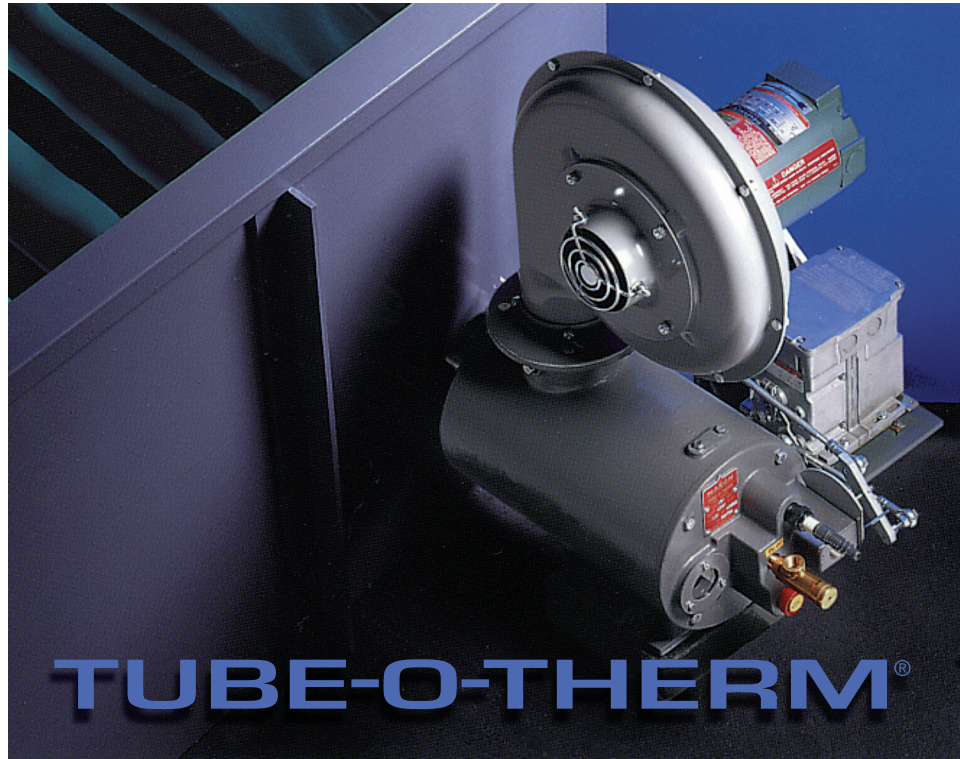


TUBE-O-THERM®

Low Temperature Gas Burners



- Fires directly into small-bore immersion tubes
- Burner-to-tube direct firing system allows uniform heat transfer, eliminates “hot spots”, and produces faster bring-up times
- Economical and efficient package design with integral low power blower costs less and saves energy (external blower models also available)
- No hassle installation and easy maintenance access with wall mounted design
- Burns natural, propane or butane gas and produces reduced levels of NOx and CO
- Flame scanner capability for all sizes
- Four models sized for 3”, 4”, 6”, 8” and 10” diameter tubes
- Heat releases up to 2500 kW
- No powered exhaust required, saving energy

Product description

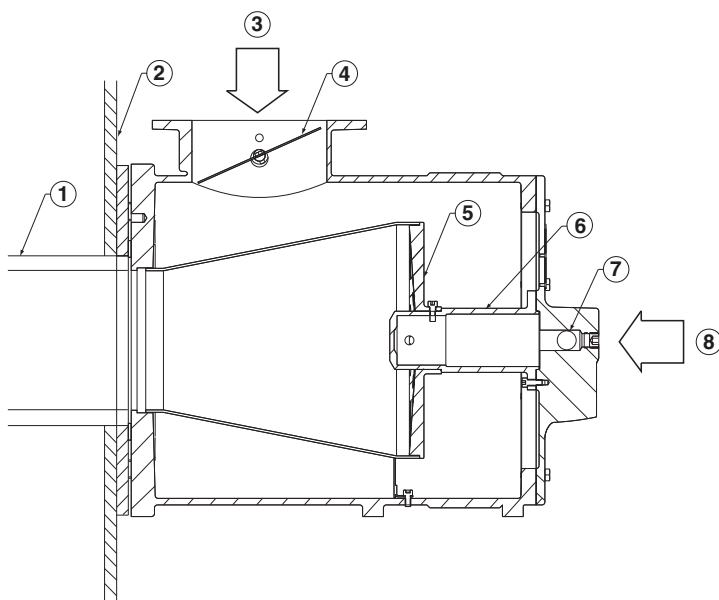
MAXON TUBE-O-THERM® burners are nozzle-mixing, gas fired, refractory-less burners specifically designed for firing into a small bore tube. The burner fires cleanly with natural gas, propane, butane or LPG blends.

TUBE-O-THERM® burners are available in two basic versions:

- packaged with integral combustion air blower
- EB (external blower) for use with an external combustion air source for extended capacities

Both versions incorporate a gas and air valve linked together to control the gas/air ratio over the full throttling range of the burner. Gas flows through the gas nozzle where it mixes with the combustion air.

- 1) Fire tube
- 2) Tank wall
- 3) Air inlet
- 4) Air control valve
- 5) Air mixing plate
- 6) Gas nozzle
- 7) Gas control valve
- 8) Gas inlet



Available TUBE-O-THERM® burner sizes

Typical burner data							
Fuel: natural gas at 15°C with 10.9 kWh/Nm ³ HHV - sg = 0.6 [1]							
Combustion air: 15°C - 21% O ₂ - 50% humidity - sg = 1.0 [1]							
Stated pressures are indicative. Actual pressures are a function of air humidity, altitude, type of fuel and gas quality.							
TUBE-O-THERM® burner	Size	3"		4"		6"	
	Description	Pkgd. [2]	EB	Pkgd. [2]	EB	Pkgd. [2]	EB
Maximum capacity	kW	120	220	220	400	490	880
Pilot capacity	kW	12	22	22	40	32	59
Minimum capacity	kW	12	22	22	40	39	70
Gas pressure burner inlet	mbar (g)	59	181	51	166	64	191
Gas pressure burner test port	mbar (g)	54	157	45	145	51	155
Combustion air pressure required	mbar (g)	9	42	11	39	15	43

[1] sg (specific gravity) = relative density to air (density air = 1.293 kg/Nm³) Given data on packaged burners are those on 50 Hz operation. For 60 Hz operation, the burner requires a different blower motor. In this case, the capacities will rise 20%, air and gas pressures will rise 44%.

Typical burner data					
Fuel: natural gas at 15°C with 10.9 kWh/Nm ³ HHV - sg = 0.6 [1]					
Combustion air: 15°C - 21% O ₂ - 50% humidity - sg = 1.0 [1]					
Stated pressures are indicative. Actual pressures are a function of air humidity, altitude, type of fuel and gas quality.					
TUBE-O-THERM® burner	Size	8" burner			
	Description	Pkgd. [3]	EB	8" HC 8" tube [2]	8" HC 10" tube [2]
Maximum capacity	kW	855	1555	2200	2500
Pilot capacity	kW	85	155	147	147
Minimum capacity	kW	85	138	73	82
Gas pressure burner inlet	mbar (g)	64	190	312	361
Gas pressure burner test port	mbar (g)	57	180	276	349
Combustion air pressure required	mbar (g)	17	62	74	68

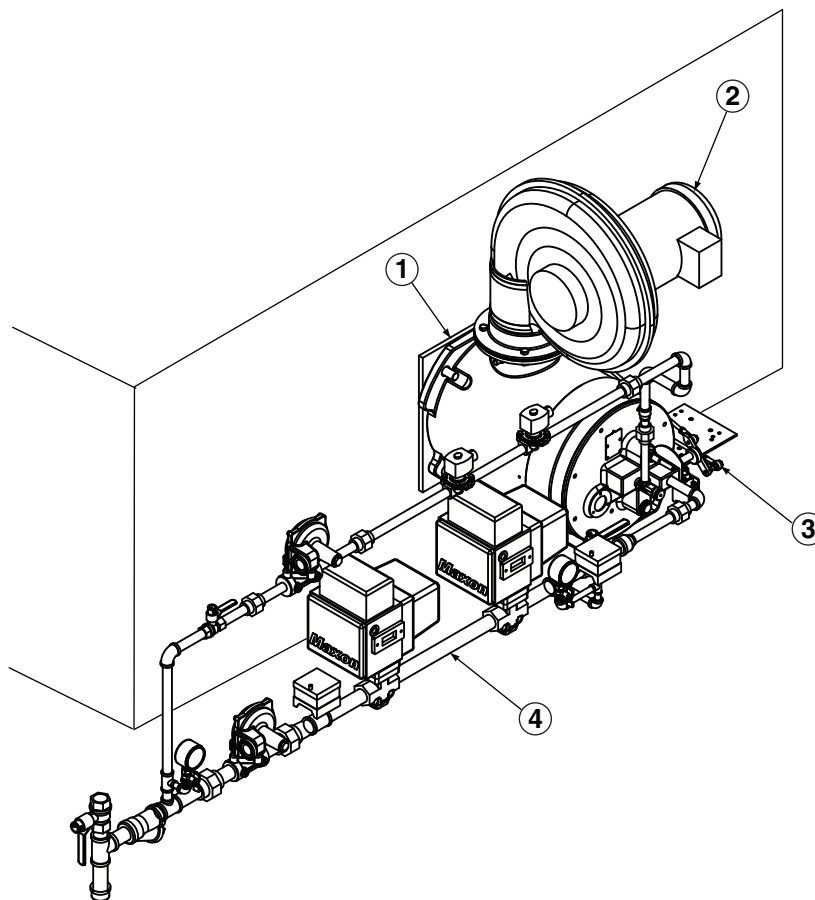
[1] sg (specific gravity) = relative density to air (density air = 1.293 kg/Nm³)

[2] HC burners require the use of an external blower (EB) Given data on packaged burners are those on 50 Hz operation. For 60 Hz operation, the burner requires a different blower motor. In this case, the capacities will rise 20%, air and gas pressures will rise 44%.

Applications

Typical applications include industrial solution heating jobs such as dip tanks, glycol reboilers, spray washers, pickling or quench tanks and salt baths. TUBE-O-THERM® burners may also be used with proper design for indirect air heaters and bakery ovens.

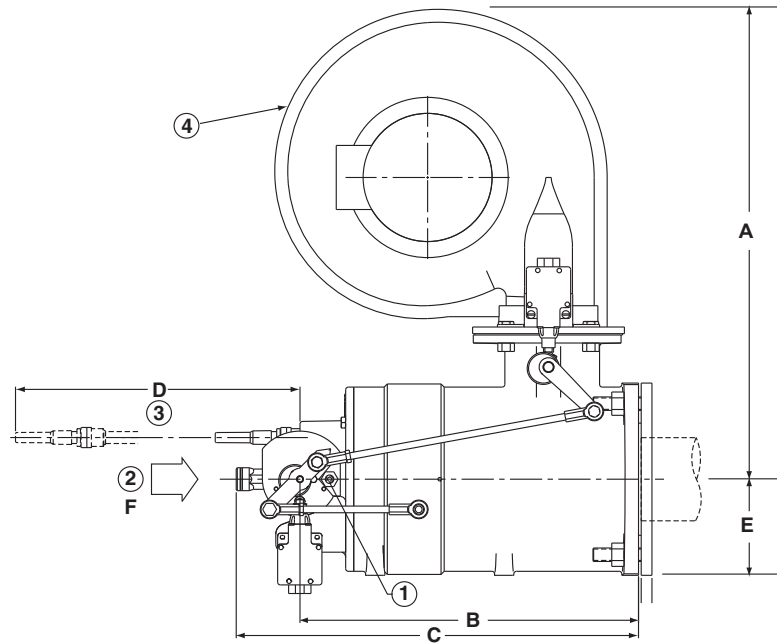
- 1) TUBE-O-THERM® burner
- 2) Combustion air fan
- 3) Air/gas control linkage
- 4) MAXON gas pipe train



Dimensions and weights

Packaged TUBE-O-THERM® burners

- 1) Gas test connection
- 2) Gas inlet
- 3) Required dimension for ignitor removal
- 4) Combustion air blower

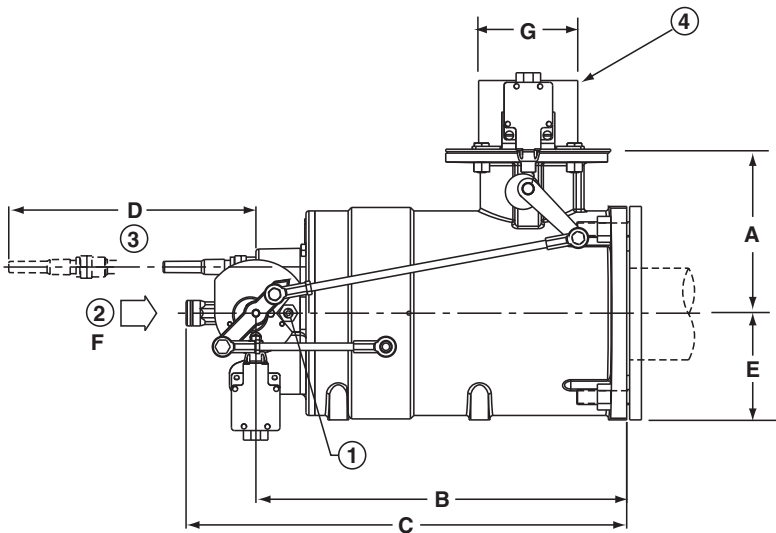


Dimensions in mm unless stated otherwise							
Burner size	A	B	C	D	E	F [1]	Weight kg
3"	549	401	478	267	124	1/2"	66
4"	587	445	517	267	145	1/2"	77
6"	725	521	585	381	197	3/4"	120
8"	780	603	648	356	234	1-1/4"	170

[1] Connections are threaded (NPT or ISO)

EB (external blower) TUBE-O-THERM® burners

- 1) Gas test connection
- 2) Gas inlet
- 3) Required dimension for ignitor removal
- 4) Combustion air inlet



Dimensions in mm unless stated otherwise								
Burner size	A	B	C	D	E	F [1]	G	Weight kg
3" EB	171	400	475	267	124	1/2"	102	48
4" EB	200	445	517	267	145	1/2"	102	61
6" EB	239	520	585	381	197	3/4"	152	91
8" EB	295	603	648	356	234	1-1/4"	152	134

[1] Connections are threaded (NPT or ISO)

Typical emissions

TUBE-O-THERM® burners utilize rapid mixing of fuel and air to suppress formation of NOx. With lower levels of excess air than many tube burners, the TUBE-O-THERM® also controls the production of CO to low levels at most of its firing rates. Exact emissions performance may vary in your application. Contact MAXON for information on installation specific estimates or guarantees. No guarantee of emissions is intended or implied without specific written guarantee from MAXON.

