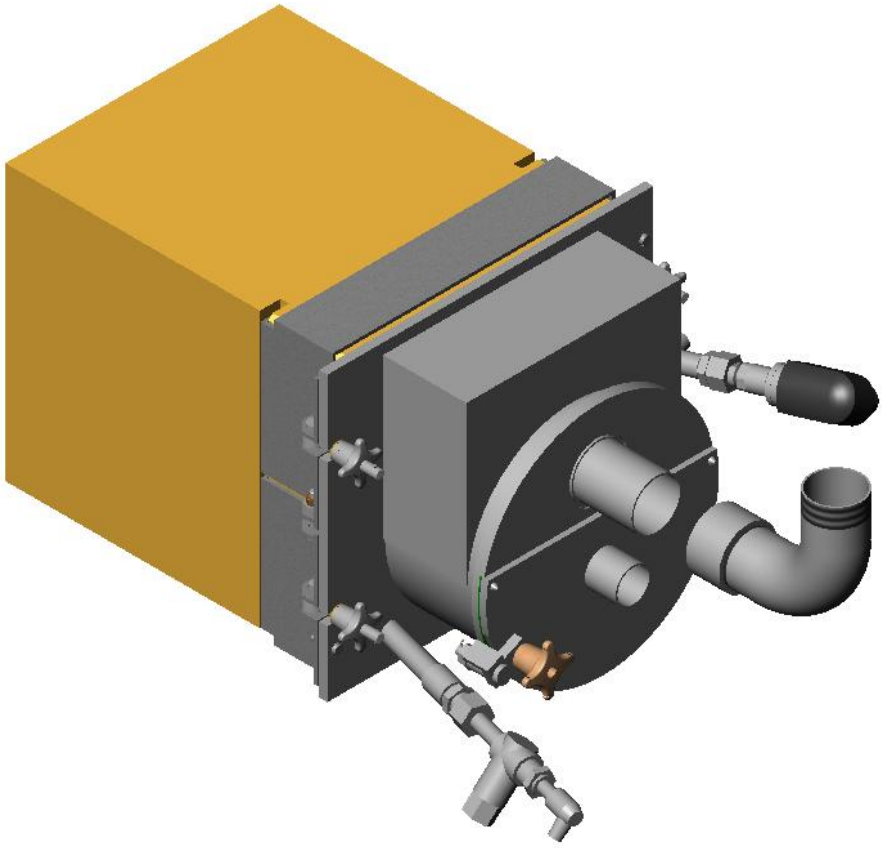
ALBATCH FC BURNER

Gas and liquid fuel versions

INSTALLATION, ASSEMBLY,

AND MAINTENANCE PROCEDURES

June 2017



Air Liquide

1 - INTRODUCTION

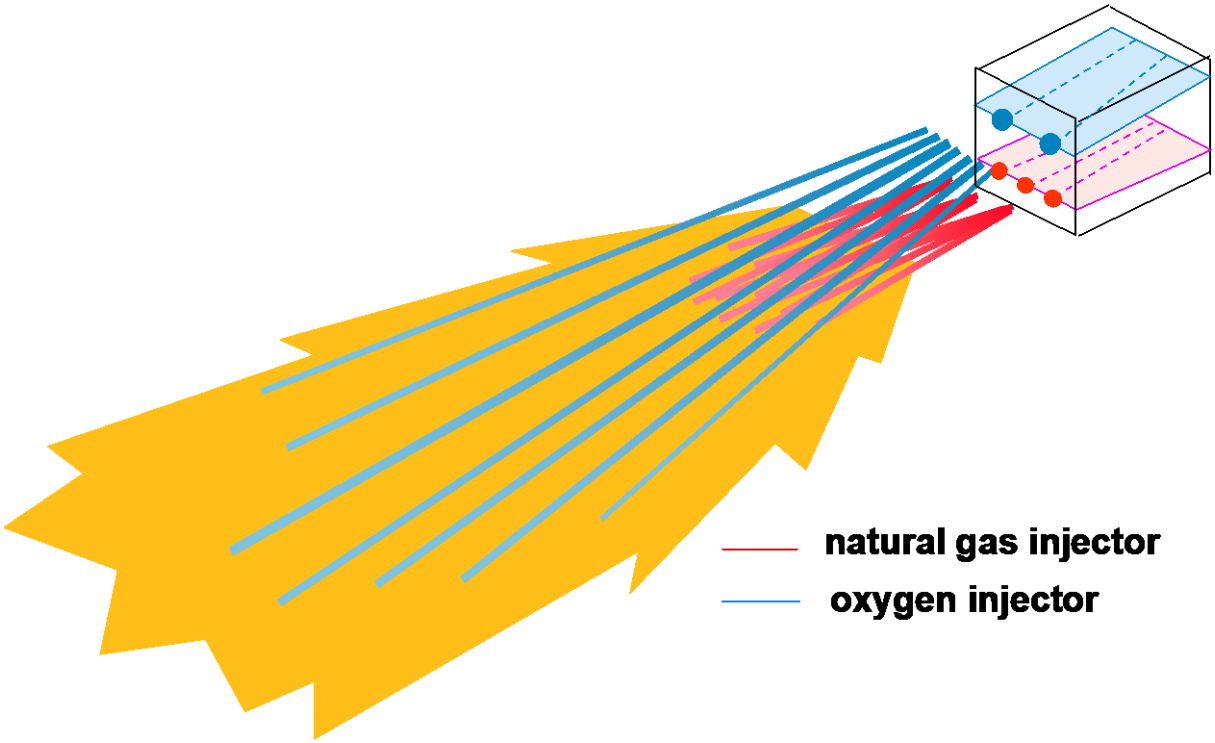
The ALBATCH FC burner is a non-water-cooled oxy-fuel burner especially designed for batch melting furnaces. This burner is particularly dedicated to applications where a wide flame, automatic ignition system and/or flame supervision are essential.

An ignition pilot burner and a flame supervision cell can be integrated into the burner body.

The ALBATCH FC burner uses a design (Patent pending) where fuel and oxygen mix outside the burner block. Fuel and oxygen are introduced into the furnace through a unique configuration of injectors that produces a highly luminous flame up to three times wider than conventional oxy-fuel burners.

The fuel is distributed, at the bottom of refractory burner block, among three fuel gas injectors arranged in a fan-shaped configuration, so that the streams of fuel form a wide sheet of gas in the furnace. Oxygen is injected at lower velocity from two injectors located at the top of the block, which direct the oxygen flow towards the jets of fuel.

Control of the flame shape and luminosity can be obtained by injecting a small proportion of the oxygen flow (for a total ranging from 3 % to 15 % of the combustion oxygen) via 2 orifices around each of the three natural gas injectors at the bottom of the block in a pipe-in-pipe configuration.



