



Burners : RP-130 M   RP-140 M   RP-150 M   RP-250 M   RP-280 M

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# 1. General

## 1.1. Forewords

Thank you for using Oilon-products. We hope you are content with the product and our service. This manual is intended to guide operation and maintenance of the product. We pursue to improve our products and services. Therefore we readily accept feedback about on our operation and maintenance manuals. Feedback may be sent to [info@oilon.com](mailto:info@oilon.com)




Installation and maintenance of the device must be performed by a certified personnel. If you need help with maintenance issues, please contact your nearest representative or Oilon Oy technical support. Contact information can be found on our website at [www.oilon.com](http://www.oilon.com)

## 1.2. Conventions in this Manual

### 1.2.1 Warning symbols in this manual

Read these instructions carefully before installation, commissioning or maintenance of the burner. The given instructions must be followed.

Symbols used are :

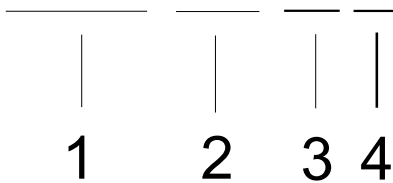
 <b>DANGER!</b>	<p>Be careful. The DANGER symbol indicates a possible danger of bodily harm or lethal injury.</p>
 <b>CAUTION</b>	<p>Pay attention. The CAUTION sign indicates a possible danger of damage to the device, components or surroundings.</p>
 Note	<p>Notes indicate tips, hints and other essential information.</p>

**KEEP THIS MANUAL ALONG WITH THE INSTALLATION RECORD AND THE ELECTRICAL SCHEMES AVAILABLE NEAR THE BURNER!**

### 1.3. Type labelling on Oilon burners

#### 1.3.1 Example of type labelling

**GRP-150 M-II**



Label element 1: Fuel

KP	Light fuel oil
RP	Heavy fuel oil
GP	Gas
GKP	Gas + light fuel oil
GRP	Gas + heavy fuel oil

Label element 2: burner size categorization

Label element 3: method of control

H	Two-stage
T	Three-stage
M	Modulating
ME	Modulating with a separate fan
P	High-Low or modulating with an electronic controller
LH	High-low with a preheater
	On-Off


Label element 4: possible additional code


## 1.4. General information


### 1.4.1 Burner features and general information

BURNER CONTROL	
BURNER APPLICATIONS	Most heating appliances such as hot water boilers, steam boilers, air heaters and thermo fluid boilers
APPLICABLE FUEL	<ul style="list-style-type: none"> <li>The burners are suitable for use on heavy fuel oil, with a viscosity of max. 380 mm<sup>2</sup>/s (cSt) at a temperature of +50 °C and on burners with electric tracing max. 700 mm<sup>2</sup>/s (cSt) at a temperature of +50 °C.</li> <li>Temporarily light fuel oil</li> </ul>
MINIMUM VISCOSITY FOR IN-LET OIL	1.5 mm <sup>2</sup> /s (cSt)
IN-LET OIL TEMPERATURE	The temperature of oil coming to the burner should be from 60 to 100 degrees Celsius.
OIL FILTRATION	The oil coming to the burner must be filtered before the oil pump. Maximum filtration degree is 125 µm.
PREHEATER	Oil is preheated in the burner's preheater to the atomizing temperature. The oil temperature is controlled by an electronic regulator.
HEAT CARTRIDGES	Oil pump and solenoid valves are equipped with heat cartridges.
ADDITIONAL HEATING	The burner pipes are equipped with trace heating
HEAVY FUEL OIL ATOMIZING VISCOSITY	
LIGHT FUEL OIL ATOMIZING VISCOSITY	1.5 to 12 mm <sup>2</sup> /s (cSt) at a temperature of +20 °C
OIL ATOMIZING PRESSURE	25 - 30 bar for heavy fuel oil 20 - 25 bar for light fuel oil
OIL PUMP	RP 130 M : TA2 RP 140 M : TA2 RP 150 M : TA2 RP 250 M : TA3 RP 280 M : TA3
NUMBER OF NOZZLES	1
NOZZLE CONTROL	Nozzle valve piston opens the nozzle. The nozzle valve is controlled with a solenoid valve.
BURNER MAX. TURNDOWN RATIO	1:2,5 (100 - 40 %)

COMBUSTION AIR FAN	The fan provides the air needed in the combustion. It is dimensioned to provide a sufficiently high and even air pressure for efficient combustion in modern combustion chamber.
REQUIRED COMBUSTION AIR QUANTITY	15 m <sup>3</sup> of combustion air for each burnt kilo of oil
SERVOMOTOR AND COMPOUND REGULATOR	Controls the burner capacity and the air/fuel ratio according to the capacity demand.
OPERATING TEMPERATURE	0... + 45 C°

 <b>DANGER!</b>	<ul style="list-style-type: none"> <li>• The burner must be installed firmly. Vibrations may damage burner or its components.</li> <li>• Never store any inflammable material in the boiler room.</li> <li>• Never use a naked flame while checking the burner or the boiler.</li> <li>• Keep the boiler door closed while starting the burner and during burner operation.</li> <li>• Do not touch the oil pipes during burner operation. They may be hot.</li> <li>• Do not touch the levers of the compound-regulator or adjusting rod leading out from the compound-regulator, and do not leave things lying close to them when burner is operating.</li> <li>• Wear hearing protectors, if there is noise in the boiler room.</li> </ul>
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 <b>DANGER!</b>	<ul style="list-style-type: none"> <li>• IN CASE OF FIRE OR OTHER EMERGENCY</li> <li>• Switch off the main switch.</li> <li>• Close the main fuel shut-off valve outside the plant.</li> <li>• Take appropriate actions.</li> </ul>
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 <b>Note</b>	<ul style="list-style-type: none"> <li>• Local regulations and requirements must be adhered to when installing or servicing the burner.</li> <li>• Correct installation and adjustment together with regular servicing are the most reliable guarantees of trouble-free burner operation.</li> <li>• The burner has to be installed in such a way that the motor shaft lies horizontally; however, it is not allowed to install the burner upside down.</li> <li>• Use only original spare parts. When ordering spare parts please give the burner type and serial number indicated on the burner nameplate.</li> </ul>
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## 1.5. Inspecting boiler room

### 1.5.1 Take care of the boiler room

- Maintain tidiness in the boiler room and keep the door closed
- Make sure there is always enough water (pressure) in the heating system.
- Make sure the boiler and the chimney are swept regularly, at least once a year
- Check the correct adjustment of the flue damper and the gate valve regularly.



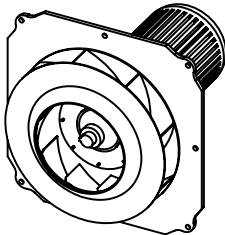
- Make sure the burner room combustion air gap (air in-let hole) is open.
- Make sure the shut-off valves on pressure gauges are shut.
- Make sure tightness of the pipeworks, safety appliances of the boiler system, pipeworks, and the burner are checked regularly according to rules and regulations of public authorities.
- Check boiler and it's components.
- Making a maintenance contract is recommended.

 <p><b>DANGER!</b></p>	<p>Never use a naked flame while checking the burner or the boiler. Never store any inflammable material in the boiler room. Wear hearing protectors, if there is noise in the boiler room.</p>
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## 2. Burner operation

### 2.1. Burner operation modulating ( M ) burners

#### 2.1.1 Combustion air



Burner device has been provided with a fan that is tailored to produce high and steady air pressure, that is required to get a flawless ignition and good combustion in a modern combustion chamber. A servomotor controls the amount of air fed according to the amount of fuel combusted.

#### 2.1.2 Pre-ventilation, purging and ignition

Before ignition burner runs through pre-ventilation and purging periods.

During the pre-ventilation period the burner fan is ran with full load settings to exhaust explosive fumes from the boiler.

Purging period flushes the nozzle valve and the utilisation circuit. The nozzle valve is preheated and the oil temperature controller ensures adequate temperature has been reached for fuel atomizing.

During purging period solenoid valve (NC) is closed and solenoid valves (NO) and main solenoid valves (NC) are open. During this time oil does not flow through the control circuit, but only to the nozzle valve of the utilisation circuit.

After the end of the purging period servomotor turns to the position of ignition load and solenoid valve (NC) opens and solenoid valve (NO) closes. The oil pressure begins to take effect on the nozzle control circuit. Oil flows from the nozzle. Spark between the ignition electrodes ignites oil spraying from the nozzle.

#### 2.1.3 Atomizing

During burner operation the capacity controller drives the servomotor, which drives the oil regulator and air dampers between partial load and full load according to the capacity demand.

If the burner shuts down, solenoid valve (NC) and main solenoid valves close, solenoid valve (NO) opens. Oil pressure is released from nozzle valve. Nozzle valve springback closes the needle valve in the nozzle and closes the oil flow in the nozzle.

The oil quantity to be burnt (= burner capacity) is regulated by means of the oil regulator by throttling the oil return flow. At partial load the oil regulator is open and at full load closed.

To get a sufficient viscosity for the fuel atomizing the oil temperature is raised with a preheater device. The temperature of the heated oil is controlled electronically.

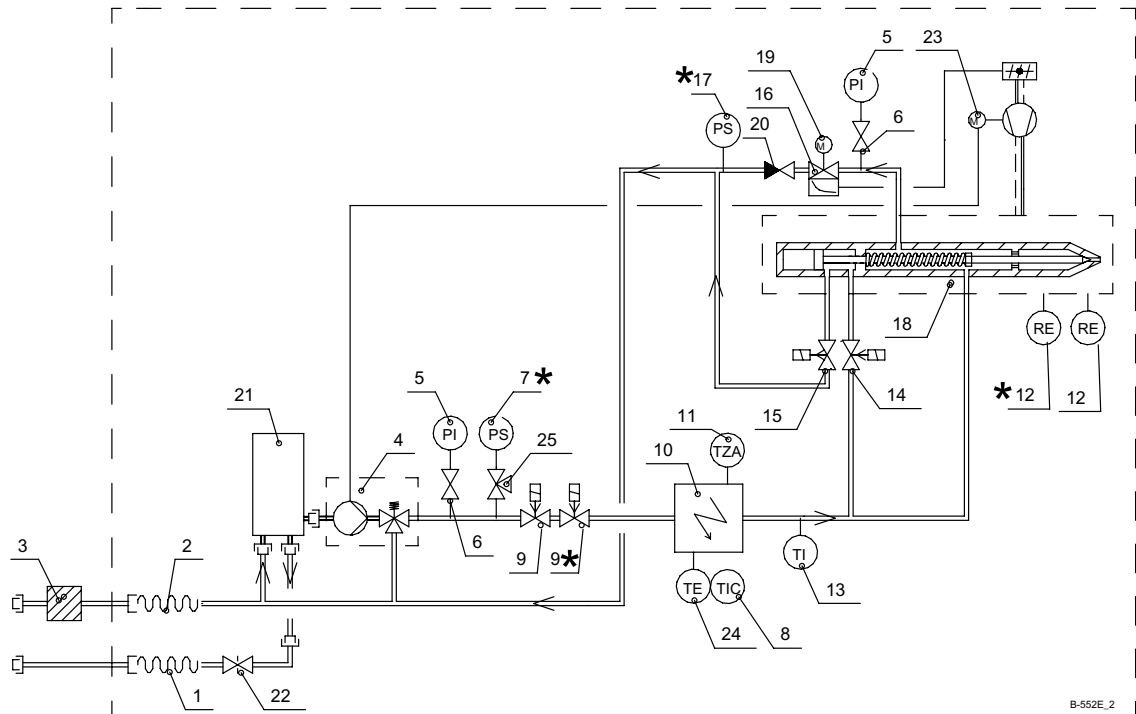
Atomizing pressure is provided by the burner oil pump.

