Selas TFR Burner™

SAFETY

These instructions pertain only to the TFR Burner series and should only be used for its intended purpose. Only qualified personnel should work on the TFR Burner to ensure proper installation, especially when installing gas piping or electrical wiring. All installations MUST follow/meet region requirements. If unsure about this information, contact your local gas or electric company. This product can cause serious injury/harm if misused; any person working with the TFR Burner should be equipped with proper protective equipment, such as safety glasses, ear protection, closed-toe shoes, and adequate clothing attire. Contact the factory if you have any questions or concerns regarding the TFR Burner series.

Warning: *This guide* ***does not*** *provide every eventuality; the information provided should be considered when working with the TFR.*

Description: How It Works

The TFR burner series is a small-bore immersion tube burner producing high thermal transfer efficiency in reduced pipe sizes to reduce the size and the cost of immersion tubes. The burner uses a split combustion cone head, allowing air into the flame at three (3) points while producing cooling for the combustion tubes. Nozzle assembly uses fuel and air jets to manufacture a compelling mix of fuel and combustion air to create solid flame stability for the burner. These burners can be customizable, including compact, pre-piped, pre-wired, packaged burners.

Applications

The TFR Burner series are ideal for:

- Parts Cleaning
- Water Heating
- Salt Bath Heaters
- Produce Washing
- Quench Tanks
- Vaporizers
- Bottle Washers
- Planting Solutions
- Acid Bath Heaters
- Spray Washers
- Product Storage Tanks
- Liquid Tank Heating
- Specialty designed for small bore tube applications

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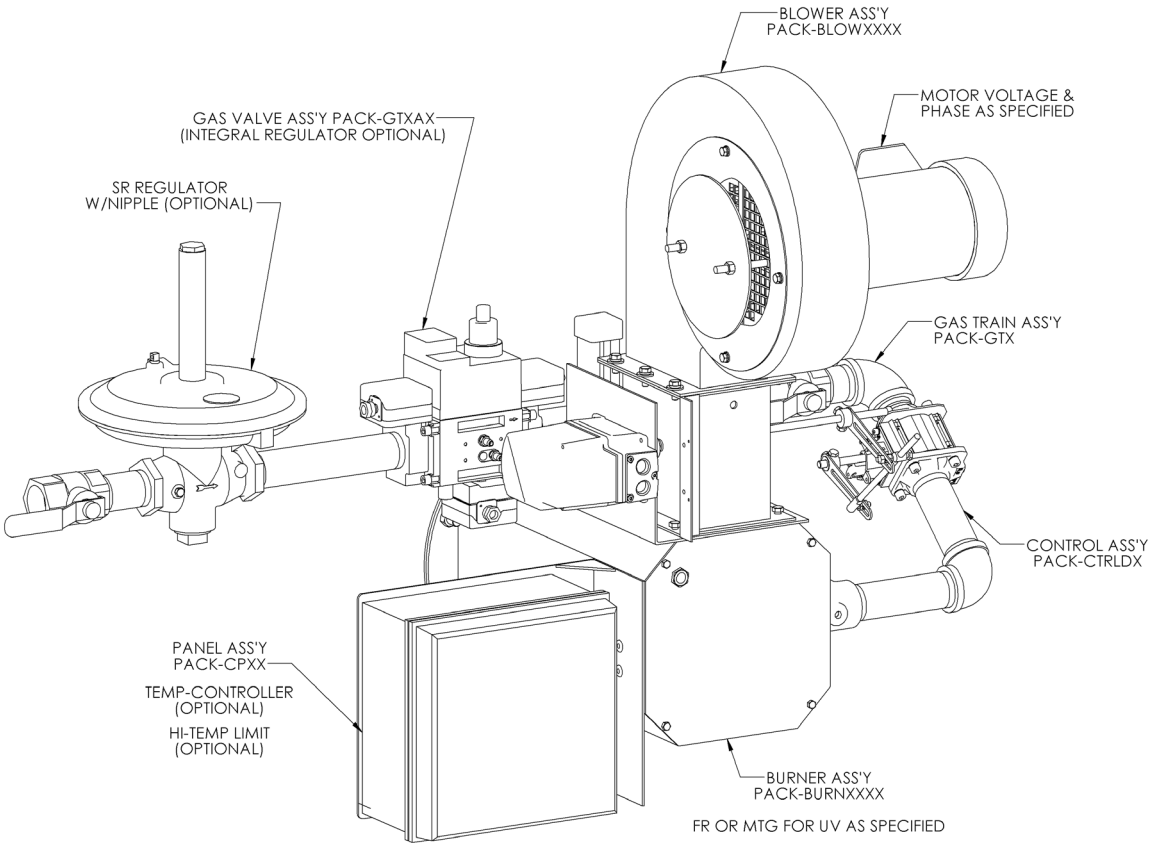
Installation

Before installation, carefully examine the burner for physical damage due to transporting, storage, or offloading. Damages found should be reported immediately to the factory.

