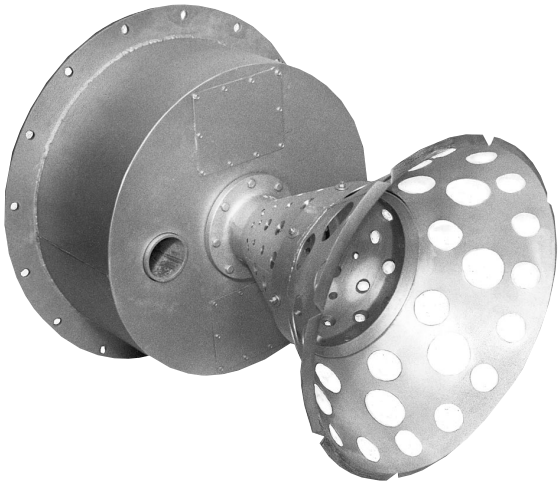
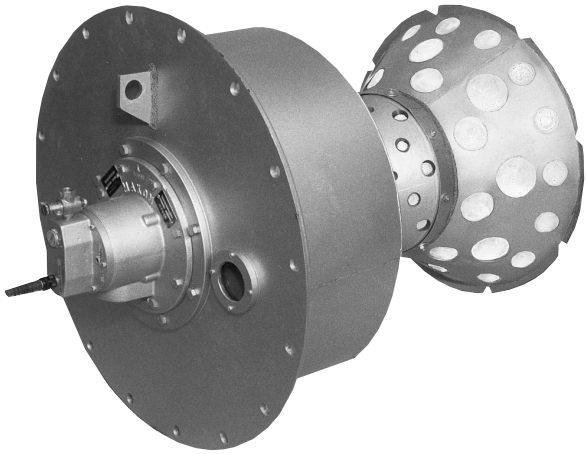
Circular INCINO-PAK® Burners





Circular INCINO-PAK® Burner shown with wall mounting plug

- **Circular INCINO-PAK® Burners** have been specifically designed for the thermal incineration in cylindrical combustion chambers of combustible gaseous effluents from a wide variety of industrial processes.
- **These special cone-type COMBUSTIFUME® Burners** provide outside-the-duct access to the raw gas pilot, ignitor, and flame safeguard components. The vital parts are easily retractable and protected from the heat from the combustion chamber. Easy installation, operation, and maintenance are assured.
- **Considerable savings in primary energy** are realized since the raw gas Circular INCINO-PAK® Burners do not require any external combustion air source. All the oxygen for combustion comes from the oxygen content normally in most effluent air streams.
- **Two popular sizes are offered:** 4,000,000 or 8,000,000 maximum Btu/hr capacities. Both sizes provide 20:1 turndown capabilities on natural gas.
- **Application of a Maxon Circular INCINO-PAK® Burner greatly simplifies** the construction of your cylindrical incinerator chamber, since both burner sizes are available as “standard” with a through-the-wall mounting, or complete with an insulated “wall mounting plug” that further simplifies burner installation.

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

Circular INCINO-PAK® Burners

Principle of Operation

The time-tested Maxon AIRFLO® Burner principles are also designed into the Circular INCINO-PAK® Burner. A customer-installed **profile plate** surrounds the burner and **creates a pressure drop** which directs the passing effluent air stream through the **burner's cone and extension ring** at a high velocity where it is mixed with a controlled volume of fuel gas. With the intensive mixing and turbulent condition created within the burner's mixing cone, a rapid temperature rise from the combustion reaction is produced to help ensure complete incineration of the effluents.

The burner is a nozzle-mixing type which does not need external combustion air; only the fuel gas flow needs to be controlled.

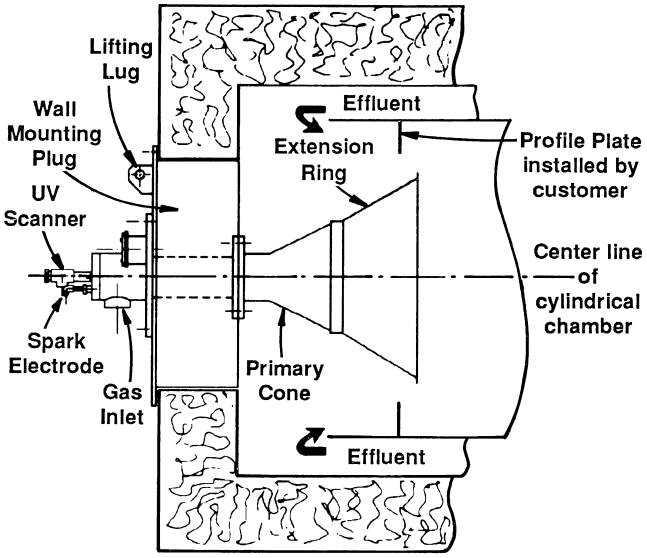
The burner can be ignited by means of the integrated raw gas pilot, or by direct-spark ignition of the main burner. **Direct-spark ignition must incorporate a "low fire start" inter-lock.**

A special feature is the central gas inlet on which a spark ignitor, a pilot and sight tube for the UV-scanner are mounted. These vital parts are easily retractable and protected from the heat emanating from the combustion chamber. **Neither the pilot nor ignitor/sight tube need any compressed/cooling air.**

The mixing cone is two-part: the **primary cone** of a special stainless steel, which can withstand very high temperatures. It not only guarantees resistance to high-reaching temperatures but also ensures accurate supply of oxygen-bearing effluent to the burner.

Radial and tangential drillings in this primary cone create the right swirl required to mix oxygen-bearing effluent and gas correctly inside the mixing cone resulting in an excellent flame stability and a large turndown.

