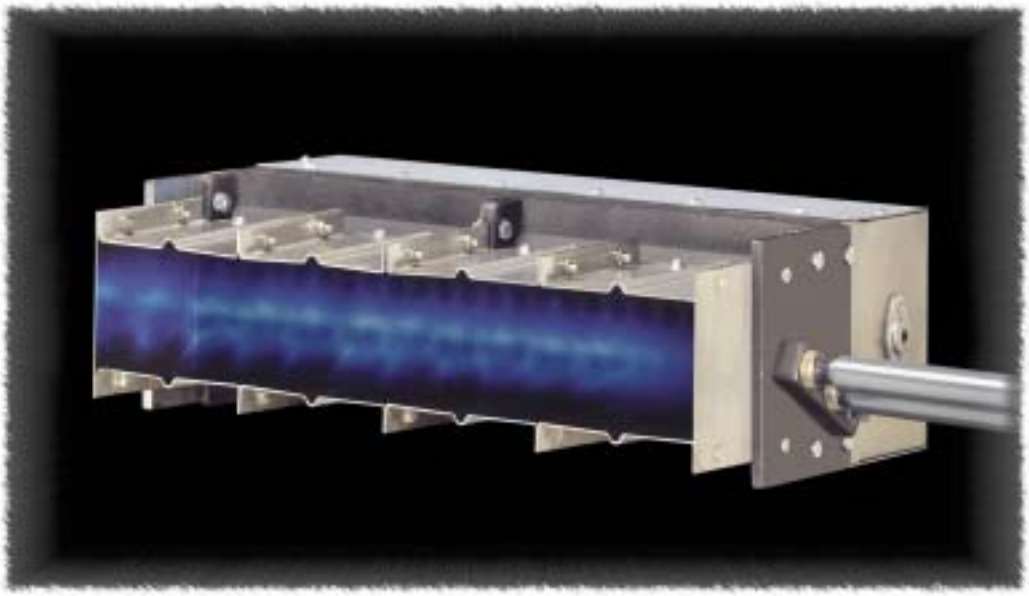
Maxon CROSSFIRE® Line Burner



- **Operational flexibility**
  - High moisture air streams
  - Low O_2 air streams
  - Highly inert air streams
  - Parallel velocities up to 4000 fpm, cross velocities up to 3000 fpm
- **Extremely low emissions** - NO_X levels of 25 ppm and CO levels of 250 ppm at 3% O_2 are possible. Contact your Maxon sales representative about your specific application.
- **Temperature uniformity** to enhance product quality
- **Up to 25:1 turndown** for process flexibility
- **High firing capacity** - up to 2,500,000 Btu/hr/ft (732 kW/ft)
- **Nozzle-mixing line burner** for use with low pressure natural gas firing
- **Also available in stainless steel housings and nickel-plated body versions**

MAXON®
CORPORATION 201 East 18th Street, P.O. Box 2068, Muncie, Indiana, 47307-0068. Phone: (765) 284-3304. Fax: (765) 286-8394

Maxon CROSSFIRE® Line Burner

Design and Application Details

Maxon CROSSFIRE® Burners are nozzle-mixing, modular line burners designed for a variety of fresh and recirculated air process heating applications. The burner is available in a variety of arrangements, including straight, grid and ladder sections. An external blower supplies combustion air.

The CROSSFIRE® Burner is primarily used for in-duct firing. The CROSSFIRE® Burner can be designed within a system to allow for up to 2,500,000 Btu/hr/ft (732 kW/ft). The maximum fuel pressures and air pressures required for varying maximum firing loads are described in the table below.

Test Connection Pressures

Maximum Capacity MMBtu/hr/ft	Required Air Pressure (inches w.c.)*	Required Fuel Pressure (inches w.c.)*
1.00	2.9	7.4
1.25	4.5	11.4
1.50	6.2	16.4
1.75	8.2	22.1
2.00	10.5	28.8
2.25	12.9	36.3
2.50	15.7	44.8

*Differential pressures measured at test connection. Air and gas DP is differential over system static pressure.

Test Connection Pressures (metric)

Maximum Capacity kW/ft	Required Air Pressure (mbar)*	Required Fuel Pressure (mbar)*
300	7.2	18.4
375	11.2	28.4
450	15.4	40.9
525	20.4	55.0
600	26.2	71.7
660	32.1	90.4
732	39.1	111.6

*Differential pressures measured at test connection. Air and gas DP is differential over system static pressure.

Principle of Operation

The design of the CROSSFIRE® burner allows for extremely low emissions of both NO_X and CO. Impingement of a series of jets containing a substantially homogeneous mixture of fuel and air creates stability and extremely short flame lengths. The high excess air translates into low NO_X levels. The inherently stable design allows operation of the burner in a fuel lean condition without creating high levels of CO.

The burner performs optimally at a specific fuel/air ratio throughout the firing range. Deviation from the optimum fuel/air ratio will result in trade-off between NO_X and CO emissions. For example, a fuel lean setting (in reference to optimum fuel/air ratio) will result in lower NO_X emissions but higher CO emissions. Conversely, a fuel rich setting, again in reference to the optimum fuel/air ratio, will result in higher NO_X emissions with lower CO levels.

The fuel/air ratio is controlled by a Maxon MICRO-RATIO® Valve throughout the operating range. The MICRO-RATIO® Valve allows for a variable fuel ramp corresponding to the chosen maximum lineal firing duty. The MICRO-RATIO® Valve is sized according to the fuel and air flow requirements for the entire combustion system. For MICRO-RATIO® Valve sizing information, see Sections 7000 and 7100 of the Maxon product catalog.

For optimum performance and emissions control in applications with variable process flow, use Maxon's SMARTFIRE™ Intelligent Combustion Control System. See Maxon catalog section 7200 for more details.

201 East 18th Street, P.O. Box 2068, Muncie, Indiana, 47307-0068. Phone: (765) 284-3304. Fax: (765) 286-8394

Capacities and Operating Data

Performance Data

Lineal heat release at high fire	Btu/hr/ft	1,000,000	1,250,000	1,500,000	1,750,000	2,000,000	2,250,000	2,500,000
Minimum lineal heat release	Btu/hr/ft	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Turndown ratio		10:1	12.5:1	15:1	17.5:1	20:1	22.5:1	25:1
Flame length	feet [1]	2.7	3.2	3.6	4.0	4.3	4.7	5.0
Pilot pressure/heat release	"w.c.* [2] / Btu/hr	5-8" w.c. / 40,000 Btu/hr						
Combustion air flow	SCFM	250	313	375	438	500	563	625
Air pressure at burner inlet	("w.c.) [3]	2.3	3.6	5.1	7.0	9.1	11.5	14.2
Air pressure at burner test connection	("w.c.)*	2.1	3.3	4.7	6.4	8.3	10.5	13.0
Fuel pressure at burner inlet (natural gas)	("w.c.) [3]	8.5	13.3	19.2	26.1	34.1	43.2	53.3
Fuel pressure at burner test connection (natural gas)	("w.c.)*	7.4	11.5	16.6	22.5	29.4	37.3	46.0
NOx emissions [4]	ppm @ 3% O_2	<25 ppm corrected to 3% O_2 dry						
CO emissions [4]	ppm @ 3% O_2	<250 ppm corrected to 3% O_2 dry						

[1] Flame length is based on 50% excess combustion air. Flame length will vary depending on various application parameters (e.g. passing air stream velocity, oxygen content, and combustion air preheat temperature)
[2] At inlet of adjustable pilot orifice.
[3] Air and gas DP is differential over system static pressure.
[4] Emissions stated are not guaranteed. Actual emission performance may vary. Contact Maxon for specific application details.
*Differential pressures measured at burner test connections. Air and gas DP is differential over system static pressure.

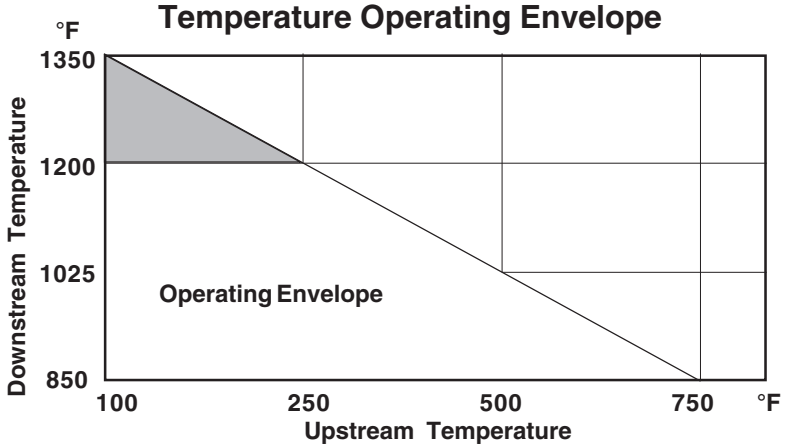
Operating Environment

Variable		Minimum	Maximum
Inlet Combustion Air Temp.	°F	Ambient	200
Inlet Combustion Air O_2 Level	% O_2	20.8	20.8
Air Stream Cross Velocity	ft/min	0	3000
Air Stream Axial Velocity	ft/min	0	4000
Upstream Air Temperature	°F	See Chart Below	
Downstream Air Temperature	°F		
Process Air Stream O_2 Level	% O_2	4	21

The burner can operate in a variety of environments. Typical operating environments, limits on their variables, and notes concerning operation of the burner are presented at left.

It is important to note that inlet combustion variables such as O_2 level and combustion air temperature will change air pressure requirements and/or maximum firing capacity.

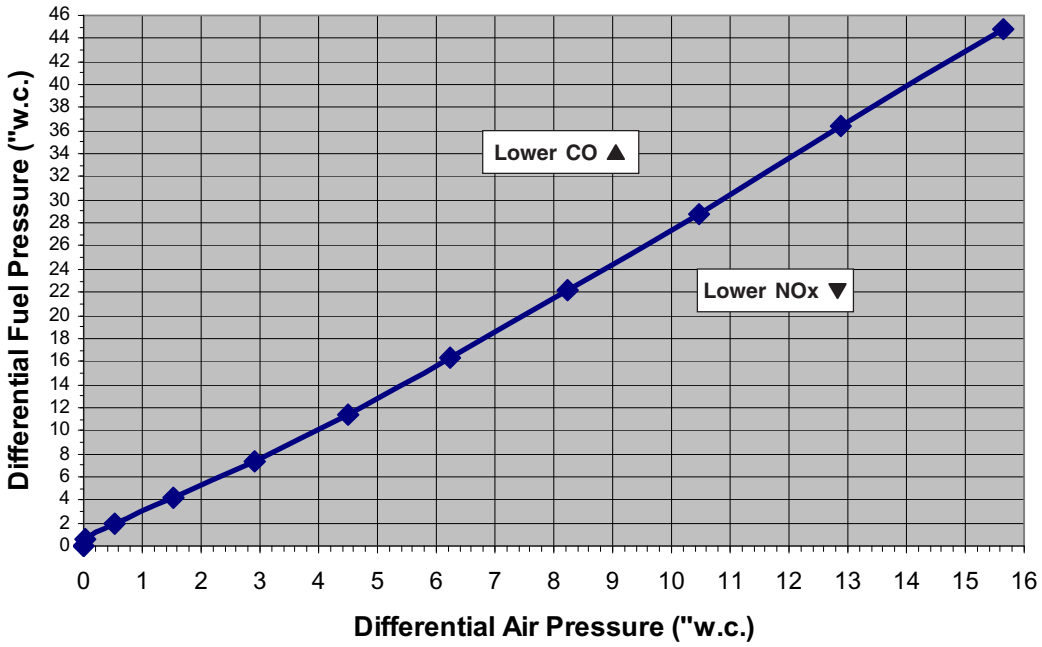
Temperature Operating Envelope



Consult Maxon for operation in shaded region. Ability to operate in shaded region is dependent upon operating conditions.

