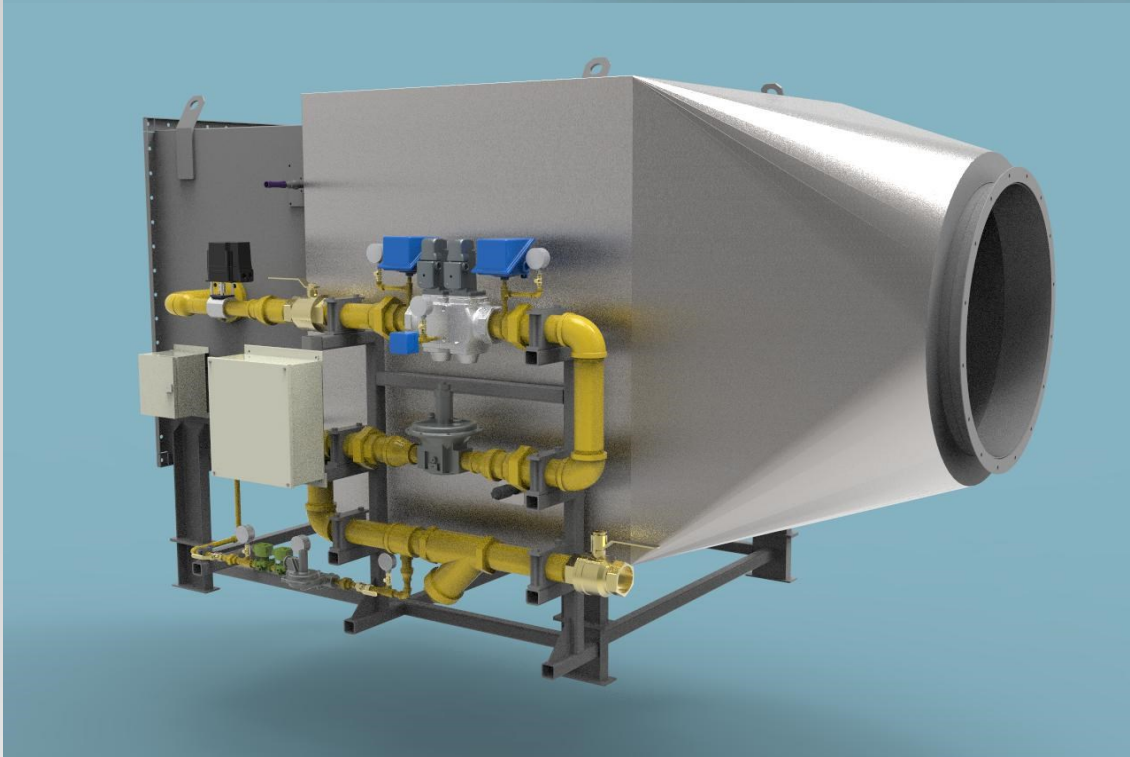
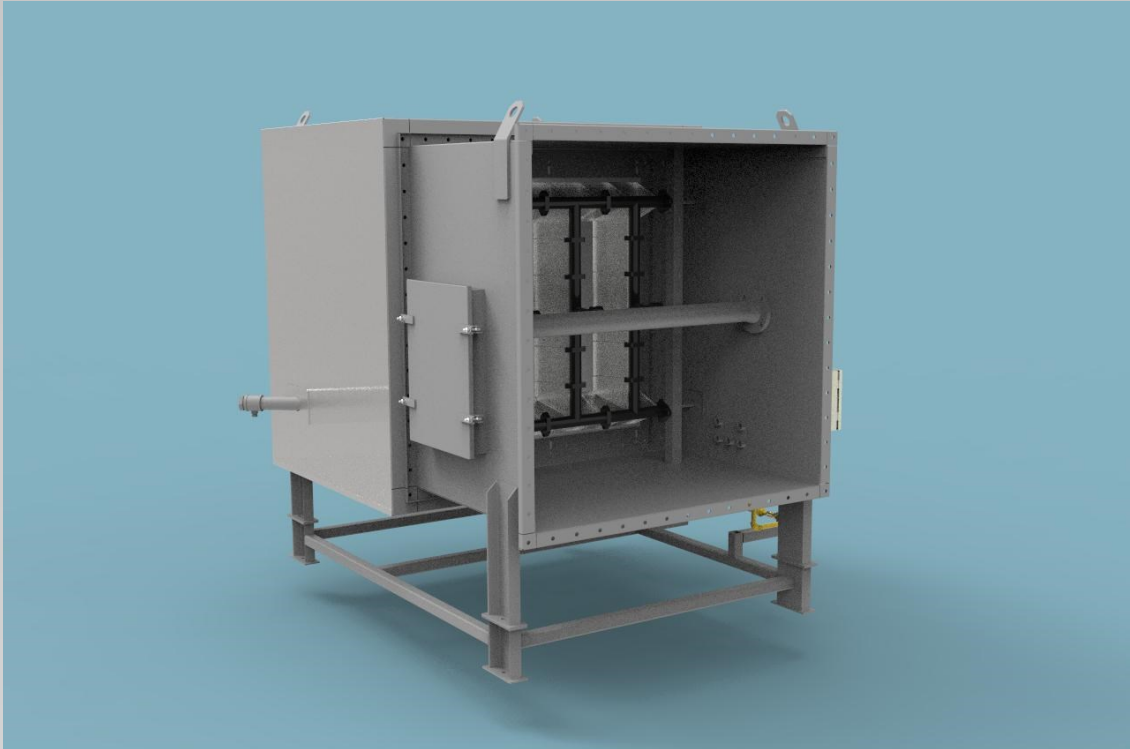




***STAR/HEATER TYPE F***  
***INDUSTRIAL PROCESS AIR HEATER***  
***TECHNICAL GUIDE***



## **STAR/HEATER**

### **TYPE F DIRECT FIRED PROCESS AIR HEATERS**

The StarHeater type F is a duct style process air heater that provides low or high temperature air for drying, baking, and curing processes. This packaged heater system comes in two pieces: the burner section housing the burner and fuel train, and the heater section to contain the flame. This heater system optionally comes with a burner management control system to provide flame safety, fault annunciation, and single or multi-loop PID temperature control. The StarHeater has 28 standard burner configurations ranging from 500,000 btu/hr to 62,500,000+ btu/hr. Burners are sized to fit the application, not the other way around.



