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PHOENIX TH

Tube Fired Burner

Operations & Maintenance Manual

ISO 9001 Certified

This manual covers units built after July 2024 (S/N: 3240024822)

FILE: MANUAL PN 57338 PHOENIX TH revision 5/30/2025

WARNING

Read the OPERATION MANUAL before operating this equipment.

This equipment uses LPG and Natural Gas – flammable fuels. Inherent hazards exist and a thorough understanding of the equipment is required to allow safe operation and maintenance.

Allow only a TRAINED and FULLY QUALIFIED PERSON to service this equipment.

Any time a component must be replaced, use the same type, model, etc. DO NOT SUBSTITUTE! The consequences from such actions are unpredictable and may lead to dire outcomes.

The burner is likely to have HOT surfaces. Always wear protective clothing when approaching the burner.

Symbols and Conventions

Special symbols are used to denote hazardous or important information. You should familiarize yourself with their meaning and take special notice of the indicated information.

Please read the following explanations thoroughly.

GENERAL WARNING OR CAUTION

Indicates hazards or unsafe practices which can result in damage to the equipment or cause personal injury. Use care and follow the instructions given.

FLAMMABLE GAS HAZARD

Indicates a potential hazard which can result in severe personal injury or death. Use extreme care and follow the instructions given.

ELECTRICAL DISCONNECT REQUIRED

Indicates a potentially dangerous situation which can result in severe personal injury or death or damage to equipment. Use great care and follow the instruction given.

Table of Contents

1. INTRODUCTION

Product Description

- The Phoenix TH (Tube Heat) is a nozzle-mixing burner designed for tube firing applications with multiple fuel capability. The burner consists of a housing, rear cover, air and fuel inlet blocks, igniter, flame rod (if selected), UV scanner adapter (if selected), gas tube, nozzle and air shroud.
- The Phoenix TH features an adjustable nozzle to maintain correct air velocity for different sized tube applications and fuels.
- The Phoenix TH can be used with or without an exhaust leg recuperator; Algas-SDI recommends the Phoenix RH (Recupe Heat). An exhaust leg recuperator is a heat exchanger that transfers heat from the exhaust air to the combustion air. Preheating the combustion air can increase the fuel efficiency by as much as 20%. The TH can handle combustion air temperatures up to 1000°F.

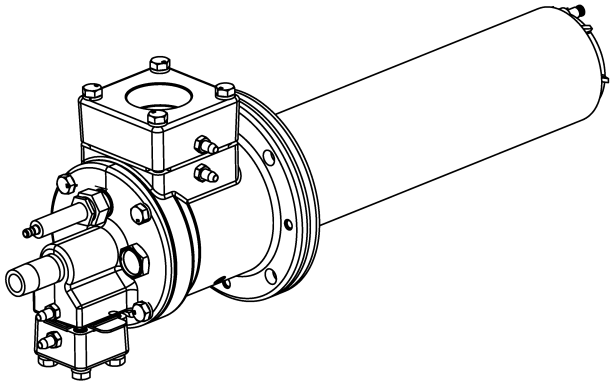


Figure 1.1 – Phoenix TH Burner

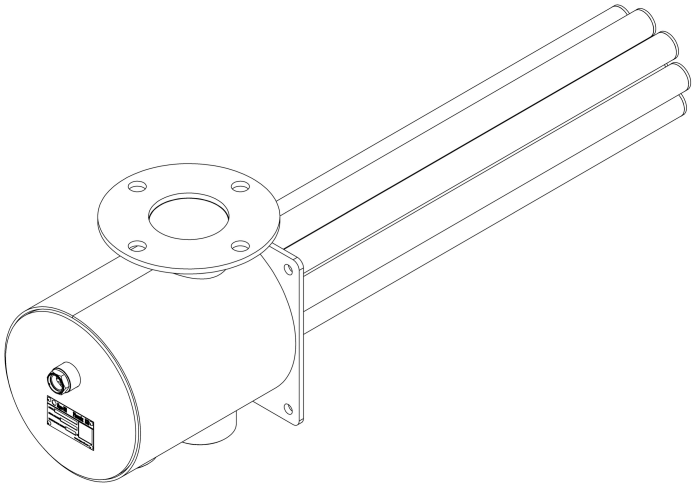


Figure 1.2 – Phoenix RH Recuperator

Major Components

The Phoenix TH Burners consists of the following components (Refer to Figure 1.3):

1. Burner Body
2. Burner Nozzle
3. Gas Tube
4. Burner Rear Cover
5. Air Shroud
6. Fuel Inlet Block
7. Air Inlet Block
8. Igniter
9. Flame Supervision
10. O-rings
11. Gaskets
12. Orifice Plates

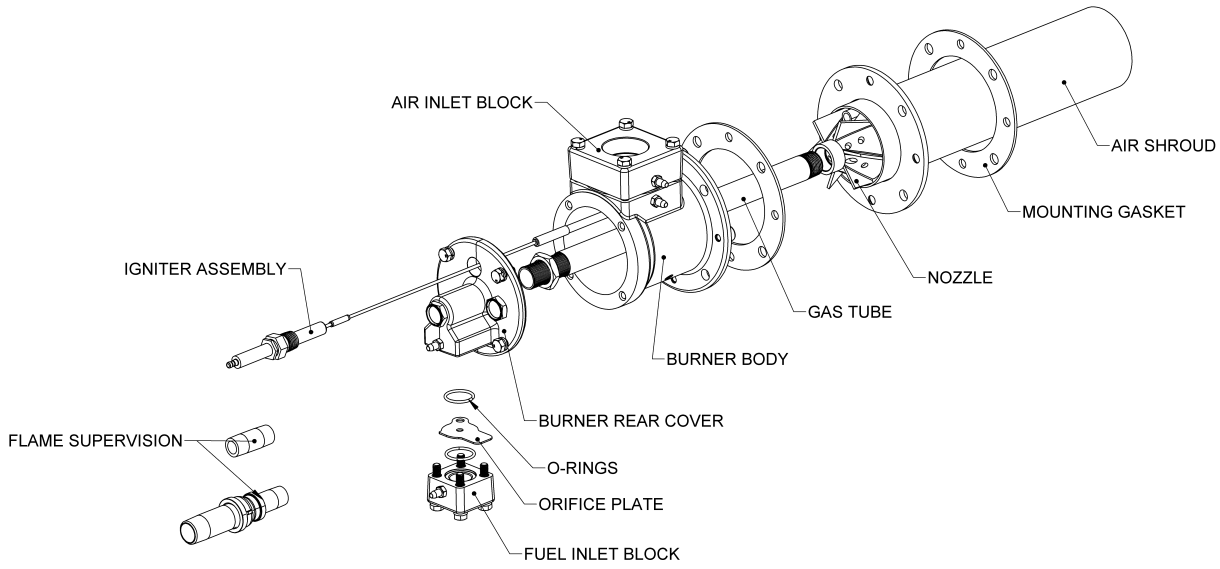


Figure 1.3 – Phoenix TH Major Components

2. System Design

Radiant Tube Burner Selection

Calculate the required heat release per tube

- Given the net heat requirement of the furnace (BTU/hr), divide by the number of radiant tubes to determine the required heat release per tube.

Calculate the tube surface area

- The burner transfers its heat to the process through the wall of the tube. The total area of the tube inside the furnace must be known to calculate the required burner input.
- The formula to calculate the tube surface area is:
  - $Tube\ Surface\ Area = OD \times \pi \times n \times L$
  - OD = the outside diameter of the tube in inches.
  - π = 3.142
  - n = number of tube legs
    - 2 for a U-tube
    - 3 for a trident tube
    - 4 for a W-tube
  - L = the total length of each leg in inches

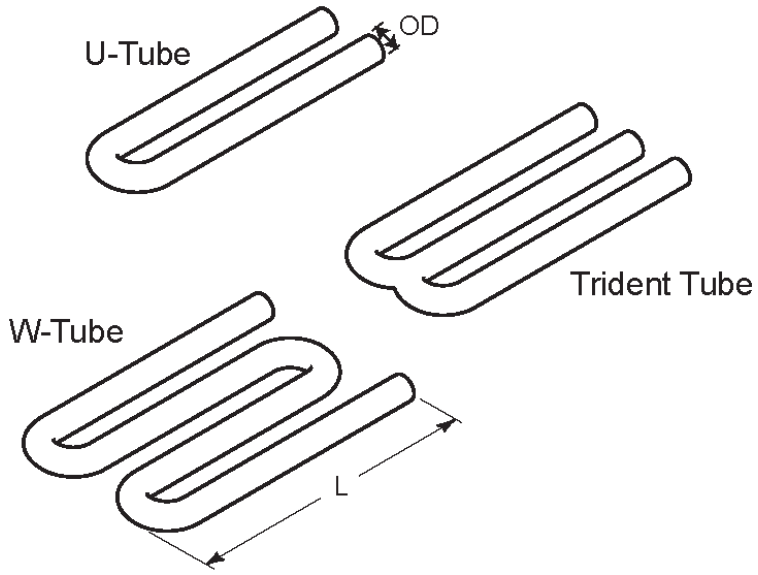


Figure 2.1 – Tube Dimension

Determine the maximum heat transfer rate

- The maximum heat transfer rate is the maximum amount of heat that the tube can radiate to the process per time unit.