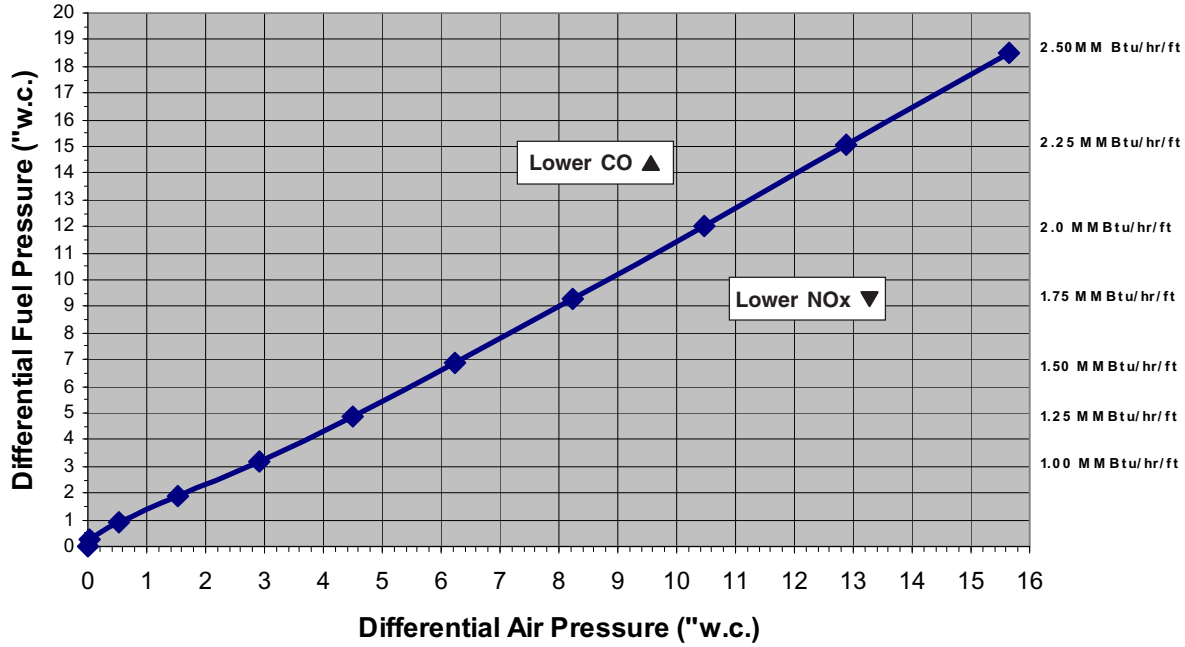
Capacities and Operating Data

Natural Gas Fuel/Air Settings



NOTE: Pressure measured at burner test connections; refer to inlet pressure requirements for fan sizing

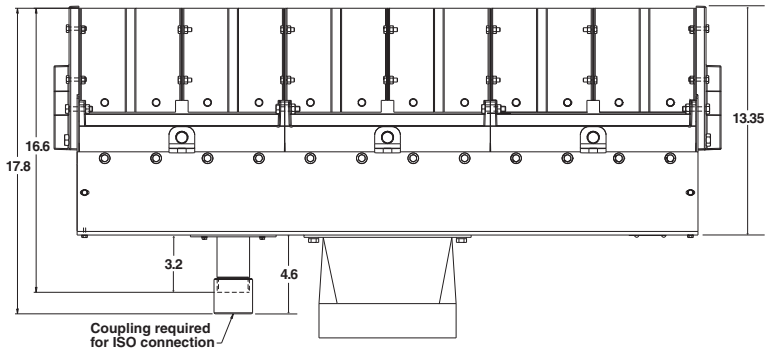
Propane Fuel/Air Settings



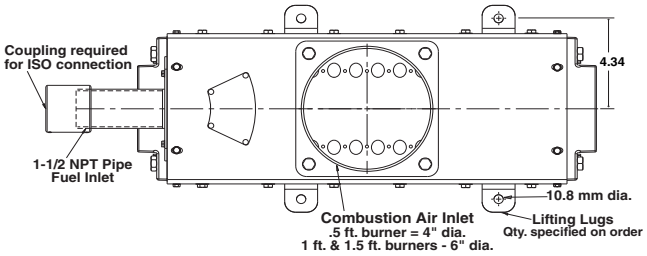
NOTE: Pressure measured at burner test connections; refer to inlet pressure requirements for fan sizing

Dimensions *(in inches)*

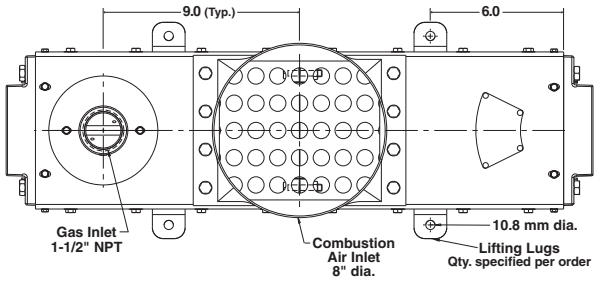
Side View
(back inlet section shown)



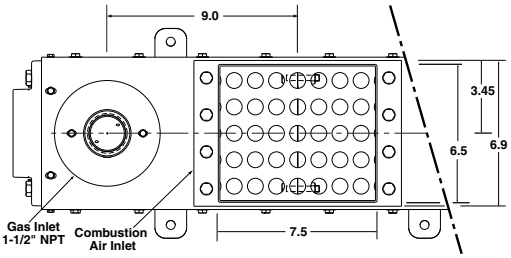
Bottom View
end inlet section



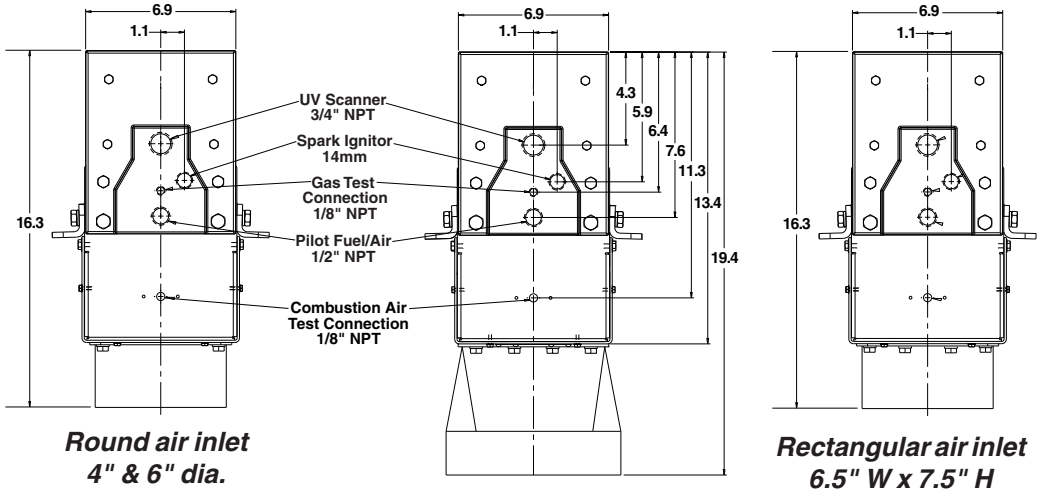
Bottom view
back inlet section w/round air inlet



Bottom view
back inlet section w/retangular air inlet



Pilot End View



Round air inlet
4" & 6" dia.

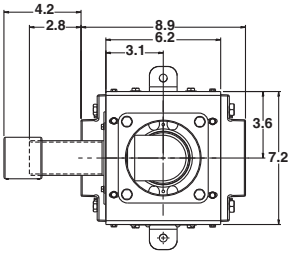
Round air inlet
8" dia.