### **QUALITY**



- \* Quality construction using robust 10 gauge mild or stainless steel for long lasting service
- \* High strength support legs with slotted mounting feet to allow for thermal expansion of heater body
- \* Weatherproof design to allow for outdoor or indoor installation
- \* A full set of adjustable profile plates are included with each heater to allow for field adjustments to changes in process air flow
- \* 800°F heat resistant coating provided on all mild steel components
- \* 4" thick mineral wool insulation with 16 gauge galvanized insulation skin is provided on heater section. The insulation and skin is designed to allow for thermal expansion and watershed
- \* Sight port included for visual inspection of the spark, pilot flame and main flame to allow for easy maintenance and commissioning
- \* Welded main gas header is generously sized to provide proper gas distribution and temperature uniformity
- \* 6000 volt full wave ignition transformer is mounted inside weatherproof enclosure to provide protection and long service life
- \* Pressure taps to measure upstream air, downstream air and differential gas pressure provided to allow for ease of maintenance and commissioning
- \* Included process air pressure switch measures differential pressure across the burner to prove sufficient air flow



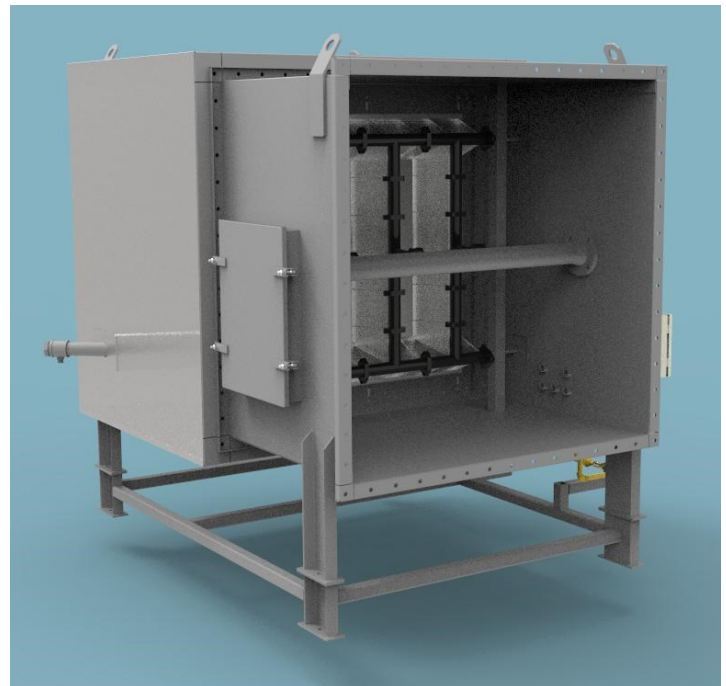
Front of **STARHEATER**<sup>®</sup>

## **PERFORMANCE**

- \* 30:1 burner turndown allows for application flexibility
- \* 13 standard sizes ranging from 18" diameter round to 90" square
- \* Standard process air flow capability up to 84,300 standard ft<sup>3</sup>/min (scfm) and beyond
- \* Outlet temperatures to 1200°F and beyond allow for more efficient drying capability in certain applications
- \* Duct static pressure capability to 28"wc and beyond make the StarHeater perfectly suited for fluidized bed drying applications
- \* Inlet air temperatures to 650°F and beyond allow for heat recovery to be used, providing lower operating costs

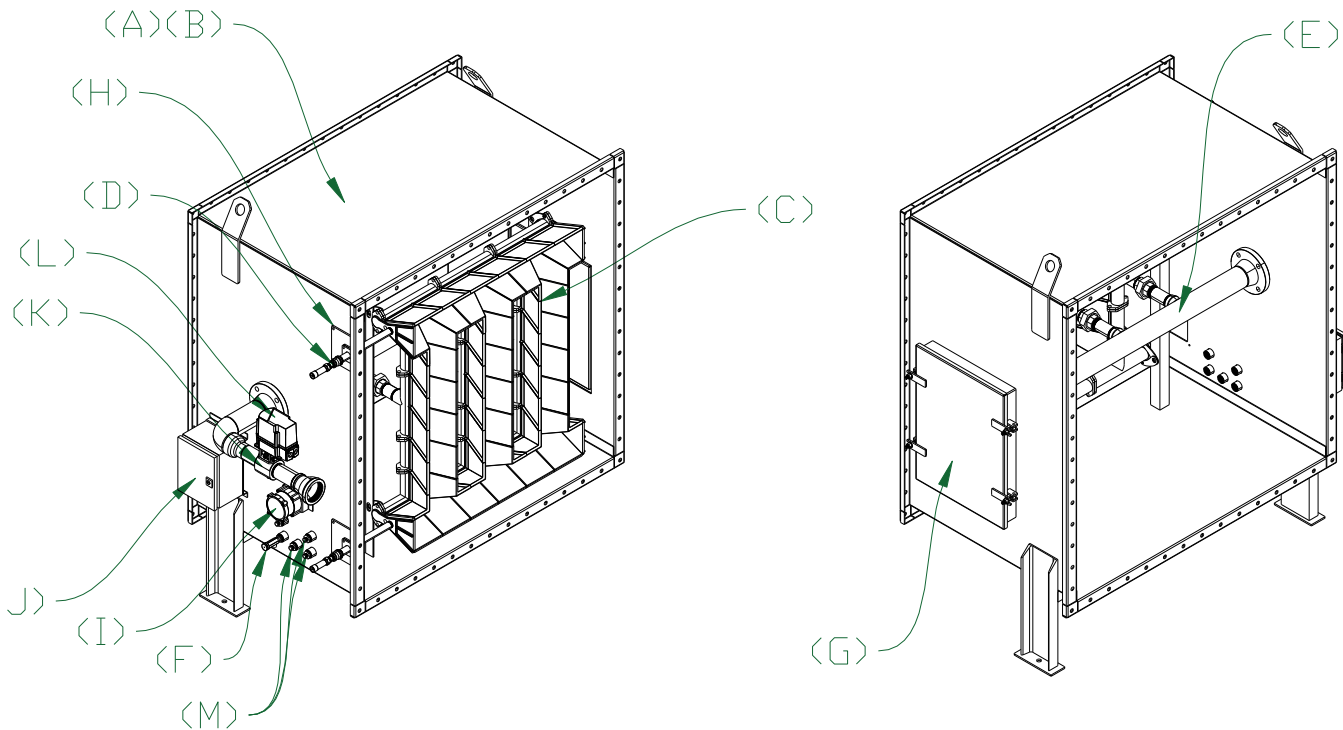
## **VALUE**

- \* Direct fired burner uses the process air for combustion, no combustion air fan required. This saves on both installation and operating cost while providing a more flexible design
- \* Burner or heater section can be inter-changed in the field without replacing the entire heater
- \* Lifting lugs to allow for ease of installation and maintenance
- \* Quick open man way access hatch included to allow for easy service and adjustment of burner and profile plates
- \* Externally mounted flame sensors to provide easy service and inspection
- \* Small side access hatch to allow service of spark igniter and related cabling without entering the heater
- \* Compact design allows for total heater lengths less than 96"



