STARCOMBUSTION SYSTEMS LLC

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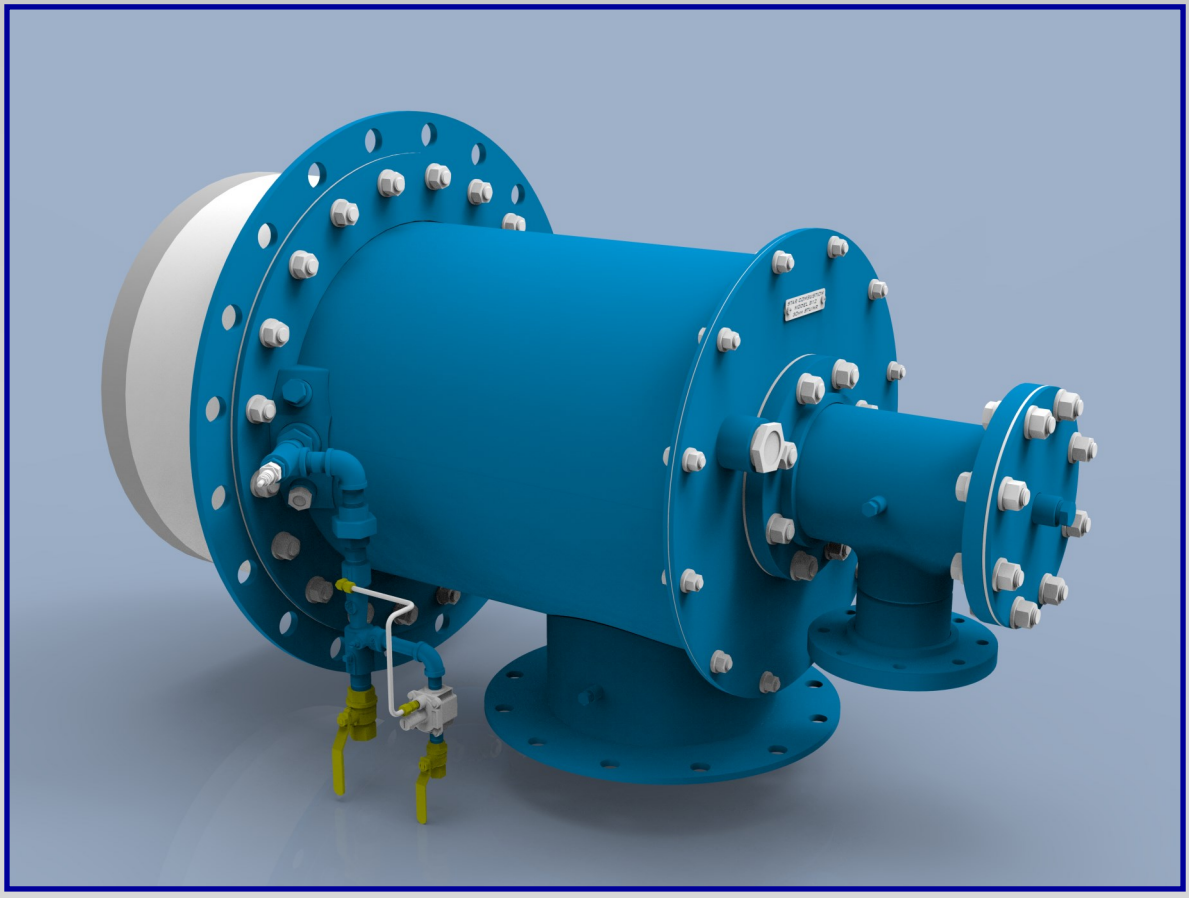
STAR | Bx

ALL PURPOSE, HIGH CAPACITY LOW OR HIGH TEMPERATURE BURNER



- ⇒ Flexible, all purpose design for low or high temperature applications
- ⇒ Low NOx and CO emissions
- ⇒ Excellent flame stability over a very wide range of air/fuel ratios from fuel rich to high excess air
- ⇒ Burner can operate using virtually any commercially available liquid or gaseous fuel including low btu waste fuels and heavy fuel oil
- ⇒ Mounting designed for an excellent seal in a wide variety of combustion chamber pressures

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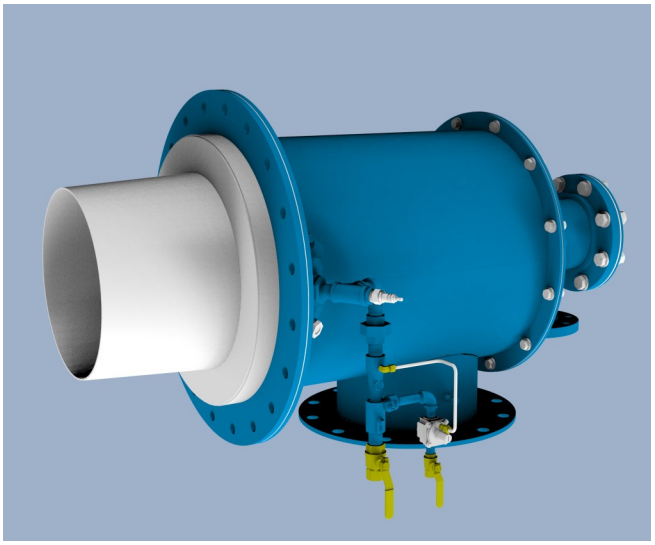
Features

The Star|Bx burner is an extremely flexible, all purpose burner designed for both low and high temperature applications. The burner's versatility makes it suitable for everything from a 200°F air heating application to a 2800°F furnace application.

- Sizes range from 3,000,000 btu/hr to 150,000,000 btu/hr with higher capacities available upon request
- The flame is very stable over a wide range of air/fuel ratios from excess air to fuel rich
- 15:1 turndown from maximum to minimum capacity when running on gas
- Burns any clean fuel gas including natural gas, propane gas, butane gas, propane/air mix, and many low btu waste fuels
- DF version adds liquid fuel capability to burn virtually any liquid fuel oil from #2 to #6/heavy fuel oil heated to <100SSU viscosity
- Up to 8:1 turndown from maximum to minimum capacity when running on liquid fuels
- Refractory burner tile available for high temperature applications
- Stainless steel burner tile available for low temperature applications
- Burner can be ignited via direct spark ignition for sizes B10x-xG and smaller
- Pilot ignition available on all burner sizes
- Flame sensing via UV scanner or flame ionization rod



Typical Applications

- Direct fired low or high temperature air heaters
- Direct fired high temperature furnaces
- Thermal oxidizers
- Rotary dryers
- Rotary kilns
- Fluid bed dryers
- Spray dryers
- Grain dryer
- All purpose design allows for use in virtually any low or high temperature application