ALBATCH FC burner operation principle

The ALBATCH FC burner is composed of:

- a square section refractory burner block with an inner shape inserted in the furnace wall or door
- a metallic burner body attached to the burner block which ensures the oxygen distribution
- a fuel injection system

Both the metallic and the refractory parts of the burner are cooled by the oxygen flow. Experimental and modeling studies have been carried out to design the inner shape of the burner in order to ensure efficient cooling and to prevent any deposit forming inside the block.

The alloy steels employed for the metallic parts (stainless steel 316L type for the burner body and the fuel lance, KANTHAL APM type for the gas fuel injectors) offer good resistance to corrosion for the burner's "cold part" and good resistance to temperature and oxidation for the "hot part".

The AZS rebounded material (Al_2O_3 + ZrO_2 + SiO_2) used for the refractory burner block is resistant to thermal shocks and the many atmospheres encountered in the various processes.

Other refractory compositions are available upon request, to suit the customer process.

The ALBATCH FC burner concept has been developed to minimize the oxygen pressure requirements, which makes it compatible with the On-site oxygen supply (VSA).

The ALBATCH FC burner can operate from 50 % to 150 % of its nominal firing rate.

The ALBATCH FC burner is referenced for natural gas and fuel oil (model 2000).

2 - DESCRIPTION OF THE ALBATCH FC BURNER

The ALBATCH FC burner gas version is composed of (see Figure 1):

- The burner block (1) made of refractory material,
- The fixation system (2) for mounting the burner body on the block,
- A ceramic fiber gasket (3) positioned between the burner block and the burner body,
- The burner body (4) with its VITON flat gasket (5),
- The fuel gas lance (6) with high temperature alloy injectors (7).

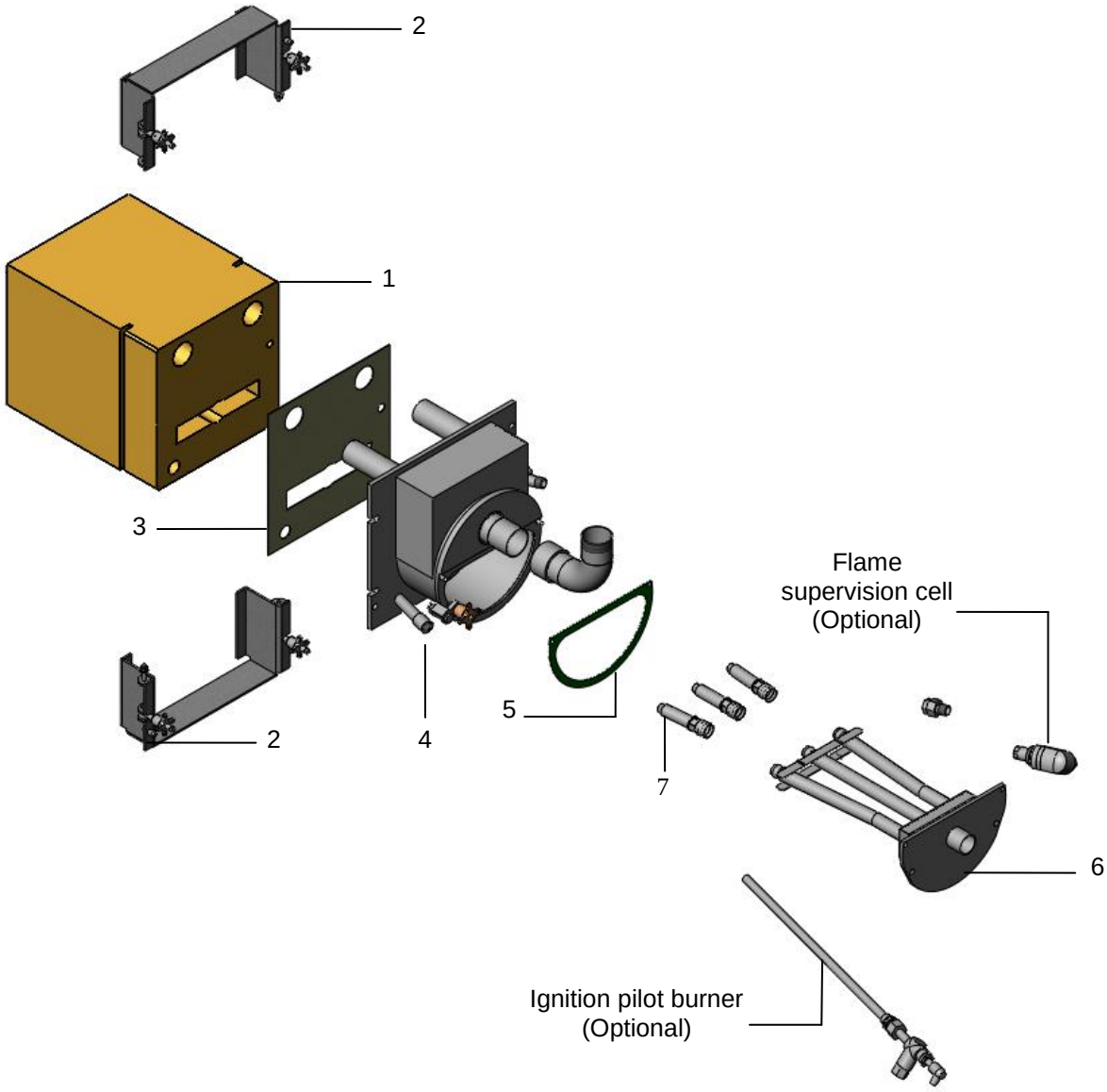


Figure 1

The ALBATCH FC burner fuel oil version is composed of (see Figure 2):

- The burner block (1) made of refractory material,
- The fixation system (2) for mounting the burner body on the block,
- A ceramic fiber gasket (3) positioned between the burner block and the burner body,
- The burner body (4) with its VITON flat gasket (5),
- The fuel oil lance (6) with high temperature alloy injectors (7) and an insulation packing (8).