Back of **STARHEATER**<sup>®</sup>

## STAR/HEATER INLET SECTION CONSTRUCTION

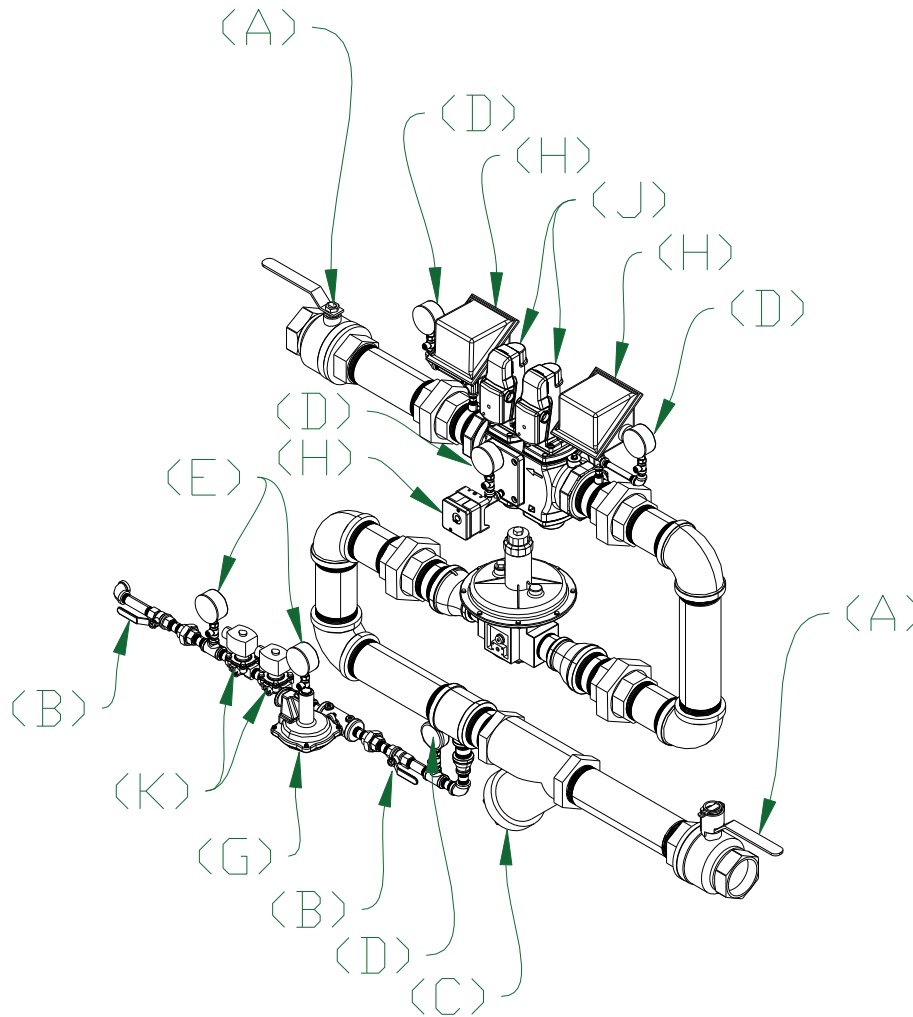


### INCLUDED COMPONENTS:

- (A) 10 gauge construction in mild, 304 stainless, or 316 stainless steel with inlet flange
- (B) Mild steel construction is coated with a robust 800°F heat resistant coating
- (C) Duct style burner configured to fit the heater size including spark igniter, flame sensor, and pilot (on burner sizes 050 and above)
- (D) UV scanner or flame ionization rod flame sensor. On size 030 and larger burners, dual flame sensors are used to prove flame propagation. When using UV scanners on heaters that are used more than 24hr/day, self check type is used
- (E) Main gas distribution header, welded/flanged
- (F) Pilot gas adjusting orifice on burner sizes 050 and above
- (G) 24" x 18" access hatch to inspect and adjust burner and profile plates
- (H) 6" x 6" access hatch(s) to inspect and replace spark igniter and flame sensors from the outside
- (I) Process air pressure switch to prove process air flow across the burner
- (J) 6000v full wave ignition transformer mounted inside NEMA 4 enclosure including duct feed through insulator and ignition cable/terminations
- (K) Main gas control valve assembly
- (L) High precision actuator direct coupled to main gas control valve (120VAC power, 4-20mA/0-10v analog input and output)
- (M) Test ports to monitor process air pressure as well as main gas pressure
- (N) Fuel train to meet all standards within North America including NFPA 86, Factory Mutual, CSA, and GE-GAP/IRI. Option available to meet EN-746/CE and Australian Gas Assoc standards



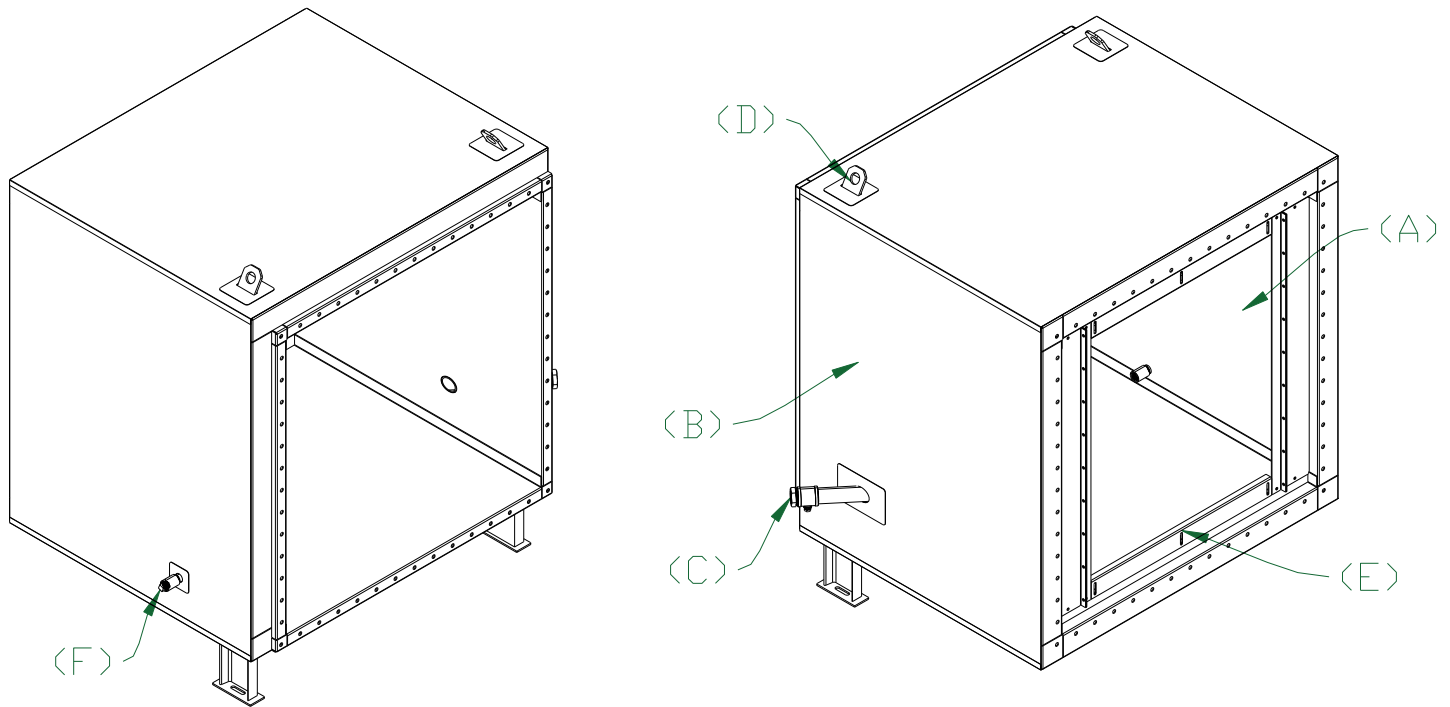
## STAR/HEATER FUEL TRAIN CONSTRUCTION



### INCLUDED COMPONENTS:

- (A) Inlet and outlet ball valve
- (B) Inlet and outlet pilot ball valve on burner sizes 050 and above
- (C) Inlet gas filter
- (D) Inlet, regulator, leak test, and outlet pressure gauge with isolation cock
- (E) Pilot regulator and pilot outlet pressure gauge with isolation cock on burner sizes 050 and above
- (F) Main gas regulator
- (G) Pilot gas regulator on burner sizes 050 and above
- (H) Low and high gas pressure switches
- (I) Valve proving pressure switch
- (J) Dual main gas shut off valves with visual indication and proof of closure switch
- (K) Dual pilot gas solenoid valves on burner sizes 050 and above

