Specifications of "HC" AIRFLO® burners

Typical burner data Fuel : natural gas with 1000 Btu/ft³ HHV - sg = 0.6 [1] Stated pressures are indicative. Actual pressures are a function of air humidity, altitude, type of fuel and gas quality							
Application			Boiler firing		Process firing		
			TEG-firing [2]	AUX-firing [3]	High temp. (Tin > 212° F)	Low temp. (Tin < 212° F)	
Nominal capacity per ft	[4]	MBtu/h HHV	5.12	5.12	5.12	5.12	
Min. capacity per ft		MBtu/h HHV	0.68	0.68	0.68	0.50	
Upstream temperature	Max.	°F	1100	100	1100	210	
	Min.	°F	N/A	-20	-20	-20	
Max. downstream temperature	[5]	°F	1750	1400 [5]	1750	1750	
Process air local differential pressure		"wc	0.18 - 0.67	0.18 - 0.27	0.13 - 0.67	0.18 - 0.89	
Air factor			N/A	3.5	3.5	3.5	
Nat. gas pressure @ burner inlet	[6]						
Nat. gas pressure @ nominal capacity		psi	14.5 - 19	14.5 - 19	14.5 - 19	14.5 - 19	
Nat. gas pressure @ min. capacity		"wc	7.1	7.1	7.1	4	
Flame length at 50 % capacity or up	[7]	ft	11 … 16	8 … 15	11… 16	8… 15	
Flame width at 50 % capacity or up		ft	1.6	1.6	1.6	1.6	
Burner displacement		in.²/ft	185.5				

[1] sg (specific gravity) = relative density to air (density air = 0.0763 lbs/ft³(st)).
[2] TEG = turbine exhaust Gas
[3] AUX = Auxilary firing
[4] Maximum capacity will depend on application boundary conditions such as acceptable flame length, required emissions, available oxygen, up/downstream temperatures, duct lay-out, process air differential pressure, …). Therefore, the actual maximum capacity might be lower than 5.12 MBtu/h per foot or could be up to and even above 8.5 MBtu/h per foot in specific applications.
[5] Limitation on downstream temperature from 1750° F down to 1400° F is due to possible risk of higher NO_x emissions when this limit is crossed.
[6] The stated pressures are valid for burner sizes up to 4 ft. For larger burners, the gas inlet pressures will be higher. Refer to graph below for correct gas pressures. Stated pressures are measured at burner gas inlet tube.
[7] Flame length is only given as a guideline. Actual flame length depends on a number of parameters such as process air oxygen level, process air pressure drop across burner (contact MAXON for specific information) .

Required gas fuel pressures at different burner capacities

Because of the high fuel outlet pressures, the fuel flow will be subsonic at the lower burner capacity range and sonic for higher capacities. The effect of this phenomenon can be seen on the graph below. At low capacities the differential pressure versus capacity relationship is quadratic. When burner capacities are increased and exceed 5 MBtu/h per foot, this relationship is linear.

Fuel differential pressures in psi (natural gas with 1000 Btu/ft³ HHV - sg = 0.6) related to the required burner capacity (MBtu/h) per foot of burner.

