

MAIOR P 500.1 AB Z3  
MAIOR P 600.1 AB Z3



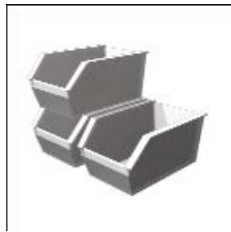
**Technical data**



**Operating instructions**



**Electric diagrams**



**Spare parts list**



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MAIOR P 500.1 AB TC 220-440-60

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MAIOR P 500.1 AB TL 220-440-60

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MAIOR P 600.1 AB TC 220-440-60

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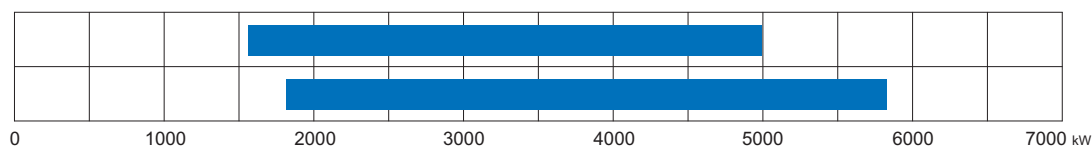
MAIOR P 600.1 AB TL 220-440-60

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MAIOR P 500.1

MAIOR P 600.1



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## GENERAL WARNINGS - CONFORMITY DECLARATION

MAIOR burners are designed for the combustion of light oil. The design and function of the burners meet the standard EN267. They are suitable for use with all heat generators complying with standard within their respective performance range. Any other type of application requires the approval of ECOFLAM.

Installation, start-up and maintenance must only be carried out by authorised specialists and all applicable guidelines and regulations must be complied with.

### BURNER DESCRIPTION

MAIOR burners are progressive mechanical fully automatic monoblock devices. Emissions values may differ, depending on combustion chamber dimensions, combustion chamber load and the firing system (three-pass boilers, boilers with reverse firing).

### PACKAGING

The burner, and all the additional components are supplied in a modular system of packages according to the configuration ordered that based on the country of installation shall follow the applicable standards and the local rules and code of practise.

The following standards should be observed in order to ensure safe, environmentally sound and energy-efficient operation:

### EN 267

Automatic forced draught burners for liquid fuels.

### EN 60335-1, -2-102

Specification for safety of household and similar electrical appliances, particular requirements for gas burning appliances

### INSTALLATION LOCATION

The burner must not be operated in rooms containing aggressive vapours (e.g. spray, perchloroethylene, hydrocarbon tetrachloride, solvent, etc.) or tending to heavy dust formation or high air humidity. Adequate ventilation must be provided at the place of installation of the furnace system to ensure a reliable supply with combustion air.

Declaration of conformity for dual fuel burners

We,  
**Ecoflam Bruciatori S.p.A.**

declare under our sole responsibility that the products:

**MAIOR P 500.1 AB Z3**  
**MAIOR P 600.1 AB Z3**

conform to the following standards:  
EN 267: 2010  
EN 60335-1: 2008  
EN 60335-2-30: 2006  
EN 60335-2-102: 2007  
EN 55014-1: 2008 + A1: 2009  
EN 55014-2: 1998 + A1: 2001 + A2: 2008

These products are built in accordance with the following directives  
2006/42/EC Machinery directive  
2004/108/EC EMC directive  
2006/95/EC Low voltage directive

CE certification, when required, must be done at installation site by the end user

Resana, 20th December 2010  
M. PANIZZON



**BURNER SELECTION:** Type of operation and configuration must be done by professional personnel in order to grant correct working of the burner. Installation, start-up and maintenance must be carried out by authorised specialists and all applicable guidelines and regulations (including local safety regulations and codes of practise) must be observed.

### We accept no responsibility for damage arising from:

- inappropriate use;
- incorrect installation and/or repair on the part of the buyer or any third party, including the fitting of non-original parts;
- non authorised modifications made on the burner.

### Final delivery and instructions for use

The firing system installer must supply the operator of the system with operating and maintenance instructions on or before final delivery. These instructions should be displayed in a prominent location at the point of installation of the heat generator, They should include the address and telephone number of the nearest customer service centre.

### Notes for the operator

The system should be inspected by a specialist at least once a year. Depending on the type of installation, shorter maintenance intervals may be necessary. It is advisable to take out a maintenance contract to guarantee regular servicing.

Ecoflam burners have been designed and built in compliance with all current regulations and directives.

All burners comply to the safety and energy saving operation regulations within the standard of their respective performance range. The quality is guaranteed by a quality and management system certified in accordance with ISO 9001:2008.



## BURNER DESIGNATION

## MAIOR P 400.1 AB Z3 TC 230-400-50

## RANGE NAME BY FUEL TYPE

MAIOR Light oil

## MODEL SIZE (Gas: kW; Oil: kg/h)

MAIOR P 400.1 330 kg/h - 3900 kW

## EMISSIONS

- Standard Class 1 - OIL EN267 (&lt;250 mg/kWh)

## OPERATION TYPE

AB 2 stages oil

AB Z3 2 stages oil with 3 nozzles

## HEAD TYPE

TC Short head

TL Long head

## FUEL

Light oil

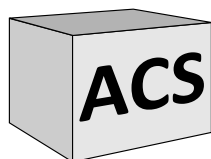
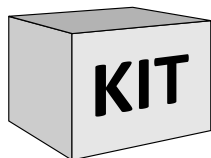
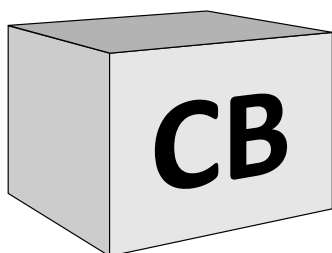
BIODIESEL Biodiesel

KEROSENE Kerosene

## ELECTRICAL POWER SUPPLY

230-400-50 230-400 Volt, 50 Hz

## MODULAR DELIVERY SYSTEM



## Light oil burners

All light oil burners are delivered complete in one single packaging including filter and flexible hoses up to 6 MW.

Additional accessories and options shall be installed by the installer in accordance to the instruction and local safety regulations and codes of practise.

## KITS - Accessories

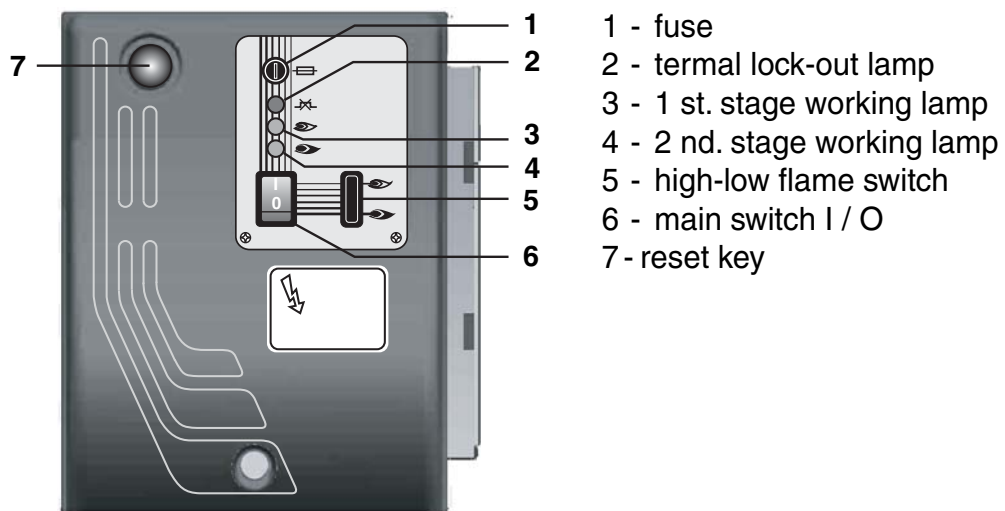
Kits and accessories are managed and delivered separately.

## Component type

CB	Complete burner
KIT	Kits
ACS	Accessories

## BURNER DESCRIPTION

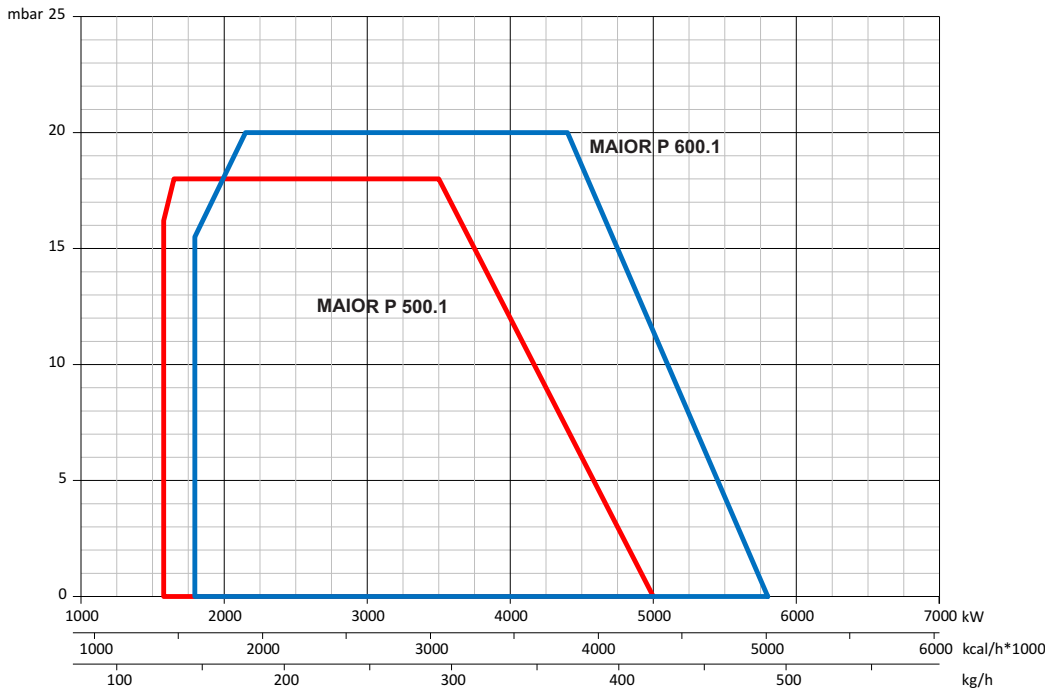
### Control panel



## TECHNICAL DATA

MODEL		MAIOR P 500.1 AB	MAIOR P 600.1 AB
Thermal power max.	kW	5.000	5.800
	kcal/h	4.300.000	4.988.000
	kg/h	422	489
Thermal power min.	kW	1.200	1.500
	kcal/h	1.032.000	1.290.000
	kg/h	101	126
Operation mode	Type	2 stages with 3 nozzles	
Regulation ratio nominal	Type	1+2 OIL	
Fuel	Type	Light oil (L.C.V. 10.200 kcal/kg max. visc 1,5°E at 20°C) - EL Hu = 11,86 kWh/kg	
Emission class	std	Standard Class 1 OIL EN267 (<250 mg/kWh)	
Control unit	Type	LAL 2. 44	
Air regulation	Type	Air flap	Air flap
Air flap control with servomotor	Model	SQM50	
Flame monitoring	Type	photoresistor	
Ignitier	Model	BRAHMA	
Motor	kW	15	
Rpm	N°	3.400	3.400
Voltage	V/Hz	254/440 V - 60 Hz (220 V auxiliary)	
Total power consumption operation	W	16.500	
Weight body BBCH	Kg		
Electrical panel protection level	IP	IP40	IP40
Sound pressure level without silencer	dB(A) Lab tests	91,1	92,8
Sound pressure level with silencer		85,7	86,7
Ambient temperature storage	Min/Max	-20°...+70° C	
Ambient temperature use		-10°...+60° C	
Oil pump	Model	TA3	TA4
Oil pump motor	kW	0,74 kW	1,1 kW
Nozzles	Type	according to the output requested	