- Under no circumstances should pipe work or gas valves be used for lifting; it can cause fittings to loosen or damage the valves contributing to leaks during operation.
- Use the structure of your application and supplied mounting brackets to mount the burner in the firing position.
  - Minimize transmission of vibration and heat to the burner.
- Electrical equipment can be prewired in an enclosed terminal on the assembly or attached to the control panel with flame and temperature control options.
- The burner may be mounted to the tank via one of three methods:
  - Bolted to customer-supplied studs welded on the tank wall.
  - Bolted to an accessory mounting plate supplied with the burner which is intended to be welded to the tank wall.
  - Bolted to an appropriate size ANSI 125# mounting flange welded to the fire tube and protruding from the tank. The exposed tube and flange should not exceed 2.5” measured from the mounting face of the flange to the tube wall.
- See section Mounting Instructions in this document for example drawings.
- To protect the tank, tube, or tank-to-tube interface from premature failure, ensure the mounting spool is no longer than 3”.
  - The flange connection will run hot. Use a shield or guard in this area but do NOT insulate.
- Establish a suitable supply of fresh air available for combustion and general ventilation.
  - This will help prevent gas leakage in valves and pipe work from forming combustible gas/air pockets.
  - Buildings with high negative pressures should duct combustion air to the burner or utilize higher pressure external blower (EB) models.
- Allow enough space around the burner to be accessible for maintenance and adjustments.

For specific questions, consult the factory.

TFR Burner



Gas Supply

- Gas piping to the burner needs to be an adequate size to have the correct pressure at the burner valve assembly inlet.
  - If unsure about sizing or available pressure, contact local gas supplier with any questions.
- The following maximum pipeline velocities are recommended to avoid excessive noise and erosion:

Unfiltered Supply	65.6 ft/sec (20 m/s)
Filtered Supply (250 microns)	148 ft/sec (45 m/s)

- A manual shut-off valve should be built into the gas supply pipe, followed by a union or flanged joint; the valve should be next to the burner.
  - This valve provides the supply and removal of the burner assembly for maintenance purposes.
  - The manual shut-off valve needs to be easy to access.
  - It is recommended that all installations add a drip leg and gas strainer on the fuel inlet to each burner. This can be optionally provided by Selas on request.
- Valves and gas piping should not be used for lifting or supporting, as stated in the instructions. Instead, use appropriate brackets for support and installation.

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Gas Supply (Cont.)

- Prior to connecting the gas supply, ensure the available gas pressure is correct.
- Check the design and installation of the gas supply system to ensure the pressures over the maximum design rating of the equipment cannot be reached during fault conditions.
- Vent piping should be supplied for vented regulators if a burner is installed in a closed space.
    - There should not be multiple vents used for regulators and should be terminated in a safe space (preferably above roof level).
- The gas supply pipe will be full of air and will require purging.
- Qualified personnel should only conduct purging and leak testing that follow local safety requirements.
- Before conducting a leak test, operators should be aware of maximum pressure ratings on all devices.
- The manual shut-off valves should be left in the closed position until the plant has been commissioned by qualified personnel.

Electrical Supply

- Confirm that the electrical power supply fits the system voltage and frequencies (HZ) requirements.
    - Where three phase motors are utilized, provide a properly sized motor starter.
    - Ensure the control wiring and cabinet have a solid earth ground.
- The wiring on the burner should fit the local electrical code requirements of practice.
- All conduits should be kept clear of heat zones.
- Local means of electrical isolation should be installed close to the burner.
- Ensure that the electrical voltage does not vary from the specified by more than 6%.
- High-temperature wire should be used for all electrical connections.
- Do no use gas pipe work as electrical earth.

Immersion Tube Design Considerations

- Immersion tubes should be constructed from Schedule 40 black iron pipe. After the first immersion tube leg and return, the pipe schedule may be reduced to Schedule 10 pipe.
- The first immersion tube leg must be at least 10 pipe diameters in length.
- Total immersion tube length should be limited to a maximum of 80% heat transfer efficiency. Above 80%, condensation and combustion gases can contribute to internal corrosion of the immersion tube.
- If high efficiency (>80% efficiency) operation is desired, contact Selas for design considerations and recommendations.
- Stainless pipe may be substituted for black iron if chemical attack is anticipated or if long-term corrosion of the immersion tube is a concern.
- All immersion tube elbows and returns should be long radius. Mitered elbows are not allowed and will interfere with the burner's operation.
- Immersion tube arrays must be supported from below to carry the assembly weight. Do not cantilever tube weight at the tank wall or depend on the burner mounting to carry the immersion tube weight.
- Immersion tubes will also tend to float in solution from buoyancy. It is recommended to provide travel limitations on top of tube arrays with chains or cross bars.
- DO NOT rigidly weld immersion tubes anywhere to the tank except for at the burner penetration of the tank wall. It is recommended that the immersion tube exit the solution inside the tank as it transitions to a vertical stack.
- Avoid penetrating the tank wall in two locations as the tube array will expand and contract with operation.

