STARCOMBUSTION SYSTEMS LLC

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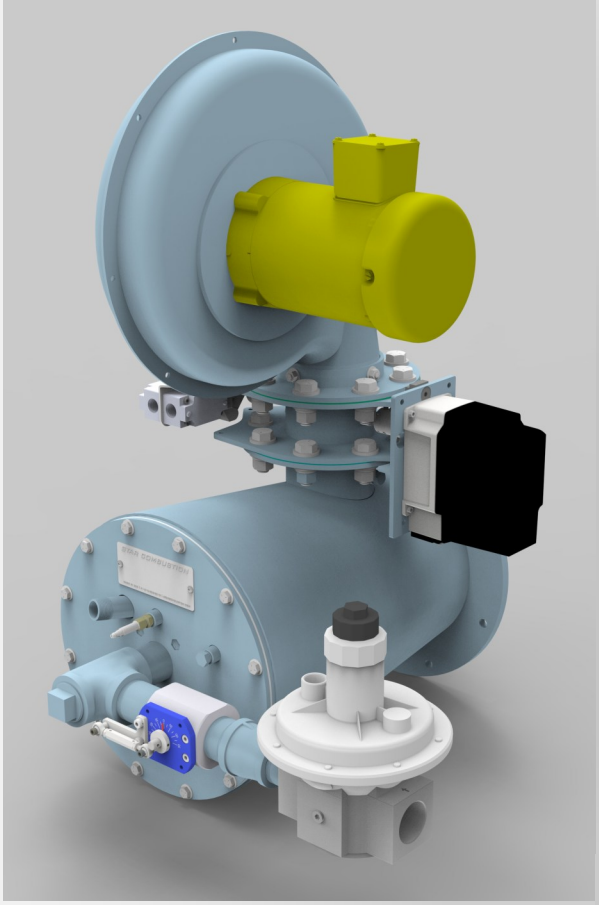
STAR | Ix

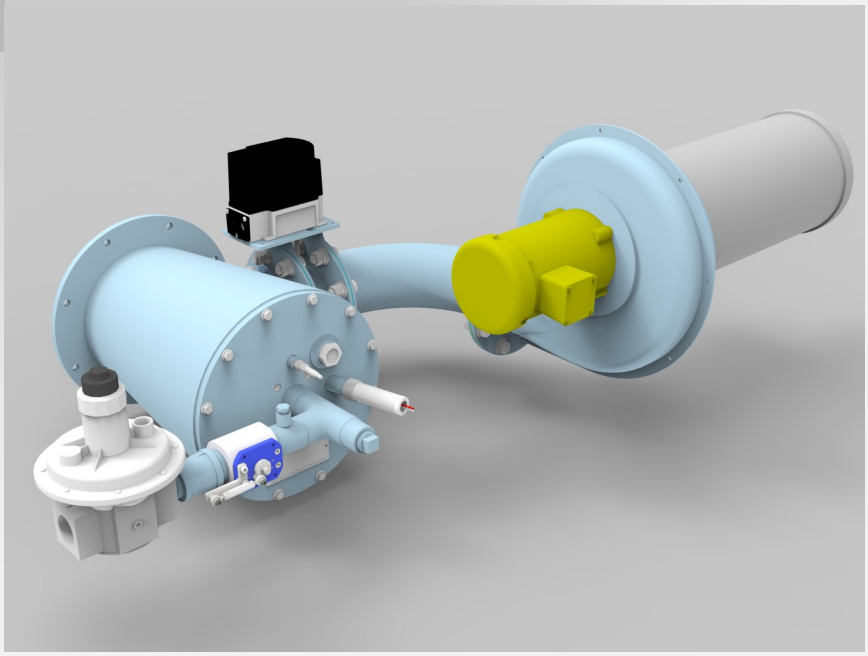
PACKAGED HIGH INTENSITY IMMERSION BURNER

TECHNICAL GUIDE



- ⇒ Integral combustion air fan and high precision air/ fuel ratio control for ease of application
- ⇒ Low NOx and CO emissions
- ⇒ Simple set up and adjustment
- ⇒ High velocity flame promotes excellent heat transfer through immersion tube
- ⇒ Mounting designed for an excellent seal and cool mounting flange

- ⇒ Optional low profile design to fit underneath spray washers with low spray hood enclosures
- ⇒ Air fuel ratio control options include parallel positioning and ratio regulator control
- ⇒ The burner can be started using a pilot or direct spark ignition at low fire



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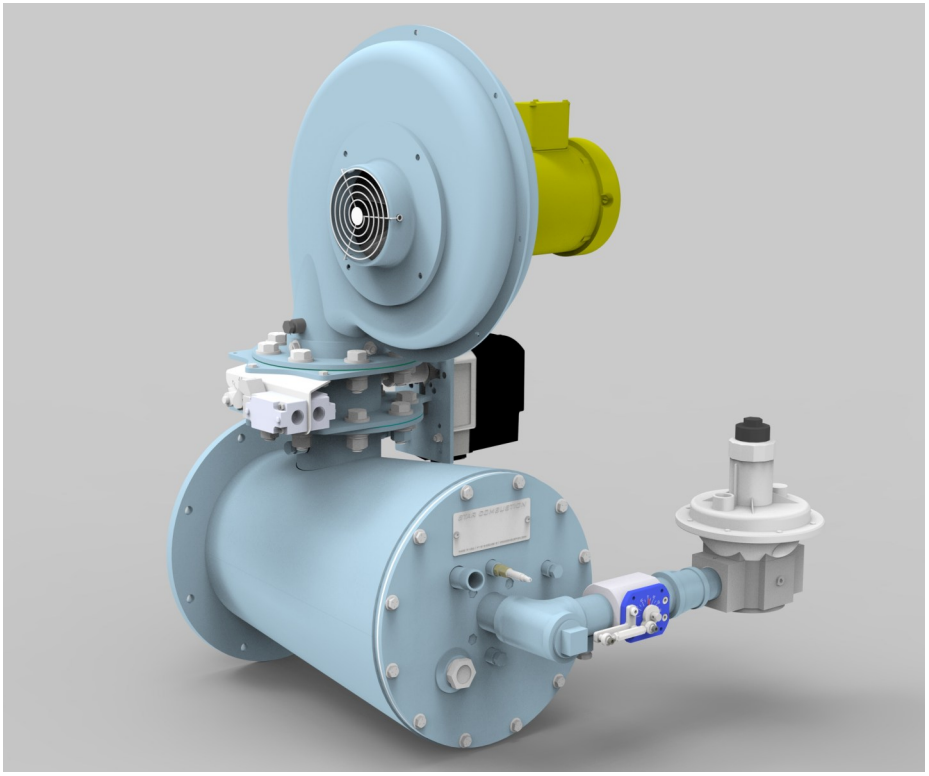
Typical Applications

- Industrial spray washers
- Tank/water heating
- Water bath heaters
- Paint finishing lines
- Parts cleaning
- Can washers
- Quench tanks
- Salt bath heaters
- Vaporizers
- Any application that requires liquid heating



Features

The Star|Ix burner is a packaged burner designed for high efficiency liquid heating applications. The burner is packaged with a combustion air fan and air/fuel ratio control valves as standard, and can optionally be supplied with built on fuel train and burner management controls for a turnkey burner package.

- Packaged burner sizes range from 235,000 btu/hr to 3,500,000 btu/hr with external blower versions to 5,300,000 btu/hr
- 10:1 turndown from maximum to minimum capacity
- Small bore, high efficiency immersion tubes save space and provide uniform heat transfer
- Immersion tube sizes 2”, 3”, 4”, 6”, and 8”
- Optional construction to match competitive burner mounting patterns
- Air/fuel ratio control options include: Star|Linc parallel position system, air valve with gas ratio regulator, or the burner can be ordered with no air/fuel ratio control valves included
- Burns any clean fuel gas including natural gas, propane gas, butane gas, and propane/air mix
- Direct spark or pilot ignition options
- Worldwide use with NPT or BSP/ISO connections as well as 60Hz or 50Hz combustion air fan motors
- An orifice plate differential pressure gas meter is included with every burner to assure easy set up

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STAR | Ix—SPECIFICATIONS 60Hz

Packaged Ix Burner Size	I2P	I3P	I4P	I6P	I8P
Maximum Capacity (btu/hr HHV)	240,000	550,000	1,000,000	2,500,000	3,500,000
Minimum Capacity (btu/hr HHV)	24,000	55,000	100,000	250,000	350,000
Combustion Air Press @ inlet (“wc)	7.1	7.4	10.3	10.4	10.2
Static Combustion Air Press @ test conn ("wc)	7.0	7.0	10.0	10.0	10.0
Estimated Tube Back Pressure (“wc)	1.8	2.6	3.8	4.0	2.0
Differential Combustion Air Pressure ("wc)	5.2	4.4	6.2	6.0	8.0
Combustion Air Flow (scfh, 15% Excess Air)	2,683	6,148	11,179	27,947	39,125
Combustion Air Flow (scfm, 15% Excess Air)	45	102	186	466	652
Combustion Air Fan Horsepower	1/2HP	1/2HP	1/2HP	2HP	3HP
Natural Gas Inlet Pressure @ ratio reg ("wc)	20-60	20-60	20-60	20-60	20-60
Natural Gas Metering Orifice	SBO-I-5	SBO-D-7	SBO-396	SBO-559	SBO-551
Nat Gas Differential Press @ Metering Orif ("wc)	4.6	6.7	7.2	5.8	4.2
Natural Gas Flow (scfh, 1002 btu/ft^3, 0.6 sg)	240	549	998	2,495	3,792
Immersion Tube Length, 80% Efficiency	21ft	29ft	38ft	54ft	62ft