Rectangular air inlet
6.5" W x 7.5" H

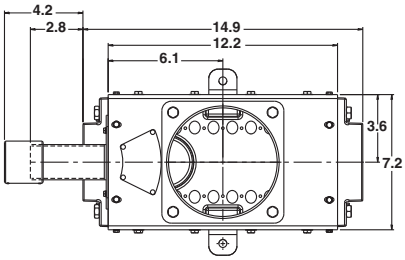
Dimensions *(in inches)*

Straight Burner Sections

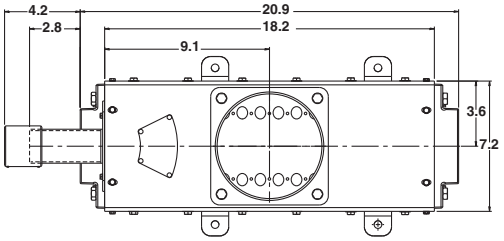
.5 ft. burner - end inlet



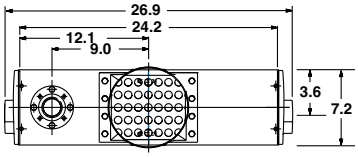
1 ft. burner - end inlet



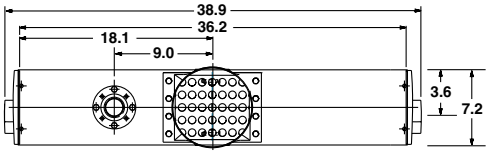
1.5 ft. burner - end inlet



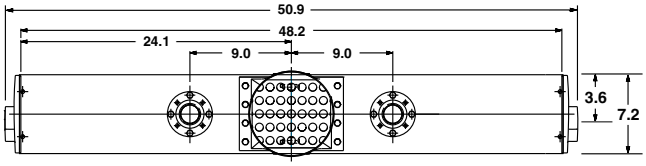
2 ft. burner - back inlet



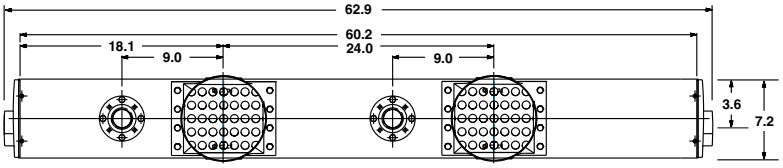
3 ft. burner - back inlet



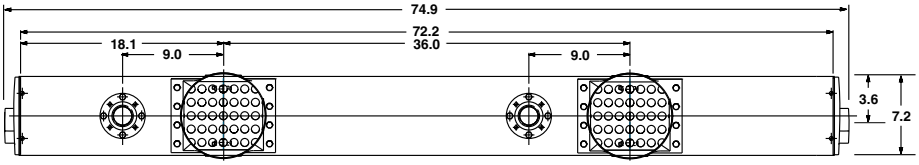
4 ft. burner - back inlet



5 ft. burner - back inlet



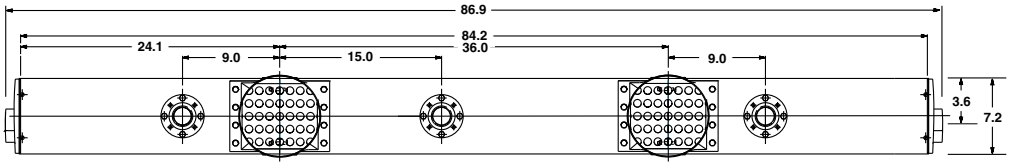
6 ft. burner - back inlet



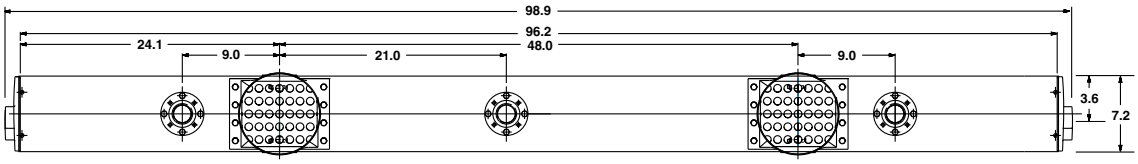
Dimensions *(in inches)*

Straight Burner Sections

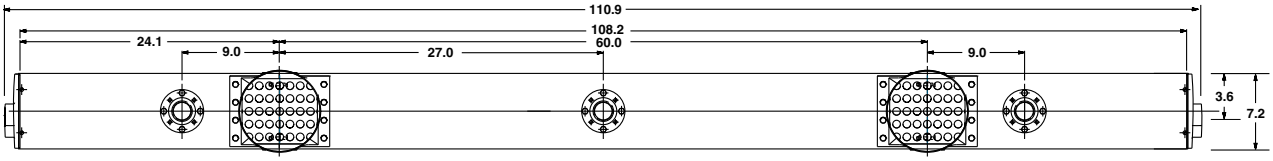
7 ft. burner - back inlet



8 ft. burner - back inlet

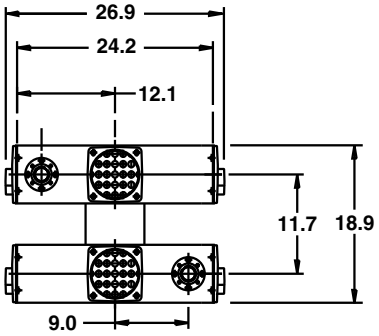


9 ft. burner - back inlet

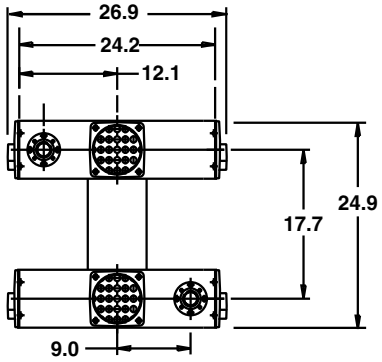


Dimensions *(in inches)*

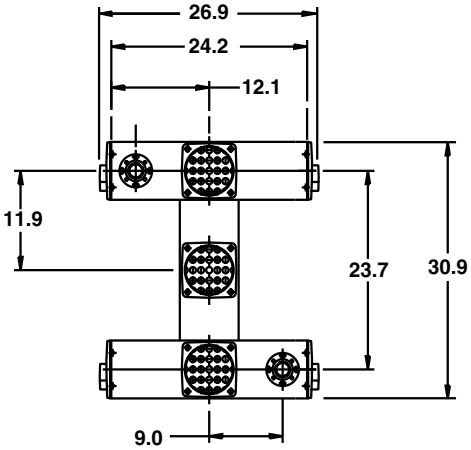
2 ft. back inlet grid sections



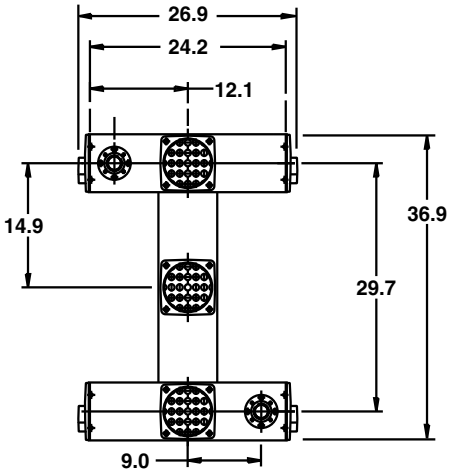
2 BI XF GRD with 12" span



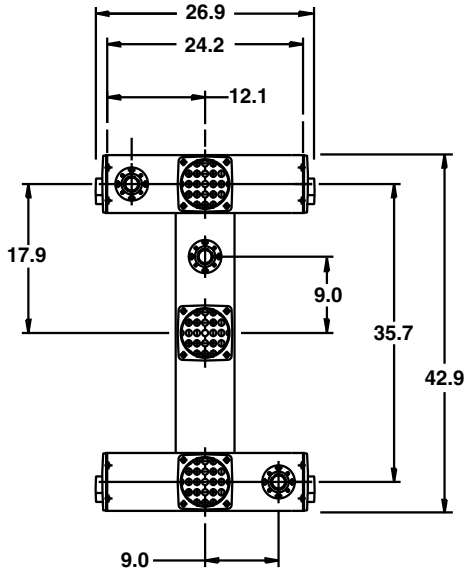
2 BI XF GRD with 18" span



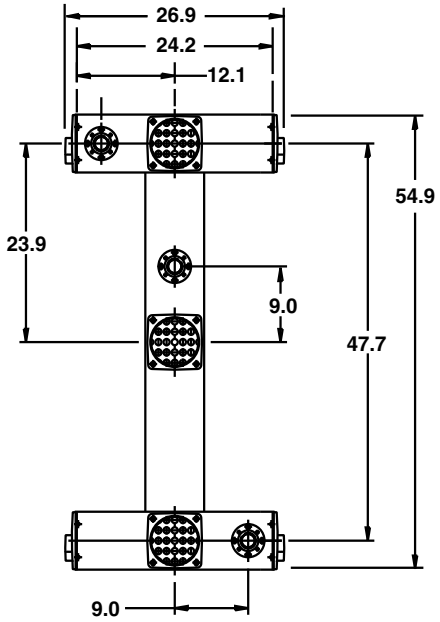
2 BI XF GRD with 24" span



2 BI XF GRD with 30" span



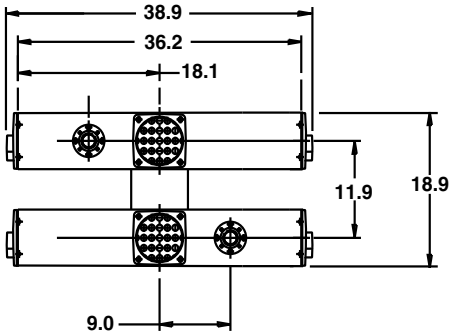
2 BI XF GRD with 36" span



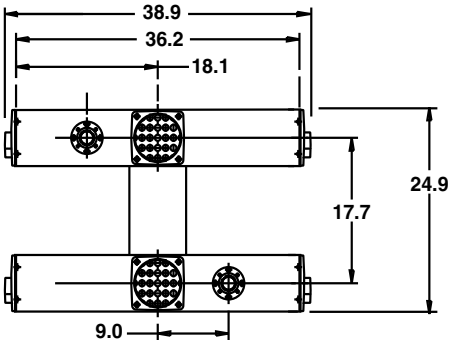
2 BI XF GRD with 48" span

Dimensions *(in inches)*

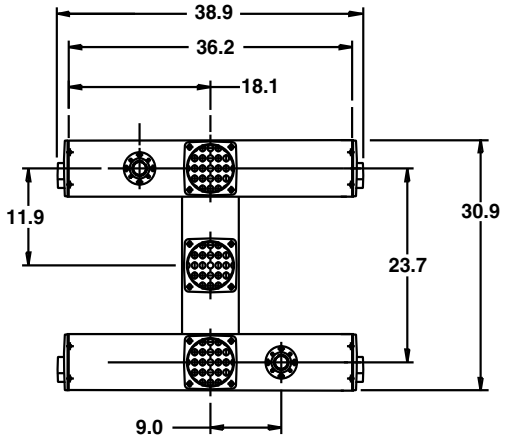
3 ft. back inlet grid sections



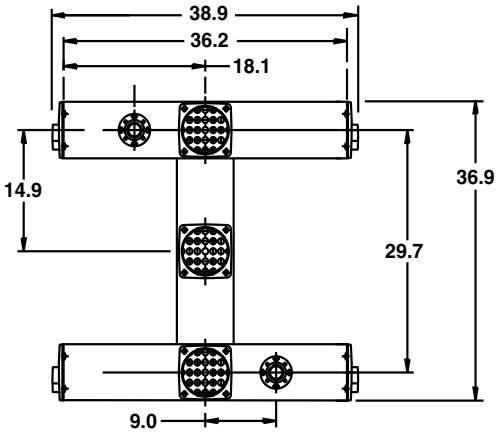
3 BI XF GRD with 12" span