Stack Design Considerations

- Immersion tubes should exit the solution from inside the tank to turn vertical and transition to the exhaust stack.
- Provide a stack damper or adjustable orifice to keep the immersion tube under positive pressure and combat "stack effect" of rising hot gases. "Chugging" or burner instability can be a symptom of excessive stack draw.
- Stack dampers or orifices should be designed to have no more than 80% of the total stack area. Do not design or allow for 100% stack closure.
- Building pressure for most fired equipment should be maintained at balanced to slightly positive pressure. Negative pressure in the building can reduce burner capacity, create operating instabilities, and draw stack gases back into the space.
- Stacks should be constructed with operating temperatures in mind. Provide guarding and labelling as appropriate to safe guard personnel from hot surfaces.
- A stack break or diluting tee can be used to blend in building air and cool stack temperatures to help manage building or roof penetrations. *See information on next page.*

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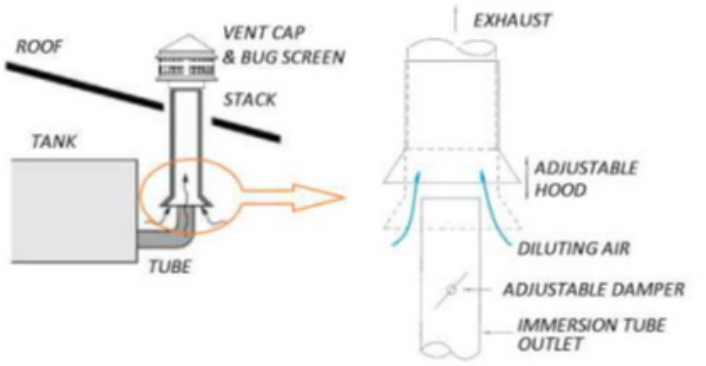
Additional Information on Stack Breaks and Diluting Tees:

A draft breaking hood is an open connection between the burner tube outlet and the exhaust stack. It allows fresh dilution air to pass into the exhaust and mix with the exhaust gases. The advantages of a draft hood are:

- The burner operation is less sensitive to atmospheric conditions, and
- The temperature of the exhaust is lower when passing through the roof.

Note: Leave access between the draft hood and the tube exhaust. An adjustable damper plate helps to reduce acoustic resonance in the tube.

An adjustable hood height allows field tuning of the dilution air and gives maintenance access to the tube outlet and adjustable damper. The 'rule-of-thumb' for maximum vertical run above the equipment before the draft break should be the greater of 10 pipe diameters or 6 feet. The goal is to minimize excessive draft by minimizing the vertical pipe run from the exit of the water tank to the draft break but also consider safety in the event of an exhaust problem.



Diluting tees should be at least one pipe diameter larger than the immersion tube. Size the diluting tee based upon total flow of exhaust gases and diluting air to achieve a target temperature and resultant ACFH flow.

Example:

The immersion tube is 4", so the draft break should be no further than 6 feet up (since 10 x 4 = 40" is less than 6 feet) unless this position creates a safety concern.

Stack:

Make sure that the stack is large enough to handle the heated exhaust flow plus the dilution air.

Example:

Burner fires about 551,000 Btu/hr maximum, therefore the exhaust flow is about 6790 SCFH.

For dilution air at 75°F and burner exhaust at 1100°F, then 14,620 SCFH air is needed to achieve 400°F in stack.

Total exhaust flow is 21,400 SCFH or 34,730 ACFH (~580 ACFM).

Recommended roof exhaust stack is 8".

Note: If you use a common stack for more than one burner, then make sure that the stack is large enough to handle the exhaust flow plus any dilution air from all the burners.

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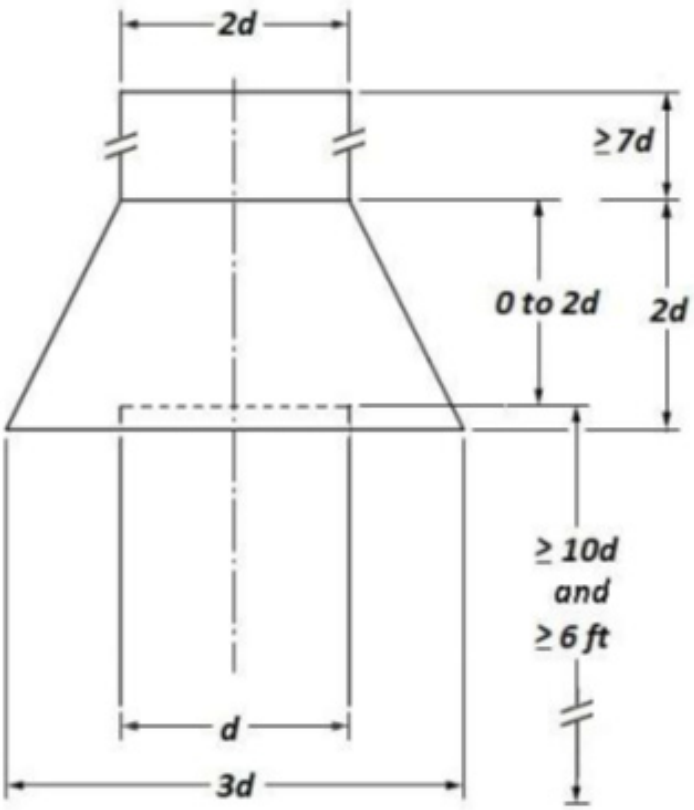
Generalized Dimensional Guide for Hood