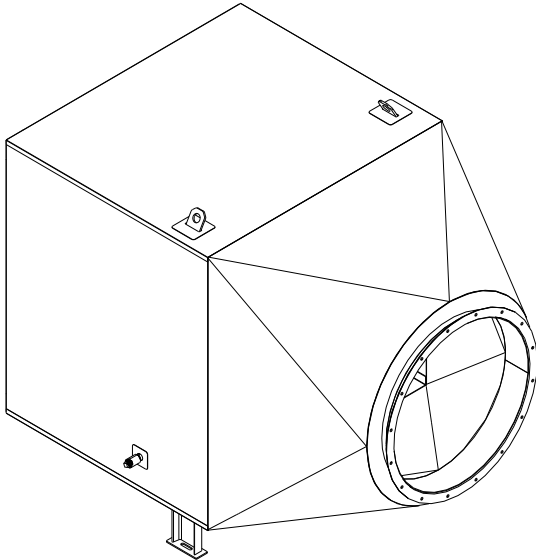
## STAR/HEATER OUTLET SECTION CONSTRUCTION



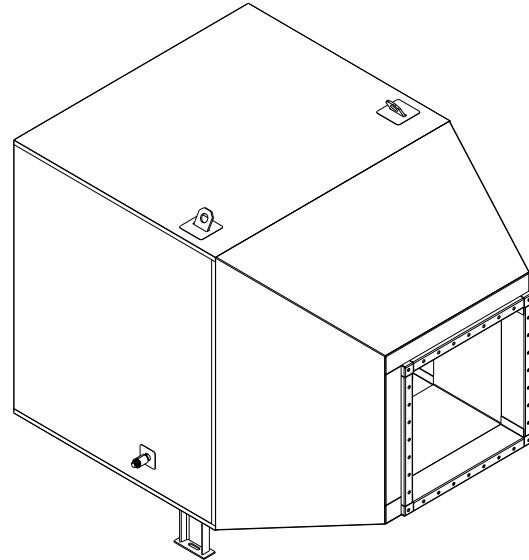
### INCLUDED COMPONENTS:

- (A) 10 gauge construction in mild, 304 stainless, or 321 stainless steel with full dimension outlet flange, square to round, or square to square reducer sections
- (B) 4" mineral wool insulation clad with .032" thick galvanized steel on STD and HTS heater sections, 6" internal refractory insulation on HTR heater section. When external insulation is applied, the heater "free floats" under the insulation skin, allowing the heater to expand and contract as normal without distorting the insulation
- (C) Sight port to allow clear view of spark, pilot, and main flame
- (D) Lifting lugs provided to for ease of installation
- (E) Adjustable burner profile plates to provide proper pressure drop and flow conditioning for duct burner
- (F) Pressure sensing port to sense pressure downstream of profile plate

## **STAR/HEATER OUTLET SECTION CONSTRUCTION**



**SQUARE TO ROUND REDUCED  
OUTLET OPTION**



**SQUARE TO SQUARE REDUCED  
OUTLET OPTION**

### **TYPE F STARHEATER AVAILABLE OPTIONS:**

- \* Square to round reduced outlet transition section with connecting flange
- \* Square to square reduced outlet transition section with connecting flange
- \* Square to rectangle reduced outlet transition section with connecting flange
- \* Other options available for heater outlet connections
- \* For low emissions or re-circulated air heater, use the Type R StarHeater
- \* Custom options available for insulation cladding, including stainless steel
- \* Custom stands available to raise heater centerline to match dryer inlet
- \* Flex connections available for process duct or dryer connection
- \* Perforated plates available to evenly distribute process air prior to burner
- \* Process air fans and fan to heater ductwork available to meet any application

## STAR/HEATER CAPACITIES AND SPECIFICATIONS

### Heater Specifications

Heater Size	Heater Outside Dimensions L x W (inches)	Nominal Air Flow Capacity (scfm) at normal velocity	Maximum Air Flow Capacity (scfm) at maximum velocity	Maximum Burner Size	Maximum Burner Capacity (btu/hr)
18	18 diameter	1,770	2,650	005	650,000
26	26 x 26	4,700	7,050	010	1,250,000
30	30 x 30	6,250	9,380	040	5,000,000
38	38 x 38	10,030	15,050	070	8,750,000
42	42 x 42	12,250	18,380	090	11,250,000
50	50 x 50	17,370	26,050	135	16,875,000
54	54 x 54	20,250	30,380	150	18,750,000
62	62 x 62	26,700	40,050	220	22,000,000
66	66 x 66	30,250	45,380	220	27,500,000
74	74 x 74	38,030	57,050	325	32,500,000
78	78 x 78	42,250	63,380	325	40,625,000
86	86 x 86	51,370	77,050	042	52,500,000
90	90 x 90	56,250	84,380	500	62,500,000

### Burner Section Specifications

	ST Inlet Section	HT Inlet Section
Maximum Inlet Temperature	250°F	500°F
Minimum Oxygen Content of Inlet Air	20.5%	20.5%
Minimum Air Velocity Across Burner (reduced max cap)	800 ft/min (0.05"wc DP)	800 ft/min (0.05"wc DP)
Maximum Air Velocity Across Burner	5000 ft/min (2.1"wc DP)	5000 ft/min (2.1"wc DP)
Materials of Construction	Mild Steel	304 Stainless Steel
Differential Gas Pressure, Natural Gas 1mm btuh/ft	13.9"wc	13.9"wc
Differential Gas Pressure, Natural Gas 1.25mm btuh/ft	21.7"wc	21.7"wc
Differential Gas Pressure, Propane Gas 1mm btuh/ft	5.3"wc	5.3"wc
Differential Gas Pressure Propane Gas 1.25mm btuh/ft	8.3"wc	8.3"wc
Minimum Supply Pressure to Fuel Train Inlet	3 psig	3 psig
Maximum Supply Pressure to Fuel Train Inlet	10 psig	10 psig

### Heater Section Specifications

	STX Outlet Section	HTX Outlet Section	HTR Outlet Section
Maximum Outlet Temperature	650°F	1000°F	1500°F
Insulation Type	External Mineral Wool	External Mineral Wool	Internal Refractory
Materials of Construction	Mild Steel	321 Stainless Steel	Mild Steel
Air Pressure Drop Through Heater at Max Air Flow	<2.0"wc	<2.0"wc	<2.0"wc
Expected NO <sub>x</sub> (lower emissions burners available)	<80 ppm at 3% O <sub>2</sub>	<80 ppm at 3% O <sub>2</sub>	<80 ppm at 3% O <sub>2</sub>
Expected CO (lower emissions burners available)	<300 ppm at 3% O <sub>2</sub>	<250 ppm at 3% O <sub>2</sub>	<200 ppm at 3% O <sub>2</sub>