- The maximum heat transfer rate of a tube depends on the temperature of the chamber and how the tube is mounted inside the furnace or not enclosed.
- An enclosed tube has a lower maximum heat transfer rate than a tube which is free to radiate in all directions.

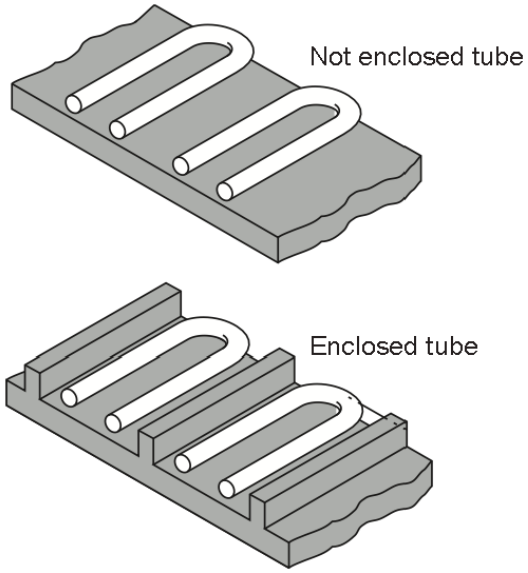


Figure 2.2 – Tube Classification

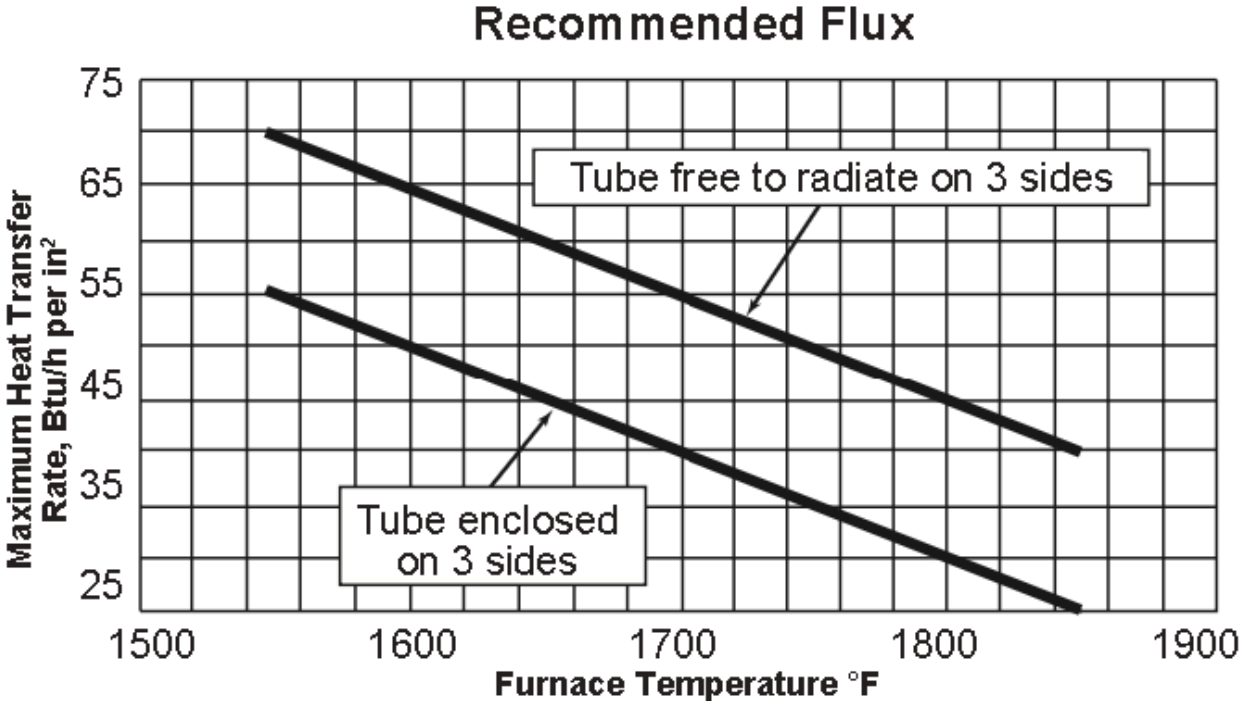


Figure 2.3 – Recommended Flux

Calculate the maximum release

- Multiply the previously calculated tube surface area by the maximum heat transfer rate:
  - $Maxium\ heat\ release = tube\ surface\ area \times maximum\ heat\ transfer\ rate$

Compare the heat releases

- Compare the required heat release with the maximum heat release.
- If the required heat release is greater than the maximum heat release, then the number or the size of the radiant tubes must be increased.

CAUTION: Exceeding the maximum heat release will significantly shorten the tube life.

Determine the efficiency

- The presence of a recuperator has a significant effect on the efficiency of the system. See the table below for the estimated effect a recuperator can have on a system.

Table 2.1 – Estimated Gross Efficiency*

Furnace Chamber Temperature	Without Recuperator (Ambient Air)	With Recuperator (Preheated Air)
1000°F (538°C)	57%	71%
1300°F (704°C)	51%	68%
1550°F 843°C)	47%	65%
1650°F (899°C)	44%	64%
1750°F (954°C)	41%	63%
1850°F (1010°C)	39%	62%

*Actual efficiency will vary depending on fuel used, recuperator design, burner operating conditions, etc.

Calculate the gross burner input

- Calculate the gross burner input with the formula below:
  - $Gross\ Burner\ Input = (Required\ Heat\ Release)/Efficiency$

Compare the gross burner input

- Compare the gross burner input with the maximum tube input. The size of the radiant tube must be increased if the gross burner input is greater than the maximum tube input from the table on the next page.

Table 2.2 - Maximum Tube Input	
Tube (inches)	**Maximum Input (BTU/hr)**
4	300,000
5	600,000
6	900,000
8	1,500,000
10	2,500,000
12	3,500,000

- Exceeding these inputs may result in burner pulsation or other operational problems.

Sizing Example

Application Parameters

- 4 U-tubes with ø4.5” with a 75” effective length.
- 500,000 BTU/hr total required heat release with recuperator.
- 1,650°F chamber temperature.
- Tube free to radiate on 3 sides.

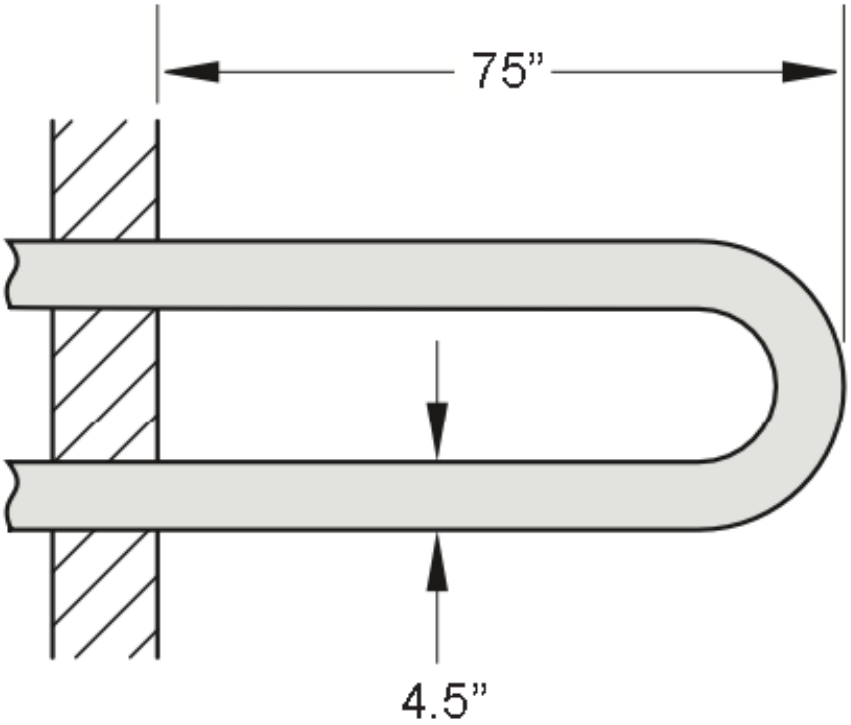


Figure 2.4 – Sizing Example

1. The required heat release per tube is:
   - $(Total\ required\ heat\ release)/(Number\ of\ tubes) = Required\ heat\ release\ per\ tube$
   - $(500{,}000\ BTU/hr)/4 = 125{,}000\ BTU/hr$

2. Tube surface area for each tube
   - $Tube\ Surface\ Area = OD \times \pi \times n \times L$
   - $4.5 \times 3.142 \times 2 \times 75 = 2120.85 in\text{^}2$
3. From figure 2.3 “Recommended Flux”, find the maximum heat transfer rate:
   - 60 BTU/in^2/hr
4. The maximum permissible heat release per tube is:
   - $Maxium\ heat\ release = tube\ surface\ area \times maximum\ heat\ transfer\ rate$
   - $2120.85 in\text{^}2 \times 60\ \mathrm{BTU/in\text{^}2/hr} = 127{,}251\ BTU/hr$
5. This is sufficient, as only 125,000 BTU/hr is required.
6. From table 2.1, Estimated Gross Efficiency, determine the efficiency with the use of a recuperator.
   - 64%
7. The gross burner input per tube is:
   - $\frac{(Required\ heat\ release)}{Efficiency} = Required\ heat\ release\ per\ tube$
   - $\frac{125{,}000}{64\%} = 195{,}312\ BTU/hr$
   - Size the system for 200,000 BTU/hr per burner.
8. Compare the result from the previous step (7) to the required maximum inputs from table 2.2, Maximum Tube Input. The gross burner input is less than 300,000 BTU/hr; the 4” OD tube can be used.