The special connection between the primary cone and extension ring allows for expansion in all directions. The construction is such that **no mounting or support brackets are required,** thus avoiding deformation.



Cross sectional view

If necessary, the **extension ring** can be replaced, e.g. if the burner has to operate under severe working conditions.

A complete Circular INCINO-PAK® Burner system normally includes a gas train, an adjustable gradient-type gas control valve and a combustion control panel. Your Maxon representative can help you choose from the broad range available.

Circular INCINO-PAK® Burner applications

This burner is typically used for direct gas-fired incineration of combustible gaseous effluents in applications such as:

Coil coating lines	Paint baking ovens
Fiberglass curing	Printing processes
Lithographing ovens	Textile dryers
Metal coating lines	Wire enameling

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Design and Application Details

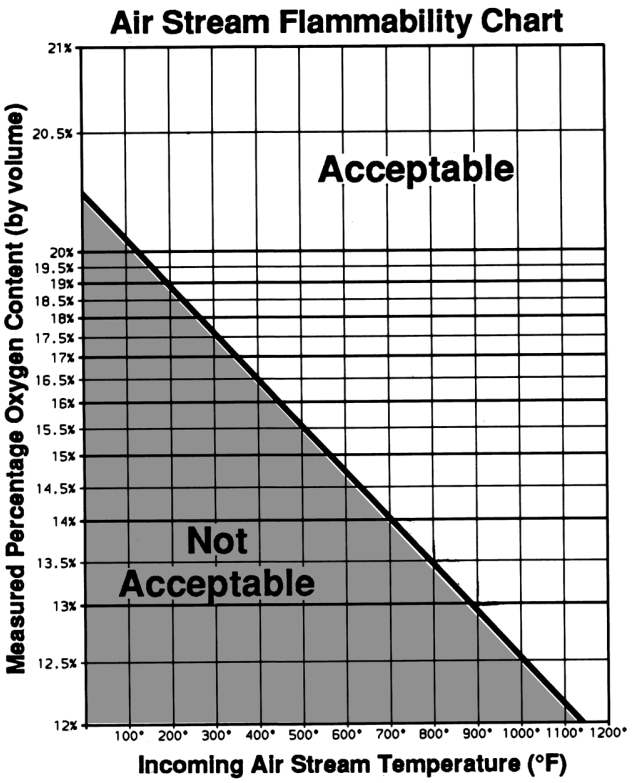
Determine air stream flammability limits and/or minimum oxygen content levels.

Since oxygen content within the effluent is critical to the flammability range of any raw gas type burner, it also directly affects the maximum capacity (Btu/hr) of a Circular INCINO-PAK® Burner.

The chart (below) graphically relates the incoming air stream temperatures (°F) and the measured percentage of oxygen remaining in this effluent.

Any combination of temperature and oxygen level falling above the raw gas firing diagonal line should support combustion with a raw gas Circular INCINO-PAK® Burner system.

CAUTION: Combinations of incoming temperatures and measured percent of oxygen falling **below** the diagonal line **are not acceptable applications for the raw gas Circular INCINO-PAK® Burner.** Alternate choices may be selected from Maxon catalog sections 4200 and/or 5700.



Profiling for higher temperature applications

When calculating profile dimensions for Circular INCINO-PAK® Burner systems in applications with higher inlet air temperatures, greater temperature rises, and/or variable air stream volumes, the effluent with elevated temperatures and densities must be considered.

Burner Design Parameters

Temperature limits:

Maximum Temperatures	Inlet	1200°F (649°C)
	Outlet	1700°F (927°C)

Burner net free areas:

4M size	110 square inches
8M size	170 square inches

Calculating Circular INCINO-PAK® Burner capacity requirements in effluent air streams:

Sample calculations for designing a raw gas Circular INCINO-PAK® Burner system for a thermal fuel incinerator (with 16+% oxygen level) are provided on the following page.

To calculate heat requirements, you must know:

_____ SCFM of effluent air stream

_____ °F inlet air temperature

_____ °F outlet air temperature

Performance Selection Data

Design procedure and calculation example *(continued)*

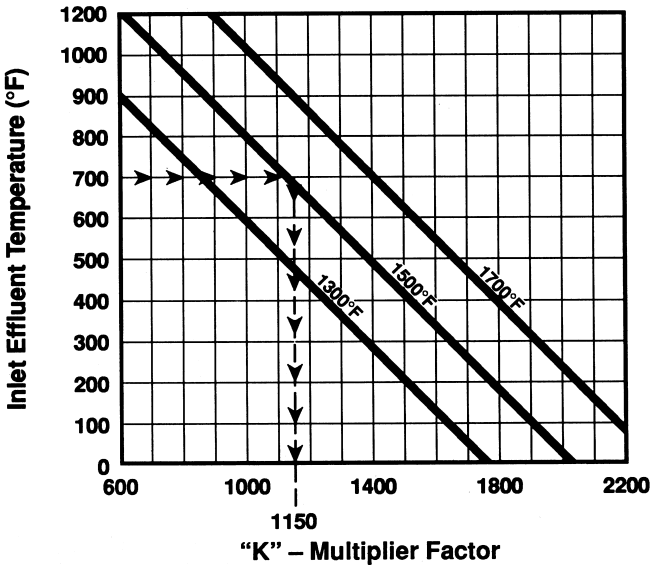
General Selection Procedure

1. **Determine available oxygen level in air stream to be heated.**
   For a raw gas application, we will use 16+% oxygen level.
2. **Determine the SCFM of air through the incinerator. Include any variations in this flow.**
   For our calculations, we will use a constant volume air fan of 5000 SCFM.
3. **Determine inlet temperature of effluent to Circular INCINO-PAK® Burner.**
   We will use inlet temperature of 700°F.
4. **Determine outlet or discharge temperatures from the incinerator.**
   For our example, we will design for 1500°F.
5. **Calculate maximum total heat required.**