Notes for Diagram:

1. Exhaust stack shown 2d is actually determined by:
   a. Total exhaust flow (burner plus dilution) per code (NFPA 54, IFGC)
   b. Standard vent pipe size
   c. At least one standard pipe size greater than the immersion tube size
2. Proper dilution entrainment requires a straight vertical run of 7d length before any turns.
3. Adjustable hood to immersion tube outlet shown 0 to 2d allows field adjustment of dilution air entrainment.



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TFR Burner Operation

Installation and commissioning of combustion equipment should be undertaken by experienced gas professionals due to inherent hazards. Consult all local codes and standards before undertaking the installation or operation of this equipment.

Read and understand the combustion system manual and all related system manuals as this equipment may include necessary sequence, safety, installation, and operation requirements to prevent hazardous conditions, fire, or explosion.

Step 1. Verify System Installation
Check the fit and torque on all mechanical connections. Ensure all gas piping has been securely connected and pressure tested for leaks. Check rotation of all system fans, blowers, and pumps. Test and verify function and settings of all safety devices including limit switches, position switches, pressure switches, flame sensors, and all other system permissive.

Step 2. Purge System
With manual gas valves in the closed position, energize system fans and combustion air blower. Ensure system exhaust is open, and all dampers are in an open (flow) condition. Allow system to operate for a minimum of four (4) total volume exchanges before attempting burner ignition.

Step 3. Pilot Ignition
With main manual gas valves in the closed position, open pilot manual valves and energize combustion systems to allow ignition attempt under supervision of flame safety system. With pilot ignition achieved, repeat this process multiple times to ensure pilot ignition is repeatable and reliable. Then shut system down and proceed to step 4. If the burner pilot fails to light within the allowable ignition period, return to step 2 and re-purge the system.

Step 4. Main Ignition
Re-purge system as described in step 2. Ensure low fire start position and permissive switch are satisfied if system is designed for low fire start. With a demonstrated, stable pilot flame achieved, open main gas valves, and energize combustion system under supervision of flame safety system. Pilot flame should light and transition to main burner in a controlled, stable fashion. If main flame fails to light, purge the system and repeat.

Step 5. Operating Range
With a stable main flame achieved, release the system to temperature control and allow the burner to operate full range. Main flame should remain stable and always proven. Tuning of the burner ratio across the operating range may be required depending upon the method of ratio control. During operation, allow system to achieve set point temperature. During this period, monitor equipment for heat, expansion, leakage, or other abnormal behavior. Immediately stop operation and address abnormal behavior before restarting burner system.

Step 6. Records and Maintenance
Keep system operating manuals available to equipment operators and maintenance personnel. Periodic maintenance and inspection of this equipment is recommended and may be required by local, municipal, or regional codes. Selas recommends equipment be inspected by qualified personnel at least once a year.

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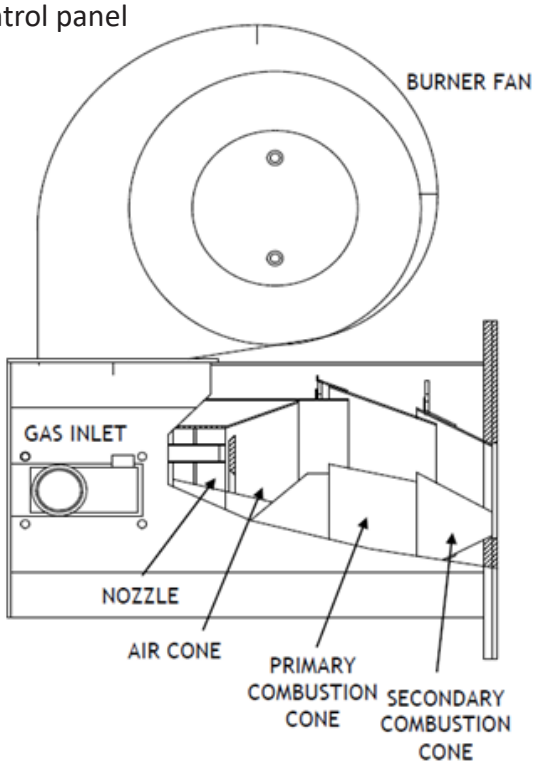
Options/Accessories

- External blower (EB)
- Ultraviolet scanner
- Temperature control
- High temperature limit
- Main gas regulator
- Remote terminal control panel



Maintenance

The factory suggests qualified or experienced personnel should do maintenance for the TFR burners at a minimum of every six (6) months. Other variables might occur for the burner to need maintenance earlier than the suggested time; for specific questions, consult the factory.