In-let oil pressure to the pump varies case-specificly; See 'Pump adjustments'.

The nozzle is controlled by the the control circuit pressure (open-close).

For safety reason there is a throttle plug in the control flow line fitted to the connection of solenoid valve (NC), with an aperture of  $\varnothing 1,5$  mm. This plug reduces the strong control flow, which is directed onto the spring-loaded piston.

### 2.1.4 PI-diagram of M-burner



1. Return to tank
2. Oil to Burner
3. Oil filter
4. Oil pump
5. Pressure gauge
6. Closing valve (normal position closed)
7. Pressure switch
8. Temperature indicator and controller
9. Main solenoid valves, NC (Normal closed)
10. Preheater
11. Limit thermostat preheater
12. Flame detector
13. Temperature indicator

- 14. Solenoid valve, NC (normal closed) + throttle plug diam. 1,5 mm
- 15. Solenoid valve, NO (normal open)
- 16. Oil regulator
- 17. Pressure switch
- 18. Nozzle valve
- 19. servo motor
- 20. Non-return valve
- 21. De-aerator
- 22. Drilled-ball valve (normal position closed)
- 23. Servo motor
- 24. Temperature sensor
- 25. Three way valve

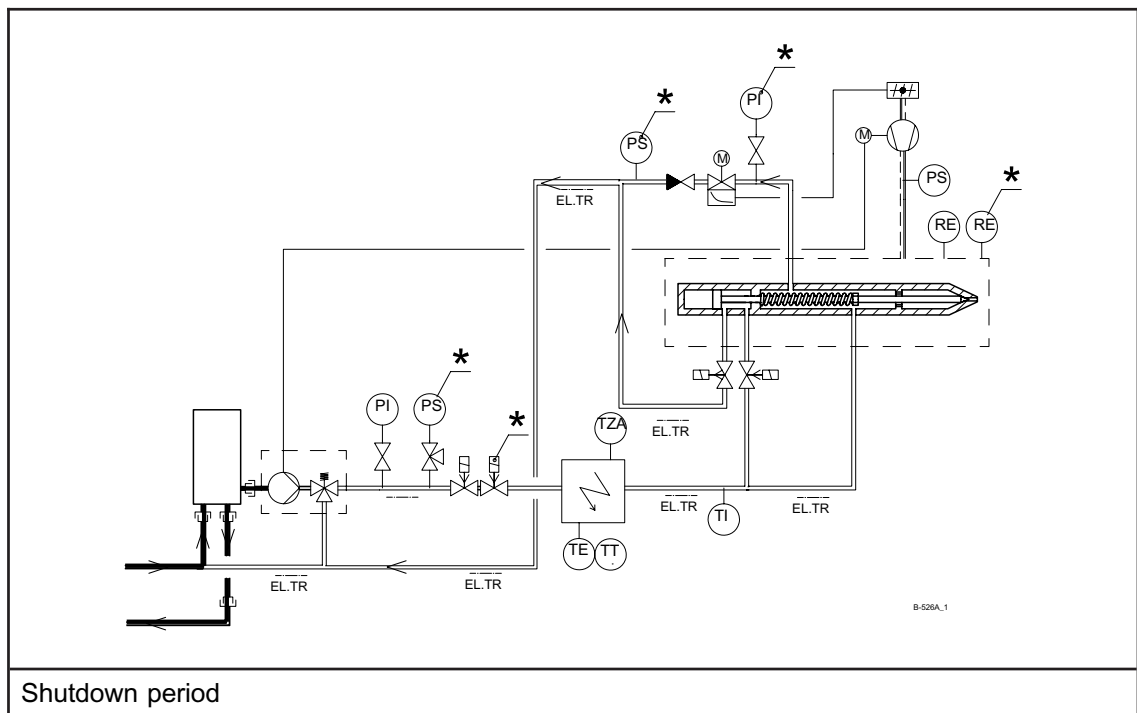
NC = default position closed  
 NO = default position open

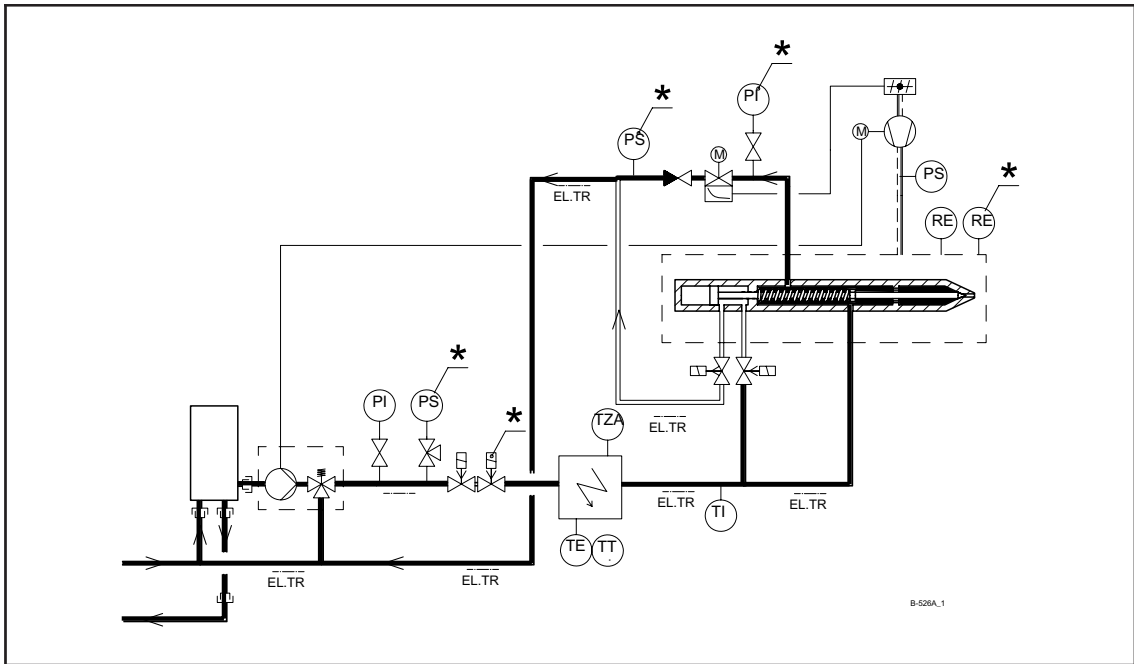
\* Components marked with a star symbol may be included or excluded according to class and customer requirements