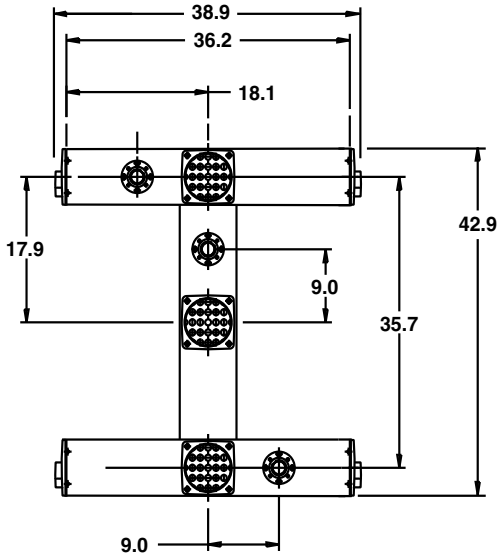
3 BI XF GRD with 18" span



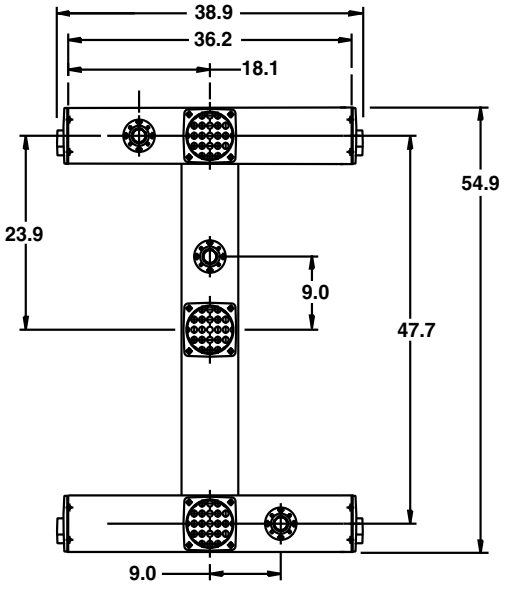
3 BI XF GRD with 24" span



3 BI XF GRD with 30" span



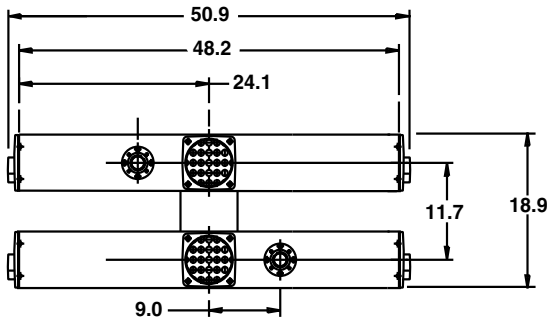
3 BI XF GRD with 36" span



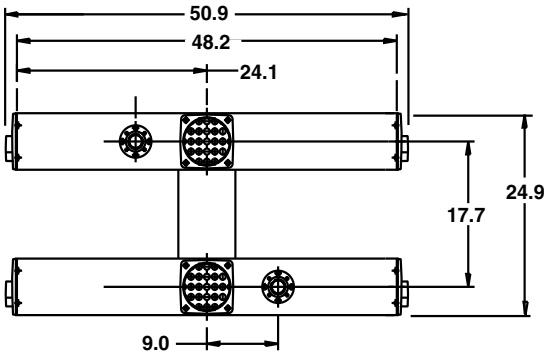
3 BI XF GRD with 48" span

Dimensions *(in inches)*

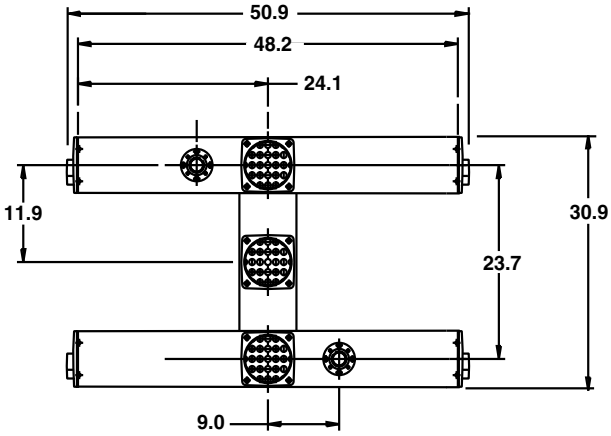
4 ft. back inlet grid sections



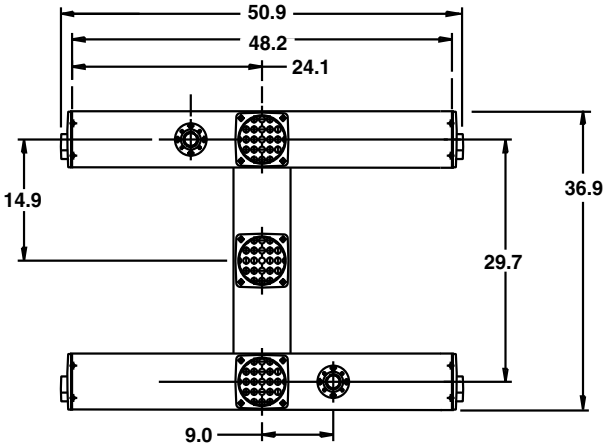
4 BI XF GRD with 12" span



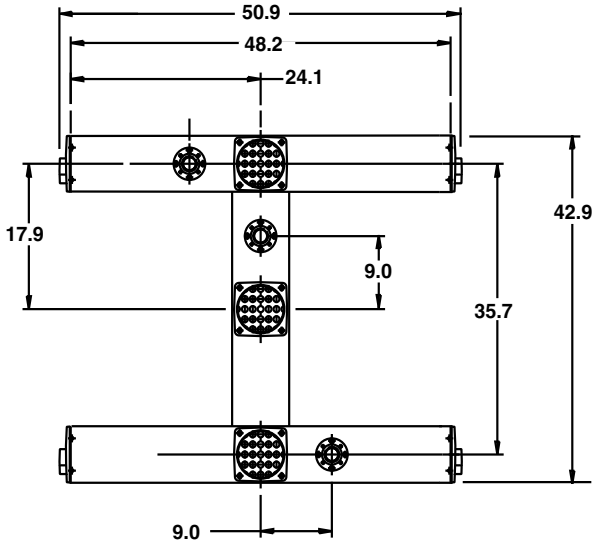
4 BI XF GRD with 18" span



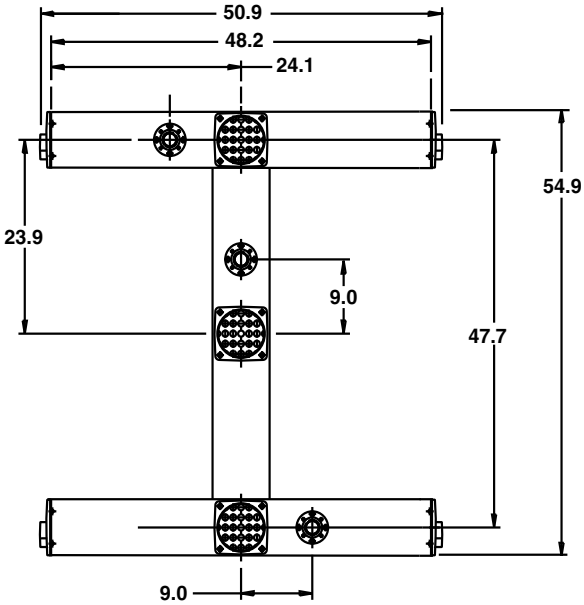
4 BI XF GRD with 24" span



4 BI XF GRD with 30" span



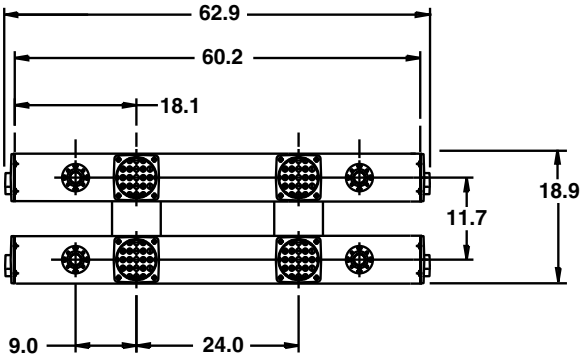
4 BI XF GRD with 36" span



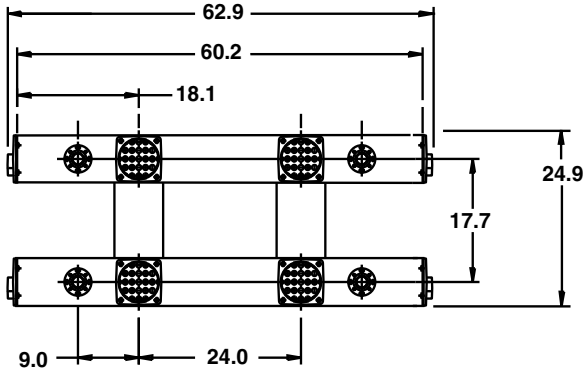
4 BI XF GRD with 48" span

Dimensions *(in inches)*

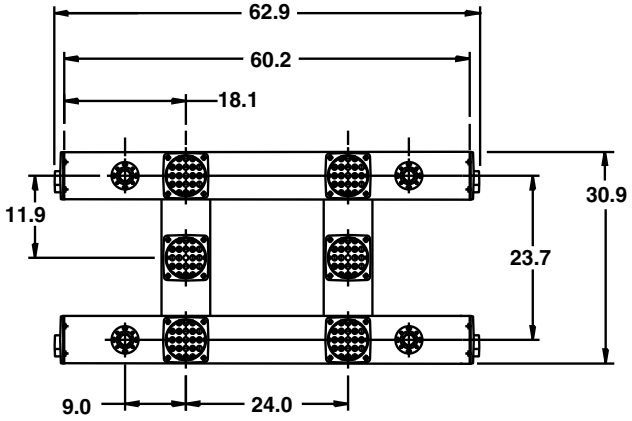
5 ft. back inlet grid sections



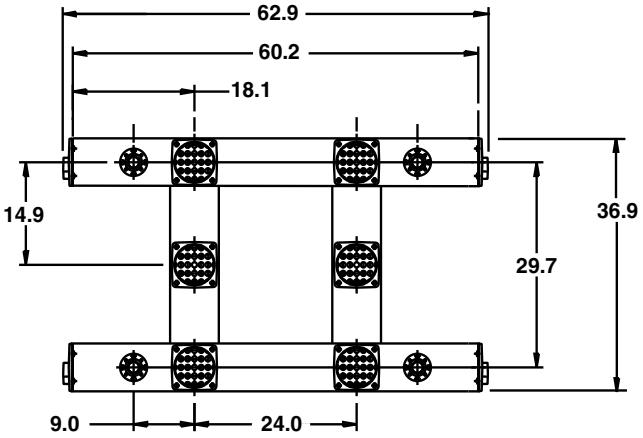
5 BI XF GRD with 12" span



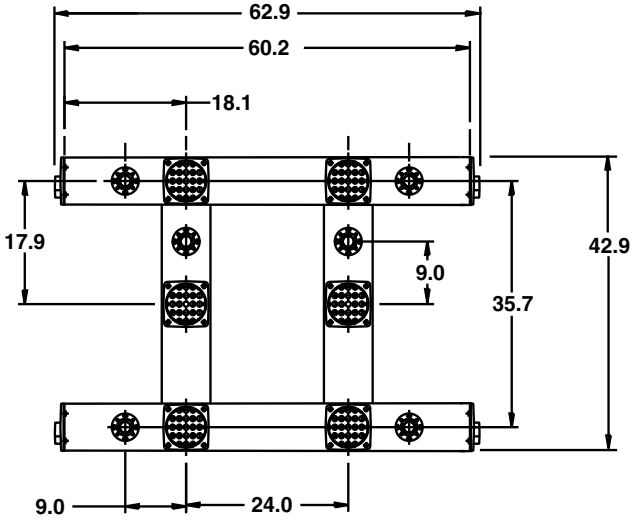
5 BI XF GRD with 18" span



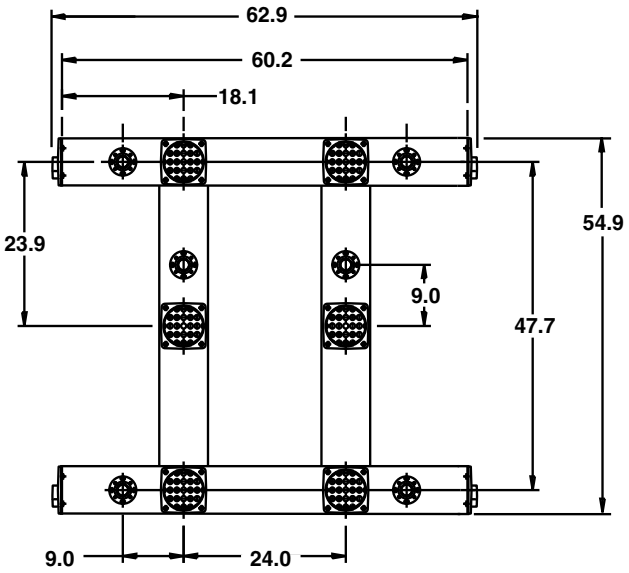
5 BI XF GRD with 24" span



5 BI XF GRD with 30" span



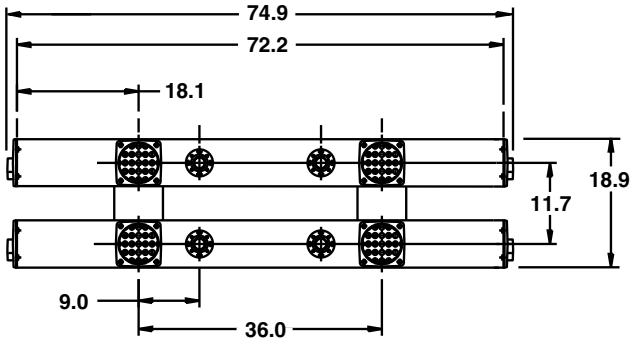
5 BI XF GRD with 36" span



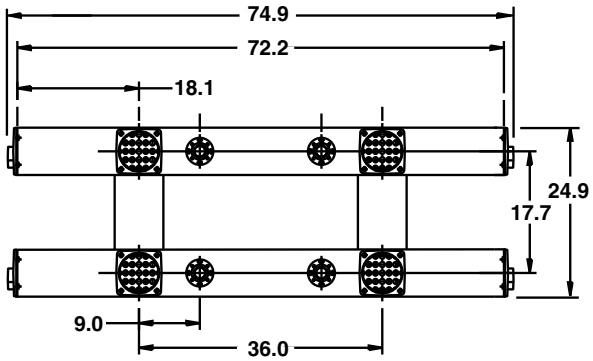
5 BI XF GRD with 48" span

Dimensions *(in inches)*

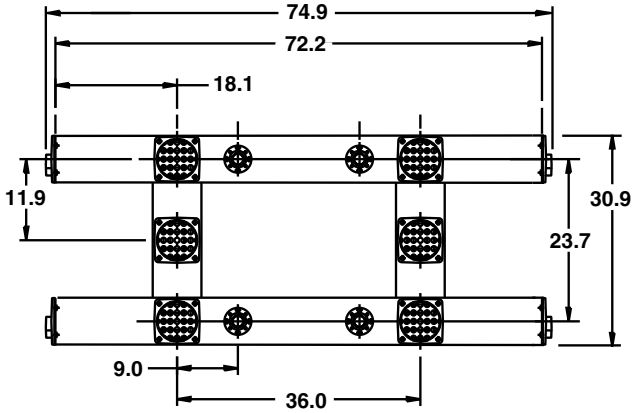
6 ft. back inlet grid sections



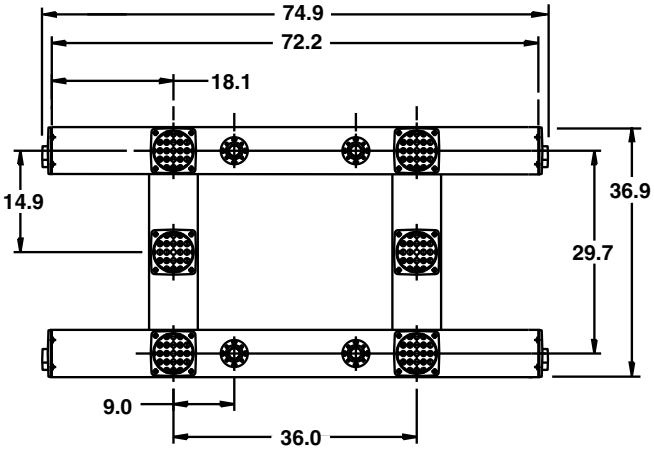
6 BI XF GRD with 12" span



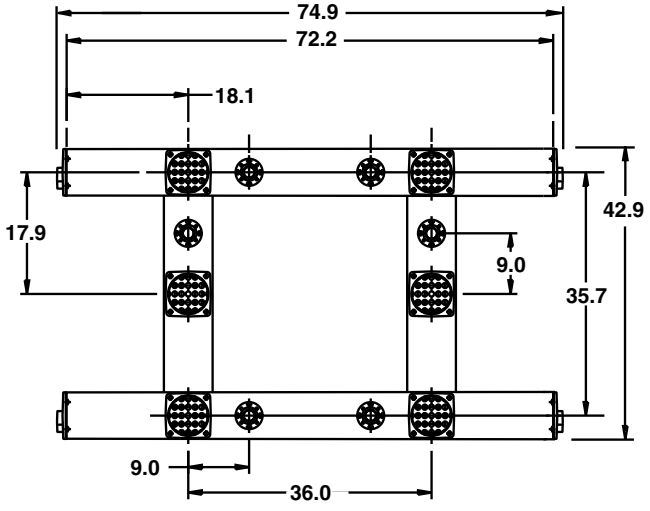
6 BI XF GRD with 18" span



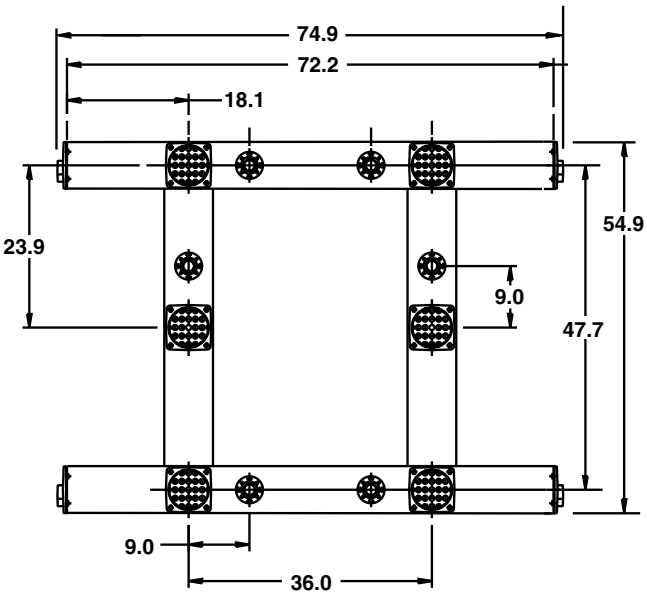
6 BI XF GRD with 24" span



6 BI XF GRD with 30" span