Read "Specifications of TUBE-O-THERM® burners" for correct and complete information on TUBE-O-THERM® burners.

Specifications of TUBE-O-THERM® burners

3" & 4" TUBE-O-THERM® burners

Typical burner data					
Fuel: natural gas at 15°C with 10.9 kWh/Nm ³ HHV - sg = 0.6 [1]					
Combustion air: 15°C - 21% O ₂ - 50% humidity - sg = 1.0 [1]					
Stated pressures are indicative. Actual pressures are a function of air humidity, altitude, type of fuel and gas quality.					
TUBE-O-THERM® burner	Size	3" burner		4" burner	
	Description	Pkgd.	EB	Pkgd.	EB
Maximum capacity [2]	kW	120	220	220	400
Pilot capacity	kW	12	22	22	40
Minimum capacity	kW	12	22	22	40
Natural gas pressure at burner inlet	mbar (g)	59	181	51	166
Natural gas pressure at burner test port	mbar (g)	54	157	45	145
Natural gas pilot gas pressure at burner test port	mbar (g)	1	3	0.9	2.5
Combustion air pressure at burner inlet	mbar (g)	9	42	11	39
Combustion air pressure at burner test port	mbar (g)	7.2	23.6	7.6	26.5
Differential air pressure [3]	mbar	2.5	7.0	2.3	7.1
Propane gas pressure at burner inlet	mbar (g)	25	80	25	81
Propane gas pressure at burner test port	mbar (g)	23	72	22	72
Propane gas pilot gas pressure at burner test port	mbar (g)	0.8	2.7	0.5	2.0
Maximum combustion air volume required	m ³ /h	134	245	245	445
Tube length (sized for 80% efficiency)	m	9	10	11	12
Tube diameter (Schedule #40 pipe or lighter)	DN	80	80	100	100
Packaged burner blower motor	kW	0.37	N/A	0.37	N/A
Packaged burner sound levels at 1 meter (no silencer)	dB(A)	85	N/A	86	N/A
Packaged burner sound levels at 1 meter (with silencer)	dB(A)	82	N/A	83	N/A

[1] sg (specific gravity) = relative density to air (density air = 1.293 kg/Nm³)

[2] Packaged burner capacities with 50 Hz fan. For operation on 60 Hz, increase capacity 20%. Fuel and air pressures should be increased by 44%. Motor power will increase by 73%. Packaged burners need to be ordered with the appropriate blower motor depending on 50 or 60 Hz availability.

[3] Differential combustion air pressure readings in a no-fire condition. Differential combustion air pressure readings can be used to diagnose problems such as blocked tubes or closed exhaust dampers.

NOTE: Burner performance can be drastically affected by tube configuration and static conditions within tube created by dampers in exhaust stack.

For proper burner adjustment, MAXON advises the use of an oxygen content meter. Optimal oxygen level in exhaust stack should read between 3 and 4 vol. % dry when measured with the burner operating at the maximum capacity firing rate.

6" TUBE-O-THERM® burners

Typical burner data			
Fuel: natural gas at 15°C with 10.9 kWh/Nm ³ HHV - sg = 0.6 [1]			
Combustion air: 15°C - 21% O ₂ - 50% humidity - sg = 1.0 [1]			
Stated pressures are indicative. Actual pressures are a function of air humidity, altitude, type of fuel and gas quality.			
TUBE-O-THERM® burner	Size	6" burner	
	Description	Pkgd.	EB
Maximum capacity [2]	kW	490	880
Pilot capacity	kW	32	59
Minimum capacity	kW	39	70
Natural gas pressure at burner inlet	mbar (g)	64	191
Natural gas pressure at burner test port	mbar (g)	51	155
Natural gas pilot gas pressure at burner test port	mbar (g)	0.5	1.5
Combustion air pressure at burner inlet	mbar (g)	15	43
Combustion air pressure at burner test port	mbar (g)	9.0	29.8
Differential air pressure [3]	mbar	3.6	9.7
Propane gas pressure at burner inlet	mbar (g)	31	102
Propane gas pressure at burner test port	mbar (g)	27	84
Propane gas pilot gas pressure at burner test port	mbar (g)	0.7	2.0
Maximum combustion air volume required	m ³ /h	545	979
Tube length (sized for 80% efficiency)	m	15	17
Tube diameter (Schedule #40 pipe or lighter)	DN	150	150
Packaged burner blower motor	kW	1.5	N/A
Packaged burner sound levels at 1 meter (no silencer)	dB(A)	88	N/A
Packaged burner sound levels at 1 meter (with silencer)	dB(A)	84	N/A

[1] sg (specific gravity) = relative density to air (density air = 1.293 kg/Nm³)

[2] Packaged burner capacities with 50 Hz fan. For operation on 60 Hz, increase capacity 20%. Fuel and air pressures should be increased by 44%. Motor power will increase by 73%. Packaged burners need to be ordered with the appropriate blower motor depending on 50 or 60 Hz availability.

[3] Differential combustion air pressure readings in a no-fire condition. Differential combustion air pressure readings can be used to diagnose problems such as blocked tubes or closed exhaust dampers.

NOTE: Burner performance can be drastically affected by tube configuration and static conditions within tube created by dampers in exhaust stack.

For proper burner adjustment, MAXON advises the use of an oxygen content meter. Optimal oxygen level in exhaust stack should read between 3 and 4 vol. % dry when measured with the burner operating at the maximum capacity firing rate.

8" TUBE-O-THERM® burners

Typical burner data					
Fuel: natural gas at 15°C with 10.9 kWh/Nm ³ HHV - sg = 0.6 [1]					
Combustion air: 15°C - 21% O ₂ - 50% humidity - sg = 1.0 [1]					
Stated pressures are indicative. Actual pressures are a function of air humidity, altitude, type of fuel and gas quality.					
TUBE-O-THERM® burner	Size	8" burner			
	Description	Pkgd.	EB	HC	8" HC 10" tube
Maximum capacity [2]	kW	855	1555	2200	2500
Pilot capacity	kW	85	155	147	147
Minimum capacity	kW	85	138	73	82
Natural gas pressure at burner inlet	mbar (g)	64	190	312	361
Natural gas pressure at burner test port	mbar (g)	57	180	276	349
Natural gas pilot gas pressure at burner test port	mbar (g)	1	3.2	1.2	1.8
Combustion air pressure at burner inlet	mbar (g)	17	62	74	68
Combustion air pressure at burner test port	mbar (g)	8.7	26.5	53.2	34.2
Differential air pressure [3]	mbar	2.4	6.7	6.7	6.5
Propane gas pressure at burner inlet	mbar (g)	31	110	152	173
Propane gas pressure at burner test port	mbar (g)	29	92	120	152
Propane gas pilot gas pressure at burner test port	mbar (g)	1	3.2	0.7	0.8
Maximum combustion air volume required	m ³ /h	952	1731	2449	2782
Tube length (sized for 80% efficiency)	m	20	22	26	28
Tube diameter (Schedule #40 pipe or lighter)	DN	200	200	200	250
Packaged burner blower motor	kW	2.2	N/A	N/A	N/A
Packaged burner sound levels at 1 meter (no silencer)	dB(A)	89	N/A	N/A	N/A

[1] sg (specific gravity) = relative density to air (density air = 1.293 kg/Nm³)

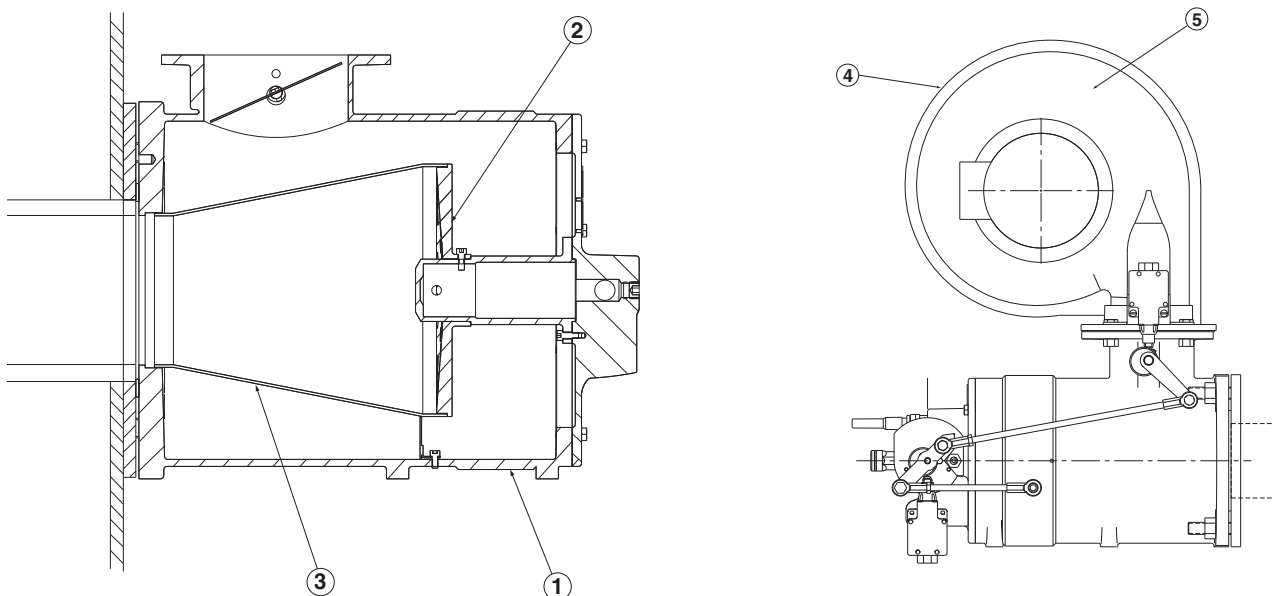
[2] Packaged burner capacities with 50 Hz fan. For operation on 60 Hz, increase capacity 20%. Fuel and air pressures should be increased by 44%. Motor power will increase by 73%. Packaged burners need to be ordered with the appropriate blower motor depending on 50 or 60 Hz availability.

[3] Differential combustion air pressure readings in a no-fire condition. Differential combustion air pressure readings can be used to diagnose problems such as blocked tubes or closed exhaust dampers.

NOTE: Burner performance can be drastically affected by tube configuration and static conditions within tube created by dampers in exhaust stack.

For proper burner adjustment, MAXON advises the use of an oxygen content meter. Optimal oxygen level in exhaust stack should read between 3 and 4 vol. % dry when measured with the burner operating at the maximum capacity firing rate.

Materials of construction



Item number	Part	Material
1	Housing	Class 3000 gray iron
2	Air plate	Class 3000 gray iron
3	Reducing transition	304 stainless steel (1.4301)
4	Blower housing	Stamped steel
5	Impeller (inside blower)	319 cast aluminum

Selection criteria

TUBE-O-THERM® burner versions

Standard TUBE-O-THERM® burner package includes a combustion air blower with a non-sparking aluminum impeller. A built-in pilot and spark ignitor is included in the cast iron burner body, as well as the air and gas control valves, gas nozzle, pilot adjustable orifice and provisions for your flame detector. Burner design permits blower to be rotated at 90° intervals around centerline for application flexibility. Please refer to burner and blower dimensions to insure blower orientation is possible.

Model EB (external blower) TUBE-O-THERM® burners, like all TUBE-O-THERM® burner assemblies, provide extended capacities with remote blowers and deliver heat efficiently into your fired tube application.