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STAR | Bx–SPECIFICATIONS

Model Bx Burner Size	04	06	08	10	12	14
Maximum Capacity (million btu/hr HHV)	3.0	6.0	12.0	20.0	30.0	40.0
Minimum Capacity (million btu/hr HHV)	0.2	0.4	0.8	1.35	2.0	2.67
Combustion Air Differential Pressure ("wc)	28.0	28.0	28.0	28.0	28.0	28.0
Combustion Air Flow (scfh, 15% Excess Air)	32,373	64,799	129,598	215,997	323,996	431,994
Combustion Air Flow (scfm, 15% Excess Air)	540	1,080	2,160	3,600	5,400	7,200
Natural Gas Differential Pressure ("wc)	8.0	8.0	8.0	8.0	8.0	8.0
Natural Gas Flow (scfh, 1002 btu/ft^3, 0.6 sg)	2,994	5,988	11,976	19,960	29,940	39,920
Flame Length (ft)	6.0	8.0	10.0	12.0	15.0	16.0
Flame Diameter (ft)	1.5	2.0	3.0	4.0	4.0	4.5

Model Bx Burner Size	16	18	20	22	24	26
Maximum Capacity (million btu/hr HHV)	55.0	70.0	90.0	110.0	125.0	150.0
Minimum Capacity (million btu/hr HHV)	3.67	4.67	6.0	7.3	8.3	10.0
Combustion Air Differential Pressure ("wc)	28.0	28.0	28.0	28.0	28.0	28.0
Combustion Air Flow (scfh, 15% Excess Air)	593,992	755,990	971,987	1,187,984	1,349,993	1,619,989
Combustion Air Flow (scfm, 15% Excess Air)	9,900	12,600	16,200	19,800	22,500	27,000
Natural Gas Differential Pressure ("wc)	8.0	8.0	8.0	8.0	8.0	8.0
Natural Gas Flow (scfh, 1002 btu/ft^3, 0.6 sg)	54,890	69,860	89,820	109,780	124,751	149,701
Flame Length, approx (ft)	17.0	17.0	19.0	20.0	25.0	28.0
Flame Diameter, approx (ft)	5.0	5.0	5.0	5.0	5.0	6.0

Notes:

The above calculations are determined using the following data:

1) Flame lengths are approximate and are measured from the end of the combustion sleeve firing with 15% excess air on natural gas, consult Star Combustion for flame lengths using other fuels
2) Natural gas (Birmingham, AL) with HHV of 1002 btu/ft3, 0.6 specific gravity, and 9.41:1 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) To achieve full turndown of the burner, it should be set to run with 30% excess air at minimum capacity
5) Combustion differential air pressure shown is for the combustion air flow listed using 15% excess air

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STAR | Bx—MODEL NUMBER

STAR|B(I) (II) (III) - (IV) (V) (VI) - (VII) (VIII) (VIIII)

TABLE I - Burner Size

Abbreviation	Definition
04	3,000,000 btu/hr HHV
06	6,000,000 btu/hr HHV
08	12,000,000 btu/hr HHV
10	20,000,000 btu/hr HHV
12	30,000,000 btu/hr HHV
14	40,000,000 btu/hr HHV
16	55,000,000 btu/hr HHV
18	70,000,000 btu/hr HHV
20	90,000,000 btu/hr HHV
22	110,000,000 btu/hr HHV
24	125,000,000 btu/hr HHV
26	150,000,000 btu/hr HHV

TABLE II - Air Nozzle

Abbreviation	Definition
S	Stainless steel, applications <1800°F
R	Refractory, applications <2950°F

TABLE III - Fuel

Abbreviation	Definition
G	100% gaseous fuel
DF	Dual fuel - gas and oil

TABLE IV - Tile or Discharge Sleeve

Abbreviation	Definition
S	Stainless steel, applications <1800°F
R	Refractory, applications <2950°F
X	Customer supplied discharge sleeve/tile

TABLE V - Pilot Configuration

Abbreviation	Definition
D	Direct spark ignition, sizes B10 and smaller
P	Star|Bx pilot assembly, all sizes

TABLE VI - Flame Sensing

Abbreviation	Definition
FR	Flame ionization rod, stainless air nozzle only
UV	UV scanner, customer supplied

TABLE VII - Air Inlet Position

Abbreviation	Definition
UB	12:00 position, as viewed from back of burner
AUR	1:30 position, as viewed from back of burner
HR	3:00 position, as viewed from back of burner
ADR	4:30 position, as viewed from back of burner
DB	6:00 position, as viewed from back of burner
ADL	7:30 position, as viewed from back of burner
HL	9:00 position, as viewed from back of burner
AUL	10:30 position, as viewed from back of burner

TABLE VIII - Gas Inlet Position

Abbreviation	Definition
UB	12:00 position, as viewed from back of burner
AUR	1:30 position, as viewed from back of burner
HR	3:00 position, as viewed from back of burner
ADR	4:30 position, as viewed from back of burner
DB	6:00 position, as viewed from back of burner
ADL	7:30 position, as viewed from back of burner
HL	9:00 position, as viewed from back of burner
AUL	10:30 position, as viewed from back of burner

TABLE VIIII - Mounting Ring

Abbreviation	Definition
M	Include burner wall mounting ring with gaskets
X	Customer supplied mounting ring

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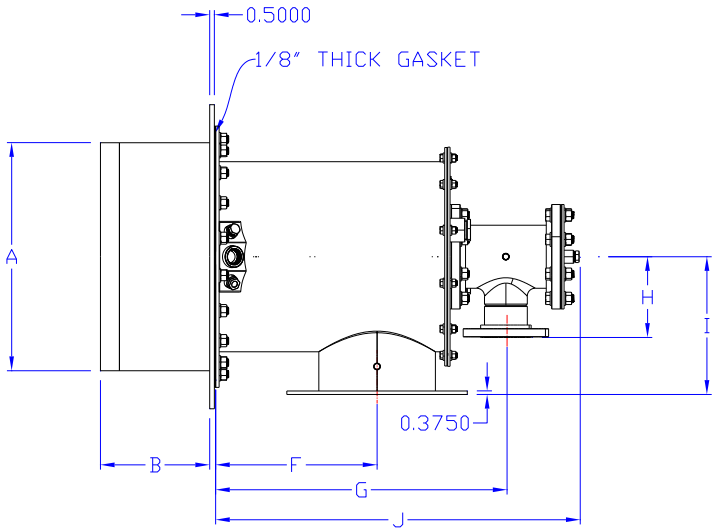
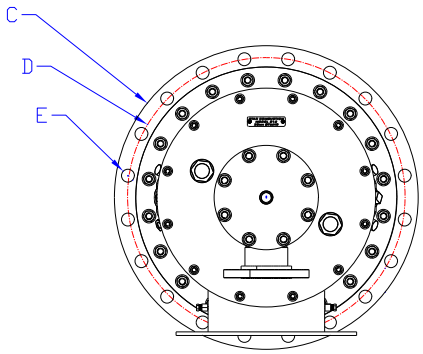
STAR | Bx–DIMENSIONS REFRACTORY TILE