External Fan Ix Burner Size	I2E	I3E	I4E	I6E	I8E
Maximum Capacity (btu/hr HHV)	350,000	800,000	1,500,000	3,600,000	5,300,000
Minimum Capacity (btu/hr HHV)	24,000	55,000	100,000	250,000	350,000
Combustion Air Press @ inlet (“wc)	16.8	19.2	28.9	26.2	28.9
Static Combustion Air Press@ test conn ("wc)	16.5	18.7	28.2	25.0	28.3
Estimated Tube Back Pressure (“wc)	3.6	6.0	9.0	8.3	6.0
Differential Combustion Air Pressure ("wc)	12.9	12.7	19.2	16.7	22.3
Combustion Air Flow (scfh, 15% Excess Air)	3,913	8,943	16,768	40,243	59,247
Combustion Air Flow (scfm, 15% Excess Air)	65	149	279	671	987
Combustion Air Fan Horsepower	1-1/2HP	1-1/2HP	3HP	5HP	7-1/2HP
Natural Gas Inlet Pressure @ ratio reg ("wc)	40-60	40-60	40-60	40-60	40-60
Natural Gas Metering Orifice	SBO-I-5	SBO-D-7	SBO-396	SBO-559	SBO-551
Nat Gas Differential Press @ Metering Orif ("wc)	9.9	14.1	16.1	11.9	10.7
Natural Gas Flow (scfh, 1002 btu/ft^3, 0.6 sg)	349	798	1497	3593	5289
Immersion Tube Length, 80% Efficiency	24ft	35ft	43ft	63ft	72ft

The above calculations are determined using the following data:

1) Capacities shown are for a the burner firing into a sch 40 immersion tube with size and length for 80% efficiency. Consult Star Combustion for other combustion chamber conditions.
2) Natural gas (Birmingham, AL) with HHV of 1002 btu/ft3, 0.6 specific gravity, and 9.74:1 stoichiometric air fuel ratio
3) Air and gas flows are based on operating conditions at standard temperature and pressures: 68°F ambient air at sea level
4) Air and gas flows and pressures could vary depending on atmospheric conditions

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STAR|Ix–MODEL NUMBER

STAR|I (I) (II) (III) - (IV) (V) (VI) - (VII) (VIII) (IX) - (X) (XI) (XII) - (XIII)

TABLE I - Burner Size

Abbreviation	Definition
2P	2" - 240,000 btu/hr HHV max capacity
2E	2" - 350,000 btu/hr HHV max capacity (external fan)
3P	3" - 550,000 btu/hr HHV max capacity
3E	3" - 800,000 btu/hr HHV max capacity (external fan)
4P	4" - 1,000,000 btu/hr HHV max capacity
4E	4" - 1,500,000 btu/hr HHV max capacity (external fan)
6P	6" - 2,500,000 btu/hr HHV max capacity
6E	6" - 3,600,000 btu/hr HHV max capacity (external fan)
8P	8" - 3,500,000 btu/hr HHV max capacity
8E	8" - 5,300,000 btu/hr HHV max capacity (external fan)

TABLE II - Fuel

Abbreviation	Definition
G	Natural Gas
P	Propane
X	Special fuel

TABLE III - Connections

Abbreviation	Definition
US	NPT connections
EU	BSP/ISO threaded connections

TABLE IV - Fuel inlet arrangement

Abbreviation	Definition
T	Fuel inlet 12:00 (not available with low profile fan arr)
L	Fuel inlet 9:00
B	Fuel inlet 6:00 (not available with low profile fan arr)
R	Fuel inlet 3:00

TABLE V - Pilot Configuration

Abbreviation	Definition
P	Pilot adjusting orifice included
S	Direct Spark Ignition

TABLE VI - Flame Sensing

Abbreviation	Definition
F	Flame ionization rod included
UV	UV scanner, customer supplied

TABLE VII - Air Control Valve

Abbreviation	Definition
P	Air control valve included, order actuator bracket sep
S	Air control valve included, Star|Linc actuator included
N	No air control valve included

TABLE VIII - Air Control Valve Position switches

Abbreviation	Definition
B	Purge and light off position switches included
P	Purge position switch included
L	Light off position switch included
N	No position switches included

TABLE IX - Fuel Control Valve

Abbreviation	Definition
R	Ratio regulator system included
P	Gas control valve included, order actuator bracket sep
S	Gas control valve included, Star|Linc actuator included

TABLE X - Combustion Air Fan

Abbreviation	Definition
A	Fan with 240/480/3/60 motor included
C	Fan with 575/3/60 motor included
W	Fan with 380/3/50 motor included
X	Fan with special voltage motor
N	No combustion air fan included

TABLE XI - Combustion Air Fan Arrangement

Abbreviation	Definition
U	Standard position with upright fan
LR	Low profile air inlet elbow included air inlet at 3:00
LL	Low profile air inlet elbow included air inlet at 9:00

TABLE XII - Combustion Air Filter

Abbreviation	Definition
N	No filter included
F	Combustion air filter included

TABLE XIII - Wall Mount Plate

Abbreviation	Definition
N	No wall mounting plate included
P	Wall mounting plate included

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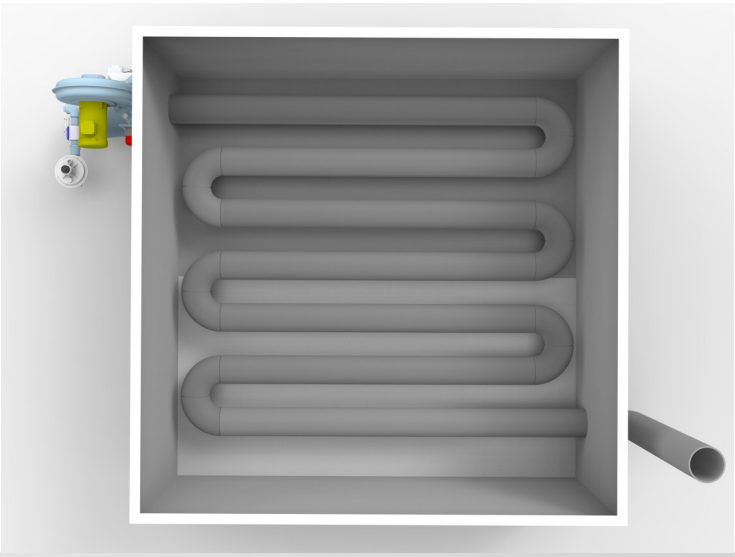
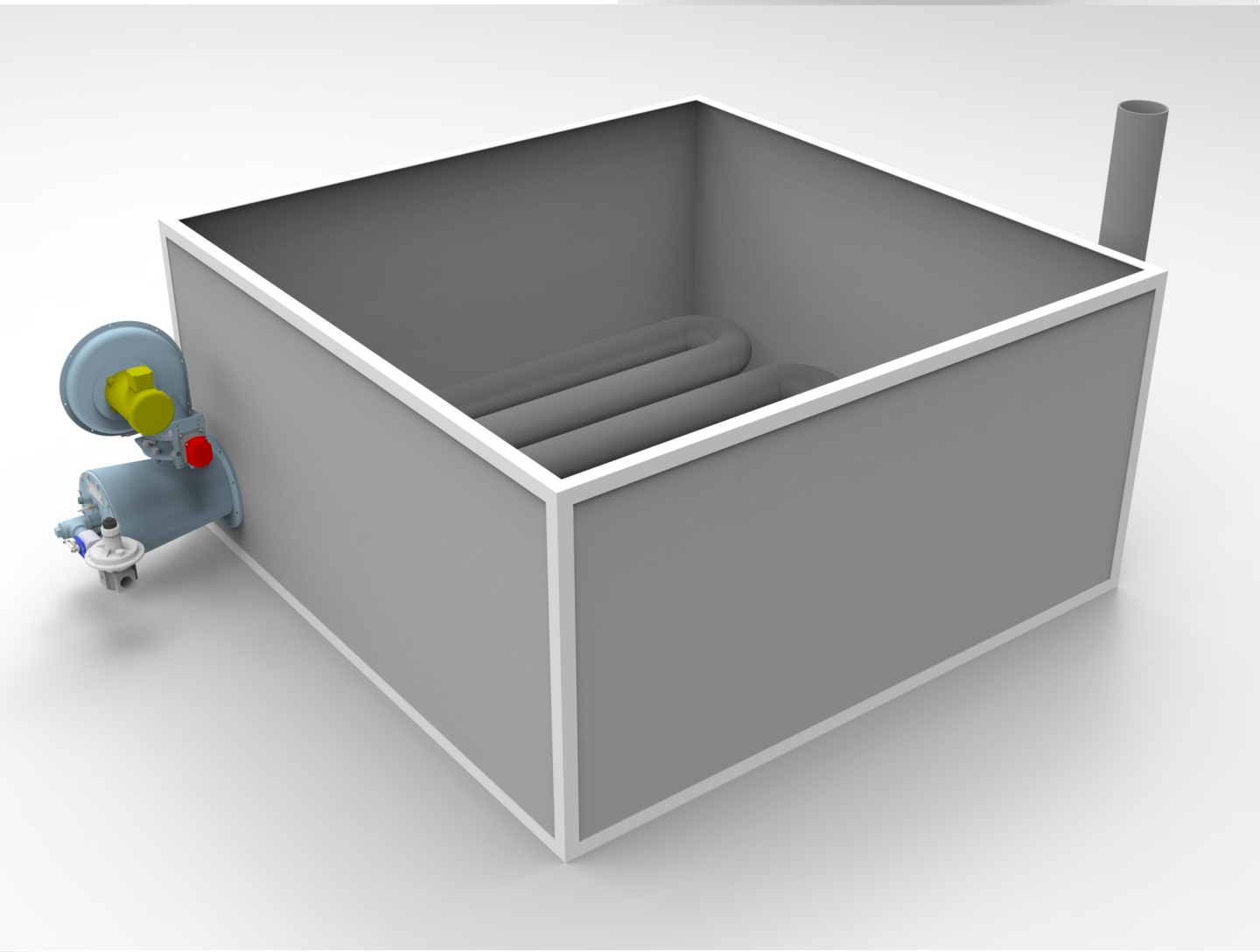
STAR|Ix– TYPICAL APPLICATION

- The Star|Ix burner is normally mounted in a tank filled with liquid and is fired into an immersion tube that traverses the tank.
- The high velocity flame inside of the immersion tube transfers heat through the immersion tube to the liquid quickly and efficiently.
- The immersion tube diameter and length is determined by the heat capacity required and the desired efficiency.