Btu/hr = SCFM x "K"
(from step 2) (from chart below)

Multiply SCFM of air by multiplier (K), which combines hypothetical available heat and a 1.08 composite air heating factor to give the value in Btu required being "gross heating value" of fuel. Since multiplier (K) varies with inlet and discharge air temperature, the various factors are graphically shown below:

For 1300°F, 1500°F and 1700°F discharge temperatures



Evolvement of "K" = $\left(\frac{\text{CFH gas}}{\text{SCFM air}}\right)$ x 1000

Enter chart at 700°F inlet temperature line (from step 3); follow across to intersect the 1500°F discharge temperature sloped line, then drop straight down to read the "K" multiplier factor of 1150.

Therefore, the maximum heat input required:

Btu/hr = 5000 SCFM x 1150 = 5,750,000

Calculating Circular INCINO-PAK® Burner profile opening:

6. "Net" profile opening calculations:

$$\textbf{Net Area (in}^2\textbf{)} = \frac{\textbf{ACFH}}{\textbf{1655 x "K" x } \sqrt{\frac{\textbf{inches wc drop}}{\textbf{specific gravity}}}}$$

$$\textbf{ACFH} = \text{SCFM x } \left(\frac{460 + \text{inlet temp.}}{460 + \text{ambient temp.}}\right) \text{ x 60 min/hr}$$

"K" = 0.78 orifice coefficient for Circular INCINO-PAK® Burner profile opening

Inches wc drop = desired pressure drop
(see optimum range on page 5755)

$$\textbf{Specific gravity} = 1.0 \text{ x } \left(\frac{460 + \text{ambient temp.}}{460 + \text{inlet temp.}}\right)$$

7. "Gross" opening calculations:

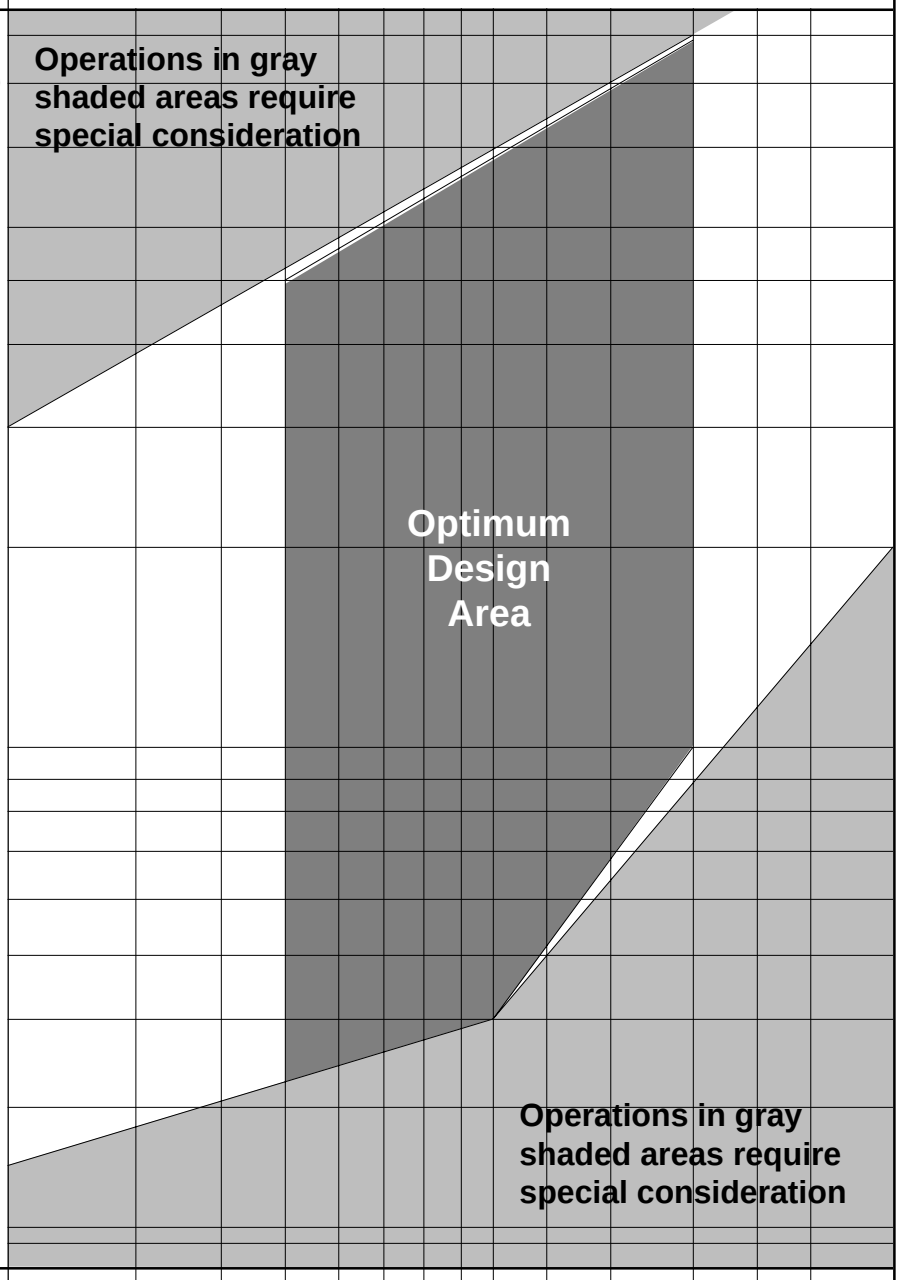
Gross opening =
net area (from step 6) + (425.6 in² (approx. area of extension sleeve blockage) – burner net free area (from chart pg. 5753))