Air inlet flanges conform to ANSI 125# FF dimensions

Gas inlet flanges are standard ANSI 150# RF flanges

Burner and tile mounting flanges conform to ANSI 125# FF dimensions

Size	A	B	C	D	E	#	F	G	H	I	J	Air Inlet Size	Gas Inlet Size
04	14.000	11.500	21.000	18.750	1.125	12	7.125	15.250	4.750	8.250	20.500	4”	2”
06	16.000	11.500	23.500	21.250	1.125	16	12.500	22.063	7.063	12.375	29.250	6”	3”
08	16.000	11.500	23.500	21.250	1.125	16	12.500	23.063	7.063	12.375	30.250	8”	3”
10	22.000	11.500	29.500	27.250	1.375	20	15.000	29.963	7.125	13.500	33.250	10”	3”
12	24.000	11.500	32.000	29.500	1.375	20	17.000	30.563	8.500	14.500	39.500	12”	4”
14	26.000	11.500	34.250	31.750	1.375	24	18.000	33.563	8.750	15.500	41.250	14”	6”
16	28.000	11.500	36.500	34.000	1.375	24	17.750	36.188	8.875	15.625	45.250	16”	6”
18	30.000	17.500	38.750	36.000	1.375	28	20.000	39.750	9.875	17.500	53.625	18”	6”
20	34.000	17.500	43.750	40.500	1.625	32	21.750	42.125	11.250	20.000	53.500	20”	6”
22	38.000	17.500	48.750	42.250	1.625	32	23.500	45.500	11.250	22.000	54.750	22”	6”
24	40.000	23.500	50.750	47.250	1.625	36	23.500	46.625	11.250	23.000	58.500	24”	6”
26	44.000	23.500	55.250	51.750	1.625	40	25.500	49.75	11.250	25.000	59.000	26”	6”

Dimension listed are for general use 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.

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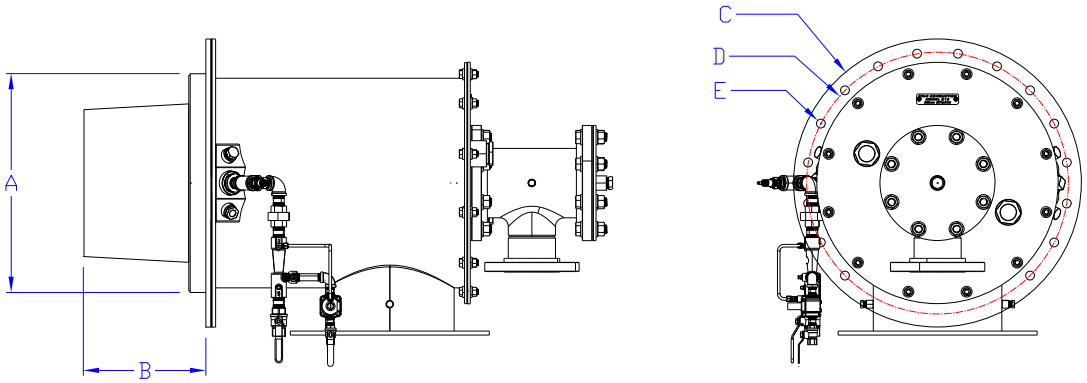
STAR | Bx–DIMENSIONS STAINLESS SLEEVE



Burner and tile mounting flanges conform to ANSI 125# FF dimensions

Size	A	B	C	D	E	#
04	10.563	11.500	16.000	14.250	1.000	12
06	12.563	11.500	19.000	17.000	1.000	12
08	12.563	11.500	19.000	17.000	1.000	12
10	18.563	11.500	25.000	22.750	1.250	16
12	20.563	11.500	27.500	25.000	1.250	20
14	22.563	11.500	29.500	27.250	1.375	20
16	24.563	11.500	23.000	29.500	1.375	20
18	26.563	17.500	34.250	31.750	1.375	24
20	30.563	17.500	38.750	36.000	1.375	28
22	34.563	17.500	43.750	40.500	1.625	32
24	36.563	23.500	46.000	42.750	1.625	32
26	40.563	23.500	50.750	17.250	1.625	36

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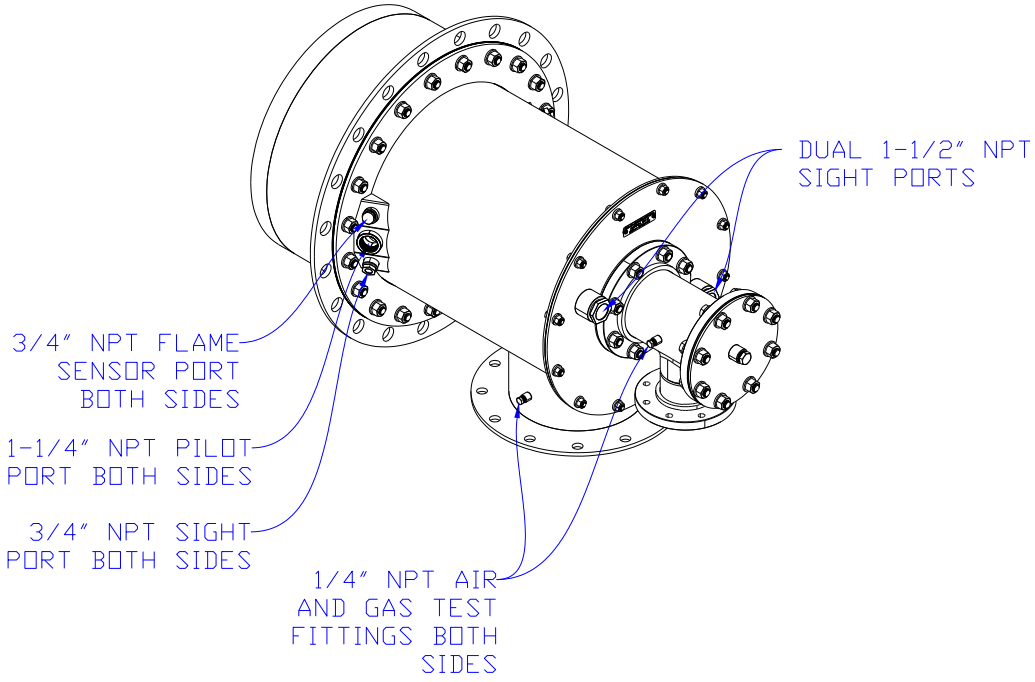