Air Shroud Length

- The air shroud length varies based on the location of the hot face of the furnace relative to the mounting flange of the burner.

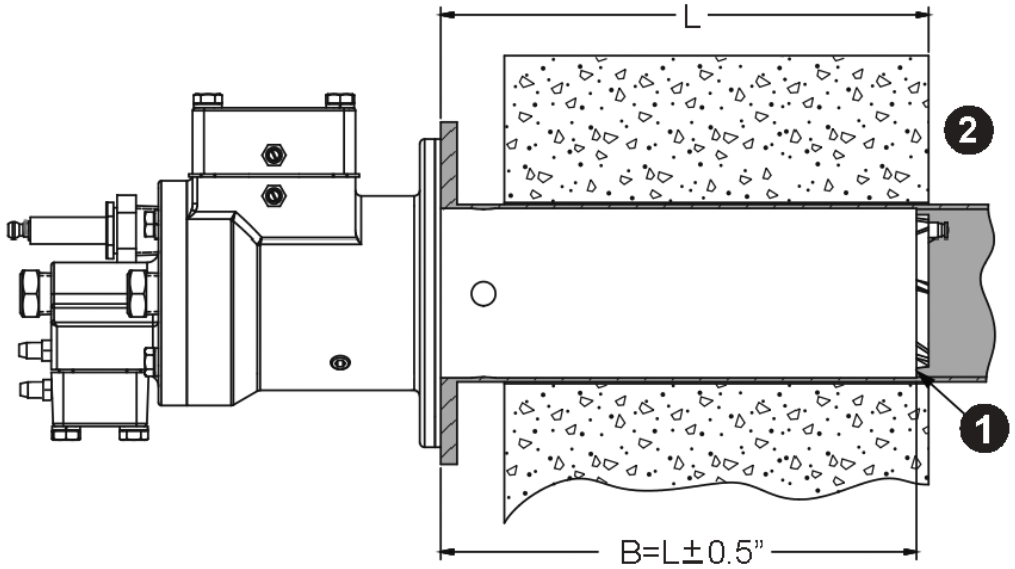


Figure 2.5 – Air Shroud Length

- The end of the air shroud (1) must be within ±0.5” of the face of the furnace wall (2).
- The length closest to your requirements should be chosen, air shroud lengths (dimension B) can be found in the TH specification sheet.

Tube Design

Elbows

- Only standard and sweep elbows are recommended.
- The first elbow should be at least eight (8) tube diameters from the face of the burner.

Stack

- Ensure that the stack is large enough to handle the exhaust flow plus the dilution air.
- The stack must be at least one pipe size larger than the tube exhaust.

Draft Breaking Hood

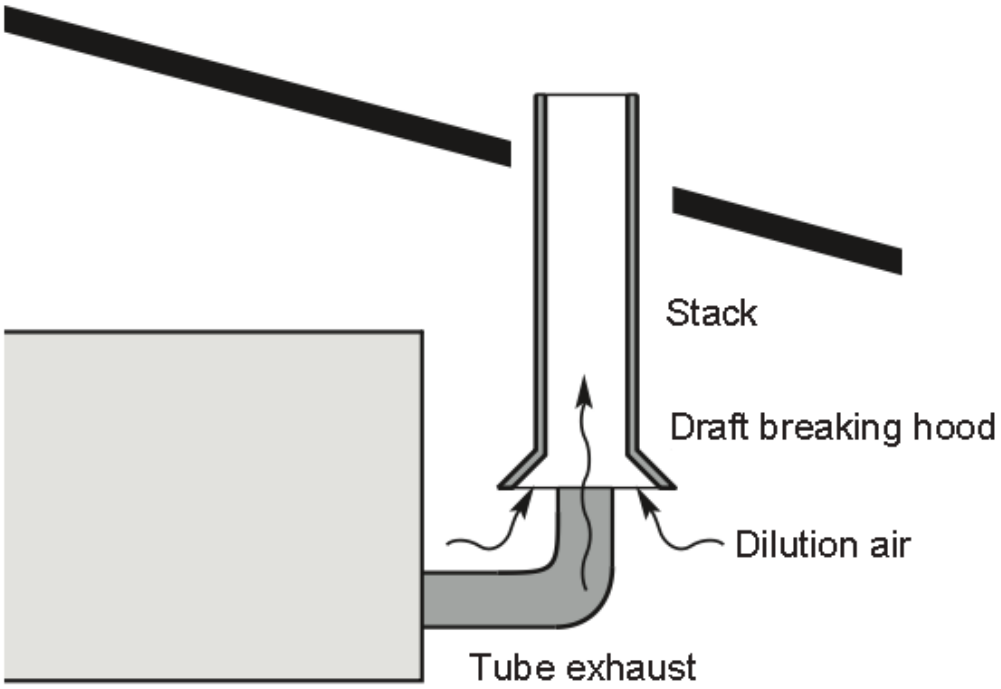


Figure 2.9 – Draft Breaking Hood

- A draft breaking hood is an open connection between the heater tube exhaust and the exhaust stack. It allows for fresh dilution air to pass into the exhaust and mix with the exhaust gases.
- A draft hood is advantageous for:
  - The burner operation is less susceptible to atmospheric conditions.
  - The temperature of the exhaust gasses is lower when they pass through the roof.

  NOTE: Ensure that it is possible to get access between the draft hood and the tube exhaust. Then a damper plate can be installed if there is acoustic feedback in the tube.

Control Methodology

- The control methodology is the basis for the rest of the design process. Once you know what your system will look like, you can select the individual components. Which control methodology you choose depends on the type of process that you want to control.
- There two main methods to control the input of a TH system.
  - Modulating Control
  - High/Low Control

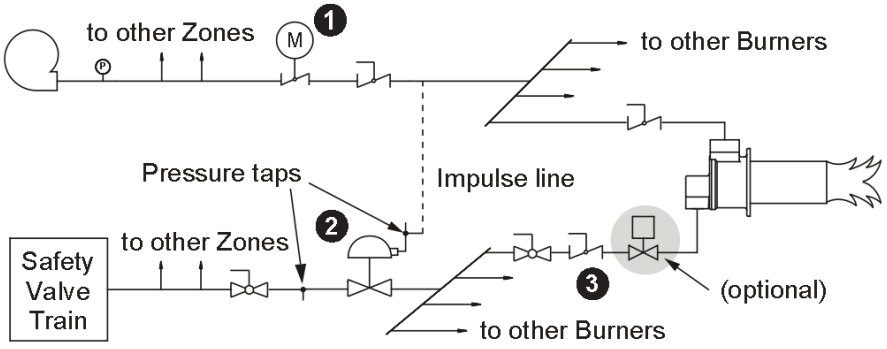
Modulating Control

- A burner system with modulating control gives an input that is in proportion with the demands of the process. Any input between high and low fire is possible. The burner operates at 15% excess air at high fire, and 100% excess air (min.) at low fire.

High/Low Control

- A system with high/low control gives a high or low fire input to the process. No input between high and low fire is possible. The burner operates at 15% excess air at high fire, and 100% excess air (min.) at low fire.
- The only difference in the components is the type of actuator on the automatic butterfly valve.
- Figure 2.10 shows the schematics of these control methods.