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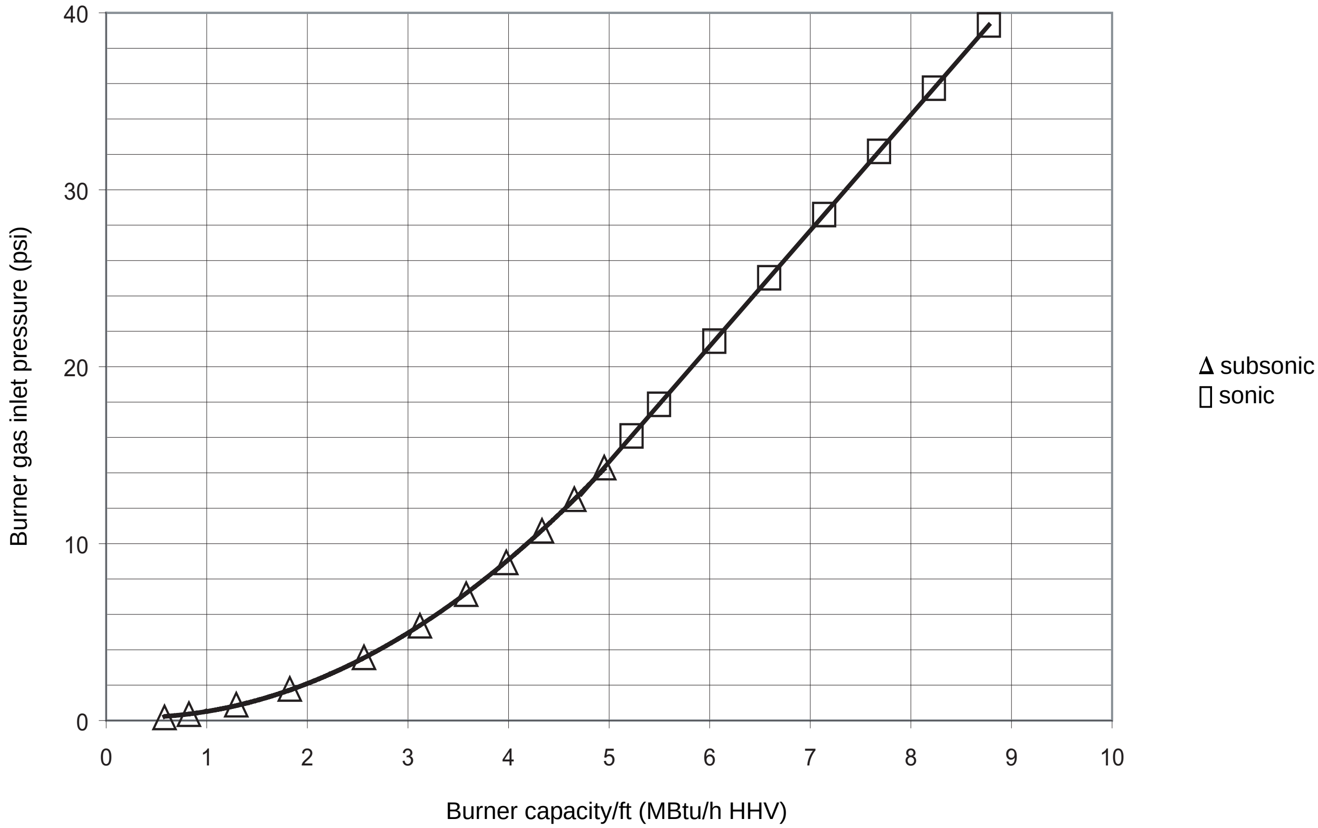
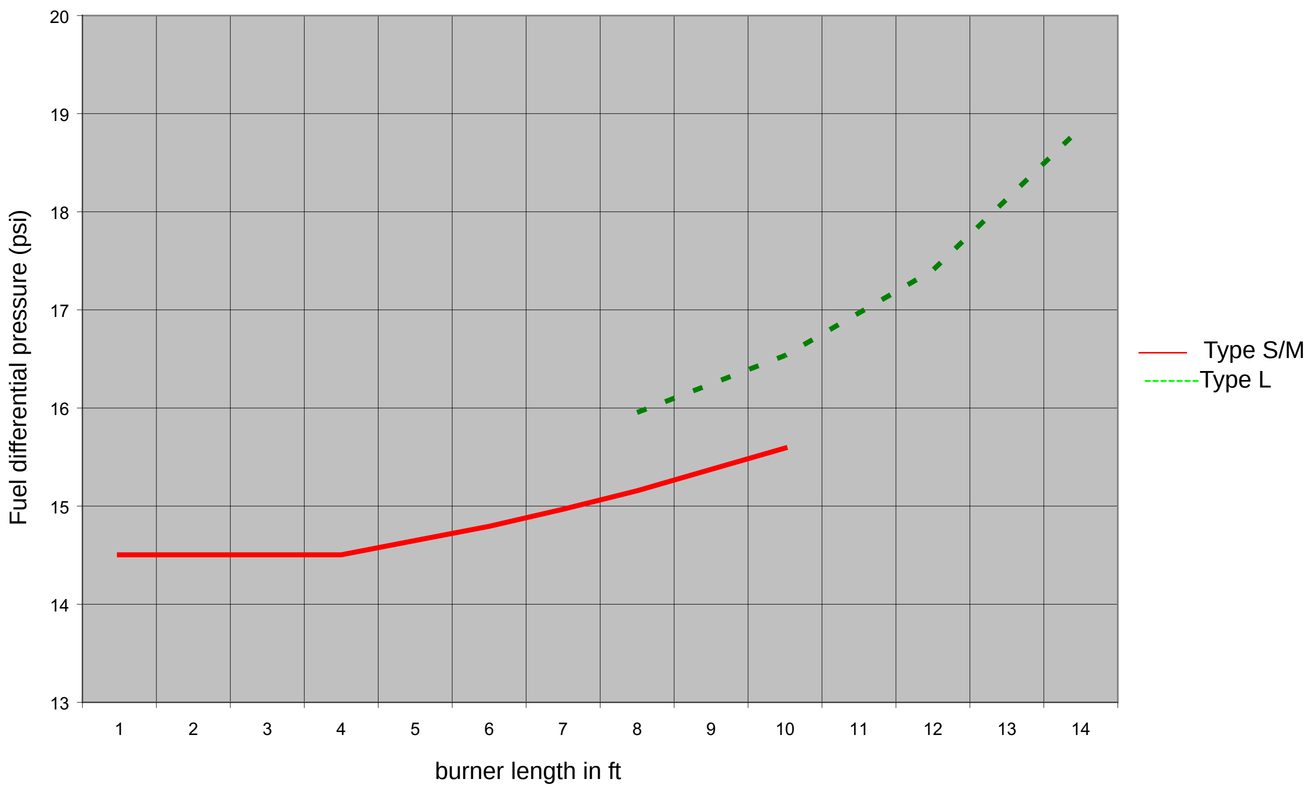


Above graph is only valid for burner sizes equal or smaller than 4 ft.
Longer burners will need higher fuel pressures. See graph on the next page.

Influence of burner size on required fuel inlet pressure

Due to increasing pressure losses in burner manifold for longer burner, the required fuel inlet pressure will increase. Check below graph for correct fuel inlet pressure. For type L burners the required inlet pressures are higher because of additional pressure losses in gas flexibles.

Fuel differential pressures in psi (natural gas with 1000 Btu/ft³ HHV - sg = 0.6) required for nominal capacity of 5.12 MBtu/h per foot (HHV) in relation with burner length in ft.

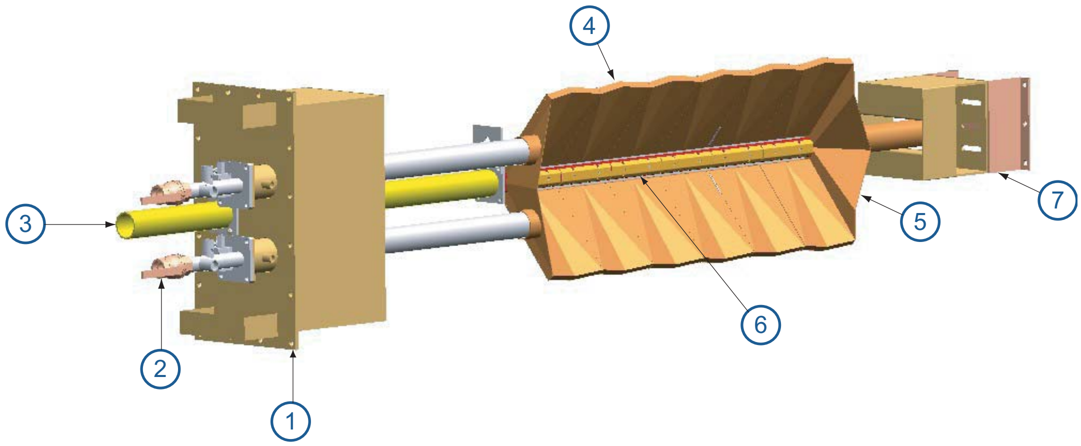


Materials of construction

The complete "HC" AIRFLO® burner assembly, including the LVDT/HC pilots, consists of high grade stainless steel components exclusively.