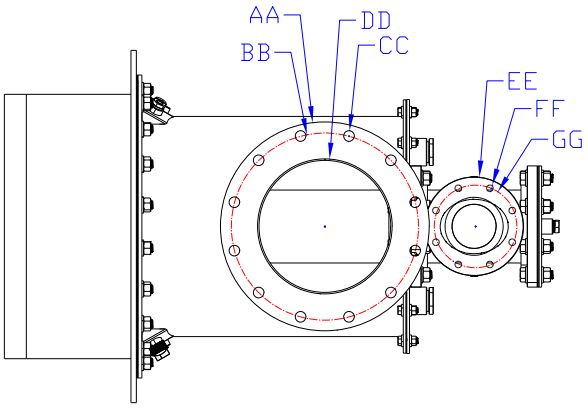

AIR AND GAS INLET FLANGE DIMENSIONS

Size	AA	BB	CC	#	DD	EE	FF	GG	#
04	9.000	7.500	0.750	8	4.500	6.000	4.750	0.750	4
06	11.000	9.500	0.875	8	6.625	7.500	6.000	0.750	4
08	13.500	11.750	0.875	8	8.625	7.500	6.000	0.750	4
10	16.000	14.250	1.000	12	10.750	7.500	6.000	0.750	4
12	19.000	17.000	1.000	12	12.750	9.000	7.500	0.750	8
14	21.000	18.50	1.125	12	14.000	11.000	9.500	0.875	8
16	23.500	21.250	1.125	16	16.000	11.000	9.500	0.875	8
18	25.000	22.750	1.250	16	18.000	11.000	9.500	0.875	8
20	27.500	25.000	1.250	20	20.000	11.000	9.500	0.875	8
22	29.500	27.250	1.375	20	22.000	11.000	9.500	0.875	8
24	32.000	29.500	1.375	20	24.000	11.000	9.500	0.875	8
26	34.250	31.750	1.375	24	26.000	11.000	9.500	0.875	8

Air inlet flanges conform to ANSI 125# FF dimensions

Gas inlet flanges are standard ANSI 150# RF flanges

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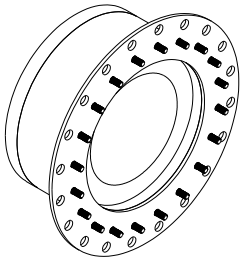
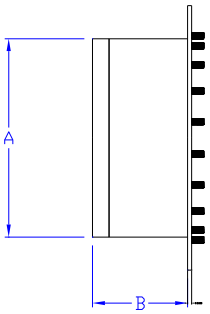
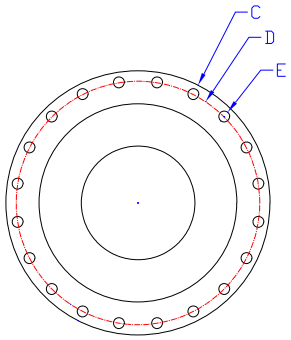




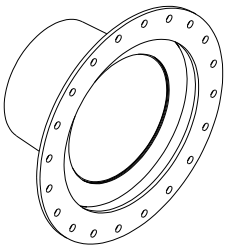


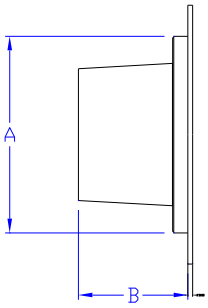
REFRACTORY TILE DIMENSIONS

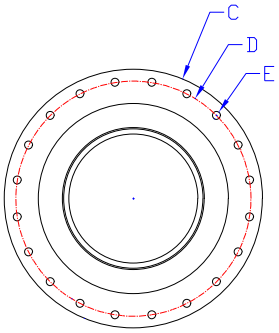
Size	A	B	C	D	E	#
04	14.000	11.500	21.000	18.750	1.125	12
06	16.000	11.500	23.500	21.250	1.125	16
08	16.000	11.500	23.500	21.250	1.125	16
10	22.000	11.500	29.500	27.250	1.375	20
12	24.000	11.500	32.000	29.500	1.375	20
14	26.000	11.500	34.250	31.750	1.375	24
16	28.000	11.500	36.500	34.000	1.375	24
18	30.000	17.500	38.750	36.000	1.375	28
20	34.000	17.500	43.750	40.500	1.625	32
22	38.000	17.500	48.750	42.250	1.625	32
24	40.000	23.500	50.750	47.250	1.625	36
26	44.000	23.500	55.250	51.750	1.625	40

STAINLESS STEEL SLEEVE DIMENSIONS

Size	A	B	C	D	E	#
04	10.563	11.500	16.000	14.250	1.000	12
06	12.563	11.500	19.000	17.000	1.000	12
08	12.563	11.500	19.000	17.000	1.000	12
10	18.563	11.500	25.000	22.750	1.250	16
12	20.563	11.500	27.500	25.000	1.250	20
14	22.563	11.500	29.500	27.250	1.375	20
16	24.563	11.500	23.000	29.500	1.375	20
18	26.563	17.500	34.250	31.750	1.375	24
20	30.563	17.500	38.750	36.000	1.375	28
22	34.563	17.500	43.750	40.500	1.625	32
24	36.563	23.500	46.000	42.750	1.625	32
26	40.563	23.500	50.750	17.250	1.625	36