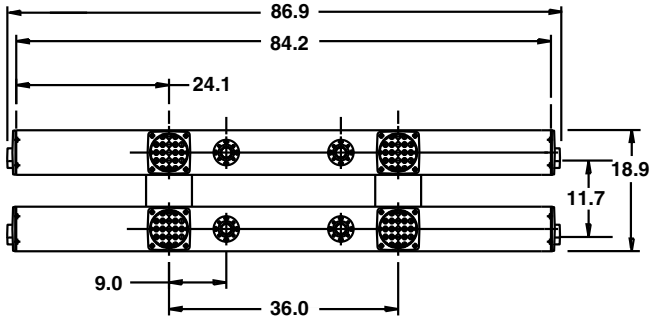
6 BI XF GRD with 36" span



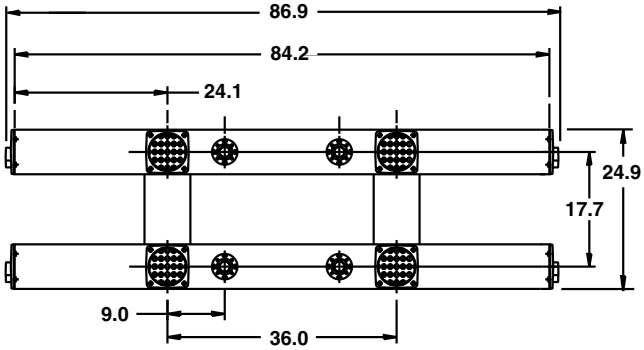
6 BI XF GRD with 48" span

Dimensions *(in inches)*

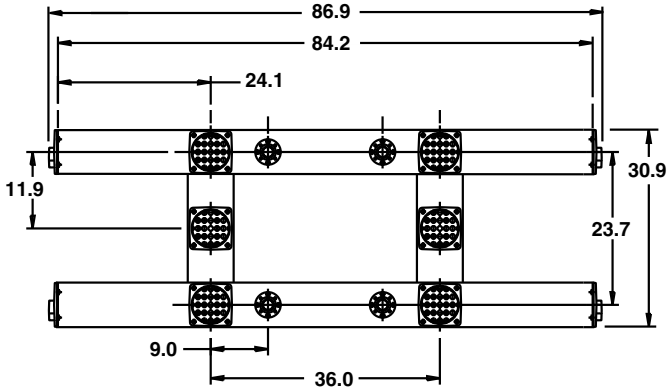
7 ft. back inlet grid sections



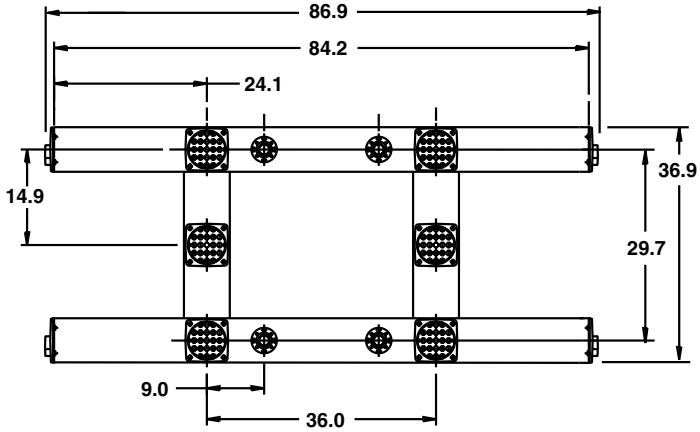
7 BI XF GRD with 12" span



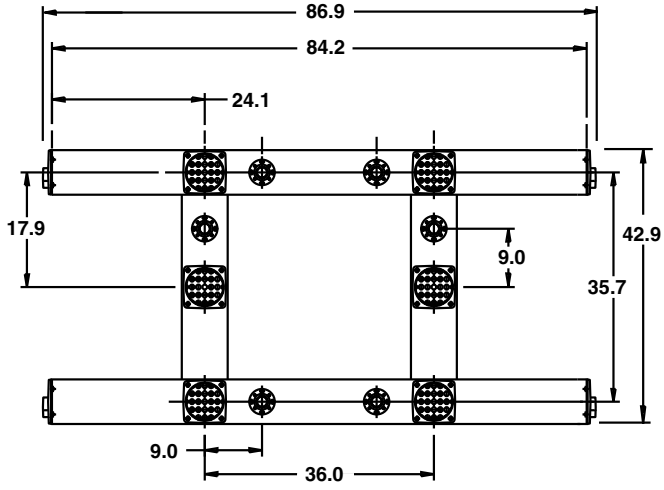
7 BI XF GRD with 18" span



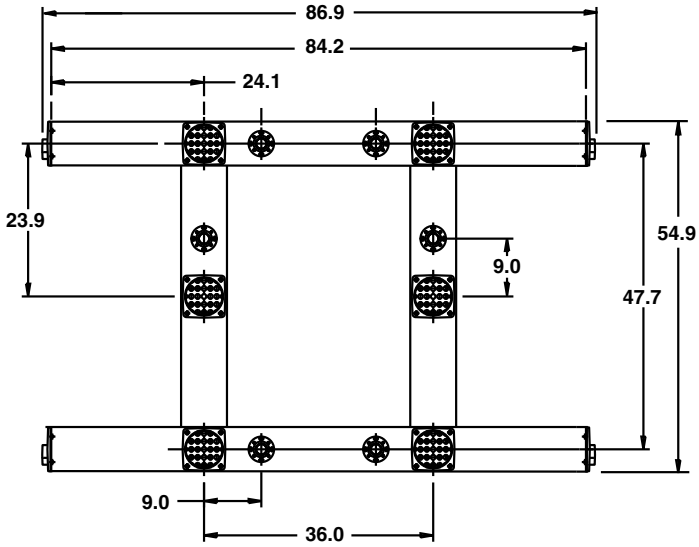
7 BI XF GRD with 24" span



7 BI XF GRD with 30" span



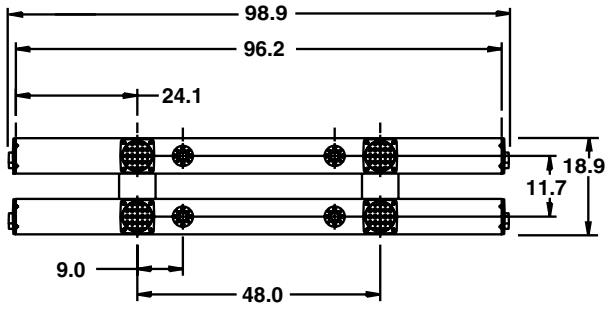
7 BI XF GRD with 36" span



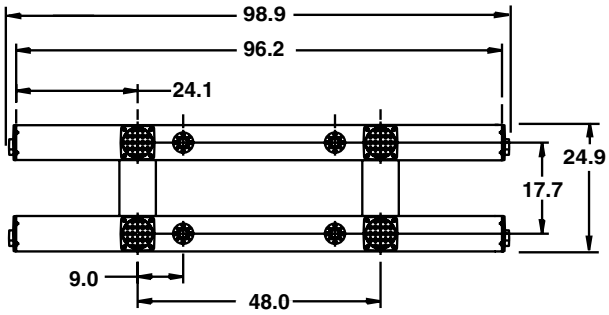
7 BI XF GRD with 48" span

Dimensions *(in inches)*

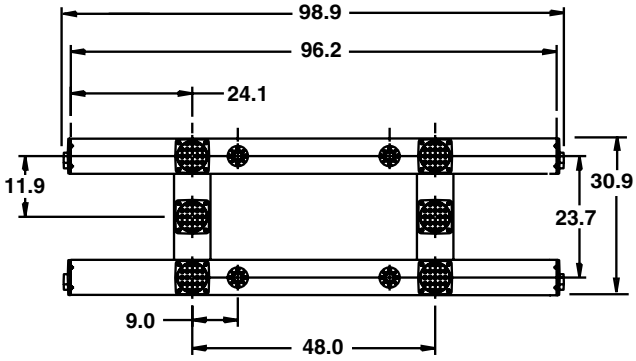
8 ft. back inlet grid sections



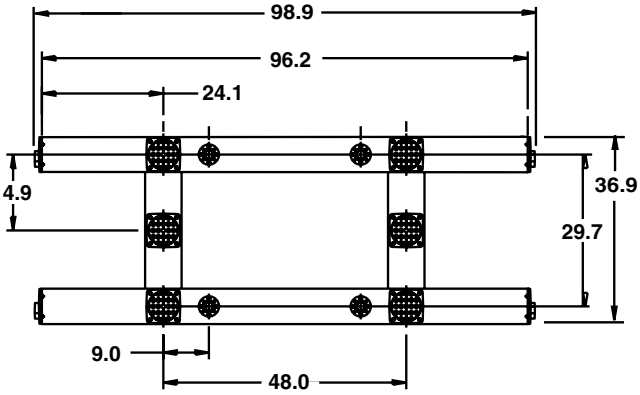
8 BI XF GRD with 12" span



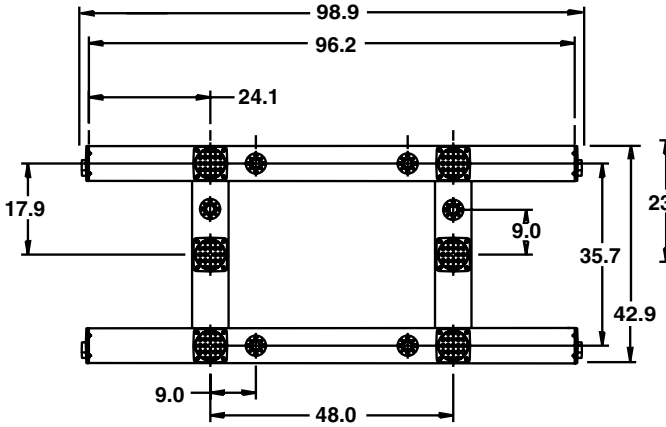
8 BI XF GRD with 18" span



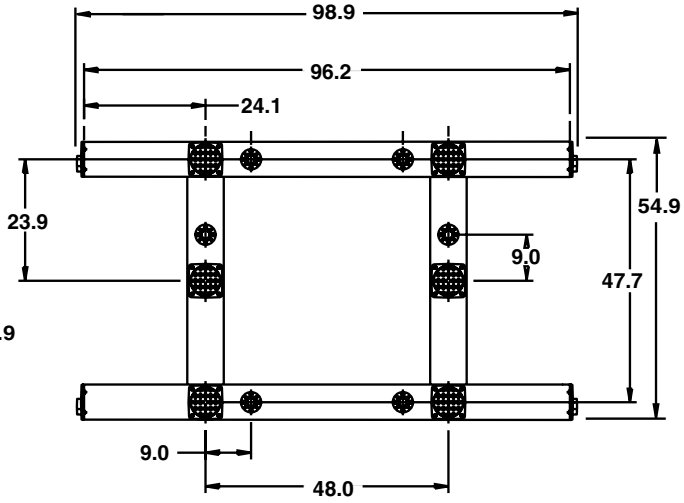
8 BI XF GRD with 24" span



8 BI XF GRD with 30" span



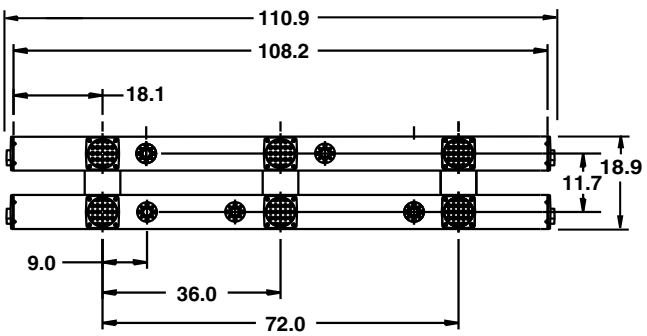
8 BI XF GRD with 36" span



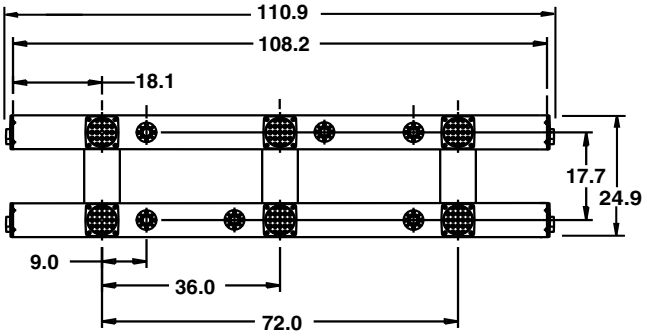
8 BI XF GRD with 48" span

Dimensions *(in inches)*

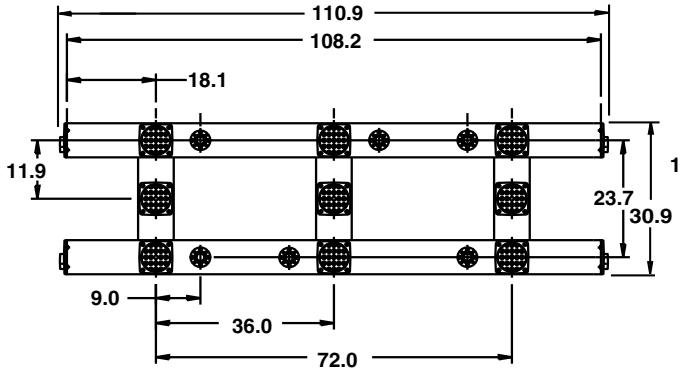
9 ft. back inlet grid sections



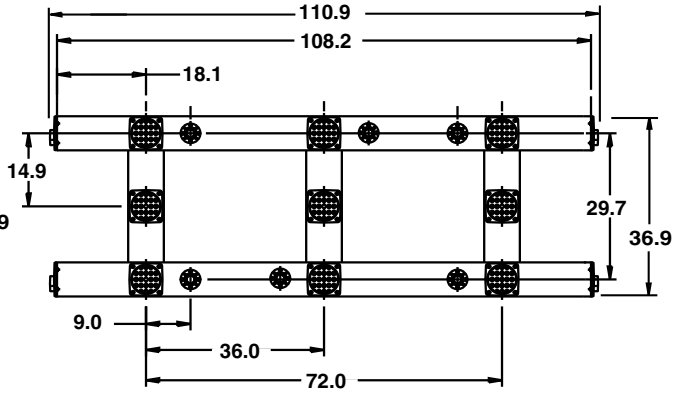
9 BI XF GRD with 12" span



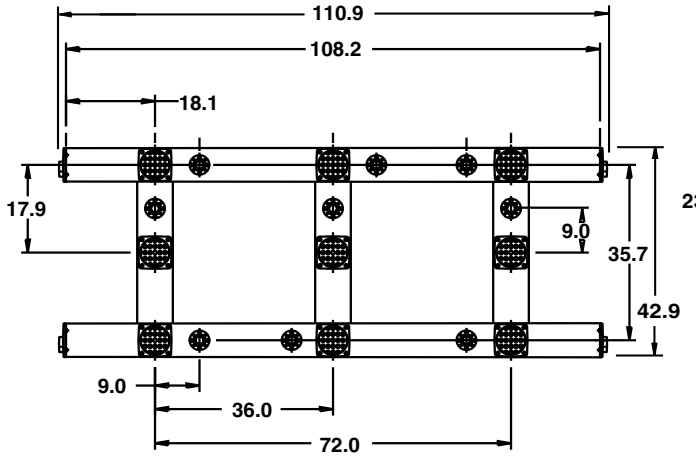
9 BI XF GRD with 18" span



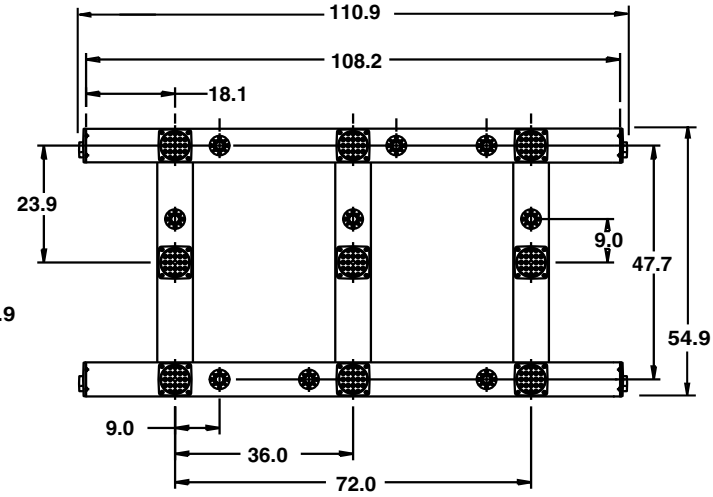
9 BI XF GRD with 24" span



9 BI XF GRD with 30" span



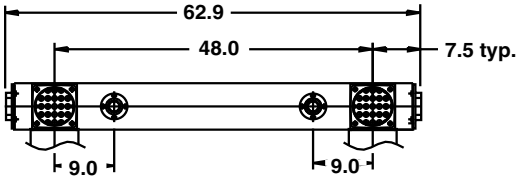
9 BI XF GRD with 36" span



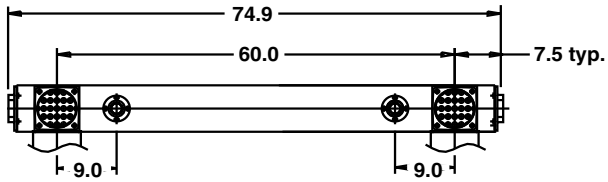
9 BI XF GRD with 48" span

Dimensions *(in inches)*