## WORKING FIELDS



Calculation of burner output  
 $Q_F$  = Burner output (kW)  
 $Q_N$  = Rated boiler output (kW)  
 $\eta$  = Boiler efficiency (%)

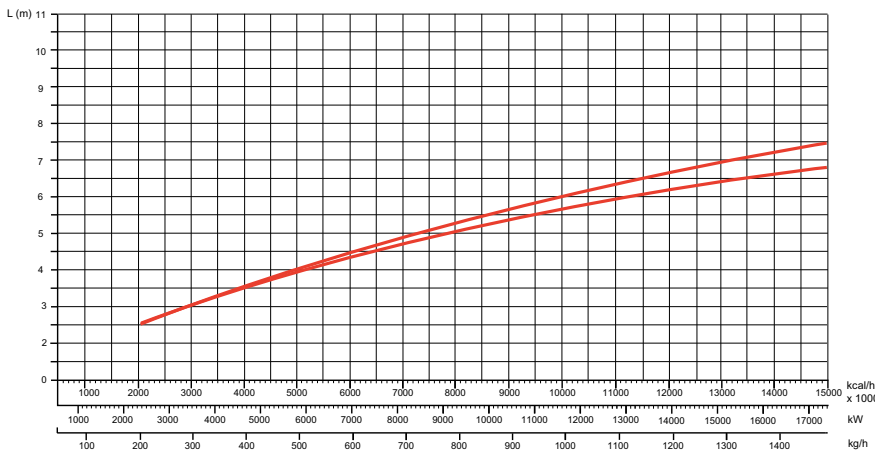
$$Q_F = \frac{Q_N}{\eta} \times 100$$

### Working fields

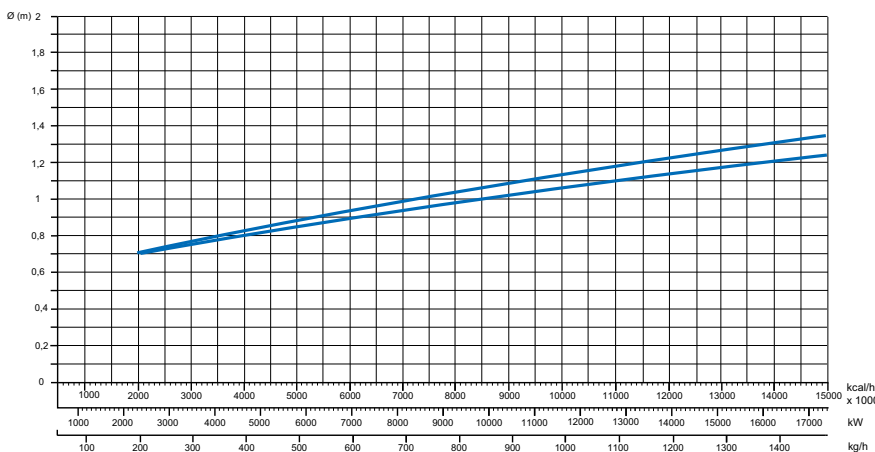
The working field shows burner output as a function of combustion chamber pressure. It corresponds to the maximum values specified by EN 276 measured at the test fire tube. Boiler efficiency should be taken into consideration when selecting the burner.

## TEST BOILER - FLAME DIMENSIONS

FLAME LENGTH LIGHT OIL BURNERS



FLAME DIAMETER LIGHT OIL BURNERS



The burner/boiler matching does not pose any problem if the boiler is CE type-approved.  
 If the burner must be combined with a boiler that has not been CE type-approved and/or its combustion chamber dimensions are clearly smaller than those indicated in diagram, consult the manufacturer.  
 The firing rates were set in relation to special test boilers, according to EN 267 regulations.

The sizes are indicative and depend on the configuration, the combustion chamber pressure and the draught. The values have been taken out from tests executed with flame tubes.

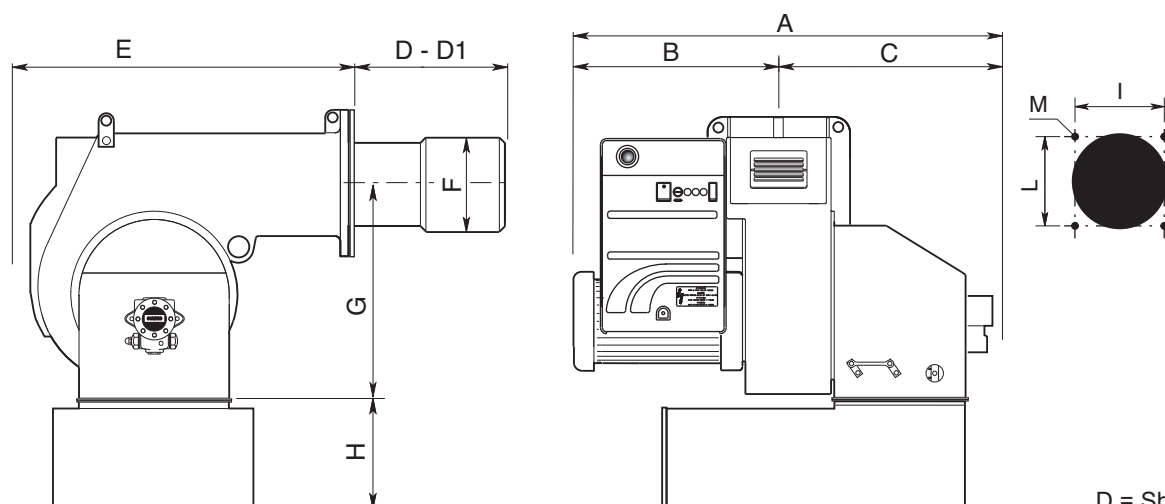
The dimensions of the flame are made in test boiler in laboratory without resistance therefore exists max and min length that take into account the difference in length that comes from the boiler backpressure.

Example:

Burner thermal output = 8000 kW;  
 L flame (m) = 5 m (medium value)  
 D flame (m) = 1 m (medium value)

**WARNING:** Some flame modifications can be done in our FLEXSHOP in the factory in order to shape the flame and adapt it to some special boiler or application.

## OVERALL DIMENSIONS



D = Short head  
D1= Long head

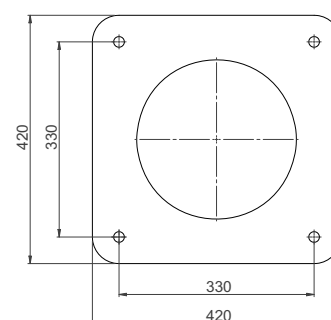
Dimensions (mm)

	A	B	C	D	D1	E	F	G	H1	I	L	M
MAIOR P 500.1	1180	535	645	355	555	970	320	570	965	330	330	M16
MAIOR P 600.1	1190	545	645	355	555	970	320	570	965	330	330	M16

## Burner-boiler mounting flange

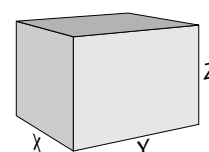
Fixing hole dimensions are "I" and "L" as per dimension table.  
Boiler hole shall be done according to the blast tube dimension "F" plus 15-25 mm in order to be able to extract it during maintenance.

**WARNING:** Please follow the suggested dimension for the hole on the boiler flange in order to fit the burner. Make sure that between the boiler and the blast tube proper insulation is fitted.



## Packaging (only burner)

	X	Y	Z	kg
MAIOR P 500.1 AB	1575	1575	1040	
MAIOR P 600.1 AB	1575	1575	1040	





## OIL OPERATING MODE - GENERAL SAFETY FUNCTIONS

### START-UP MODE

As soon as the furnace system is required to supply heat the burner control circuit will close and the program be started. After the program has run down the burner will start. The air damper is closed when the burner is out of operation.

The automatic furnace controller controls and monitors the starting function. The electric actuator opens the closed air damper to low fire position position so that the burner will sweep the furnace compartment and exhaust ports. At the end of the specified pre-ventilation time the solenoid valves will open and thus allow the pressurized oil to flow to the nozzle.

The oil will be atomized, mixed with the combustion air and ignited.

A safety period is provided to allow the flame to develop a proper and steady pattern.

On the termination of the safety period, a flame signal must have been received by the automatic furnace controller via the flame monitor and remain on until the regular shut-off.

The startup program of the burner has now been completed.

### GENERAL SAFETY FUNCTIONS

In case a flame does not develop when starting the burner (fuel release) the burner will shut off at the end of the safety period (safety lock-out).

A safety lock-out will also occur in the case of flame failure during operation, air flow failure during the pre-ventilation phase and pressure failure during the whole period of burner operation.

Any failure of the flame signal at the end of the safety period and a flame signal during

### OIL OPERATING MODE

After the flame has developed the load regulator (thermostat) will be enabled which brings the burner into its operating position.

The load regulator will now control the burner automatically between its partial-load and full-load stages.

Depending on the heat demand, the electric actuator of the mechanical compound control system will be fed with the OPEN or CLOSE signal via the regulator and thus increase or decrease the oil and air flow rates.

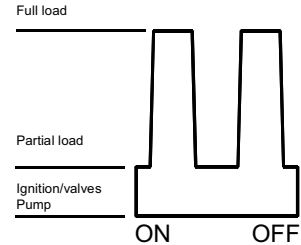
The air damper will be closed when the burner is out of operation and will thus prevent cold air flowing through the burner chamber, heat exchanger and chimney. The interior cooling losses will be greatly minimized.

the pre-ventilation phase (external light control) will result in a safety lock-out with the control box being locked.

The trouble is indicated by the trouble signal lamp lighting up. The control box can be unlocked immediately after a safety lock-out by pressing the unlocking key. The program unit will return to its starting position and proceed with the restart of the burner. A voltage failure will result in a regular shut-off of the burner. Upon voltage

### Oil control:

#### 2-stage sliding



recovery there may be an automatic restart unless another interlock is provided, e.g. by the safety system. In any case of trouble the fuel oil supply will be shut off right away. The program unit will stop at the same time causing also the trouble location indicator to stop. The symbols will indicate the kind of trouble.

## INSTALLATION

### Fitting the burner to the boiler

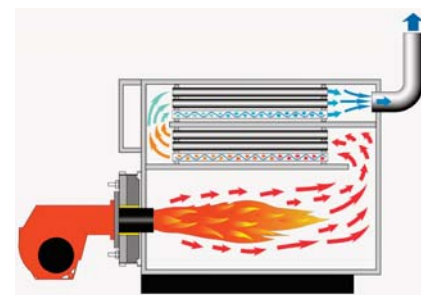
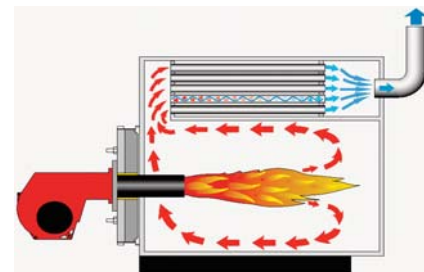
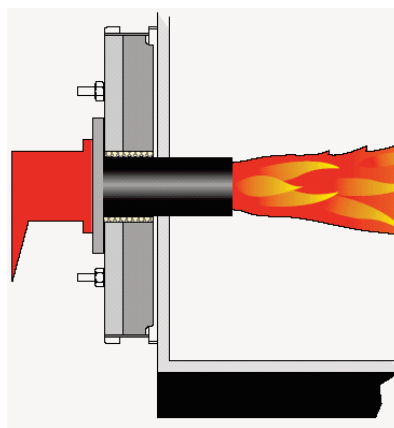


**WARNING:** handling and moving operations must be carried out by specialised personnel. Use the eyebolts to lift the burner in order that it will not overturn and fall down.