Figure 2

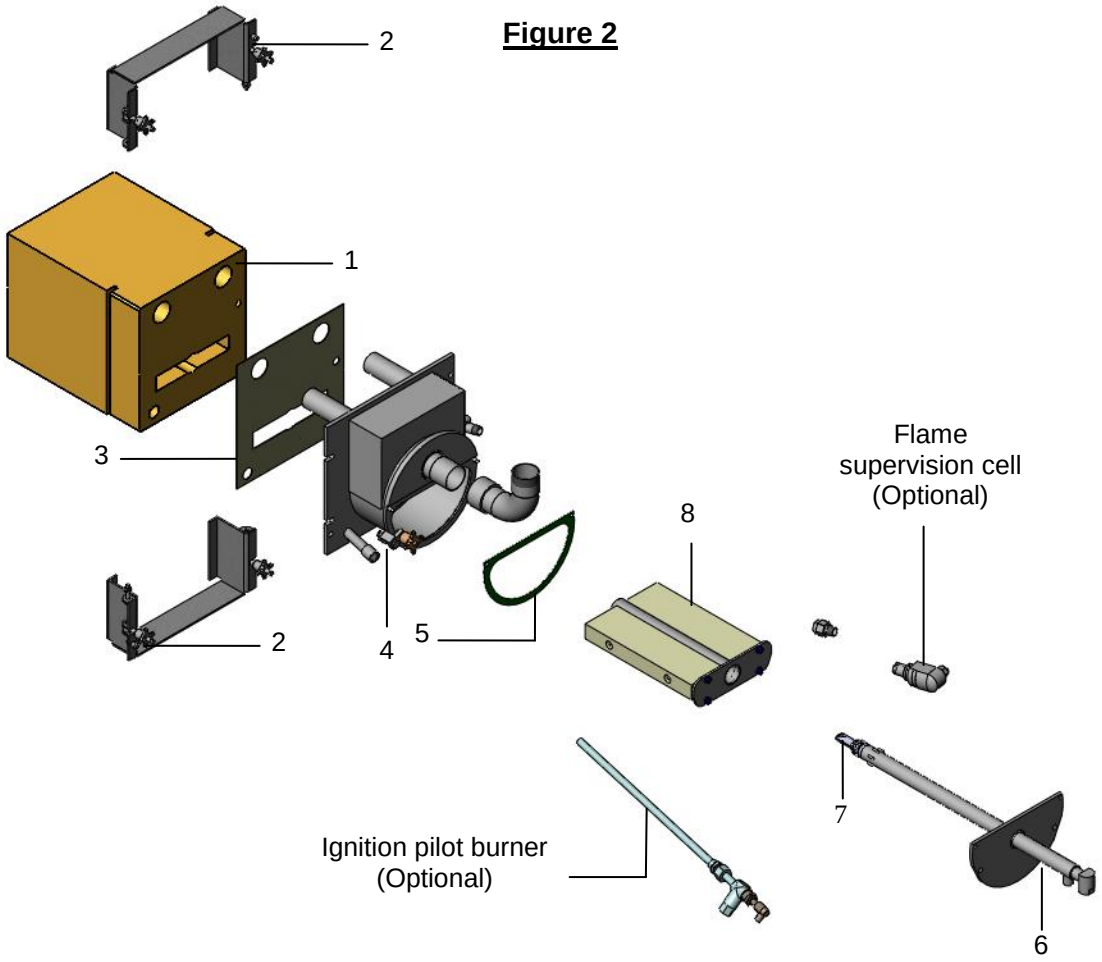


Figure 2

In standard version, the burner body can integrate an ignition pilot burner and a flame supervision cell.

All of the materials used for the burner fabrication are compatible with pure oxygen. All the burner metallic parts must be clean of dust and oil.

3 - INSTALLATION OF THE BURNER

Before installation of the block inside the furnace wall or door, proceed to a blank assembling of all burner parts to verify the centering of fuel gas/oil nozzles inside the block hole.

3.1 INSTALLATION OF THE FIXATION SYSTEM

Warning: the fixation system (2 pieces) must be mounted on the burner block before the block is installed in the furnace wall or door except if rear part of block is outside the furnace wall or door and there is enough room for brackets installation above and below the block

The fixation system is in two parts: it is assembled with the supplied set of nuts and bolts (see Figure 3).

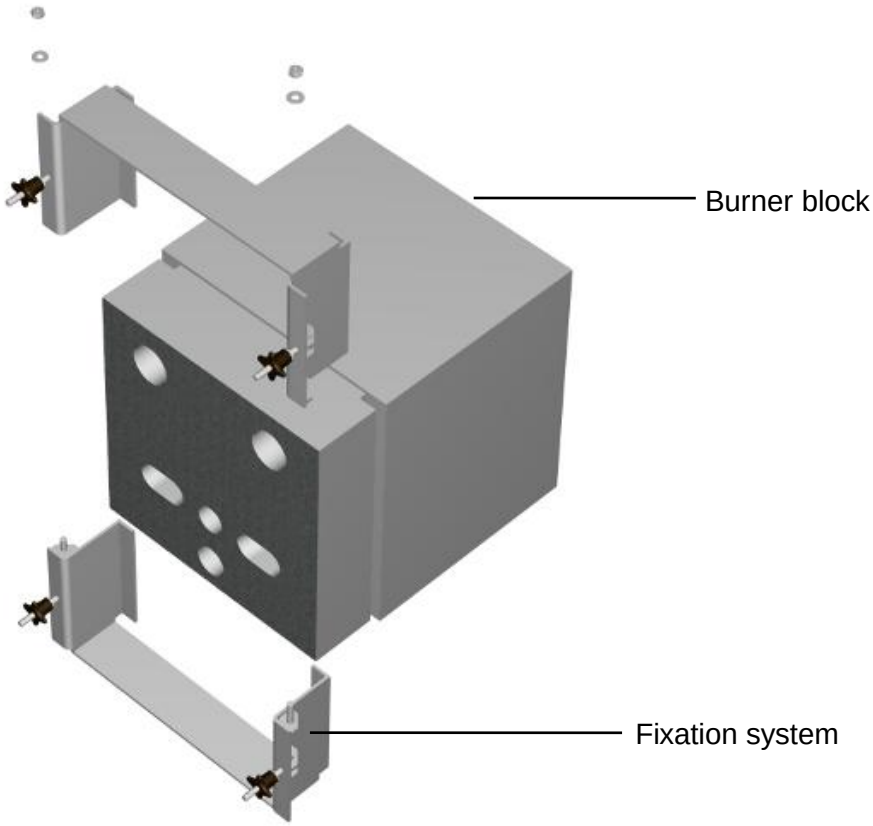


Figure 3

3.2 INSTALLATION OF THE BURNER BLOCK

The block has 2 oxygen orifices and 3 gas orifices.

Since the ALBATCH FC burner is intended for installation on different types of furnace, this chapter can provide only general information (See Appendix A for the dimensions of the ALBATCH FC burner).

Before installing the burner block, check that the support of the block is horizontal or inclined no more than 5-10° toward the surface of the charge, to make sure that flames are not oriented towards the crown of the furnace and avoid backflow of aggressive condensate from the furnace atmosphere.

- Place the burner block in the dedicated furnace opening. Make sure that the burner is correctly centered and the two oxygen orifices are above the natural gas orifices and horizontal before pushing the block into final position.
- If the burner is not installed before several hours, plug the hole of the refractory block with alumina wool.
- Ensure a proper tightness around the burner block with a heat resistant material

In order to be sufficiently protected from the furnace radiation, the burner block outlet face must be placed in the same plane as the inner furnace wall or slightly in recess.
Good tightness of the burner block mounting in the wall is essential to limit air inlets near the burners and reduce the formation of nitrogen oxides. It is recommended that the block is mounted with small refractory wedges and / or fibrous refractory sheets. Mortaring the block in place would be most desirable.