1. First, de-energize and lock out all electrical and fuel sources.
2. Then, remove motor-impeller subassembly and clean impeller blades. Replace when complete.
3. Remove rear cover from burner air housing to access internal components.
4. Next, remove igniter (ignition wand).
   a. Inspect ceramic for cracks and replace if necessary.
   b. Then, using a soft wire brush, clean the igniter tip.
5. Next, remove the flame-sensing device (flame rod or UV scanner).
   a. Flame rod - Inspect ceramic for any cracks or damage and replace if necessary. Clean metal detector rod using emery paper.
   b. UV scanner - Clean the UV scanner bulb with a soft cloth. Make sure not to touch the glass bulb itself with bare hands.
6. Remove accumulated dirt or debris from burner air housing.
7. Inspect the burner air cones for severe damage.
   a. Small cracks/fishers or slight distortion in the air cones are acceptable and not dangerous to the operation of the burner.
   b. If the burner air cones are severely damaged, then the burner needs to be dismantled to fit replacements.
8. Remove and check the pressure switch impulse lines for any blockage.
9. Replace igniter and detector. Set spark wand (igniter) orientation and insertion depth per instruction and diagram on page 12. Reattach electrical connectors onto igniter and detector.
10. Replace rear access cover and re-energize electric and fuel sources.
11. While the burner is shut down, check the integrity and correct operation of safety pressure switches and solenoids.
12. It is essential to check for gas leaks in the burner valve assembly.
13. Lastly, compare all burner gas and air settings with previously recorded service record.
    a. Qualified personnel should perform a test fire before putting the burner back into operation.

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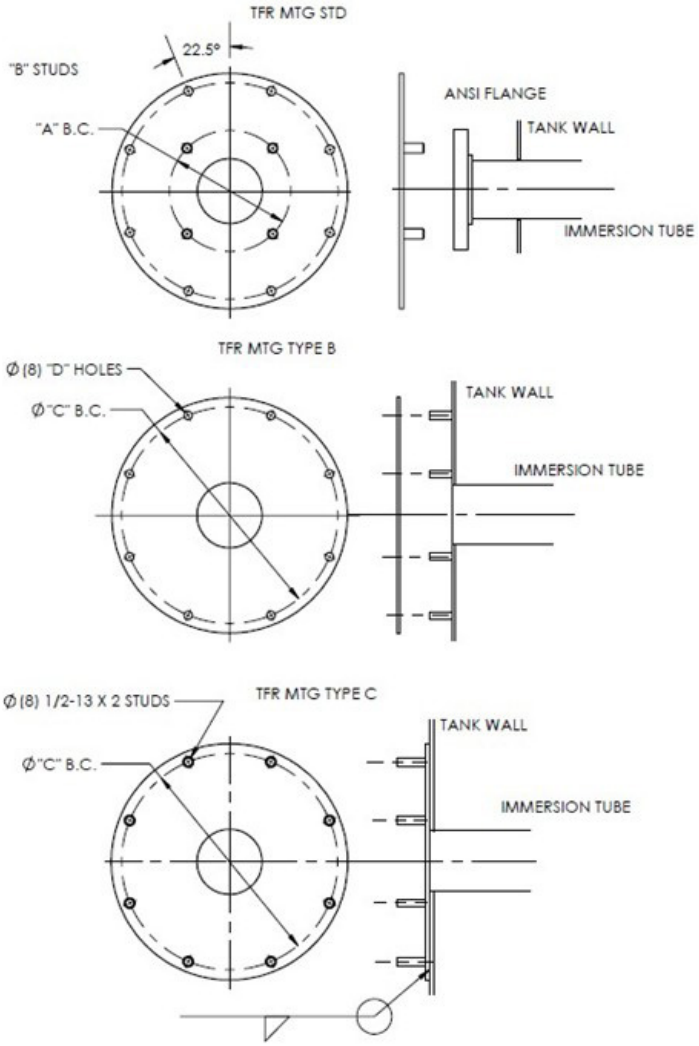
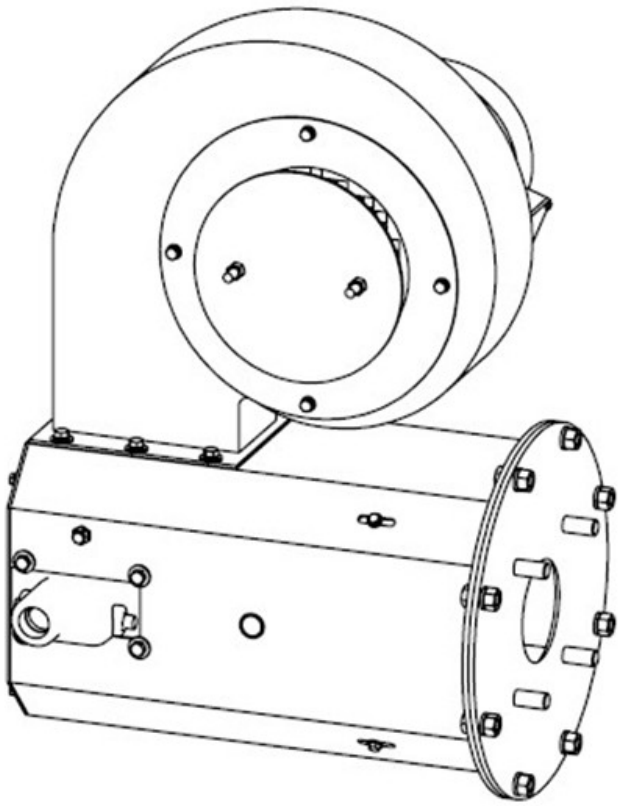
Mounting Options