Burner designation

Burner	Size	Type	Connection	Fuel	Mounting	Accessories
TOT	4	PKGD-50	ISO	NAT	WALL	FLTR-AO

Burner

TOT - TUBE-O-THERM burner

Size

3 - 3"

4 - 4"

6 - 6"

8 - 8"

8HC - 8" high capacity

Type

PKGD-50 - Packaged: includes combustion air blower 50 Hz

PKGD-60 -Packaged: includes combustion air blower 60 Hz

EB - External blower: combustion air blower not included with burner

Connection

ANSI - ANSI threaded connection for gas

ISO - ISO threaded connection for gas

Fuel

BUT - Butane

NAT - Natural gas

PROP - Propane

Mounting

WALL - Wall mounted including wall mounting plate

WALL_NOFLG - Wall mounted excluding wall mounting plate

Accessories

FLTR - Combustion air filter

FLTRSLNCR - Filter/silencer combination

AO - Pilot gas adjustable orifice

AD - Combustion air adapter (for EB types only)

Application details

Typical applications are industrial solution heating jobs such as dip tanks, spray washers, pickling or quench tanks and salt baths. TUBE-O-THERM® burners may also be used with proper design for indirect air heaters and bakery ovens.

Temperature limitations

TUBE-O-THERM® burner internal components include Rulon bearings which have a maximum temperature limit of 260°C. At no time should combustion air inlet temperatures exceed this temperature.

Consider the temperature limit of the blower motor, the control actuator, the flame detector, and other electrical components when establishing the maximum ambient temperature around TUBE-O-THERM® burners. Most electrical devices are not suitable for ambient temperatures in excess of 60°C.

Combustion air oxygen content

The combustion air inlet to TUBE-O-THERM® burners should be located so that it consumes fresh, clean air with 20.9% oxygen. Avoid locating combustion air inlets near process exhaust outlets, volatile fumes or other inert gaseous materials.

If the TUBE-O-THERM® is used for indirect heating of air streams or process gases, avoid firing the burner when the process stream is not present to cool the fire tube array. Careful design of the fire tube array is required in these applications for expansion and temperature management.

Piloting & ignition

Pilot piping and regulator should be sized carefully for the full pilot and capacity shown on pages 1-2.1-7 to 9. Pilot regulator pressure range should match the pressure range used for the main gas regulator. This will eliminate the possibility of chattering in the pilot regulator when the main gas (higher pressure) is at high fire and the burner operates with continuous pilot. If burner controls are set to operate with interrupted pilot, chattering would not be a concern.

NOTE: The best option is to run the pilot interrupted. If the pilot is not interrupted, catalog minimums cannot be obtained. Some local codes may not allow the use of a continuous pilot. Mount pilot valve as close to the burner as possible. The pilot valve should be able to take 0.5 bar pressure at its outlet.

Refer to pages 1-2.1-7 to 9 for the proper pilot gas pressure as measured at the burner gas test port. The adjustable orifice inside the pilot can be used to establish the required pressure (4 mm hex wrench required). The pilot solenoid should be located close to the burner to allow gas to reach burner before flame safeguard “times out”.

The self-piloting feature of the burner allows pilot gas to bypass the internal gas control valve and issue from the main gas nozzle ports.

Low fire start: Main flame light-off is possible above minimum fire position, but a larger pilot will be required and turndown may be sacrificed if control design does not allow different light off and minimum positions. Direct ignition is feasible at capacities larger than full minimum. Again, turndown will not be sacrificed if control is separate for light off and minimum positions.

Ratio control

The TUBE-O-THERM® burner combustion air and fuel gas controls are factory-set and characterized to provide proper air/fuel ratios at specific supply pressures. Use combustion air blowers with relatively flat static pressure profiles (+/- 10%).

Regardless of the type of automatic control (high-low or modulating), TUBE-O-THERM® burners should not exceed 15% of maximum rating for pilot ignition and/or main flame light-off.

The built-in air and gas flow control valves are mechanically linked together. At low capacity, the air valve is slightly open but the gas valve is practically closed.

If some higher firing rate is selected for low fire on high-low installations, both valves will be opened wider. The increased combustion air will necessitate more gas for pilot ignition.

The burner's maximum output may be limited by adjusting the linkage to the actuator motor. In these under-fired conditions, size combustion air blower to full maximum capacity due to the linkage profile and expected blower characteristic.

The TUBE-O-THERM® burner was designed to accept a variety of electric modulating motors. Contact MAXON for application details of your preferred actuator.

For more accurate gas/air ratio control, use MAXON SMARTLINK® MRV or MICRO-RATIO® valves on TUBE-O-THERM® burners without internal air/gas valves.

Typical ignition sequence

- Pre-purge of burner and installation, according to the applicable codes and the installation's requirements.
- Combustion air control valve shall be in the minimum position to allow minimum combustion air flow to the burner.
- Pre-ignition (typically 2s sparking in air).
- Open pilot gas and continue to spark the ignitor (typically 5s).
- Stop sparking, continue to power the pilot gas valves and start flame check. Trip burner if no flame can be detected from here on.
- Check pilot flame stability (typically 5s) to prove the stable pilot.
- Open main gas valves and allow enough time to have main gas in the burner (typically 5s + time required to have main gas in the burner).
- Close the pilot gas valves.
- Release to modulation (allow modulation of the burner).

Above sequences shall be completed to include all required safety checks during the start-up of the burner (process & burner safeties).

Flame supervision

The TUBE-O-THERM® burner will operate with a variety of flame detectors for all burner sizes. Flame rods are not available. Contact MAXON for specific questions on flame detection.

Piping

Main gas train should be sized to give no more than 2 to 5 mbar pressure drop between gas pressure regulator and burner inlet to obtain catalog minimums. It is recommended to size the regulator for capacity at the required pressure, carefully considering pipe train losses.



Do not size fuel trains to match burner inlet thread sizes. Inlet fuel threads are typically different than a correctly sized fuel train. Reduction to the burner inlet thread size should be made as close to the burner as possible.

Fuels

Natural gas, propane, butane and other commercially available fuel gases can be used. Fuel pressures in capacity tables are listed for natural gas and propane gas. Adjust operating fuel pressures and flows according to your fuel.

Expected emissions

TUBE-O-THERM® burners utilize rapid mixing of fuel and air to suppress formation of NOx. Typical NOx formation from the burner will be 30-40% less than conventional burners.

With lower levels of excess air than many tube burners, the TUBE-O-THERM® also controls the production of CO to low levels at most of its firing rate. Higher levels of excess air are used at lower firing rates to prevent condensation in the fire tube which elevates CO production at minimum and idle input. Expect little or no CO at high firing rates with low fire CO production determined by process parameters.

Exact emissions performance may vary in your application. Contact MAXON for information on installation specific estimates or guarantees. No guarantee of emissions is intended or implied without specific written guarantee from MAXON.

Tube length and configuration

Tube design should consist of a specified length of Schedule #40 pipe or lighter in the same size as burner (unless specified otherwise). Tubes may be constructed of iron, steel, or stainless steel. It is possible to fire TUBE-O-THERM® burners into tube diameters larger than the size designation. Contact your MAXON representative for further information on tube sizing or material selection.

MAXON suggests that the first straight pass of tube consist of the minimum length shown below for each tube size. Burner capacity may be reduced if tube layout has multiple miter turns.

Burner size	Recommended first pass length
3" & 4"	15 pipe diameters minimum
6" & 8"	10 pipe diameters minimum

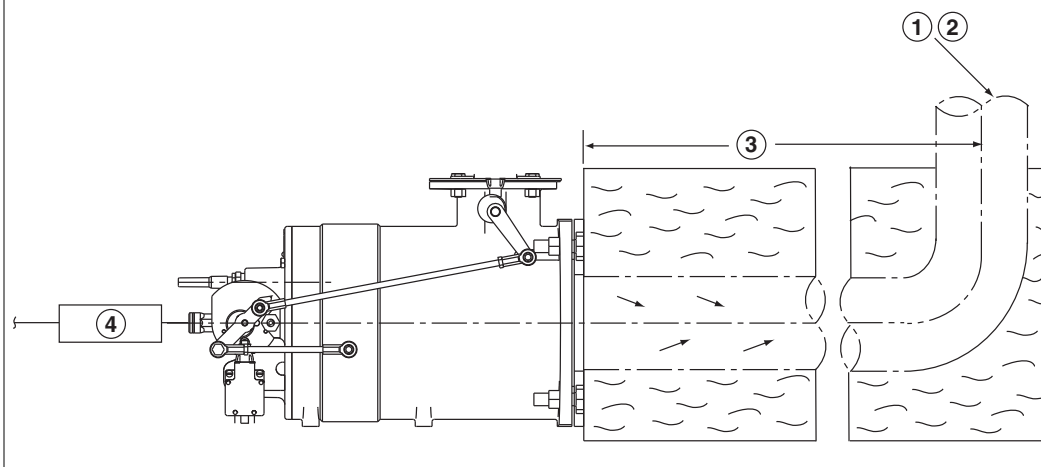


Firing tube length and resulting wetted tube surface area determines combustion transfer efficiency. Refer to efficiency vs. tube length charts on page 1-2.1-16 through 18.

Many factors affect overall system efficiency. Typical installations run in the 70% to 80% range. Space considerations (including tube displacement) may limit possible tube lengths and reduce efficiency. Above 80% efficiency, there is a risk of condensation-caused tube damage.

Typical installation

- 1) Stack dampers optional
- 2) Tank & fire tube (by others)
- 3) First pass length
- 4) Gas train



Small bore immersion tubes can be sized for efficiencies lower than 80% if tank space is limited or if complete freedom from tube condensation is desired.

NOTE: Schedule 40 pipe should be used for at least the first 0.6 meter of tube length.

Tube exhaust requirements



WARNING: Failure to follow the recommended exhaust considerations could result in poor burner performance and/or corrosion of the fired tube due to condensation.

Historically, conventional immersion tube burners were sized for 70% efficiency, since this percentage provided a compromise between operating fuel economy and tube length.

Small-bore tubes require less space than conventional tubes. Therefore, small-bore tubes can be made longer to provide efficiencies of 80% or more.

Tubes sized for 80% efficiency will have low exhaust temperatures, causing condensation to form in them during start-up or during long idling periods. This condensation will normally evaporate after the burner has run at high fire for a brief period of time. If extended idling periods are expected, a condensate drain should be provided at the low point nearest the exhaust and the immersion tube should be pitched towards the exhaust.

If the immersion tube will operate at efficiencies of 75% or lower, the exhaust leg can exit through the liquid surface in the tank without designing for condensation. However, the length of the exhaust tube must also be considered in the design as explained below.

These considerations also extend to the exhaust lengths after the tube exits the liquid surface. An exhaust tube exiting the tank will continue to transfer heat and cool the products of combustion to their condensation point. Therefore, an atmospheric break or dilution tee should be used. By doing so, the diluting atmospheric air will depress the dewpoint temperature of the combustion products so that they may exhaust out of the plant with minimal condensation.

If the dilution tee option is chosen, there must be safeguards to ensure that the diluting air is not restricted or blocked. If this were to occur, condensation inside the stack could result, with condensate flowing downward to the low point in the tube, possibly blocking the tube and causing burner instability.



Because of the high firing rates possible with this burner and the low cross-sectional area of the tubes, no draft or chimney effect should be designed for, or expected. If an optional exhaust stack damper is used, size the damper for 85% of the area of the stack.



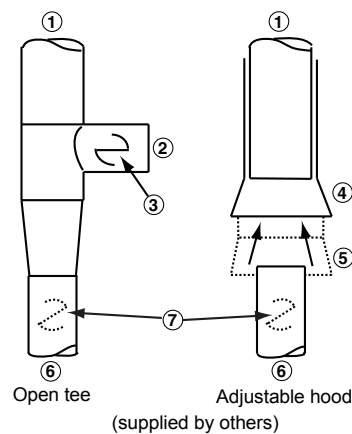
Note that TUBE-O-THERM® burners release heat beginning at the burner mounting surface. In most cases, the fire tube must be fluid backed. Extension stubs or insulated fire tube entries are not recommended and risk thermal damage to the burner, structure and the tube.

Immersion tubes are usually vented to the outdoors, except for those in highly ventilated areas such as a plating room with continuous high-volume exhaust. An exhaust fan is generally not required but may be used in cases of high building negative pressure. Exhaust is normally diluted to avoid the need for high-temperature fans, but adequate make-up air must be available.

This diluting can be done with an open tee installed in a vertical run (or in a horizontal run with the open end down), but such a system mixes slowly.

An adjustable hood (shown in sketch below) offers much better performance. In all cases, care must be taken that all products of combustion are exhausted from the building.