- Tighten the mounting bracket.

First heating-up of the block must follow same heating curve as the refractory component of the furnace door where burner is mounted.

Never use internal hole of the block to lever or displace the block

3.3 PREPARATION OF THE BURNER PARTS

The burner is delivered "Oxygen clean". Before assembling the burner, make sure that all parts have not been contaminated by grease, oil or particulates. If it has been contaminated, all metallic parts of the burner must be thoroughly cleaned one by one in order to eliminate all traces of oil or grease and of particulates. Use only oxygen compatible products for this operation. In case of a doubt on what product to use and procedure, contact an Air Liquide representative.

3.4 INSTALLATION OF THE BURNER BODY ON THE BLOCK

Install the burner body in the block just before firing it.

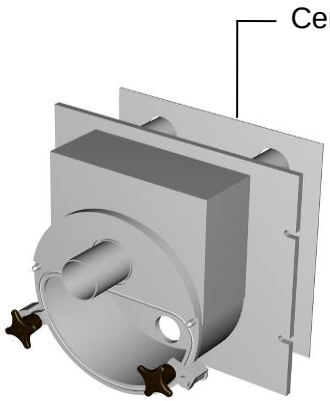


Figure 4

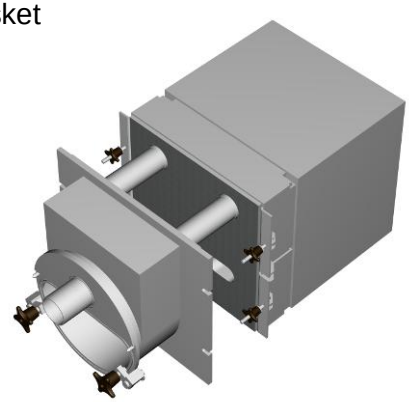


Figure 5

1) Place the square ceramic fiber gasket on the burner body (see Figure 4),

2) Connect the oxygen hose to the burner and open the manual valve: from now on, cooling air must flow through the burner,

3) Remove the alumina wool plugs from the block, and check that the inside of the block is not obstructed by foreign materials (fibrous refractory or melting metal residue),

4) Place the burner body in the block (see Figure 5),

5) Place the bracket adapter bolts in the burner body plate slots, and tighten them to compress the ceramic fiber gasket by 50%.

The manual oxygen valve must always be opened, except when removing the burner body. Never use the burner body as a lever to displace the block. Cooling air must be clean, dry and oil-free.

3.5 INSTALLATION OF THE IGNITION PILOT BURNER, FLAME SUPERVISION CELL AND GAS LANCE

The gas lance is mounted in the burner body only when everything is ready to fire the burner.

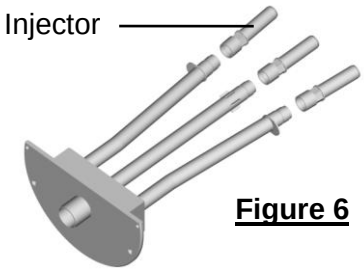


Figure 6

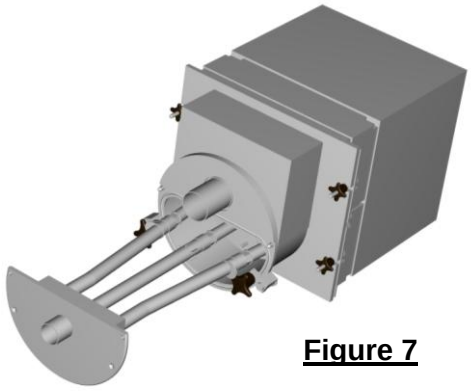


Figure 7

1) Install the ignition pilot burner, adjust its position so that the extremity is in recess in the block (1 cm), connect the fuel and air supplies as well as the electrical connection for the spark,
2) Install the flame supervision cell with its electrical connection,
3) Install the flat VITON gasket on the burner body flange,
4) Mount the gas injectors on the gas lance (see Figure 6), use special grease compatible with oxygen, tightening must be done by hand (no tools),
5) Check that the gas orifices are not obstructed by foreign material,
6) Connect the gas flexible hose,
7) Check cooling air is flowing through O2 burner body,
8) Insert the gas lance in the burner body (see Figure 7),
9) Tighten the nuts to compress the flat VITON gasket,
10) Open the manual natural gas valve.

In order to avoid overheating of the metallic parts, fire the burner immediately.

WHEN COOLING AIR IS NOT AVAILABLE, THE GAS LANCE MUST BE DISMOUNTED FROM THE BURNERS.
IF THE GAS LANCE IS LEFT IN THE BURNER WITHOUT COOLING, SYSTEMATICALLY INSPECT IT AS DAMAGE MAY HAVE OCCURRED TO THE METALLIC PARTS (see maintenance chapter)

4 - BURNER MAINTENANCE

It may be necessary to remove a burner for regular maintenance inspections or when the burner is not used for a long period of time.

4.1 INSPECTION OF THE INJECTORS

1) Turn the burner off,
2) Close the manual natural gas valve,
3) Unfasten the gas lance nuts,
4) Remove the gas lance,
5) Check the gas injector tips and the inside of the burner block,
6) Replace the gas injector tips if necessary (check that the new gas injectors are free of traces of oil and grease, and clean if necessary),
7) Reinstall the gas lance as described in section 3.5.

During the first month of operation of the burner, inspection of the injectors must be carried out every week. During the second month, the period between inspections can be extended to two weeks. Air Liquide recommends that each gas injector is inspected every month, and every time a burner is left in the furnace without cooling air.

4.2 UNMOUNTING THE BURNER

When the burner is not going to be used for extended periods of time, the burner should be removed from the burner block.

1) Turn the burner off,
2) Close the manual natural gas valve,
3) Unfasten the gas lance nuts,
4) Remove the gas lance,
5) Remove the ignition pilot burner,
6) Remove the flame supervision cell,

7) Unfasten the bracket bolts,
8) Remove the burner body from the burner block,
9) Plug the block orifices with Alumina wool,
10) Disconnect O2 flex hose from burner body and NG flex hose from gas lance,
11) Store the burner body and the gas injectors in a clean dry area.

A burner that was previously removed may be re-installed by following the same procedure as described in Chapter 3.

Use only new ceramic gasket for the burner body to block tightness.

All the burner metallic parts must be carefully cleaned for use with pure oxygen.
The inside of the block has to be inspected and cleaned if necessary.

Before attempting burner mounting on a hot furnace, the operator should perform a dry run of the burner assembly in a less hostile environment.

4.3 GASKET INSPECTION

The flat VITON gasket on the flange, and the gaskets of the quick connecting components, must be inspected every 3 months.