Combustion air at ambient temperature
(Radiant & Immersion applications)



Pre-heated combustion air
(Radiant applications)

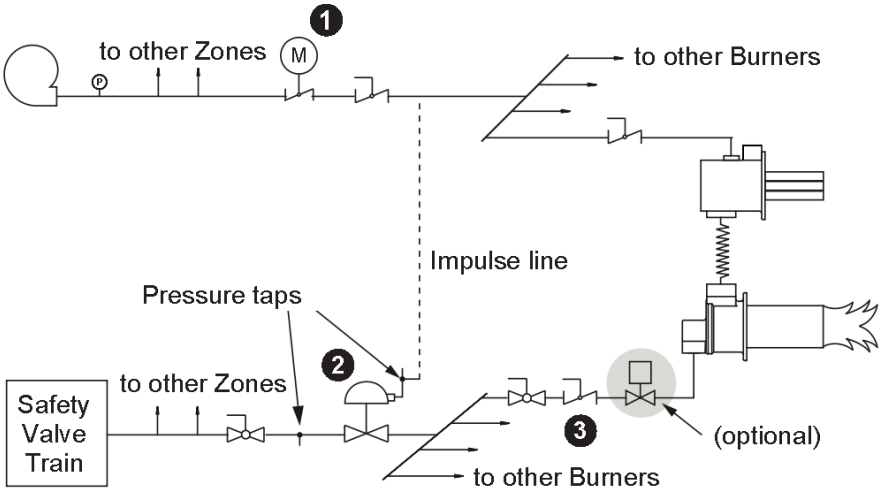


Figure 2.10 – System Schematics

Automatics gas shut-off by burner (Optional)

- As an option, an automatic gas shut off valve can be installed. If the flame monitoring system detects a failure, the gas shutoff valve will close, interrupting the supply of gas to the burner that caused the failure.
  - Air: the control valve (1) is in the air line. It sets the air flow to the required value.
  - Gas: The ratio regulator (2) allows the required amount of gas to go to the burner. Low fire gas is limited by the ratio regulator (2). High fire gas is limited by the manual butterfly valve (3).

Ignition System

CAUTION: Do ***NOT*** apply any assembly compound to the threads of the igniter. You can cause bad grounding of the spark plug if you apply grease to it. Bad ground of the spark may result in a weak spark.

CAUTION: a 6,000-7,000 VAC ignition transformer must be used to supply power to the igniter. If equipment other than recommended are used, the performance may vary from Algas-SDI published values.

- For the ignition system use:
  - 6,000-7,000 VAC transformers
  - Full wave spark transformers
  - One transformer per burner
- DO NOT use:
  - 10,000 VAC transformers
  - Twin outlet transformers
  - Distributor type transformers
  - Half wave spark transformers

- TH burners are capable of direct spark ignition anywhere within the listed operating range. However, it is recommended that low fire start be used. Local safety and insurance requirements demand that you limit the maximum time that a burner takes to ignite. These time limits vary from country to country. For the USA the time limit is 15 seconds, for Europe it is 3 seconds.
- The time that a burner takes to ignite depends on:
  - The distance between the gas shut-off valve and the burner
  - The air/gas ratio
  - The gas flow at start conditions
- In the USA, with a time of 15 seconds to ignition, there should be sufficient time to ignite the burners. It is possible, however, to have the low fire too low to ignite within the time limit. Under these circumstances you must consider the following options:

- Start at higher input levels
- Resize and/or relocate the gas controls

Flame Monitoring Control System

- A flame monitoring system consists of two main parts:
  - Flame sensor
  - Flame monitoring control

  NOTE: A flame monitoring system may not be required for tube fired burners. According to NFPA 86, combustion safeguards on radiant tube type heating systems are not required where a means of ignition is provided and the systems are arranged and designed such that either of the following conditions is satisfied:

  - The tubes are of metal construction and open at one or both ends with heat recovery systems, if used, that are of explosion-resistant construction.
  - The entire radiant tube heating system, including any associated heat recovery system, is of explosion-resistant construction.
- It is recommended to check your local standards to verify.

3. INSTALLATION

Handling

- ***Verify that the area is clean.***
- ***Protect the burner from weather, dirt, and moisture.***
- ***Protect burner from excessive temperature and humidity.***
- ***Take care not to drop or damage the burner.***

Storage

- ***Verify that the burner is clean and free of damage.***
- ***Store burner in a cool, clean, dry room.***
- ***After ensuring that everything is present and in good condition, keep the burner in the original package if possible.***

Checklist Before Installation

Intake

- To admit fresh combustion air from outdoors, provide an opening in the room of at least one square inch per 4,000 BTU/hr. In the presence of corrosive fumes or materials in the surrounding environment, supply burner with clear air from an uncontaminated area or provide a filtering system which shall not impede burner operation.

Exhaust

- Do not allow exhaust to accumulate in the work area. Provide means for exhausting them from the furnace and the building.

Access

- Install the burner in such a way that you can get easy access for inspection and maintenance.

Environment

- Verify that the local environment matches the operating specifications of the burner. Check the following items:
  - Type and supply pressure of the fuel
  - Availability of enough fresh, clean combustion air
  - Humidity, altitude, and temperature of air
  - Absence of damaging corrosive fumes or materials in the air

Preparing the Burner

- Phoenix TH burners are assembled and preset at the factory. However, adjustments may be necessary for individual applications. If an adjustment of the nozzle is required, see the installation instructions below.

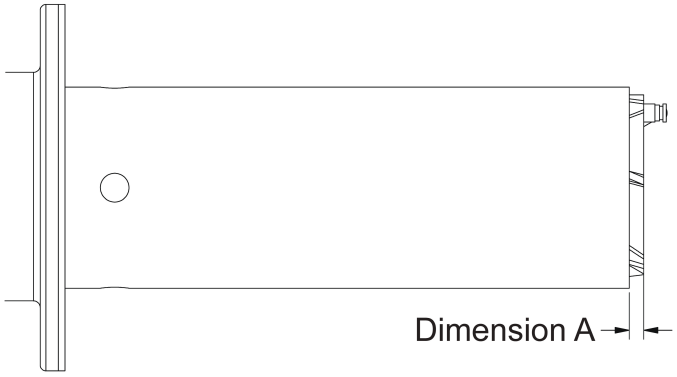


Figure 3.1 – Nozzle Adjustment

Table 3.1 Dimension A mm (in) for TH010-TH030				
Fuel	50k-100k	101k-150k	151k-200k	201k-300k
Natural Gas	6.4 (0.25)	6.4 (0.25)	9.5 (0.37)	9.5 (0.37)
Propane	3.2 (0.13)	3.2 (0.13)	6.4 (0.25)	6.4 (0.25)

Table 3.2 Dimension A mm (in) for TH035-TH075					
Fuel	301k-350k	351k-400k	401k-500k	501k-600k	601k-750k
Natural Gas	9.5 (0.37)	12.7 (0.5)	12.7 (0.5)	15.9 (0.63)	15.9 (0.63)
Propane	6.4 (0.25)	9.5 (0.37)	9.5 (0.37)	12.7 (0.5)	12.7 (0.5)

Adjust the Nozzle

To adjust the nozzle, if required, do the following.

NOTE: Place the burner on a suitable flat surface.

- The distance between the end of the air shroud and the end of the nozzle, dimension A, is very important. If dimension A is not correct, burners may not operate properly.
- Based on the information provided in Table 3.1 or Table 3.2, verify that dimension A is correct for your operating conditions.

- Dimension A is different for each fuel type, tube diameter and burner size.

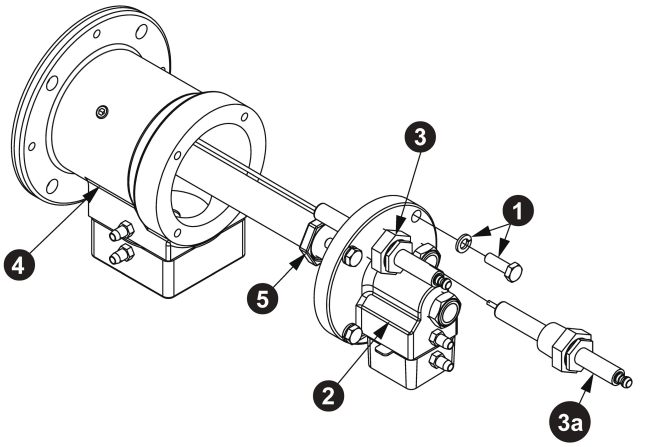


Figure 3.2 – Disassemble the burner

1. Remove the igniter assembly (3) and flame rod(3a), if applicable.
2. Remove the four washers and bolts (1).
3. Pull the rear cover (2) far enough away from the housing (4) to get access to the lock nut (5).
4. Loosen the lock nut (5).
5. Push the assembly back together (5).
6. Hold the rear cover (2) in position and screw the nozzle in or out to adjust dimension A.
7. Carefully pull the rear cover (2) and nozzle assembly out of the housing (4).

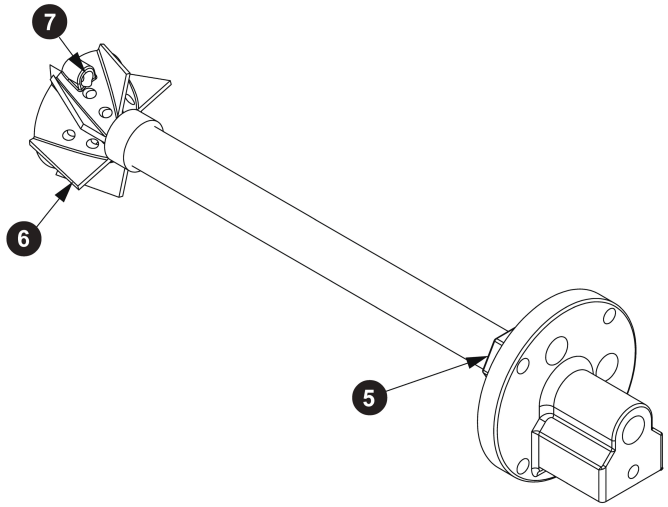


Figure 3.3 – Adjust the nozzle

8. Turn the nozzle (6) over the shortest distance until the opening (7) in the nozzle for the igniter rod (3) aligns with the appropriate opening in the rear cover (2).
9. Make sure that the nozzle (6) does not move and tighten the lock nut (5).
10. Reinstall igniter assembly (3) or (3a) and flame rod (3) if used.