- 1) To outdoors or exhaust fan
- 2) Diluting air tee
- 3) All adjustments to be locked in position
- 4) Adjustable hood
- 5) Diluting air
- 6) Immersion tube
- 7) Exhaust stack damper

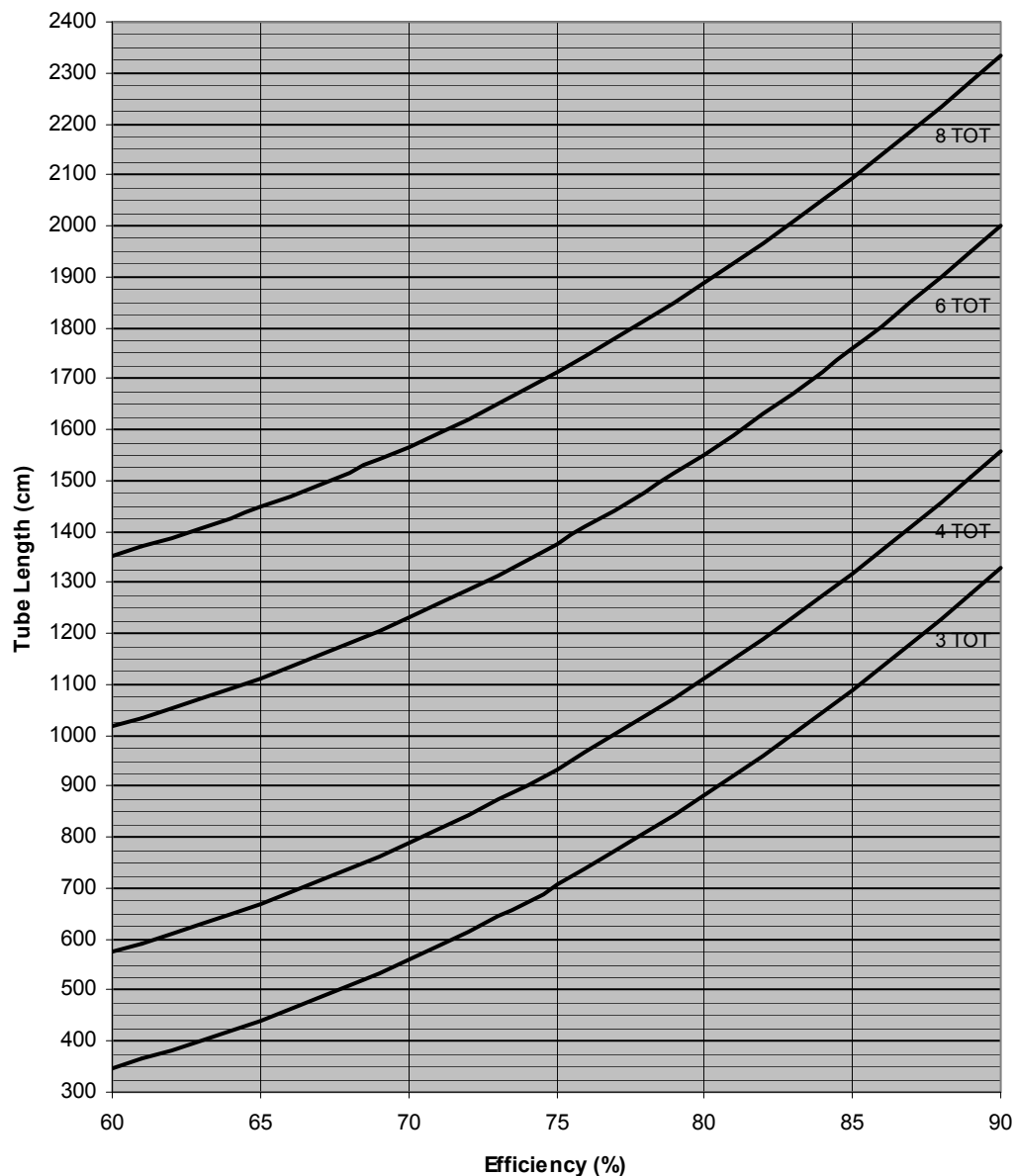


Cross-sectional area of the exhaust hood should be a minimum of 1.5 times the fired tube cross-sectional area.

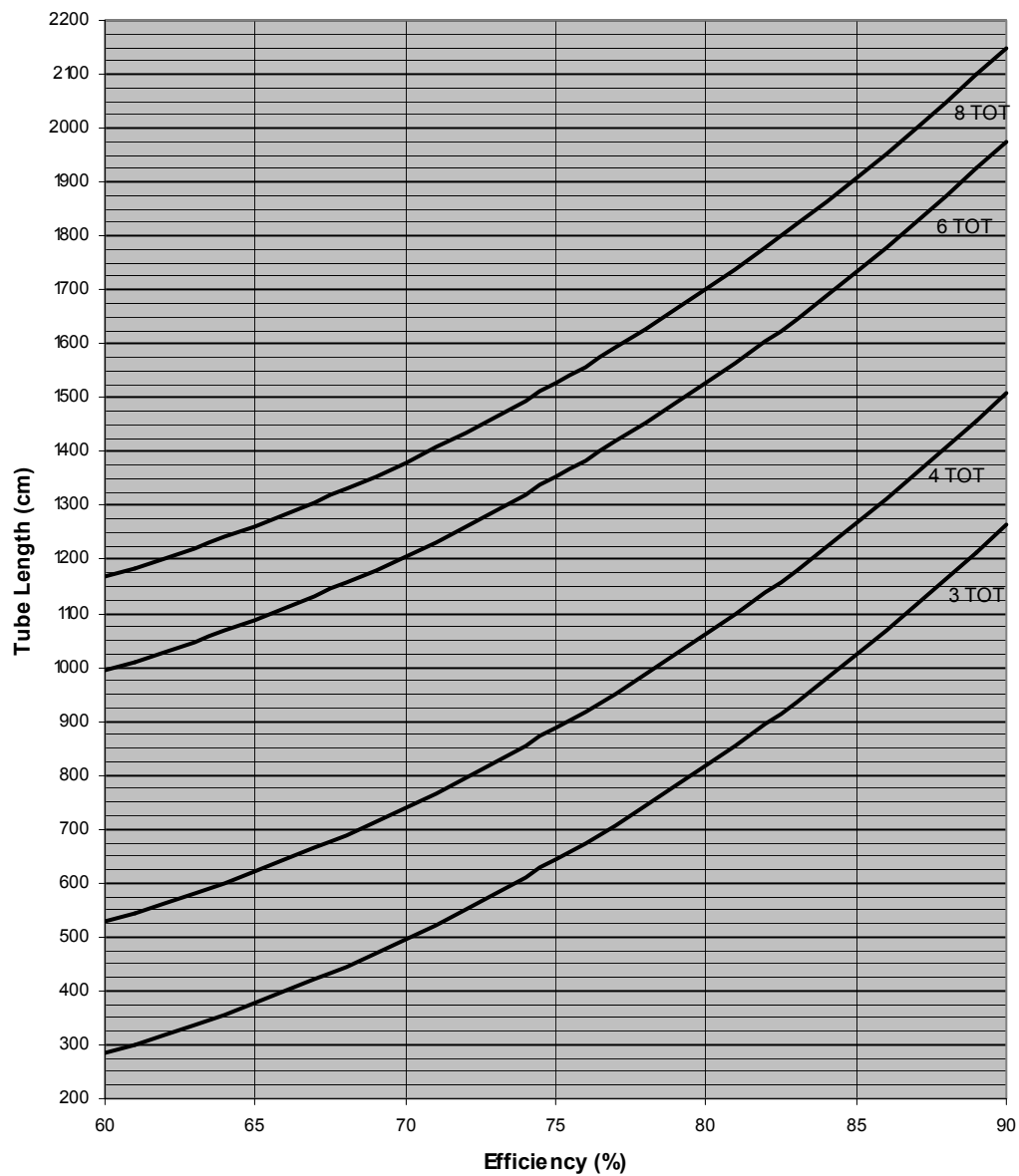
Because of the high firing rates possible with this burner and the low cross-sectional area of the tubes, no draft or chimney effect should be designed for, or expected. If an optional exhaust stack damper is used, size the damper for 85% of the area of the stack. The use of an exhaust stack damper could also help solve resonance in some cases.

Immersion tube sizing

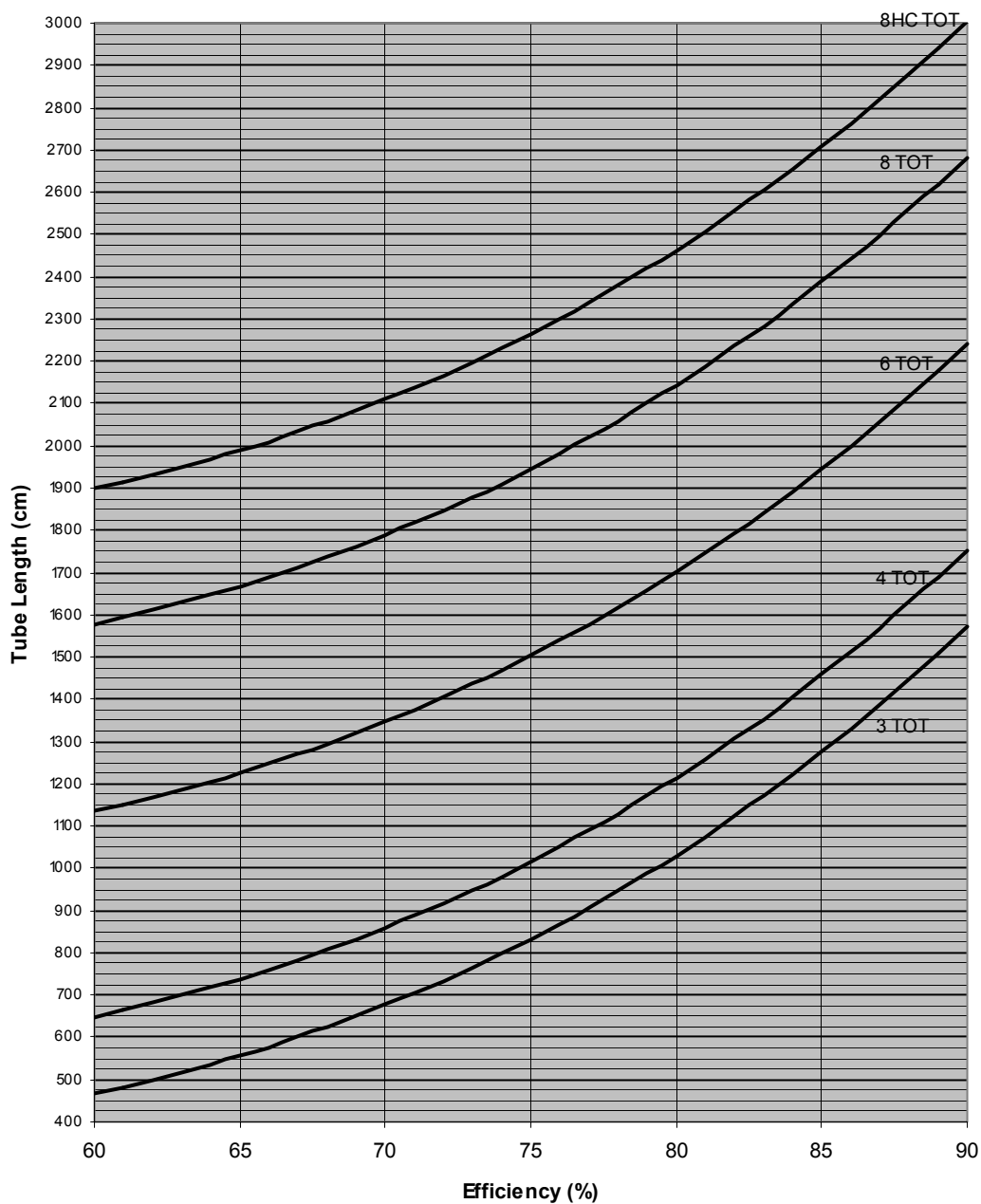
60 Hz Pkgd TOT Efficiency



Pkgd TOT 50Hz Efficiency



EB TOT Efficiency



- Systems sized for 80% efficiencies or higher need to account for condensation during extended idling periods. Refer to Selection Criteria on pages 1-2.1-10.
- Use the centerline lengths of elbows when computing total tube length.
- Note that longer tube lengths are required to achieve the same efficiency on external blower (EB) versions. This is due to increased maximum firing rate.
- When a burner will not be firing at its maximum capacity, the tube length will decrease to maintain the same efficiency. Contact MAXON for tube length calculations in these cases.

Indirect firing

Tube sizing charts are applicable only to liquid-backed immersion tubes. Indirect-fired applications (non-liquid backed fired tubes) could require additional length depending on the specific application. For indirect firing in moving air streams, the tube sizing charts will look different. Contact MAXON for more details on these applications.

Recommended air stream velocity across fired tubes is 10 to 15 m/s.