## STAR/HEATER CAPACITIES AND SPECIFICATIONS

Burner Size	Burner Capacity at 1mm btuh/ft (btu/hr, HHV)	Burner Capacity at 1.25mm btuh/ft (btu/hr, HHV)	Minimum Burner Capacity (btu/hr, HHV)	Fuel Train Inlet Size
005	500,000	650,000	15,000	3/4" NPT
010	1,000,000	1,250,000	30,000	1" NPT
015	1,500,000	1,875,000	45,000	1" NPT
020	2,000,000	2,500,000	60,000	1-1/2" NPT
030	3,000,000	3,750,000	90,000	1-1/2" NPT
040	4,000,000	5,000,000	120,000	1-1/2" NPT
050	5,000,000	6,250,000	150,000	1-1/2" NPT
060	6,000,000	7,500,000	180,000	1-1/2" NPT
070	7,000,000	8,750,000	210,000	2" NPT
080	8,000,000	10,000,000	240,000	2" NPT
090	9,000,000	11,250,000	270,000	2-1/2" NPT
100	10,000,000	12,500,000	300,000	2-1/2" NPT
120	12,000,000	15,000,000	360,000	2-1/2" NPT
135	13,500,000	16,875,000	405,000	3" NPT
150	15,000,000	18,875,000	450,000	3" NPT
160	16,000,000	20,000,000	480,000	3" NPT
180	18,000,000	22,500,000	540,000	3" NPT
200	20,000,000	25,000,000	600,000	3" NPT
220	22,000,000	27,500,000	660,000	3" NPT
250	25,000,000	31,375,000	750,000	3" NPT
300	30,000,000	37,500,000	900,000	3" NPT
325	32,500,000	40,625,000	975,000	3" flanged
345	34,500,000	45,000,000	1,035,000	3" flanged
360	36,000,000	48,750,000	1,080,000	3" flanged
420	42,000,000	52,500,000	1,260,000	3" flanged
450	45,000,000	46,250,000	1,350,000	4" flanged
500	50,000,000	62,500,000	1,500,000	4" flanged

Capacities air based on 0.65 specific gravity natural gas with 1050 btu/ft<sup>3</sup> higher heating value.

Minimum capacities are based on air flow velocity across the burner of 3000 ft/min.

Flame will be completely contained within the heater when profile plates are adjusted with a minimum of 0.5"wc profile.

## STAR/HEATER MODEL NUMBER INTERPERETATION

StarHeater Type F TABLE (I) - TABLE (II) - TABLE (III) - TABLE (IV) - (TABLE V) - (TABLE VI) - (TABLE VII)

Example: StarHeater Type F54-NG-ST-HTX-DR-150-R

**TABLE I — Heater Size**

Heater Size	Dimensions	SCFM nominal	SCFM maximum	Max Burner Size
18	18" OD ROUND	1,765	2,650	005
26	26" x 26" OD	4,700	7,050	010
30	30" x 30" OD	6,250	9,380	040
38	38" x 38" OD	10,030	15,050	070
42	42" x 42" OD	12,250	18,380	090
50	50" x 50" OD	17,375	26,050	135
54	54" x 54" OD	20,250	30,380	150
62	62" x 62" OD	26,700	40,050	200
66	66" x 66" OD	30,250	45,380	220
74	74" x 74" OD	38,030	57,050	325
78	78" x 78" OD	42,250	63,380	325
86	86" x 86" OD	51,360	77,050	042
90	90" x 90" OD	56,250	84,380	500

**TABLE II—Fuel Type**

Abbreviation	Definition
NG	Natural Gas
PG	Propane Gas
BG	Mixed Gas with Butane
DG	Dual Natural and Propane Gas

**TABLE III—Burner Section Type**

Abbreviation	Definition
ST	Mild Steel (< 250°F inlet temp)
HT	304 Stainless Steel (< 500°F inlet temp)

**TABLE IV—Heater Section Type**

Abbreviation	Definition
STX	Standard design, external insulation (< 650°F outlet temp)
HTX	High temp design, external insulation (< 1000°F outlet temp)
HTR	High temp design, internal insulation (< 1500°F outlet temp)

**TABLE V—Fuel Train Mounting**

Abbreviation	Definition
DR	Fuel train mounted directly on right side of heater
DL	Fuel train mounted directly on left side of heater
RR	Fuel train remote mounted, inlet on right side of heater
RL	Fuel train remote mounted, inlet on left side of heater

**TABLE VI — Burner Size**

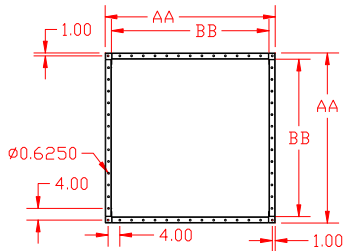
Burner Size	Nominal Burner Capacity (BTU/hr, HHV)	Maximum Burner Capacity (BTU/hr, HHV)
005	500,000	650,000
010	1,000,000	1,250,000
015	1,500,000	1,875,000
020	2,000,000	2,500,000
030	3,000,000	3,750,000
040	4,000,000	5,000,000
050	5,000,000	6,250,000
060	6,000,000	7,500,000
070	7,000,000	8,750,000
080	8,000,000	10,000,000
090	9,000,000	11,250,000
100	10,000,000	12,500,000
120	12,000,000	15,000,000
135	13,500,000	16,875,000
150	15,000,000	18,875,000
160	16,000,000	20,000,000
180	18,000,000	22,500,000
200	20,000,000	25,000,000
220	22,000,000	27,500,000
250	25,000,000	31,375,000
300	30,000,000	37,500,000
325	32,500,000	40,625,000
345	34,500,000	45,000,000
360	36,000,000	48,750,000
420	42,000,000	42,500,000
450	45,000,000	46,250,000
500	50,000,000	62,500,000

**TABLE VII - Outlet Transition Type**

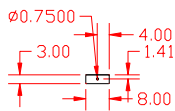
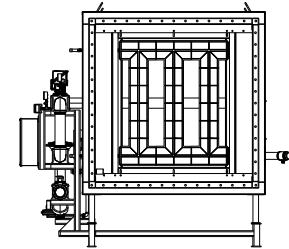
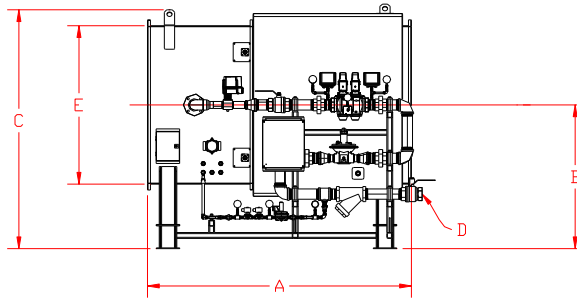
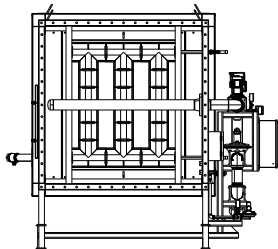
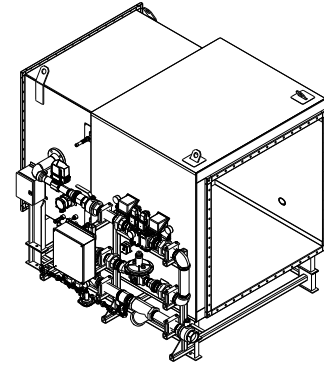
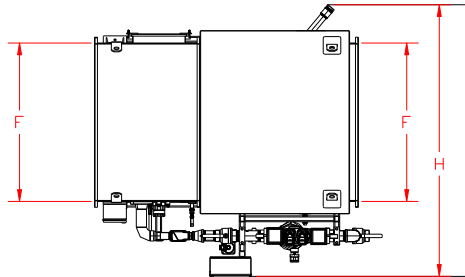
Abbreviation	Definition
F	Full dimension flanged outlet
R	Square to round transition outlet with flange
S	Square to square/rectangle transition outlet with flange
X	Special dimension outlet