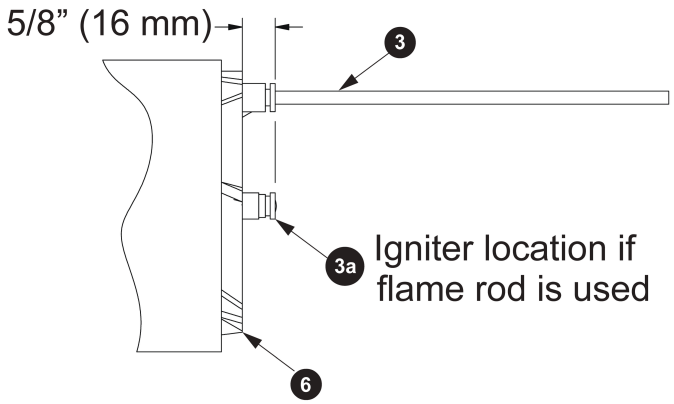


Figure 3.4 – Igniter and flamerod (if used) location

11. The disk end of the igniter assembly and flame rod should be approximately 5/8" (16mm) past the face of the nozzle (6).
12. The rods are adjustable at the threaded end of the rod.
13. Tighten the compression nut on the rods after positioning.
14. Install the rear cover (2) to the housing, (4) at the relative position that you need to match the pipe work.
15. Install the four washers and bolts (1).

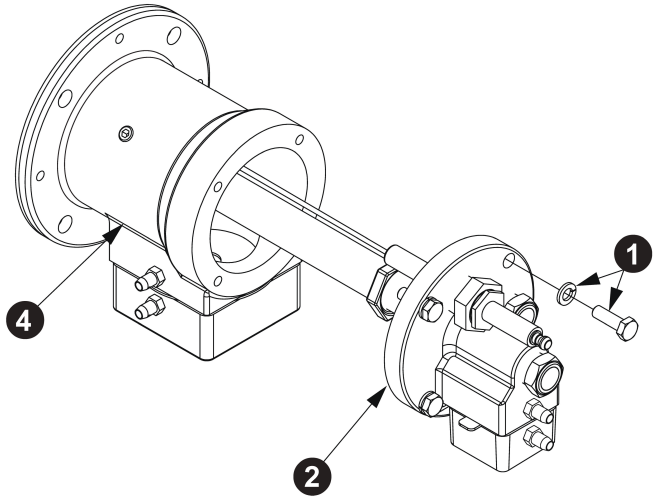


Figure 3.5 – Assemble the burner

16. Reconnect the piping.

CAUTION: The maximum torque value for fasteners used on the Phoenix burners is 25 ft.lbs, unless otherwise noted. Applying a higher torque may result in damage.

Install the UV Scanner (if selected)

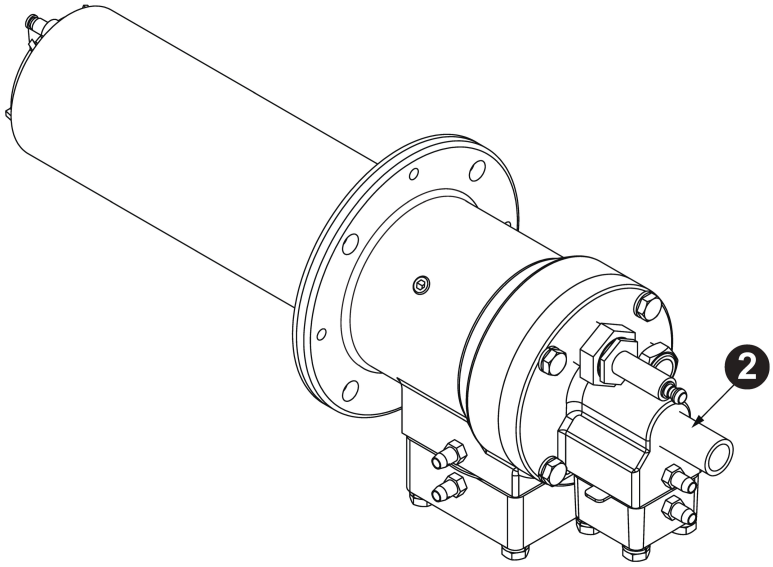


Figure 3.6 – Location of UV Scanner

CAUTION: The UV scanner must be protected from high temperatures, especially if the combustion air is preheated.

To adjust the nozzle, if required, do the following.

- Install the UV scanner.
- Ensure that the UV scanner is connected to the electrical circuit of the burner.
- Flame monitoring controls that stop the spark as soon as a signal is detected may prevent establishments of the flame, particularly when using UV scanners. The flame monitoring control must maintain the spark for a fixed time interval that is long enough for ignition.

WARNING: Connecting the flame sensor of a burner to the electrical circuit of the wrong burner can cause fires and explosions.

The UV scanner must be compatible to the flame monitoring control that is used. Refer to the manual of your selected control for proper selection of the scanner.

Recuperator Installation

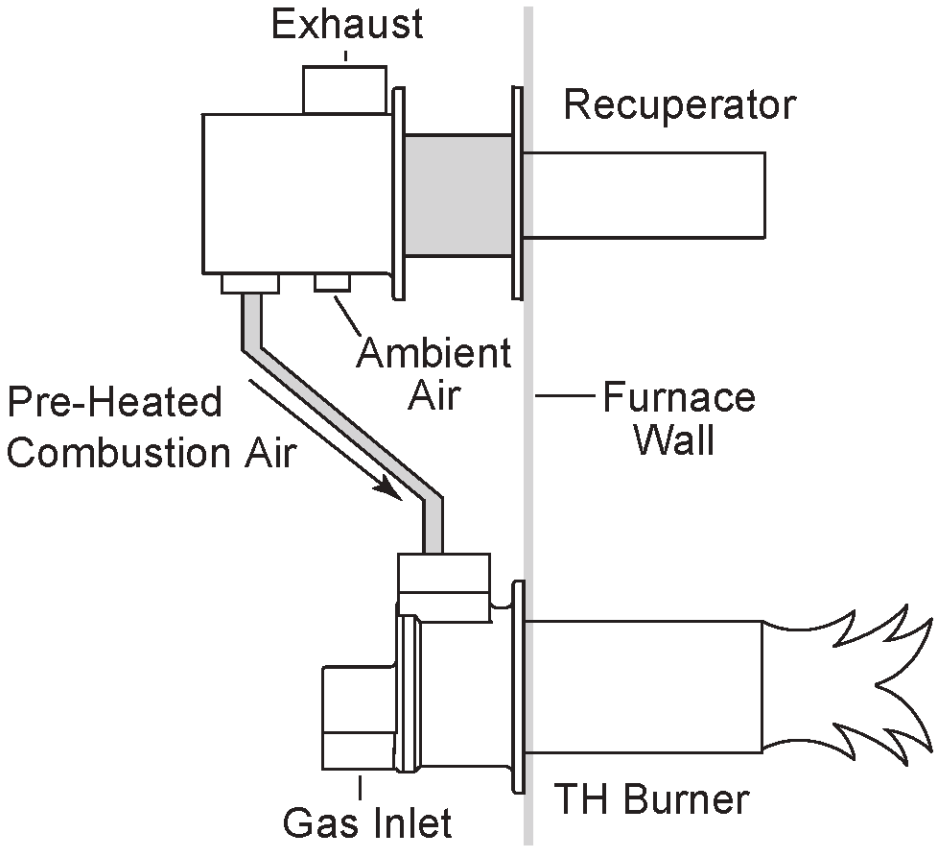


Figure 3.7 – Recuperator Installation

- In radiant tube applications, TH burners can be used in conjunction with an exhaust leg recuperator.
- Insulate hot air piping and the portion of the recuperator, grey shaded section, as shown in figure 3.7.
- Ensure the pipe thread sealant is rated for the maximum expected preheated combustion air temperature.

CAUTION: DO NOT INSULATE THE BURNER.

- The use of flexible nipples in hot air piping is strongly recommended to account for thermal expansion.

Checklist After Installation

To verify proper system installation, do the following:

- Verify that there are no leaks in the gas and air lines.

- Verify all components of the flame monitoring control system are properly installed in the correct locations and all wiring, pressure, and impulse lines are properly connected.
- Verify components of spark ignition system are installed and functioning properly.
- Verify that the blower rotates in the correct direction. If incorrect, have a qualified electricians rewire the blower to reverse its rotation.
- Verify all valves are installed in the proper location and correctly orientated relative to the gas or air flow direction.