To perform the installation of the burner into the boiler drill the boiler plate according to the dimension given on this manual and place the burner towards it by lifting and moving the burner by means of eyebolts.

Place the gasket on the burner flange and install the burner into the boiler by fixing nuts into the bolts.

The space between the blast tube and the boiler lining must be sealed with appropriate insulating material.

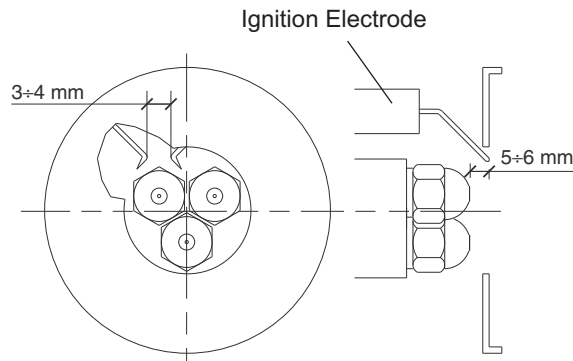


### BURNER LINING

#### Check before burner installation:

1. Depending on the type of boiler (reverse flame or three pass) check the burner blast tube installation depth according to the data specified by the boiler manufacturer or consult the burner producer.
2. From the factory the nozzle for progressive version must be specified from the customer according to boiler output and combustion chamber geometry, otherwise we will select the nozzle for the 80% capacity of the burner.
3. Check the ignition electrodes and the nozzle on the burner head as per factory setting (see figures). The setting of the mixing and ignition unit according to the boiler output will be performed during commissioning procedure.
4. Check that the head is preset at 50%.

#### Position of the electrodes - nozzle installation



### MAIN SWITCH

0 - OFF

1 - ON



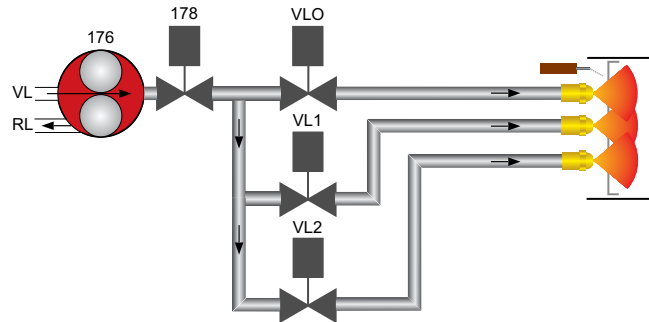
## INSTALLATION

### Oil connection

**!** **WARNING:** make sure that the feeding line is properly dimensioned and is in compliance with the local safety rules and code of practise in the country of installation

#### HYDRAULIC CIRCUIT LIGHT OIL FEEDING

- 176: oil pump
- 178: solenoid valve
- RL: return line
- VL: suction line
- VLO: working oil valve
- VL1: working oil valve
- VL2: working oil valve



#### OIL PRESSURE CONTROL (FEED)

The feed pressure is controlled by means of the pressure regulator installed in the pump and should be set at 12 bar. The pressure regulator is operated by turning its screw. Make sure to fill the pump with oil prior to taking into operation.

#### PUMP BLEEDING

Open the feed and return stop valves and ensure the ring line (if any) is in operation. Reduce the oil pressure at the pressure regulating valve. Turn on the pump by pressing the contactor. Check the pump for proper direction of rotation. Check for proper oil delivery and absence of leaks in the hydraulic oil system. For bleeding the pump open the pressure gauge connection, for example. When taking the burner into operation pro

ceed by gradually increasing the pressure to operating level (12 bar).

#### CHECKING THE PRESSURE (OIL SUCTION PRESSURE)

The maximum permissible vacuum is 0,4 bar. At higher vacuum levels the fuel oil will tend to separate air from oil which may lead to operating trouble. In the ring line mode of operation the recommended oil pressure is 1,2 bar.

#### OIL CONNECTION

Hoses are used for connection to the oil lines and stop valves. The hoses must be installed according to the applicable standards (relieved of tensile load, free of distortion) to avoid kinking and exclude the danger of breakage. Take care when mounting the oil lines to bring their ends as

close to the burners as possible and to arrange them in a way that the boiler door and the burner can be swung out without any obstruction.

Refer to the technical documentation for the line dimensions for the feed and return lines from the stop valves to the tank.

#### OIL FILTER

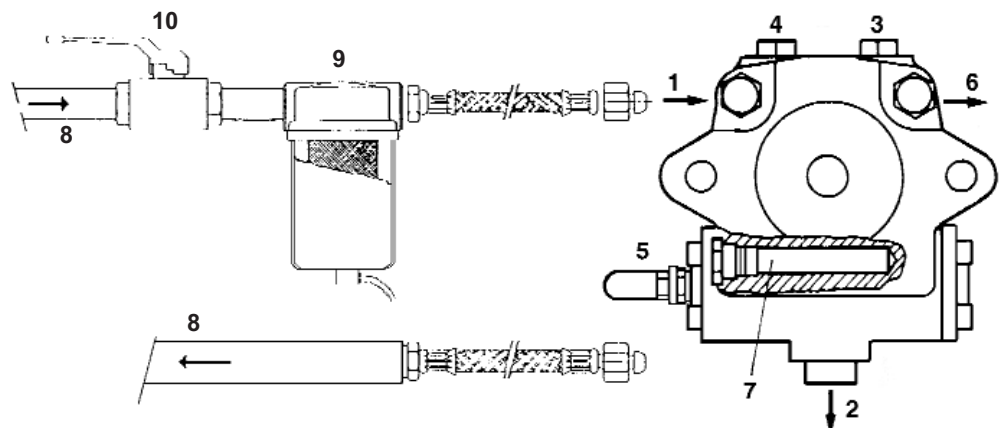
A filter must be installed upstream of the pump to protect the oil pressure pump and the hydraulic system.

#### INSTALLATION OPTIONS

- Two-line installation (separate feed and return lines without delivery pump).
- Ring line system (with delivery pump and gas-air separator).

#### LEGENDA

1. Inlet
2. Return
3. Bleed and pressure gauge port
4. Vacuum gauge port
5. Pressure adjustment
6. Nozzle outlet
7. Heater
8. Hose
9. Oil filter
10. Oil ball valve



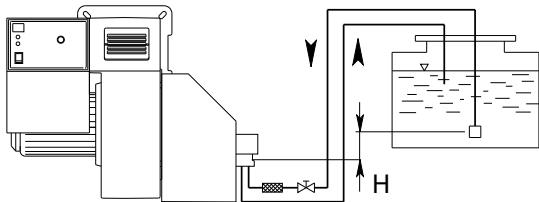
**!** **WARNING:** Check that the pump rotation is correct and before start up it has been pre-filled

## INSTALLATION

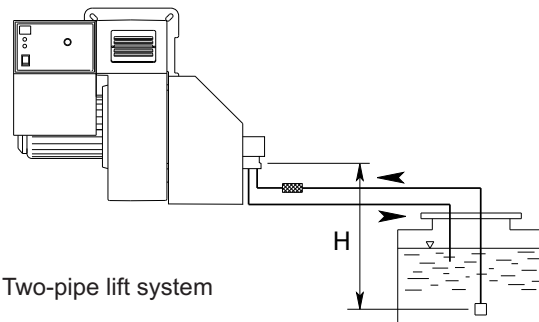
### Feeding and suction line for light oil

#### SUCTION LINE LENGTHS FOR PIPE SYSTEMS

- Two-pipe siphon feed system



- Two-pipe lift system



The burner is equipped with a self-priming pump which is capable of feeding itself within the limits listed in the table at the side.

H (m)	PIPE LENGTH (m)				
	TA3			TA4	
	ø 14 mm	ø 16 mm	ø 20 mm	ø 20 mm	ø 30 mm
3	10	32	115	65	150
2,5	8	28	110	60	150
2	7	25	100	55	150
1,5	6	22	95	50	150
1	5	20	85	45	150
0,5	--	17	75	40	150
0	--	15	65	35	150
-0,5	--	10	55	28	150
-1	--	5	45	22	150
-1,5	--	--	37	12	150
-2	--	--	30	7	150
-2,5	--	--	22	--	150
-3	--	--	9	--	123
-3,5	--	--	--	--	78
-4	--	--	--	--	38

**WARNING:** To calculate the length of the pipework all the straight parts, curves, up and down pipes must be taken into consideration. The static suction height is the distance between the standing valve and the axis of the burner pump.

Negative pressure must not exceed 0,45 bar; if negative pressure is greater pump operation may become faulty, leading to an increase in mechanical noise and perhaps even breakage.

All oil ring installations must comply with the local safety rules existing in the country of installation

#### The pumps that are used can be installed both into single-pipe and double-pipe systems:

**Single-pipe system:** a single pipe drives the oil from the tank to the pump's inlet that deliver the pressurized oil to the nozzle and part of the oil not used goes back to the pump. With this single pipe the by-pass plug must be removed and the return port must be sealed with steel plug and washer.

**Double-pipe system:** this is the default solution from the factory. The return pipe send the excess oil from the pump to the tank. Depending on the type of pump used to change from a 1-pipe system to a 2-pipe-system, insert the by-pass plug (as for ccw-rotation referring to the pump shaft).

**Note for commissioning:** during commissioning, the filter, pipelines and pumps must be pre-filled with fuel oil and vented. The direction of rotation of the motor should be checked. When commissioning it must be ensured that pump never run dry.

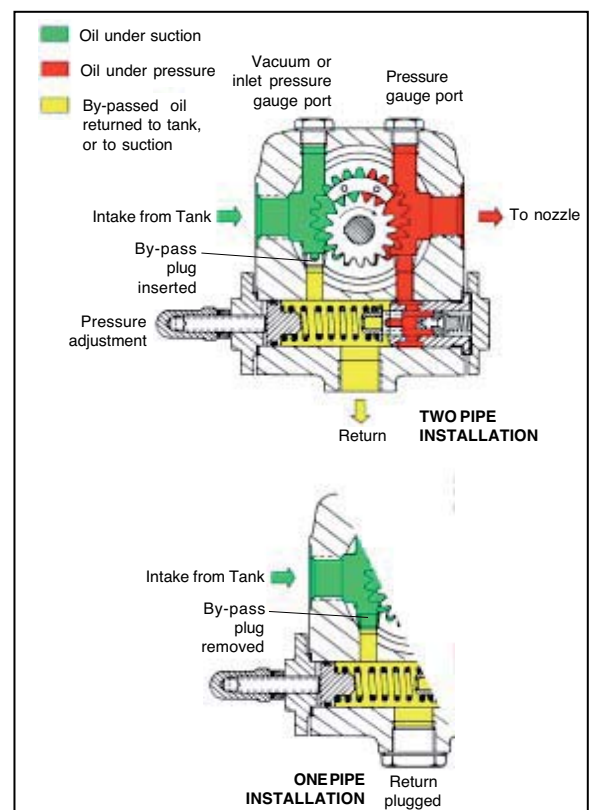
#### NOZZLE SELECTION

Please refer to diagram to select Ecoflam recommended nozzle for the output that is required given the output necessary in the installation. Regular maintenance is highly recommended.

