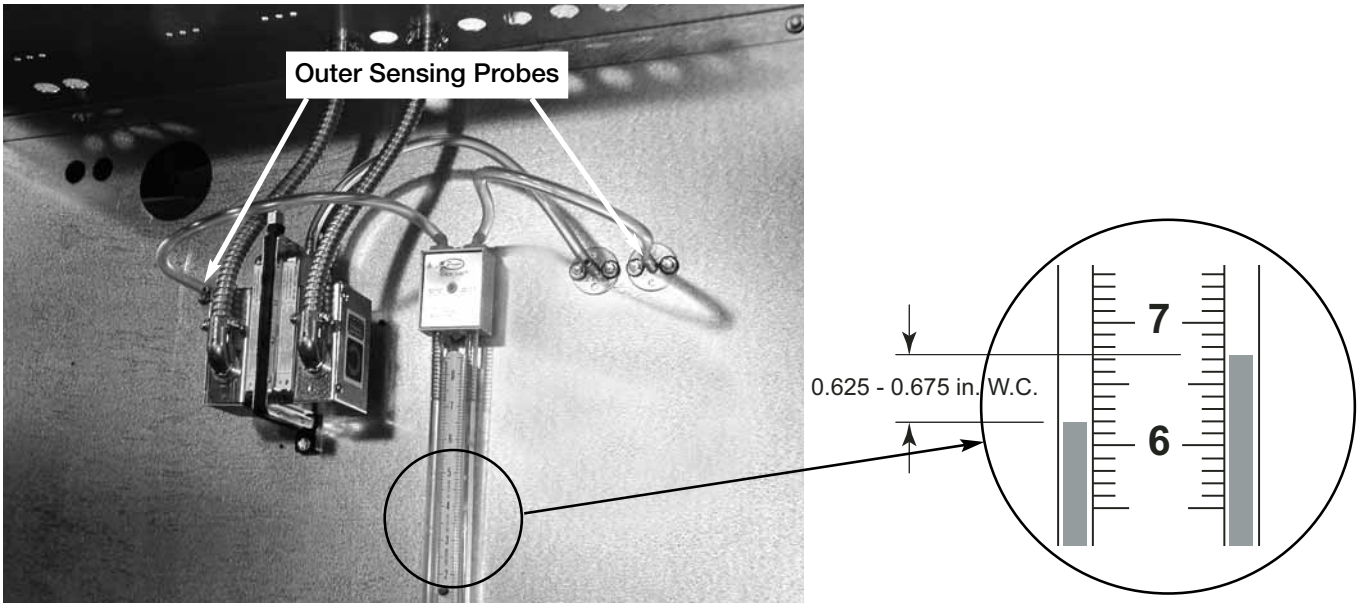

Figure 18. *Measuring the Pressure Drop*

Start-Up - Direct Gas

Step 5 Set the Low Fire Time Delay

Set the low fire time delay to 75% of its maximum setting. See figure #20.

Step 6 Set the Maximum Firing Rate

Monitor the units actual temperature rise by placing a thermocouple in the unit's inlet and a second in the discharge, downstream of the burner.

Send the unit to maximum fire by disconnecting and isolating the proper wire on the Maxitrol amplifier (Terminal #3 for Maxitrol 44 as shown in figure #20).

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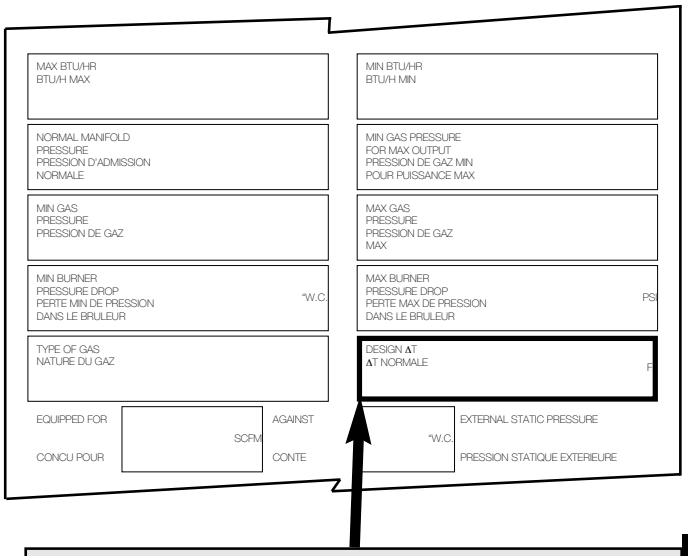
Figure 19. *Direct Gas Nameplate*



WARNING!

Do not set the burner maximum firing rate based on gas pressure. It should be set based on the unit's designed temperature rise shown on the direct gas label.

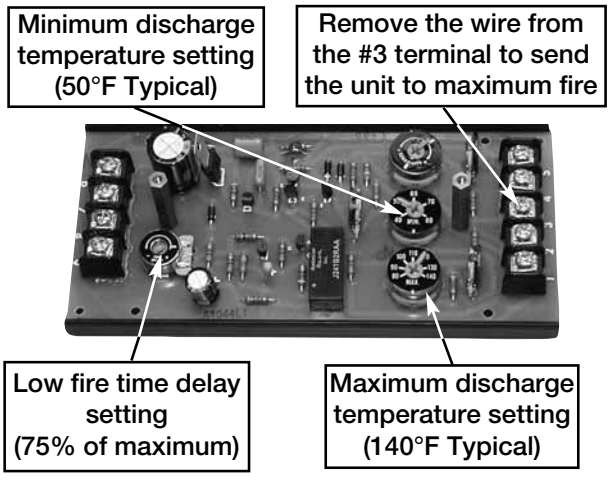


Figure 20. *Maxitrol Series 44*

Start-Up - Direct Gas

Step 6 Set the Maximum Firing Rate

While monitoring the units temperature rise, set the maximum firing rate by adjusting the regulator (as shown in figures #21 and #22) until the designed temperature rise is achieved. After setting the maximum firing rate, reconnect the wire to the amplifier.

IMPORTANT!
Setting the maximum firing rate during mild weather conditions may cause the high limit to trip out during extreme conditions requiring manual resetting.

NOTE!
The minimum setting for the maximum firing rate may be higher than required. This is acceptable, the burner will still modulat as needed.

NOTE!
Gas trains are equipped with either separate regulators and modulating valves or with a combined modulating regulator.