Prepare for Start Up/Adjustment

After installation of the burner system components is complete, the following shall be followed to prepare for adjustments:

- Close all the burners shut-off valves.
- Try to light a burner before the purge and other timing relays have finished their cycles. Verify that the flame monitoring system indicates a flame failure.
- Trip pressure switches and other limit interlocks. Verify that the main shutoff valve train closes.

DANGER: If simulated limits or simulated flames do not shut down the fuel system with the required failure response time, immediately correct the problem and retest before proceeding.

4. OPERATION

Adjustment Procedure

Reset the System

- Close the gas shutoff valves.
- Fully open the manual air valves at each burner.
  - Drive the automatic zone air control valve to high fire.
  - Adjust the automatic zone air control valve so that it is fully open.
- Start the blower.
  NOTE: Make sure that the blower rotates in the correct direction. If incorrect, have a qualified electrician rewire the blower to reverse its rotation.

Set High Fire Air

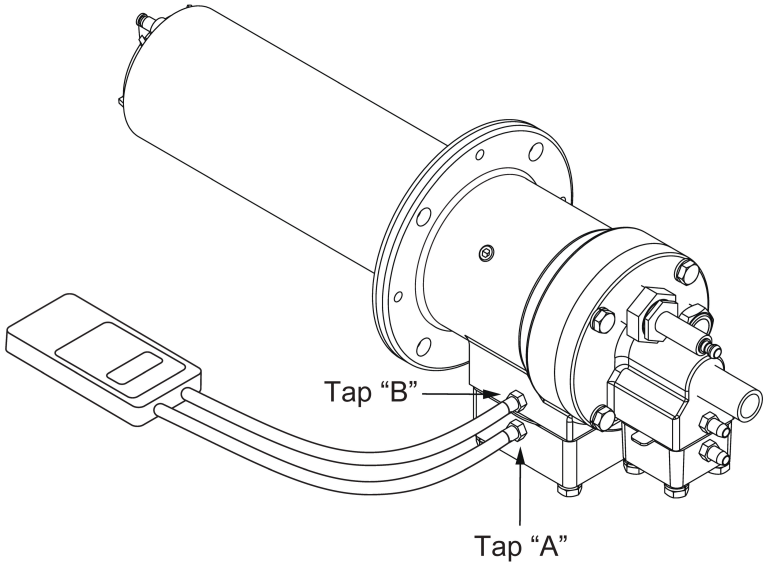


Figure 4.1 – Set high fire air

NOTE: The following steps apply to an ambient air system with orifice plates installed.

- Make sure that the system is at high fire.
- Set high fire air.
- Use the air curve of the specification sheet for your burner to find the air pressure differential that you need at high fire. This will be the high fire target.
  - Make sure that pressure tap A and pressure tap B of the burner are open. (Open the internal screw.)

- Connect the manometer to tap A and tap B of the burner (across the air orifice).
- Adjust the manual zone air valve until the high fire air pressure differential is at the target value. Ensure that the valves at every burner are fully open.
- Measure and note the air pressure differential for all other burners in the zone.
- If all the measured differential pressures are within 0.3” w.c. of each other, then proceed to the next section. If the variation is greater than 0.3” w.c., then it will be necessary to adjust the manual air valve at each burner to improve the balance.

CAUTION: Make sure that all the pressure taps are closed.
Verify the required input levels. Firing at higher levels will reduce the life of the tube and potentially destroy tubes.

NOTE: The following steps apply to a preheated combustion air system with a recuperator installed, along with no orifice plates installed:

- Make sure that the system is at high fire.
- Set high fire air.
- Use the ambient static pressure at the air inlet curve in the specification sheet for your burner to find the static air pressure that you need at high fire. This will be the high fire target.
  - Make sure that pressure tap A on the burner is open. (Open the internal screw.)
  - Adjust the manual zone air valve until the high fire air pressure differential is at the target value. Ensure that the valves at every burner are fully open.
  - Measure and note the static air pressure for all other burners in the zone.
  - If all the measured static pressures are within 0.3” w.c. of each other, then proceed to the next section. If the variation is greater than 0.3” w.c., then it will be necessary to adjust the manual air valve at each burner to improve the balance.

CAUTION: Make sure that all the pressure taps are closed.

Set Low Fire Air

NOTE: The following steps apply to an ambient air system with orifice plates installed.

1. Make sure that the system is at low fire.
2. Set low fire air.

3. Choose one burner in the zone. Connect the manometer to tap A and tap B of the burner (across the air orifice).
4. Adjust the automatic zone air valve until the low air fire air pressure differential is 0.2” w.c. This is your initial setting only. Further adjustment may be required.
5. Repeat steps 3 to 5 for other zones, if any.

NOTE: The following steps apply to a preheated combustion air system with a recuperator installed, along with no orifice plates installed:

1. Make sure that the system is at low fire.
2. Set low fire air.
3. Choose one burner in the zone. Connect the manometer to tap A.
4. Adjust the automatic zone air valve until the low air fire static air pressure is
   - 0.05” w.c. for the TH030 (300,000 BTU/hr)
   - 0.2” w.c. for the TH075 (750,000 BTU/hr)
5. This is your initial setting only. Further adjustment may be required.
6. Repeat steps 2 and 3 for other zones, if any.

Verify the Air Settings

Make sure that all the settings are still the same after cycling the system several times between high fire and low fire.

Ignite the Burners

Manual Ignition

1. Drive the zone automatic air control valve to low fire.
2. Ensure that the combustion blower is running.
3. Set the manual butterfly valve at each burner to 50% open.
4. Set the adjusting screw on the ratio regulator, 6 turns clockwise, that results in fuel lean combustion.
5. Open the zone manual shutoff valve.
6. Start the ignition transformer.

DANGER: Do not touch the igniter or the ignition wire when the ignition is active. You will get an electric shock.

7. While viewing down the peepsight, open the shutoff valve at the burner. Burner should ignite.
8. If the burner does not ignite within 15 seconds, close the shutoff valve and purge with air. Repeat steps 6 to 8 without any adjustments to ensure that all air is purged from the gas piping.

9. If the burner still does not ignite, adjust an additional turn down on the ratio regulator.
10. Repeat steps 6 to 9 as necessary.
11. Repeat steps 6 to 10 for all other burners in the zone.

Automatic Ignition

1. Drive the zone automatic air control valve to low fire.
2. Ensure that the combustion blower is running.
3. Set the manual shutoff valve at each burner to 50% open.
4. Set the adjusting screw on the ratio regulator, 6 turns clockwise, that results in fuel lean combustion.
5. Open the zone manual shutoff valve.
6. Open the shutoff valve at each burner.
7. Initiate the ignition sequence through the flame monitoring system.
8. Check that all the burners in the zone have ignited.
    a. If a gas solenoid valve is fitted at each burner, then repeat step 7 for all burners in the zone.
    b. If burners do not light, purge with air and adjust an additional turn down, clockwise, on the ration regulator. Repeat step 7.

NOTE: It may be necessary to repeat step 7 two to three times to purge all the air out of the gas piping.
If burners do not shut down automatically, close the shut off valve and stop the setup process.

9. If all the burners have ignited, then drive the zone air valve to high fire. Ensure that the burners stay ignited.

Set High Fire Gas

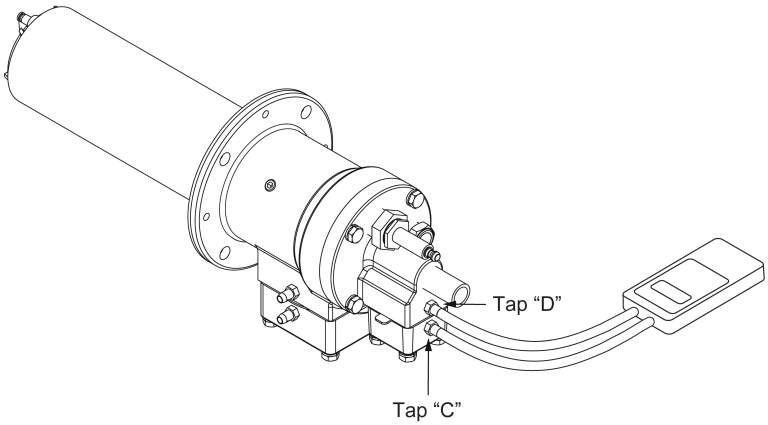


Figure 4.2 – Set high fire gas

1. Use the gas curves on the appropriate specification sheet to find the gas pressure differential needed at high fire. This is the target value for high fire.
2. Ensure that pressure tap C and pressure tap D of the burner are open (open the internal screw).
3. Connect the manometer to tap C and tap D of the burner (across the gas orifice).
4. Measure the high fire gas pressure drop for the first burner.
5. Adjust the manual butterfly valve at the burner until the gas flow is at the target value.
6. Repeat step 4 and step 5 for the other burners in the zone (if any).
7. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5" w.c. higher than the loading line pressure. It should not exceed the maximum pressure rating of the ratio regulator.
8. Measure the oxygen level in the exhaust, using an oxygen analyzer.
9. If the O_2 level is between 2.5% and 4%, the level is correct. If not, adjust the manual gas butterfly valve until you have the appropriate level.
10. Repeat steps 2 through step 9 for the other burners.
11. For each burner, connect the manometer across pressure taps C and D and measure the pressure drop.
    - If all pressure drops are at or below the target value, then the settings are correct.
    - If necessary, adjust the manual zone air butterfly valve to obtain the target value.
12. Verify settings when the furnace is at operating temperature.