Burner	Immersion Tube	"A" Bolt Circle	"B" Studs	"C" Bolt Circle	"D" DIA. Holes
TFR-B-65	2-1/2" (65 mm)	5-1/2" (140 mm)	M16 x 46 mm	11" (280 mm)	33/64" (13 mm)
TFR-B-80	3" (80 mm)	6" (153 mm)			
TFR-C-80					
TFR-B-100	4" (100 mm)	7-1/2" (191 mm)			
TFR-C-100				13-3/8" (340 mm)	
TFR-C-150	6" (150 mm)	9-1/2" (241 mm)	3/4-10 x 46 mm		35/64" (14 mm)
TFR-D-150			M18 x 46 mm	15-3/8" (390 mm)	
TFR-D-200	8" (200 mm)	11-3/4" (298 mm)			

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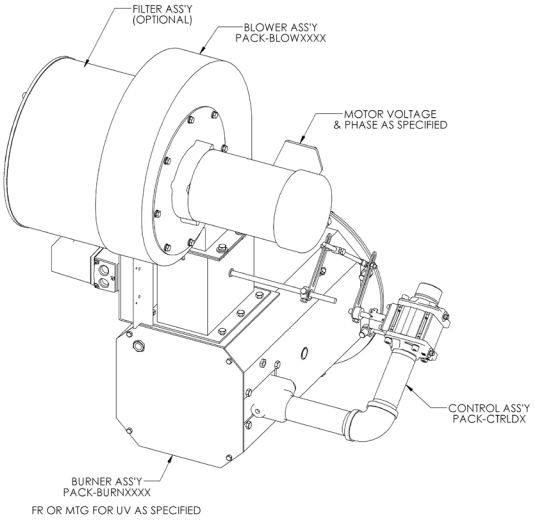
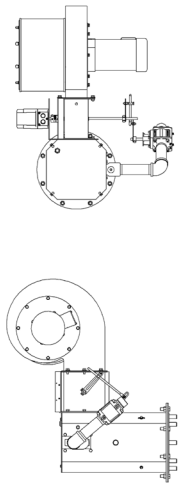
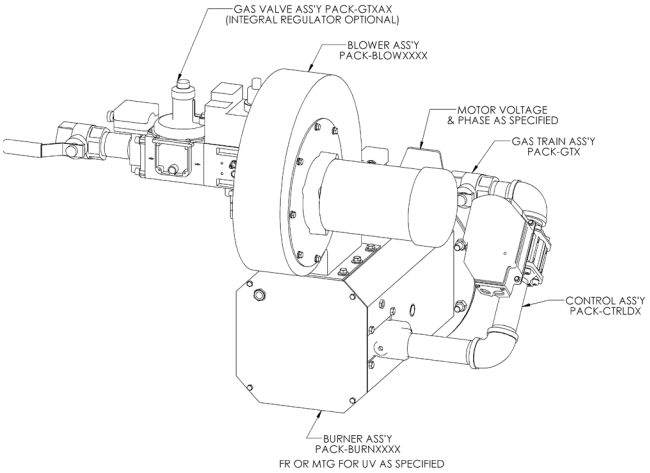
Air/Gas Control Options