STAR|Ix IMMERSION TUBE DESIGN CONSIDERATIONS

⇒ Size the immersion tube length according to tube length versus efficiency chart on page 7. The lengths given in the chart are for the centerline length of the tube that is immersed in the liquid being heater.

⇒ The capacities listed on the capacities and specification chart on page 3 are gross capacities. To get net heat capacity into the tank, multiply the gross capacity by the efficiency. Running the burner with excess air levels greater than 15% will reduce the net capacity into the tank.

⇒ The immersion tube is normally manufactured from schedule 40 carbon steel pipe, but can also be manufactured from stainless steel piping. Do not use piping heavier than schedule 40.

⇒ If using stainless steel pipe for the immersion tube, schedule 10 pipe can be used, but schedule 40 pipe must be used for at least the first 2 feet at the burner end.

⇒ It is recommended to use short or long radius sweep elbows for the return bends. Single or multiple miter return bends can be used, but only on the second and successive returns, the first turn must be a short or long radius sweep elbow. Single miter return bends may reduce overall gross burner capacity.

⇒ The first return bend should be no closer than 10 pipe diameters from the burner.

⇒ Slope the tube down towards the exhaust slightly to prevent any condensation build up at the burner.

⇒ The immersion tube sizing chart shown on page 7 is for tube immersed in liquid. If using the burner for an indirect air heating application, please consult Star Combustion Systems for design criteria.

⇒ If using the Star|Ix burner for zinc phosphate detergent applications, use electro-polished stainless steel for the immersion tube construction, and limit the burner capacity to 50-60% of the packaged burner rating. This will lessen the likelihood of sludge building up on the tube, causing pre-mature failure.

⇒ If using the burners to heat cooking oil, consult Star Combustion for application assistance.

⇒ If using the Star|Ix burner for iron phosphate detergent applications, use stainless steel for the immersion tube construction. In this instance, the packaged burners can be used at full capacity, but the external blower burners should not have more capacity than the packaged burners.

⇒ The exhaust should be designed to have an atmospheric break soon after the immersion tube exits the tank in order to minimize the possibility of condensation in the immersion tube, but above personnel height, see figure 1. Size the remaining exhaust piping to be at least 1.5 times the cross sectional area of the immersion tube.

⇒ An exhaust damper can optionally be placed at the end of the immersion tube near the exit. This will normally be set to 100% open. While not normally present, this damper can be closed slightly in the rare case where there is some combustion noise.

⇒ If the immersion tube is sized for 80% efficiency or higher, and if the burner will run at lower firing rates for extended periods of time, then a plan must be made for condensation inside of the immersion tube. Install a larger diameter stack at the tube exhaust, along with a condensate drain valve. This stack should have cross sectional area of 1.5 times the cross sectional area of the immersion tube.

⇒ The immersion tube should not be fastened anywhere inside the tank except at the entrance and exit ends where it is seal welded to the tank wall. The tube should be supported in a way where it can free float inside the tank to prevent damage due to expansion and contraction.

⇒ The immersion tube should be placed high enough from the tank floor to avoid being immersed in sludge build up, but low enough to prevent possible un-immersed sections. Both situations will damage the immersion tube.

⇒ A low water level switch must be used to shut off the burner. It should be placed above the immersion tube to prevent low water levels from exposing and damaging the tube.

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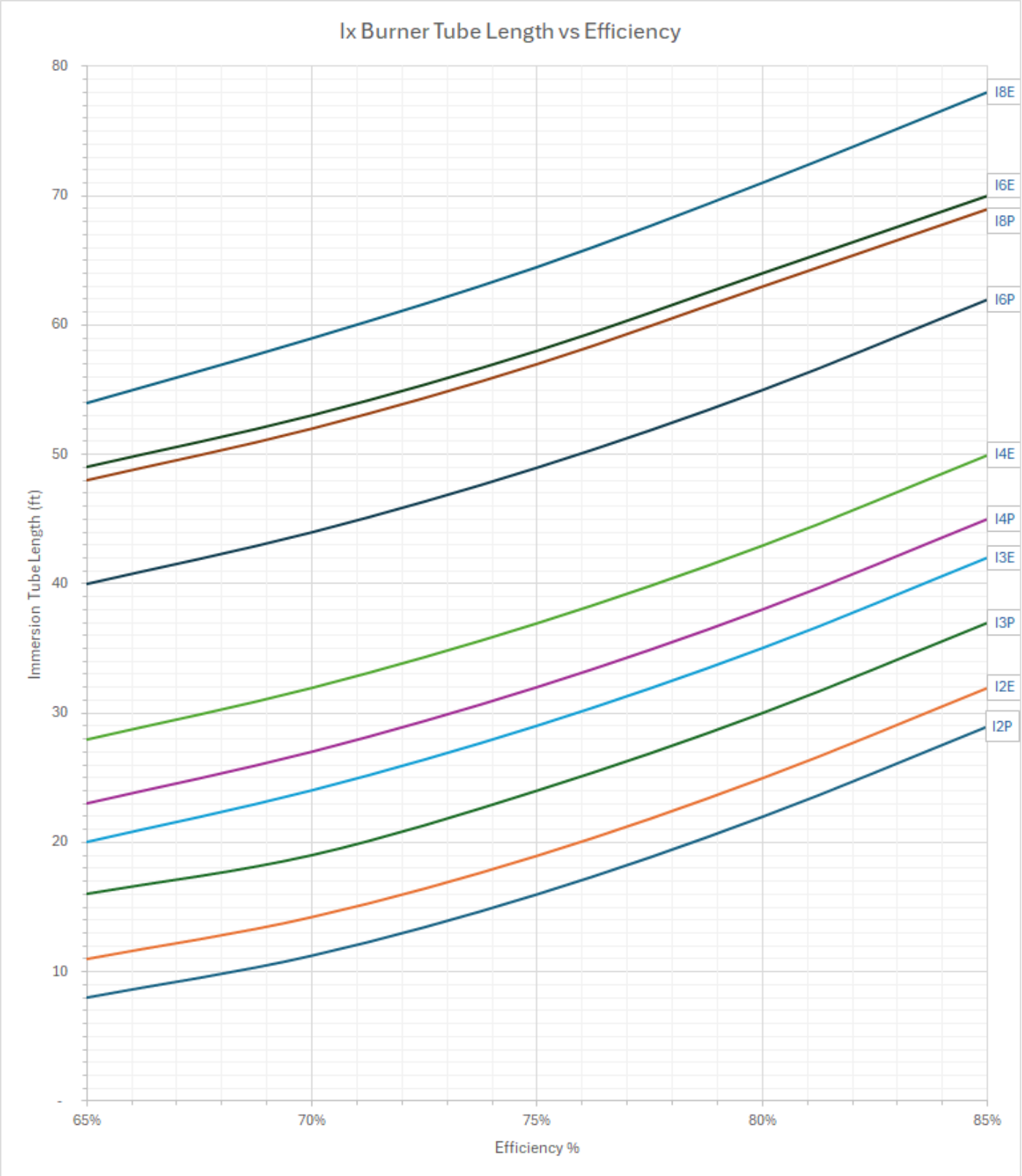
STAR|Ix IMMERSION TUBE DESIGN



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STAR|Ix MOUNTING CONSIDERATIONS