CAUTION: Make sure that all the pressure taps are closed.

Verify Gas Settings

NOTE: The following steps apply to an ambient air system with orifice plates installed.

- Make sure that all the settings are still the same after you cycle the system several times between high fire and low fire.
- When all settings have been completed, mark the position of the indicator on each butterfly valve to indicate valve position. This will save time later.

DANGER: Ensure that you close all the pressure taps after you remove the manometer. Gas that leaks from the pressure taps can cause fires and explosions.

Adjust Low Fire Gas

1. Drive the system to low fire.
2. If a burner goes out, close shutoff valves. Go to Step 5 of “Ignite the Burners” on page 27 and follow instructions.
3. Adjust the ratio regulator until the O2 level is between 10% and 14%.

   If the oxygen levels are between 10% and 14%, but the temperature continues to rise above the desired level:

   i. Reduce low fire air flow by adjusting the zone air control valve linkage. Recheck oxygen levels at low and high fire.
   ii. If necessary, repeat step 3.

Start Procedure

DANGER: If a burner does not light, and the system does not shut down automatically, then you must close the main shutoff valve. An uncontrolled flow of gas can cause fires and explosions.

Do not touch the igniter assembly or the ignition wire when the ignition is on. You will get a shock

Manual Ignition

1. Make sure the shutoff valve at each burner is closed.
2. Start air blower.
3. Drive the automatic zone air control valve to low fire.
4. Start the ignition transformer.
5. Open the shutoff valve at each burner checking to ensure that the burner lights.

Automatic Ignition

1. Start the blower.
2. Open all the shutoff valves.
3. Start the ignition sequence.
4. Verify that the flame is present at each burner.

If a burner does not light and:

- **The system does not shut down automatically**: Close the main shutoff valve manually. Do NOT operate the system. Go to "Checklist After Installation" on page 23. Repeat the start procedure.
- **The system shuts down automatically**: See “Troubleshooting” on page 34.

Stop Procedure

1. Close the following valves:
   - The manual shutoff valve at the main control valve.
   - The manual shutoff valve for each burner zone.
2. Let the burners cool down. Keep the blower on until the chamber temperature is less than 1000°F (500°C) and then stop the blower.

NOTE: Keeping the blower on after the burner is off protects the burner and the other components from hot gases that flow back through the burner.

Static Air Pressures

When a burner uses preheated combustion air, there are no air orifices installed. In that case, the static air pressure is used to set the initial air flow of a burner. From there on the burner is further adjusted.

5. Maintenance

Preventative maintenance is the key to a reliable, safe, and efficient system. The core of any preventive maintenance system is a list of periodic tasks. The following are suggestions for monthly and annual checks:

NOTE: The monthly and yearly lists are an average interval. In the case of a dirty environment, service interval may need to be shortened.

WARNING: Extreme caution must be taken due to the potential of flammable vapor being exposed to the atmosphere creating an ignition. Do not operate any equipment that may create a spark during maintenance.

WARNING: High voltage ignition transformer can cause severe injury or death when handled incorrectly. Do not perform maintenance until power has been disconnected from ignition transformer.

Monthly Checklist (Optional)

- Inspect flame sensing devices for good conditions, and cleanliness.
- Check for proper inlet air/gas ratios.
- Test all the alarm systems for proper signals.
- Check igniter assembly for damage or distortion.
- Check valve motors and control valves for free, smooth action and adjustment.
- Measure and record the high fire oxygen levels in the exhaust every month. If there is any change, find the cause and correct it.
- View down the peepsights on the burners and down the exhaust legs of the tubes to check for unusual flame or carbon build-up. If necessary, remove the burner to investigate.

Annual Checklist

- Test interlock sequence of all safety equipment. Manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer.
- Test (leak test) safety shut-off valves for tightness of closure.
- Test main fuel hand valves for operation.
- Test pressure switch settings by checking switch movements against pressure settings and comparing with actual impulse pressure.
- Visually check ignition cable and connectors.
- Inspect impulse piping for leaks.

- Remove and inspect all the burners. Clean off any carbon build up.
- Make sure that the following components are not damaged or distorted.
  - The burner nozzle
  - The igniter assembly
  - The gas tube
- If applicable, remove and clean all the orifice plates.

6. Troubleshooting

Troubleshooting Procedures

Potential Problem	Possible Cause	Proposed Solution
Start-up sequence runs but does not light, no ignition.	There is no power to the ignition transformer.	Restore the power to the ignition transformer.
	Open circuit between the ignition transformer and the igniter assembly.	Repair or replace the wiring to the igniter assembly.
	The igniter rod needs cleaning.	Clean the igniter rod
	The igniter rod is not correctly grounded to the burner	Clean the threads of the igniter rod and the burner. Do not use thread sealant on the ignition plug threads.
	The igniter rod is grounded to the nozzle or to the air shroud	Check the igniter rod location
	The igniter rod and flame rod wiring is revered.	Correct wiring.
Start-up sequence runs but does not light, not enough gas.	There is air in the gas line.	Repeat the start attempt several times.
	The gas pressure into the ratio regulator is too low.	Measure the gas pressure into the ratio regulator and adjust gas pressured if necessary.
	The impulse line to the ration regulator is leaking.	Repair any leaks.
	Start gas solenoid valve does not open, if installed.	Check wiring to the valve. Check output from the flame safeguard. Check solenoid valve coil for proper operation. Replace if necessary/
	Manual shutoff valve closed.	Open the shutoff valve.
	Manual shutoff valve not open.	Open manual shutoff valve.
Start-up sequence runs but does not light, too much gas.	Gas pressure out of ratio regulator is too high.	Check adjustments. If necessary, remove regulator and investigate.

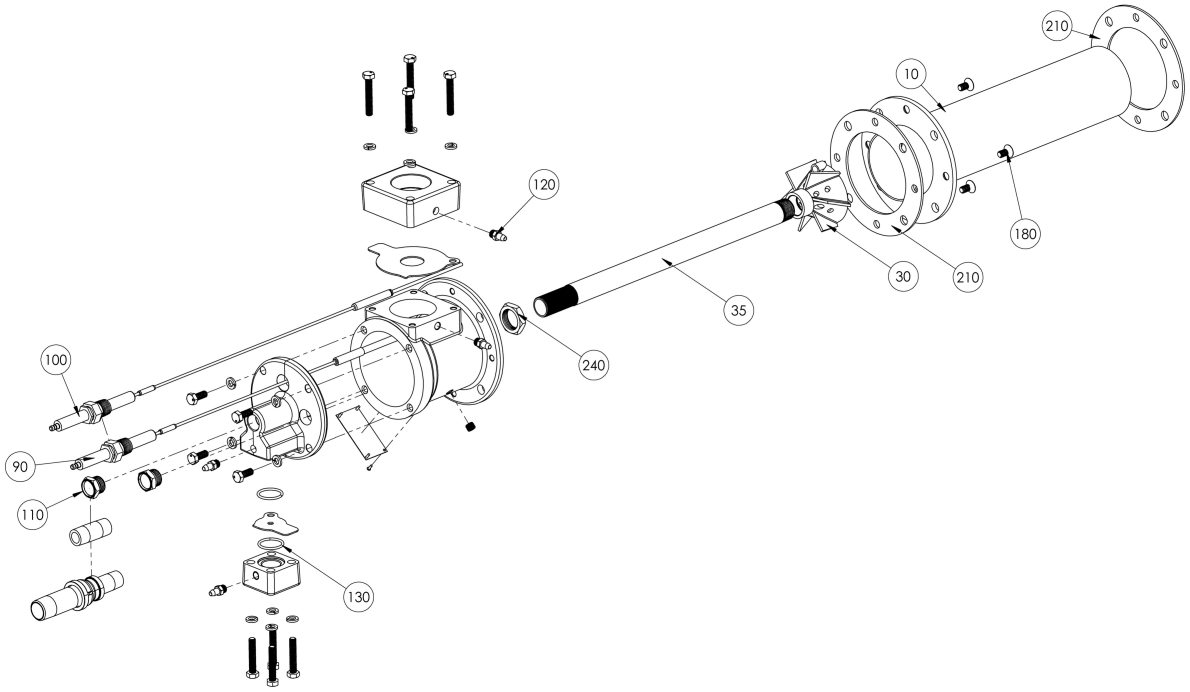
Potential Problem	Possible Cause	Proposed Solution
Start-up sequence runs but does not light, poor ignition.	Incorrect type of flame safety, must have ignition during all the trial for ignition.	Change flame monitoring equipment.
	Wrong type of ignition transformer.	Use correct type.
Start-up sequence runs but does not light.	Improper air/gas settings.	Check pressure and settings and adjust as necessary.
Start-up sequence runs but does not light, poor ignition.	Incorrect type of flame safety, must have ignition during all the trial for ignition.	Change flame monitoring equipment.
	Wrong type of ignition transformer.	Use correct type.
Start-up sequence runs but does not light.	Improper air/gas settings.	Check pressure and settings and adjust as necessary.
Start-up sequence runs but does not light, insufficient flame signal.	Flame rod or UV scanner needs cleaning.	Clean the flame rod or UV scanner lens.
	Flame rod is grounded to nozzle.	Adjust position so ceramic insulation contacts nozzle.
	Flame rod and igniter rod reversed.	Reposition igniter rod or flame rod.
Start-up sequence runs but does not light, improper air/gas ratio.	Air in the gas line.	Repeat start-up several times.
	Ratio regulator incorrectly set.	Adjust to proper setting.
The low fire flame is weak or unstable.	Not enough gas.	Readjust gas flow at ratio regulator.
	Not enough air.	Open automatic valve slightly.
The burner does not light or goes off when it cycles to high fire.	Burner set too lean, becoming unstable as air increases.	Adjust the settings to provide more gas.
	Insufficient pressure into ratio regulator.	Adjust the pressure settings on the main gas regulator or change spring.
	Main gas adjustment valve not open enough.	Adjust the main gas adjustment valve.
	Marginal air pressure switch setting.	Adjust the air pressure switch setting.
	Gas pressure switch set incorrectly.	Adjust switch setting.