Multiple burner arrangement

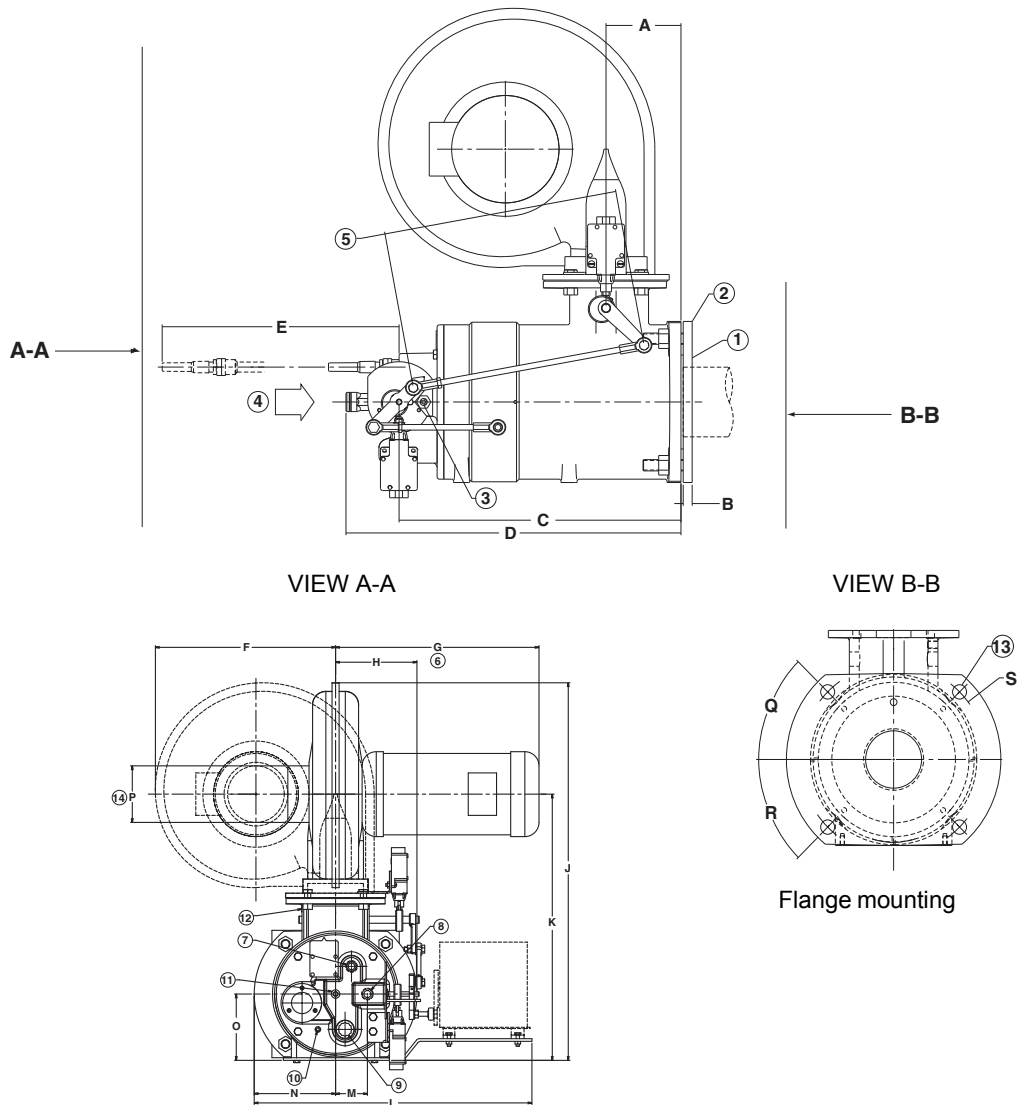
Multiple burner installations fed by a single pipe train should incorporate a balancing valve and a swing check valve installed as close as possible to each burner gas inlet for improved heating uniformity and more dependable light-off. Otherwise, gas manifold may act as a reservoir, preventing reliable light-off during trial for ignition period of your control panel sequence.

Dimensions and weights

3" packaged TUBE-O-THERM® burner

- 1) Mounting plate
- 2) Continuous weld mounting plate to tank wall
- 3) Gas test connection 1/8"
- 4) Gas inlet
- 5) This dimension is critical for proper operation and must be held 333 mm ±7 mm
- 6) Motor may change based on availability. Size will not exceed dimension shown.
- 7) Spark ignitor location 1/2"
- 8) Main gas inlet 1/2"
- 9) Scanner connection 3/4"
- 10) Air test connection 1/8"
- 11) Pilot gas inlet 3/8"
- 12) Combustion air test connection 1/8"
- 13) Recommended mounting stud M16
- 14) Air inlet

Threaded connections are available in NPT or ISO, depending on the burner type



Dimensions in mm unless stated otherwise

A	B	C	D	E [1]	F	G	H	J	K
107	13	401	478	267	340	365	147	673	483

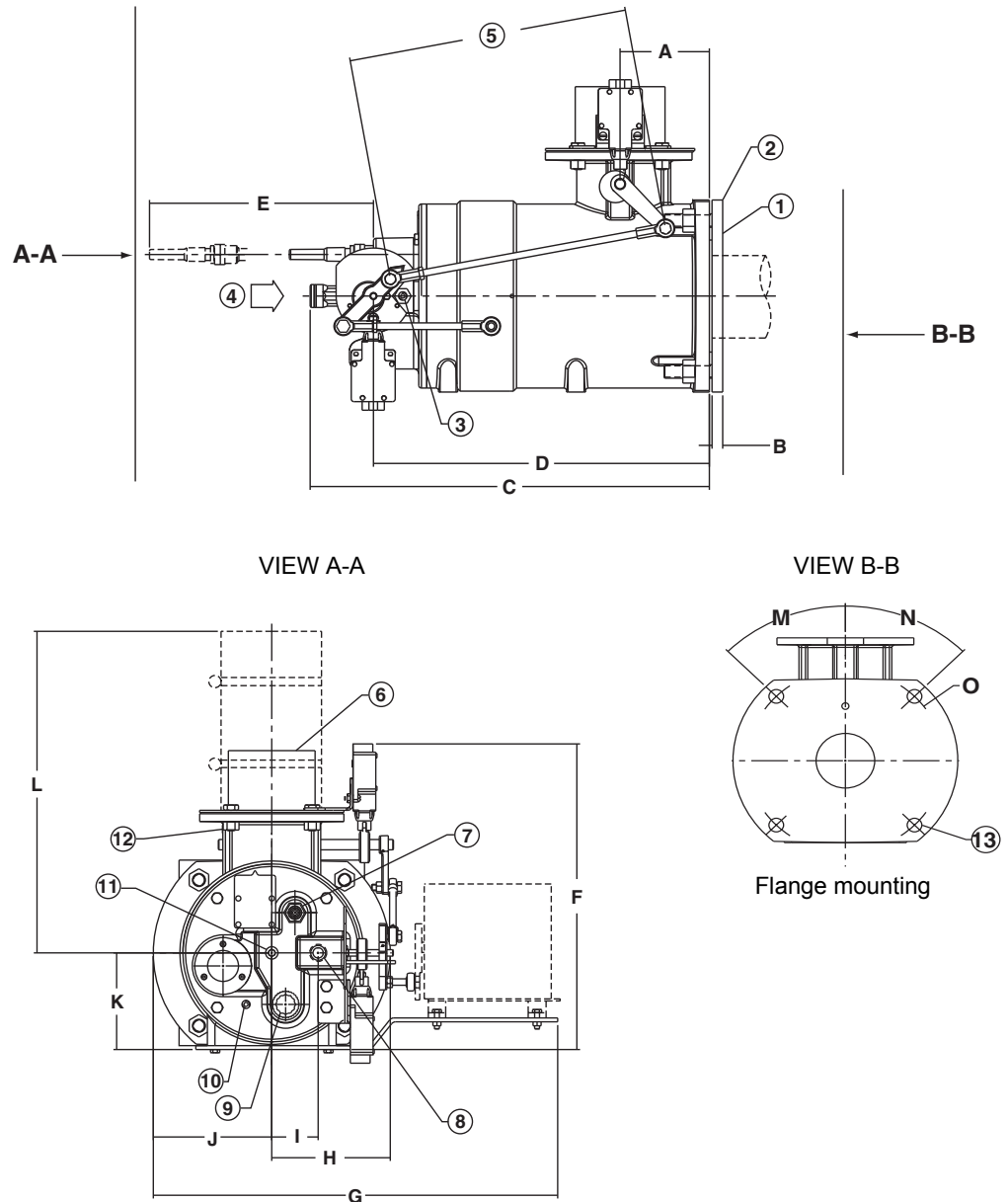
L	M	N	O	P Ø	Q	R	S Ø	Weight kg
498	57	147	124	102	45°	45°	254	66

[1] Required dimension for ignitor removal

3" EB (external blower) TUBE-O-THERM® burner

- 1) Mounting plate
- 2) Continuous weld mounting plate to tank wall
- 3) 1/8" gas test connection
- 4) Gas inlet
- 5) This dimension is critical for proper operation and must be held 345 mm \pm 7 mm
- 6) Air inlet
- 7) Spark ignitor location 1/2"
- 8) Main gas inlet 1/2"
- 9) Scanner location 3/4"
- 10) Air test connection 1/8"
- 11) Pilot gas inlet 3/8"
- 12) Combustion air test connection 1/8"
- 13) Recommended mounting stud M16

Threaded connections are available in NPT or ISO, depending on the burner type



Dimensions in mm unless stated otherwise

A	B	C	D	E [1]	F	G	H
107	13	475	400	267	391	498	147

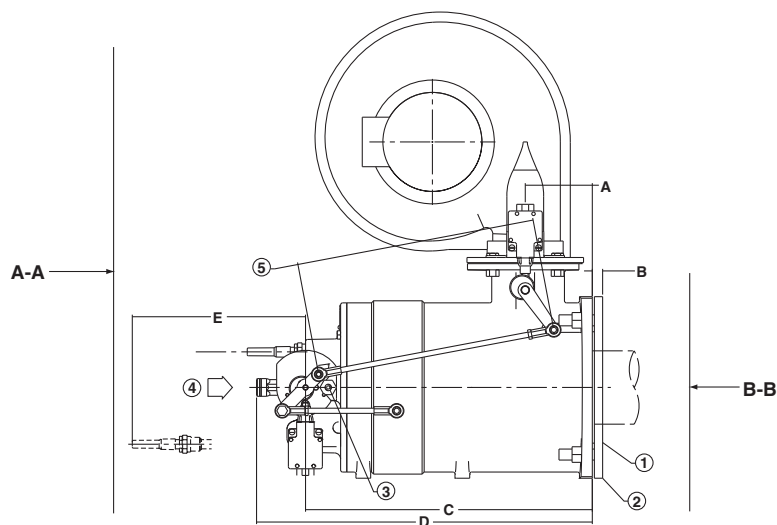
I	J	K	L	M	N	O Ø	Weight kg
57	147	124	396	45°	45°	254	48

[1] Required dimension for ignitor removal

4" packaged TUBE-O-THERM® burner

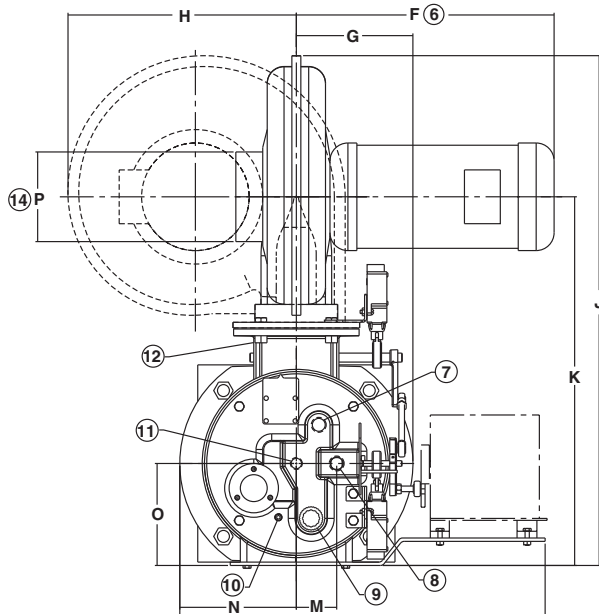
- 1) Mounting plate
- 2) Continuous weld mounting plate to tank wall
- 3) Gas test connection 1/8"
- 4) Gas inlet
- 5) This dimension is critical for proper operation and must be held 368 mm ± 7 mm
- 6) Motor may change based on availability. Size will not exceed dimension shown.
- 7) Spark ignitor location 1/2"
- 8) Main gas inlet 1/2"
- 9) Scanner location 3/4"
- 10) Air test connection 1/8"
- 11) Pilot gas inlet 3/8"
- 12) Combustion air test connection 1/8"
- 13) Recommended mounting stud
- 14) Air inlet