**!** Note      The burner has to be connected to the oil circulation system according to the oil supply diagram.

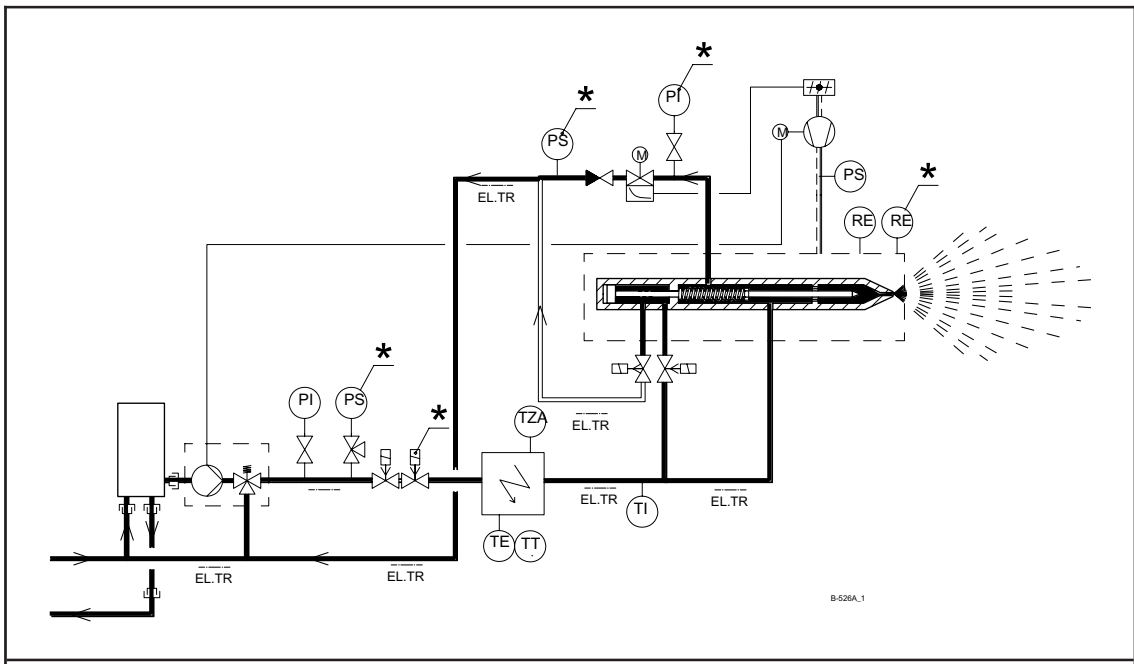
## 2.2. Oil circulation in the burner

### 2.2.1 Oil circulation periods on a modulating burner ( M )





Purging period

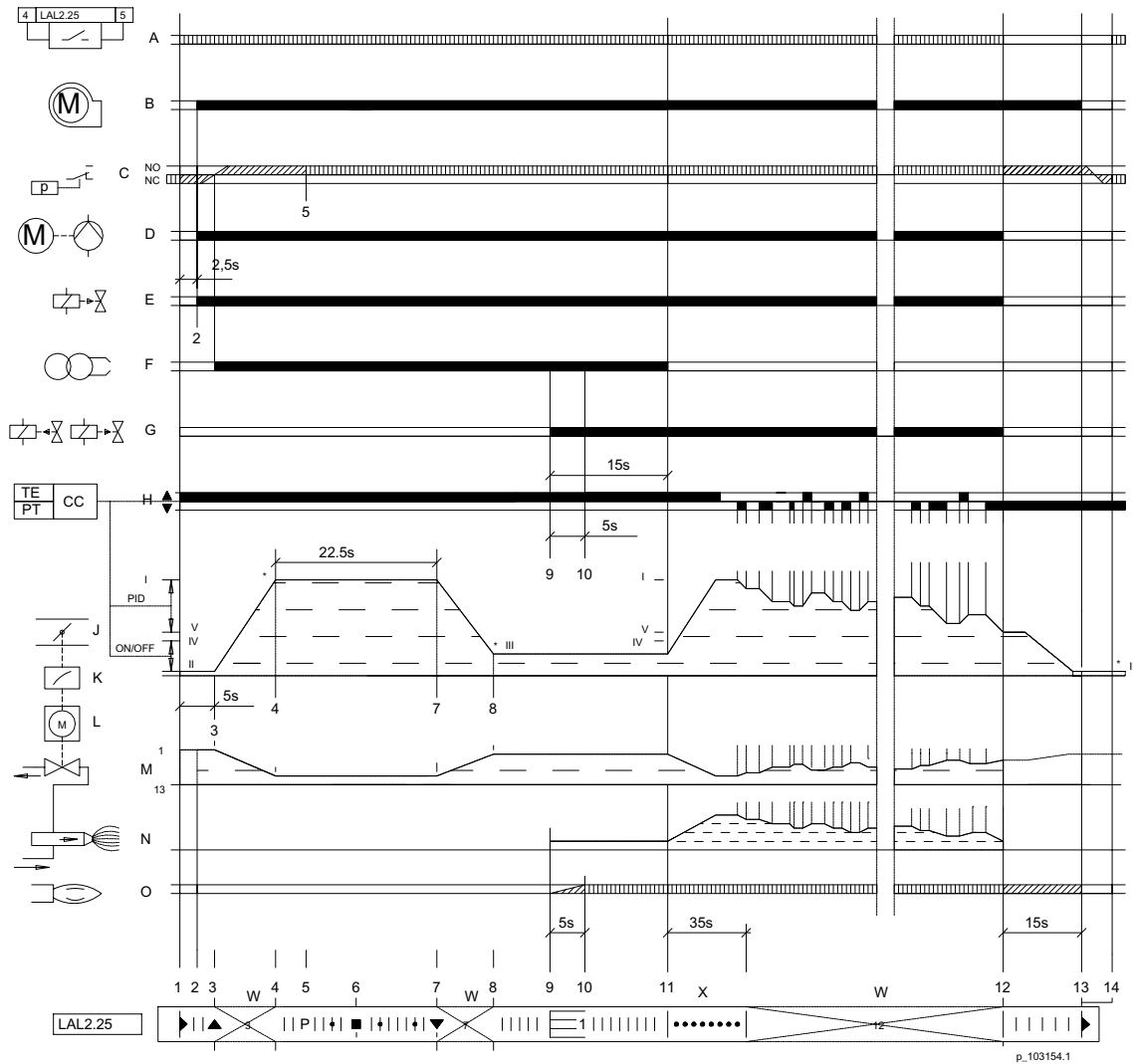


Atomizing period

\* Components marked with a star symbol may be included or excluded according to class and customer requirements

### 2.3. Sequence program, fuel oil

#### 2.3.1 Time Sequence Diagram LAL.2.25



Required input signals to control unit	Control signals	Permissible input signals to control unit

### 2.3.2 Time sequence diagram legend

- A Control loop
- B Fan
- C Differential air pressure switch
- D Oil pump
- E Main solenoid valve, NC
- F Ignition transformer
- G Control circuit solenoid valves, NC and NO
- H Capacity controller
- J Air dampers
- K Adjustable cam disc, air
- L Servomotor
- M Oil regulator
- N Nozzle valve
- O Flame signal
- W Sequence switch stopped
- X Sequence switch idle steps
- \* Required start signal to control unit terminal 8

### 2.3.3 Adjustable switching points on the cam switches of the servomotor

- I switching point of full load
- II switching point of the "closed" position after controlled shutdown
- III switching point of ignition load
- IV switching point of partial load before change over to modulating area
- V switching point of partial load at the low limit of the modulating area (V-I)
- VI free
- VII free

## 2.4. Automated functions in a modulating burner, oil fuel

### 2.4.1 Sequence point 1. Prerequisites for start-up

- Failures and interlocks are reset
- Limit switch on burner flange is closed
- Control unit is reset (lockout indicator at symbol ◀)
- Control switch in position 2, 3, 4 or 5 (A) \*M\*
- Contact of burner switch-on/switch-off level in capacity controller is closed or it is by-passed with manual operation position 3, 4 or 5 of control switch (A)
- Contact of boiler thermostat or pressurestat closed
- Preheater control switch in position 1 (heating ON)
- Required start signal from the limit switch of the switching point II in the servomotor to terminal 8 in the control unit
- oil temperature > min. or temperature controller (min.) by-passed (light fuel oil)
- Contact C/NC of differential air pressure switch is closed (differential air pressure < min.)
- Contacts of the low oil pressure switch connected to the control circuit are closed
- External contacts connected to the control circuit are closed
- Start signal at terminal 12 in control unit.

### 2.4.2 Sequence point 1.1. Start-up (lockout indicator of the control unit is at symbol ◀)

- Control loop closes
- Control program (sequence switch) of control unit starts.
- Checking of the flame detection circuit is in process

### 2.4.3 Sequence point 2

- Fan motor starts
- Oil pump motor starts
- Main oil valve opens and purging of nozzle valve with warm oil begins.
- After the differential air pressure switch has changed over its contact to position C/ NO pre-ignition begins (differential air pressure > min.).

### 2.4.4 Sequence point 3. Lockout indicator of the control unit is at symbol ▲

- Servomotor runs to switching point I (air dampers are open)
- Sequence switch does not operate during the running time.

### 2.4.5 Sequence point 4. Servomotor has run to switching point I (Air dampers are open)

- Start signal from the limit switch of switching point I to terminal 8 in control unit. Otherwise the start-up program interrupts and the control unit remains (symbol ▲) waiting for start signal (no failure).
- Pre-purge (22,5 s) with nominal air quantity begins.



- 2.4.6 Sequence point 5. Lockout indicator of the control unit is at symbol P**
- Differential air pressure switch has to have changed its contact over to position C/NO.
- 2.4.7 Sequence point 6. Lockout indicator of the control unit is at symbol ■**
- Control of flame supervision circuit completed
- 2.4.8 Sequence point 7. Lockout indicator of the control unit is at symbol ▼**
- Pre-purge (22,5 s) completed
  - Servomotor runs to switching point III (ignition load)
  - Sequence switch is stopped during the running time.
- 2.4.9 Sequence point 8. Servomotor has run to switching point III (ignition load)**
- Required start signal from the limit switch of switching point III to terminal 8 in control unit. Otherwise the start-up program interrupts and the control unit remains (symbol ▼) waiting for start signal (no failure).
- 2.4.10 Sequence point 9. Safety time (5 s) begins**
- Contact of return oil pressure switch (max.) must have been closed (C/NC)
  - in control circuit of nozzle valve solenoid valve NC opens and solenoid valve NO closes
  - Oil pressure is released to control circuit of the nozzle valve. Nozzle valve needle moves back and opens the nozzle valve.
  - Fuel atomizing from the nozzle begins with pressure set for ignition phase.
  - Oil spraying through the nozzle is ignited by the electric arc
- 2.4.11 Sequence point 10. Ohjelmareleen ohjelmaosoitin on symbolin 1 kohdalla**
- Safety time ends (5s)
  - Flame burns at set ignition load.
- 2.4.12 Sequence point 11. Lockout indicator of the control unit is at symbol | (operating)**
- Ignition stops (electric arc)
  - Sequence switch stops for the running time
  - Control signal from terminal 20 on the control unit for the running time
  - Servomotor runs to switching point IV (< V) before switching over to modulating area (between switching points V and I)
  - When the load is high and the burner is turned on all the time, capacity controller (PID, 3-step control) adjust the burner capacity on the modulating area (I - V) to correspond to the load. With signal "increase" or "decrease" from the capacity controller or from the control switch in manual operation, the servomotor of air dampers and oil regulator is regulated to the direction "open" or "closed" according to the capacity demand.

- Burner operates thus supervised by control unit and controlled by capacity controller according to set controller parameters and functions (see documentation of controller)
- Burner shuts down when the load is small and the process value exceeds the burner switch-off level set on the controller or controlled by the boiler thermostat/ pressurestat. In manual operation the burner shuts down controlled by the boiler thermostat/ pressurestat only.
- If the oil temperature rises above the set limit on the preheater limit thermostat- the burner shuts down. (thermostat lockup)
- stop and restart if the flame signal is lost during operation (wire link B has been cut away from the from the plug section of the control unit)
- Stop and restart if the return oil pressure rises too high

Wire link B has been cut away at the factory.

#### 2.4.13 Sequence point 12. Controlled shutdown (control loop opens)

- Sequence switch starts and begins to program the permissible post-purge time (15 s)
- Oil pump motor stops
- Main oil valve closes
- Solenoid valve NC closes and NO opens in the control circuit
- Nozzle valve closes when the oil pressure in the control circuit disappears
- Flame extinguishes
- With control signal from terminals 10 and 11 of the control unit servomotor runs to switching point II (air dampers to position "closed" and oil regulator to position "open").

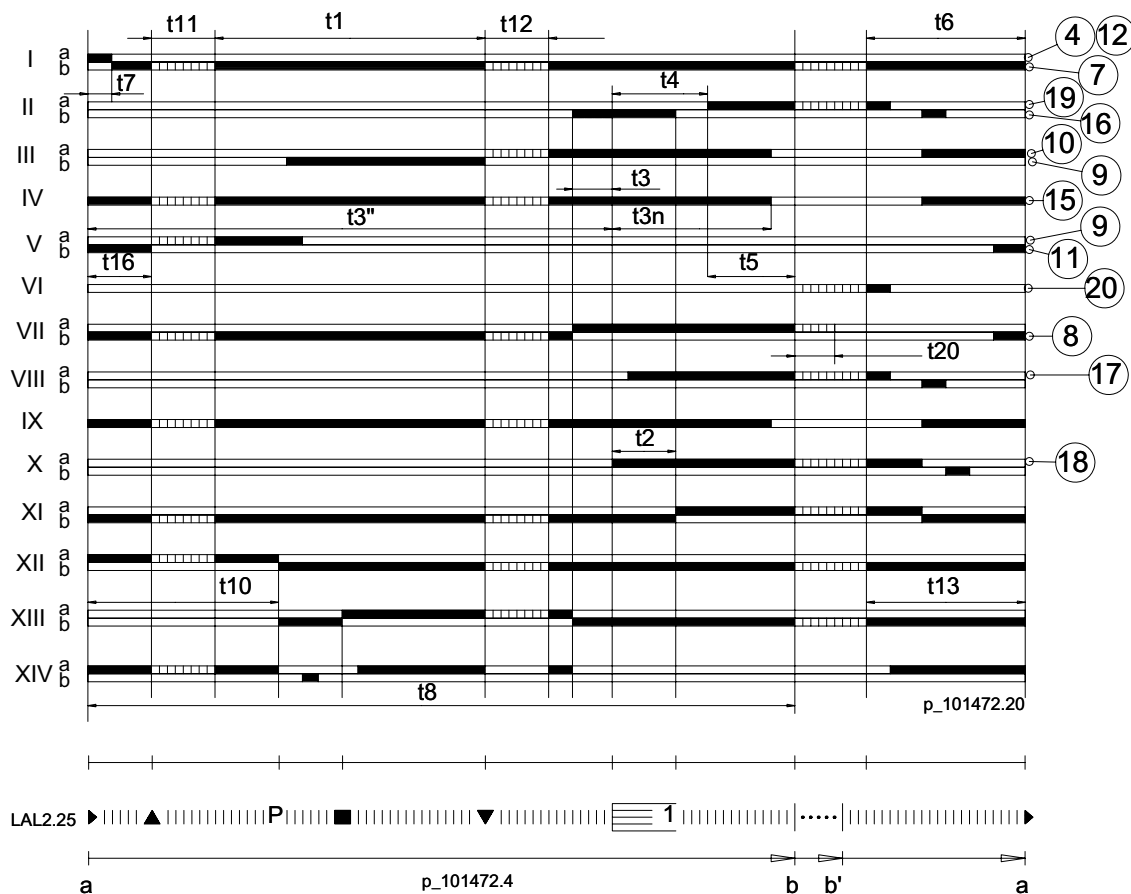
#### 2.4.14 Sequence point 13. Lockout indicator of the control unit is at symbol ◀

- Permissible after-burn time (15 s) ends
- Flame simulation tests initiate in control unit.
- Sequence switch stops
- Fan motor stops

Re-start possible, if the prerequisites for start-up are fulfilled (see Sequence point 1.)