Nozzle has to be cleaned in petrol or paraffin and if filter or other parts are defective or damaged the nozzle must be replaced.

NOZZLE CHART IS AVAILABLE ON APPENDIX PAGE

#### SUNTEC TA



## INSTALLATION

### Electrical connections

**!** **WARNING:** Electrical wiring must be carried out with electrical supply disconnected and with burner switch in position OFF. Electrical supply must correspond to the one shown on the burner label.

#### APPLICABLE STANDARD

The electrical connection work comprising all the installation materials, terminals and earth connections must be carried out in accordance with the applicable regulations. For the electrical installation of the burner care must be taken to observe the circuit diagram made out for the furnace system.

The electrical connection of the burner and instruments shall be entrusted to authorized specialists only.

**NOTE:** For the installation of the connection cables care must be taken to provide cable loops of sufficient length to allow for the swing-out of the boiler door and burner.

Make sure after the completion of the electrical connection work to check the

wiring of the electrical system of the burner. This should include a check of the direction of rotation of the burner motor (fan).

#### GENERAL WARNINGS:

All applicable electrical safety regulations must be followed. Failure to correctly dimension the suitable input power and earth the equipment may cause damages to person and compromise the correct function of the burner therefore the electrical system shall be checked by qualified personnel.

The manufacturer declines all responsibility for modifications or connections different from those shown in the electrical scheme.

Adapters, multiple plugs and extension cables may not be used for the

equipment's power supply.

An omnipolar switch in accordance with current safety regulations is required for the mains supply connection.

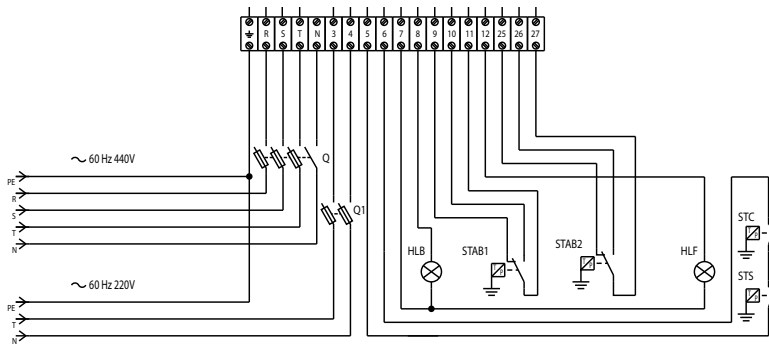
#### ELECTRICAL CONNECTION

##### 1) of the burner

- Built-in electrical cabinet

Use cable gland in order to secure the required level of protection. All the links, power and control, are connected to the terminal block of the cabinet. Provide cables in sufficient length to secure the rotation of the burner body according to the assembly.

Check and adjust the size of the contactors and thermal relays and the wires section according to the motor and supply voltage specs.



#### LEGENDA

- HLB: lock-out lamp
- STAB: two stages thermostat
- HLF: burner on flame lamp
- STC: boiler thermostat
- STS: safety thermostat
- STAB: High/Low flame thermostat

## START-UP: CHECKING PROCEDURE

### CHECKS BEFORE COMMISSIONING:

- That the burner is assembled in accordance with the instructions given here.
- Setting the combustion components.
- All electrical connections must be correct.
- Check the burner motor for correct direction of rotation.
- The heat generator must be ready for operation, and the operating regulations for the heat generator must be observed.
- The heat generator and heating system must be filled with water and the circulating pumps must be in operation.
- The temperature regulator, pressure regulator, low water detectors and any other safety or limiting devices that might be fitted must be connected and operational.
- The exhaust gas duct must be unobstructed and the secondary air system, if available, must be operational.
- An adequate supply of fresh air must be guaranteed.
- Check tank, lines and oil pump are filled with oil and correct oil nozzle is fitted.
- With burner in starting position check that air damper is in "CLOSED" position.
- Check that control box is unlocked and in its original position.
- A standard-compliant measuring point must be available, the exhaust gas duct up to the measuring point must be free of leaks to prevent anomalies in the measurement results.

### OIL START-UP

Open all shut-off valves of oil supply system.

- Mount pressure gauge in the feed line and return line.
- Mount the pressure gauge for checking the pump suction pressure.
- Make sure that the nozzle is size and mounted correctly.
- Fill pump with oil.

### Bleeding of oil system

Shortly start the burner and check for proper direction of rotation. Bleed the oil line and oil pump.

**CAUTION:** The hydraulic system has been filled with oil by the manufacturer. This may cause ignition trouble when initially operating the system. When starting the burner take care to increase the oil pressure slowly to the operating level.

**Prior to the initial fuel feed start make a functional test of the burner program flow:**

### Oil system:

- Open all shut-off valves of the oil supply system.
- The oil solenoid valve in the feed line disconnect on the terminal strip (see Circuit Diagram).
- Start burner and check program flow for correct start-up sequence:
  1. Fan starts.
  2. Pre-ventilating damper.
  3. Air pressure check.
  4. Partial-load air damper.
  5. Ignition.
  6. Valves open (disconnected valve remains closed).
  7. Safety lock-out after expiry of safety period (see control box).
- Reconnect the valve.
- Unlock the control box.

## EXHAUST GAS TEST

To ensure an economically efficient and trouble-free operation of the system it will be necessary to adjust the burner specifically in accordance with the furnace system. This is achieved by means of a fuel-combustion air compound control unit which adjusts the burner to ensure a proper combustion. Exhaust gas tests are required for this purpose.

The percentage CO<sub>2</sub> and O<sub>2</sub> and the exhaust gas temperature will have to be measured to determine the efficiency and combustion quality.

Prior to any measurement make sure to check the boiler and exhaust gas system for absence of leaks.

### Secondary air will falsify the measured results

Check that the exhaust gases have a residual oxygen (O<sub>2</sub>) content as low as possible and a carbon dioxide (CO<sub>2</sub>) content as high as possible.

The carbon monoxide content of the exhaust gases must be below the currently applicable specifications in all load stages. In the fuel oil combustion mode the permissible soot number in the exhaust gas is not allowed to be exceeded

### DETERMINING THE VOLUMETRIC GAS FLOW RATE

The thermal furnace output of a boiler (Q<sub>F</sub>) is the amount of heat supplied with the gas in a unit of time.

When taking the burner into operation the volumetric fuel flow rate should be selected according to the nominal thermal capacity of the boiler.

#### Example:

Nom. thermal output	Q <sub>N</sub>	1000 kW
Boiler efficiency	η <sub>K</sub>	0,88
Calorific value of gas	H <sub>u</sub>	9,1 kWh/m <sup>3</sup>
Gas pressure	p <sub>U</sub>	100 mbar
Barometer reading	p <sub>amb</sub>	980 mbar
Gas temperature relative	t <sub>gas</sub>	15°C
Gas temperature absolute	T	(t <sub>gas</sub> +273)
Standard atmospheric pressure	p <sub>n</sub>	1013 mbar

$$Q_F = \frac{Q_N}{\eta_K} = \frac{1000}{0,88} = 1136 \text{ kW}$$

Volumetric gas flow rate at STP:

$$V_{Bn} = \frac{Q_N}{H_u \cdot \eta_K} = \frac{1000}{9,1 \cdot 0,88} = 125 \text{ m}^3/\text{h}$$

Volumetric gas flow rate in operating condition:

$$V_{BB} = V_{Bn} \frac{T}{273} = \frac{p_n}{p_{amb} + p_u} = 125 \frac{273+15}{273} \frac{1013,25}{980+100} = 123,9 \text{ m}^3/\text{h}$$

### Recommended combustion parameters

Fuel	Recommended (%) CO <sub>2</sub>	Recommended (%) O <sub>2</sub>
Natural gas	10 ÷ 9	3,1 ÷ 4,8
Light oil	13 ÷ 11,5	3,3 ÷ 5,3
Heavy oil	12,5 ÷ 11	4,2 ÷ 6,2

**WARNING:** if the installation is above sea level the output of the burner vary base on the diagram.

The regulation of the burner in this case shall take into account the reduced power of the burner due to the missing air.

Ratio between O<sub>2</sub>- and CO<sub>2</sub>- for natural gas H (CO<sub>2</sub>max = 11,7%)

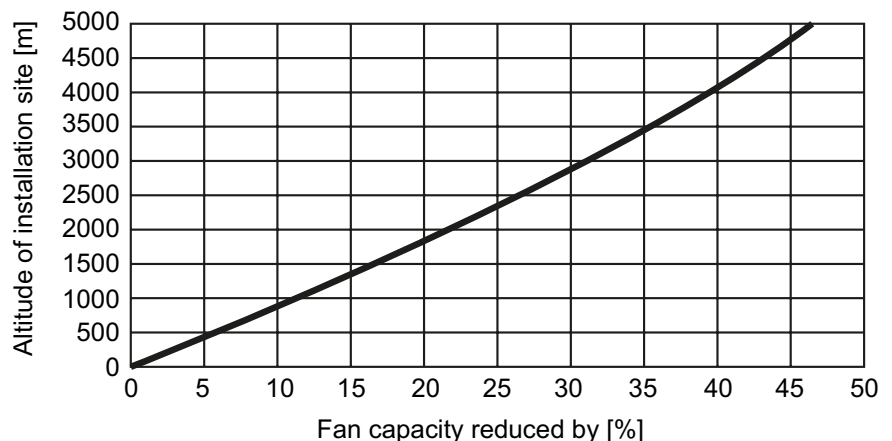
Ratio between O<sub>2</sub>- and CO<sub>2</sub>- for light oil EL (CO<sub>2</sub>max = 15,40%)

Ratio between O<sub>2</sub>- and CO<sub>2</sub>- for heavy oil S (CO<sub>2</sub>max = 15,60%)

$$O_2 = 21 \frac{CO_2\text{max} - CO_2\text{gem}}{CO_2\text{max}} = \%$$

CO<sub>2</sub> gem = % CO<sub>2</sub> measured on dry flue gases

Mean air pressure vs. altitude above sea-level



## START-UP OIL SIDE

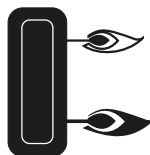
### Fuel selection - Start-up

Proceed with start up. On the switch put the operation on minimum capacity.

#### MAIN SWITCH

0 - OFF

1 - ON



: operation on minimum capacity

: operation on maximum capacity (automatic operation)



**KMV contactor:** check the air fan motor rotation.  
If the rotation is not correct invert the two phases on the power supply.



KMV

### START UP THE BURNER

The control box starts the pre-purge cycle, the fan motor and the oil motor and opens the air flaps in full open position.

At the end of pre-purging, the control box drives the servomotor into the ignition position and starts the ignition transformer.

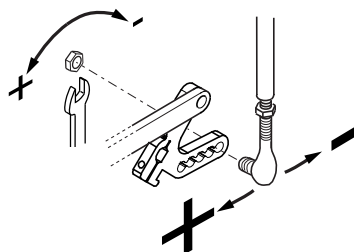
After a few seconds the control box opens the oil valve and starts the flame. After the flame stabilisation the control box drives the servomotor in the low flame.

In case of faulty ignition, the control box switches the burner into safety condition, in such a case you must rearm the burner.

Gradually go step by step using the selector on position 0 to stop the flame, from the low flame to the high flame in order to have a stable flame. For each position from 0 to 90° do oil setting adjusting oil return pressure as described in the next pages. When the servomotor arrives at 90° you have completed first tuning of air and oil flow according to the boiler capacity required. Check the combustion values and adjust the oil pressure.