Burner and tile mounting flanges conform to ANSI 125# FF dimensions

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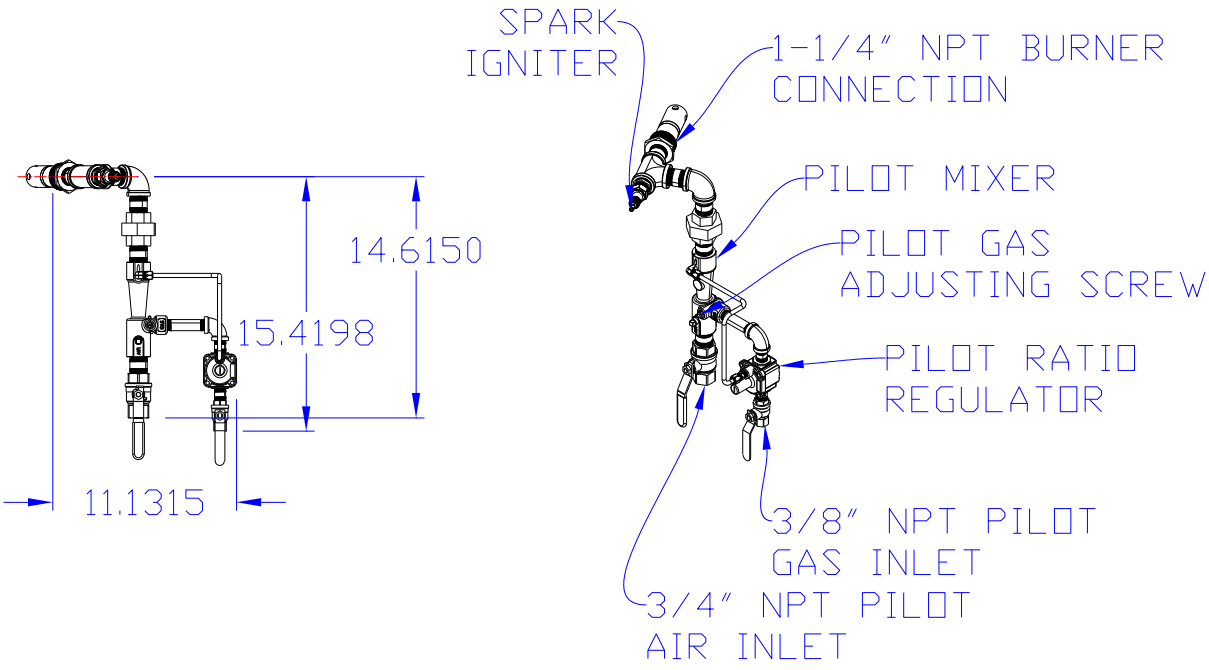
STAR | Bx–PILOT DATA



Please read all installation and commissioning instructions before proceeding with installation.

Supply pilot combustion air at 10"-60"wc. The Star|Bx Pilot burner is a premix pilot and requires combustion air for proper operation.

The Star|Bx Pilot capacity is approximately 100,000 btu/hr with a combustion air inlet pressure of 28"wc. The capacity will be higher with more combustion air pressure, and lower with less.

Supply pilot gas pressure to the pilot ratio regulator inlet at 14"wc -28"wc. Gas pressure should not exceed 28"wc or ratio regulator damage may result.

With constant combustion air to the mixer inlet, use the gas adjusting screw to adjust the pilot flame. It is sometimes easier to adjust the pilot with the pilot removed from the burner, firing into open air.

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STAR | Bx—INSTALLATION

Please read all installation and commissioning instructions before proceeding with installation.

***** 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.

The Star|Bx burner is an integral part of an industrial heating process. Combustion chamber, system fans, fuel train, burner management, temperature controls, high temperature limit, and corresponding ductwork must be supplied to compete the heating system for the equipment operation.

The Star|Bx may require external support. Use a support positioned near the back of the burner to the floor in instances where the heater wall is not robust enough to support the burner.

A wall gasket should be used between the burner tile or discharge sleeve and the heater wall. This is especially important for instances where there is a back pressure in the combustion chamber.

A flat surface between the burner tile flange and the heater wall is necessary to seal the burner in on high back pressure combustion chambers. A burner mounting ring with studs can be provided by Star Combustion Systems. This mounting ring comes with burner mounting studs pre-installed and is seal welded on to the combustion chamber wall.

The Star|Bx burner can be mounted and fired in any direction. If up firing the burner, care should be taken so that debris cannot fall into the burner and cause blockage of the air or gas nozzle.

Contact Star Combustion Systems LLC at +1-513-282-0810 or service@starcombustion.com for questions or further information.

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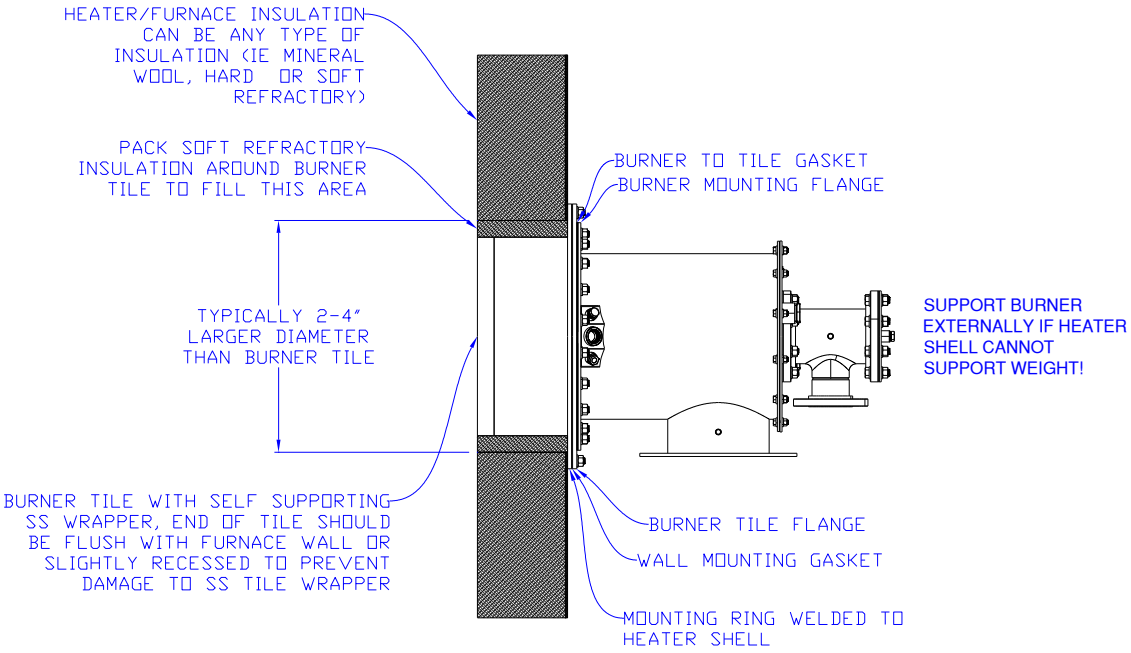
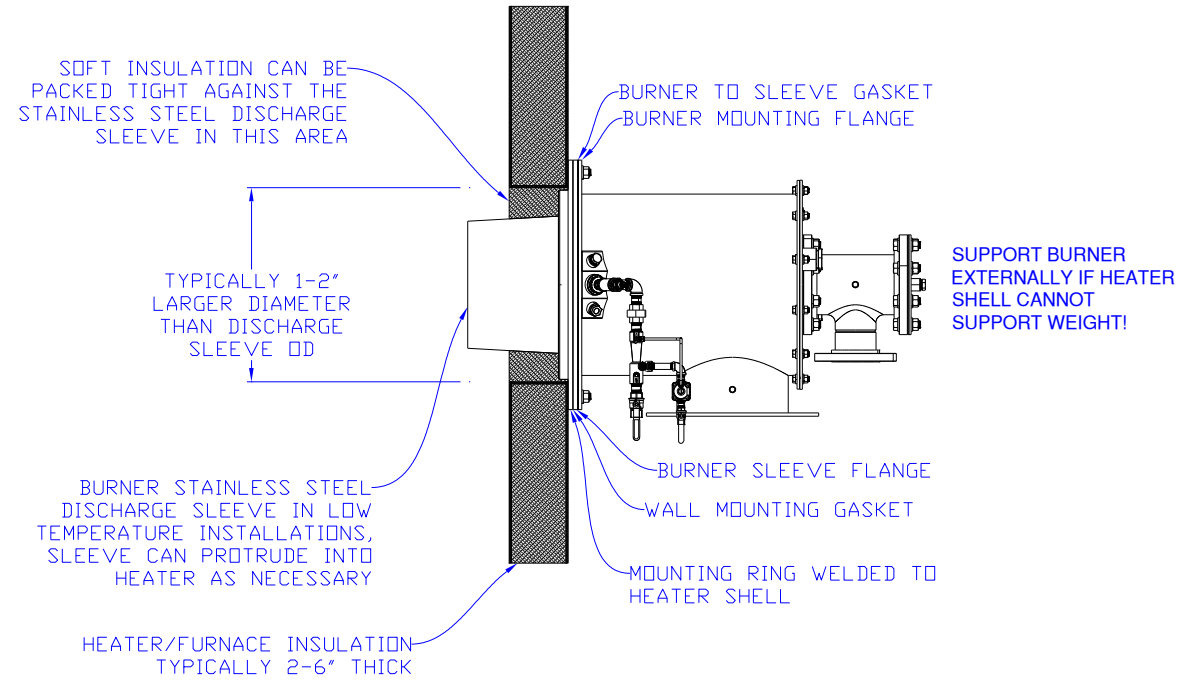
STAR | Bx–INSTALLATION