## 2.5. Control Program of the Sequence Switch

### 2.5.1 Control program diagram



#### Lockout indication

- a - b = start-up sequence
- b - b' = idle steps (operation)
- b(b') - a = post-purge sequence (reset of control unit)

Numbers 4...20 are the control output contacts from the sequence switch relay

### 2.5.2 Switching times (in seconds) of the control program of the sequence mechanism

t1	Pre-purge time with air dampers open	22,5
t2	Safety time	5
t3	Pre-ignition time "SHORT" (transformer connected to terminal 16)	2,5
t3''	Pre-ignition time "LONG" (transformer connected to terminal 15)	from start command
t3n	Post-ignition time (transformer connected to terminal 15)	15

t4	Interval between beginning of t2 and release of voltage at terminal 19	7,5
t5	Interval between end of t4 and release of voltage at terminal 20	7,5
t6	Post-purge time	15
t7	Interval between start-up command and release of voltage at terminal 7	2,5
t8	Duration of start-up (without t11 and t12)	47,5
t11	Running time for air dampers to OPEN position (air dampers position control)	optional
t12	Running time for air dampers to IGNITION position (air dampers position control)	optional
t13	Permissible after-burn time	15
t16	Interval from start-up to OPEN command for air dampers	5
t20	Interval up to the self-shutdown of the sequence mechanism (idle steps)	35

Switching times in seconds in the sequence of the burner start-up are valid for frequency of 50 Hz. For 60 Hz frequency, switching times are reduced by approx. 20 %.

## 2.6. Control Program under Fault Conditions and Lockout Indication

### 2.6.1 Principle

In case of any fault fuel injection is stopped immediatly. The sequence mechanism stops along with the lockout indicator. The symbol above the reading mark of the indicator gives the type of fault.

### 2.6.2 Fault indications on a modulating burner

SYMBOL	FAULT	CAUSE	Note
◀	Lockout	the CLOSE signal has not been delivered to terminal 8 from air damper servomotor or contact have not been closed between terminals 12 and 4 or 4 and 5.	
◀	Lockout	Extraneous light (e.g. non-extinguished flame, leaking fuel valves, defect flame supervision circuit, etc.).	
▲	Interruption of start-up sequence	the OPEN signal has not been delivered to terminal 8 from the air damper servomotor.	Terminals 6, 7 and 15 remain under voltage until the fault is corrected!
P	Lockout	Lockout because the air pressure signal has not been received at the start of the air pressure control.	From this point on till controlled shut down every air pressure failure triggers a lockout. Too little difference in air pressure (<min.) triggers a lockout when differential air pressure switch connector (C/NC) engages a control signal to control unit terminal 13.
■	Lockout	Fault in the flame detection circuit	
▼	Interruption of start-up sequence	The ignition position signal has not been delivered to terminal 8 from air damper servomotor	Terminals 6, 7 and 15 remain under voltage until the fault is corrected!

1	Lockout	Flame signal has not been received during safety time.	Every flame signal failure after safety time sequence leads to a lockout
1	Lockout	Return line pressure switch (max) triggering stops fuel injection.	Pressure switch is optional component. May not be included to delivery.
	Lockout	The flame signal has been lost during burner operation	If the wire link B has been cut from the plug section of the control unit, repetition of startup sequence follows
	Lockout	Air pressure signal lost during operation	

### 2.6.3 Restart


The control unit can be reset immediately after a lockout has occurred. After resetting (as well as after correction of a fault, which resulted in a controlled shutdown, or after each mains failure) the sequence switch always returns to its start position, whereby only terminals 7, 9, 10 and 11 receive voltage in accordance with the control program. It is only then that the control unit begins with a new burner start-up.

Do not keep the reset button pressed for more than 10 seconds.

## 2.6.4 Control unit LAL 2.25



1. Reset button
2. Program indicator
3. Fuses

 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>• Control unit is a safety device. It is NOT allowed to open nor make alterations or adjustments to it.</li> <li>• The control unit must be completely separated from supply voltage before carrying out any procedures to it.</li> <li>• All safety functions must always be tested when using for the first time and after changing the fuse.</li> <li>• The control unit must be kept safe from water drops and sprays at all times</li> </ul>
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## 2.7. Additional heating

### 2.7.1 Description

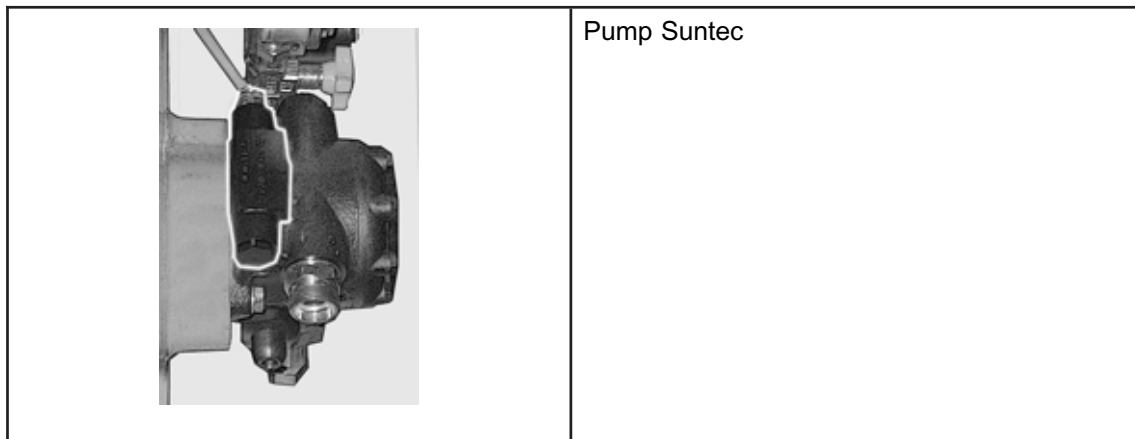
Additional heating keeps the burner ready for use. Additional heater devices ensure oil fluency by keeping oil viscosity adequately low.

Keep heating on at all times. If the heaters are turned off they must be turned ON AT LEAST 2 HOURS BEFORE starting the burner.

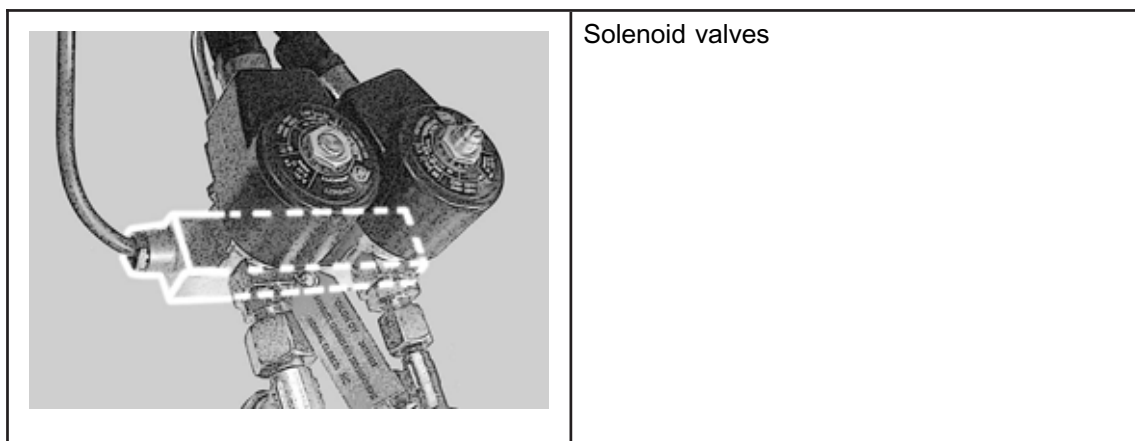
If the oil viscosity is too high :

- ignition does not happen or it is difficult
- the oil pump and sealing components are overstressed which may lead to premature degrading.

### 2.7.2 Heating cartridges on pumps

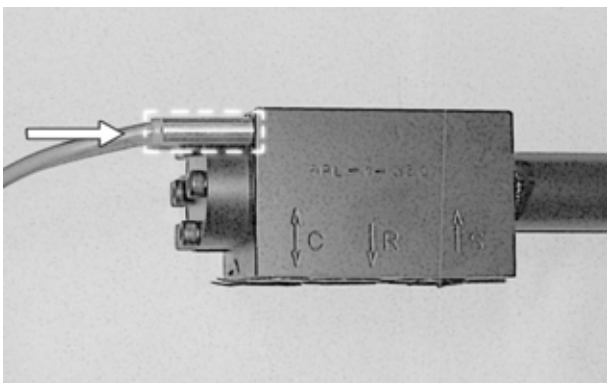
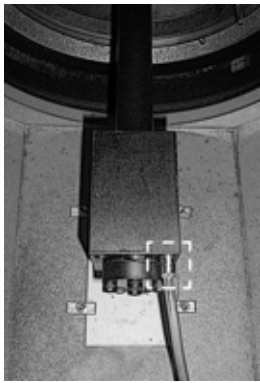


### 2.7.3 Heating cartridges on solenoid valves

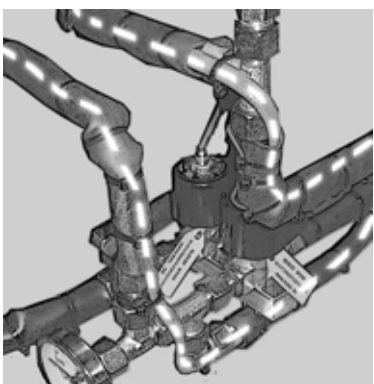




### 2.7.4 Heating cartridges on nozzle valve


	<p>Press the cartridge in to the opening.</p>
	<p>Top view of the nozzle valve</p>

### 2.7.5 Heating the pipes and hoses with heating cables

	<p>The heating cables must run in direct contact with the pipe surface. Loose cable does not conduct heat into the pipings.</p>
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2.7.6 Technical data