Every year, all these sealing components must be replaced by new ones.

Note:
The fuel oil injector is equipped with 3 o-rings which must be replaced by new ones every year.

5 - SAFETY

Every operator who manipulates the ALBATCH FC oxy-fuel burner should be trained on oxygen safety procedures. In particular, operators must be aware of the following minimum safety instructions for oxygen use:

- **Never use oil or grease for oxygen piping, nor assembling burner parts.**
- **Do not use organic materials for tightness components.**
- **Always clean all parts before installing them.**

Failure to respect these instructions may cause ignition in the oxygen circuit, and further propagation along the oxygen piping.

6- SPARE PARTS

(For these, we advise you to send us a copy of the duly filled parts list. Indicate in the column Qty the number of wished parts and mention the type and the part number of your device.)

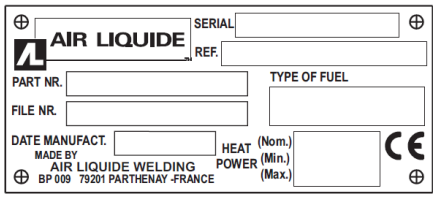
ALBATCH FC 1000 Natural gas version

For articles tracked down on photos or sketch and not appearing in tables, to send us a copy of the concerned page and to put in evidence the mark in question.

☐	Normally in stock.
⊙	Not in stock.
	In demand.

Rep	Ref.	Stock	Qty	Description
1	IAG11234	⊙		Refractory block
2	IAG20845	⊙		Fixation system
3	IAG30813	☐		Ceramic gasket
4	IAG11359	⊙		Burner body
5	IAG41654	☐		VITON flat gasket
6	IAG20930	⊙		Fuel lance
7	IAG41608	⊙		Injector
Option		⊙		*Ignition pilot burner lg 600 mm*
Option		⊙		*Flame supervision cell*

➢ If order of parts indicate the quantity and note the number of your burner below.



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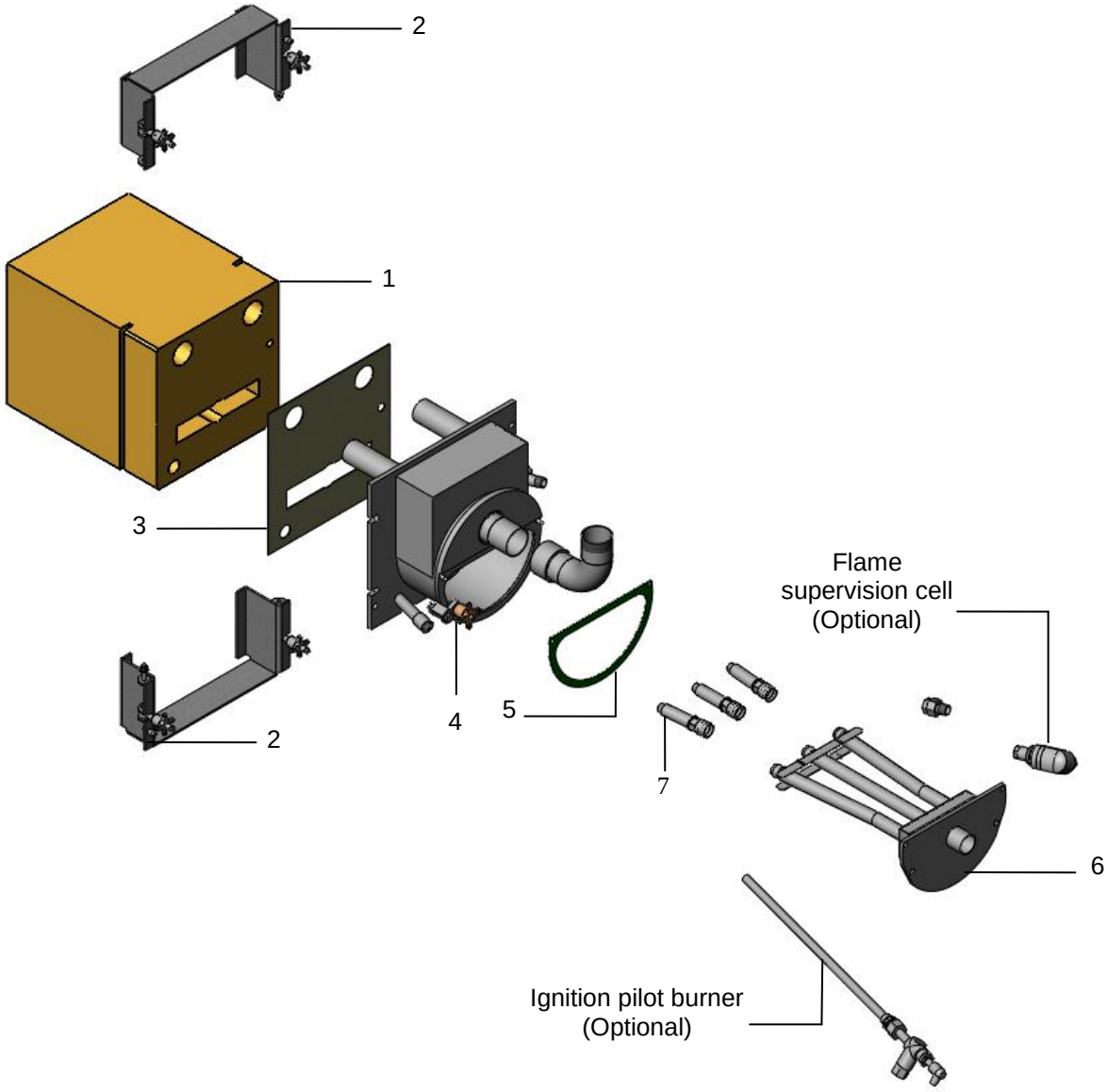
ALBATCH FC 2000 Natural gas version

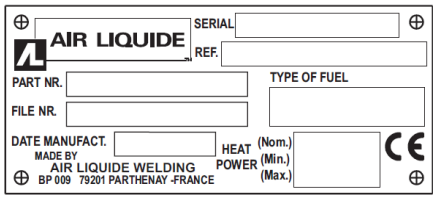


For articles tracked down on photos or sketch and not appearing in tables, to send us a copy of the concerned page and to put in evidence the mark in question.

☐	Normally in stock.
⊙	Not in stock.
	In demand.

Rep	Ref.	Stock	Qty	Description
1	IAL50363-02-A IAL50363-03-A IAL50363-04-A	⊙ ⊙ ⊙		ERMOLD Refractory block ZM9-27V Refractory block SUPERCAST B160 Refractory block
2	IAL50047-00-B	⊙		Fixation system
3	IAL50365-00-B	☐		Ceramic gasket
4	IAL50366-00-B	⊙		Burner body
5	IAL50052-00-A	☐		VITON flat gasket
6	IAL50371-00-0	⊙		Fuel lance without fuel gas injector
7	IAL50051-10-A IAL50051-20-A	⊙ ⊙		Ø17,2 injector Ø15,4 injector
Option		⊙		*Ignition pilot burner*
Option		⊙		*Flame supervision cell*

➢ If order of parts indicate the quantity and note the number of your burner below.