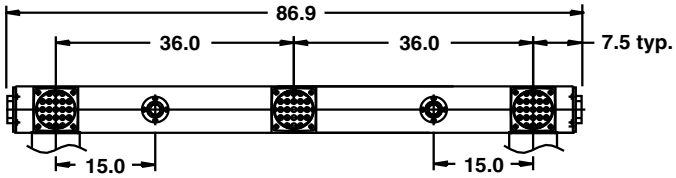
Horizontal spacing of CROSSFIRE® ladders



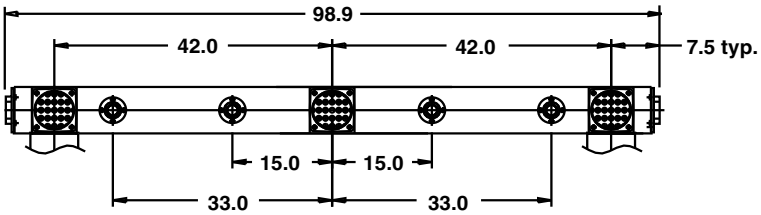
4 ft. CROSSFIRE® Ladder



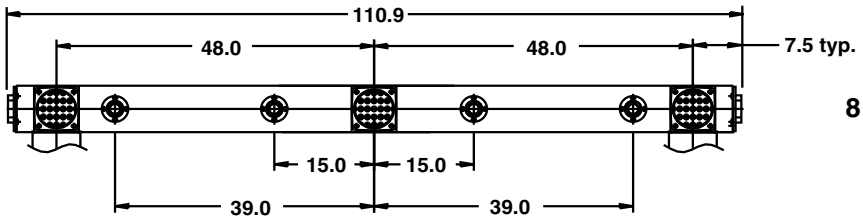
5 ft. CROSSFIRE® Ladder



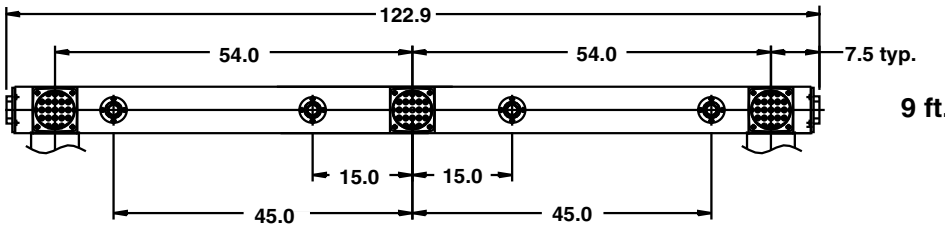
6 ft. CROSSFIRE® Ladder



7 ft. CROSSFIRE® Ladder



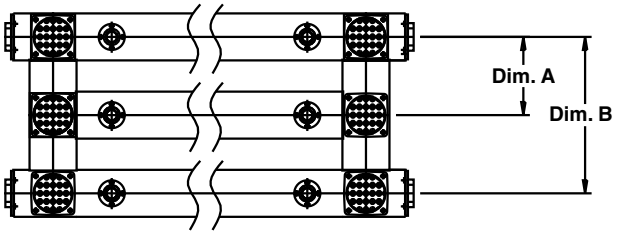
8 ft. CROSSFIRE® Ladder



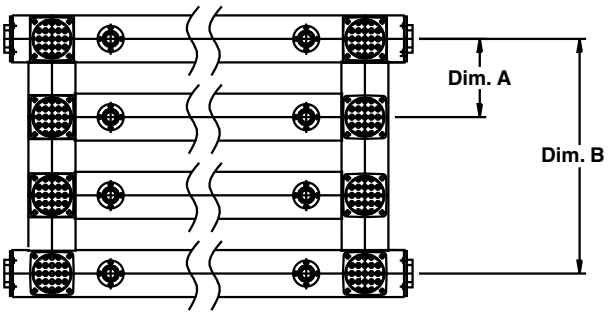
9 ft. CROSSFIRE® Ladder

Dimensions *(in inches)*

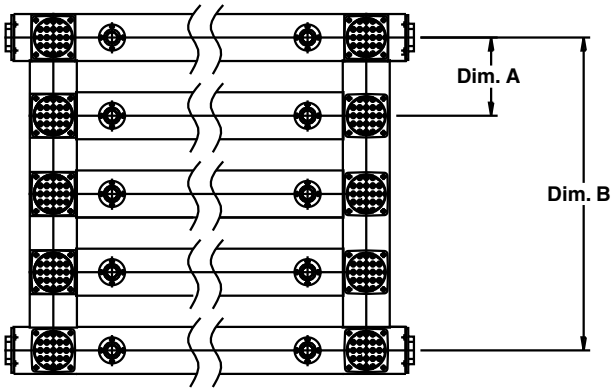
Vertical spacing of CROSSFIRE® ladders



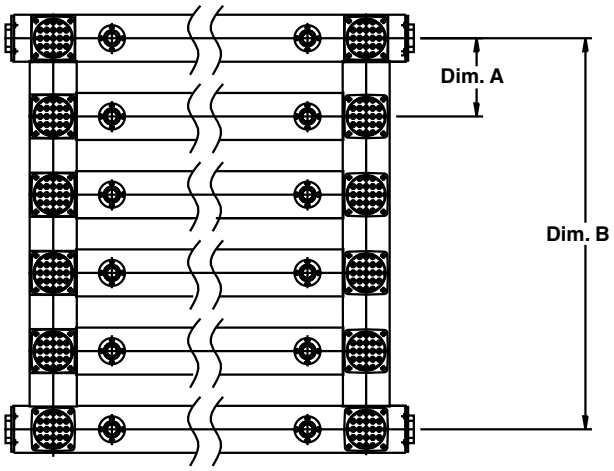
Cross Member		Dim. A (inches)	Dim. B (inches)
Designation	Description		
112	Qty. 1 - 12" spacing	12	24
118	Qty. 1 - 18" spacing	18	36
124	Qty. 1 - 24" spacing	24	48
130	Qty. 1 - 30" spacing	30	60



Cross Member		Dim. A (inches)	Dim. B (inches)
Designation	Description		
212	Qty. 2 - 12" spacing	12	36
218	Qty. 2 - 18" spacing	18	54
224	Qty. 2 - 24" spacing	24	72
230	Qty. 2 - 30" spacing	30	90



Cross Member		Dim. A (inches)	Dim. B (inches)
Designation	Description		
312	Qty. 3 - 12" spacing	12	48
318	Qty. 3 - 18" spacing	18	72
324	Qty. 3 - 24" spacing	24	96
330	Qty. 3 - 30" spacing	30	120



Cross Member		Dim. A (inches)	Dim. B (inches)
Designation	Description		
412	Qty. 4 - 12" spacing	12	60
418	Qty. 4 - 18" spacing	18	90
424	Qty. 4 - 24" spacing	24	120
430	Qty. 4 - 30" spacing	30	150

See page 5616 for horizontal spacing of CROSSFIRE® ladders

Notes

Installation Instructions

Please read all installation and start-up instructions prior to working with the burner. A view port providing a clear view of the entire flame is strongly recommended.