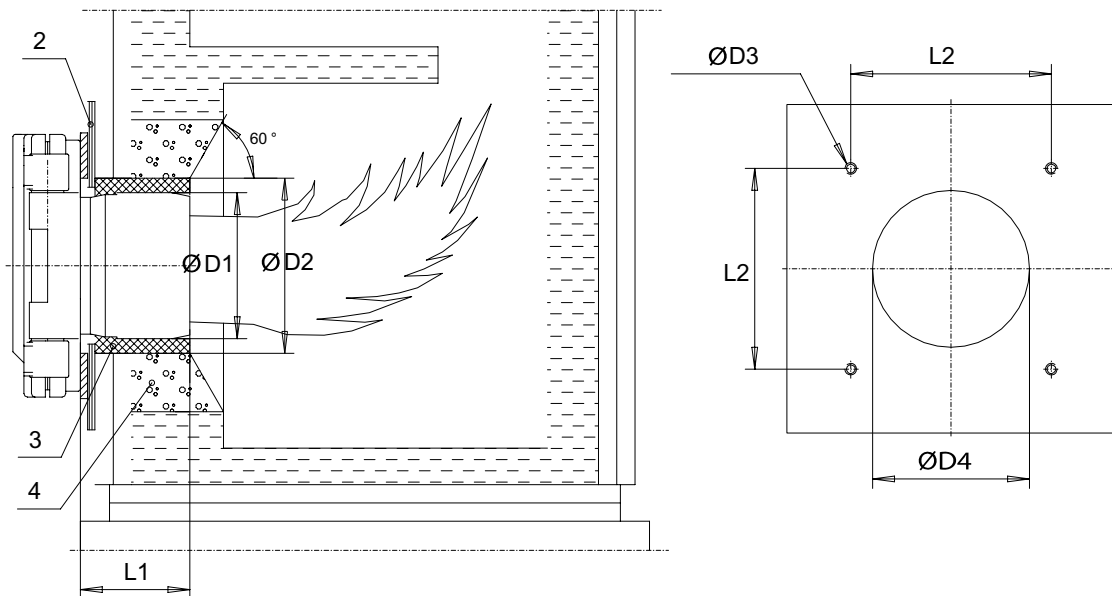
Heating cartridge capacity	40 W/230 V
Heating cartridge dimensions	10 x 50 mm
Heating cartridge electric cable	2500 mm
Heating cable	Self adjusting - capacity decreases as the pipe temperature rises.
Heating cable capacity	230 V 45 W/m in +10 C°

 <b>DANGER!</b>	Heating cartridge case may be hot
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## 3. Installing the burner

### 3.1. Burner Installation

#### 3.1.1 Mounting dimensions



1. Gasket
2. Mounting plate
3. Ceramic wool or similar
4. Refractory

Burner	Dimensions in mm					
	D1	D2	D3	D4	L1	L2
RP130	200	240	M16	215	200	275
RP140	240	280	M16	255	220	275
RP150	270	310	M16	285	230	275
RP250	270	310	M16	290	300	365
RP280	300	340	M16	320	312	365

#### 3.1.2 Burner mounting


The boiler front plate must be prepared in accordance with the given dimensions.

The threads of the bolts must be coated with graphite-bearing grease prior to fitting

The burner has to be installed in such a way that the motor shaft lies horizontally; however, it is not allowed to install the burner upside down.

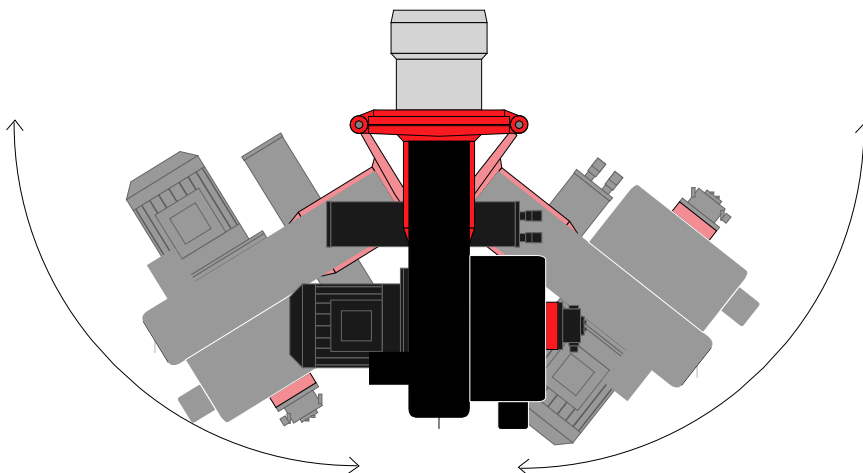
Remove the transportation bracket after the burner is attached to the boiler

Make sure there is enough free space on the side to allow the burner to swing fully open


 <b>CAUTION</b>	<p>The burner must be installed firmly. Vibrations may damage burner or its components.</p>
---	---

### 3.2. Burner hinges

#### 3.2.1 Standard composition

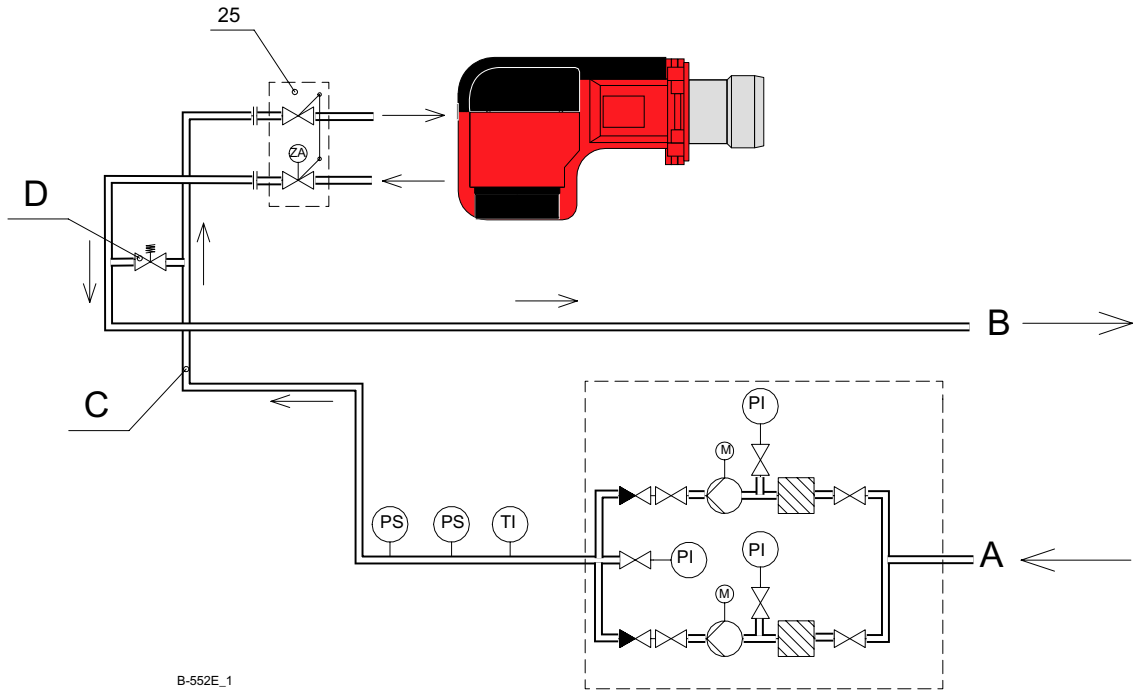


As standard the burner can be hinged to the left. The burner can be changed to be hinged to the right by changing the position of the hinge pins.

 <b>CAUTION</b>	<p>Switch off the electric power from your burner before burner swing-out.</p>
---	--

### 3.3. Exemplary Oil supply diagram

#### 3.3.1 Oil supply diagram



B-552E\_1

25 - double closing valve (accessory)

A - Oil from tank

B - Return line to tank

C - Oil from pumping unit

D - Pressure regulating valve

The oil throughput from the pumping unit must be at least  $1,2 \times$  quantity of oil to be burned  $\text{kg/h} + 150 \text{ kg/h}$

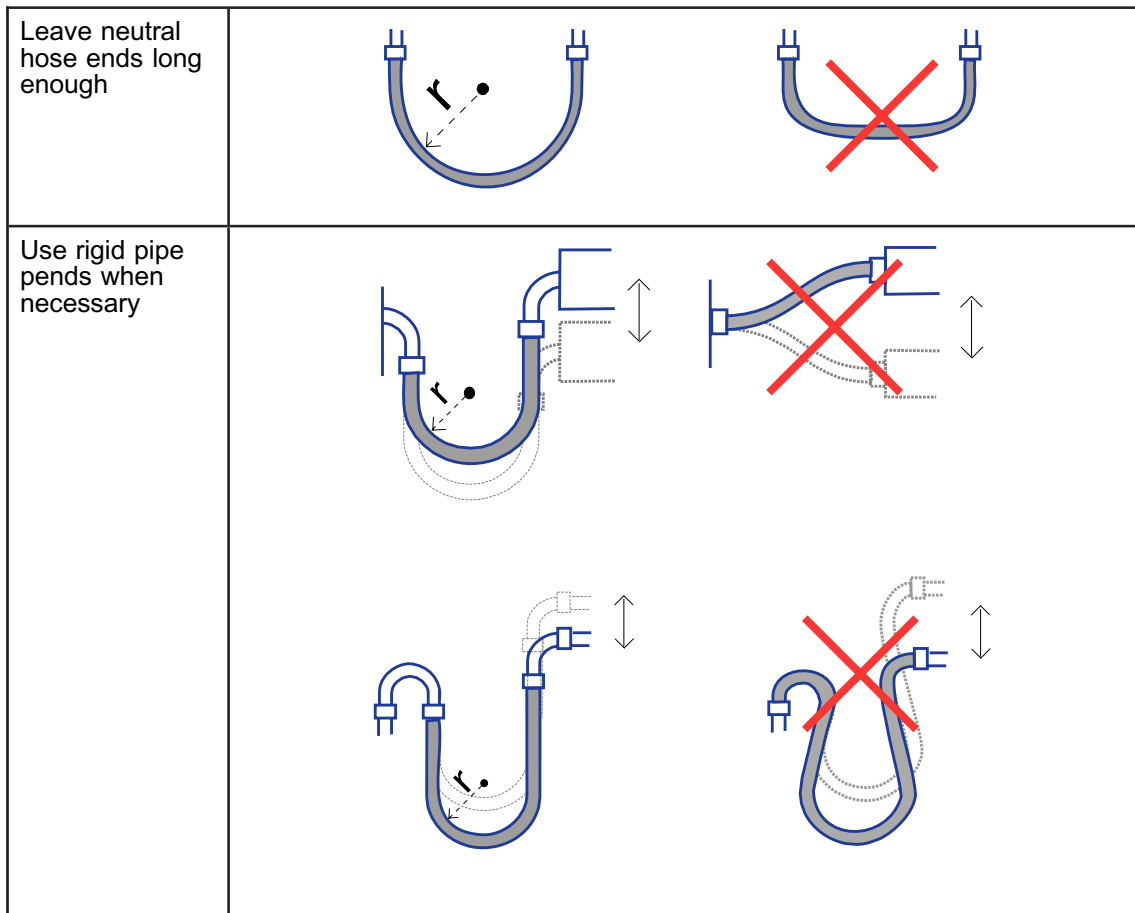
Example

If	Then
burner capacity is 200kg/h	throughput must be $1,2 \times 200 \text{ kg/h} + 150 \text{ kg/h} = 390 \text{ kg/h}$

<b>!</b> Note	Pay attention to instructions from the pump manufacturer when dimensioning the pipeworks.
---------------	---