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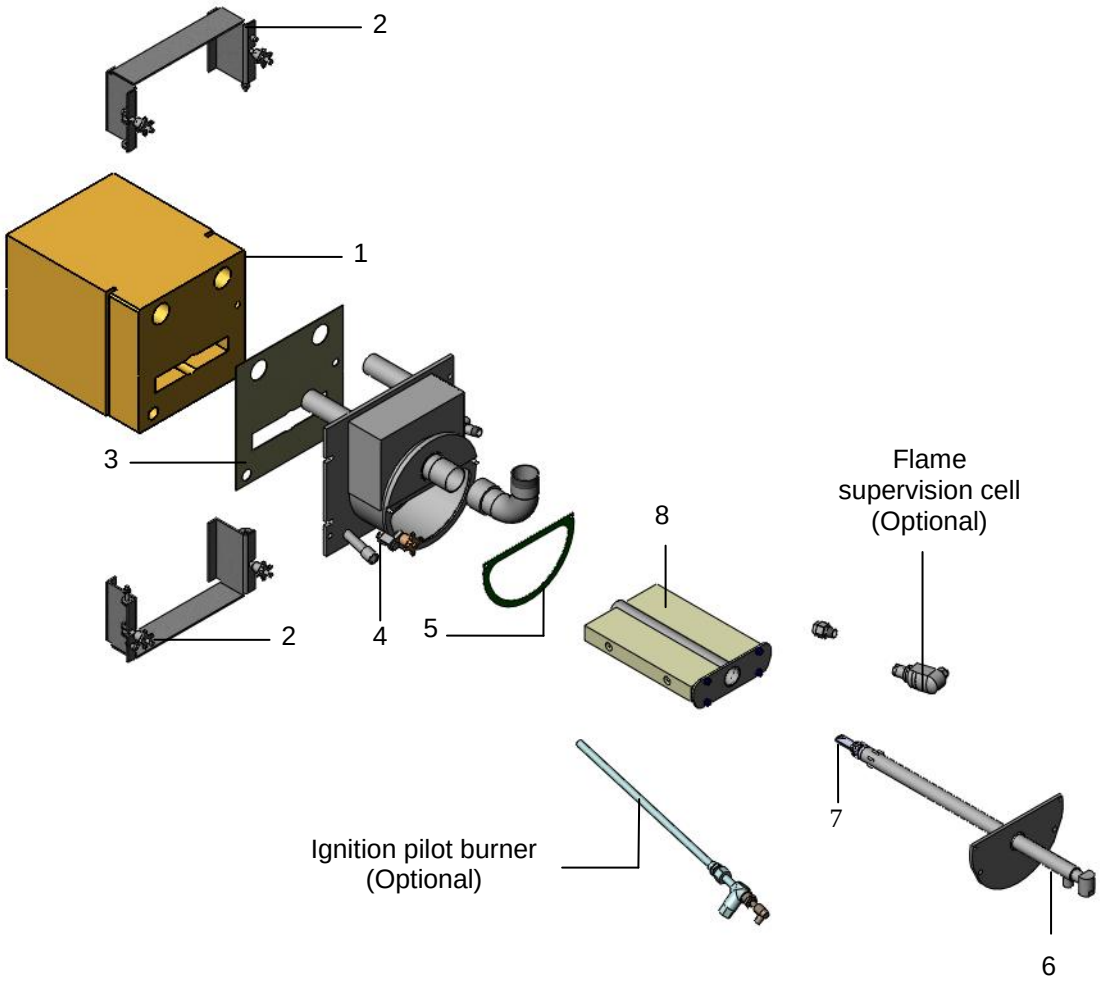
ALBATCH FC 2000 fuel oil version

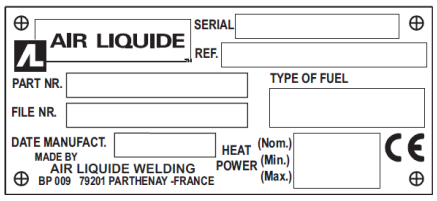


For articles tracked down on photos or sketch and not appearing in tables, to send us a copy of the concerned page and to put in evidence the mark in question.

☐	Normally in stock.
⊙	Not in stock.
	In demand.

Rep	Ref.	Stock	Qty	Description
1	IAL50363-02-A	⊙		ERMOLD Refractory block
	IAL50363-03-A	⊙		ZM9-27V Refractory block
	IAL50363-04-A	⊙		SUPERCAST B160 Refractory block
2	IAL50047-00-B	⊙		Fixation system
3	IAL50365-00-B	☐		Ceramic gasket
4	IAL50366-00-B	⊙		Burner body
5	IAL50052-00-A	☐		VITON flat gasket
6	IAL50369-00-A	⊙		Fuel lance equipped with fuel oil injector
7	IAL50321-00-0	⊙		Fuel oil injector
8	IAL50368-10-0	⊙		Insulation packing
	IAL50368-00-0	⊙		Insulation packing support
Option		⊙		*Ignition pilot burner*
Option		⊙		*Flame supervision cell*

➢ If order of parts indicate the quantity and note the number of your burner below.



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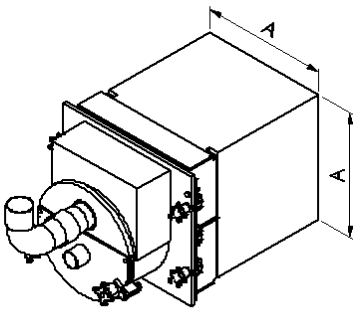
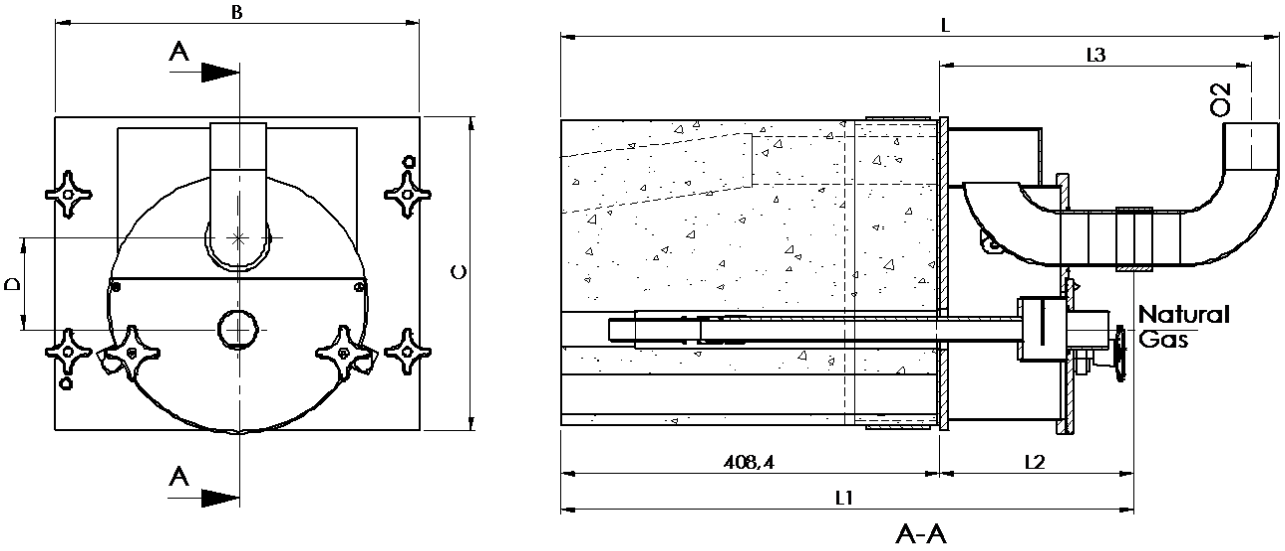
7 - APPENDIX