Threaded connections are available in NPT or ISO, depending on the burner type



VIEW A-A

VIEW B-B



Flange mounting

Dimensions in mm unless stated otherwise

A	B	C	D	E [1]	F	G	H	J	K
104	13	445	517	267	365	165	323	732	530

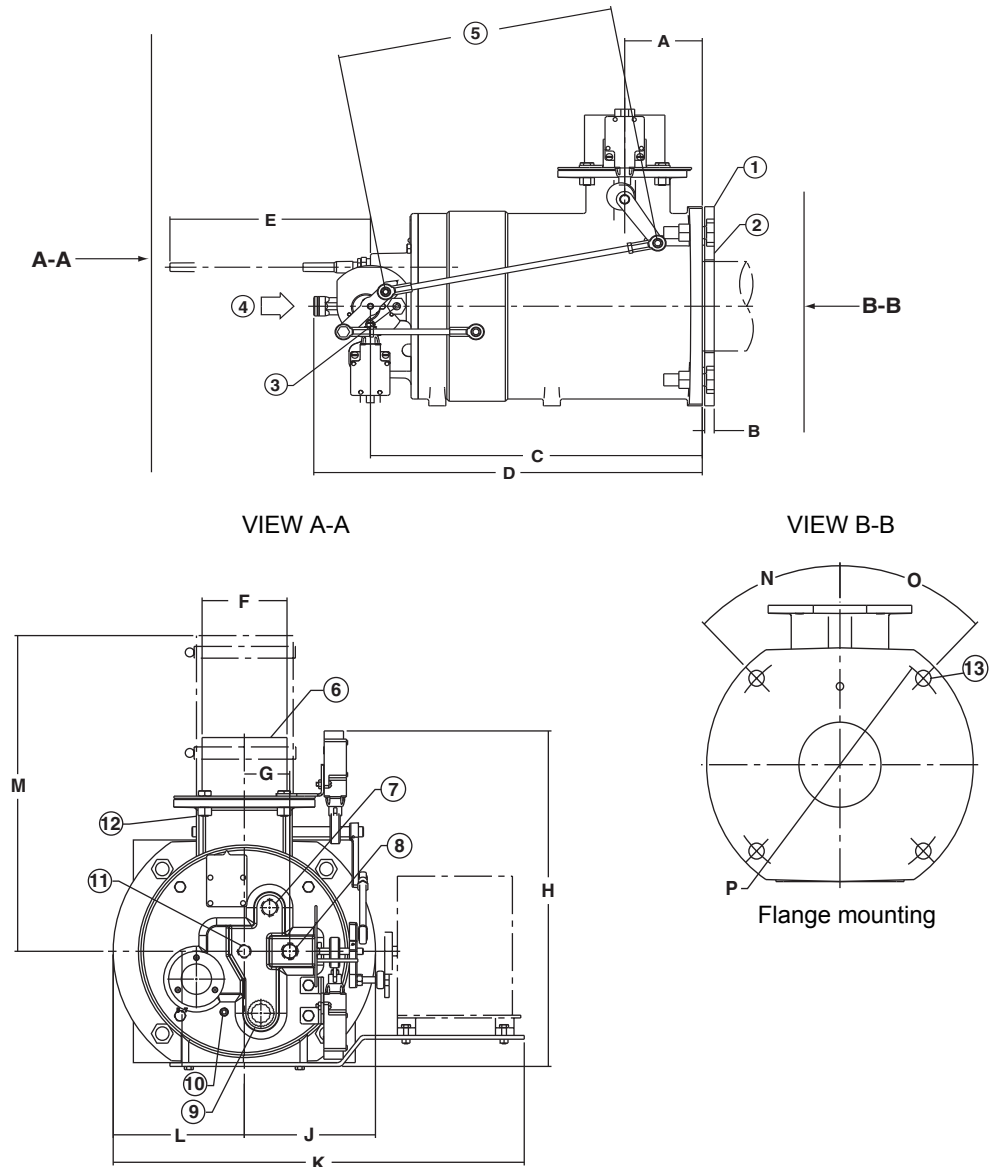
L	M	N	O	P Ø	Q Ø	R	S	Weight kg
518	64	165	145	127	292	45°	45°	77

[1] Required dimension for ignitor removal

4" EB (external blower) TUBE-O-THERM® burner

- 1) Mounting plate
- 2) Continuous weld mounting plate to tank wall
- 3) 1/8" gas test connection
- 4) Gas inlet
- 5) This dimension is critical for proper operation & must be held $368 \text{ mm} \pm 7 \text{ mm}$
- 6) Air inlet
- 7) Spark ignitor location 1/2"
- 8) Main gas inlet 1/2"
- 9) Scanner location 3/4"
- 10) Air test connection 1/8"
- 11) Pilot gas inlet 3/4"
- 12) Combustion air test connection 3/4"
- 13) Recommended mounting stud M16

Threaded connections are available in NPT or ISO, depending on the burner type



Dimensions in mm unless stated otherwise							
A	B	C	D	E [1]	F Ø	G	H
104	13	445	517	267	102	57	430

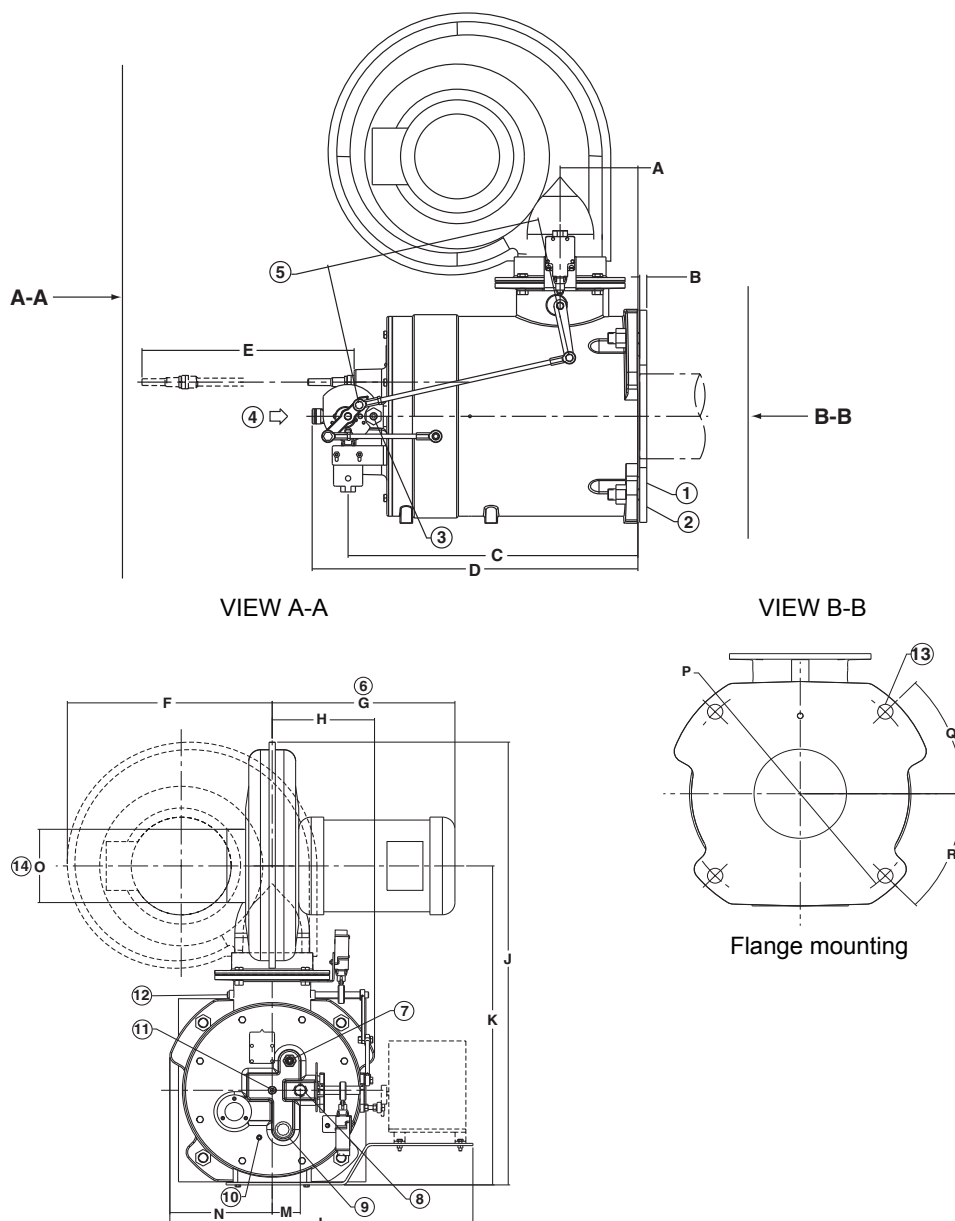
J	K	L	M	N	O	P Ø	Weight kg
165	518	165	404	45°	45°	292	60

[1] Required dimension for ignitor removal

6" packaged TUBE-O-THERM® burner

- 1) Mounting plate
- 2) Continuous weld mounting plate to tank wall
- 3) 1/4" gas test connection
- 4) Gas inlet
- 5) This dimension is critical for proper operation & must be held 387 mm ± 7 mm
- 6) Motor may change based on availability. Size will not exceed dimension shown.
- 7) Spark ignitor location 1/2"
- 8) Main gas inlet 3/4"
- 9) Scanner location 3/4"
- 10) Air test connection 1/8"
- 11) Pilot gas inlet 3/8"
- 12) Combustion air test connection 1/8"
- 13) Recommended mounting stud M20
- 14) Air inlet

Threaded connections are available in NPT or ISO, depending on the burner type



Dimensions in mm unless stated otherwise

A	B	C	D	E [1]	F	G	H	J
140	13	521	585	381	417	371	208	922

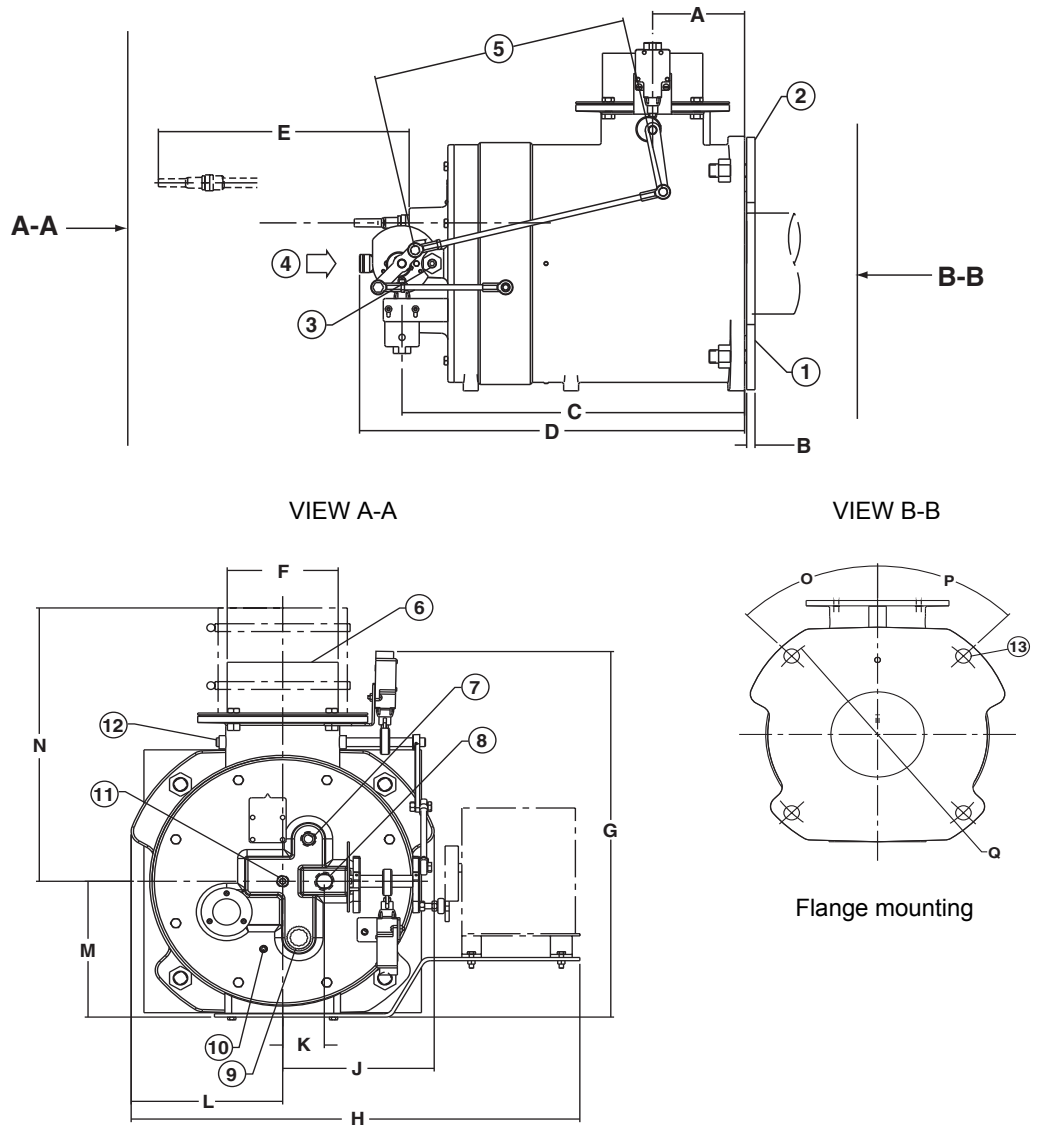
K	L	M	N	O Ø	P Ø	Q	R	Weight kg
663	616	57	208	152	397	45°	45°	120