REFRACTORY TILE



STAINLESS STEEL DISCHARGE SLEEVE



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STAR | Bx—COMMISSIONING

***** IMPORTANT *****

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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|Bx 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 process, exhaust, and/or combustion air fans are operating properly and in the correct direction. Most fans will have a direction arrow to indicate correct direction. Bump each motor on for a second or so and observe the rotation direction, reverse the direction as necessary, according to the motor wiring.

Verify process air pressure switches are 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 all system fans are interlocked with the burner management system. All system fans should be interlocked with the burner management system via a contactor auxiliary or a VFD at speed contact.

Provide initial adjustment to high temperature limit controller(s). Verify the high temperature limit controller(s) is/are programmed for the appropriate sensor input and that the correct sensor is connected. The limit controller should be programmed to fault when a sensor is disconnected or faulty. A sensor test should be performed to verify the appropriate sensor is connected by disconnecting the sensor wires AT THE SENSOR END, then verifying the appropriate limit controller shows a disconnected sensor on the display. The set point of the controller(s) should be determined by the customer, and is/are normally set to protect the heater and any equipment downstream of the heater. Once this set point is determined, program this into the limit controller as necessary.

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.

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 above the combustion chamber 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.

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Verify initial adjustments to main gas regulator. Adjust main gas regulator to an outlet pressure between 12"wc and 28"wc higher than the combustion chamber 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 so the combustion air differential pressure, measured between the combustion air test connection and the combustion chamber, reads 0.3"wc at the minimum or lightoff position. Refer to instructions for the air fuel ratio controller being used for further information on how to set this valve.

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 differential pressure, measured between the combustion air test connection and the combustion chamber, reads 28"wc at the maximum or purge 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.

Put the burner firing rate controller in manual and verify it is at the minimum or lightoff firing rate position. 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.

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 air/fuel ratio controller air control valve, 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. For applications that do not use combustion air for purging, the burner management system will normally keep the combustion air control valve at minimum or lightoff position for purge.

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

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 lightoff position. This position must be proven with a lightoff position switch physically mounted to the air/fuel ratio controller gas control valve, or from the air/fuel ratio controller purge position switch output.

Once lightoff 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.) A spark will not be visible from the sight port of the burner.

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.

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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 a hard blue flame. If the flame is orange or transparent, 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.

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.

- ◊ 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 heater 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 process air pressure switch by disconnecting the upstream sensing port. The final setting of this switch should be 0.4”wc.
- ◊ 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 exhaust and other air pressure switches by bringing the set point below actual or disconnecting the sensing port(s). Final settings of these switches should be determined by the local fuel gas codes, normally 50% below the lowest pressure measured at the switch.
- ◊ 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 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 high temperature limit is protecting downstream equipment from unintended heating during commissioning. Some product load inside the process equipment may be necessary to absorb the heat and allow proper high fire gas adjustments.

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Use a manometer to measure differential combustion air and gas pressure between the combustion air pressure test connection and the downstream heater pressure connections, as well as the gas pressure test connection and the downstream heater pressure connection.

Use the charts provided in the following pages 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. 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.

Once the heater and system reach full operating temperature/capacity, re-verify all pressures and set points on the burner interlocks. 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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Star Combustion B04 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	200,000	200	0.0	12.2	2,442	41	0.2
10.0%	480,000	479	0.2	11.3	5,409	90	0.8
20.0%	760,000	758	0.5	10.8	8,208	137	1.8
30.0%	1,040,000	1038	1.0	10.8	11,232	187	3.4
40.0%	1,320,000	1317	1.5	10.8	14,256	238	5.4
50.0%	1,600,000	1597	2.3	10.8	17,280	288	8.0
60.0%	1,880,000	1876	3.1	10.8	20,304	338	11.0
70.0%	2,160,000	2156	4.1	10.8	23,328	389	14.5
80.0%	2,440,000	2435	5.3	10.8	26,352	439	18.6
90.0%	2,720,000	2715	6.6	10.8	29,376	490	23.1
100.0%	3,000,000	2994	8.0	10.8	32,400	540	28.0