The light weight flexible construction without the use of thick castings makes the burner very suitable to handle thermal stress due to fluctuating temperatures (for example change over from gas turbine to fresh air operation), while maintaining its mechanical durability.

1) Mounting plug
2) LVDT/HC pilot burner
3) Gas inlet
4) Mixing plates
5) End plates
6) Deflector plates
7) Mounting support



N°	DESCRIPTION	MATERIAL
1	Mounting plug	AISI304 (1.4301)
2	LVDT/HC pilot burner	AISI304 (1.4301)
3	Gas inlet	AISI304 (1.4301)
4	Mixing plates	Hastelloy X (2.4613)
5	End plates	Hastelloy X (2.4613)
6	Deflector plates	Hastelloy X (2.4613)
7	Mounting support	AISI304 (1.4301)

Selection criteria

Application details

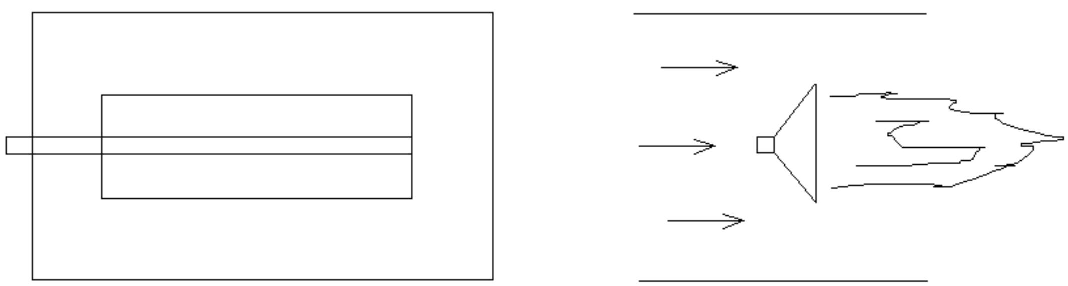
The "HC" AIRFLO® burner has been designed to provide high output capacities per foot of burner length. The recirculating flame pattern provides low emission combustion in fresh air and low oxygen process air firing. Typical applications are turbine exhaust gas reheating, start-up burners for fluidized bed combustion, large incinerators and processes with low oxygen recirculating air heating.

Process air local differential pressure

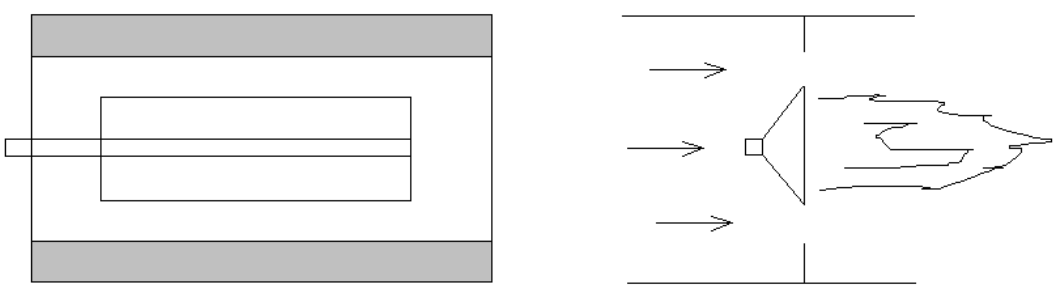
"HC" AIRFLO® burners are designed to operate at a low local process air differential pressure between 0.13 "wc and 0.89 "wc across the burner. (refer to table page 4-22.2-8. for optimal values depending on the application). The local process air differential pressure is the difference between the static pressures measured just upstream and downstream of the burner. The remaining process air pressure loss across the burner will always be much lower than this local differential pressure. A minimum local differential pressure across the burner is required for good burner performance.

To create this pressure drop at a given process air flow, it could be necessary depending on the installation, to install profile plates around the burners. In case these profile plates are required, MAXON can provide them to be installed in the process air duct.