Radius = $\sqrt{\frac{\text{Gross opening}}{3.14}}$

Diameter = 2 x radius

Performance Selection Data

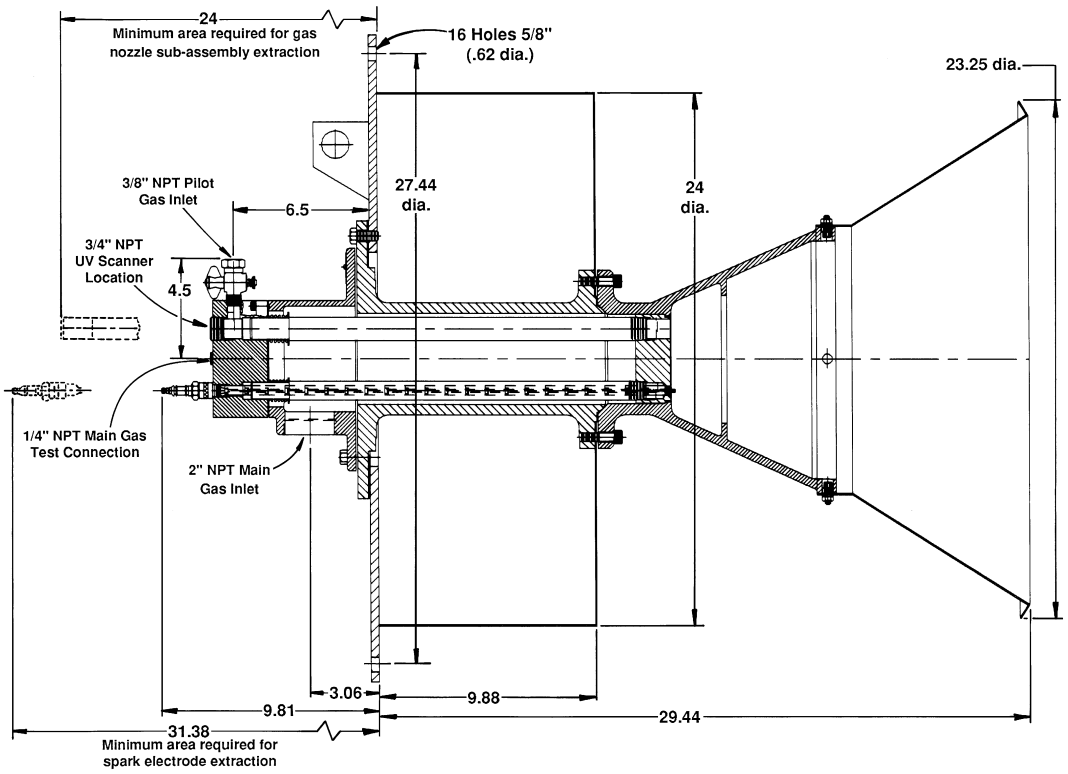
Required natural gas inlet pressures (in inches wc) for capacities shown	Capacities (Btu/hr)	
	4M	8M
18" wc	6,000,000	12,000,000
12.5" wc	5,000,000	10,000,000
8" wc	4,000,000	8,000,000
4.5" wc	3,000,000	6,000,000
3.2" wc	2,500,000	5,000,000
2" wc	2,000,000	4,000,000
1.125" wc	1,500,000	3,000,000
0.5" wc	1,000,000	2,000,000
0.125" wc	500,000	1,000,000
	450,000	900,000
0.08" wc	400,000	800,000
	350,000	700,000
	300,000	600,000
0.03" wc	250,000	500,000
	200,000	400,000
	150,000	300,000
0.005" wc	100,000	200,000
	50,000	100,000



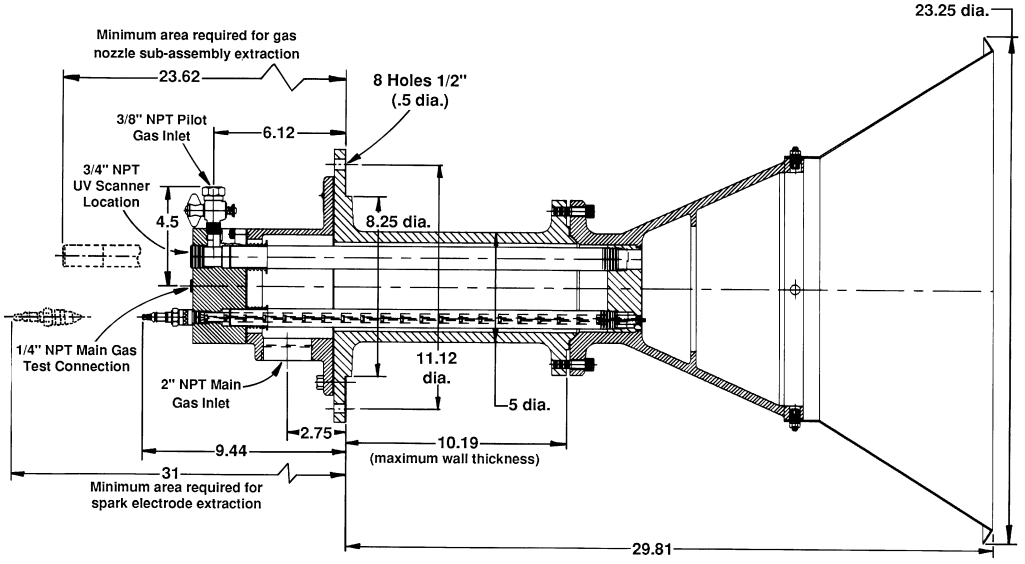
Duct static pressure drop through profile plate (inches wc)	0.2		0.3	0.4	0.5		0.7	0.9	1.0	1.2	1.5	2.0	2.5	3.0	4.0
Approximate air stream velocities (SFPM)	1500		1750	2000		2500		3000		3500		4500		5500	