Star Combustion B06 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	400,000	399	0.0	12.2	4,883	81	0.2
10.0%	960,000	958	0.2	11.3	10,819	180	0.8
20.0%	1,520,000	1517	0.5	10.8	16,416	274	1.8
30.0%	2,080,000	2076	1.0	10.8	22,464	374	3.4
40.0%	2,640,000	2635	1.5	10.8	28,512	475	5.4
50.0%	3,200,000	3194	2.3	10.8	34,560	576	8.0
60.0%	3,760,000	3752	3.1	10.8	40,608	677	11.0
70.0%	4,320,000	4311	4.1	10.8	46,656	778	14.5
80.0%	4,880,000	4870	5.3	10.8	52,704	878	18.5
90.0%	5,440,000	5429	6.6	10.8	58,751	979	23.0
100.0%	6,000,000	5988	8.0	10.8	64,799	1,080	28.0

The above calculations are determined using the following data:

1) Flame lengths are approximate and are measured from the end of the combustion sleeve firing with 15% excess air on natural gas, consult Star Combustion for flame lengths using other fuels
2) Natural gas (Birmingham, AL) with HHV of 1002 btu/ft3, 0.6 specific gravity, and 9.41:1 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) To achieve full turndown of the burner, it should be set to run with 30% excess air at minimum capacity
5) Combustion differential air pressure shown is for the combustion air flow listed using 15% excess air

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Star Combustion B08 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	800,000	798	0.0	12.2	9,767	163	0.2
10.0%	1,920,000	1916	0.2	11.3	21,637	361	0.8
20.0%	3,040,000	3034	0.5	10.8	32,832	547	1.8
30.0%	4,160,000	4152	1.0	10.8	44,928	749	3.4
40.0%	5,280,000	5269	1.5	10.8	57,023	950	5.4
50.0%	6,400,000	6387	2.3	10.8	69,119	1,152	8.0
60.0%	7,520,000	7505	3.1	10.8	81,215	1,354	11.0
70.0%	8,640,000	8623	4.1	10.8	93,311	1,555	14.5
80.0%	9,760,000	9741	5.3	10.8	105,407	1,757	18.5
90.0%	10,880,000	10858	6.6	10.8	117,503	1,958	23.0
100.0%	12,000,000	11976	8.0	10.8	129,599	2,160	28.0

Star Combustion B10 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	1,350,000	1347	0.0	12.2	16,482	275	0.2
10.0%	3,220,000	3214	0.2	11.3	36,288	605	0.8
20.0%	5,090,000	5080	0.5	10.8	54,971	916	1.8
30.0%	6,960,000	6946	1.0	10.8	75,167	1,253	3.4
40.0%	8,830,000	8812	1.6	10.8	95,363	1,589	5.5
50.0%	10,700,000	10679	2.3	10.8	115,559	1,926	8.0
60.0%	12,570,000	12545	3.2	10.8	135,755	2,263	11.1
70.0%	14,440,000	14411	4.2	10.8	155,951	2,599	14.6
80.0%	16,310,000	16277	5.3	10.8	176,146	2,936	18.6
90.0%	18,180,000	18144	6.6	10.8	196,342	3,272	23.1
100.0%	20,000,000	19960	8.0	10.8	215,998	3,600	28.0

The above calculations are determined using the following data:

1) Flame lengths are approximate and are measured from the end of the combustion sleeve firing with 15% excess air on natural gas, consult Star Combustion for flame lengths using other fuels
2) Natural gas (Birmingham, AL) with HHV of 1002 btu/ft3, 0.6 specific gravity, and 9.41:1 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) To achieve full turndown of the burner, it should be set to run with 30% excess air at minimum capacity
5) Combustion differential air pressure shown is for the combustion air flow listed using 15% excess air

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Star Combustion B12 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	2,000,000	1996	0.0	12.2	24,417	407	0.2
10.0%	4,800,000	4790	0.2	11.3	54,093	902	0.8
20.0%	7,600,000	7585	0.5	10.8	82,079	1,368	1.8
30.0%	10,400,000	10379	1.0	10.8	112,319	1,872	3.4
40.0%	13,200,000	13174	1.5	10.8	142,559	2,376	5.4
50.0%	16,000,000	15968	2.3	10.8	172,798	2,880	8.0
60.0%	18,800,000	18762	3.1	10.8	203,038	3,384	11.0
70.0%	21,600,000	21557	4.1	10.8	233,278	3,888	14.5
80.0%	24,400,000	24351	5.3	10.8	263,518	4,392	18.5
90.0%	27,200,000	27146	6.6	10.8	293,757	4,896	23.0
100.0%	30,000,000	29940	8.0	10.8	323,997	5,400	28.0

Star Combustion B14 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	2,670,000	2665	0.0	12.2	32,597	543	0.2
10.0%	6,410,000	6397	0.2	11.3	72,237	1,204	0.8
20.0%	10,150,000	10130	0.5	10.8	109,619	1,827	1.8
30.0%	13,890,000	13862	1.0	10.8	150,011	2,500	3.4
40.0%	17,630,000	17595	1.6	10.8	190,402	3,173	5.4
50.0%	21,370,000	21327	2.3	10.8	230,794	3,847	8.0
60.0%	25,110,000	25060	3.2	10.8	271,185	4,520	11.0
70.0%	28,850,000	28792	4.2	10.8	311,577	5,193	14.6
80.0%	32,590,000	32525	5.3	10.8	351,969	5,866	18.6
90.0%	36,330,000	36257	6.6	10.8	392,360	6,539	23.1
100.0%	40,000,000	39920	8.0	10.8	431,996	7,200	28.0

The above calculations are determined using the following data:

1) Flame lengths are approximate and are measured from the end of the combustion sleeve firing with 15% excess air on natural gas, consult Star Combustion for flame lengths using other fuels
2) Natural gas (Birmingham, AL) with HHV of 1002 btu/ft3, 0.6 specific gravity, and 9.41:1 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) To achieve full turndown of the burner, it should be set to run with 30% excess air at minimum capacity
5) Combustion differential air pressure shown is for the combustion air flow listed using 15% excess air

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Star Combustion B16 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	3,670,000	3663	0.0	12.2	44,805	747	0.2
10.0%	8,810,000	8792	0.2	11.3	99,284	1,655	0.8
20.0%	13,950,000	13922	0.5	10.8	150,659	2,511	1.8
30.0%	19,090,000	19052	1.0	10.8	206,170	3,436	3.4
40.0%	24,230,000	24182	1.6	10.8	261,682	4,361	5.4
50.0%	29,370,000	29311	2.3	10.8	317,193	5,287	8.0
60.0%	34,510,000	34441	3.1	10.8	372,705	6,212	11.0
70.0%	39,650,000	39571	4.2	10.8	428,216	7,137	14.6
80.0%	44,790,000	44701	5.3	10.8	483,728	8,062	18.6
90.0%	49,930,000	49830	6.6	10.8	539,239	8,987	23.1
100.0%	55,000,000	54890	8.0	10.8	593,995	9,900	28.0