Appendix A: ALBATCH FC burner dimensions

ABATCH FC burner gas version										
Model (kW)	**L**	**L1**	**L2**	**L3**	**A**	**B**	**C**	**D**	**O_2 (Oxygen)**	**NG (Natural Gas)**
1000	749	617,9	209,5	316,5	275	337	285	67	M-G 1"1/2 BSPT	M-G 1" BSPT
2000	774,5	618,4	210	336	330	392	340	98	M-G 2" BSPT	M-G 1"1/4 BSPT

ABATCH FC burner fuel oil version											
Model (kW)	**L**	**L1**	**L2**	**L3**	**A**	**B**	**C**	**D**	**O_2 (Oxygen)**	**Atomizing fluid**	**Fuel oil**
2000	774,5	618,4	210	336	330	392	340	98	M-G 2" BSPT	F-G 3/8" BSPP	F-G 1/4" BSPP





Appendix B: Capacity ranges and pressure drop

- Capacity ranges of the ALBATCH FC burner:

Model	Maximum capacity	Nominal capacity	Minimum capacity
ALBATCH FC 1000 Gas version	1500 kW	1000 kW	500 kW
ALBATCH FC 2000 Gas and liquid versions	3000 kW	2000 kW	1000 kW

- Pressure drop of the ALBATCH FC burner:

The ALBATCH FC burner requires low oxygen and fuel inlet pressures. The table below gives some values of the pressure drop through the burner depending on the model and flow rates.

ALBATCH FC 1000 Gas version (2 orifices of 8 mm)	**Flow rate (Nm^3/h)**	**Pressure drop (mbar)**
Oxygen	156	33
	210	46
Natural gas	71	26
	95	57

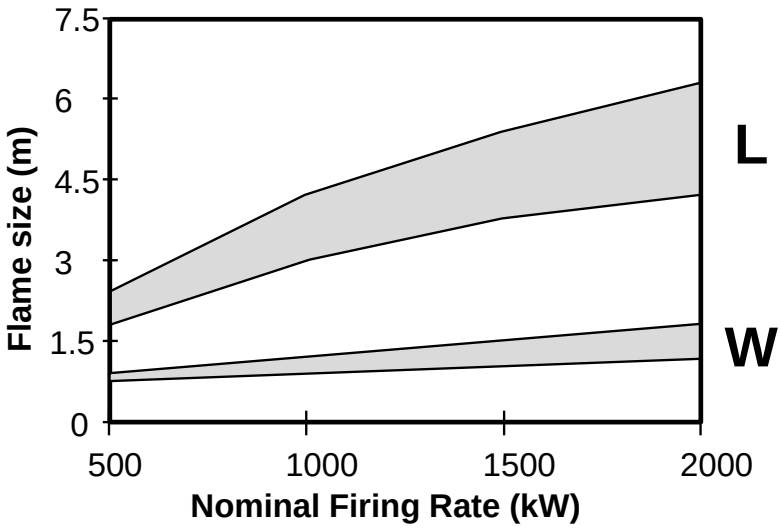
ALBATCH FC 2000 Gas version (2 orifices of 8 mm)	**Flow rate (Nm^3/h)**	**Pressure drop (mbar)**
Oxygen	213	6
	313	22
	417	36
Natural gas	94	7
	140	24
	187	40

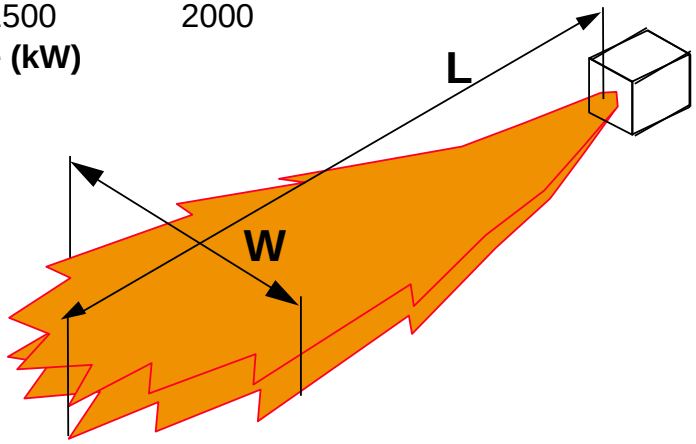
Appendix C: Flame length and heat transfer

- Flame length of the ALBATCH FC burner:

The ALBATCH FC burner produces a highly luminous flame up to three times wider than conventional oxy-fuel burners (pipe-in-pipe configuration) and allows an effective energy transfer.

The flame dimensions for the ALBATCH FC burner in a pilot furnace are presented in the figures below:





The flame shape of the ALBATCH FC burner may be modified by changing the geometry (diameter) of the natural gas injectors and by adjusting (via the calibrated orifices located in the burner body) the flow rate of the oxygen injected around the three natural gas injectors.