Envelope Dimensions (in inches)

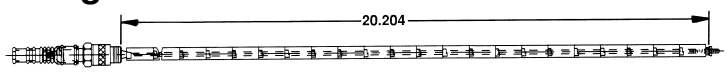
Series “G” Circular INCINO-PAK® Burner with wall mounting plug



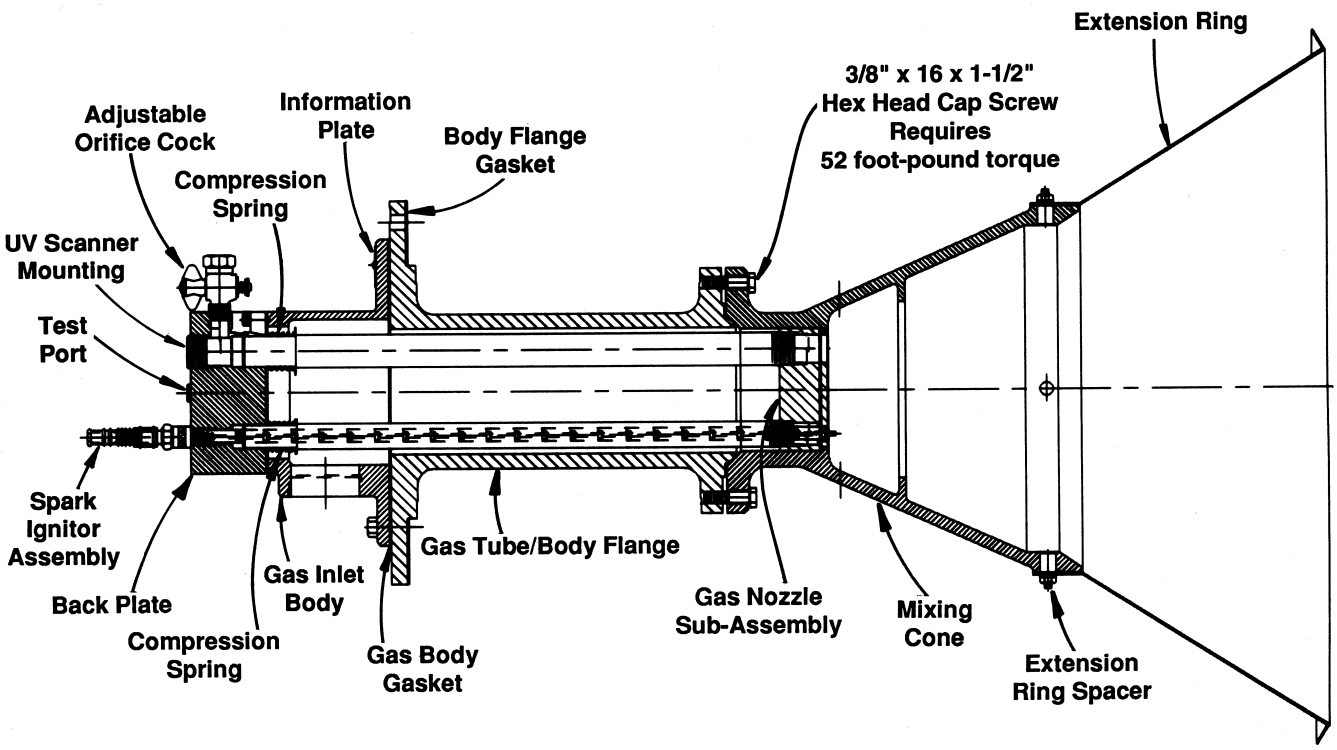
Series “G” Circular INCINO-PAK® Burner for through-wall mounting



Spark Ignitor



Component Identification



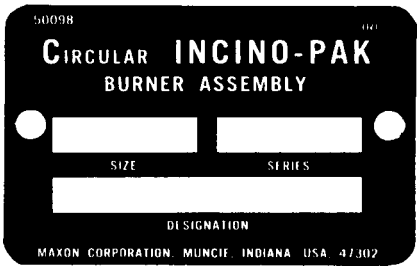
Suggested spare parts

– Spark ignitor assembly
– Extension ring

To order parts for an existing Circular INCINO-PAK® Burner assembly, list:

1. Name(s) or part(s) from above illustration
2. Quantity of each required
3. Burner nameplate information:
   - size and series number of burner
   - designation
   - if available, serial number of Maxon fuel shut-off valve in-line to burner (This serial number is on Maxon valve's nameplate.)

Nameplate



Notes

Installation Instructions

General

These mounting instructions for Circular INCINO-PAK® Burners are in addition to the specific instructions offered for other Maxon component items:

– **Shut-Off Valves** (pages 6100-S-1 through S-10)
– **Flow Control Valves** (pages 7000-S-1 through S-4)

Clean fuel lines are essential to prevent blockage of pipe train components or burner gas ports. All dirt, scale and pipe dope should be blown out of any gas line before actually connecting to the burner system.

Main gas shut-off cock should be upstream of both main gas regulator and pilot line take-off. Use it to shut off fuel to both pilot and main burner during shutdown periods of more than a few hours.

Maxon Control Valves, such as the Series "Q" and MICRO-RATIO® Valves, are not intended for tight shut-off.