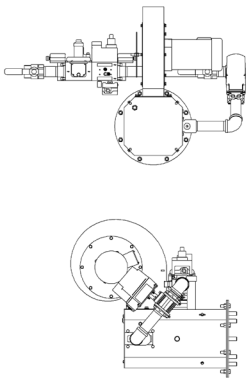
Linked Air/Gas



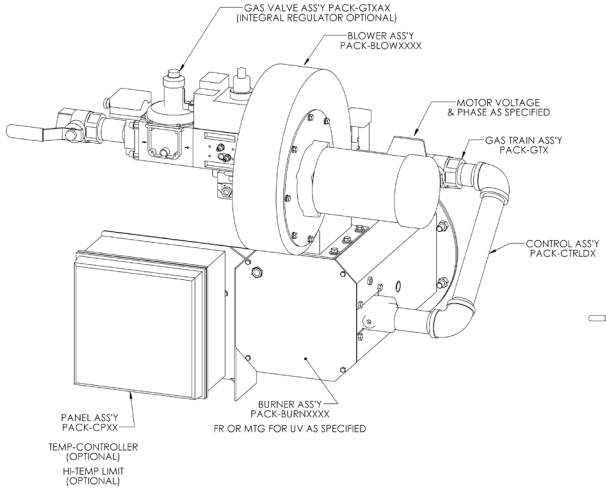


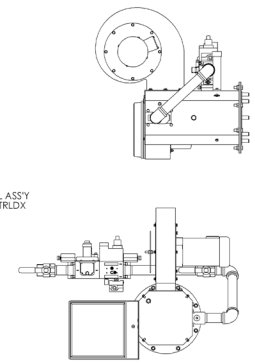
Full Air/Modulated Gas





Full Air/Gas Hi/Lo





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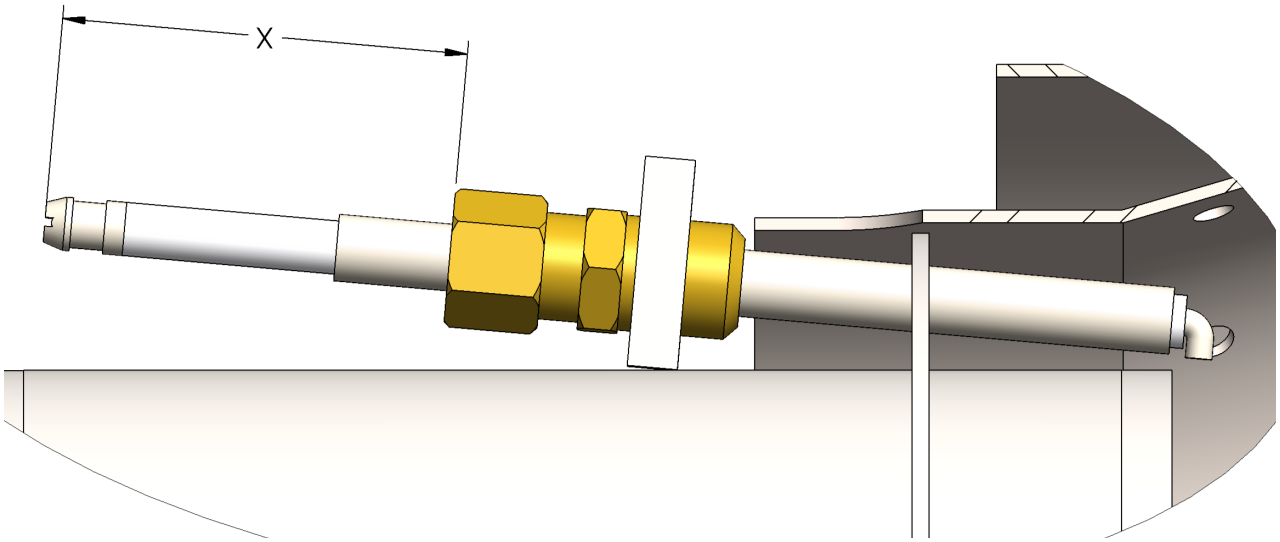
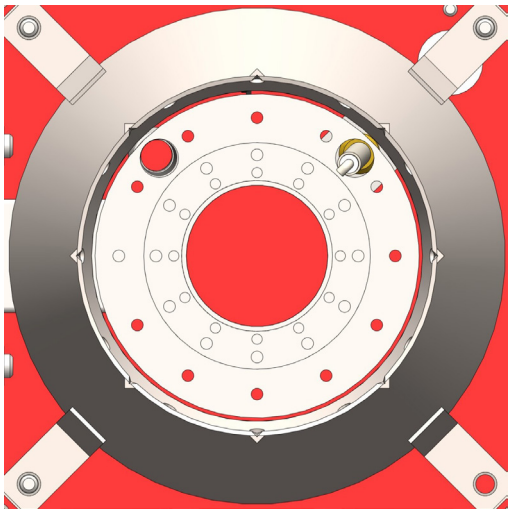
Spark Wand (Igniter) Placement

Insert spark wand (igniter) through compression fitting assembly as shown in diagram below, noting tip orientation and extension length “X”. Tighten compression nut to hold igniter securely in place. Do not over tighten.



Burner	TFR-B-65	TFR-B-80	TFR-B-100	TFR-C-80	TFR-C-100	TFR-C-150	TFR-D-150	TFR-D-200
X	1-15/16”	1-15/16”	2”	2-1/8”	2-1/8”	2-1/8”	2-1/8”	2-1/8”

Spark Wand (Igniter) Orientation



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Troubleshooting Chart

Symptom	Cause	Remedy
Burner light up sequence does not start	No electrical supply	• Check electrical supply at local isolator • Check the control fuse
	Burner electrical control circuits are not in 'start up' condition.	• Check controls and switches in control circuit • Check all pressures switches and micro-switches
	Airflow pressure switch not made	• Check setting on switch; if this is correct, check the airflow
	Low gas pressure switch not made	• Check setting on switch; if this is correct, check the gas pressure
Start Cycle begins but burner locks out or shuts down before initiating the ignition sequence	Low combustion air pressure differential	• Reset burner pressure switch • If pressure switch is set correctly, open the air damper on the combustion air fan • Check that the combustion air fan motor is rotating in the correct direction • Check that the combustion air fan is running; if not, check the overload or circuit breakers

Troubleshooting Chart (Cont.)