Separate Regulator and Modulating Valve

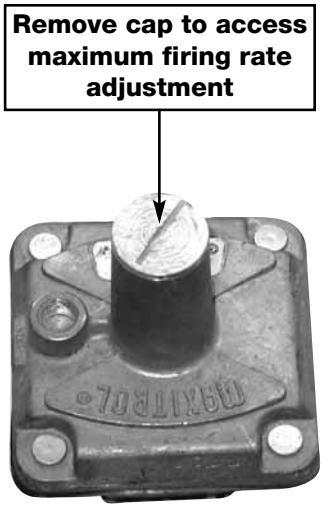


Figure 21. *Separate Regulator and Modulating Valve*

Combined Modulating Regulator

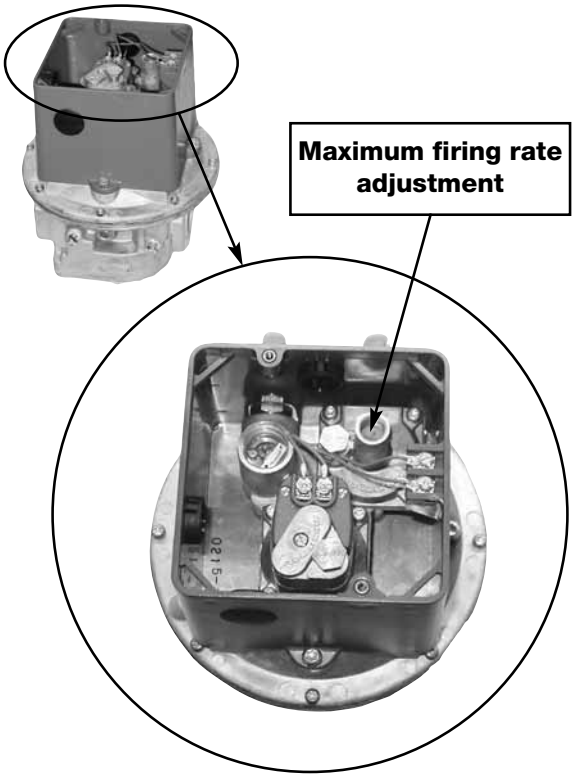


Figure 22. *Combined Modulating Regulator*

NOTE!
Clockwise rotation increases the temperature rise, counterclockwise rotation decreases the temperature rise.

Start-Up - Direct Gas

Step 7 Set the Minimum Firing Rate

Disconnect and isolate one of the wires running to the modulating valve to send the unit to its minimum firing rate. Set the minimum firing rate by adjusting the needle valve as shown in the figures #23 and #24.

After setting the minimum firing rate, shut off the pilot to ensure that the flame safeguard can still read the main flame signal. Reconnect the wire to the modulating valve and open the pilot shut-off valve.

IMPORTANT!
The proper setting for the minimum firing rate results in a small ribbon of continuous flame across the entire burner.

IMPORTANT!
Do not allow the disconnected wire to come in contact with a potential ground. Damage to the amplifier or transformer could result.

NOTE!
On units with a 42 inch or greater burner, the flame safe guard will automatically shut off the pilot 10 seconds after the burner has been ignited.

NOTE!
Gas trains are equipped with either separate regulators and modulating valves or with a combined modulating regulator.

NOTE!
Adjusting the maximum and minimum fire requires the inlet air sensor to be set higher than the outdoor air temperature in order to start the burner. Once high and low fire have been set, the inlet air sensor should be set to the desired temperature.

Separate Regulator and Modulating Valve

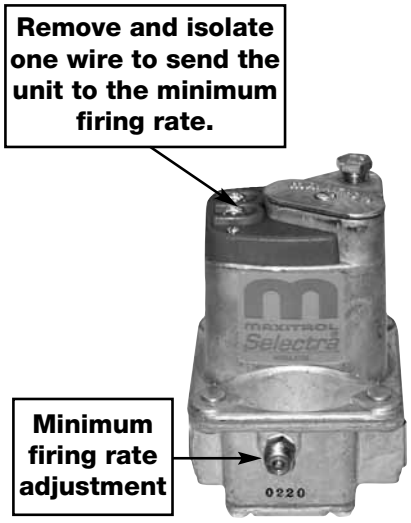


Figure 23. *Separate Regulator and Modulating Valve*

NOTE!
Counterclockwise rotation increases the minimum fire rate setting, clockwise rotation decreases the setting.

Combined Modulating Regulator

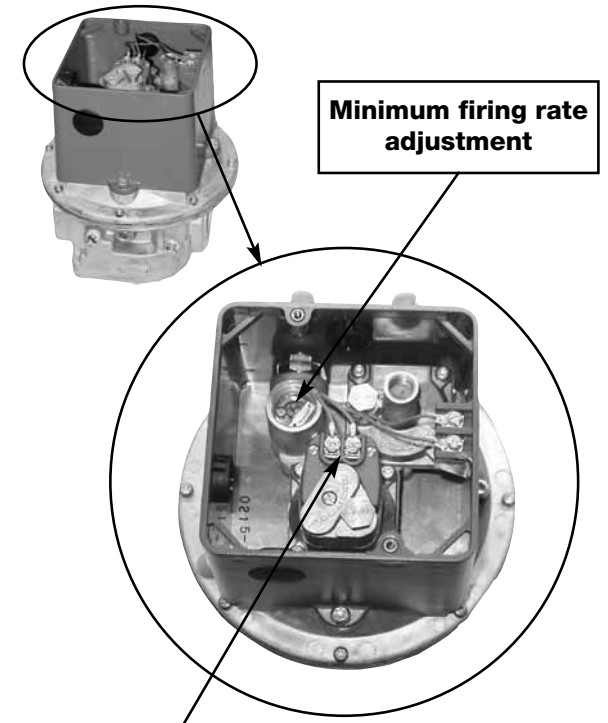


Figure 24. *Combined Modulating Regulator*

Step 8 Set Daytime Temperature

Set the daytime temperature settings to the desired daytime space temperature, the setting is located in the TSCP. See figure #25.

NOTE!
For units without a 7 day time clock, skip steps #9 and #10.

Step 9 Set Nighttime Temperature

Set the nighttime temperature settings to the desired nighttime space temperature, the setting is located in the TSCP which should be mounted in the space. See figure #25.

NOTE!
For the unit to function properly, the day temperature should always be set higher than the night temperature.

Step 10 Program The 7 Day Time Clock

Follow the detailed Programming and Operating Instructions for 7 Day Time Clock that shipped with the unit. Set the timer *ON* times to the times when the daytime temperature setting is to be used. Set the timer *OFF* times to the times when the nighttime temperature setting is to be used. See figure #25.