Potential Problem	Possible Cause	Proposed Solution
The burner is erratic and does not respond to adjustment.	Internal damage to the burner, some parts inside the burner are loose, dirty or burned out.	Contact Algas-SDI.
The burner is unstable and produces soot, smoke or excessive carbon monoxide.	The air/gas ratio is out of adjustment.	Reset the burner controls and clean ignition rod and UV scanner. * See “Operation” section.
	Bleed fitting (if used) is dirty	Clean fitting. Check and clean filters, igniter rod and UV scanner. * (If necessary).
	* After this step it is important that you clean the igniter rod and UV scanner, and make sure that there is no excessive soot on the nozzle. Clean where necessary.	
Burner pulsates or produces noise.	Acoustic feedback from tube.	Slide a piece of steel plate over the end of the tube until the rumbling disappears. Weld the plate in place. Readjust the burner controls if necessary.
	Input inconsistent with nozzle settings.	Check if input is consistent with nozzle settings and adjust if necessary.
	Too much air.	Check oxygen levels and adjust to 2% to 4% O2 (at high fire).
	Burner could be improperly set to fire at an input rate which exceeds its maximum rated capacity.	Check the pressure drops to verify that the inputs are at the correct levels. Reduce the input on the air and gas as required to achieve the specified inputs.
	Negative pressure in the building.	In some cases, building exhaust systems create a negative pressure that “pulls” on the exhaust outlet of the tube. By placing a washer or restriction pate over the tube outlet, this suction can be equalized by burner pressure.
Cannot achieve full capacity.	Combustion air inlet filter is blocked.	Clean the filter.
	Gas pressure too low into the ratio regulator.	Adjust gas pressure.

Potential Problem	Possible Cause	Proposed Solution
Cannot achieve full capacity. (Continued from previous page)	Loading line pressure too low.	Open the zone air control valve to increase the air volume and pressure. Recheck all burner settings.
	Adjusting valve has closed.	Open the valve to previous setting and check the input and flue gas settings to verify proper operations.
	Blower is wired incorrectly.	A blower wired to turn backwards will produce approximately 60% of its rated capacity. Check the rotation of the blower impeller. If spinning backwards, have a qualified electrician reverse the electrical wiring.
Cannot initiate start sequence.	Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.
	High gas pressure switch has tripped.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Low gas pressure switch has tripped.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Malfunction of flame monitoring system such as shorted out flame sensor or electrical noise in the sensor line.	Have a qualified electrician investigate and rectify.
	Purge cycle not completed.	Check flame safeguard system, or purge timer.
	Main power is off.	Make sure power is on to control system.
	No power to control unit.	Have a qualified electrician investigate and rectify.

7. Spare Parts

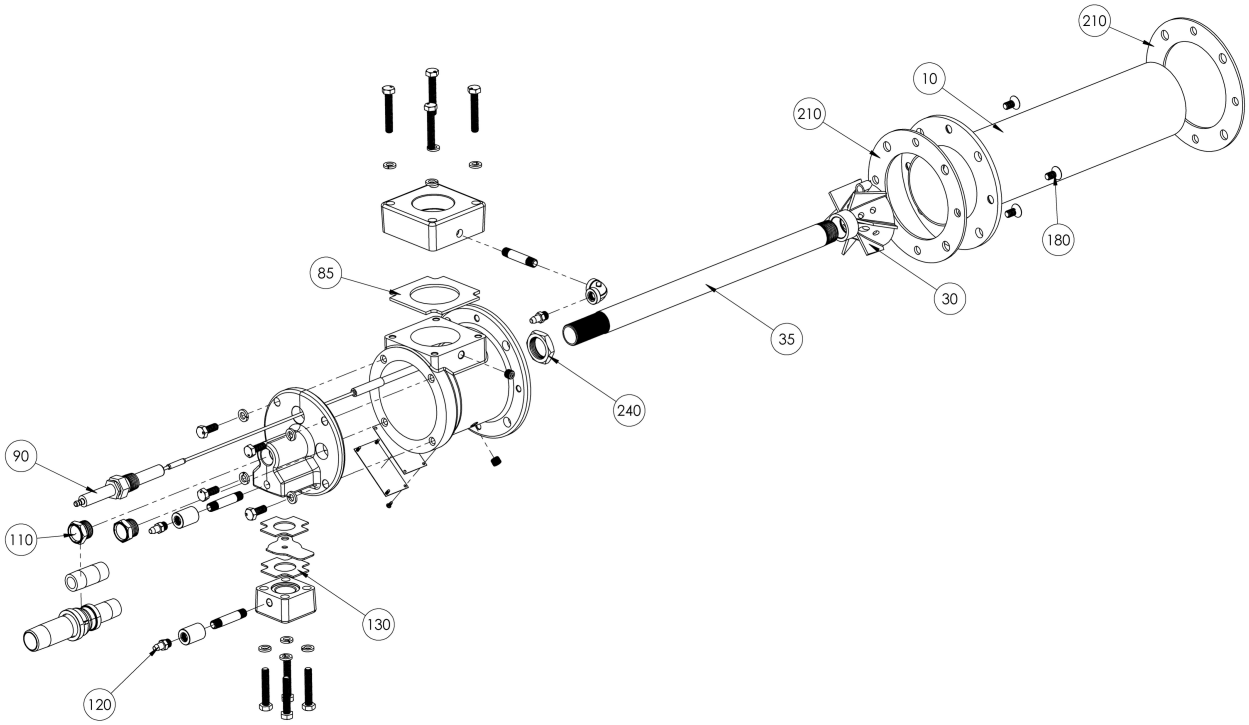
Spare Part List Models TH010 – TH075 (Ambient Air)



Item No	Description	Qty.	TH010-075
10	Air Shroud[1]	1	7001-4091-*XX*
30	Nozzle, non-Flamerod	1	7001-5372
30	Nozzle, Flamerod	1	7001-5372-01
35	Gas Tube[1]	1	7001-5415-*XX*
90	Igniter Assembly[1]	1	7001-4092-*XX*
100	Flamerod Assembly[1]	1	7001-4110-*XX*
110	Peepsight	1	7001-9487
120	Pressure Tap	4	7001-9003
130	O-ring	2	7001-9004
180	Mounting Screws	4	7001-9012
210	Mounting Gasket	2	7001-5117
240	Lock Nut, Gas Tube	1	7001-9286

[1] Part number depends on the burner length; contact Algas-SDI to confirm PN for specific burner length.

Spare Part List Models TH010 – TH075 (Pre-Heated Air)



Item No	Description	Qty.	TH010-075
10	Air Shroud[1]	1	7001-4091-*XX*
30	Nozzle, non-Flamerod	1	7001-5372
30	Nozzle, Flamerod	1	7001-5372-01
35	Gas Tube[1]	1	7001-5415-*XX*
85	Air Inlet Gasket	1	7001-5264-04
90	Igniter Assembly[1]	1	7001-4092-*XX*
110	Peepsight	1	7001-9487
120	Pressure Tap	3	7001-9003
130	Fuel Orifice Gasket	2	7001-5265-03
180	Mounting Screws	4	7001-9012
210	Mounting Gasket	2	7001-5117
240	Lock Nut, Gas Tube	1	7001-9286

[1] Part number depends on the burner length; contact Algas-SDI to confirm PN for specific burner length.

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