Do not discard packing material until all parts have been identified. (Some parts are shipped loose with the burner.)

The burner accounts for a portion of the total combustion system (see typical piping schematic below). The sizing and installation instructions for other components such as valves, control motors, blowers, regulators, switches, etc. can be found in the corresponding sections of the Maxon Catalog.

The CROSSFIRE® Burner requires an external blower to supply combustion air. The combustion fan should not be positioned where inert gases could be drawn into the combustion air intake. Electrical service must match the voltage, phase, and cycle of the combustion fan as well as all other electrical system components.

Gas and air are piped separately into the burner assembly. The gas piping and air ducting should be sufficiently large enough to flow the maximum capacity at the rated pressures. Filters for both fuel and air may be required in some environments to prevent plugging of gas and/or air ports.

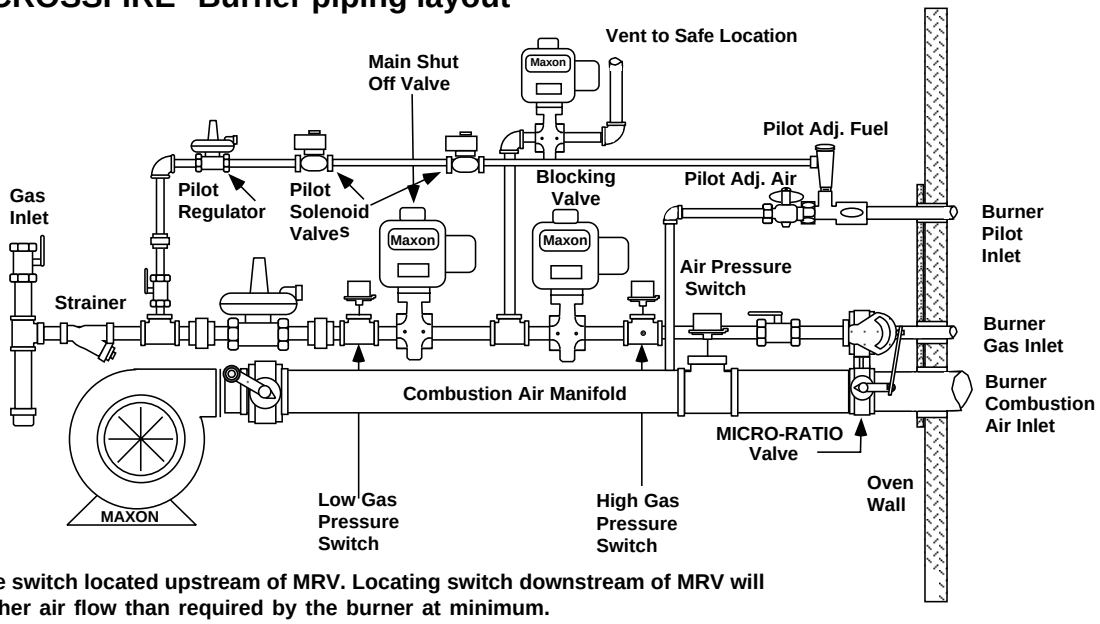
For CROSSFIRE® Burner assemblies four feet and over in length, multiple gas and air inlets are utilized to ensure uniform distribution. As with all combustion systems, proper manifolding practices must be sufficient to feed each air and gas inlet with equal flow. However, it is further recommended that balancing dampers and air pressure taps be installed within each branch of the air manifold to facilitate equal distribution of the combustion air flow to each air inlet.