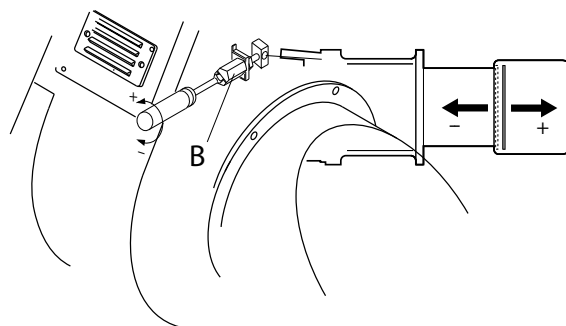
### Adjusting the maximum air flow rate

In order to adjust the maximum air flow rate see figure with selector in maximum operation. Loosen the nut holding the air damper transmission rod and correct air flow till you reach the combustion values suggested by reading the value on the combustion analyser. If you do not reach acceptable air flow rate you shall adjust the firing head. Move the head forward to increase air flow backwards to reduce.



### Firing head setting

The firing head is pre-adjusted at the 50% from the factory. The setting fully open enables to reach the full power of the burner and full close to reach the minimum power of the burner. The optimal position depends on the output that we need to reach but the default setting shall be modified only when you are not able to reach the suggested combustion value by adjusting the air flow in the maximum flame.





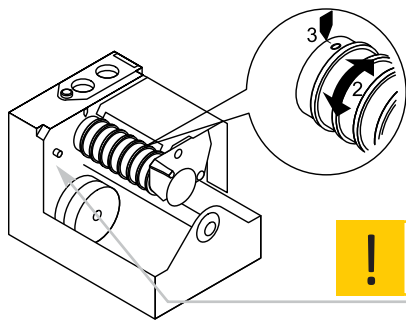
## START-UP OIL SIDE

### Servomotor SQM50 - Air damper motor pre-setting

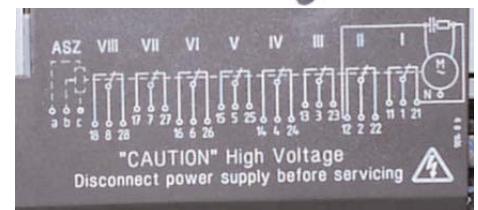
LANDIS SQM 50.381A2

Remove cover to gain access to the adjusting cams. The cams are to be adjusted through the suitable key provided. Description:

- I - Limit switch for air damper "3rd. stage" position adjustment (Max. power).
- II - Limit switch for the air damper position at burner's shut down.
- III - Limit switch for air damper "1st. stage" position adjustment (Min. power).
- IV - Limit switch for air damper "2nd. stage" position adjustment.
- V - Switches from 3rd stage to 2nd stage (always 5° bigger than 2nd stage adjusting limit switch).
- VI - Limit switch for 2nd stage's solenoid valve opening release.
- VII - Limit switch for 3rd stage's solenoid valve opening release.
- VIII - Limit switch "NOT USED".



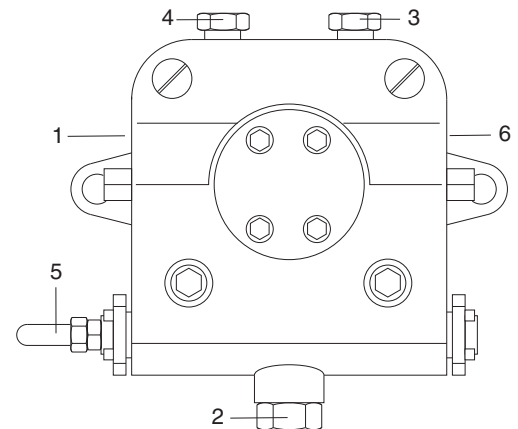
**!** **WARNING: Do not use the button cam drum release button.**



### Adjusting the pump pressure

- 1 - INLET
- 2 - RETURN
- 3 - BLEED AND PRESSURE GAUGE PORT
- 4 - VACUUM GAUGE PORT
- 5 - PRESSURE ADJUSTMENT
- 6 - TO NOZZLE

SUNTEC TA....



The pump pressure is set at a value of 12 bar during the testing of burners. Before starting the burner, bleed the air in the pump through the gauge port. Fill the piping with light oil to facilitate the pump priming. Start the burner and check the pump feeding pressure. In case the pump priming does not take place during the first pre-purging, with a consequent, subsequent lock-out of the burner, rearm the burner's lock-out to restart, by pushing the button on the control box. If, after a successful pump priming, the burner locks-out after the prepurging, due to a fuel pressure drop in the pump, rearm the burner's lock-out to restart the burner. Do never allow the pump working without oil for more than three minutes.

**!** **NOTE:** before starting the burner, check that the return pipe is open. An eventual obstruction could damage the pump sealing device.

## MAINTENANCE PROGRAM



Burner and boiler servicing must only be carried out by authorised qualified personnel at least once a year. Depending on the type of installation, shorter maintenance intervals may be necessary. The system operator is advised to take out a maintenance contract to guarantee regular servicing.

**WARNING:** Use original spare parts.

### SAFETY WARNINGS:

1. Turn off the power supply and protect the system from accidental start-up
2. Cut oil
3. Make sure there is no residual power in the system and that the actions in points 1 and 2 have been completed
4. Before opening the burner casing, ensure that the fan motor has stopped completely

### MAIN SWITCH

0 - OFF

1 - ON



Failure to observe any of these instructions will result in the risk of death or injury!

### WORKS RECOMMENDED AS PART OF ANNUAL BURNER MAINTENANCE:

- Emergency stop button function check
- Check burner start characteristics
- Run burner test and input measurement in the boiler room
- Clean the combustion components and replace defective parts if necessary
- Check the combustion head components and make sure that all components are in good condition otherwise replace them
- Replace ignition electrodes and nozzle if necessary and check their correct position after any intervention
- Flame monitor and automatic combustion control unit function check
- Clean the fan wheel and the housing and grease rotating parts if necessary
- Clean the oil filter cartridge with gasoline periodically and check the tightening of the O rings, replace them if necessary
- Make visual inspection of the burner's electrical components and eliminate malfunctions if necessary
- Burner safety devices function check (air pressure/switches if any)
- Commissioning the burner and correct the adjustment values if necessary

**NOTES ON REASSEMBLING:** Perform the described step in reverse order and make sure to refit components as they were originally assembled and the system is free from leaks. Use only original spare parts.

**DRAW UP A MEASUREMENT REPORT ACCORDING TO THE LOCAL REGULATION AND CODES OF PRACTISE OF THE COUNTRY**

## MAINTENANCE PROGRAM

### EXHAUST GAS LOSS

Exhaust gas loss by way of free heat will occur as a result of the temperature difference between the fuel-air mixture entering the furnace chamber and the gases discharged. Any increase in the excess of air and the resultant higher exhaust gas volume will cause the exhaust gas loss to rise. The exhaust gas loss can be calculated as follows:

$$q_A = (t_A - t_L) \frac{A_1}{CO_2} + B$$

- $q_A$  = exhaust gas loss [%]
- $t_A$  = exhaust gas temperature [°C]
- $t_L$  = combustion air temperature [°C]
- $CO_2$  = volumetric content of carbon dioxide [%]

	Light oil EL	Heavy oil S	Natural gas	Town gas	LPG
A1	0,50	0,490	0,370	0,350	0,420
B	0,007	0,007	0,009	0,011	0,008

### Example

Data measured in natural gas mode:  
 CO<sub>2</sub> content of exhaust gases: 10,8%  
 Exhaust gas temperature: 195°C  
 Air intake temperature: 22°C

The exhaust gas loss can be calculated as follows:

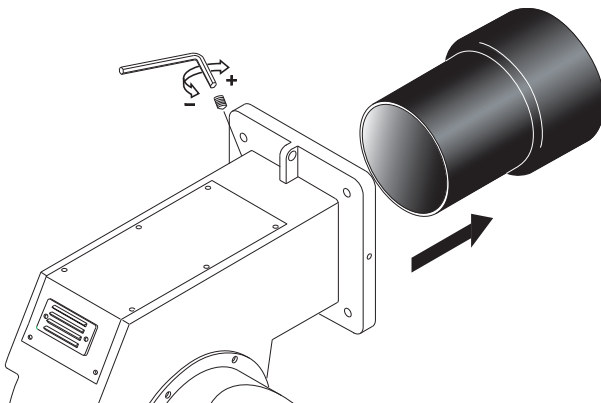
$$q_{Af} = (195-22) \left( \frac{0,37}{10,8} + 0,009 \right) = 7,48\%$$

Data measured in fuel oil mode:  
 CO<sub>2</sub> content of exhaust gases: 12,8%  
 Exhaust gas temperature: 195°C  
 Air intake temperature: 22°C

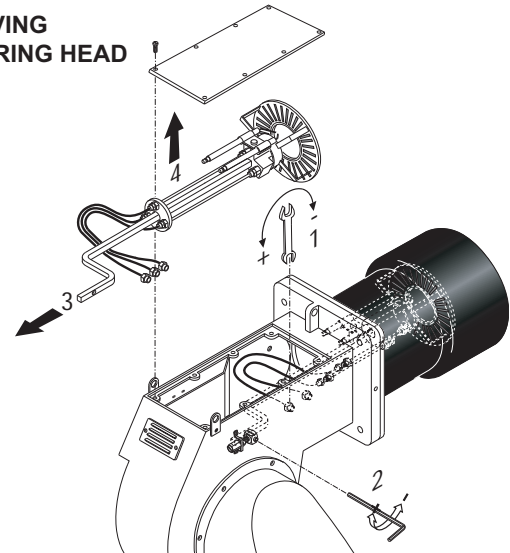
The exhaust gas loss can be calculated as follows:

$$q_{Af} = (195-22) \left( \frac{0,49}{12,8} + 0,007 \right) = 7,83\%$$

### REMOVING THE BLAST TUBE



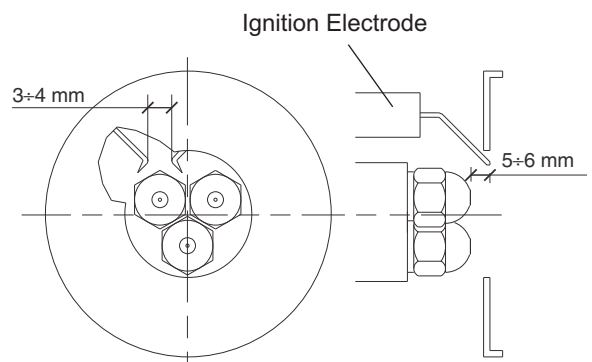
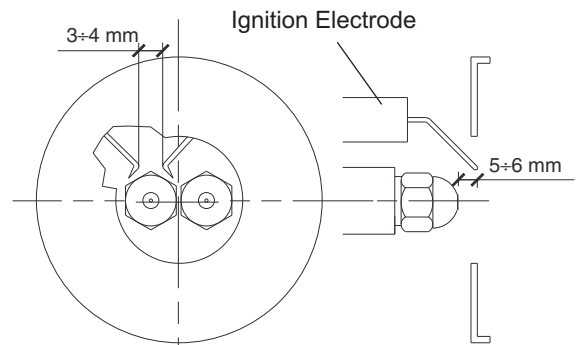
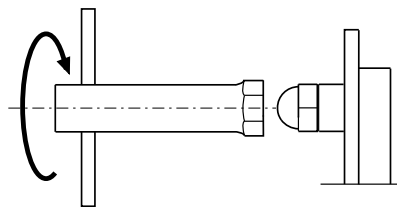
### REMOVING THE FIRING HEAD



### POSITION OF ELECTRODES

#### ATTENTION:

to remove the nozzle use the suitable box wrench taking care to not damage the electrodes. Check the position of the electrodes after any intervention as wrong position could cause ignition troubles.