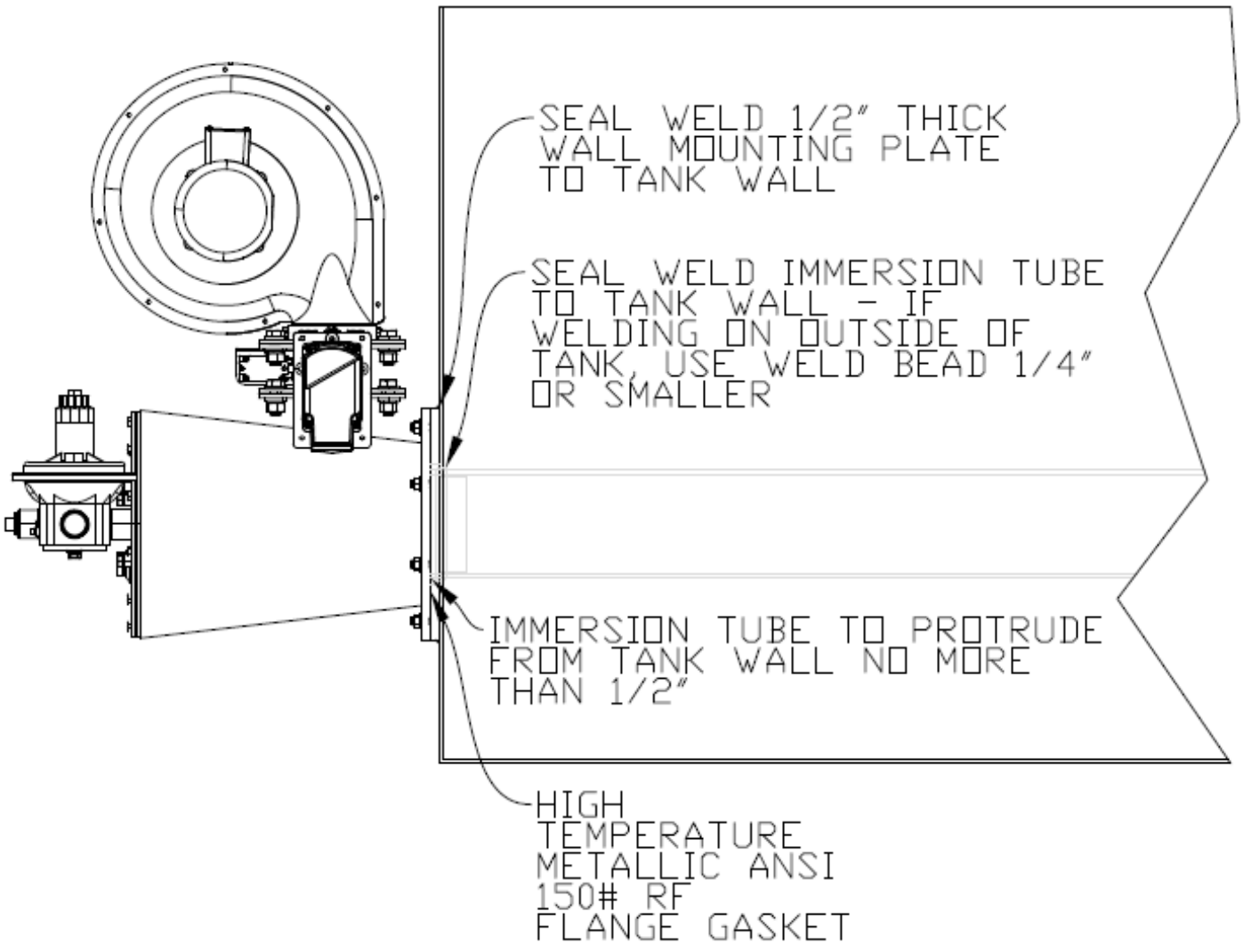
⇒ Seal weld the Star Combustion or customer supplied 1/2" thick mounting plate to the tank wall.

⇒ The hole in the mounting plate for the immersion tube is 3/4" larger in diameter than the OD of the immersion tube to allow for a weld bead for the immersion tube on the outside of the tank.

⇒ The immersion tube should be flush with the mounting plate, it should protrude approximately 1/2" through the tank wall.

⇒ Use a metallic high temperature ANSI 150# RF flange gasket between the mounting plate and the burner. This gasket can be supplied by Star Combustion or by the customer.

⇒ It is not recommended to stub mount the Star|Ix burner as the exposed part of the immersion tube will get very hot and may decrease the life of the tube.



STAR | Ix Exhaust Considerations

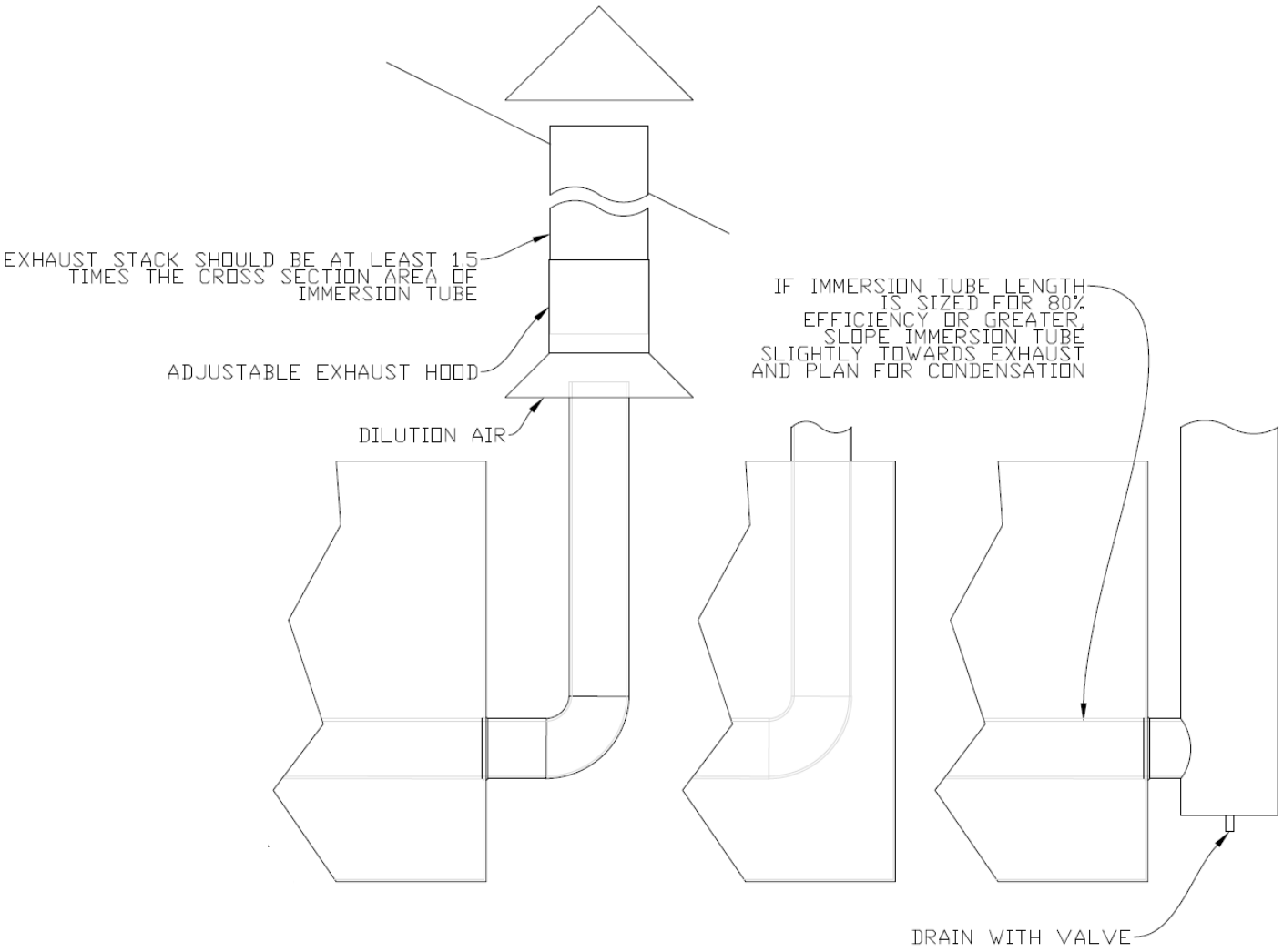
⇒ See illustration below for three different types of immersion tube exhaust designs.

⇒ The exhaust should be designed to have an atmospheric break soon after the immersion tube exits the tank in order to minimize the possibility of condensation in the immersion tube, but above personnel heigh, see illustration below. Size the remaining exhaust piping to be at least 1.5 times the cross sectional area of the immersion tube.

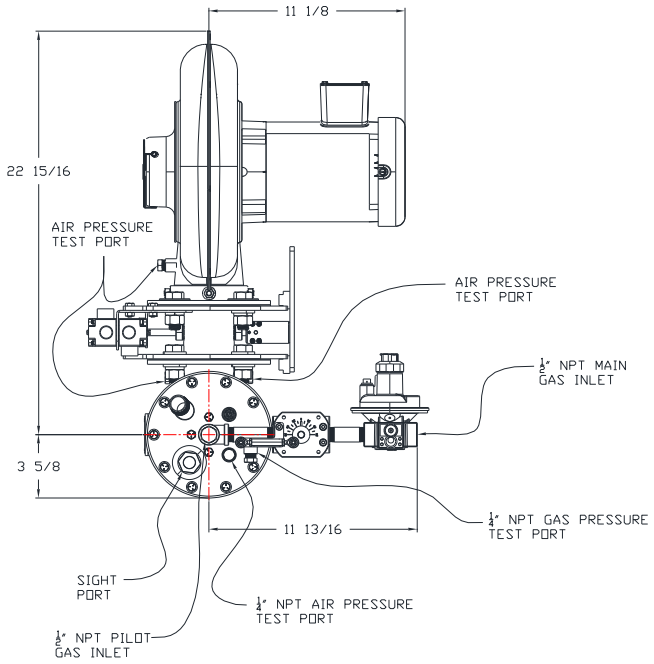
⇒ An exhaust damper can optionally be placed at the end of the immersion tube near the exit. This will normally be set to 100% open. While not normally present, this damper can be closed slightly in the rare case where there is some combustion noise.

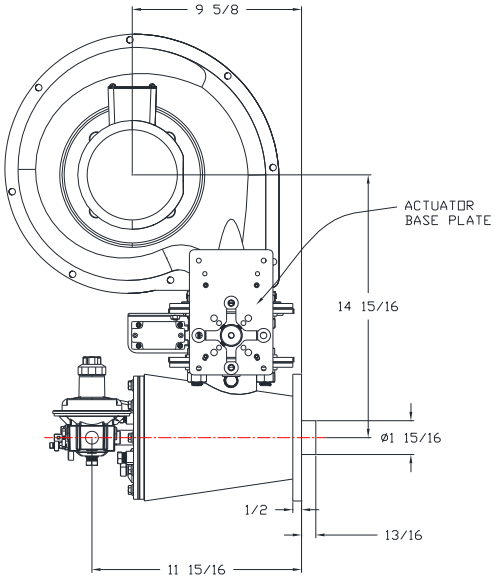
⇒ If the immersion tube is sized for 75% efficiency or less, then the exhaust can exit vertically out of the tank without penetrating the tank wall.