Star Combustion B18 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	4,670,000	4661	0.0	12.2	57,014	950	0.2
10.0%	11,210,000	11188	0.2	11.3	126,331	2,106	0.8
20.0%	17,750,000	17715	0.5	10.8	191,698	3,195	1.8
30.0%	24,290,000	24242	1.0	10.8	262,330	4,372	3.4
40.0%	30,830,000	30768	1.6	10.8	332,961	5,549	5.4
50.0%	37,370,000	37295	2.3	10.8	403,592	6,727	8.0
60.0%	43,910,000	43822	3.1	10.8	474,224	7,904	11.0
70.0%	50,450,000	50349	4.2	10.8	544,855	9,081	14.5
80.0%	56,990,000	56876	5.3	10.8	615,486	10,258	18.6
90.0%	63,530,000	63403	6.6	10.8	686,118	11,435	23.1
100.0%	70,000,000	69860	8.0	10.8	755,993	12,600	28.0

The above calculations are determined using the following data:

1) Flame lengths are approximate and are measured from the end of the combustion sleeve firing with 15% excess air on natural gas, consult Star Combustion for flame lengths using other fuels
2) Natural gas (Birmingham, AL) with HHV of 1002 btu/ft3, 0.6 specific gravity, and 9.41:1 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) To achieve full turndown of the burner, it should be set to run with 30% excess air at minimum capacity
5) Combustion differential air pressure shown is for the combustion air flow listed using 15% excess air

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Star Combustion B20 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	6,000,000	5988	0.0	12.2	73,251	1,221	0.2
10.0%	14,400,000	14371	0.2	11.3	162,280	2,705	0.8
20.0%	22,800,000	22754	0.5	10.8	246,238	4,104	1.8
30.0%	31,200,000	31138	1.0	10.8	336,957	5,616	3.4
40.0%	39,600,000	39521	1.5	10.8	427,676	7,128	5.4
50.0%	48,000,000	47904	2.3	10.8	518,395	8,640	8.0
60.0%	56,400,000	56287	3.1	10.8	609,114	10,152	11.0
70.0%	64,800,000	64671	4.1	10.8	699,834	11,664	14.5
80.0%	73,200,000	73054	5.3	10.8	790,553	13,176	18.5
90.0%	81,600,000	81437	6.6	10.8	881,272	14,688	23.0
100.0%	90,000,000	89820	8.0	10.8	971,991	16,200	28.0

Star Combustion B22 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	7,300,000	7285	0.0	12.2	89,123	1,485	0.2
10.0%	17,570,000	17535	0.2	11.3	198,004	3,300	0.8
20.0%	27,840,000	27784	0.5	10.8	300,669	5,011	1.8
30.0%	38,110,000	38034	1.0	10.8	411,584	6,860	3.4
40.0%	48,380,000	48283	1.5	10.8	522,499	8,708	5.4
50.0%	58,650,000	58533	2.3	10.8	633,414	10,557	8.0
60.0%	68,920,000	68782	3.1	10.8	744,329	12,405	11.0
70.0%	79,190,000	79032	4.1	10.8	855,244	14,254	14.5
80.0%	89,460,000	89281	5.3	10.8	966,159	16,103	18.5
90.0%	99,730,000	99531	6.6	10.8	1,077,074	17,951	23.0
100.0%	110,000,000	109780	8.0	10.8	1,187,989	19,800	28.0

The above calculations are determined using the following data:

1) Flame lengths are approximate and are measured from the end of the combustion sleeve firing with 15% excess air on natural gas, consult Star Combustion for flame lengths using other fuels
2) Natural gas (Birmingham, AL) with HHV of 1002 btu/ft3, 0.6 specific gravity, and 9.41:1 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) To achieve full turndown of the burner, it should be set to run with 30% excess air at minimum capacity
5) Combustion differential air pressure shown is for the combustion air flow listed using 15% excess air

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Star Combustion B24 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	8,300,000	8283	0.0	12.2	101,331	1,689	0.2
10.0%	19,970,000	19930	0.2	11.3	225,051	3,751	0.8
20.0%	31,640,000	31577	0.5	10.8	341,709	5,695	1.8
30.0%	43,310,000	43224	1.0	10.8	467,744	7,796	3.4
40.0%	54,980,000	54870	1.5	10.8	593,779	9,896	5.4
50.0%	66,650,000	66517	2.3	10.8	719,813	11,997	8.0
60.0%	78,320,000	78164	3.1	10.8	845,848	14,097	11.0
70.0%	89,990,000	89810	4.1	10.8	971,883	16,198	14.5
80.0%	101,660,000	101457	5.3	10.8	1,097,918	18,299	18.5
90.0%	113,330,000	113104	6.6	10.8	1,223,953	20,399	23.0
100.0%	125,000,000	124750	8.0	10.8	1,349,988	22,500	28.0

Star Combustion B26 Burner

Burner Firing Rate	Burner Capacity (btu/hr)	Gas Flow (scfh)	Gas Press Setting ("wc)	Desired Air Fuel Ratio (X:1)	Air Flow (scfh)	Air Flow (scfm)	Air Press Setting ("wc)
0.0%	10,000,000	9980	0.0	12.2	122,086	2,035	0.2
10.0%	24,000,000	23952	0.2	11.3	270,467	4,508	0.8
20.0%	38,000,000	37924	0.5	10.8	410,396	6,840	1.8
30.0%	52,000,000	51896	1.0	10.8	561,595	9,360	3.4
40.0%	66,000,000	65868	1.5	10.8	712,793	11,880	5.4
50.0%	80,000,000	79840	2.3	10.8	863,992	14,400	8.0
60.0%	94,000,000	93812	3.1	10.8	1,015,191	16,920	11.0
70.0%	108,000,000	107784	4.1	10.8	1,166,389	19,440	14.5
80.0%	122,000,000	121756	5.3	10.8	1,317,588	21,960	18.5
90.0%	136,000,000	135729	6.6	10.8	1,468,786	24,480	23.0
100.0%	150,000,000	149701	8.0	10.8	1,619,985	27,000	28.0

The above calculations are determined using the following data:

1) Flame lengths are approximate and are measured from the end of the combustion sleeve firing with 15% excess air on natural gas, consult Star Combustion for flame lengths using other fuels
2) Natural gas (Birmingham, AL) with HHV of 1002 btu/ft3, 0.6 specific gravity, and 9.41:1 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) To achieve full turndown of the burner, it should be set to run with 30% excess air at minimum capacity
5) Combustion differential air pressure shown is for the combustion air flow listed using 15% excess air