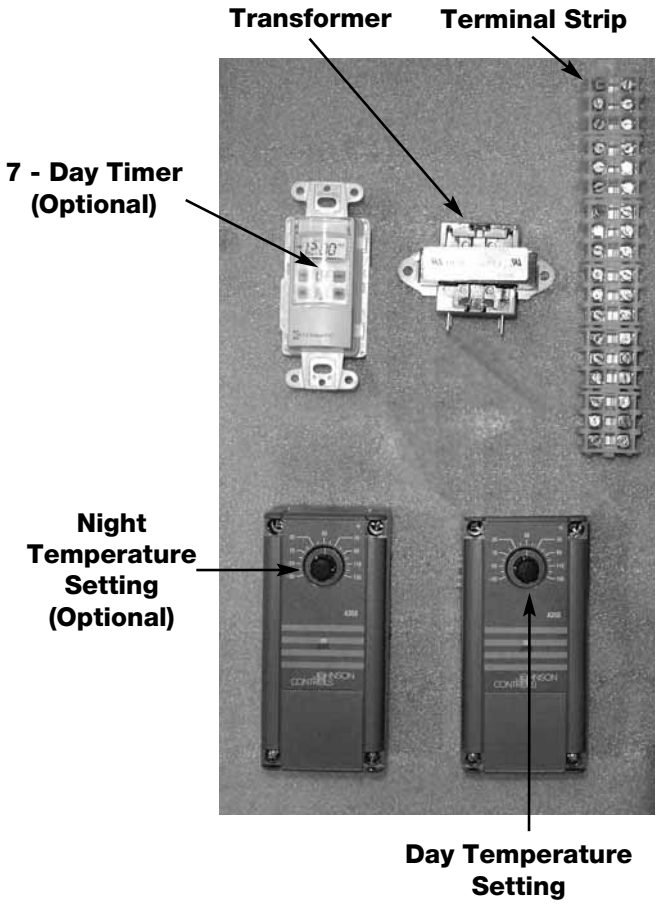


Figure 25. *TSCP Controls*

Step 11 Flame Signal Check

To measure the flame signal connect a standard DC voltmeter to the flame amplifier test jacks + and - (com) as shown in figure #26. The flame signal should be above 1.25 VDC and steady.

Check the flame signal with the burner at pilot only, minimum fire, mid-fire and high-fire.

NOTE!
If the flame signal is not above 1.25 VDC and steady, consult the troubleshooting section.

Figure 26. *Flame Signal Check*

Operation - Electrical without 7 Day Timer

1. Switch (S2) in Summer Mode

- Power passes to terminal G
- Power passes to optional freeze protection relay (FZ1) and if temperature is acceptable N.C. contact (FZ1) remains closed
- Power passes to damper which opens
- When damper is fully opened, damper relay (D1) is energized and N.O. damper limit switch (DL1) closes.
- Power passes to and energizes supply starter relay (ST1)
- Supply starter contact (ST1) closes and power reaches and energizes supply fan
- Supply fan starts

2. Switch (S2) in Winter Mode

- If space temperature is less than the daytime temperature setting, the N.O. temperature sensor contact (TS) closes
- Power passes to terminal W1 then to fan relay (R4)
- Fan relay (R4) is energized and N.O. contact (R4) closes
- Power passes to terminal G
- Power passes to optional freeze protection relay (FZ1) and if temperature is acceptable N.C. contact (FZ1) remains closed
- Power passes to damper which opens
- When damper is fully opened, damper relay (D1) is energized and N.O. damper limit switch (DL1) closes.
- Power passes to and energizes supply starter relay (ST1)
- Supply starter contact (ST1) closes and power reaches and energizes supply fan and heat relay (R2)
- N.O. heat relay contact (R2) closes
- Power passes to and energizes terminal 5 of the Flame Safe Guard (FSG)
- Power passes to N.C. high limit control contact (HLC1) which is closed if the temperature has remained below the HLC1 set point
- Power passes to N.O. and N.C. gas pressure contact(s) (PS1, PS3) which are both closed if gas pressure is within the set range
- Power passes to terminal 6 of the FSG
- FSG begins direct gas burner sequence (see direct gas sequence)

3. Flame Safe Guard (FSG) Sequence

- Verifies proper airflow with airflow switch PS2
- Verifies no flame present at burner
- Initiates 10 second prepurge
- Sends power to open pilot valve (V1) and energizes the spark generator (SG1) (clicking of the spark generator may be heard).
- Energizes spark generator for up to 10 seconds to light pilot and confirm flame.
- Powers the main gas valves (V2 and V3) open
- Shuts down spark generator
- Continuously monitors the flame and airflow
- Performs self-diagnostic check every four seconds

Operation - Electrical with 7 Day Timer

1. Switch (S2) in Summer Mode

- Power passes to terminal G
- Power passes to optional freeze protection relay (FZ1) and if temperature is acceptable N.C. contact (FZ1) remains closed
- Power passes to damper which opens
- When damper is fully opened, damper relay (D1) is energized and N.O. damper limit switch (DL1) closes.
- Power passes to and energizes supply starter relay (ST1)
- Supply starter contact (ST1) closes and power reaches and energizes supply fan
- Supply fan starts