Main gas regulator is essential to maintain a uniform system supply pressure. A separate regulator should be provided in the branch leading to each burner system if more than one is served by a common main. Size regulator for full system capacity at required pressure, including pipe train losses and any positive chamber pressure. Follow the instructions attached to the regulator during installation.

Pilot take-off should be upstream of main gas regulator but downstream of main gas cock. It should normally include its own pilot gas regulator (selected to meet pilot flow and pressure needs), a solenoid valve, and shut-off cock. The adjustable gas orifice cock at the pilot inlet simplifies adjustment.

Fuel shut-off valves (when properly connected to a safety control system) shut the fuel supply off with a loss of electrical power. **Manual reset valves** require operator attendance each time the system is started up (or restarted after a shut-down). **Motorized shut-off valves** permit automatic start/restart when used with appropriate control system.

Test connections are essential for burner adjustment. At a minimum, they should be provided at each burner inlet. Test connections should never be installed in elbows or pipe tees. **Test connections must be plugged except when readings are being taken.**

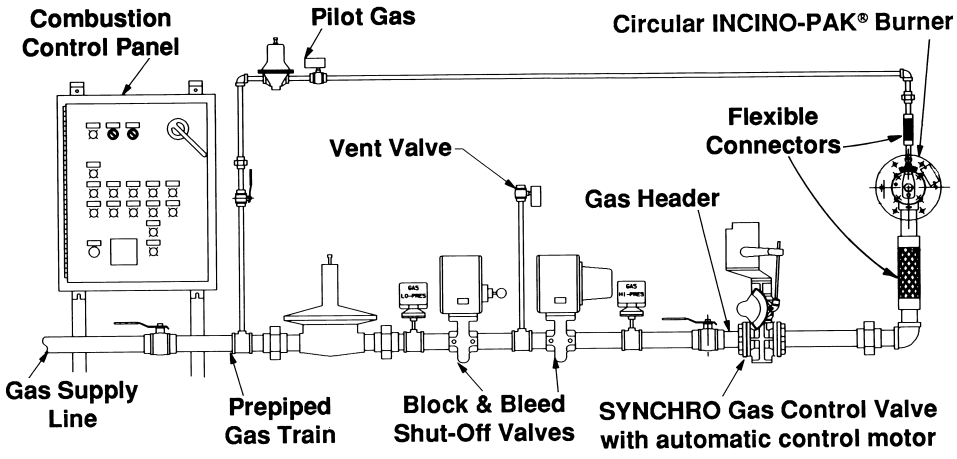
Circular INCINO-PAK® Burners are special configurations of back inlet feed sections designed to provide "outside-the-duct" access to the pilot, ignitor and flame safeguard components.

These burners are used in end-fired incinerators or preheaters. As such, the mounting and installation of Circular INCINO-PAK® Burners differs slightly from other types of Maxon AIRFLO® Burners.

Circular INCINO-PAK® Burners mount through the duct/chamber wall and extend their burner mixing cones out into the air stream. They must still be profiled in the chamber, since a pressure drop must be maintained within certain limits just like all Maxon AIRFLO® Burners.

The externally mounted burner body housing remains on the outside of the duct/chamber.

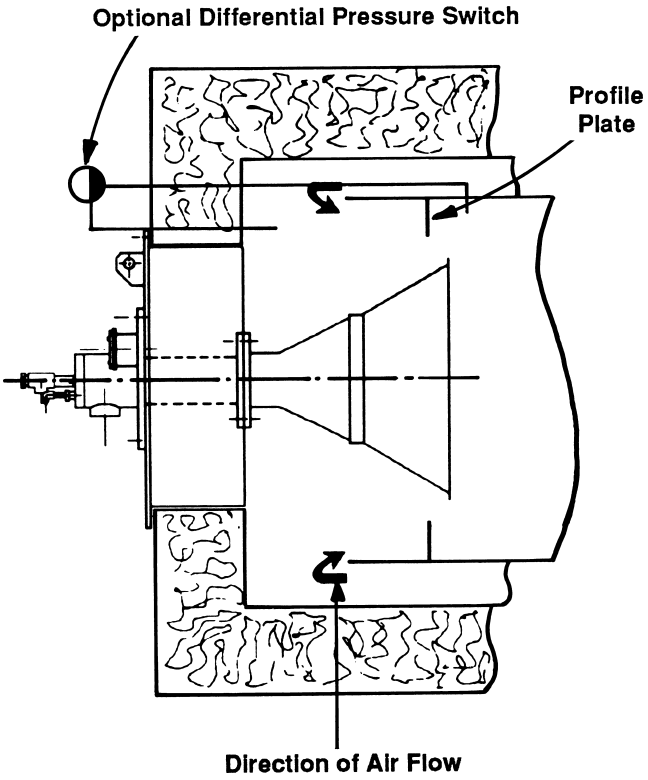
A typical Circular INCINO-PAK® Burner system piping layout is illustrated in the drawing below:



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

Installation Instructions

Circular INCINO-PAK® Burner mounting



The Circular INCINO-PAK® Burner is used only for the heating of air in motion. It should be mounted so as to direct its flame **parallel to** and **in the same direction** as the **movement of the air** which is to be heated.

Do not mount the Circular INCINO-PAK® Burner so that the flow of air is across the face of the cone, nor should it be mounted too near to a turn in the duct which will cause the air to be directed at an angle over the burner.

Flow of air at operating temperature must be uniform and pressure drops not less than the values specified for the application.

Customer fabricated profile plate required.

To assure proper operating design pressure drop for optimum performance of your Maxon Circular INCINO-PAK® Burner, it is necessary to reduce the duct area at the location of the burner assembly. This is done by “silhouetting” the burner element with an opening in a plate at right angles to the direction of the air stream movement.