## STAR/HEATER WITH OUTLET OPTION F DIMENSIONS

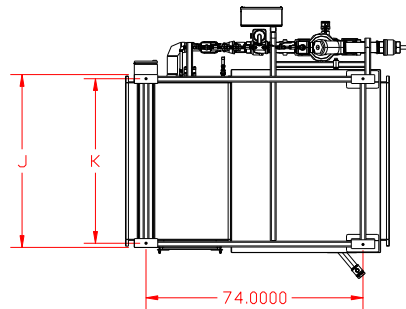
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INLET / OUTLET FLANGE



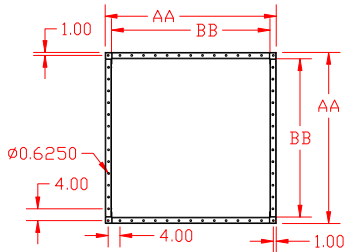
FOOT PLATE



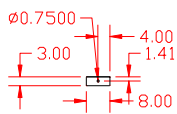
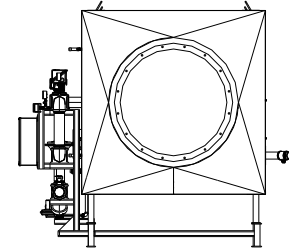
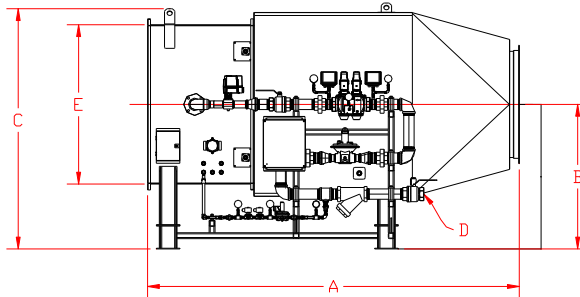
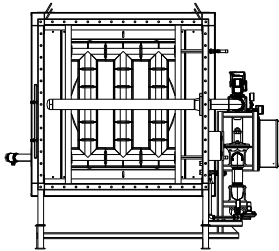
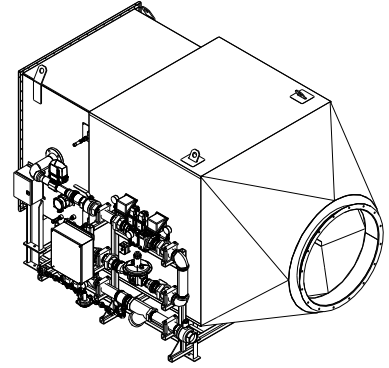
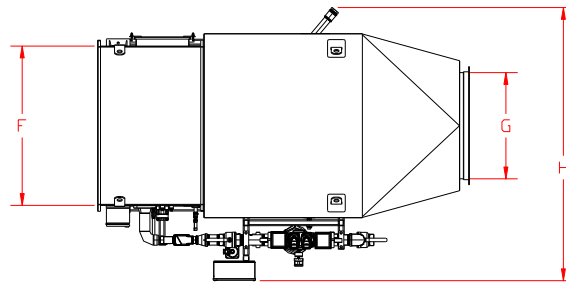
Heater Size	A	B	C	D	E	F	H	J	K	AA	BB
26	90	35	53.5	See page 9	26	26	65	30.92	28.105	30	26
30	90	37	57.5	See page 9	30	30	69	34.92	32.105	34	30
38	90	41	65.5	See page 9	38	38	77	42.92	40.105	42	38
42	90	43	69.5	See page 9	42	42	81	46.92	44.105	46	42
50	90	47	77.5	See page 9	50	50	89	54.92	52.105	54	50
54	90	49	81.5	See page 9	54	54	93	58.92	56.105	58	54
62	90	53	89.5	See page 9	62	62	101	66.92	64.105	66	62
66	90	55	93.5	See page 9	66	66	105	70.92	68.105	70	66
74	90	59	101.5	See page 9	74	74	113	78.92	76.105	78	74
78	90	61	105.5	See page 9	78	78	117	82.92	80.105	82	78
86	90	65	113.5	See page 9	86	86	125	90.92	88.105	90	86
90	90	67	117.5	See page 9	90	90	129	94.92	92.105	94	90

## STAR/HEATER WITH OUTLET OPTION R DIMENSIONS

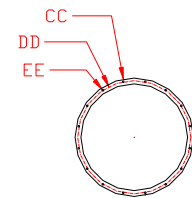
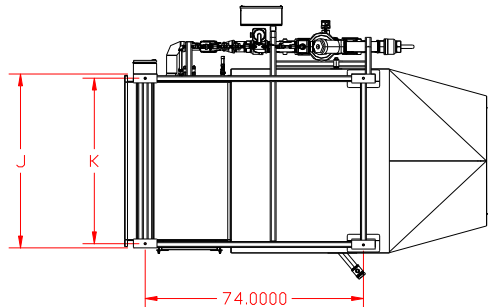
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INLET FLANGE