### OIL FILTER CLEANING



**ATTENTION:** Periodically clean oil cartridge with gasoline and replace them if it is necessary!

## TROUBLESHOOTING INSTRUCTIONS

The list of faults/causes/possible solutions for a set of main failures is a guideline for professional personell authorised to carry out service and maintenance.

Irregular burner operation or malfunction: check that every adjustment parameter is correctly set as per instruction on this manual.

TROUBLESHOOTING TABLE OIL OPERATION			Burner doesn't start	Fuel pump noisy / unprimes / leaks	Burner starts with continuous pre-purge	Burner starts and then goes into lock-out	Pilot Ignition failure (1st safety time - LFL only)	Main Ignition failure (2nd safety time)	Burner lock-out after flame appearance / pulsation	Flame control repeats the cycle and doesn't give consent	Smoke in flame - dark Bacharach	Burner doesn't switch into Hi flame	Burner lock-out during operation	LFL	LAL
STATUS	CAUSES	REMEDIES													
HEAVY OIL	Preheating period too long	Check GEFTRAN controller, replace if necessary	X								X		X	YES	YES
	Defective Gefran controller	Replace control unit	X								X		X	YES	YES
PRE-START (MISSING SIGNALS)	Defective control box unit	Replace control box unit	X			X	X	X	X	X		X	X	YES	YES
	No electrical power supply Wrong electrical connections	Check switches/contactors Check connections	X											YES	YES
	Air pressure switch not "closed"	Check contacts	X											YES	YES
	Boiler thermostats open	Check contacts	X											YES	YES
	Fan motor overload intervention	Replace fuse	X											YES	YES
	Auxiliaries fuses interrupted	Replace fuse	X											YES	YES
	Servomotor [CLOSE] position switch not reach	Check servomotor settings	X											YES	YES
PRE-START (OIL PUMP)	High vacuum in oil pipe due to dirty filter	Clean filter or replace filter cartridge		X							X			YES	YES
	Burner is higher than oil tank by more than 3 m	Reduce Height or prepare a ringline pump		X							X			YES	YES
	Air in the oil pipeline	Re-tighten pipe connections		X										YES	YES
SEQUENCE START	Servomotor [OPEN] position switch not reach	Check servomotor settings			X									YES	YES
	Servomotor [MIN] position switch not reach	Check servomotor settings			X									YES	YES
	Extraneous Light	Eliminate light source				X								YES	YES
	Fuel solenoid valve fails to close (Light oil Burner - direct ignition)	Clean valves or replace if necessary				X								YES	YES
LACK OF AIR	Air pressure switch fail to connect to Terminal 14	Check contacts				X								YES	NO
	Fan contaminated/dirty	Clean fan				X					X		X	YES	NO
	Fan motor rotation direction not correct	Check direction and contactor				X					X		X	YES	NO
IGNITION & FLAME STABILISATION PERIOD	Flame supervision circuit internal test failed	Replace control unit				X								YES	NO
	Pilot flame failure - Pilot gas valves not open	Check valves contacts / replace if necessary					X							YES	NO
	Pilot flame establish - weak flame signal	Check flame sensor Replace if necessary					X							YES	NO
	Ignition transformer faulty	Replace					X	X						YES	YES
	Ignition cable & electrodes defective	Replace					X	X						YES	YES
	Electrode bad position	Check setting / replace if necessary					X	X						YES	YES
	Fuel oil solenoid valve fails to open	Check contacts and clean valves. Replace solenoid coil if necessary							X					YES	YES
ONLY FOR OIL BURNER	Air pressure switch not close, Oil pump contactor open	Check air pressure switch contacts							X					NO	YES
	No oil supply	Check shut-off valves Check Pump, replace if necessary							X					NO	YES
	Oil pump coupling broken	Replace pump unit							X					NO	YES
COMBUSTION	Flame sensor signal failure	Clean, re-position or replace if necessary				X	X	X	X				X	YES	YES
	Head adjustment not correct	Check settings								X	X		X	YES	YES
	Oil/Air mixture setting not correct	Check settings								X	X		X	YES	YES
	Dirty combustion head	Clean or replace disk if necessary								X	X		X	YES	YES
	Nozzle dirty or damaged	Clean or replace nozzle if necessary								X	X			YES	YES
	Fuel pressure inappropriate	Adjust pressure or replace pump if necessary								X	X		X	YES	YES
	Capacity reduction	Check filter, pump pressure and nozzle. Replace item if necessary									X			YES	YES
	Load control device does not close	Check load control, replace if necessary										X	X	YES	YES

## OPERATING TROUBLE

In case of operating trouble it should be checked whether the system is in proper working order.

Make a check for the following:

1. Availability of fuel.  
Correct position of fuel selector switch.
2. Availability of electric power in the burner system.
3. Proper functional order and setting of all control and safety instruments such as temperature controller, safety limiter, water failure cut-out, electrical limit switches, etc.

If the trouble is not found to be due to any of the above-mentioned points it will be necessary to test the burner functions very carefully.

Prevailing conditions:

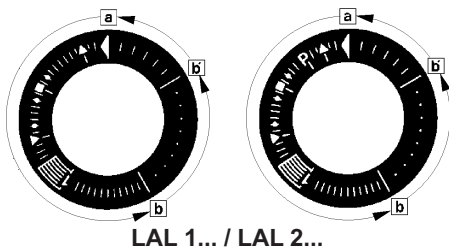
The burner will be found to be out of operation and in faulty and interlocked position. Proceed with searching for the cause of the trouble and eliminate it. Unlock the control box by pressing the fault eliminate key and start the burner.

Do not press the fault eliminate key longer than 10 seconds.

The start-up program will be initiated and should be carefully monitored.

The possible cause of the fault may be quickly found by reference to the fault indicator of the control box and watching the start-up and operating program.

### Control program in the case of trouble and fault indicator LAL 1... / LAL 2...



LAL 1... / LAL 2...

**a-b** Starting program

**b-b'** In a number of time versions; idle steps of the program unit to self-stop after burner start-up (b' = operating position of program unit)

**b(b')-a** After-flushing program after regular stop. In the starting position "a" the program unit will automatically stop or initiate an immediate restart of the burner, e.g. after a fault has been eliminated

- Duration of the safety period for single-tube burners
- Duration of the safety period for burners with ignition gas valve

**Basically, any type of trouble will result in the immediate stop of the fuel supply.** At the same time, the program unit and consequently the fault indicator will stop. The type of trouble can be identified by the symbol opposite to the reading mark of the indicator:

◀ **No start**, e.g. because the "CLOSED" signal from the "Air Damper CLOSED" limit switch is missing or a contact is not closed between terminals (12) and (4) or (4) and (5); or the contacts of all control and safety units in the controlled system are not closed (e.g. gas pressure or air pressure switches, temperature or pressure regulators).

▲ **Operating stop** because the "OPEN" signal from the "Air Damper OPEN" limit switch is missing. Check and adjust the limit switch concerned.

**P Shut-off on trouble because there is not air pressure** signal at the beginning of the air pressure check (apply only to LAL 2.25).

**Any air pressure failure after this time will also lead to a shut-off on trouble.**

■ **Shut-off on trouble** because of a fault in the flame monitoring circuit.

▼ **Operating stop** because the position signal of the "Partial Load" limit switch (air damper in "Partial Load" position) is not available on terminal (8). Check and adjust the limit switch concerned.

**1 Shut-off on trouble** because a flame signal is not available on the expiry of the (1st) safety time.

**Any failure of the flame signal on the expiry of the safety time will also lead to a shut-off on trouble.**

| **Shut-off on trouble** because the flame signal failed during burner operation or a lack of air has occurred.

◀ **Shut-off on trouble** during or after the control program flow due to external light (e.g. by flame not extinguished, leaking fuel valves) or a faulty flame signal (e.g. fault in flame monitoring circuit, or similar); see flame monitor.

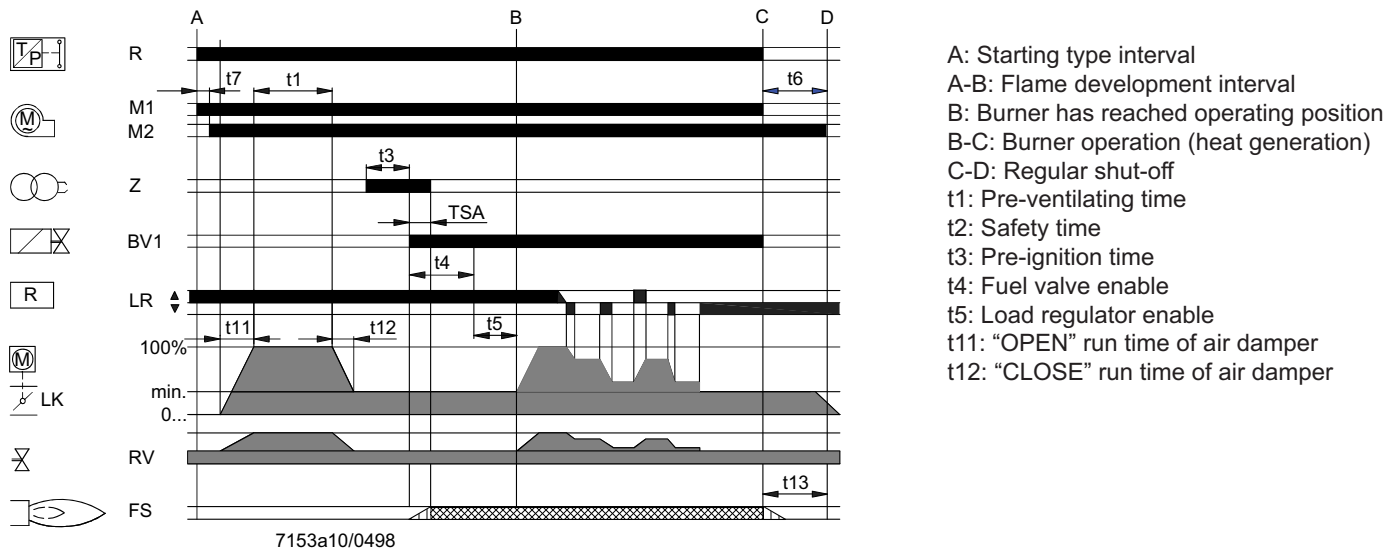
**If the shut-off on trouble occurs at any other time between start and pre-ignition that is not identified by a symbol as above, this will normally be due to an early flame signal which is considered to be a faulty flame signal.**

**The automatic furnace controller may be unlocked** immediately after a shut-off on trouble using the unlock button with integrated fault signal lamp or an external switch. After it has been unlocked (and after a defect with resultant operating stop has been eliminated and after a voltage failure), the program unit will in any case return to its starting position with voltage being only supplied to terminals 7, 9, 10 and 11 as preset by the control program. It is only at this stage that the program of the automatic furnace controller will restart the burner.

## APPENDIX

## Control box - Damper actuators

## CONTROL BOX LAL...



BV: Fuel valve

FS: Flame signal amplifier

LK: Air damper

LR: Load controller

M: Fan or burner motor

R: Control thermostat or pressurestat

RV: Modulating fuel valve

Z: Ignition transformer

## DAMPER ACTUATORS SQM50...

## Description

The SQM actuator is intended for use with two-stage sliding or modulating oil, gas or dual-fuel burners. The reversible actuator is fitted with a synchronous motor which drives a shaft via a gearbox. The shaft end carries a coupling to drive the fuel and combustion air controlling element.