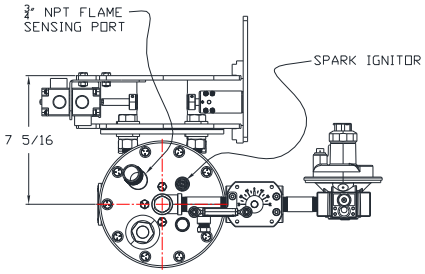
⇒ If the immersion tube is sized for 80% efficiency or higher, and if the burner will run at lower firing rates for extended periods of time, then a plan must be made for condensation inside of the immersion tube. Install a larger diameter stack at the tube exhaust, along with a condensate drain valve. This stack should have cross sectional area of 1.5 times the cross sectional area of the immersion tube.



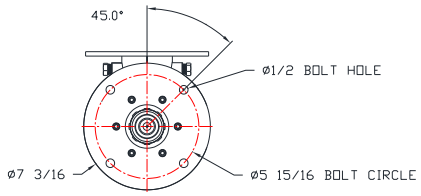
STAR | 12 – DIMENSIONS







EXTERNAL FAN



MOUNTING FLANGE
4 HOLES EQUALLY SPACED

EXTERNAL FAN
EXTERNAL AIR/FUEL CONTROL VALVES

STANDARD ANSI 125# FLANGE PATTERN
EXTERNAL FAN & EXTERNAL AIR/FUEL CONTROL

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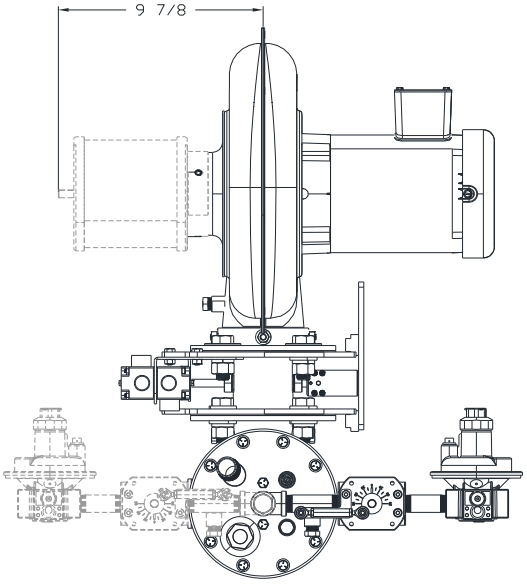
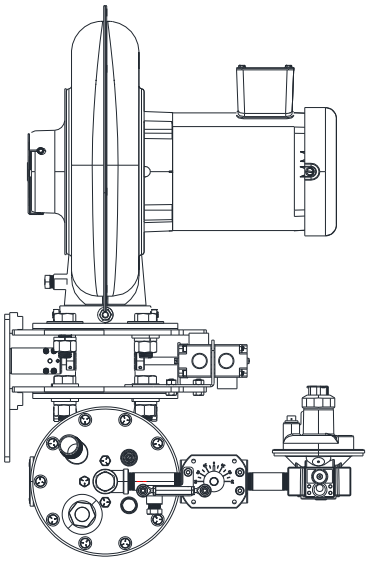


OPTIONAL FAN FILTER
ALTERNATIVE FUEL TRAIN POSITION



FLIPPED ACTUATOR MOUNT ASSY

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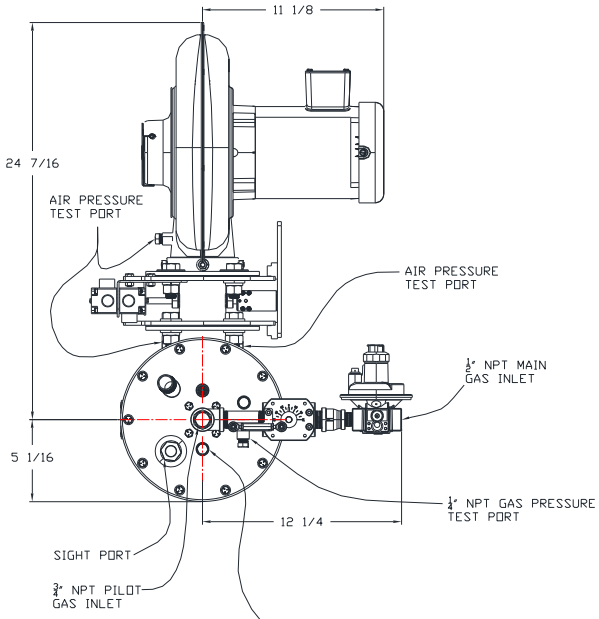
STAR | 13 – DIMENSIONS



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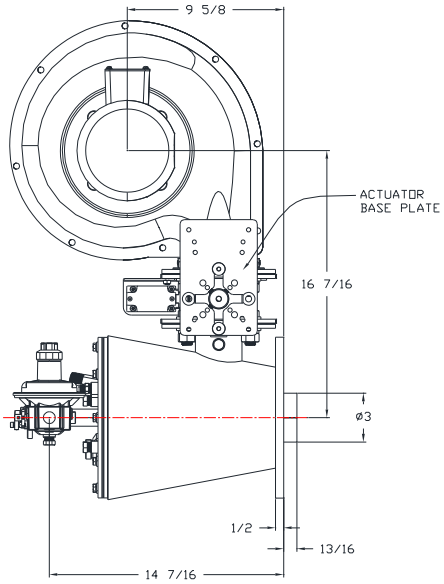
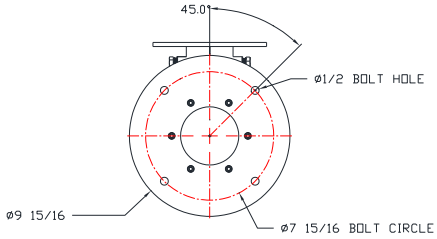
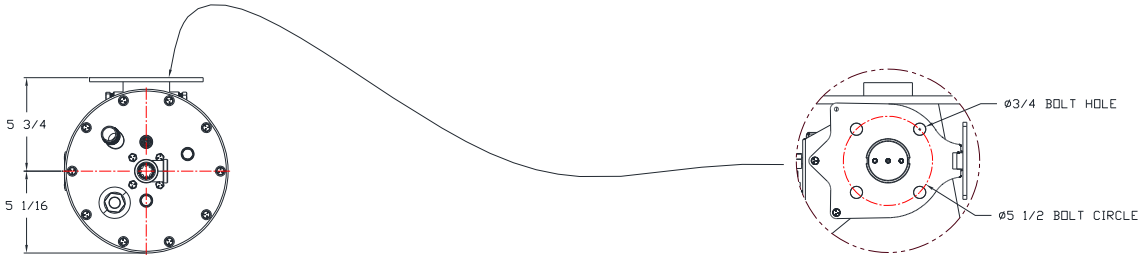




MOUNTING FLANGE
4 HOLES EQUALLY SPACED



EXTERNAL FAN
EXTERNAL AIR/FUEL CONTROL VALVES

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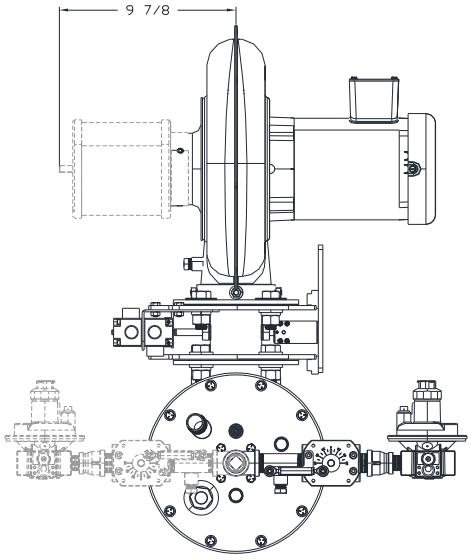
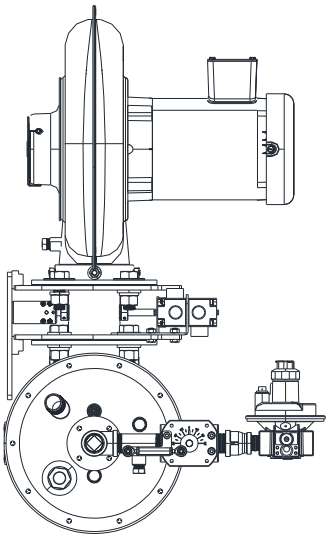


OPTIONAL FAN FILTER
ALTERNATIVE FUEL TRAIN POSITION



FLIPPED ACTUATOR MOUNT ASSY

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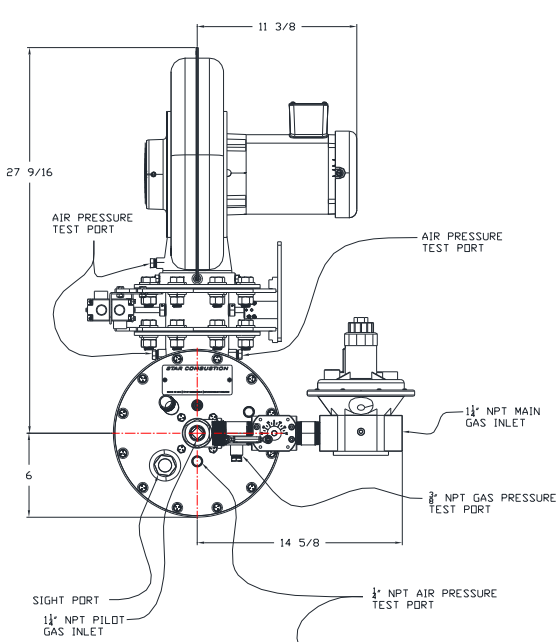