The pilot/ignition system requires air to be fed from the combustion air piping (upstream of the MICRO-RATIO® Valve) to the pilot gas mixer as shown in the piping schematic.

The burner may be mounted horizontally or vertically within a duct. Additional support is required to support the weight of the burner and gas piping. Care should be taken not to introduce any additional stresses on the gas inlet(s) at the burner. Furthermore, burner and gas piping support should be designed for thermal expansion.

Once the burner is installed within the duct, the ignitor and UV scanner tube can be installed. Separate conduit should be used for the wiring of the scanner and ignitor.

Typical CROSSFIRE® Burner piping layout



***Air pressure switch located upstream of MRV. Locating switch downstream of MRV will result in higher air flow than required by the burner at minimum.**

Maxon assumes no responsibility for the use or misuse of the piping layout shown. Specific piping and wiring diagrams should always be sumitted to the appropriate agencies for approval on each application.

Installation Instructions

The spark ignitor assembly utilized by CROSSFIRE® Burners is designed to be fed through the wall of the duct. Replacement of the ignitor is easily accomplished from outside of the duct.

To initially install the ignitor, first carefully remove the internal sub-assemblies and set aside. Insert the outer tube through the opening in the duct wall and thread into the pilot end plate. (Access covers and seal plates are available from Maxon to facilitate installation.)

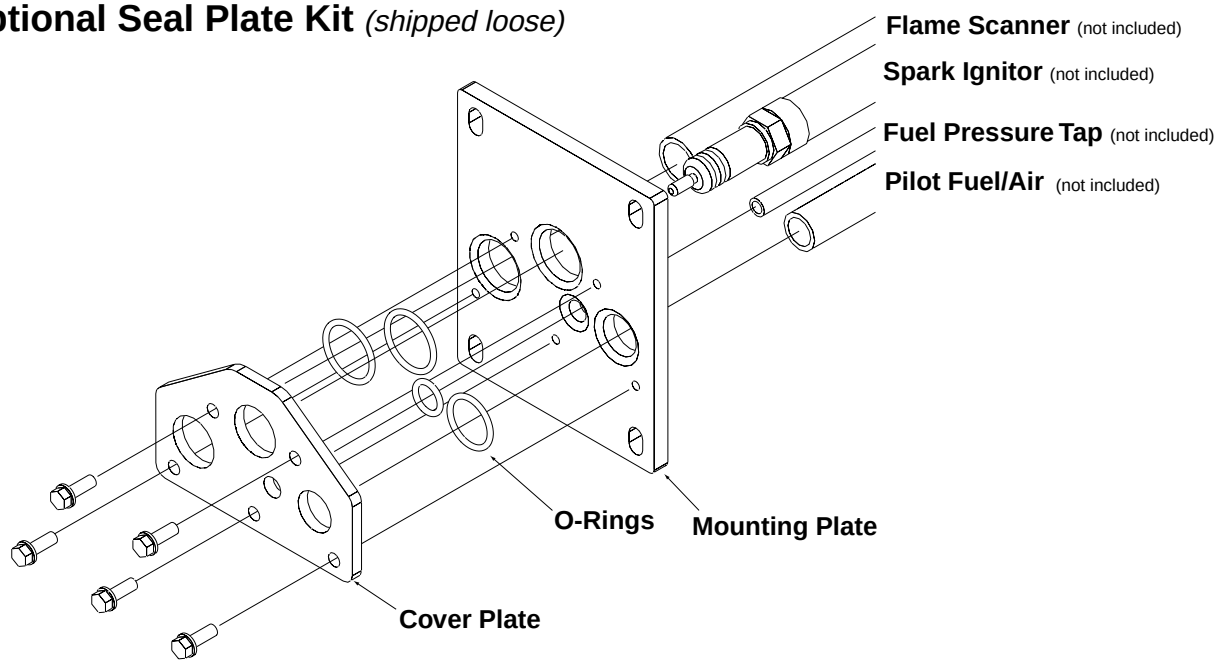
UV scanner installation:

A UV magnifying lens enhances pilot flame signal and is recommended for scanner tube lengths greater than 24".

Caution:

- **Burner assembly and fuel piping must be properly supported.**
- **Avoid external loads to fuel inlet(s).**
- **Do not overtighten fuel piping to burner connection.**
- **Use back-up wrench when tightening inlet piping.**
- **Flexible connection recommended to allow for expansion.**
- **Do not lift burner assembly from fuel inlet(s).**

Optional Seal Plate Kit *(shipped loose)*



Start-up Instructions

For initial start-up of Maxon CROSSFIRE® Burner:

1. **Close all burner fuel valves and cocks.** Make preliminary adjustment to the fuel gas regulators. Remove pilot and main gas regulators' adjusting screw covers. Turn adjusting screw down (clockwise) to approximately mid-position. Close pilot gas adjustable orifice screw by turning clockwise until it stops. (Do not over-tighten.) Then back out the adjustable orifice (counter-clockwise) 2-3 turns.
2. **Check all electrical circuitry.** Verify that all control devices and interlocks are operable and functioning within their respective settings/ranges. Be sure all air and gas manifolds are tight and that test ports are plugged if not in use.
3. **Check that air and gas pressure switches are not marginally set.** Set pressure switches with a large enough range to prevent system shutdown during initial adjustment. During final system tuning, the pressure switches should be re-adjusted.
4. **Disconnect the automatic control motor linkage** from the MICRO-RATIO® Valve. Initial start-up should only be accomplished in a manual burner control mode.
5. **Start all system related fans and blowers.** Check for proper rotation of motors and impellers. Verify that all control interlocks are operating. Allow air handling equipment to adequately purge combustion chamber. For an application with variable process flow, set process flow to maximum.

CAUTION: Do not bypass control panel timers or interlocks typically controlling sequential operations.

6. **Refer to CROSSFIRE® Fuel/Air Settings graph** (on page 5604) to obtain maximum and minimum air and fuel pressure settings for the system's maximum heat release (up to 2,500,000 Btu/hr/ft). Preliminarily set the stroke of the air and fuel valves in accordance with Maxon catalog sections 7000 and 7100. For maximum control, ensure that the fuel valve quadrant has a full stroke of 90°.
7. **Set burner to low fire position.** Main combustion air blower should be on.
8. **Open manual and pilot gas cocks, activate spark ignition transformer and pilot gas solenoid valve, then attempt pilot ignition.** If necessary, slowly increase pilot flow through adjustment of pilot regulator or pilot gas cock. Repetition of this procedure may be necessary as ignition will occur only when air trapped in the pilot line has been bled. Adjust pilot gas pressure as specified.
9. **After ignition, slowly open pilot bleed air to shorten pilot flame.** The pilot is not designed to be a full premix pilot. The pilot bleed air will prevent soot formation on spark electrode.
10. **Shut off pilot gas flow** and re-ignite several times (bleed air should be left in the open position). The flame safeguard relays should now power main fuel shut-off valves.
11. **Light the CROSSFIRE® Burner.** With pilot flame established and flame supervision operational, opening the main fuel shut-off valve will allow fuel flow to the burner.
12. **Turn minimum adjusting screw** on the MICRO-RATIO® Valve "in" (clockwise) to increase gas flow at minimum until burner ignites. Flame will be blue at the base with yellow tips. Flame should be continuous along its length.
13. **Adjust main regulator** to maintain required differential gas pressure. Re-adjust minimum adjusting screw.
14. **If pilot is interrupted as recommended,** turn off pilot and verify that flame supervision is operational.
15. **Progressively work your way up through each adjusting screw position** as per Maxon catalog sections 7000 and 7100. Above minimum firing rate, flame will transition to light blue in color. A flame that is too lean will exhibit voids along its length. Adjust the flame at each adjusting screw so that it is as short as possible, light blue in color, and without voids in the flame. Dust in the combustion air stream or process stream may cause yellow "sparklers". The air and gas pressures should be close to those presented in the Fuel/Air Settings chart. If high temperature limit trips prior to completion of adjustment, cycle back to low fire and allow the unit to cool before continuing the adjustment process.

Start-up Instructions

Test Connection Pressures

Maximum Capacity MMBtu/hr/ft	Required Air Pressure (inches w.c.)*	Required Fuel Pressure (inches w.c.)*
1.00	2.9	7.4
1.25	4.5	11.4
1.50	6.2	16.4
1.75	8.2	22.1
2.00	10.5	28.8
2.25	12.9	36.3
2.50	15.7	44.8

*Differential pressures measured at burner inlet. Air and gas DP is differential over system static pressure.

Test Connection Pressures (metric)

Maximum Capacity kW/ft	Required Air Pressure (mbar)*	Required Fuel Pressure (mbar)*
300	7.2	18.4
375	11.2	28.4
450	15.4	40.9
525	20.4	55.0
600	26.2	71.7
660	32.1	90.4
732	39.1	111.6

*Differential pressures measured at burner inlet. Air and gas DP is differential over system static pressure.

16. **Slowly cycle the unit** from light-off to minimum through maximum and back to ensure that the burner functions satisfactorily throughout the operating range. Refine adjustment if necessary.
17. **When burner performance is satisfactory and stable throughout the operating range**, re-connect the control linkage and allow unit to operate in automatic control mode.
18. **Shut system down**, closing all fuel valves. Disconnect and plug all test connections. Replace all equipment covers and caps. Tighten all linkage set screws.

Operating Tips:

The minimum firing rate attainable is dependent upon low firing rate control. Size the MICRO-RATIO® Valve, both air and fuel valves, with at least 1-3 inches w.c. pressure drop. Use the full stroke of both valves, if possible. A butterfly disc or gate valve installed upstream of the combustion air blower intake and/or downstream of the combustion air outlet (prior to MICRO-RATIO® Valve) will enable full stroke of the air butterfly.

At minimum firing rate, only the tips of the flame should be yellow. The base of the flame should still be light blue in color. Readjustment of the minimum air setting and/or minimum MICRO-RATIO® Valve adjusting screw may be necessary. A flame that is yellow at the base of the flame is deficient of air and may form soot on the face of the burner.

Variable process flow with greater than 4 inches w.c. pressure swing will significantly affect the fuel/air ratio of the flame and, subsequently, emissions. Check burner operation from minimum to maximum firing rates and at minimum and maximum process flow to ensure proper flame at all operating conditions.

For optimum performance and emissions control in applications with variable process flow, use Maxon's SMARTFIRE™ Intelligent Combustion Control System. See Maxon catalog section 7200 for more details.