[1] Required dimension for ignitor removal

6" EB (external blower) TUBE-O-THERM® burner

- 1) Mounting plate
- 2) Continuous weld mounting plate to tank wall
- 3) Gas test connection 1/8"
- 4) Gas inlet
- 5) This dimension is critical for proper operation & must be held 387 mm ± 7 mm
- 6) Air inlet
- 7) Spark ignitor location 1/2"
- 8) Main gas inlet 3/4"
- 9) Scanner location 3/4"
- 10) Air test connection 1/8"
- 11) Pilot gas inlet 3/8"
- 12) Combustion air test connection 1/8"
- 13) Recommended mounting stud M20

Threaded connections are available in NPT or ISO, depending on the burner type



Dimensions in mm unless stated otherwise

A	B	C	D	E [1]	F Ø	G	H	J
140	13	520	585	381	152	530	616	208

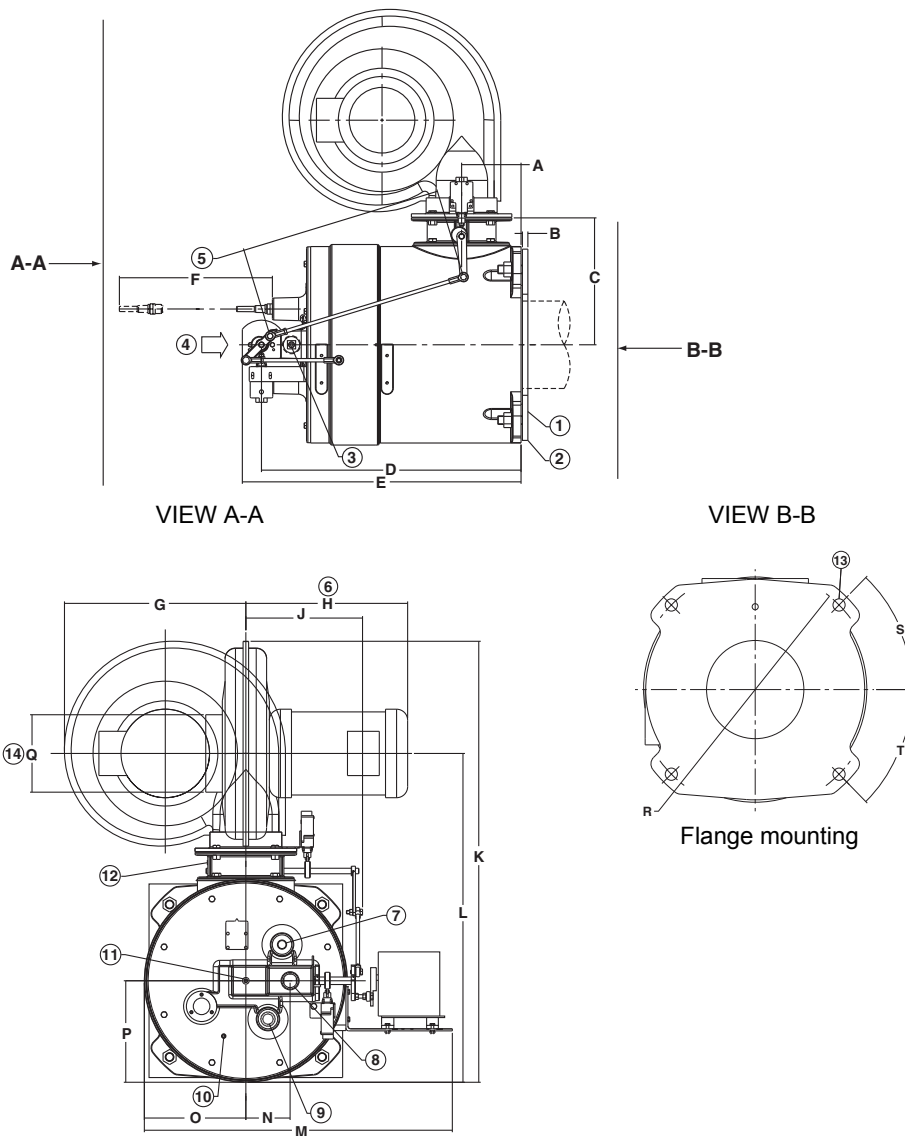
K	L	M	N	O	P	Q Ø	Weight kg
57	208	197	396	45°	45°	397	91

[1] Required dimension for ignitor removal

8" packaged TUBE-O-THERM® burner

- 1) Mounting plate
- 2) Continuous weld mounting plate to tank wall
- 3) Gas test connection 1/8"
- 4) Gas inlet
- 5) This dimension is critical for proper operation & must be held 473 mm ± 7 mm
- 6) Motor may change based on availability. Size will not exceed dimension shown.
- 7) Spark ignitor location 1/2"
- 8) Main gas inlet 1-1/4"
- 9) Scanner location 3/4"
- 10) Air test connection 1/8"
- 11) Pilot gas inlet 3/8"
- 12) Combustion air test connection 1/8"
- 13) Recommended mounting stud M20
- 14) Air inlet

Threaded connections are available in NPT or ISO, depending on the burner type



Dimensions in mm unless stated otherwise

A	B	C	D	E	F [1]	G	H	J	K
137	13	295	603	648	356	417	371	268	1013

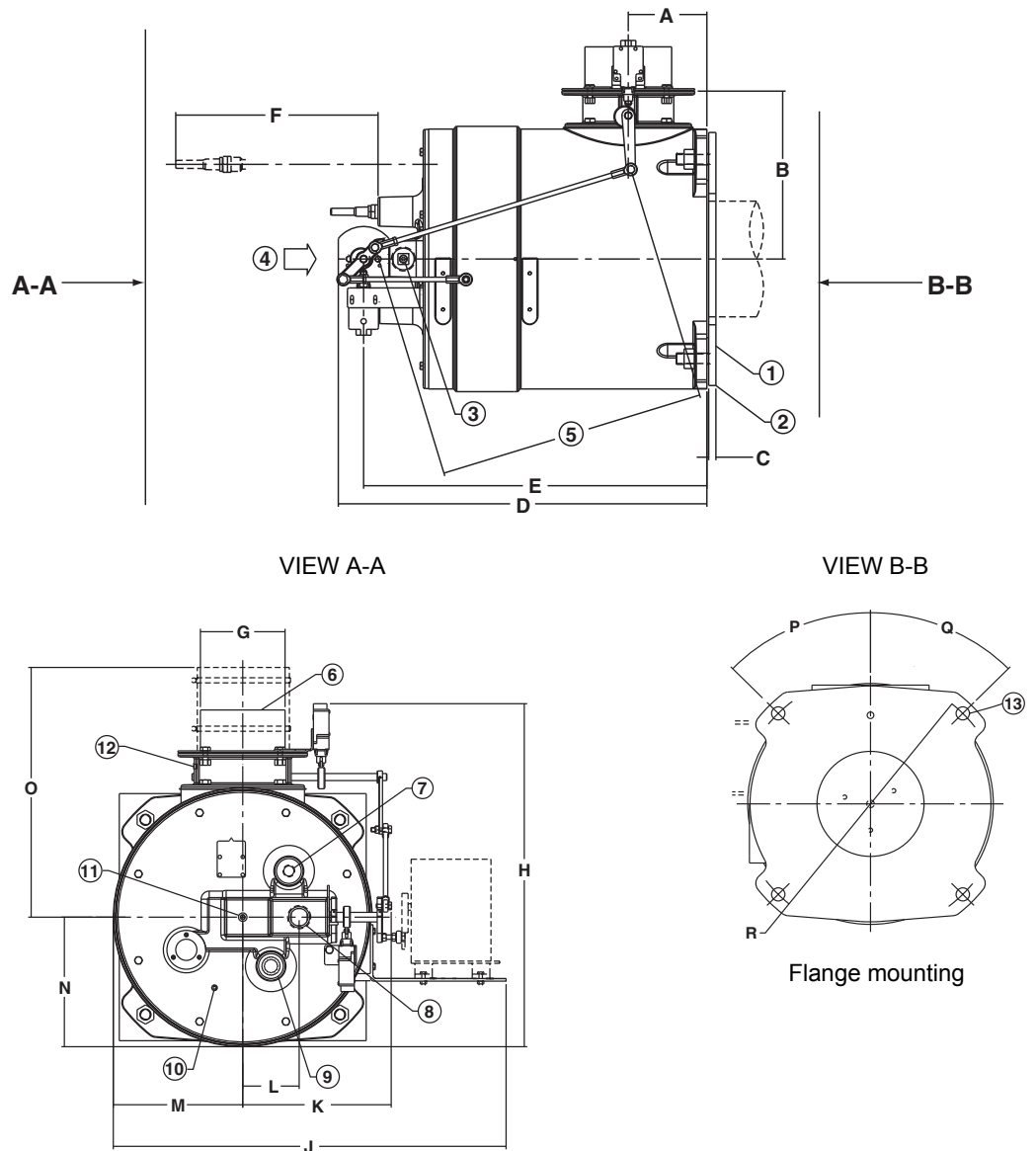
L	M	N	O	P	Q Ø	R Ø	S	T	Weight kg
755	706	102	234	234	178	495	45°	45°	168

[1] Required dimension for ignitor removal

8" EB (external blower) HC TUBE-O-THERM® burner**This drawing is valid for 8" EB, 8" HC on 8" tube, and 8" HC on 10" tube**

- 1) Mounting plate
- 2) Continuous weld mounting plate to tank wall
- 3) Gas test connection 1/8"
- 4) Gas inlet
- 5) This dimension is critical for proper operation & must be held 475 mm \pm 7 mm for EB and 457 mm \pm 7mm for HC
- 6) Air inlet
- 7) Spark ignitor location 1/2"
- 8) Main gas inlet 1-1/4"
- 9) Scanner location 3/4"
- 10) Air test connection 1/8"
- 11) Pilot gas inlet 3/8"
- 12) Combustion air test connection 1/8"
- 13) Recommended mounting stud M20

Threaded connections are available in NPT or ISO, depending on the burner type



Dimensions in mm unless stated otherwise

A	B	C	D	E	F [1]	G Ø	H	J
137	295	13	648	603	356	152.4	617	706

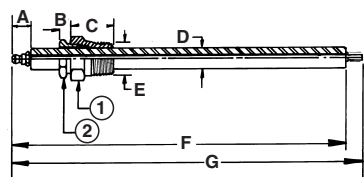
K	L	M	N	O	P	Q	R Ø	Weight kg
267	102	234	234	449	45°	45°	495	133

[1] Required dimension for ignitor removal

Accessories

Spark ignitor

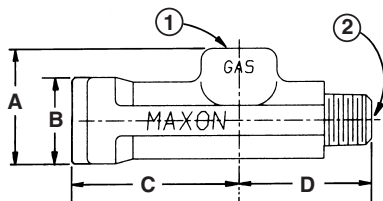
- 1) 15/16" hex
- 2) 13/16" hex



Dimensions in mm unless stated otherwise							
Burner size	A	B	C	D Ø	E NPT	F	G
3" & 4"	13	5	29	14	1/2"	222	229
6" & 8"	13	5	29	14	1/2"	311	318

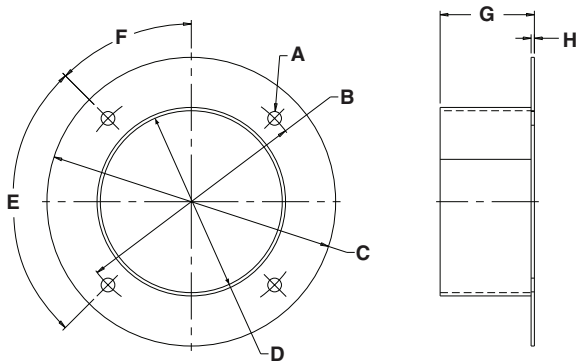
Pilot gas adjustable orifice

- 1) 3/8" NPT gas inlet
- 2) 3/8" NPT outlet



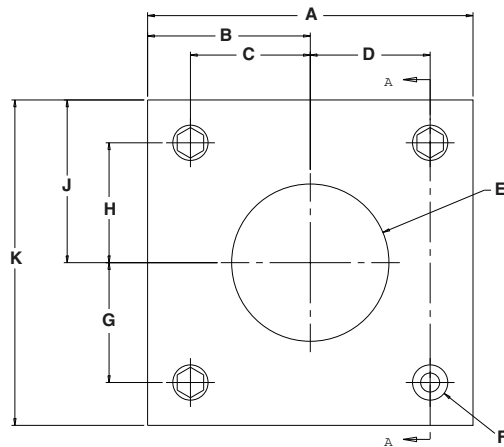
Dimensions in mm unless stated otherwise			
A	B Ø	C	D
32	25	44	32

EB adapter flange

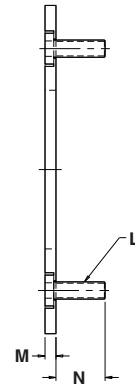


Dimensions in mm unless stated otherwise								
Burner size	A Ø	B Ø	C Ø	D Ø	E	F	G	H
3" & 4"	11	142	178	102	90°	45°	76	2.7
6" & 8"	11	190	233	147	90°	45°	76	2.7