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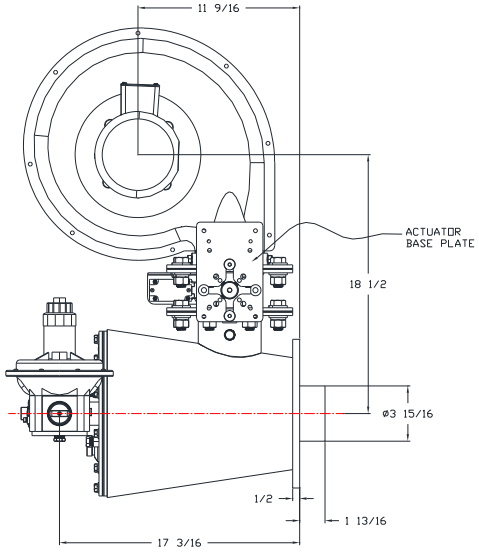
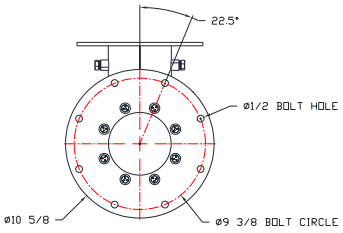
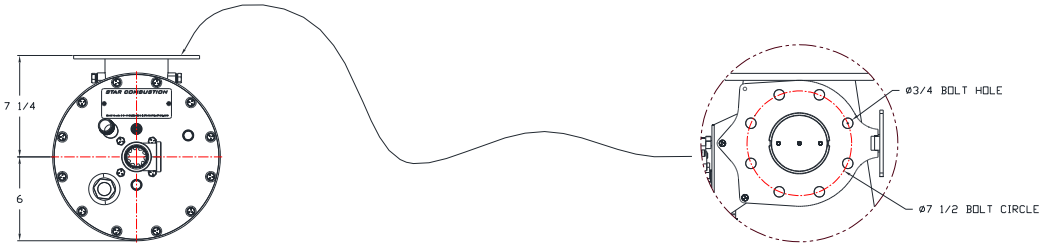




MOUNTING FLANGE
8 HOLES EQUALLY SPACED



EXTERNAL FAN
EXTERNAL AIR/FUEL CONTROLS

STANDARD ANSI 125# FLANGE PATTERN
EXTERNAL FAN & EXTERNAL AIR/FUEL CONTROL

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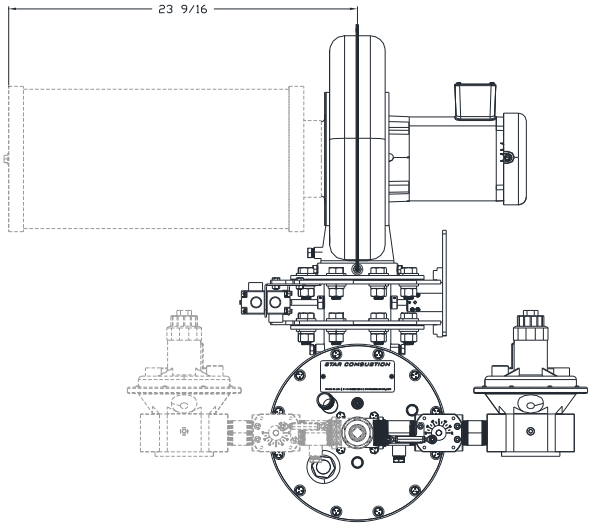
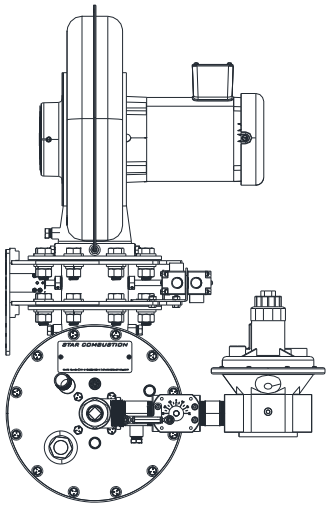


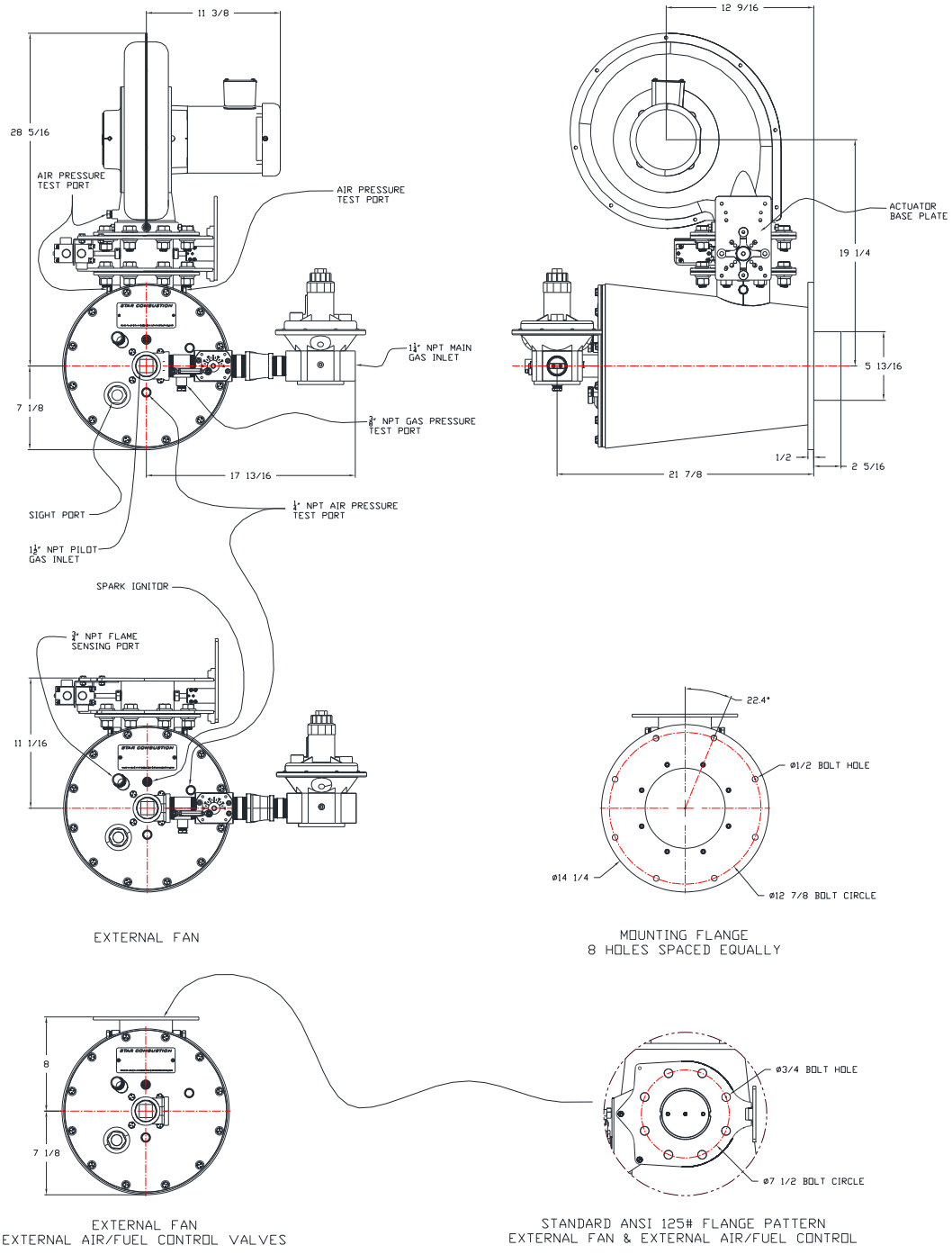
OPTIONAL FAN FILTER
ALTERNATIVE FUEL TRAIN POSITION



FLIPPED ACTUATOR MOUNT ASSY

Dimension listed are for general use and should not be used for installation drawings. Certified drawings should be obtained from Star Combustion Systems LLC to prevent any confusion or inaccuracies. Dimensions in the catalog are subject to change without notice.