"HC" AIRFLO® burner in duct WITHOUT profile plate



"HC" AIRFLO® burner in duct WITH profile plate

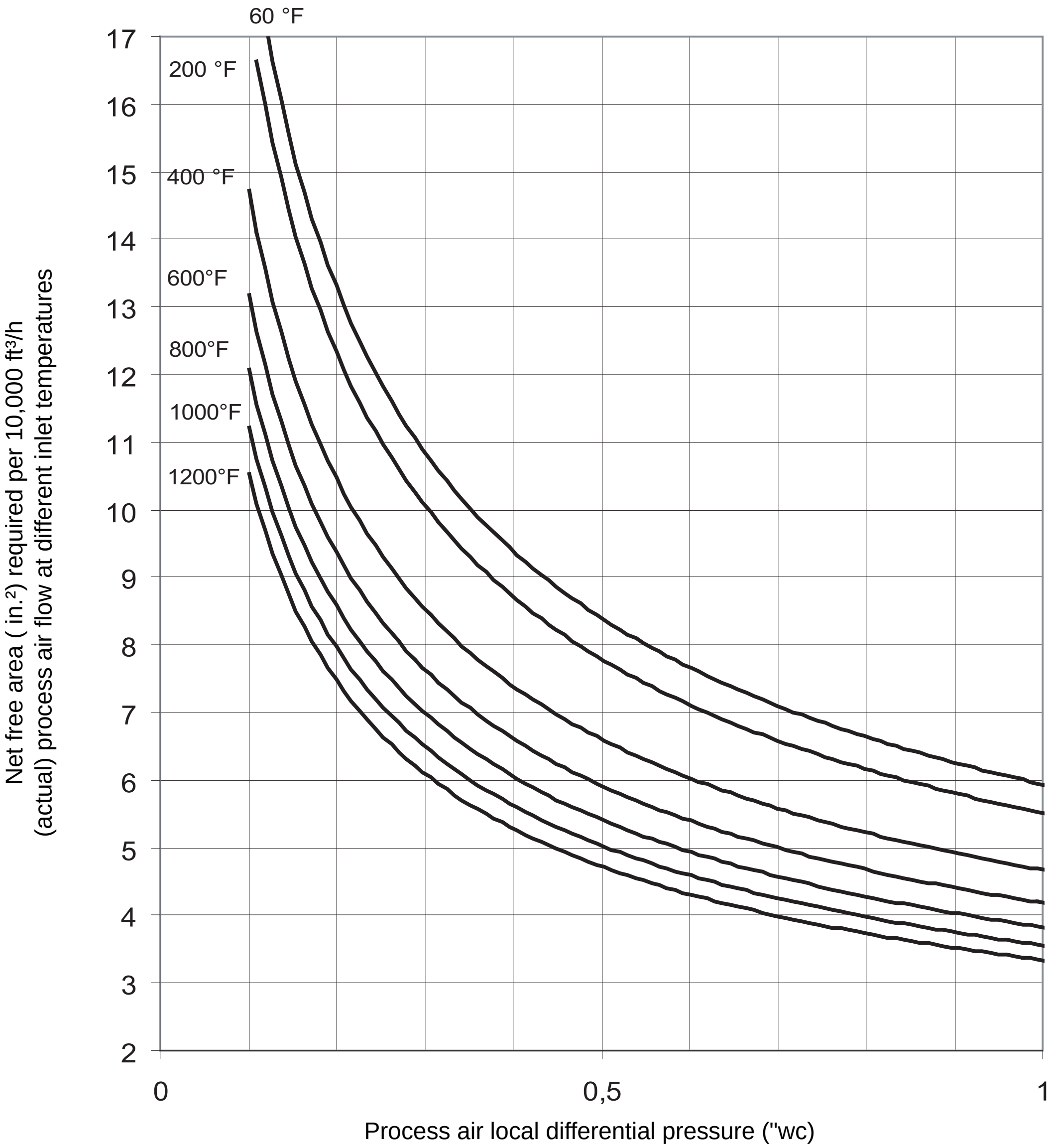


For process air differential pressure drop calculation, use the graphs on the next pages to define the net free area required around the burner. Note that the burner itself creates a displacement area of 185 in.^{2} per foot.

Process air local differential pressure drop – ducts without profile plate

The differential pressure depends on air mass flow (actual air flow and air temperature) and the geometry of duct and profile.

Use graph on this page for duct sizing in case no profile plate around the burner is used to get an indication of local differential pressures. Contact MAXON for detailed information.



Calculation example

Preheated air, 1,000,000 ft³/h (actual) at 400° F inlet temperature to be heated with 2 ft "HC" AIRFLO® burner

Determine the process air local differential pressure drop across the burner in a duct section of 37 in. x 32 in.

Duct section =37 in. x 32 in. = 1184 in.²

Burner displacement = 2 x 185.5 in.² = 371 in.²

The net free area around the burner = 1184 in.² - 371 in.² = 813 in.²

The net free area per 10,000 ft³/h process air = 813 in.²/100 = 8.13 in.²

From above graph it reads for 8.13 in.² and 400° F → 0.34 "wc

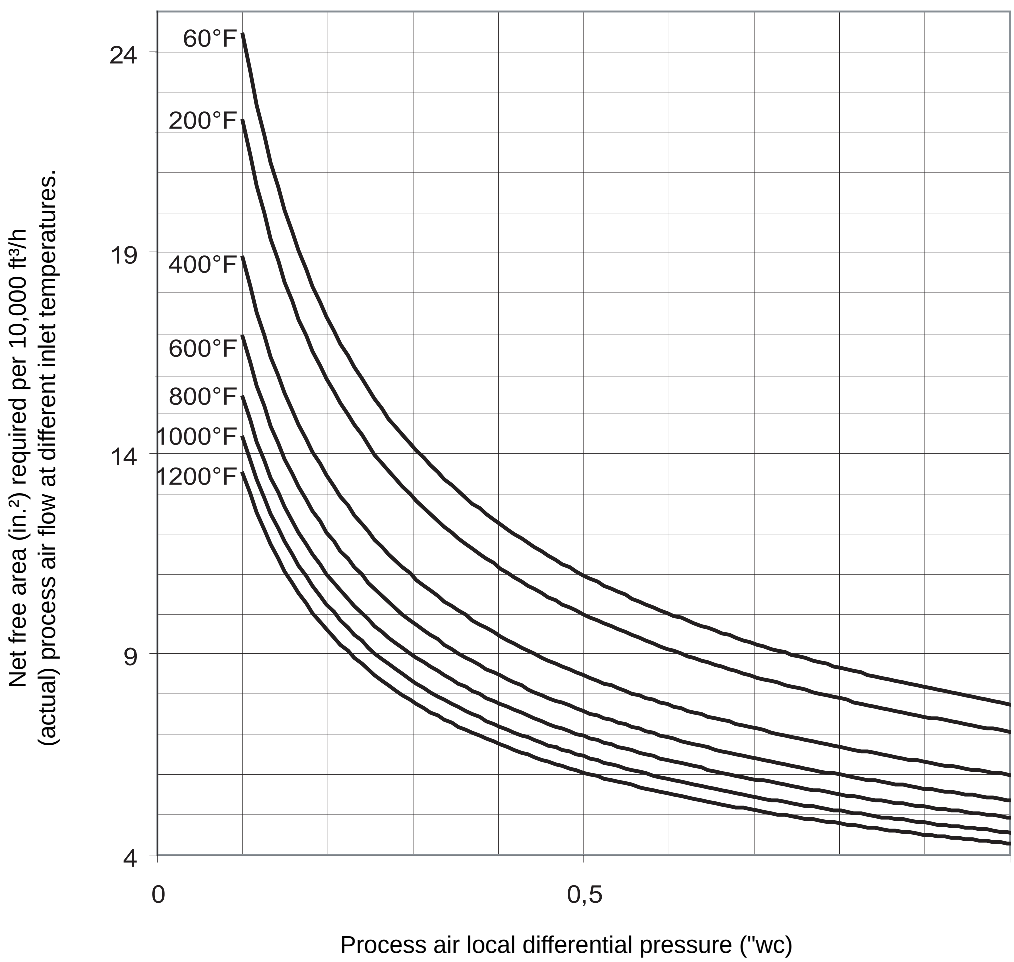
Referring to table page 4-22.2-8 it states that for high temperature process firing the process air differential pressure should be 0.13 "wc - 0.67 "wc. So the given conditions in the example are acceptable.