The SQM actuator has been designed for dual-wire control by controller or switching units with change-over contacts.

Potentiometers can be installed for a range of applications on customer's request.

The limit and auxiliary switches are set by means of manually adjustable latching cam plates. Scales are fitted between the disks to facilitate the selection of the switching points.

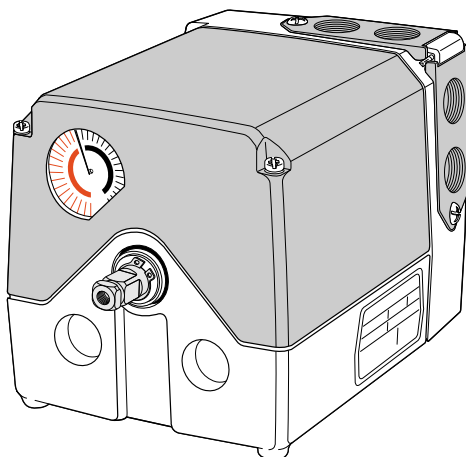
The cam plates are provided with a small pointer for indicating the switching point of a scale between the setting ranges.

An additional scale fitted to the end of the cam roller serves to indicate the position of the actuator.

The drive unit may be disconnected from the controlling element by changing over a rocker arm mounted to the gearbox.

This will allow any desired position of the controller plate to be selected by hand. Drive and output will be coupled in the vertical position of the rocker arm.

The fuel-air curve should be set over the full range of the cam plate so that operating safety will be retained also when the limit switch is overrun.



## APPENDIX

### Delavan/Monarch nozzle chart

NOZZLE GPH	PUMP PRESSURE (bar)						
	10	11	12	13	14	15	16
2,50	9,50	9,97	10,41	10,83	11,24	11,64	12,02
3,00	11,40	11,96	12,49	13,00	13,49	13,96	14,42
3,50	13,30	13,95	14,57	15,17	15,74	16,29	16,83
4,00	15,20	15,94	16,65	17,33	17,99	18,62	19,23
4,50	17,10	17,94	18,73	19,50	20,24	20,95	21,63
5,00	19,00	19,93	20,82	21,67	22,48	23,27	24,04
5,50	20,90	21,92	22,90	23,83	24,73	25,60	26,44
6,00	22,80	23,92	24,98	26,00	26,98	27,93	28,84
6,50	23,70	25,91	27,06	28,17	29,23	30,26	31,25
7,00	26,60	27,90	29,14	30,33	31,48	32,58	33,65
7,50	28,50	29,90	31,22	32,50	33,73	34,91	36,05
8,30	31,54	33,08	34,55	35,97	37,32	38,63	39,90
9,50	36,10	37,87	39,55	41,17	42,72	44,22	45,67
10,50	40,06	41,73	43,74	45,41	47,20	48,90	50,50
12,00	45,60	47,80	50,00	52,00	54,00	55,90	57,70
13,80	52,40	55,00	57,50	59,80	62,10	64,20	66,30
15,30	58,10	61,00	63,70	66,30	68,80	71,10	73,60
17,50	66,50	69,80	72,90	75,80	78,70	81,50	84,10
19,50	74,10	77,70	81,20	84,50	87,70	90,80	93,70
21,50	81,70	85,70	89,50	93,20	96,70	100,10	103,40
24,00	91,20	95,70	99,90	104,00	107,90	111,70	115,40
28,00	106,40	111,60	116,60	121,30	125,90	130,30	134,60
30,00	114,00	119,60	124,90	130,00	134,90	139,60	144,20
GPH	OUTPUT kg/h						

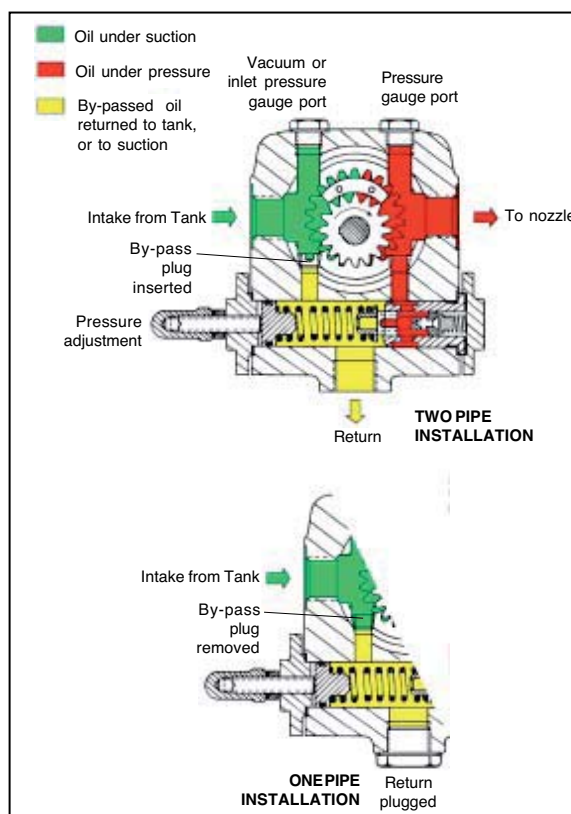
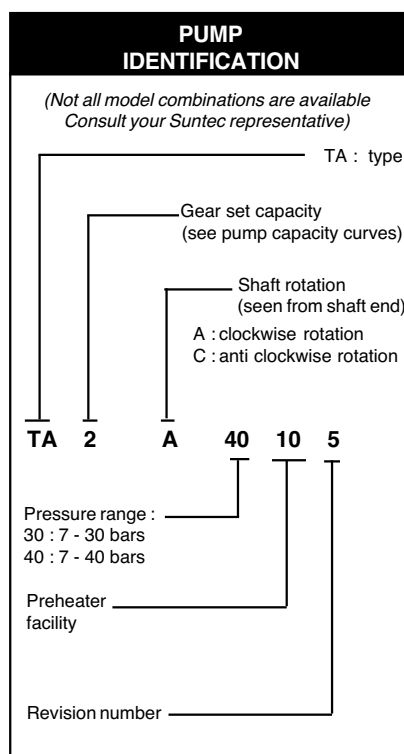
## APPENDIX

## Pumps and pressure regulators

## PUMP SUNTEC TA TECHNICAL DATA

**Note:** All TA models are delivered for two-pipe system (by-pass plug fitted in vacuum gauge port).

For one-pipe system, the by-pass plug must be removed and the return port sealed by steel plug and washer.



## General

Mounting	Flange mounting	
Connection threads	Cylindrical according to ISO 228/1	
Inlet end return	G 1/2"	
To nozzle	G 1/2"	
Pressure gauge port	G 1/4"	
Vacuum gauge port	G 1/4"	
Shaft	Ø 12 mm	
By-pass plug	Inserted in vacuum gauge port for 2 pipe system; to be removed with a 3/16" Allen key for 1 pipe system	
Weight	5,4 kg (TA2) 6 kg (TA4)	5,7 kg (TA3) 6,4 kg (TA5)

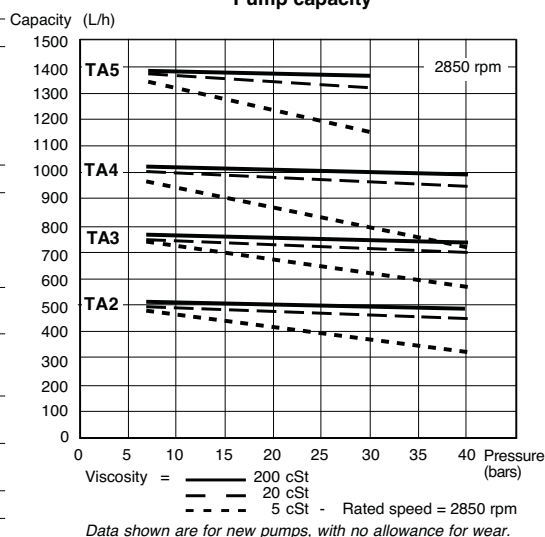
## Hydraulic data

Nozzle pressure ranges	30 : 7 - 30 bars 40 : 7 - 40 bars
Delivery pressure setting	30 bars
Operating viscosity	4 - 450 cSt
Oil temperature	0 - 140°C max. in the pump
Inlet pressure	light oil : 0,45 bars max. vacuum to prevent air separation from oil heavy oil : 5 bars max.
Return pressure	light oil : 5 bars max. heavy oil : 5 bars max.
Rated speed	3600 rpm max.
Starting torque	0,3 N.m

## Choice of heater

Cartridge	Ø 12 mm
Fitting	according to DIN 40430, NFC 68190 (N°9 elec.)
Rating	80-100 W