### 3.4. Installing hoses

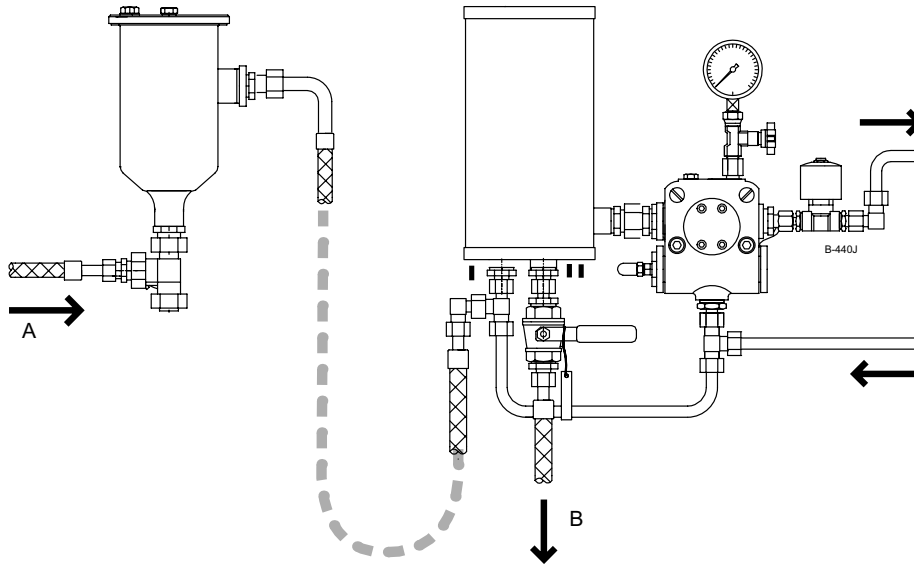
#### 3.4.1 Avoid torsion stress on hoses



#### 3.4.2 Minimum bend radius

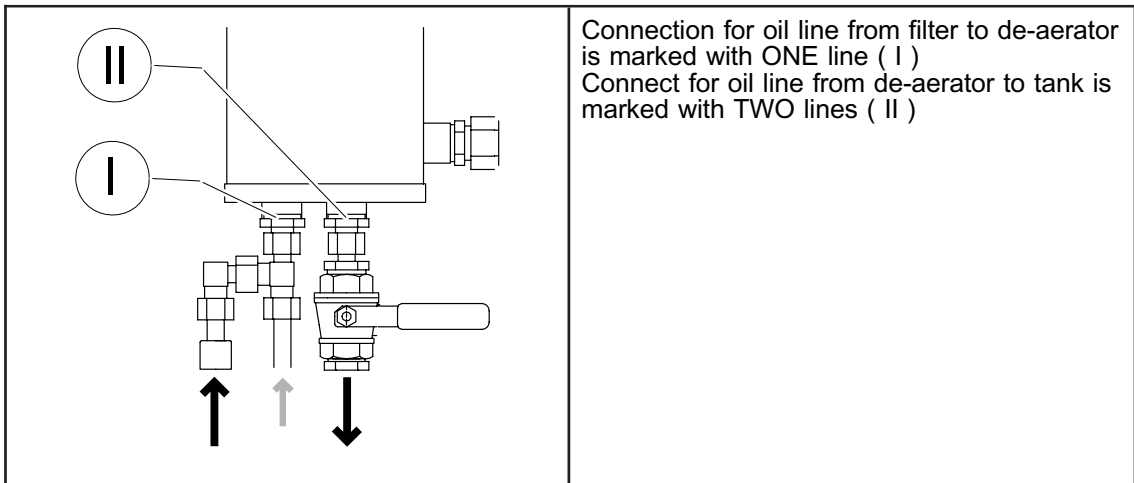
Hose diameter	Minimum bend radius ( r )
Ø 12	130 mm
Ø 15	130 mm
Ø 22	170 mm

### 3.5. De-aerator and oil filter



A = Oil from tank

B = Oil to tank



The accumulated gas must be able to vent from the deaerator. Always install the degassing unit upright.

In case the de-aerator is installed separate from the pump, the connecting line has to be trace heated and the pump has to be equipped with a heating cartridge.

## 3.6. **Electric connections**


### 3.6.1 **Connections**

The burner must be connected according to the electrical diagrams delivered together with the burner. General and local standards and regulations as well as requirements of electrical equipment on electrical connections must be adhered to. Burner instrumentation has to be configured with a switch that allows it to be disconnected from the low-voltage supply mains.




## 4. First start-up and adjusting

### 4.1. First start-up and adjusting

 <b>DANGER!</b>	<p>Keep the boiler doors closed during ignition and operation.</p>
---	--

#### 4.1.1 Preparatory to first start up


- Check the boiler and it's components are in proper working order
- Check the pipings are installed correctly and the joints are tight and have no leaks
- Check there is sufficiently water in the heating system
- Check there is adequate air inlet to the boiler room for the burner to have sufficiently air for combustion
- Check there is fuel in the oil tank
- Check electrical connection points (inputs/outputs) are correct


 <b>CAUTION</b>	<p>Prior to first start-up the oil pump must be vented. The pump must not operate without oil. See chapter "Oil Pump".</p>
---	--

#### 4.1.2 First startup with heavy fuel oil

1. Connect main voltage.
2. Switch ON additional heaters at least 2 hours before start-up.
3. Check the installation of the drilled ball valve on the return line. Check that the valve is CLOSED.
4. Check oil supply pressure and temperature. See further instructions from 'adjusting the pump'.
5. Check there is oil in the pump.
6. Check direction of rotation of the burner motor. ( The electric connections are made correctly ) Check direction of rotation of fan motor and pump motor. ( The electric connections are made correctly )
7. Check atomizing temperature is correct. See further instructions from 'nozzle capacity charts'.
8. Move the adjustment ring on burner head to middle position.
9. Check the condition and correct settings of ignition electrodes and cables.
10. Check the correct size and type of the nozzle.
11. Check the cam positions on air damper servomotor.
12. Switch the burner ON to minimum capacity.
13. Check the atomizing pressure is correct.
14. Check the return pressure for ignition phase.

15. Use an oil flow meter to check minimum capacity. ( Minimum capacity preadjusted at the factory )
16. increase capacity step-by-step by adjusting the screws.
17. Use a gas analyzer to adjust optimum values for the combustion.
18. Use an oil flow meter to check maximum capacity. ( Maximum capacity preadjusted at the factory )
19. Test the safety equipments on the burner.

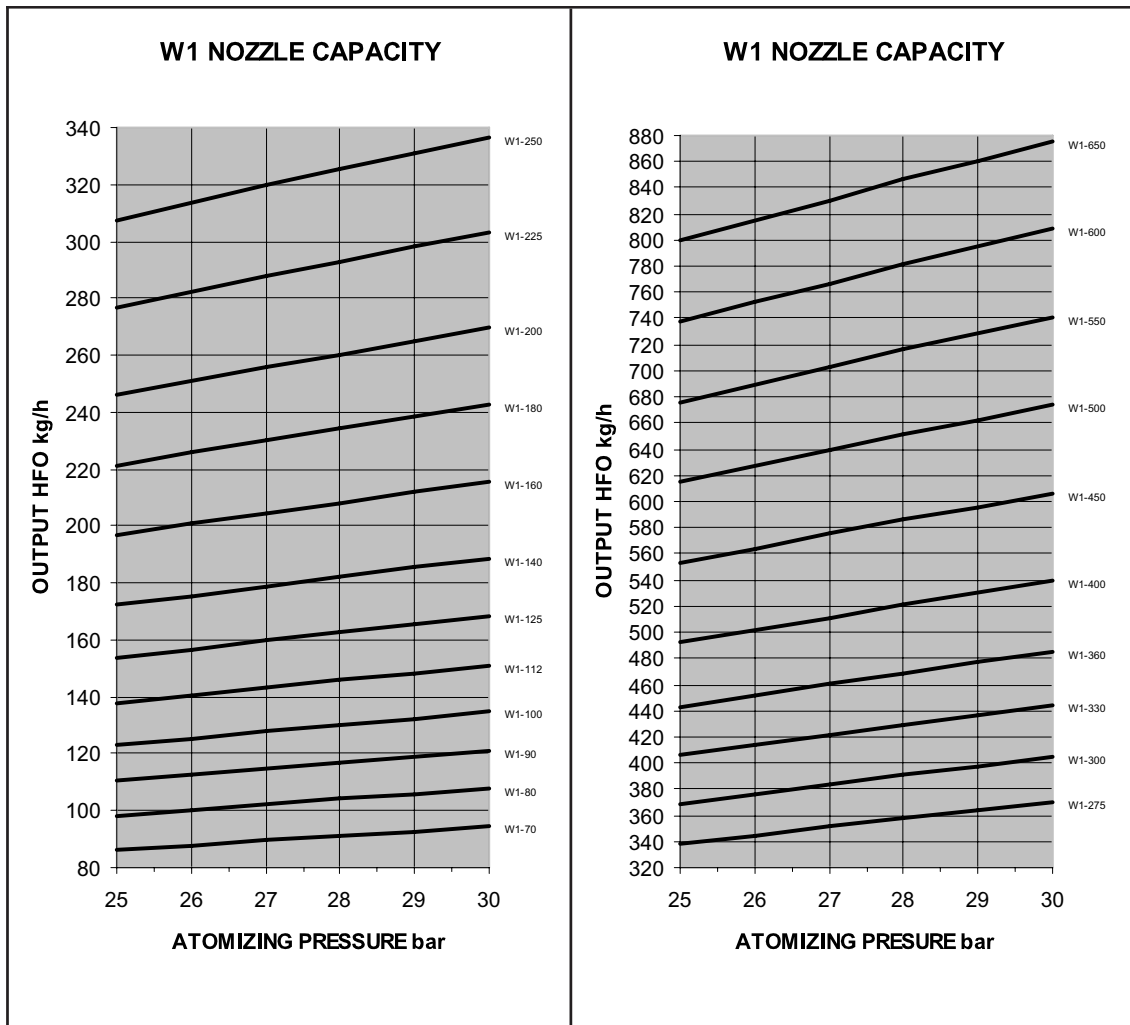
 <b>DANGER!</b>	<p>Never use a naked flame while checking the burner or the boiler. Never store any inflammable material in the boiler room.</p>
---	--

 <b>DANGER!</b>	<p>Wear hearing protectors, if there is noise in the boiler room.</p>
---	---