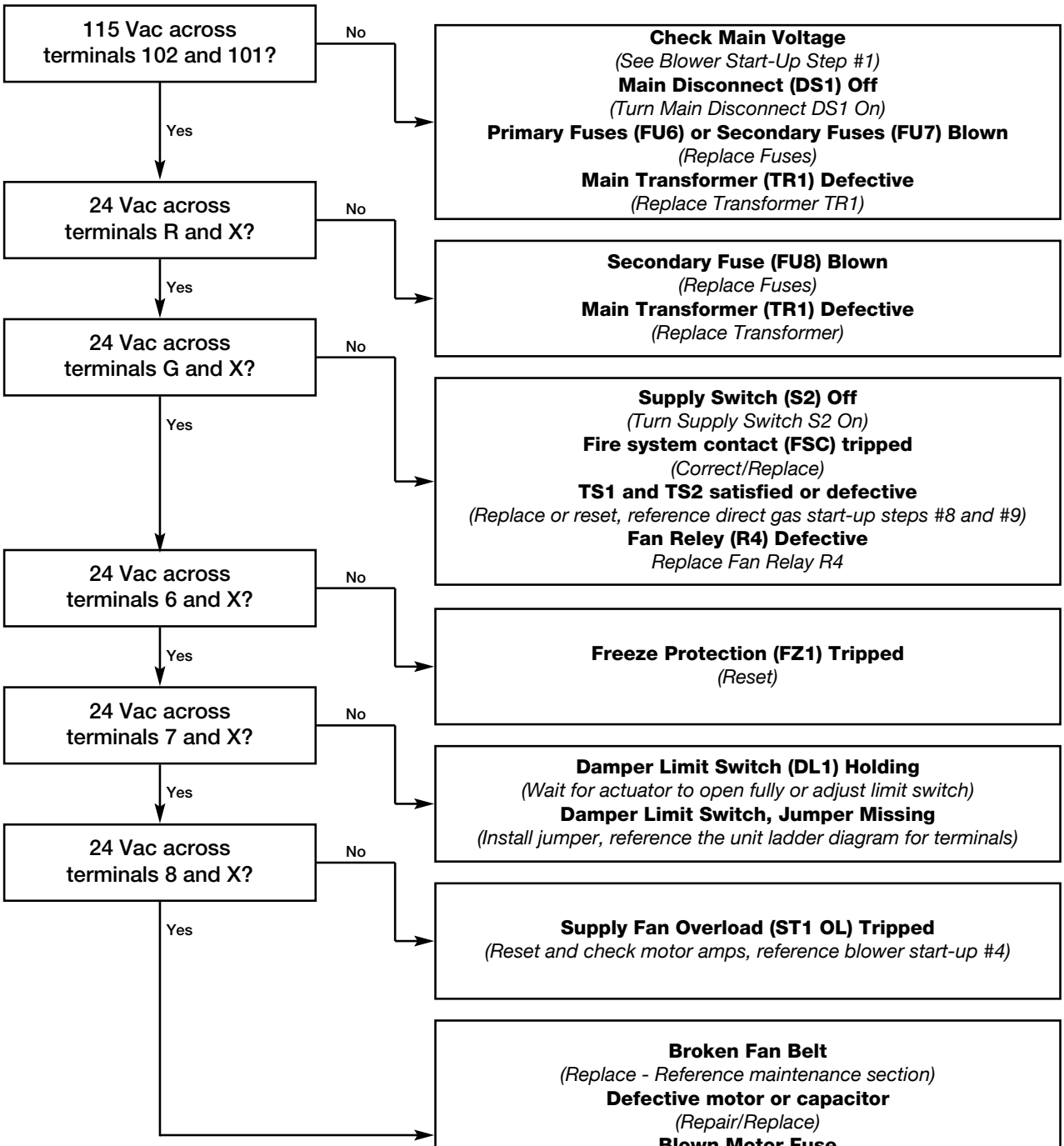
2. Switch (S2) in Winter Mode

- If space temperature is less than the daytime temperature setting, the the N.O. temperature sensor contact (TS1) closes and power passes to the timer (TC1). If the timer is on, power passes to terminal (W1). If timer (TC1) is off, but the space temperature is less than the nighttime temperature setting, the N.O. temperature sensor contact (TC2) closes and power passes to terminal (W1).
- Power passes to fan relay (R4)
- Fan relay (R4) is energized and N.O. contact (R4) closes
- Power passes to terminal G
- Power passes to optional freeze protection relay (FZ1) and if temperature is acceptable N.C. contact (FZ1) remains closed
- Power passes to damper which opens
- When damper is fully opened, damper relay (D1) is energized and N.O. damper limit switch (DL1) closes.
- Power passes to and energizes supply starter relay (ST1)
- Supply starter contact (ST1) closes and power reaches and energizes supply fan and heat relay (R2)
- N.O. heat relay contact (R2) closes
- Power passes to and energizes terminal 5 of the Flame Safe Guard (FSG)
- Power passes to N.C. high limit control contact (HLC1) which is closed if the temperature has remained below the HLC1 set point
- Power passes to N.O. and N.C. gas pressure contact(s) (PS1, PS3) which are both closed if gas pressure is within the set range
- Power passes to terminal 6 of the FSG
- FSG begins direct gas burner sequence (see direct gas sequence)

3. Flame Safe Guard (FSG) Sequence

- Verifies proper airflow with airflow switch PS2
- Verifies no flame present at burner
- Initiates 10 second prepurge
- Sends power to open pilot valve (V1) and energizes the spark generator (SG1) (clicking of the spark generator may be heard).
- Energizes spark generator for up to 10 seconds to light pilot and confirm flame.
- Powers the main gas valves (V2 and V3) open
- Shuts down spark generator
- Continuously monitors the flame and airflow
- Performs self diagnostic check every five seconds

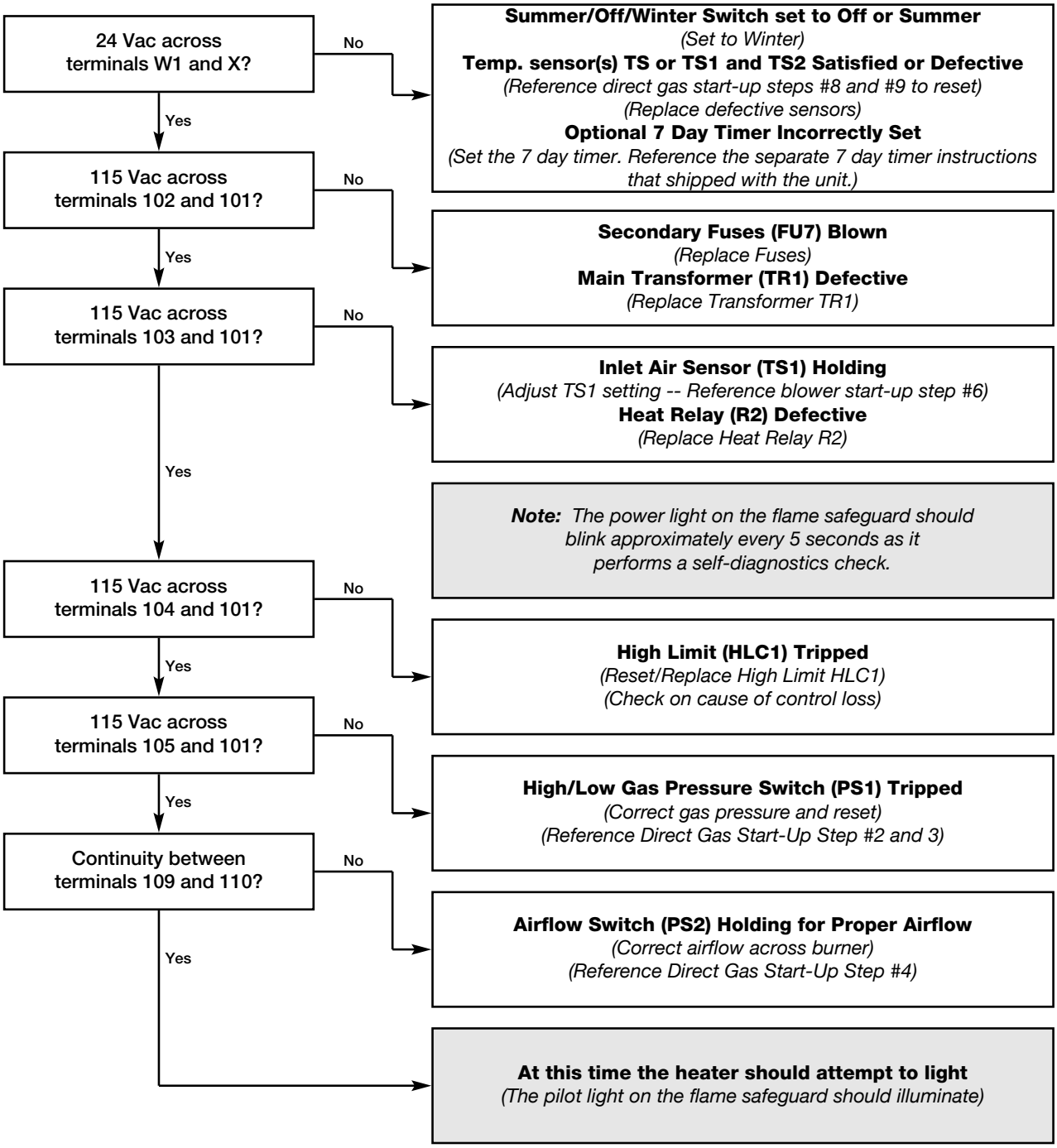
Blower Does Not Operate



Note: *At this time the supply contactor (ST1) should pull in passing power to the supply motor and the blower should start.*