STAR | 16 – DIMENSIONS



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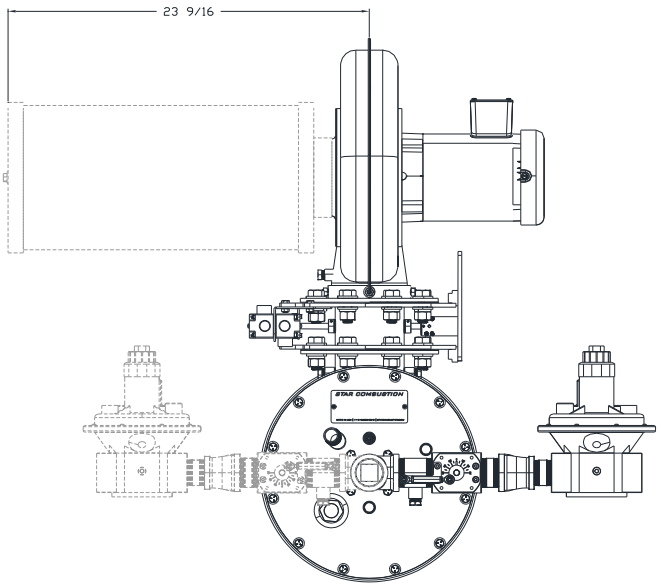
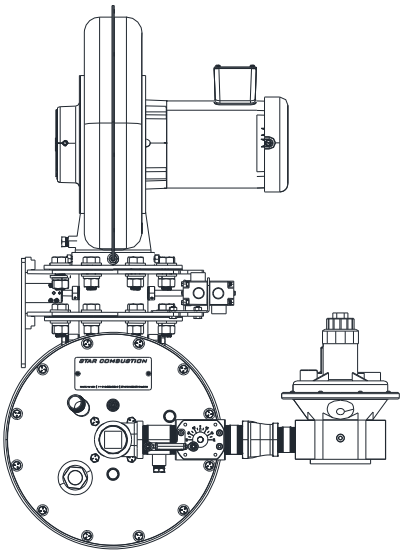
STAR | 16 – DIMENSIONS



OPTIONAL FAN FILTER
ALTERNATIVE FUEL TRAIN POSITION



FLIPPED ACTUATOR MOUNT ASSY

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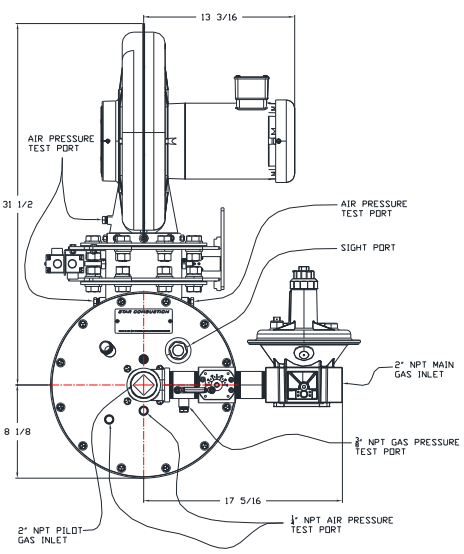
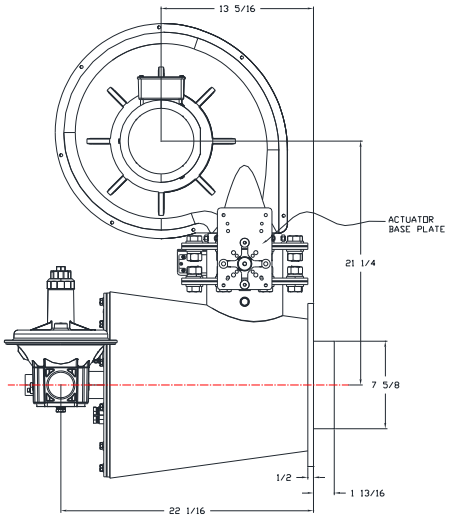
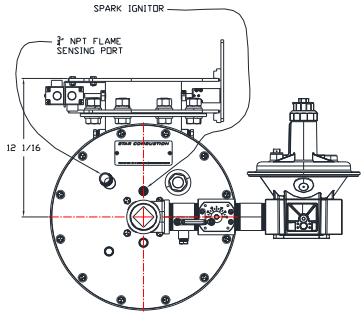
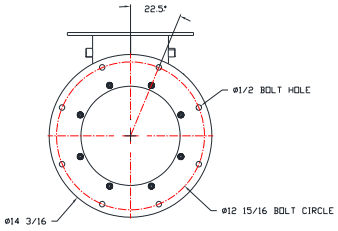
STAR | 18 – DIMENSIONS



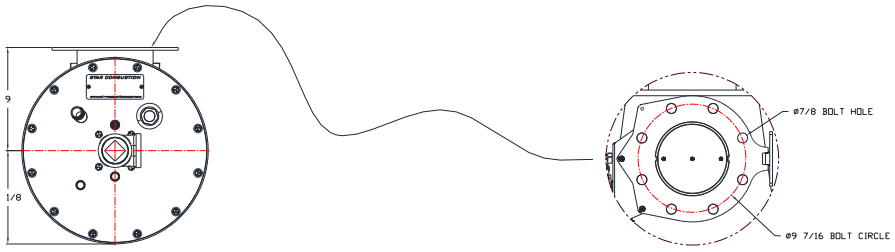




EXTERNAL FAN



MOUNTING FLANGE
8 HOLES EQUALLY SPACED



EXTERNAL FAN
EXTERNAL AIR/FUEL CONTROLS

STANDARD ANSI 125# FLANGE PATTERN
EXTERNAL FAN & EXTERNAL AIR/FUEL CONTROL

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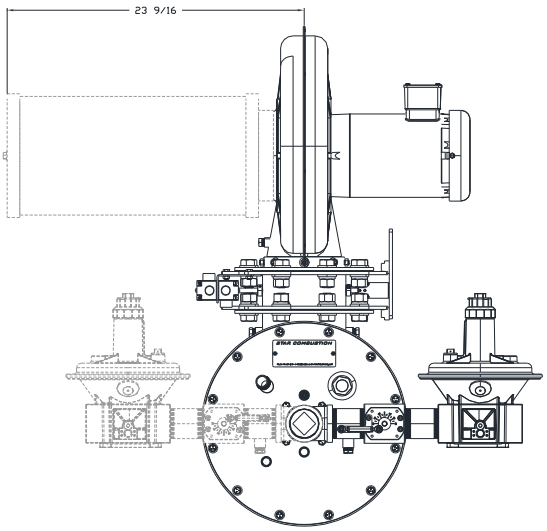
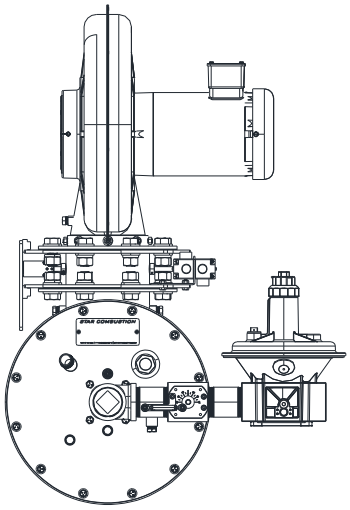
STAR | I8 – DIMENSIONS



OPTIONAL FAN FILTER
ALTERNATIVE FUEL TRAIN POSITION



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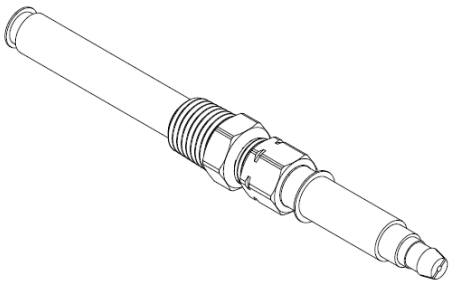
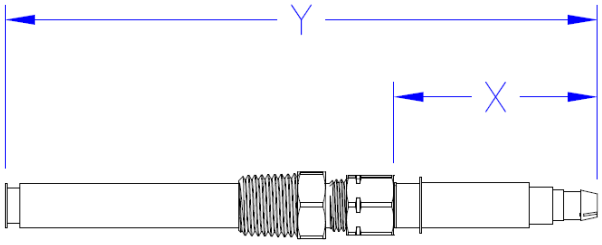
STAR|Ix – SPARK IGNITER DIMENSION





STARIIx SPARK IGNITER DIMENTIONS		
BURNER	Y DIM (INCHES)	X DIM (INCHES)
I2	5.0	1.25
I3	5.0	1.25
I4	5.0	1.25
I6	5.0	1.25
I8	5.0	1.25

STAR|Ix – COMMISSIONING

***** IMPORTANT *****

Installation and commissioning should only be done by properly trained and qualified personnel. Failure to do so can result in significant property damage, and injury or death to personnel. Follow all applicable piping and gas safety codes when installing and commissioning this system.

Observe all appropriate safety standards when working on equipment including lockout/tagout/try and confined space entry procedures. NEVER bypass any interlock designed for the safe operation of the burner system.

Once proper installation has been verified, including a fuel train, burner management system with high temperature limit, process fans, temperature controls, etc, commissioning can take place. Assure the fuel supply line has been purged up to the fuel train inlet, all system fans have been tested and are rotating in the correct direction, and that all wiring between the Star|Pac burner, fuel train, and burner management system are in place and verified correct. Verify the temperature control and high temperature limit controller sensors are installed and verified working properly.

Verify fuel supply pressure at the inlet of the fuel train is correct according to the fuel train and regulator design. DO NOT ATTEMPT TO LIGHT BURNER IF FUEL SUPPLY PRESSURE IS GREATER THAN THE DESIGN MAX PRESSURE FOR THE FUEL TRAIN, DAMAGE TO REGULATOR MAY RESULT. Contact Star Combustion Systems for further instruction if fuel supply pressure is not within range.

Verify the combustion air fan is operating properly and in the correct direction. Most fans will have a direction arrow to indicate correct direction. Bump the motor on for a second or so and observe the rotation direction, reverse the direction as necessary, according to the motor wiring.

Verify the spark igniter is set to the proper dimensions. See page 20 for illustration of settings.

Verify combustion air pressure switch is adjusted to a differential pressure that will allow the switch to function during commissioning. Adjust each switch as necessary to get the switch to satisfy the burner management interlocks as necessary.

Provide initial adjustments to low and high gas pressure switches. Remove cover to low and high gas pressure switches, adjust low and high gas pressure switches to a safe pressure setting but one that will prevent nuisance trip during commissioning. These switches will be re-adjusted later but this initial adjustment should allow for burner ignition and testing.

Verify combustion air fan is interlocked with the burner management system. All system fans should be interlocked with the burner management system via a contactor auxiliary.

Verify the exhaust damper (if installed) is set to fully open. If the exhaust damper on the immersion tube is partially or fully closed, the pressures given in the catalog will not be correct.