Process air pressure drop – with profiling

Use graph on this page for duct sizing in case a profile around the burner is used.

The data is based on a duct/profile geometry with resulting contraction factor (K = 0.78).

Contact MAXON for detailed information.



Calculation example

Fresh air, 1,700,000 ft³/h (actual) at 60° F inlet temperature to be heated with 3 ft "HC" AIRFLO® burner

Determine profile plate opening area to obtain a process air local pressure differential of 0.6 "wc

From graph above it reads for 0.6 "wc and 60° F : 10 in.² net free area per 10,000 ft³/h actual airflow

For 1,700,000 ft³/h this gives : 170 x 10 = 1700 in.² net free area around the burner

Burner displacement =3 x 185.5 = 556.5 in.²

Profile opening = net free area around the burner + burner displacement

1700 + 556.5 = 2256.5 in.²

Process air oxygen content

"HC" AIRFLO® burners are capable to fire in process air streams with far reduced oxygen levels, without the need to add additional combustion air. The required oxygen for combustion is simply extracted from the reduced oxygen process stream.

The “flammability” of "HC" AIRFLO® burners in a given process stream depends on several variables, such as:

- upstream process temperature and oxygen level
- amount of water in the process stream (cfr water injection on gasturbine)
- local process differential pressure across the burner
- burner size

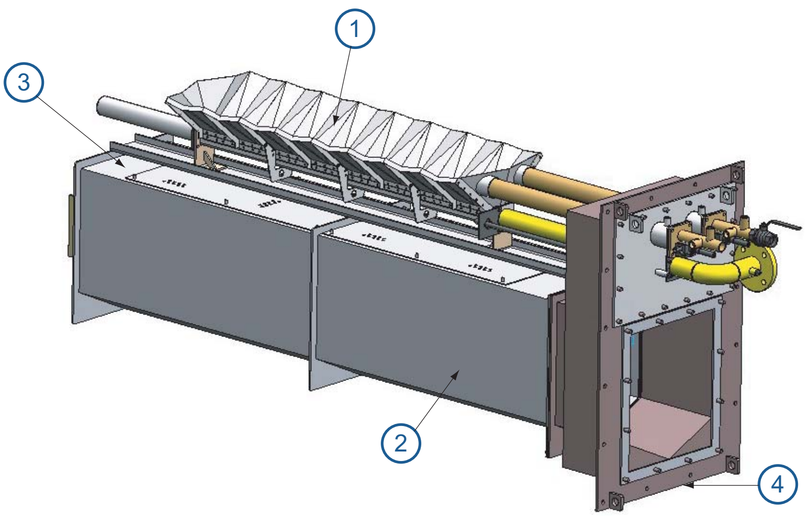
Contact MAXON for detailed information on flammability of "HC" AIRFLO® burners.

Outside the flammability limits, MAXON offers an elegant and simple solution to introduce extra combustion air by means of an air box located immediately upstream of the "HC" AIRFLO® burner.

Contact MAXON for more information.

Example of a "HC" AIRFLO® burner unit, complete with combustion air box for process air streams having extremely low oxygen content.

1) 4 ft “HC” AIRFLO® burner
2) Combustion air box
3) Perforated plate
4) Mounting plate for easy on-site mounting



Process back pressure

The "HC" AIRFLO® is designed to be used for maximum back pressures of 40 "wc (over- and under pressure). For applications where this range is not sufficient, please contact MAXON for reinforced burner design availability.

Burner capacity control

The "HC" AIRFLO® is only controlled by altering the gas flow by means of a gas control valve. Since the gas control valve outlet pressures are high (typically around 24 - 40 psi at maximum capacity), MAXON advises the use of precise and heavy duty control valves such as the MAXON SMARTLINK CV control valve.

Apart from their excellent control capabilities, these control valves have the ability of reducing high fuel pressures (typically 65 psi) directly to the desired burner inlet pressure, thus eliminating the necessity of a pressure regulator.

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The "HC" AIRFLO® is designed to operate on a process air stream which is independent of the burner capacity. Process air flow should not be controlled as a function of burner capacity but kept at a constant rate.

Piloting and ignition

Direct ignition of "HC" AIRFLO® burners is not possible.