Heater Does Not Operate

Does not attempt to light (No visible spark)



Heater Does Not Operate

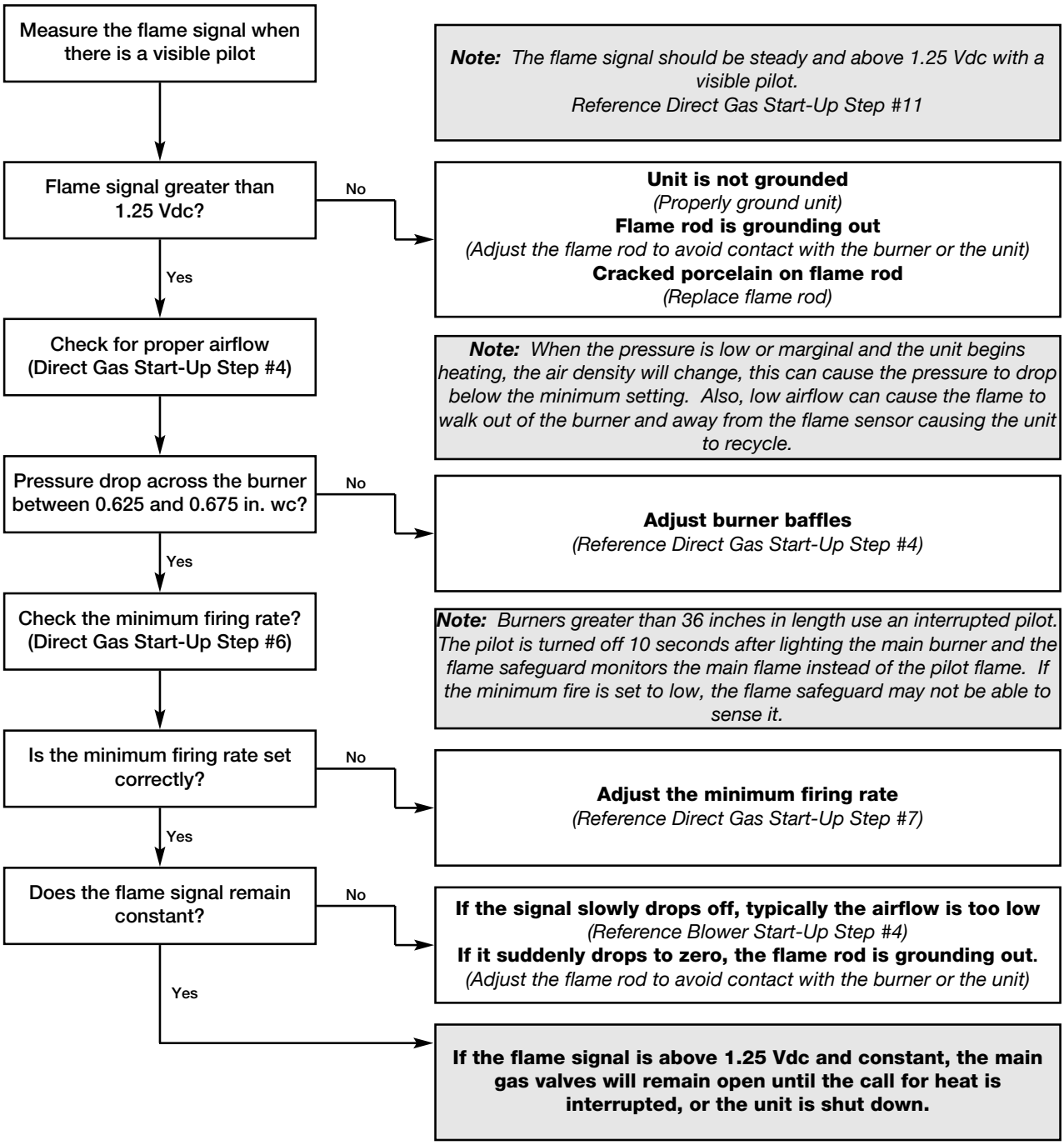
Attempts to light but no visible pilot (Visible spark)

Note: *The minimum and maximum gas pressures for your unit are shown on the direct gas label. Reference direct gas start-up procedure #1*

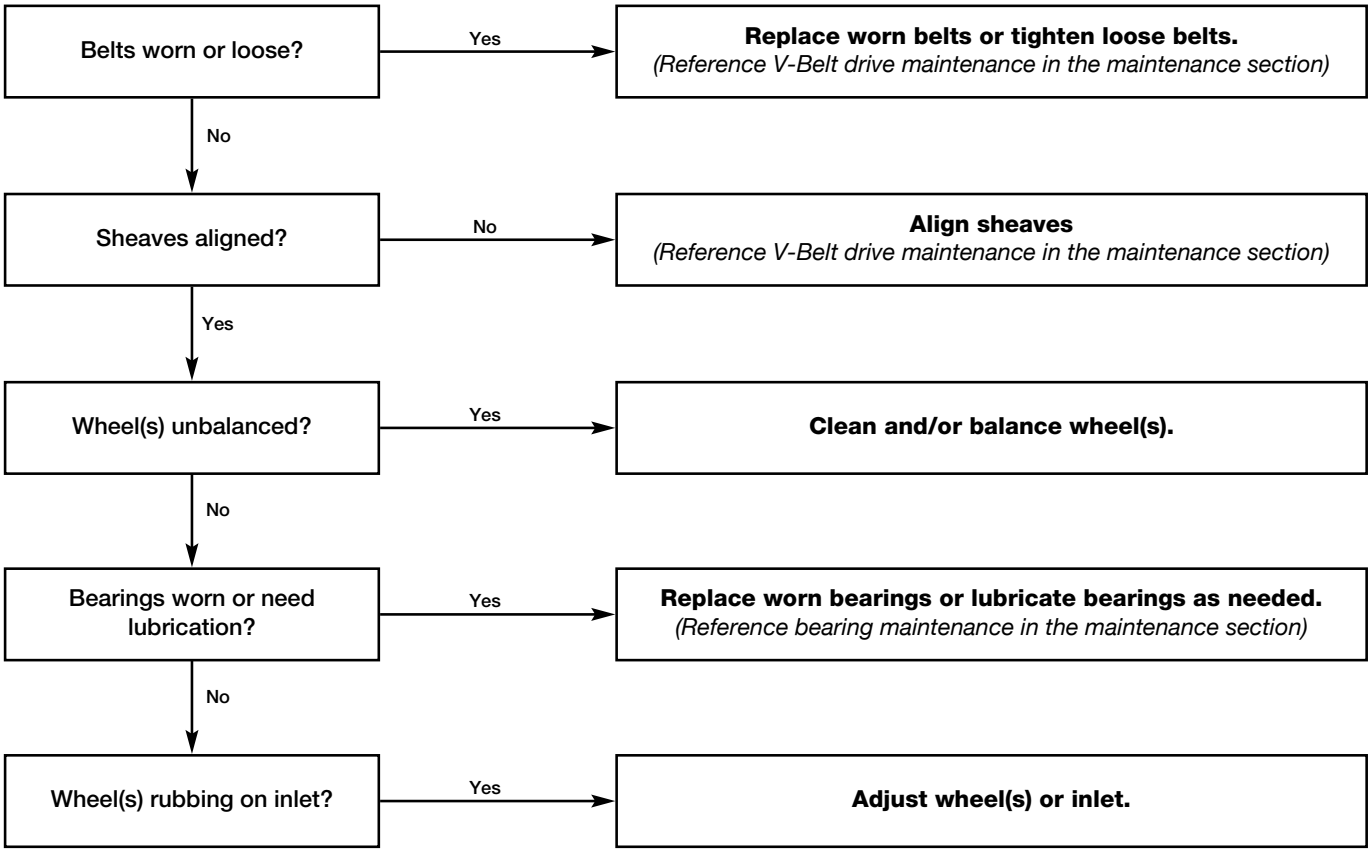
Note: *A high pilot pressure will make lighting more difficult. Lower the pilot pressure in increments until the unit lights. Then set the pilot per the instruction in Direct Gas Start-Up procedure #2)*