## 4.2. Nozzle capacity charts

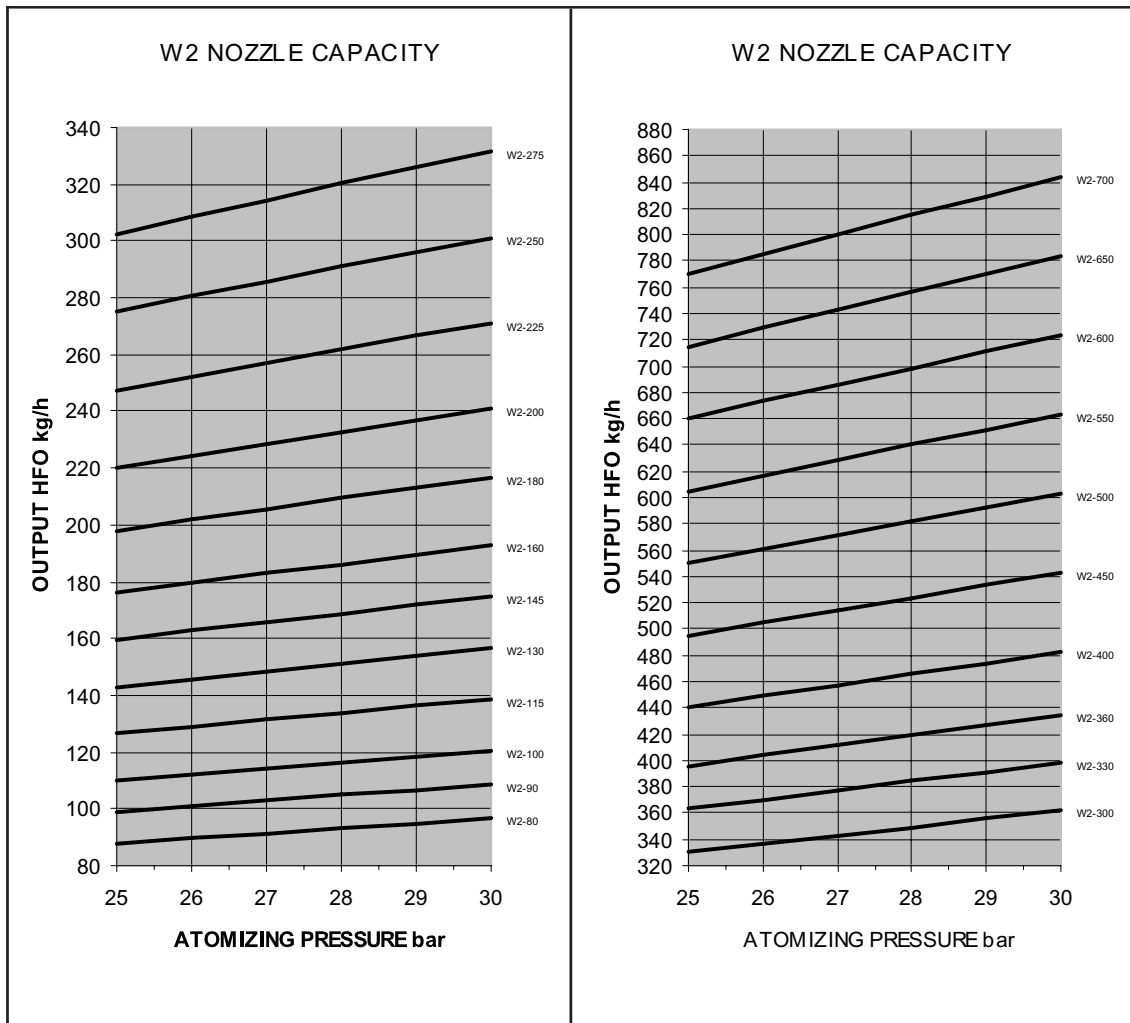
### 4.2.1 Nozzle capacity charts Fluidics 12 W1

Charts applicable when atomizing viscosity  $15 \text{ mm}^2/\text{s}$  (cSt)



4.2.2 Nozzle capacity charts Fluidics 12 W2

Charts applicable when atomizing viscosity 15 mm<sup>2</sup>/s (cSt)



FOR EXAMPLE

Oil viscosity	Atomizing temperature
180 mm <sup>2</sup> /s at 50 °C	110...115 °C
380 mm <sup>2</sup> /s at 50 °C	125...130 °C
700 mm <sup>2</sup> /s at 50 °C	135...140 °C

### 4.2.3 Fuel consumption by boiler capacity

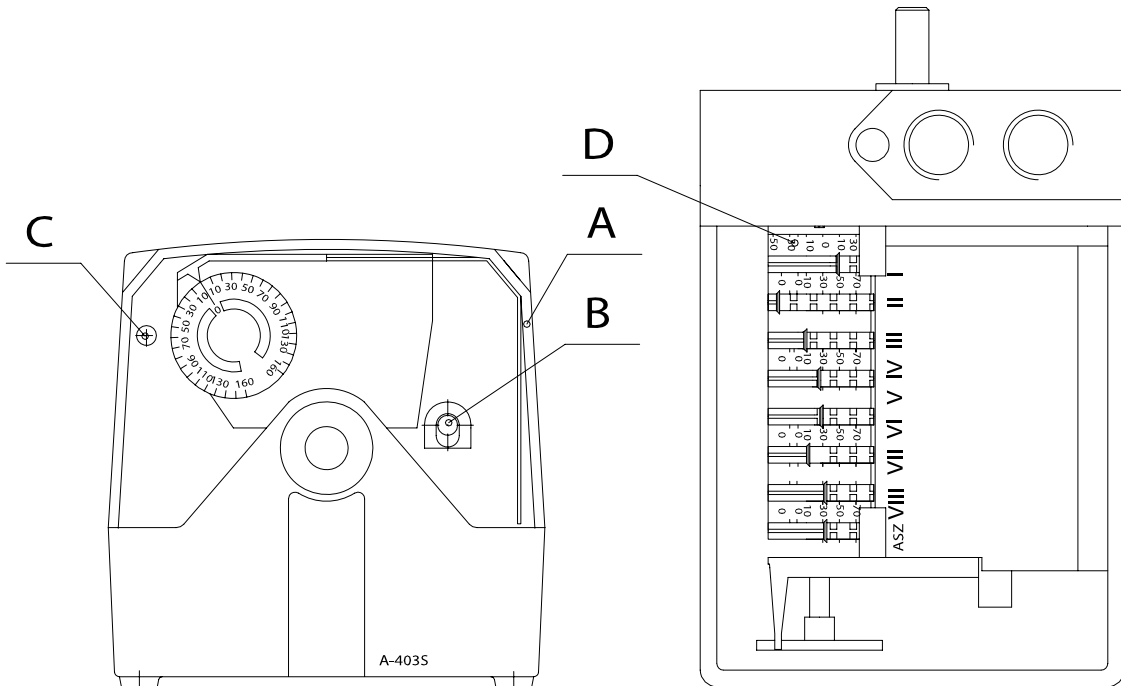
$q = P/\mu * Q$	P = boiler capacity kW μ = boiler efficiency, 0,80-0,95 Q =heat value, kWh/kg q = fuel demand, kg/h (Note! all nozzles)
-----------------	--

Heat value for light fuel oil approx. 11,86 kWh/kg and for heavy fuel oil approx. 11,22 kWh/kg. Check exact values from supplier.

### 4.3. Adjusting combustion air

#### 4.3.1 Servomotor SQM 50. cam switches


The diagram shows the basic positions of the cam discs.





Cam switches (limit switches) are set at the factory during testing as follows:

II	burner shutdown
III	ignition load
IV	load, when changing over from ignition load to partial load
V	partial load, when changing over from full load to partial load
I	full load

- A - adjusting key (under cover)
  - B - release lever
  - C - adjusted at the factory, **DO NOT RELEASE THE SWITCH!**
  - D - scale indicates only the turning angle of servomotor shaft
- With the release lever B the cam shaft can be disengaged. This makes it possible to turn the cam discs manually.

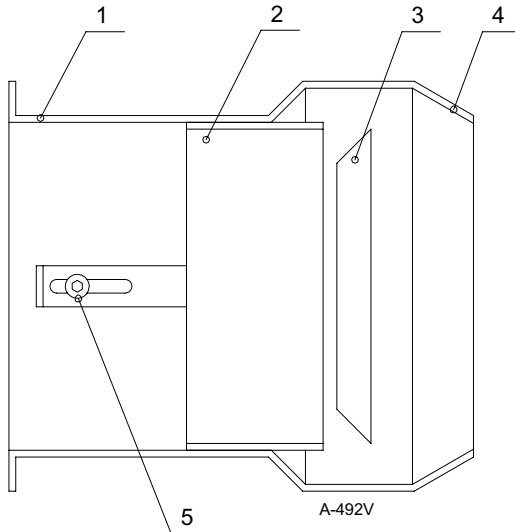
 Note	Difference between switches IV and V must be approx. 3 - 5° The black scale is in use. Cam switches VI, VII, and VIII are free ASZ (potentiometer) in use when necessary
--	--

 Note	Do a flue gas analyzis to verify adjustments
--	--

 <p><b>DANGER!</b></p>	Do not release the switch C. Change in position of cam discs will damage servomotor and change burner adjustments.
--	--

## 4.4. Adjusting pressure drop in combustion head

### 4.4.1 Combustion head components



1. Flame tube
2. Adjustment ring
3. Diffuser disc
4. Combustion head extension
5. Locking of adjustment ring

### 4.4.2 Effect of the adjustment ring

Position of the adjustment ring effects on the pressure drop in the combustion head. Pressure drop is adjusted by moving the adjustment ring back and forth thus altering the gap between the adjustment ring and the diffuser plate. With a small load the adjustment ring is positioned to the front and with a full load in the rear.

If...	Then...	And...
the adjustment ring is not positioned rear enough with a fuller load	there is too much pressure drop in the combustion head	the ignition is poor OR improper burning due to inadequate amount of air (high CO-content) OR flame tear-off from the diffuser disc when switching to fuller load
the adjustment ring is too rear with a lesser load	there is not enough pressure drop	deficient combustion (O <sub>2</sub> -values too high)

Combustion head pressure drop minimum

- with gas 2 mbar
- with heavy fuel oil 4 mbar
- with light fuel oil 3 mbar

#### 4.4.3 Note!

If the position of the adjustment ring has to be altered in relation to the diffuser disc, the air velocity and quantity in the combustion head will change. Check the combustion values by flue gas analysis and, if necessary, adjust the combustion air quantity to be adequate.

#### 4.4.4 Adjusting the combustion air

Combustion air volume is adjusted with the adjusting cam.

1. Check the surplus oxygen level from the gas flue after every adjustment with a flue gas analysator.
2. Set the combustion air levels within the operation range of the servomotor

Guideline values

CAPACITY	FUEL	O <sub>2</sub> -LEVEL %
Ignition, minimum- and part power	Heavy fuel oil	4,5 - 6
Full power	Heavy fuel oil	3 - 4,5
Ignition, minimum- and part power	Light fuel oil	3,5 - 4,5
Full power	Light fuel oil	3 - 4

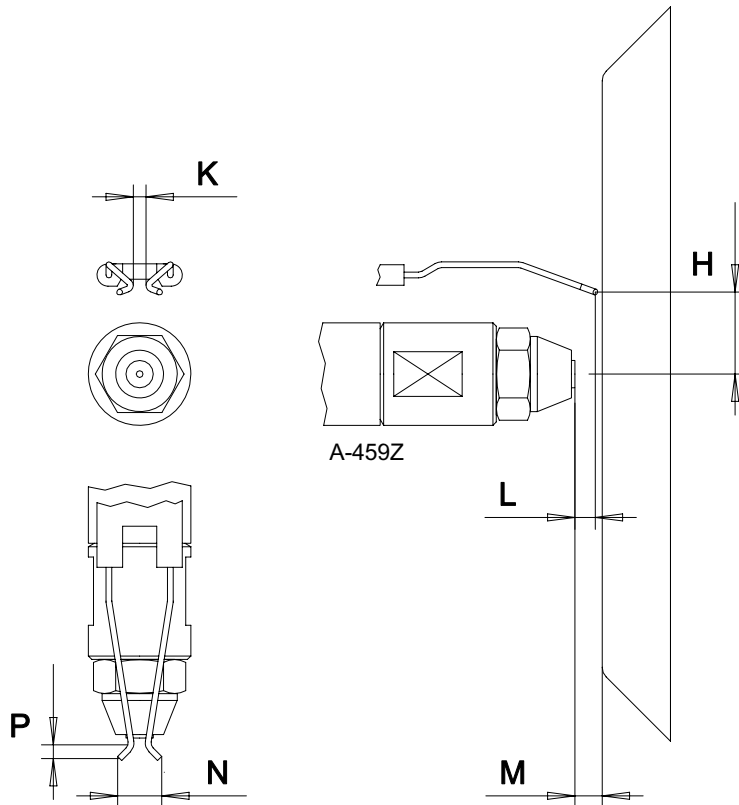
### 4.5. Setting the burner head

#### 4.5.1 Setting the ignition electrodes

Check and set the ignition electrode spark gap and the distance of the nozzle to the ignition electrodes and diffuser disc as show on the drawing