FOOT PLATE

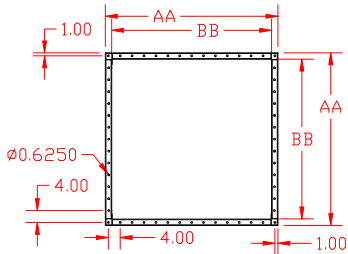


OUTLET FLANGE

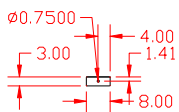
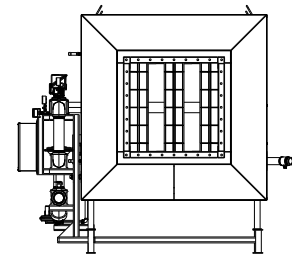
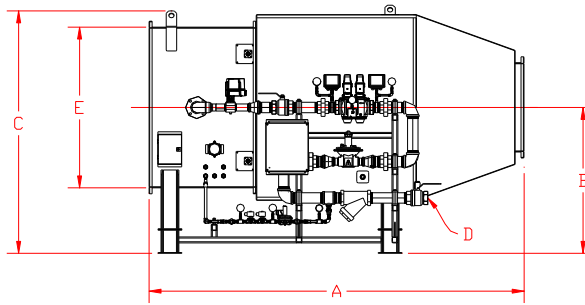
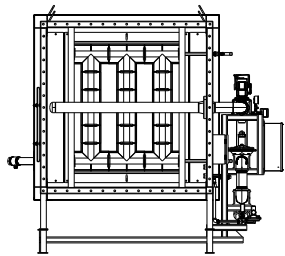
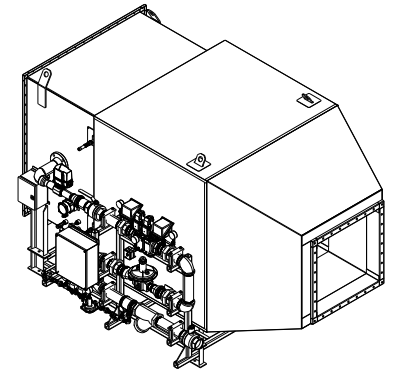
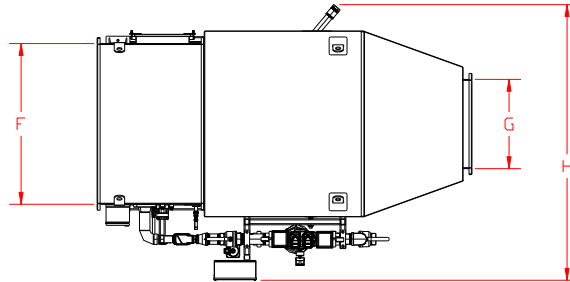
Heater Size	A	B	C	D	E	F	G	H	J	K	AA	BB	CC	DD	EE
26	126	35	53.5	See page 9	26	26	18	65	30.92	28.105	30	26	20.125	20	8 - 0.5"
30	126	37	57.5	See page 9	30	30	20	69	34.92	32.105	34	30	23.125	21.75	12 - 0.5"
38	126	41	65.5	See page 9	38	38	20	77	42.92	40.105	42	38	23.125	21.75	12 - 0.5"
42	126	43	69.5	See page 9	42	42	28	81	46.92	44.105	46	42	32.125	30.375	16 - 0.5"
50	126	47	77.5	See page 9	50	50	34	89	54.92	52.105	54	50	38.125	36.375	16 - 0.5"
54	126	49	81.5	See page 9	54	54	36	93	58.92	56.105	58	54	40.125	38.375	16 - 0.5"
62	126	53	89.5	See page 9	62	62	42	101	66.92	64.105	66	62	46.125	44.375	24 - 0.5"
66	126	55	93.5	See page 9	66	66	44	105	70.92	68.105	70	66	48.125	46.375	24 - 0.5"
74	126	59	101.5	See page 9	74	74	50	113	78.92	76.105	78	74	54.125	52.375	24 - 0.5"
78	126	61	105.5	See page 9	78	78	52	117	82.92	80.105	82	78	56.125	54.375	24 - 0.5"
86	126	65	113.5	See page 9	86	86	58	125	90.92	88.105	90	86	62.125	60.375	24 - 0.5"
90	126	67	117.5	See page 9	90	90	60	129	94.92	92.105	94	90	64.125	62.375	24 - 0.5"

## STAR/HEATER WITH OUTLET OPTION S DIMENSIONS

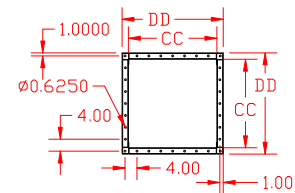
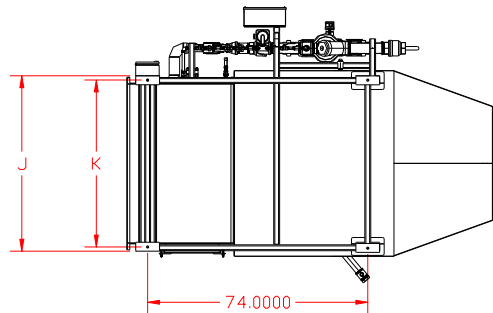
ALL DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED



INLET FLANGE



FOOT PLATE



OUTLET FLANGE

Heater Size	A	B	C	D	E	F	G	H	J	K	AA	BB	CC	DD
26	126	35	53.5	See page 9	26	26	18	65	30.92	28.105	30	26	16	20
30	126	37	57.5	See page 9	30	30	20	69	34.92	32.105	34	30	18	22
38	126	41	65.5	See page 9	38	38	20	77	42.92	40.105	42	38	22	26
42	126	43	69.5	See page 9	42	42	28	81	46.92	44.105	46	42	24	28
50	126	47	77.5	See page 9	50	50	34	89	54.92	52.105	54	50	30	34
54	126	49	81.5	See page 9	54	54	36	93	58.92	56.105	58	54	30	34
62	126	53	89.5	See page 9	62	62	42	101	66.92	64.105	66	62	36	40
66	126	55	93.5	See page 9	66	66	44	105	70.92	68.105	70	66	40	44
74	126	59	101.5	See page 9	74	74	50	113	78.92	76.105	78	74	44	48
78	126	61	105.5	See page 9	78	78	52	117	82.92	80.105	82	78	46	50
86	126	65	113.5	See page 9	86	86	58	125	90.92	88.105	90	86	50	54
90	126	67	117.5	See page 9	90	90	60	129	94.92	92.105	94	90	54	58



## STAR/HEATER INSTALLATION INSTRUCTIONS

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 type F StarHeater is an integral part of an industrial drying, curing, or heating process. System fans, burner management, temperature controls, high temperature limit, and corresponding ductwork must be supplied to compete the heating system for the drying, curing, or heating operation. Star Combustion provides these items to complete a turnkey package, contact Star Combustion and see literature under a separate cover for more details.

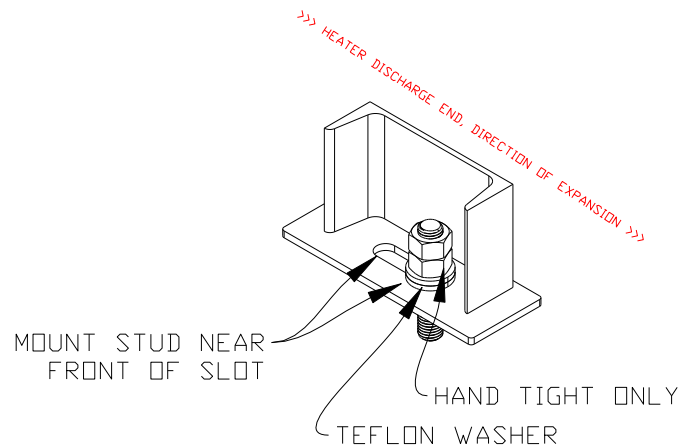
The StarHeater requires a fuel supply with a minimum of 3 psig pressure and a maximum of 10 psig pressure. If fuel supply pressure is greater than 10 psig, the system can be supplied with an appropriately sized regulator to bring the supply pressure within range. Contact Star Combustion if the fuel supply pressure is below 3 psig. Verify the fuel supply piping size is adequate for the pressure and flow required. Contact Star Combustion Systems LLC for assistance and review of supply piping if there is question.

A drip leg must be installed in the fuel supply line prior to the gas connection on the heater in order to meet applicable fuel gas piping codes.

The StarHeater will expand in the direction of the heated air outlet when at temperature. This is most prevalent in the type HTS outlet section when near the maximum operating temperature of 1000°F, and this expansion can be up to 1". All StarHeaters are provided with slotted mounting feet at the discharge end in order to let the heater expand as normal. The discharge end mount should not be fastened to the substrate tightly, but rather a nut should be installed hand tight, then a second nut should be tightened against the first in to keep it in place. The mounting stud should be

installed towards the front of the slot to allow movement in the discharge direction. The mounting substrate should allow the heater to move in the discharge direction, do not restrict movement of the heater legs/mounting pads. Do not use grout underneath mounting pads. See figure 1:

Figure 1: StarHeater Discharge end mounting arrangement



Lift the StarHeater using the lifting lugs or the designated lift points on the support frame only. Do not use a fork lift underneath the insulation skin, damage will result.