Verify the immersion tube is fully immersed. If any portion of the tube is exposed, add liquid to the tank to fully cover it with a healthy safety factor to account for evaporation when commissioning the burner.

Verify low water level switch. Verify that the low water level switch is positioned so that the burner will shut down if the water gets below a point where the tube could be exposed. It is very important to test this switch prior to lighting the burner.

Verify any automatic tank fill valves are functioning properly. Having the automatic fill valve functioning will lessen the chance of the tube becoming exposed during commissioning.

Verify the combustion chamber pressure. Attached a manometer to the test connection on the combustion chamber when all system fans are running. Make note of this pressure for future use.

STAR|Ix – COMMISSIONING

Provide initial adjustments to pilot regulator and pilot air and gas adjusting orifice. Adjust pilot gas regulator to an outlet pressure between 12"wc and 28"wc static pressure. Remove cap from pilot gas adjusting orifice, turn adjusting screw clock-wise so it is all the way closed, then turn adjusting screw counter-clockwise so it is three turns open.

Verify initial adjustments to main gas regulator. Adjust main gas regulator to an outlet pressure between 20"wc and 60"wc static pressure.

Test main and blocking gas shut off valve proof of closure switches. This test should be done with the burner off, before attempting ignition for the first time. With all the manual gas valves closed, remove the main gas shut off valve actuator from the gas valve body and verify the burner management systems indicates a fault. Repeat this procedure for the blocking gas shut off valve. Contact Star Combustion for this test procedure when using Maxon brand shut off valves.

Test valve proving system, if used. Close downstream manual gas valve and attempt valve proving test, verify it indicates failure of the main gas shut off valve. Next, close upstream manual gas valve and attempt valve proving test, verify it indicates failure of the blocking gas shut off valve.

Set combustion air control valve at minimum position. Using the air fuel ratio controller, set the main combustion air control valve to fully closed. Refer to instructions for the air fuel ratio controller being used for further information on how to set this valve. If using the Star|Linc air/fuel ratio controller, this valve position is normally pre-set. There are holes in the combustion air control valve to allow the proper low fire air through when fully closed.

Verify the light off position switch is functioning. With the combustion air control valve at minimum position, verify the light off position switch cam is actuating the light off position switch, adjust if necessary.

Set combustion air control valve at maximum position. Using the air fuel ratio controller, set the main combustion air control valve so the combustion air static pressure reads the pressure shown on the capacities and specifications chart. This will normally be somewhere between 70% and the fully open position This should be done with all the system fans running. Refer to instructions for the air fuel ratio controller being used for further information on how to set this valve. If using the Star|Linc air/fuel ratio controller, this valve position is normally pre-set.

Verify the purge position switch is functioning. With the combustion air control valve at maximum position, verify the purge position switch cam is actuating the purge position switch, adjust if necessary.

Put the burner firing rate controller in manual to prevent unexpected firing rate changes during commissioning. Refer to instructions for the air fuel ratio controller being used for further information on how to place the air/fuel ratio controller or firing rate controller in manual mode.

If using a ratio regulator for air fuel ratio control, verify that high fire adjusting valve is fully open. Adjust this valve to fully open if necessary.

If using a ratio regulator for air fuel ratio control, set the minimum bypass screw to fully open.

If using a parallel positioning type of air fuel ratio controller, set the gas control valve at minimum to 5-10° open. Refer to instructions for the air fuel ratio controller being used for further information on how to set this valve.

Start the burner. If using a burner management control panel provided by Star Combustion Systems LLC, refer to the sequence of operation provided with that control panel for directions on how to start the burner. If burner management is not provided by Star Combustion Systems LLC, refer to the manufacturer's provided literature for instruction on how to start the burner.

Once the burner management system has verified all system interlocks, it will automatically go into a purge sequence. For applications that use the combustion air for purge, the air fuel ratio controller will requested to drive the combustion air control valve to maximum or purge position. This position must be proven with a purge position switch physically mounted to the Star|Ix burner, or from the air/fuel ratio controller purge position switch output. Some applications will alternatively use a purge air pressure switch for this feedback instead of a position switch.

The burner management system should be in the purge sequence for enough time to change the air in the immersion tube at least 4 times prior to light off. Refer to the system documentation for the setting of this purge time, if adjustable in the burner management controls.

STAR|Ix – COMMISSIONING

Once the purge is complete, the burner management system will request that the air fuel ratio controller drive both the combustion air control valve and the fuel control valve to minimum or light off position. This position must be proven with a light off position switch physically mounted to the Star|Ix burner, or from the air/fuel ratio controller light off position switch output.

Once light off position is proven, the burner management system will turn on the spark ignition transformer and also the pilot shut off valves (or main shut off valves if the system is set up for direct spark ignition.)

Once spark is established, the pilot (or minimum main flame in a direct spark system) should light within 2-3 seconds. If the pilot/main does not light within the pilot flame establishing period (normally 10 seconds), verify the manual gas shut off valves are on, verify the pilot/main gas pressure is adjusted to 12-28"wc above the combustion chamber pressure, and that the pilot gas adjusting orifice is 3 turns open. Also check that the pilot solenoid valves are wired correctly and are opening at the appropriate time.

Further, check for loose pilot gas connections, and obstructions in the pilot at the burner.

The pilot should be visible from the burner sight port and should be golf ball sized. If the flame is smaller or larger than a golf ball, adjust the pilot gas adjusting orifice accordingly.

Verify main flame. Once the pilot is established, the main gas valves should open and allow main gas to flow to the burner. IMPORTANT! Verify that the pilot flame is extinguished after the main flame establishing period, normally 10 seconds after the main gas valves are opened.

Once the burner management system has interrupted the pilot, visually verify the main flame is lit all the way around the base of the burner air nozzle and provides a good flame signal. Refer to the instructions for the burner management system for a definition of what a good flame signal should be.

Adjust the low fire flame. If using a ratio regulator for air/fuel ratio control, adjust the bias spring on top of the regulator clockwise to increase fuel and counter-clockwise to decrease fuel. If necessary, the low fire bypass gas also be adjusted to decrease the fuel. We do not recommend closing this bypass completely as it is used to get a repeatable low fire flame.

If using a parallel positioning system, refer to the ratio controller manual and adjust the gas control valve setting at minimum to obtain the correct flame.

With the burner ignited, re-verify the main gas regulator outlet pressure is between 12"wc and 28"wc and adjust accordingly.

Test burner interlocks. Once the main flame is established, all burner interlocks must be tested for proper operation and set according to the applicable fuel gas code instructions. **IMPORTANT! If there is a burner interlock failure during testing, the burner system should not be used until the interlock is repaired and verified working correctly. DO NOT ATTEMPT TO BYPASS A BURNER INTERLOCK FOR ANY REASON.**

With the burner on and at minimum fire, the interlocks should shut off the burner and the appropriate alarm should be displayed on the burner management controls. Manual intervention should be necessary to re-start the burner after an interlock failure.

- ◊ If present, test the high temperature limit controller(s) by bringing the set point below actual. The final set point of the controller(s) should be determined by the customer, and is/are normally set to protect the system and any process equipment downstream of the heater.
- ◊ Test the low gas pressure switch by bringing the set point below actual. The final setting of this switch should be determined by local fuel gas codes, normally 50% below the lowest manifold pressure measured at the switch (normally seen at high fire.)
- ◊ Test the high gas pressure switch by bringing the set point above actual. The final setting of this switch should be determined by local fuel gas codes, normally 50% above the highest manifold pressure measured at the switch (normally seen at low fire.)
- ◊ Test the low water level switch by manually actuating it. This switch should be set to actuate at a level that will protect the immersion tube from failure.

STAR|Ix – COMMISSIONING

- ◊ Test the combustion air pressure switch by disconnecting the upstream sending port. The final setting of this switch should be 50% below the lowest air manifold pressure measured at the switch (normally seen at high fire.)
- ◊ Test the flame sensor by shutting off the manual gas valve in the main fuel downstream of the shut off valves when the burner is ignited.
- ◊ Test the purge position switch by bringing the control valve or actuator to a low setting that the switch and attempt to purge the burner.
- ◊ Test the low position switch by bringing the control valve or actuator to a higher setting than the switch and attempting to ignite the burner. IMPORTANT! Close the pilot manual gas valve before attempting this test to prevent un-intended ignition.
- ◊ There may be more interlocks present, test those as necessary according to the instructions for the burner management system.

Set air and gas pressures at index positions. Once the burner has been ignited and all interlocks tested and verified working correctly, verify the system can handle additional temperature and heat load. IMPORTANT! Verify that the low water level switch is protecting the immersion tube from unintended overheating during commissioning.

Use a manometer with appropriate range to measure static combustion air at the combustion air test connection, and differential gas pressure across the metering orifice plate.

If using a ratio regulator, bring the burner firing rate to high fire and use the high fire adjusting valve to adjust the main gas pressure to the correct setting.

If using a parallel position system, such as the Star|Linc, use the charts provided with the Star|Ix burner to set combustion air and gas pressures according to each air fuel ratio controller index position. Refer to instructions for the air fuel ratio controller being used for further information on how to make these adjustments.

It is always a good idea to double check the air/fuel ratio settings using an oxygen analyzer at the outlet of the immersion tube. The oxygen content of the flue gas should read between 3-4%.

Once the differential pressures have been set at all firing rates, re-attached the actuator linkage, or place the air fuel ratio controller into automatic mode and verify proper burner firing rate control. The burner is now ready for operation and the temperature controls can be adjusted.

Once the tank and system reach full operating temperature/capacity, re-verify all pressures and set points on the burner interlocks. Remove all test equipment, replace all covers and record settings as necessary. It is always wise to keep good records of both burner settings and all interlock settings to refer back to during troubleshooting.

For more information contact:

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