Symptom	Cause	Remedy
Pilot does not light	No spark	• Check electrical supply to ignition transformer • Check electrical connection to spark plug • Check operation of ignition transformer • Check condition of spark plug and clean, reset, or replace
	No pilot gas	• Check manual valve open • Check that pilot solenoid valve opens • Ensure gas is available at burner
	Not the correct amount of pilot gas	• Check pilot gas flow adjuster and pilot gas regulator
	Pilot blown out	• Reduce process air flow if possible • Increase pilot gas rate
Pilot lights but locks out when ignition de-energized	Pilot gas rate too low	• Adjust pilot gas rate
Pilot lights but the burner locks out before the main valves are energized	Flame sensor not detecting the flame	• Check sensor for damage or moisture • Clean flame sensor • Check flame sensor installation and position
	Faulty sensor	• Replace sensor

Troubleshooting Chart (Cont.)

Symptom	Cause	Remedy
Main flame does not light, and burner locks out the end of the pilot phase	Faulty main shut off valve	• Check electrical supply to valve • Check the condition of the valve; if faulty, replace it
	No main gas	• Check manual valve open • Check the adjustment of the gas control valve • Ensure gas is available at burner
	Not enough main gas	• Check main gas flow adjuster and main gas regulator
Main flame lights but shuts down after a short period of time	Pilot gas rate too high	• Adjust pilot gas rate
	Control circuit operating	• Checks control circuit, over temperature limits, etc.
	Burner gas or air ports blocked	• Check and clean • Identify source of blockage and rectify
	Flame sensor not detecting the flame	• Over firing and flame is ‘lifting off’; reset main flame firing rate • Check flame sensor installation and position • Check the main gas pressure governor
	Overfiring and flame is ‘lifting off’	• Reset main flame firing rate

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Troubleshooting Chart (Cont.)

Symptom	Cause	Remedy
Flame failure (lockout) during normal main flame operation	Faulty main shut off valve	• Check electrical supply to valve • Check condition of the valve; if faulty, replace it
	No main gas	• Check manual valve open • Check the adjustment of the gas control valve • Ensure gas is available at burner
	Not enough main gas	• Check main gas flow adjuster and main gas regulator
	Low fire set too low	• Check and adjust
	Control circuit operating	• Check control circuit, over temperature limits, etc.
	Burner gas or air ports blocked	• Check and clean • Identify source of blockage and rectify
	Flame sensor not detecting the flame	• Over firing and flame is ‘lifting off’; reset main flame firing rate • Check flame sensor installation and position
	Combustion air failure	• Inspect combustion air fan for damage • Check fan overloads • Check air filter (if fitted) and clean if necessary

Troubleshooting Chart (Cont.)

Symptom	Cause	Remedy
Flame failure (lockout) at low fire	Faulty low fire bypass valve (high low burners only)	• Low fire flame set too low • Check electrical supply to valve • Check condition of the valve; if faulty, replace
	Low fire flame set too low	• Check the adjustment of the gas control valve • Ensure gas is available at burner
	Too much air	• Check and reset air at high and low fire
	Low fire air set too low (modulating gas and air burners only)	• Check and adjust
	Control circuit operating due to temperature 'creep'	• Check control circuit, over temperature limits, and low fire settings
	Flame sensor not detecting the flame	• Check flame sensor installation and position
Main flame too long	Too much gas	• Check main gas pressure and reset • Check gas control valve and reset • Check fuel type
	Combustion air set too low	• Check air dampers, linkages, and air filter (where fitted)

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Troubleshooting Chart (Indirect Heaters)

Symptom	Cause	Remedy
Mounting stub glows red	Low combustion airflow	• Check air valve stroke
	Main flame too long	• Check the adjustment of the gas control valve
	Combustion air set too low	• Check air dampers, linkages, and air filter (where fitted) • Move the cones back using the screws in the corners
Unit will not achieve temperature	Too much process air	• Check and reset air
	Burner input setting too low	• Check and reset burner
	Leakage of cold air into system	• Source and rectify
Burner shuts down	Control circuit operating	• Check control circuit, process airflow switch, over temperature limits, and low fire setting
	Flame sensor not detecting the flame	• Check flame sensor installation and position
	Too much pressure in chamber	• Check flue
Unit produces condensation	Burner turned down too low	• Check the adjustment of the gas control valve
	Low process air volume	• Check and reset air
System intermittent or continuous pulsation	Fire tube configuration	• Close exhaust damper in small increments to smooth out pulsation. Re-check burner air and gas pressures and exhaust O_2

11012 Aurora Hudson Rd • Streetsboro, OH 44241
1-800-523-6500 • sales@selas.com
www.selas.com

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