The profile opening should be shaped to frame your burner as symmetrically as possible, and sized to maintain the desired operating pressure drop through the spaced opening surrounding the burner element.

All Maxon Circular INCINO-PAK® Burner assemblies must have a specific design operating pressure drop across and through the burner element. Consult Maxon catalog specification for the pressure drop required to obtain the burner capacity for your specific application. Install profile plates to attain this pressure drop.

For best mixing downstream, the profile plate should extend a minimum of 6" from the walls of the duct around the entire burner assembly.

The burner cone should protrude about 2 inches through the profile plate.

A differential pressure switch (or manometer) can be mounted across the profile plate to make sure the burner only operates when pressure drop is high enough. Provide sufficient test connections for measuring process differential pressure.

Observation sight windows (ports) located in duct to permit visual inspection of pilot and main burner flame(s) help on initial start-up, as well as with routine maintenance/inspections.

The Circular INCINO-PAK® is a raw gas burner. There is no flammable air-gas mixture in the feeder line. However, the burner depends completely on the effluent air stream to supply the oxygen for combustion. A correct pressure drop is therefore very important. The nominal process air pressure drop is 0.5 to 2.0" wc and should be checked prior to start-up, as well as the burner installation and its profile plate, the electrical wiring, and the leak testing of the pipe train.

Raw Gas Burner Start-Up Instructions

Read complete instructions before proceeding, and familiarize yourself with all the system's equipment components. Verify that your equipment has been installed in accordance with the original manufacturer's current instructions.

CAUTION: Initial adjustment and light-off should be undertaken only by trained and experienced personnel familiar with combustion systems, with control/safety circuitry and with knowledge of the overall installation. Instructions provided by the company and/or individuals responsible for the manufacture and/or overall installation of complete system incorporating Maxon burners take precedence over these provided by Maxon. If Maxon instructions conflict with any codes or regulations, contact Maxon Corporation before attempting start-up.

For initial burner start-up of raw gas burner system:

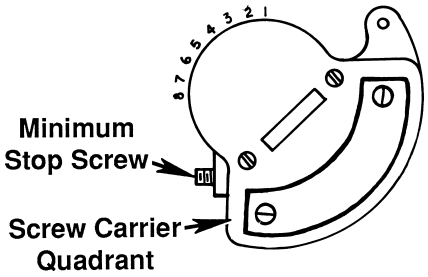
1. **Close all burner fuel valves or cocks**. Make preliminary adjustments to fuel gas regulators. Remove pilot and main gas regulators' adjusting screw covers. Turn adjusting screw down (clockwise) to approximately mid-position. Close pilot gas adjustable orifice screw by turning in clockwise until it stops. (Do not over-tighten.) Then back out the adjustable orifice (counter-clockwise) approximately 2-3 turns.
2. **Check all electric 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 being used.
3. **Check that all duct and chamber dampers are properly positioned** and locked into operating positions.

Initial start-up adjustment should only be accomplished during a "manual" burner control mode.

4. **Disconnect the automatic control motor's linkage from your Maxon Control Valve's operating crank arm** by loosening the control motor's connecting rod from the valve's toggle linkage. Manually set and secure control valve in its "minimum" position.

Series "Q" Valve with connecting base and linkage positioning a typical electric control operator

Set minimum differential pressure with minimum stop screw located on the side of the screw carrier quadrant of Series "Q" Control Valve (see sketch below).



This minimum stop screw creates a mechanical block which prohibits the screw carrier quadrant and its direct-connected air butterfly valve from closing completely. Thus a "minimum" volume of fuel is allowed in through the control valve to the burner(s). This becomes the minimum gas pressure.

Screwing in (clockwise) on the minimum stop screw through its lock nut will open up the butterfly and increase the minimum differential pressure setting.

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MUNCIE, INDIANA, USA

Raw Gas Burner Start-Up Instructions

Once your manometer readings confirm the minimum differential readings, lock the minimum stop screw in that position so the valve cannot be moved back below this minimum firing position. Regardless of what numerical value the indicator strip shows, this becomes the minimum firing position for your specific system in this application.

5. **Start all system-related fans and blowers.** Check for proper blower 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 combustion chamber plenums.

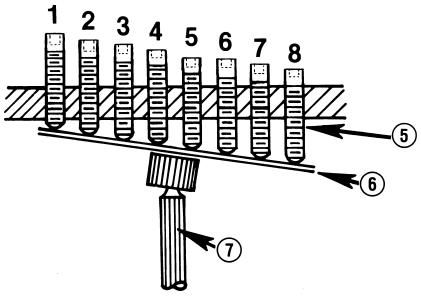
CAUTION: Do not by-pass control panel timers typically controlling sequential operations.

6. **To light and adjust gas pilot:** Pilot gas regulator should initially be set at approximately midpoint of its adjustment range. With pilot gas solenoid valve closed, open main fuel gas and pilot gas cock. Energize spark ignitor and open pilot gas solenoid. Observe pilot ignition through a sight port and/or by viewing micro-amp signal metered from flame safeguard relay circuit.

   Refine pilot setting for a hard blue flame (and/or strongest flame safeguard signal) by adjusting gas flow through pilot orifice and/or pilot regulator.

7. **Prepare to ignite main burner by adjusting main gas regulator** to approximately midpoint of its adjustment range.

   The quadrant (shown in sketch on page 5750-S-3) is rotated either manuall or by a control operator to change firing rate as indicated by a position indicator strip. The minimum stop screw limits rotation and establishes a minimum flow.