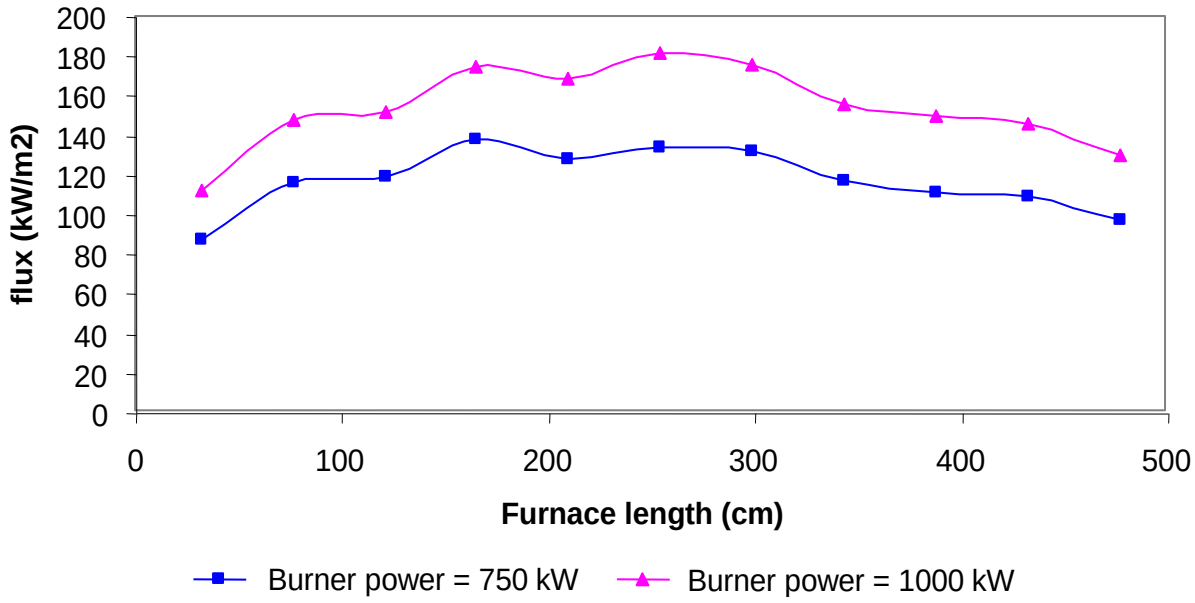
With low oxygen flow around the three natural gas injectors, mixing between the oxygen and the gas is delayed, which produces a long flame.

With higher oxygen flow, mixing between the oxygen and the gas is faster and the result is a shorter flame.

- Heat transfer of the ALBATCH FC burner

The wide and luminous flame produced by the ALBATCH FC burner allows effective energy transfer.

The profile for the transfer of heat to the charge for the ALBATCH FC 1000 model (natural gas version) in a pilot furnace is given in the figure below.

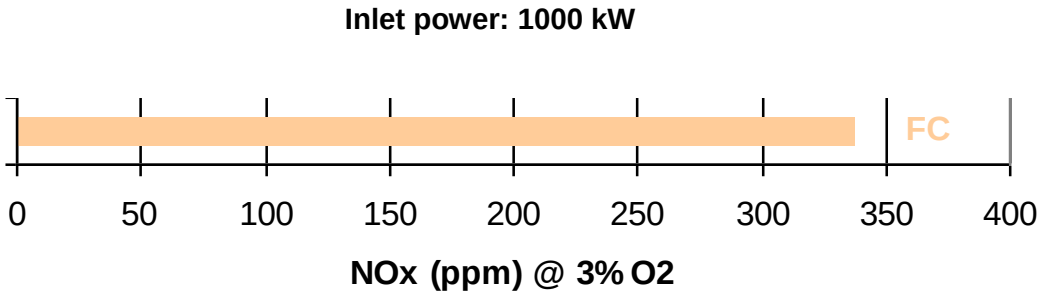


Appendix D: Nox emissions

- Nox emissions of the ALBATCH FC burner

The ALBATCH FC burner generates low NOx emissions (a factor of 4 – 5 reduction by comparison with conventional pipe-in-pipe burners) due to separated injectors and lower (- 300 °C) peak temperature.

See the following graphic where NOx emissions are presented for ALBATCH FC burner, considering 3% of O2 in exhaust gases, when this burner is operated at 1000 kW in a pilot furnace.



Appendix E: General instructions for proper working conditions

- General instructions for proper working conditions of the ALBATCH FC burner

-The ALBATCH FC burner requires control over the fuel and oxygen, so we recommend the installation of a calibrated flow meter on the fuel and oxygen lines for determining accurate volumetric or mass flow rates.

-During combustion, the burner body, the fuel lance and the burner block are cooled by the oxygen flow. However when combustion is not taking place, all parts of the burner are heated and can be destroyed by high furnace temperatures. In this case, a cooling air flow should be established using the oxygen line.
When cooling air flow is not available, the fuel lance must be dismounted from the burner. If the fuel lance is left in the burner without cooling, systematically inspect it as damage to the metallic parts may have occurred.
However, the fuel lance can remain in a hot furnace for 15 minutes without any cooling.
The cooling air flow must not come from a compressor as oils may be present in the compressed air and contaminate components which need to be clean when oxygen is present.
And it is recommended to supply a cooling air flow rate that is approximately 30 vol. % of nominal oxygen flow rate (see gas specifications for the burner operation in page 21).

-Quick-coupling systems for the oxygen and fuel will facilitate disassembly and installation.

-Quick-coupling systems also make possible to limit the time for which the burner parts, notably the fuel gas lance, are subjected to furnace temperatures without cooling flow.

-Piping needs to be supported in order to avoid stresses on the burner body which could lead to cracking of the burner block.

-Flexible hoses are advised for the burner supply. Flexible hoses can prevent the burner from damage due to stresses / expansion of the piping.

-The burner block made of AZS rebounded material (Al_2O_3 + ZrO_2 + SiO_2) is generally suitable for most applications. However, it is necessary to ensure that this material is compatible with the customer process.

-Viewing the flame through observation windows, such as peeping holes, makes burner start-up and adjustments easier.

-Oxygen and fuel supply piping must be rated for the pressure and flow rate requirements of the burner operating at maximum capacity. Avoid long distances and turns in the piping as they increase the pressure drop.

Appendix F: Gas and oil specifications for the burner operation

- Gas and oil specifications for the ALBATCH FC burner operation

MODEL	ALBATCH FC 1000	ALBATCH FC 2000
Min. oxygen temperature at burner inlet	10 °C	
Max. oxygen temperature at burner inlet	40 °C	
Min. Natural gas temperature at burner inlet	10 °C	
Max. Natural gas temperature at burner inlet	40 °C	
Oxygen supply pressure at burner inlet	50 mbar g. (Max. oxygen pressure drop through the burner at the maximum recommended firing rate)	
Natural gas supply pressure at burner inlet	100 mbar g. (Max. Natural gas pressure drop through the burner at the maximum recommended firing rate)	
Cooling air flow rate	60 Nm3/h	120 Nm3/h
Fuel oil supply pressure at burner inlet		1 - 3 bar g.
Maximum viscosity of fuel oil		40 centistokes
Nominal viscosity of fuel oil		25 centistokes
Min. fuel oil temperature at burner inlet		100 °C
Max. fuel oil temperature at burner inlet		140 °C
Atomizing air supply pressure at burner inlet		1 - 3 bar g.
Atomizing air flow rate		15 - 35 mass % fuel oil flow rate