All "HC" AIRFLO® burners will be standard equipped with two LVDT-HC PILOT BURNERS. (refer to catalog section 4-22.4 for details on this pilot burner). Note that one LVDT-HC PILOT BURNER can only carry one UV-scanner. Therefore, the standard "HC" AIRFLO® with double pilot allows for easy mounting of two UV-scanners on one burner when redundant or 1-out-of-2 detection is requested. If only one pilot is needed, the second one will have its connections plugged. Its UV-scanner port will be used as a view port and the spark ignitor will be left in the pilot burner and shall be used as a spare.

Typical ignition sequence

1. Pre-purge of combustion chamber, according to the applicable codes and the installation's requirements.
2. Pre-ignition (typically 2 s sparking in air).
3. Open pilot gas and continue to spark the igniter (typically 5 to 10s depending on local code requirement).
4. Stop sparking, continue to power the pilot gas valves and start flame check. Trip burner if no flame from here on.
5. Check pilot flame stability (typically 5 to 10 s to prove stable pilot).
6. Open main gas valves and allow enough time to have main gas in the burner (typically 5 s + time required to have main gas in the burner).
7. Close the pilot valves.
8. Release to modulation (allow modulation of the burner).

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

One pilot gas valve should be positioned as close as possible to the pilot burner gas inlet for fast ignition of the pilot burner.

Flame supervision

The flame of a "HC" AIRFLO® burner shall be supervised by a flame scanner. Scanners will be mounted on the 1" ball valve scanner connection of the included LVDT/HC pilot burner, which is the only correct position for safe supervision of both the pilot flame and main flame.

It is not possible to distinguish pilot and main flame. The "HC" AIRFLO® is designed to operate with interrupted pilot. If continuous pilot is preferred, a special continuous LVDT-HC pilot version can be used as well.

All "HC" AIRFLO® burners have standard two pilot burners installed. In most applications only one pilot burner will be connected. The second pilot burner will be used as extra view port and spare spark igniter holder. In some applications both pilot burners can be connected and can function parallel. See catalog section 4-22.4 for full details on LVDT/HC pilot burners.

Flame development and duct lay-out

The flame of "HC" AIRFLO® burners is influenced by process air differential pressure across the burner, the oxygen level and temperature of the upstream process air, burner capacity, fuel gas, duct geometry. An approximate flame length can be found in table page 4-22.2-8. Because of the high radiant flames, special care should be taken when designing burner ducts. The distance between flame and steel sheeting on internal duct wall should be at least 20 in. When burner is mounted in an internally insulated duct without cladding, minimum 8 in. between flame and duct wall should be respected. Contact MAXON for detailed information on your particular installation.

When multiple burner rows are mounted in duct, the distance between two burner rows should be at least 40 in This is to avoid the effect of flame interaction.

Fuels

Standard "HC" AIRFLO® burners can fire on natural gas, hydrogen and any mixture of both. Special adapted "HC" AIRFLO® burners are available for firing on low calorific gas, LPG, propane, butane and refinery gases. These special adapted burners have different specifications than the standard burners. Contact MAXON for available burner lengths, flammability and fuel pressures whenever one of these fuels is selected.

Expected Emissions

The production of pollutants can be highly dependant upon burner application and installation. Differing temperatures, process velocities, oxygen levels, fuels and other process related factors such as unequal process air distribution can all influence the actual level of emissions produced.

Contact MAXON for evaluation of expected emissions on your typical application.

Available burner types

For selecting the correct burner for the required capacity, different burners are available between 1 ft and 14 ft in steps of 0.5 ft.

The "HC" AIRFLO® burners are available in 3 basic versions depending on burner length :

- "HC" AIRFLO® type S burners : short sizes – 1 ft to 7.5 ft
- "HC" AIRFLO® type M burners : medium sizes – 4 ft to 10 ft
- "HC" AIRFLO® type L burners : large sizes – 8 ft to 14 ft

Type description : HC-X-Y-Z

Z : burner size (length) in ft (= burner-units) – digit between 1 and 14

Y : fuel gas — NG = natural Gas; O = other (specify)

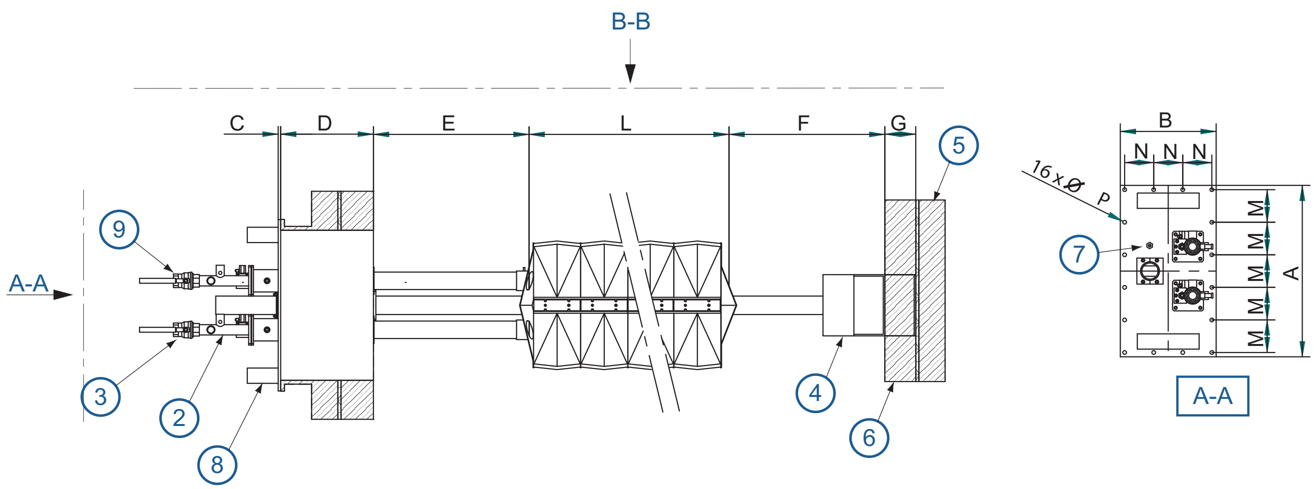
X : burner construction — S = SHORT; M = MEDIUM; L = LARGE