Each StarHeater comes standard with adjustable profile plates around the burner. These plates are factory adjusted for the airflow specified for the project. Prior to installation, check to verify the plates are still in the factory adjusted position and the bolts are securely in place.

Uniform airflow prior to the StarHeater is important in order to maintain proper airflow distribution around the burner and proper combustion. Non-uniform airflow can result in non-uniform temperature distribution downstream of the burner. Contact Star Combustion for a thorough review of the process air fan and ductwork to assure uniform airflow. Some things that can affect the airflow are; elbows in the ductwork prior to the burner, narrow width process air fans with impellers not installed in the middle of the fan casing. Star Combustion can provide perforated plates to be installed between the inlet flange of the heater or turning vanes in elbows to remedy non-uniform air flow prior to the burner.

## **STAR/HEATER INSTALLATION INSTRUCTIONS**

**Gaskets should be used between the flanges on the inlet and outlet of the heater.** Gaskets can be supplied by Star Combustion or a 1" wide high temperature rope gasket can be used. Alternatively, high temperature RTV sealant can be used.

**Every StarHeater is rated NEMA 3R / IP56 for outdoor use, no protection from the weather is necessary.** Care should be taken to prevent excessive material and debris from falling onto the StarHeater.

**The ambient temperature rating of every StarHeater is -20 °F to 120 °F.** Modifications can be made to the standard StarHeater package to account for -40 °F ambient conditions, contact Star Combustion for more details.

**The outlet flange of the StarHeater should be connected to a flexible connection that will allow the heater to expand up to 1" towards the discharge end of the heater.** A high temperature thermal expansion joint can be designed and supplied with the StarHeater, or can be supplied by the customer.

**Care should be taken when installing the StarHeater to assure the access hatch and fuel train components remain accessible for service.**

**Contact Star Combustion Systems LLC at +1-513-282-0810 for questions or further information.**

## STAR/HEATER COMMISSIONING INSTRUCTIONS

### \*\*\* 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.

Once proper installation has been verified, including a 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 StarHeater fuel train inlet, all system fans have been tested and are rotating in the correct direction, and that all wiring between the StarHeater and burner management system is 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 between 3 and 10 psig. DO NOT ATTEMPT TO LIGHT BURNER IF FUEL SUPPLY PRESSURE IS GREATER THAN 10 PSIG, DAMAGE TO REGULATOR MAY RESULT. Contact Star Combustion Systems for further instruction if fuel supply pressure is not within range.

Verify profile plate adjustment. The profile plates around the burner are installed to create a pressure drop around the burner, forcing process air through the burner mixing plate holes. This air is used for combustion air, so it is important to keep the process air pressure drop within proper range. With all system fans started and up to appropriate speed, use a manometer across the upstream

and downstream process air pressure test points on the StarHeater to verify that the pressure drop is between 1"wc and 2"wc. Pressure drops as low as 0.4"wc can be used, but a longer flame and potentially reduced burner capacity will result. While technically possible, Star Combustion does not recommend using process air pressure drops below 0.4"wc as there is potential for heater damage.

If pressure drop is not within the recommended range, stop all system fans, then take appropriate safety measures for a confined space entry into the heater. Remove the access hatch on the burner section to access the adjustable profile plates. Loosen the nuts securing the adjustable profile plates to the fixed profile plates, then adjust the top and bottom plates evenly (close them off if pressure drop is below the recommended range, open them up if pressure drop is above the recommended range.) It is important to keep the space between the top plate and the burner the same as that of the bottom plate and the burner. If there is significant difference, temperature non-uniformity can result. Additionally, verify that the adjustable profile plates are straight. If they are crooked, temperature non-uniformity can result.

Once the profile plates have been adjusted, tighten the nuts securing the adjustable profile plates to the fixed ones, then close the access hatch. Re-verify the pressure drop is within range after adjustment. If they are still out of range, re-adjust profile plates accordingly.

Verify process air pressure switch is adjusted to 0.4"wc minimum differential pressure. If adjusted higher, remove cover and change adjustment to 0.4"wc.

Provide initial adjustments to low and high gas pressure switches. Remove cover to low and high gas pressure switches, adjust low gas pressure switch to minimum setting, then adjust high gas pressure switch to 5psig or its maximum setting. These switches will be re-adjusted later, but this initial adjustment should allow for burner ignition and prevent a nuisance trip while commissioning.

## **STAR/HEATER COMMISSIONING INSTRUCTIONS**

**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 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.

**Put the burner firing rate controller in manual and verify it is at the minimum firing rate position.** Adjust the valve actuator or linkage so that the main gas control valve is approximately 15% open at the minimum firing rate position.

**Provide initial adjustments to pilot regulator and pilot gas adjusting orifice.** Adjust pilot gas regulator to an outlet pressure between 50"wc and 60"wc. 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 2 psig and 3 psig.

**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.

**Verify burner pilot and spark.** 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.

Spark should be visible from the sight port of the heater. If there is no visible spark, verify the ignition transformer wiring connections, and also the ignition feed through insulator are intact.

Once spark is established, the pilot should light within 2-3 seconds. If the pilot does not light within the pilot flame establishing period (normally 10 seconds), verify the manual gas shut off valves are on, verify the pilot gas pressure is adjusted to 50-60"wc, 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, obstructions in the pilot at the burner, and non-uniform airflow across the burner.

The pilot should be visible from the heater sight port and should be tennis ball sized. If the flame is smaller or larger than a tennis 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. Visually verify the main flame is lit all the way across the burner at low fire. The flame should look like a small zipper of flame at the base of the burner mixing plates and should not extend more than 1-2" from the burner face. If the flame is not lit all the way across or looks weak, adjust the main gas control valve open slightly. If the flame extends past the base of the burner more than 1-2", adjust the main gas control valve closed slightly.

**IMPORTANT!** Verify that the pilot flame is extinguished after the main flame establishing period, normally 10 seconds after the main gas valves are opened. The StarHeater must have an interrupted pilot in order to meet applicable fuel gas codes.

## STAR/HEATER COMMISSIONING INSTRUCTIONS

With the burner ignited, re-verify the main gas regulator outlet pressure is between 2 psig and 3 psig, 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/heater 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 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.
- ◇ 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.

**Set high fire gas pressure.** 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.

Use a manometer to measure differential gas pressure between the gas pressure test connection and the downstream heater pressure connection. Bring the main gas control valve to a fully open position either manually, or by using the firing rate controller in manual mode. Set the main gas differential pressure according to the pressure table below. Adjust the main gas regulator pressure accordingly to achieve the desired high fire differential gas pressure.

Burner	Differential pressure at nominal capacity	Differential pressure at maximum capacity
Midco HMA-2	13.9"wc natural gas	21.7"wc natural gas
Maxon NP-II	10.0"wc nat gas	15.6"wc natural gas

Once the differential pressure has been set at high fire, re-attached the actuator linkage, or place the firing rate controller into automatic mode and verify proposer burner firing rate control. The heater is now ready for operation.

Once the heater and system reach full operating temperature/capacity, verify the heater can properly expand in the direction of the outlet, adjust the mounting bolts as necessary.