Heater Does Not Operate

Visible pilot



Excessive Noise or Vibration



Note: *At this time noise and vibration should be at acceptable levels.*

Maintenance - Routine

CAUTION!
Lock-out the gas and the electrical power to the unit before performing any maintenance or service operations to this unit.

V-Belt Drives

V-belt drives must be checked on a regular basis for wear, tension, alignment and dirt accumulation.

Check the tension by measuring the deflection in the belt. See figure #27.

Check the alignment by using a straight edge across both sheaves. See figure #28.

IMPORTANT!
Premature or frequent belt failures can be caused by improper belt tension, or misaligned sheaves.

Abnormally high belt tension or drive misalignment will cause excessive bearing loads and may result in failure of the fan and/or motor bearings.

Abnormally low belt tension will cause squealing on start-up, excessive belt flutter, slippage and overheated sheaves

IMPORTANT!
Do not pry belts on or off the sheave. Loosen belt tension until belts can be removed by simply lifting the belts off the sheaves.

IMPORTANT!
When replacing V-belts on multiple groove drives all belts should be changed to provide uniform drive loading.

IMPORTANT!
Do not install new belts on worn sheaves. If the sheaves have grooves worn in them, they must be replaced before new belts are installed.

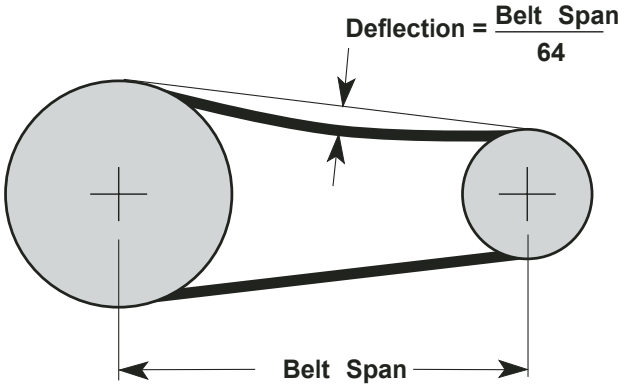


Figure 27. *Belt Tension*

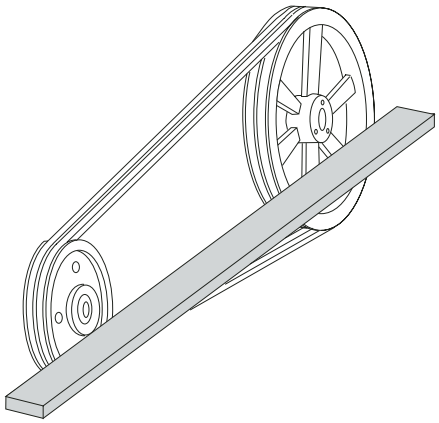


Figure 28. *Drive Alignment*

M - 1

Motors

Motor maintenance is generally limited to cleaning and lubrication (where applicable).

Cleaning should be limited to exterior surfaces only. Removing dust and grease build-up on the motor assures proper motor cooling.

Motors supplied with grease fittings should be greased in accordance with the manufacturer's recommendations.

IMPORTANT!
Do not allow water or solvents to enter the motor or bearings. Motors and bearings should never be sprayed with steam, water or solvents.

IMPORTANT!
Greasing motors is only intended when fittings are provided. Many motors are permanently lubricated, requiring no additional lubrication.

Wheels

Wheels require little attention when moving clean air. Occasionally oil and dust may accumulate on the wheel causing imbalance. When this occurs the wheel and housing should be cleaned to assure proper operation.

Maintenance - Routine

Bearings

The bearings for Greenheck fans are carefully selected to match the maximum load and operating conditions of the specific class, arrangement and fan size. The instructions provided in this manual and those provided by the bearing manufacturer will minimize any bearing problems.

IMPORTANT!

Lubricate bearings prior to periods of extended shutdowns or storage and rotate shaft monthly to aid in corrosion prevention. If the fan is stored more than three months, purge the bearings with new grease prior to start-up.

Recommended Bearing Lubrication Schedule for Greenheck Fans

Relubrication Schedule in Months*

Fan RPM	Bearing Bore Size (inches)				
	1/2 - 1	1 1/8 - 1 1/2	1 5/8 - 1 7/8	1 15/16 - 2 3/16	2 7/16 - 3
250	6	6	6	6	6
500	6	6	6	5	4
750	6	5	4	3	3
1000	5	3	2	1	1
1250	5	3	2	1	1
1500	5	2	1	1	0.5
2000	5	1	1	0.5	0.25

* Suggested initial greasing interval is based on 12 hour per day operation and 150°F maximum housing temperature. For continuous (24 hour) operation, decrease greasing interval by 50%

- If extended grease lines are present, relubricate while in operation, only without endangering personnel.
- For ball bearings (operating) relubricate until clean grease is seen purging at the seals. Be sure not to unseat the seal by over lubricating.
- For ball bearings (idle) add 1-2 shots of grease up to 2 inch bore size, and 4-5 shots above 2 inch bore sizes with a hand grease gun.
- For roller bearings add 4 shot of grease up to 2 inch bore size, and 8 shots for 2-5 inch bore size with a hand grease gun.
- Adjust relubrication frequency based on condition of purged grease.
- A high quality lithium based grease conforming to NLGI Grade 2 consistency, such as those listed below.

Mobil 532	*Texaco Multifak #2*	*B Shell Alavania #2*
Mobilux #2	*Texaco Premium #2*	*Exxon Unirex N2*

Filters

Filter maintenance is generally limited to cleaning and replacement.

If aluminum mesh filters are installed, they can be washed in warm soapy water.

An adhesive spray can be added to aluminum mesh filters to increase their efficiency.

If disposable filters are installed, they can be check by holding up to a light source. If light cannot pass through the filter, it should be replaced.