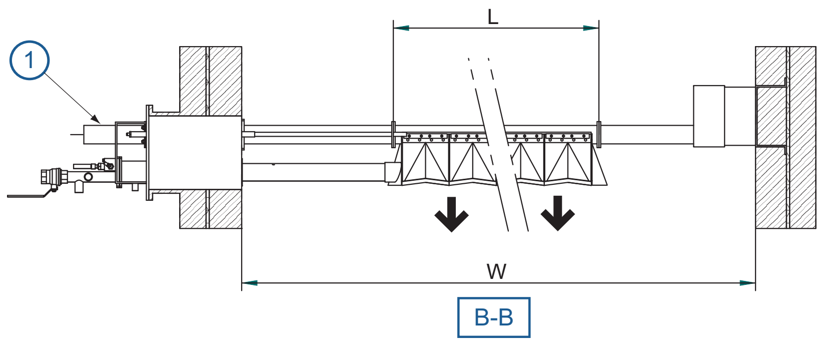
Difference between S, M & L types is because of larger thermal expansion effects on larger burners, requiring special mounting constructions. Since the total duct width is an important factor in selecting the correct burner type, there is some overlapping in the different sizes for some of the burner lengths (see table below).

Type	Maximum duct width (in.)		
	Standard material inlet t° < 1000° F	Standard material inlet t° < 1100° F	High grade material inlet t° < 1200° F
HC-S 1 ... 7.5	160	160	N/A
HC-M 4 ... 9.5	315	235	315
HC-L 8 ... 14	315	235	315

Dimensions and weights

Drawing of "HC" AIRFLO® type S (size 1 ft – 7.5 ft)





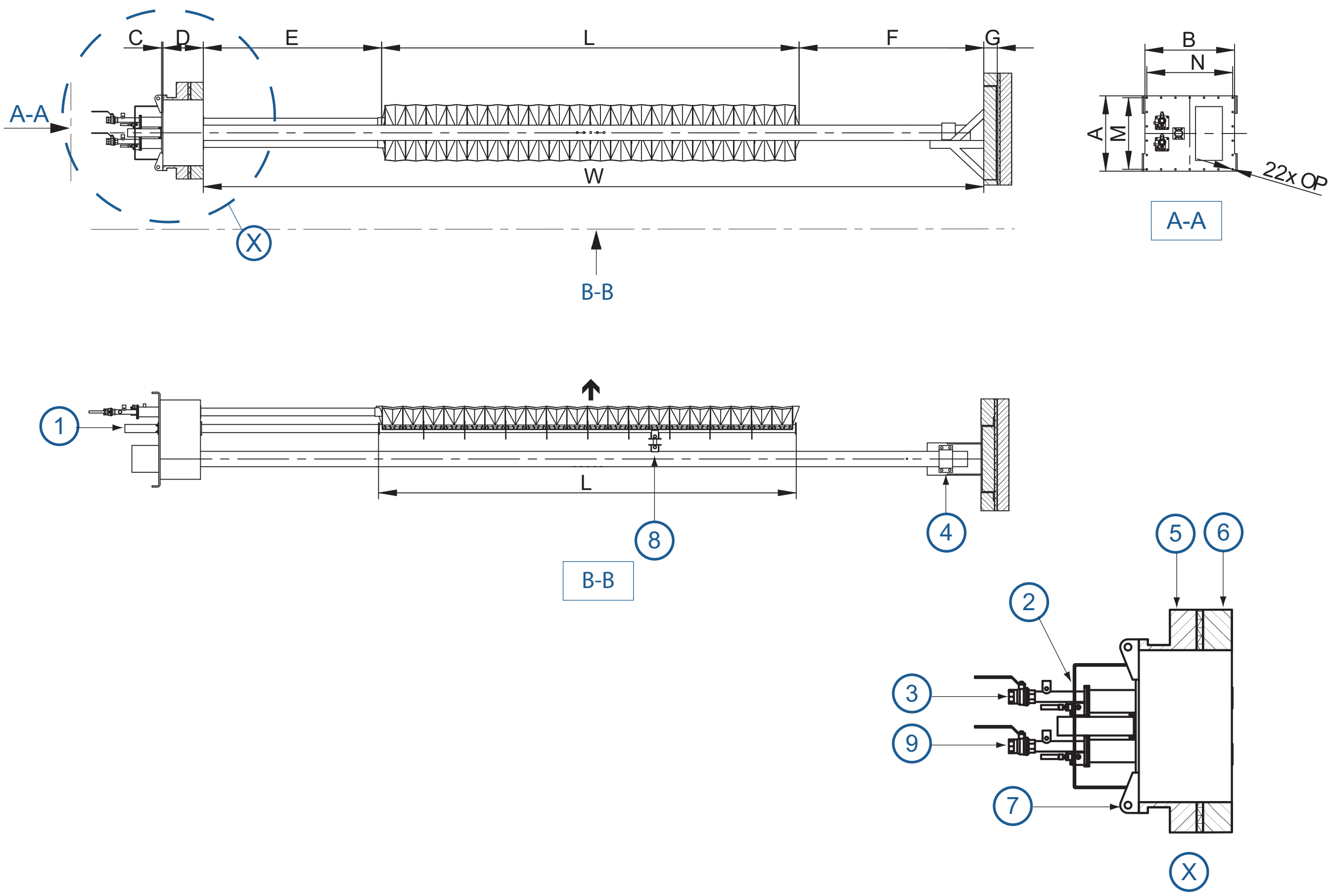
1) Gas connection 2”
2) Pilot burner
3) UV-scanner connection 1”
4) Internal mounting support
5) External duct insulation
6) Internal duct insulation
7) Upstream process air test connection
8) Mounting plug
9) Alternative UV-scanner
10) Connection or view port

Dimensions in in. unless stated otherwise											
A	B	C	D	E (min.) [1]	F (min.) [1]	G (min.)	L	M	N	ØP	W (max.)
22	12.2	0.3	8 (min) to 23.6 (max)	8	12	3.9	see table below	4.2	3.7	0.5	160
			default = 11.8			default = 3.9					

[1] Valid when duct has internal insulation (without cladding). In case of sheet metal wall, E and F should be at least 20 in.