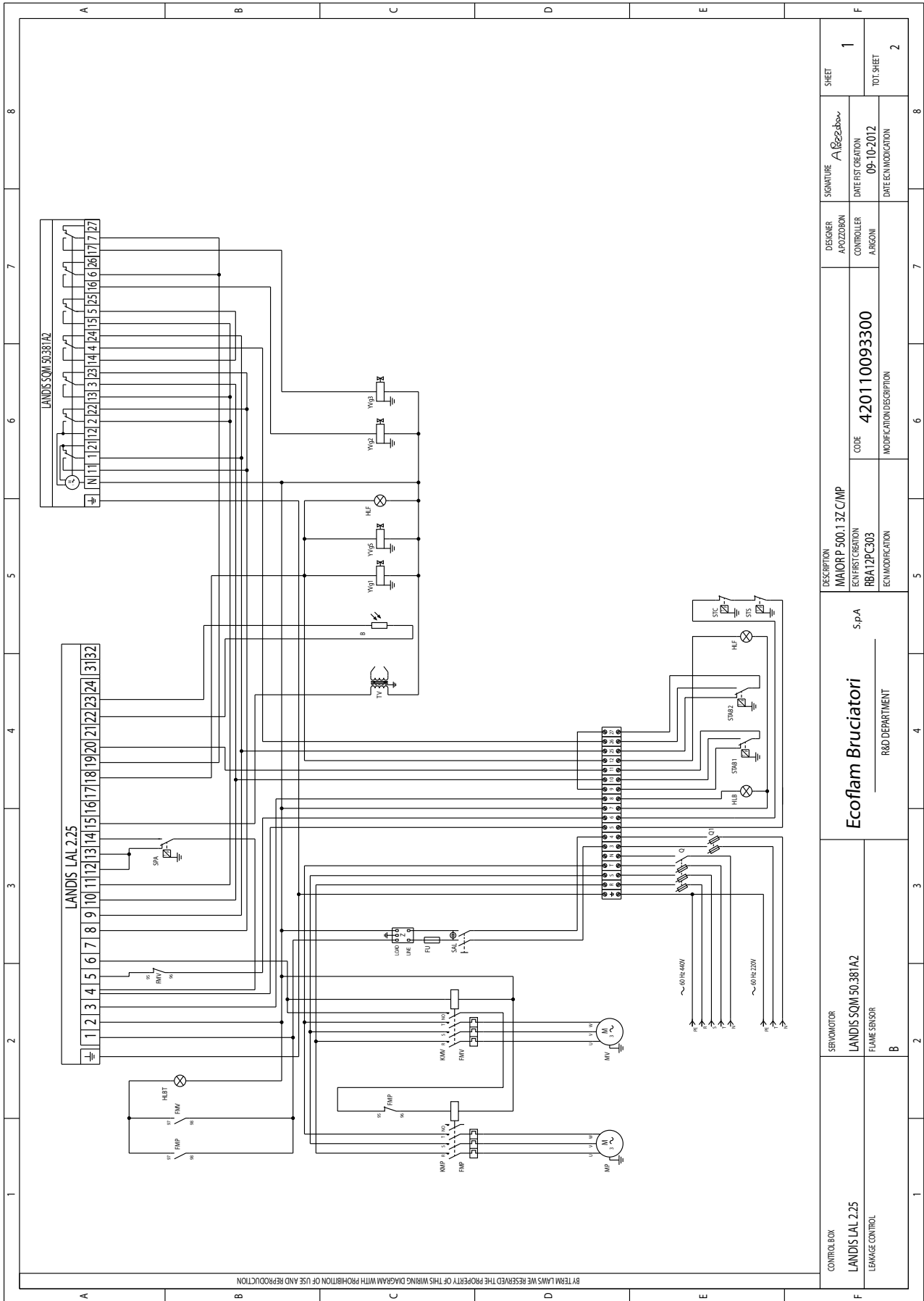
## Pump capacity





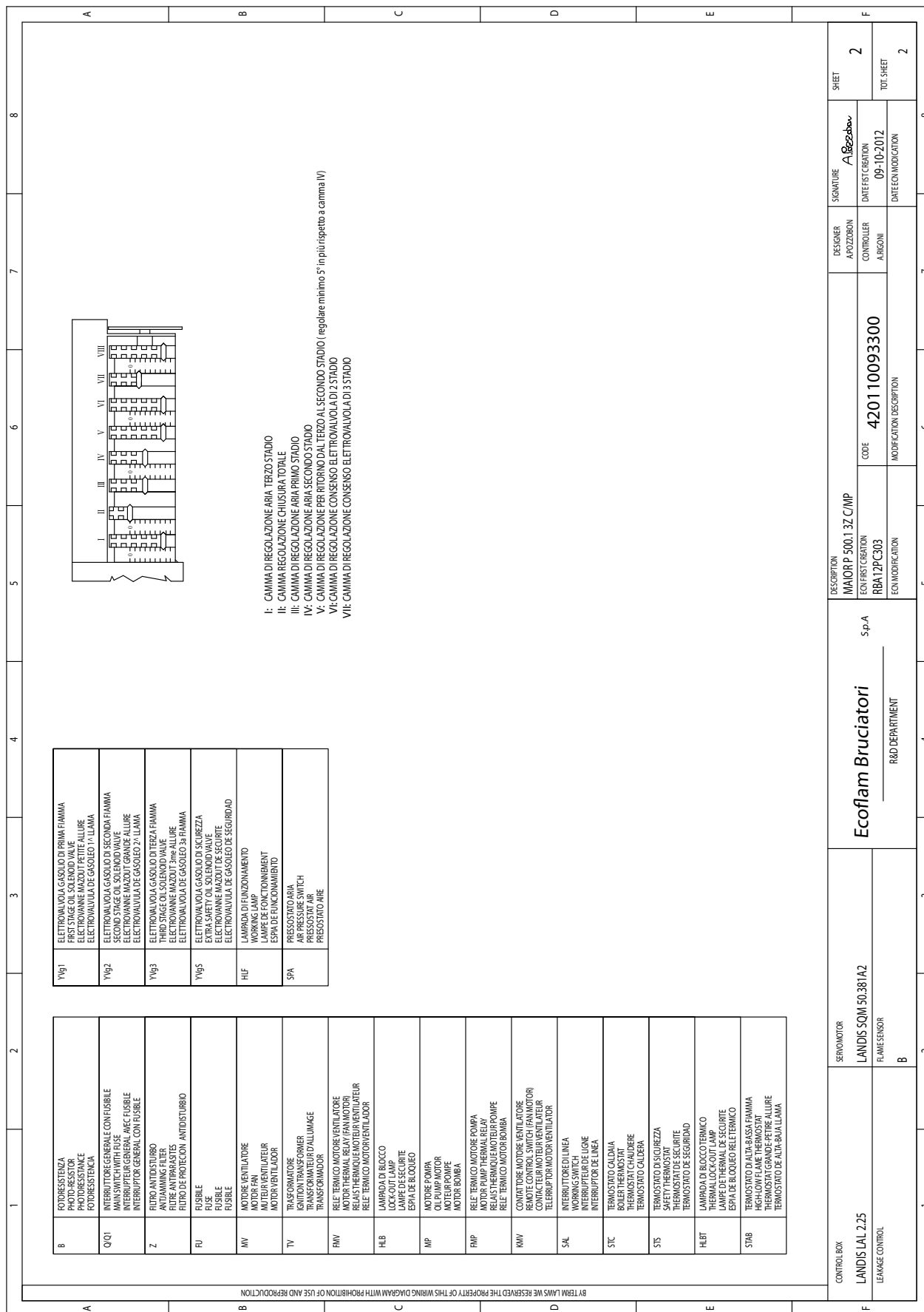
## APPENDIX

### Electrical diagrams



## APPENDIX

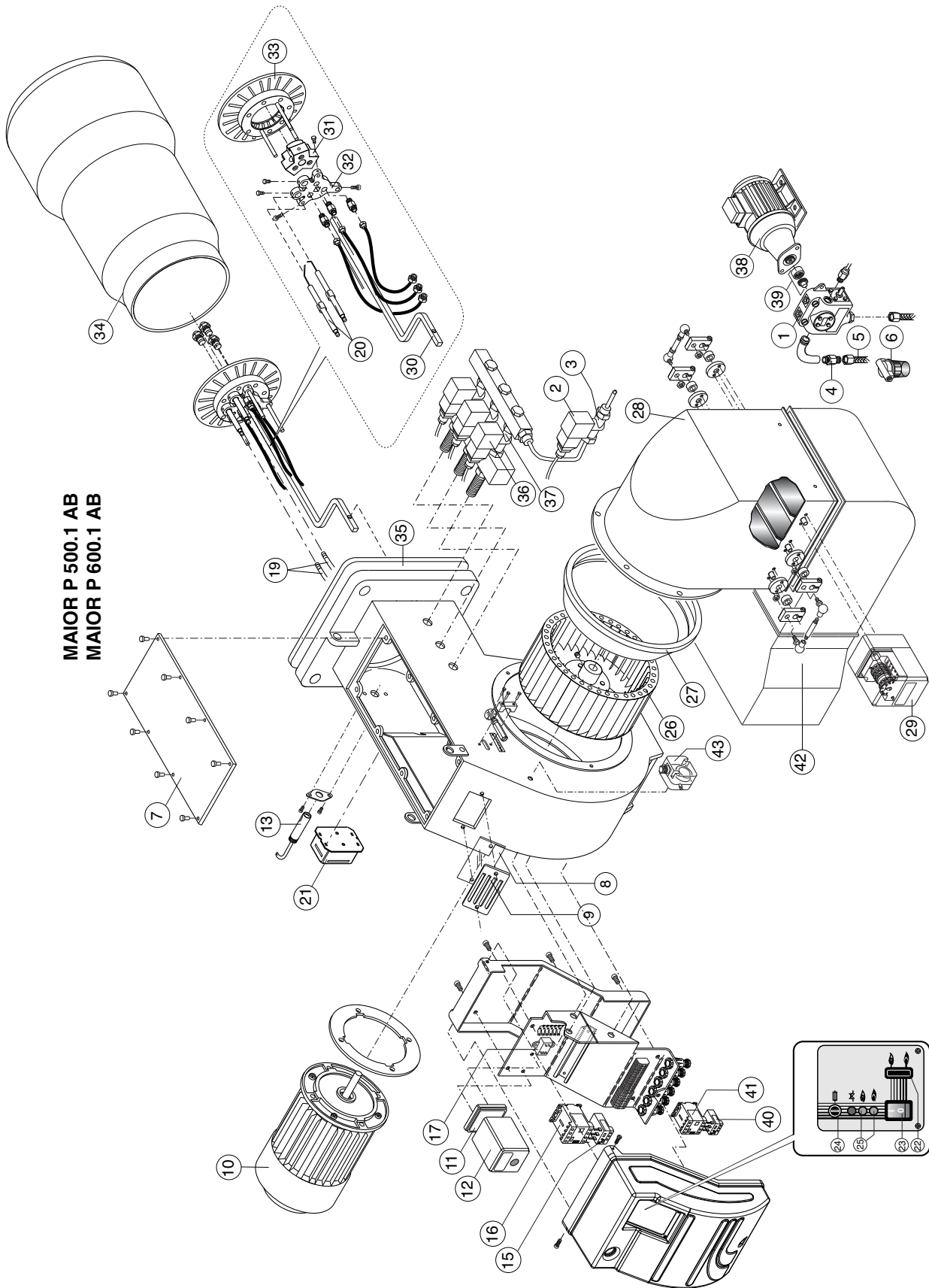
## Electrical diagrams



## APPENDIX

### Spare parts

MAIOR P 500.1 AB  
MAIOR P 600.1 AB



## APPENDIX

## Spare parts list

N°	DESCRIPTION		MAIOR P 500.1 AB code
1	OIL PUMP	SUNTEC TA3C40106	65322992
2	COIL	Parker SCEM VE140.4AR	65323782
3	OIL VALVE	Parker SCEM VE140.4AR	65323623
4	NIPPLE	TN 18X1200	65323183
5	HOSES	TN 18X1500	65323182
6	FILTER	NAFTA ATT. 1 x1 70501/03	65324103
7	COVER		65324490
8	GLASS		65320487
9	VIEWING WINDOW		65320488
10	MOTOR	15 kW	65325246
11	CONTROL BOX BASE	LANDIS	65320097
12	CONTROL BOX	LANDIS LAL2.25	65320063
13	PHOTORESISTOR	LANDIS	65320076
14	WIRING TERMINAL BOX		-
15	MOTOR THERMAL RELAY	AEG B18K-260 21-26A	65324066
16	REMOTE CONTROL SWITCH	AEG LS18K.00	65323137
17	ANTI JAMMING FILTER		65323170
18	TIMER		-
19	CABLE	TC	65320948
		TL	65320946
20	ELECTRODES		65325222
21	IGNITION TRANSFORMER	Brahma T8 13000/35	65323241
22	HIGH-LOW FLAME SWITCH	cod.360000001	65323065
23	MAIN SWITCH	cod.401001509	65323064
24	FUSE SUPPORT	FUSIT FH-B 528	65322181
25	LAMP	EL/N-SC4 Elettrospring	65322053
26	FAN	315 x 110	65325093
27	AIR CONVEYOR		65324264
28	COVER AIR INLET		65325012
29	AIR DAMPER MOTOR	SQM50.381A2	65322901
30	ROD	TC	65325013
		TL	65325014
31	NOZZLE HOLDER		65320715
32	NOZZLE HOLDER SUPPORT		65325053
33	DIFFUSER		65320784
34	BLAST TUBE	TC	65324815
		TL	65324816
35	GASKET		65321128
36	COIL	SIRAI L159-C05	65323770
37	OIL VALVE	SIRAI L159-C05	65323739
38	PUMP MOTOR	740 W	65325783
39	COUPLING (PUMP)		65325386
40	MOTOR THERMAL RELAY	LOVATO RF9 2-3,3 A	65323099
41	REMOTE CONTROL SWITCH	BG0910A	65323138
42	SILENCER		65074538
43	AIR PRESSURE SWITCH	LGW10A2P	65323047

TC = SHORT HEAD TL = LONG HEAD







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