IMPORTANT!

When reinstalling filters be sure to install them with the airflow in the correct direction. An airflow direction arrow is located on the side of the filters.

IMPORTANT!

Replacement filters should be from the same manufacturer and the same size as the original filters provided with the unit.

Maintenance - Fall

Start-Up

Repeat the Blower Start-Up procedure #5 and Direct Gas Start-Up procedure #1, 2 and 4. This will ensure that the gas and air are set properly before the heating season begins and should lead to trouble free operation all winter.

High Limit

The high limit switch may have tripped over the summer, it should be checked and reset if necessary.

Burner

Inspect the burner for accumulation of scales on both the upstream and downstream sides of the mixing plates. Any scaling or foreign material should be removed with a wire brush. Refer to figure #29.

Visually check that all holes in the mixing plates are clear. If any burner ports are plugged (even partially), clear them with a piece of wire or another appropriate tool. See figure #29.

WARNING!

Do not enlarge burner ports when clearing a blockage, performance could be affected.

Replace or tighten any loose or missing fasteners on the mixing plates. Always use zinc plated or stainless steel fasteners.

Inspect and clean the flame and spark rod. Occasional replacement of the flame rod and spark rod may be necessary to insure optimum unit performance. See figure #29.

NOTE!

Flame rods can last many years, but because of thermal expansion of the porcelain, flame rods can fail over time.

If a UV sensor is used instead of a flame rod, the sensor's lens should be cleaned at least once a year. The sensor may require more frequent cleaning, depending on the operating environment and should be check periodically over the heating season.

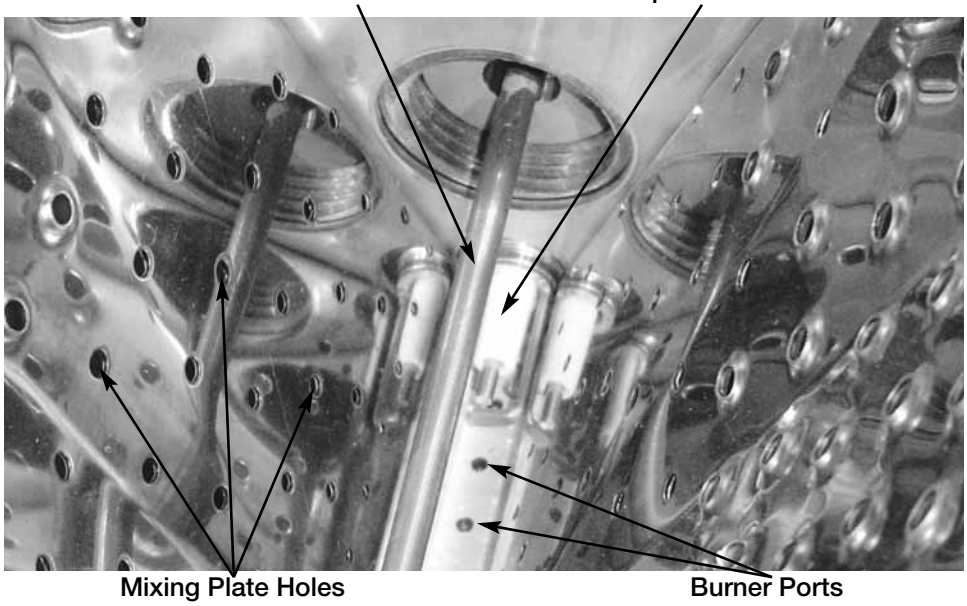


Figure 29. *Burner*

Maintenance - Log

Job Information

Job Name: _____
Address: _____
City: _____ State: _____ Zip: _____
Phone: _____ Fax: _____
Contact Person: _____

Service Organization: _____
Address: _____
City: _____ State: _____ Zip: _____
Phone: _____ Fax: _____
Work Done By: _____

Name Plate Information

Model: _____
Volts: _____ Hertz: _____ Phase: _____
Amps: _____ Mark: _____
Supply hp: _____
Serial Number: _____

Motor Voltage: _____
Motor Amperage: _____
Fan rpm: _____

Field Start-Up Documentation

Actual Voltage: _____ Hertz: _____ Phase: _____
Actual Amperage: _____

Blower Rotation _____

Air Volume Design _____cfm
Actual _____ cfm

High Fire Manifold Pressure: _____
Low Fire Manifold Pressure: _____

Maintenance Log

Date	Time	Notes:

Maintenance - Log

Maintenance Log

Date	Time	Notes:

Typical Gas Train Layout 400 - 800 MBH

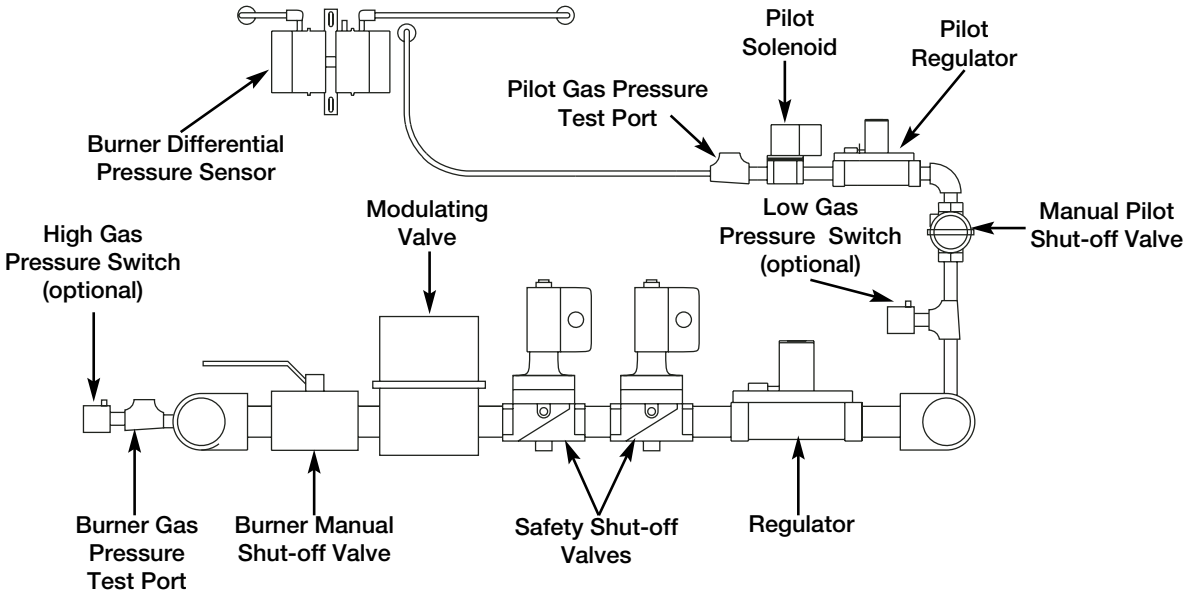


Figure 30. *400-800 MBH Gas Train*

Typical Gas Train Layout > 800 MBH

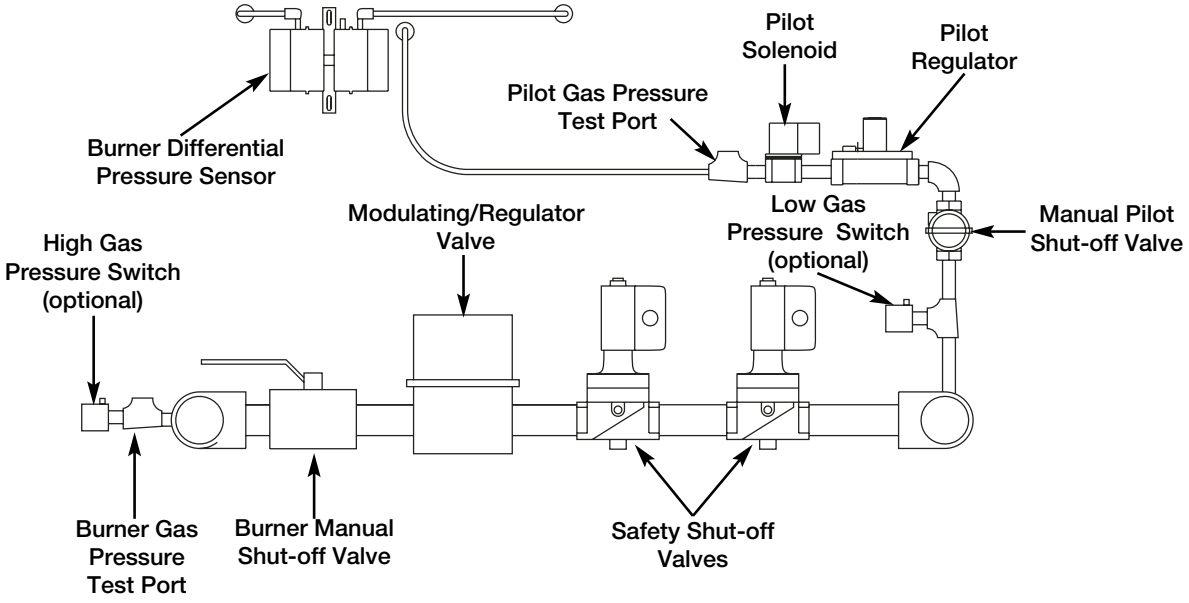


Figure 31. *Gas Train > 800 MBH*

Reference

Control Center Layout

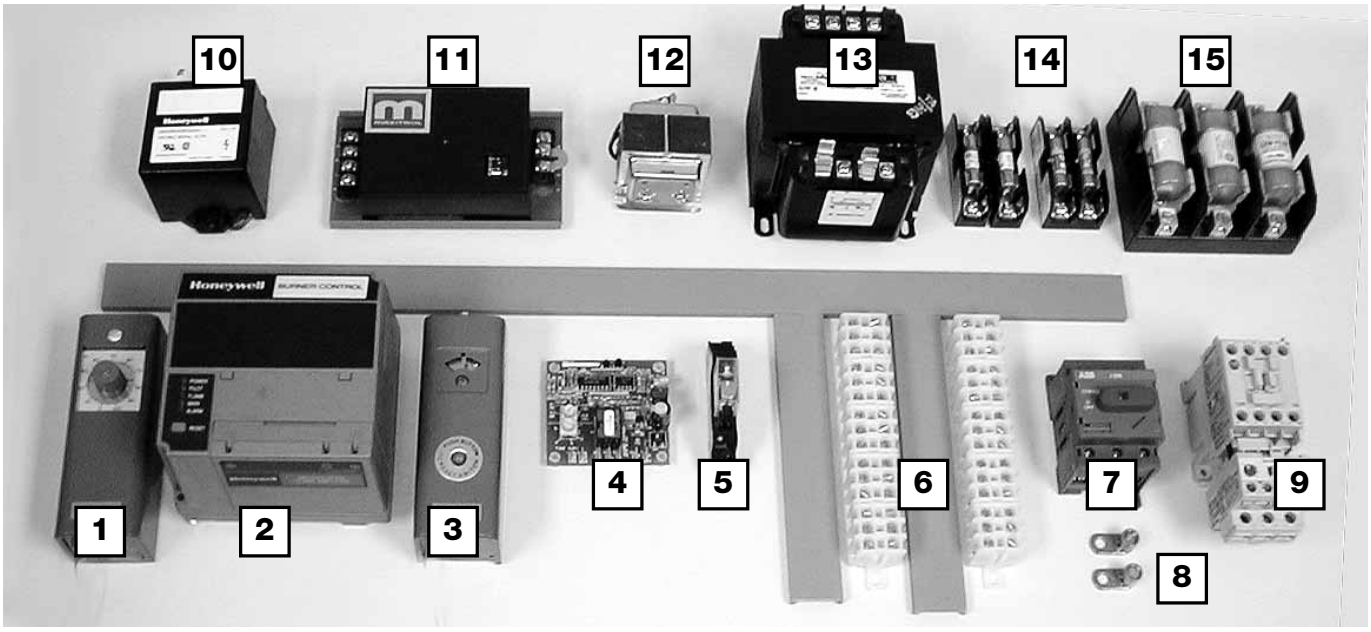


Figure 32. *Control Center*

1. Heating/Cooling Inlet Air Sensor (Optional) - Ductstat that automatically de-energizes burner when inlet air temperature rises above set point, or shuts down cooling when temperature falls below set point.
2. Flame Safeguard - Monitors flame, shutsdown unit when unsafe conditions are detected.
3. High Limit - Shuts down burner for safety reasons when discharge temperature rises above set point.
4. Building Freeze Protection (Optional) - Shuts down the unit when the air falls below the set point and remains below the set point for an adjustable period of time.
5. Heat/Cool Relay - Allows power to pass to Flame Safeguard or cooling unit.
6. Terminal Strip - 24 Volt power strip for control wiring.
7. Main Disconnect - On/Off switch, provides single point power connection to unit.
8. Grounding Lugs - Completes electrical circuit
9. Motor Starters - 24 Volt magnetic contacts for starting motors, comes standard with electronic overload, may be provided with auxiliary contacts.
10. Spark Generator - Causes the spark rod to spark and ignite the pilot.
11. Amplifier - Controls modulating gas valve based on feedback from the discharge air sensor.
12. Low Voltage Transformer - Reduces voltage for the Maxitrol system.
13. Control Transformer - Provides 24 Volts for the controls and 120 Volts for the gas train.
14. Secondary Fuses - Provides proper fusing for all electrical components other than the motors.
15. Motor Fuses - Provides proper fusing for supply and exhaust fan motor(s).

This manual is the property of the owner, and is required for future maintenance. Please leave it with the owner when you complete the job.

Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid.

Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

As a result of our commitment to continuous improvement,
Greenheck reserves the right to change specifications without notice.

GREENHECK
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DG/DGX (Space Heat) IOM FS
Rev 1 March 2004