Wall mounting plate

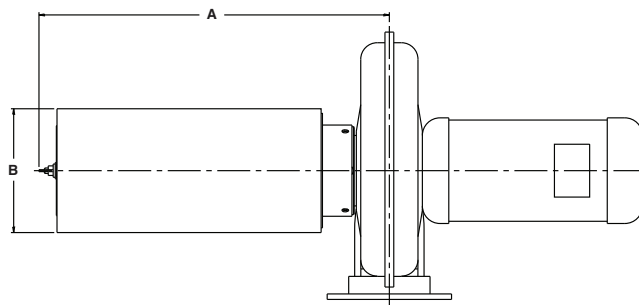


Section A-A

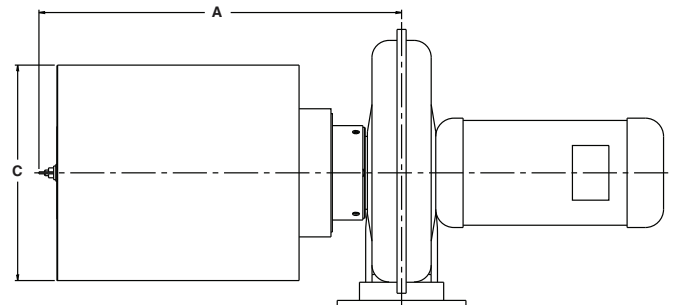


Dimensions in mm unless stated otherwise													
Burner size	A	B	C	D	E Ø	F Ø	G	H	J	K	L	M	N
3"	229	114	89	89	105	18	89	89	114	229	51	13	57
4"	279	140	103	103	130	18	103	103	140	279	51	13	57
6"	381	190	140	140	184	22	140	140	190	381	64	13	57
8"	445	222	175	175	235	22	175	175	222	445	64	13	57

Foam filter and filter/silencer



Foam filter



Foam filter/silencer

Dimensions in mm unless stated otherwise			
Burner size	A	B Ø	C Ø
3"	515	178	300
4"	500	178	300
6" & 8"	690	229	416

Installation and operating instructions for TUBE-O-THERM® burners

Application requirements

Support burner air and gas piping

Burner and pipe manifold support will be required to support weight of the burner and connected pipe train components. Pneumatic control actuators, in particular, require additional support. MAXON connecting base and linkage assemblies are designed to position the actuators to work with the burner, not to support their weight.

The TUBE-O-THERM® burner may require external auxiliary support provided by the user. Additional burner support may be required in conjunction with a stiffener plate when mounting TUBE-O-THERM® Burner onto tube or thin tank walls.

Installation instructions

Storage of TUBE-O-THERM® burners

TUBE-O-THERM® burners shall be stored dry (inside).

Handling of TUBE-O-THERM® burners

TUBE-O-THERM® burners are shipped as complete units. Handle burners with care during unpacking, transport, lifting and installation. Use proper equipment. Any impact on the burner could result in damage.

Flange the burner to the installation

Bolt the burner to the installation's burner mounting flange. Use proper gasketing. Tighten the flange bolting with correct torque. Retighten all bolts after first firing and regularly after commissioning.

Burner mounting

Horizontal mounting of the burner is preferred, but burner may be mounted in any position suitable for automatic control motor and UV scanner.

After placing burner in position, add lock washers and nuts, then draw up hand-tight only. Check that burner is centered, then tighten all nuts firmly.

For proper performance of any burner, air inlet and motor should be surrounded by clean, fresh, cool air.

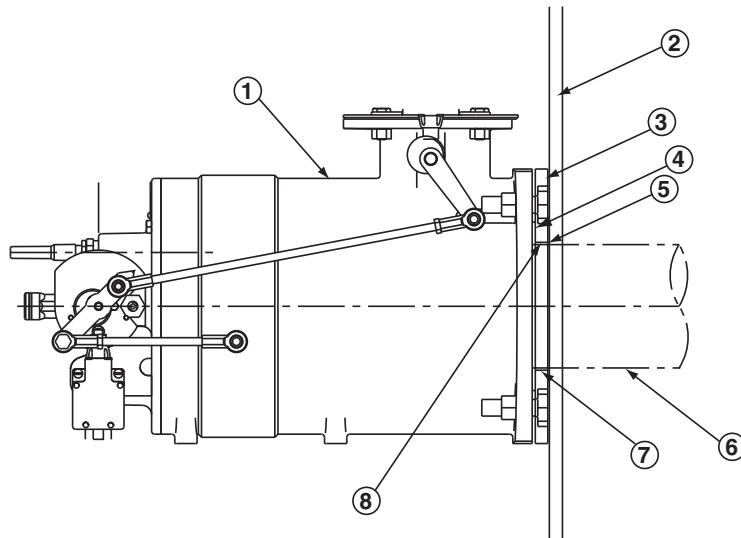
The TUBE-O-THERM® burner was designed to transfer heat to your process as efficiently as possible. As a result, your process tube, which bolts to the outlet of the TUBE-O-THERM® burner, can become hot during the burner's operation.

MAXON suggests using a burner support independent of the flange if tank walls are thin or if machine vibration is typical or expected. Consult your MAXON representative for more information.

To install the wall mounting

- Insert the immersion tube through the tank wall, making sure that it extends no more than 10 mm past the outside of the wall (the tube should be as flush as possible with the wall mounting plate once it is installed).
- Weld the immersion tube to the tank wall.
- Slip the wall mounting plate over the immersion tube (with the screw heads facing the tank wall) and seal weld the inner diameter to the tank wall. Intermittant weld the outer sides of the mounting plate for enhanced strength.
- Optional: Continuous weld the outer sides of the mounting plate. In this case, the inner diameter of the mounting plate shall not be welded.
- Attach the burner to the mounting bolts.

- 1) TUBE-O-THERM® burner
- 2) Tank wall (customer's) - immersion tube should extend no more than 10 mm past this outside wall
- 3) Wall mounting plate (MAXON) (to be welded to customer's tank)
- 4) Gasket (MAXON) - high temperature sealant applied between burner body and gasket only
- 5) Existing weld - tank wall/tube
- 6) Immersion tube (customer's)
- 7) I.D. of MAXON-supplied mounting plate is 3/4" larger than O.D. of tube. This is to allow a gap for weld clearance where the tube welds to the tank wall.
- 8) Seal weld I.D.



Protective covers

Protective covers for burner should be added in the field if exposure to dripping condensate, splashing flux, exhaust steam, etc. is unavoidable. Any such cover should be removable to provide access to burner and should not interfere with control linkage motion, observation port viewing or air inlet.



In some applications, the burner housing may become significantly warm. While this does not damage the burner or impede performance, guards or protective material may be required to protect personnel from burn hazards.

Start-up instructions for TUBE-O-THERM® Burner



Important: Do not discard packing material until all loose items are accounted for.

To prevent damage in transit, the spark ignitor, mounting ring, flame detector and connecting linkage components may be packed separately and shipped loose with the burner.

Instructions provided by the company or individual responsible for the manufacture and/or overall installation of a complete system incorporating MAXON burners take precedence over the installation and operating instructions provided by MAXON. If any of the instructions provided by MAXON are in conflict with local codes or regulations, please contact MAXON before initial start-up of equipment.



Read the combustion system manual carefully before initiating the start-up and adjustment procedure. Verify that all of the equipment associated with and necessary to the safe operation of the burner system has been installed correctly, that all pre-commissioning checks have been carried out successfully and that all safety-related aspects of the installation are properly addressed.

Initial adjustment and light-off should be undertaken only by a trained commissioning engineer.

Safety interlocks

Guarantee that all the required safety locks as described in the applicable codes or regulations, or supplementary safety blocks requested for safe operation of the overall installation, are working properly and resulting in a positive safety-lock of the burner. Do not bypass any of these safety interlocks. This will result in unsafe operation.

Checks during and after start-up

During and after start-up, check the integrity of the system. Check all bolted connections after first firing (first time on temperature) and retighten if necessary.

Purge

For safety reasons, it is required to purge the installation sufficiently to ensure that all possible combustibles are evacuated before ignition. Refer to the applicable local codes and your specific application requirements to determine the purge time.

Pilot ignition

Before ignition of the pilot, adjust the combustion air to the minimum burner air flow. Pilot will not ignite if too high an air flow. Set pilot gas flow to the correct value before pilot ignition attempt.

Main burner ignition

Set correct gas flow for burner minimum capacity before attempt of main burner ignition.

After ignition of main burner, allow some time on minimum capacity to allow the burner parts to heat up slowly.

Adjust air/gas ratio. Set maximum capacity.

Once the main flame is ignited, adjust air/gas ratio of the burner to have the required combustion quality and slowly increase capacity.

Troubleshooting

On occasions during cold start-up, a rumbling will occur in the tube until thermal equilibrium is established. This is normal and should disappear within a few minutes. A low-fire time period of approximately 2 minutes is recommended prior to high-fire operation.

If after several minutes of high-fire operation the rumbling has not decreased or the burner exhibits flame instability, shut off the burner and perform the following checks:

- Start all system-related fans and blowers. Check for proper motor rotation and impeller direction. Verify that all control interlocks are working. Allow air handling equipment to run for adequate purge of your manifolds and immersion tubes. With main gas shut off, manually advance TUBE-O-THERM® burner's operating crank to high-fire position so that air only flows through burner and immersion tube.
- Determine and verify differential air pressure at burner backplate test ports.
Connect a manometer between the gas test port and the air test port. With the burner operating crank at high-fire position, fuel valve(s) closed, air handling systems and combustion air blower on, the manometer will read the differential combustion air pressure.

Air test port should be connected to the (+) end of the manometer as it will have the higher pressure over the gas test port.

NOTE: The chart below shows normal differential combustion air pressure readings in a no-fire condition. These readings will increase when burner is firing. The fuel gas pressures shown are at high fire condition.

Burner	Size	3"		4"		6"		8"			
	Model	Pkg.	EB	Pkg.	EB	Pkg.	EB	Pkg.	EB	HC [2]	HC [3]
Differential air pressure	mbar	2.6	7.0	2.2	7.0	3.6	9.7	2.4	6.7	6.7	6.5
Natural gas pressure [1]	mbar (g)	54	157	45	145	51	155	57	180	276	349
Propane gas pressure [1]	mbar (g)	23	72	22	72	27	84	29	92	120	152

[1] at burner gas test port

[2] With 8" tube

[3] With 10" tube

If your reading is higher than these cold air pressure readings, you have a suction in your tube. This condition should not be a problem.

If your reading is lower than the cold air differential pressure reading, you have a back pressure in your tube.



If an exhaust stack damper is used, check that it is fully open and locked in place.

Excessive back pressure can cause high CO emissions, smoke and carbon in firing tube and will restrict firing capacity of the burner.



The differential air pressure setting can be used to diagnose system issues.



Burner performance can be drastically affected by tube configuration and static conditions within tube created by dampers in exhaust stack.

- All TUBE-O-THERM® burners are shipped with the air/gas linkage factory set. Check centerline to centerline dimensions on the air/gas linkage to determine that it is proper length per dimension #5 on pages 1-2.1-19 to 26. The linkage is fabricated as a turnbuckle-style link. To adjust, simply loosen the locknut and twist the arm clockwise to shorten, or counter-clockwise to lengthen the linkage.
- If air/gas linkage dimension is correct per dimensions shown on pages 1-2.1-19 to 26, check wiring diagram to blower motor to determine that dual voltage motor has been wired properly. Failure to do so will result in differential air pressure readings that are out of specification. Correct wiring errors as necessary.
- If stack damper is used in error, make certain it is full open and locked (may need to be removed).

Maintenance & inspection instructions

Safety requirements

Regular inspection, testing and recalibration of combustion equipment according to the installation manual is an integral part of its safety. Inspection activities and frequencies shall be carried out as specified in the installation manual.

Visual inspections

Regular visual inspection of all connections (air and gas piping to the burner, bolting of the burner to the tank wall) and burner flame size and aspect are essential.

In normal operation, little more is required than periodic checking to see that control motor linkage has not slipped from adjustment and that burner remains tightly mounted to the firing tube.

Burner should be shielded from splashing and physical abuse.

Inspect impeller for proper rotation, speed and dirt build-up which might reduce air flow. If your system includes an air filter, schedule maintenance as required for your plant environment.

Combustion air filters

Always keep air filters clean for optimum system performance.

Clean as needed to remove any dry accumulations. To remove oil and dirt, wash elements in hot water and detergent as necessary.

Replaceable elements can be wrung gently and allowed to air dry before returning to service. Permanent elements should generally be blown dry after rinsing, and if desired, a light coating of suitable oil applied.

To avoid interruption to service, you may wish to order a spare element set.

Flame sensing

Flame sensing is accomplished by a UV scanner. Keep scanner as close to burner as feasible. Use only minimal cooling air to scanner port. Excessive cooling air flow can impede flame detection.

Recommended spare parts

Keep local stock of spark ignitor. It is not recommended to keep local stock of other burner parts. Consult installation manual for burner spare parts and system accessories.