Removing a cover strip reveals a numbered series of adjusting screws ⑤ which bear on a set of cam strips ⑥ beneath the quadrant (see sketch above).

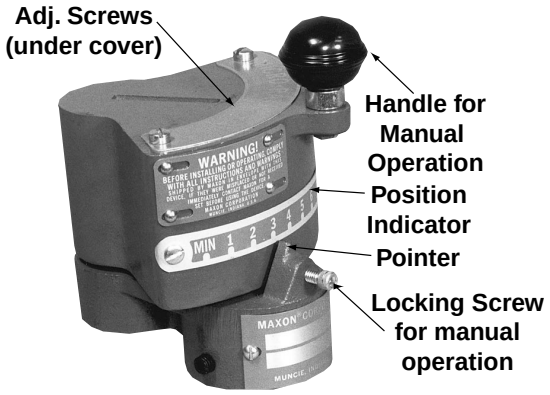
Turning in the adjusting screws ⑤ (clockwise) gives a contour to flexible steel cam strips ⑥ . These cam strips bear on a plunger and cap assembly ⑦ that determines opening of the gas butterfly valve. Cam strips serve to provide a continuous gradient.

Turning adjusting screw in until it is flush with quadrant and opens gas butterfly fully. **Do not attempt to force screw further.**

8. **With control valve at "minimum", ignite main burner by opening main fuel shut-off valve.**

All Maxon Flow Control Valves are designed for **throttling service only** and are not intended for tight shut-off.

NOTE: If your Maxon Circular INCINO-PAK® Burner was furnished with an adjustable gradient type SYNCHRO Control Valve instead of a Series "Q" Valve, proceed to step 8A for specific instructions and differences in adjustment procedures.



A. From step #4, the automatic control motor linkage has already been disconnected from your adjustable gradient type control valve and the valve is at its "minimum" position.
B. Open fuel supply and begin adjustment of appropriate adjustable gradient valve by turning in minimum (or lowest numbered) screw until desired flame is achieved.
C. Once your flame is established and refined at this position, and without advancing the screw carrier quadrant higher, screw all remaining screws down to at least the same level as your first adjusted screw.

Raw Gas Burner Start-Up Instructions

NOTE: A preliminary setting can be established with all the remaining adjusting screws. Generally, each succeeding screw needs to be screwed in approximately one full turn deeper than its preceding screw. A smooth "stair-step" gradient pre-set at this point from low to high will simplify the remaining adjustment steps.

D. Without advancing the SYNCHRO Valve quadrant, screw down on second screw (one or two turns). Then slowly advance the SYNCHRO Valve quadrant to the #1 position. Refine flame appearance at this new position.
E. Turn all higher-numbered screws in at least as far as the one last adjusted, then turn next one in as necessary to achieve desired flame while rotating valve mechanism to that position on indicator strip.
F. Repeat for each remaining screw.
NOTE: To avoid possible damage to cam strips, always turn all higher-numbered screws in as far as the one last adjusted.
G. Refine adjustment as needed, always turning valve so that position indicator matches screw being adjusted. For more fuel, turn screw in (clockwise); for less fuel, turn screw out (counter-clockwise). If screws must be turned in flush with carrier casting, increase fuel pressure and re-adjust by starting at minimum over again.
H. Cycle system off and on, and through all firing rates until satisfied with performance.
I. Reconnect control motor linkage and check that operator does not "bind" and that all interlocks are performing properly.

9. **Adjust burner "high fire" by slowly rotating fuel control valve crank arm towards its maximum.** Observe flame characteristics carefully. If flame becomes too long and yellow, gas pressure is too high and/or air velocity is too low.

NOTE: Dust and/or chemicals entrained into passing air stream may affect physical color of flame. In this case, adjust burner for stable flame shape and geometry.

To measure gas pressure, connect water column (manometer) to the test connection in burner's back plate. **To determine pressure drop**, use a manometer or differential pressure switch (see page 5750-S-2) at the profile opening. Correct pressure drop by increasing or decreasing profile opening size.

If flame is too short, gas pressure may be too low and should be increased or pressure drops are too high and may need to be decreased. Note that pressure drops should be measured only when the fan is handling air at the desired control temperature.

10. **Referring to photograph on page 5750-S-3, reconnect control motor linkage** (with control motor in low or minimum position).

Tighten toggle clamp bolt and secure clamp to motor crank.

Cycle control motor back to minimum, watching carefully that it does not bind before reaching minimum.

If it is stopped or if minimum is not reached, loosen toggle clamp screw and move toggle clamp along the connecting linkage so both motor and valve can assume their minimum positions. Then retighten toggle clamp screw. Refine adjustment by cycling several times between low and high control motor position while re-adjusting toggle clamp bolt as necessary until control motor travels through its full cycle while moving control valve crank arm from its minimum only up to the desired maximum previously determined.

11. **Relight burner and cycle control system from low to high fire several times** to observe performance. Refine adjustments of pilot and main burner minimum if necessary.

Warning: Test every UV flame sensor system for dangerous spark excitation from ignitors and other burners, as well as other possible sources of direct or reflected UV radiation.

12. **Check carefully that all interlocks and limits are in full operating condition and before system is placed into full service, instruct operator personnel on proper start-up, operation and shut-down of system**, establishing written instructions for reference.

Raw Gas Burner Start-Up Instructions

Raw Gas Firing Start-Up Instructions for Circular INCINO-PAK® Burner Sections

Circular INCINO-PAK® Burner sections are started up in the same manner as other raw gas AIRFLO® Burners, except the designed manifolding for the raw gas brings all the components to the “outside” of the duct.

Your control valve is adjusted in the same manner with Circular INCINO-PAK® Burners as described earlier for raw gas burner start-up instructions.