L (burner length) in in. & weight in lbs														
Burner size	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5
L	14	20	24.4	32	38	44	50	56	62	68	74	80	86	92
weight	156	160	165	171	178	182	187	194	200	205	209	216	222	226

Drawing of "HC" AIRFLO® type M (size 4 ft – 10 ft)



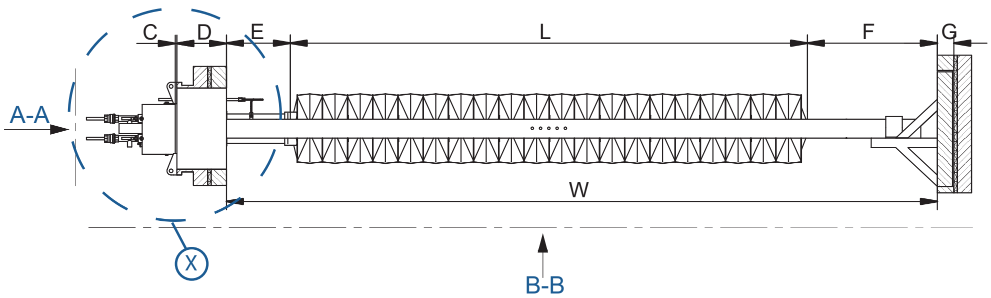
1) Gas connection 2"
2) Pilot burner
3) UV-scanner connection 1"
4) Internal mounting support
5) External duct insulation
6) Internal duct insulation
7) Mounting plug
8) Burner support hinge to allow thermal expansion
9) Alternative UV-scanner connection or view port

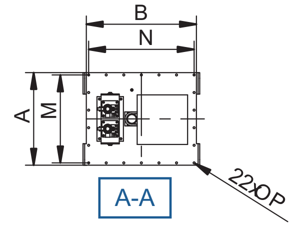
Dimensions in in. unless stated otherwise												
A	B	C	D	E (min.) [1]	F (min.) [1]	G (min.)	L	M	N	ØP	W (max.)
22	26.2	0.4	8 (min) to 23.6 (max) default = 11.8	8	16	3.9 default = 3.9	see table below	21 (5x106.4)	25 (6x106.3)	0.5	315

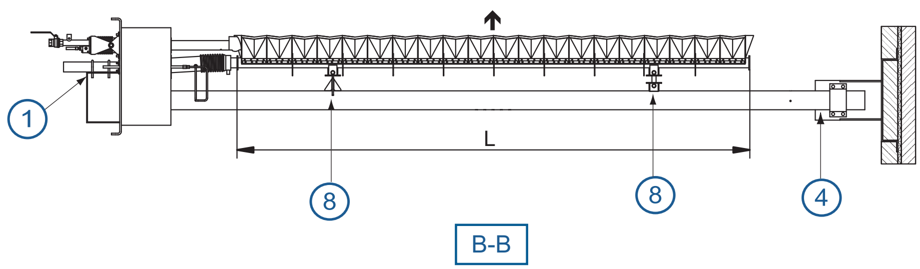
[1] valid when duct has internal insulation. In case of sheet metal wall, E and F should be at least 20 in.

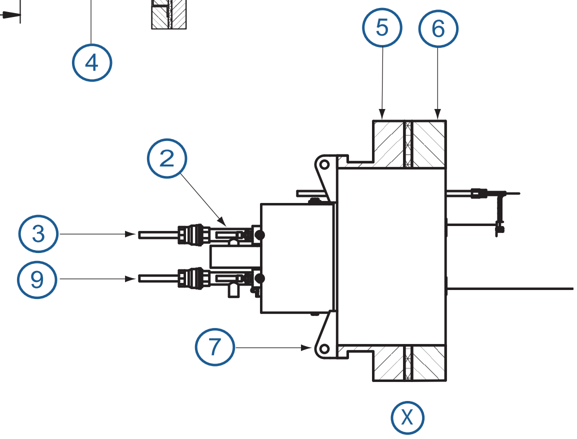
L (burner length) in in. & weight in lbs													
Burner size	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
L	50	56	62	68	74	80	86	92	98	104	110	116	122
weight	449	458	464	473	478	488	495	504	510	519	526	535	541

Drawing of "HC" AIRFLO® type L (size 8 ft – 14 ft)









1) Gas connection 2”
2) Pilot burner
3) UV-scanner connection 1”
4) Internal mounting support
5) External duct insulation
6) Internal duct insulation
7) Mounting plug
8) Burner support hinge to allow thermal expansion
9) Alternative UV-scanner connection or view port

Dimensions in in. unless stated otherwise											
A	B	C	D	E (min.) [1]	F (min.) [1]	G (min.)	L	M	N	ØP	W (max.)
22	26.2	0.4	8 (min) to 23.6 (max) default = 11.8	28 - D	16	3.9 default = 3.9	see table below	21 (5x106.4)	25 (6x106.3)	0.5	315

[1] Valid when duct has internal insulation. In case of sheet metal wall, E and F should be at least 20 in.

L (burner length) in in. & weight in lbs													
Burner size	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14
L	98	104	110	98	122	128	134	140	146	152	158	164	170
weight	579	583		590	603	609	618	624	634	642	651	662	673