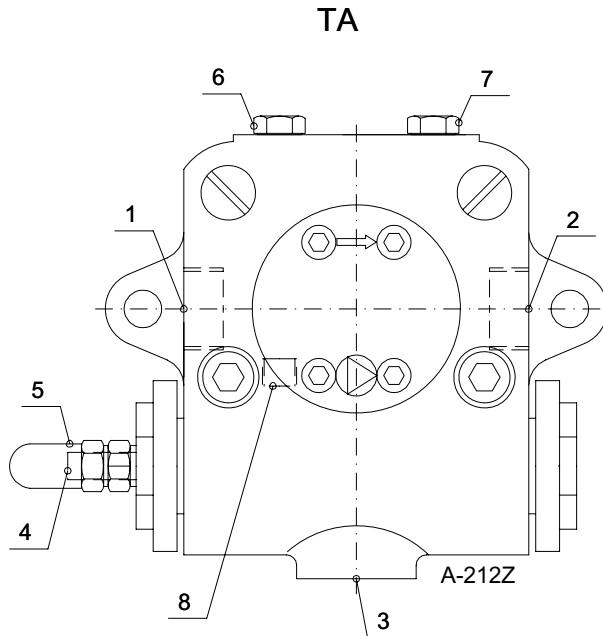
### 4.5.2 Ignition electrodes drawing



H	17 mm
K	3,5 mm
L	6 mm
M	8 mm
N	12 mm
P	4 mm

## 4.6. Adjusting oil pump

### 4.6.1 Oil pump connections



1. Suction line connection
2. Oil to nozzle
3. Return line connection
4. Pressure adjustment
5. Protective cap
6. Oil inlet pressure gauge port
7. Oil pressure gauge port (to nozzle) / air venting
8. By-pass plug

Pump body includes a drilling to accept an electric preheater.

**Note!** By-pass plug must be FITTED in when installing to M-burners

### 4.6.2 Pump values

The pump has a built-in pressure control system

TECHNICAL DATA	PUMP TA
Viscosity limits for incoming fuel: Light fuel oil	1.5 - 12 mm <sup>2</sup> /s (cSt)
Max. oil inlet pressure to burner	5 bar

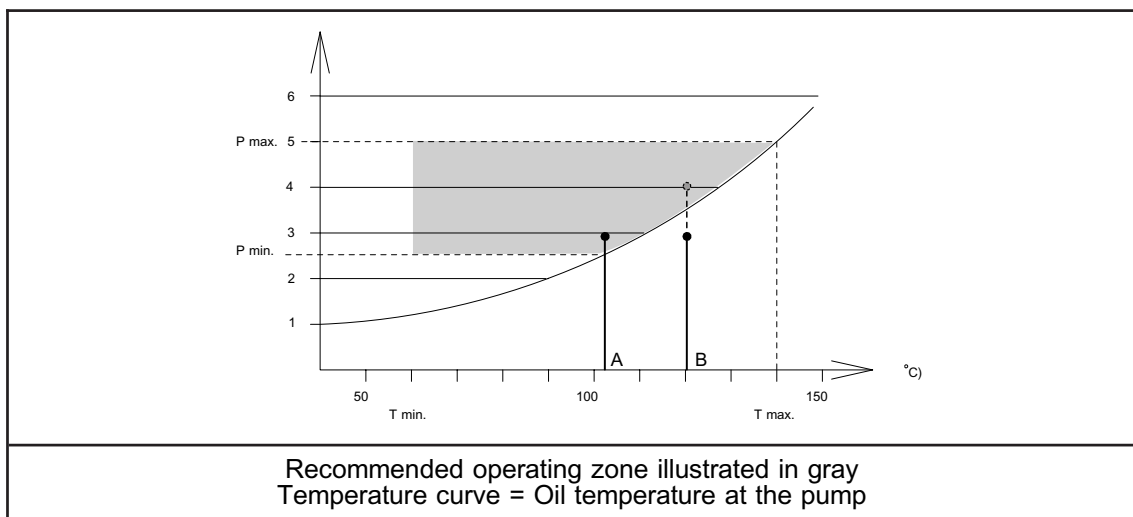
Min. oil inlet pressure to burner	2.5 bar or higher depending on oil temperature at the pump. See illustration.
In-let oil temperature range: Heavy fuel oil	60 - 100 C°
Pump operating pressure (=atomizing pressure) for heavy fuel oil	25 - 30 bar
Pump operating pressure (=atomizing pressure) for light fuel oil	20 - 25 bar

- Note! 1 bar = 100 kPa.

### 4.6.3 Adjusting the supply oil pressure

The diagram shows the required oil inlet pressure to the burner.

Check the inlet pressure to the burner from the the pressure gauge fitted to the filter cover.



Example A :

Oil temperature at the pump	In-let oil pressure to burner	Status
102 C°	2,9 bar	OK

Example B :


Oil temperature at the pump	In-let oil pressure to burner	Status
120 C°	2,9 bar	LOW PRESSURE ! Pressure must be lifted over 3,8 bar

#### 4.6.4 Pump pressure adjustment

Use the pressure adjustment screw. Turn the screw clockwise to increase the pressure. Install a pressure gauge/valve -assembly if necessary.

#### 4.6.5 Venting the oil pump

1. Loosen the plug of the pressure gauge port. Note! Do NOT remove the plug.
2. Let the burner operate for a while. Bubbles of air come out of the opening
3. Retighten the plug when no more bubbles appear


 Note	The pump is self-priming. The pump is intended for use in two-pipe system (=ring main system).
--	--

#### 4.7. Burning light fuel oil

Burner is suitable for temporary use of light fuel oil

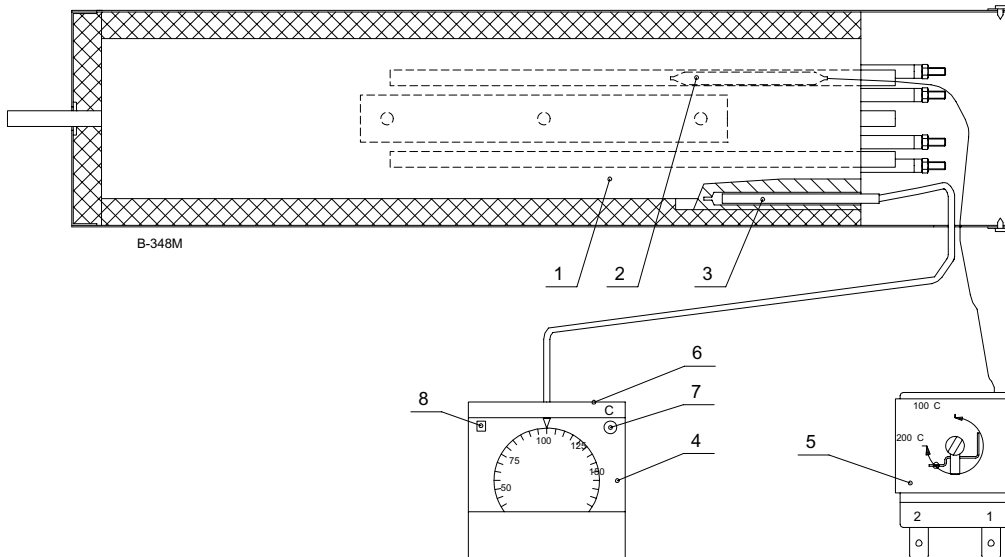
Pay attention to following:

- Turn OFF preheater when burning light fuel oil
- Decrease the atomizing pressure

 <b>CAUTION</b>	Turn OFF preheater when using light fuel oil
---	--


## 4.8. Preheater

### 4.8.1 Preheater components



1. Heater
2. Temperature sensor of limit thermostat
3. Controller sensor
4. Temperature controller
5. Limit thermostat
6. Limit set point - Low
7. Signal lamp, temperature low
8. Signal lamp, control

The burners have electrical preheaters which consists of one or several heating units. The heating units have one common regulator, and individual thermostats.

 <b>DANGER!</b>	<p>The connectors in the control box are under voltage. The safety cover is allowed to be opened only by authorized staff.</p>
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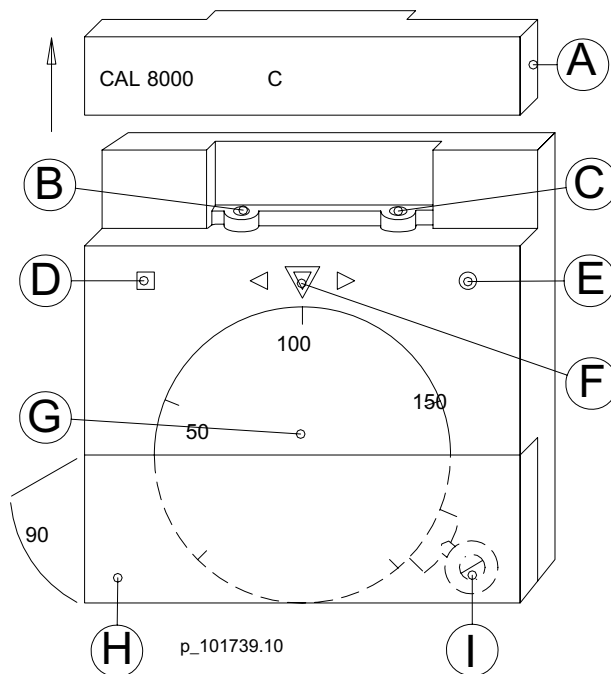
### 4.8.2 Temperature regulation

Oil atomizing temperature is adjusted with the controller.

Check the oil atomizing temperature on the thermometer.

## 4.9. Temperature Controller for Preheater






### 4.9.1 CAL 8000




A	Removable top fascia of potentiometers (manual reset and low limit). Remove sliding the fascia parallel with the display panel.
B	Manual reset potentiometer for correction of deviation. With this adjustment the position of P-range with respect to the set point can be altered. Adjust anti-clockwise, if the average temperature of oil stabilises above the set temperature during burner operation. Adjust clockwise, if the average temperature of oil stabilises below the set temperature during burner operation.
C	Setting of oil temperature low limit. Adjust the low limit point 20 to 30 °C below set point by means of the potentiometer. Rotate the definition scale (G) until the LED (F) lights up. Rotate the definition scale 20 to 30 °C above the operation set point. After this rotate the potentiometer (C) first completely anti-clockwise and then clockwise until the LED (E) just lights. Rotate the definition scale back to the right set point (atomising temperature).
D	D LED is lit, when the outlet of control channel is switched on (heating).
E	E LED is lit, when the relay of alarm channel is energised (oil temperature low).
F	Set point indication and together with two adjacent LED's indication of deviation.
G	Definition scale
H	Hinged fascia on scale lock
I	Scale lock. Rotate clockwise or anti-clockwise to unlock. Check after setting and locking the indication of set point.

#### 4.9.2 Temperature deviation indicator

Controller has three LED's, that operate in five steps and indicate the deviation of the actual value from the set point. Each step operates for 2 % (4 °C) of full scale (0...200 °C).

SIGNAL	MEANING
	more than 6 °C below set value
	6 - 2 °C below set value
	Set value $\pm$ 2°C
	2 - 6 °C above set value
	more than 6 °C above set value


 Note	It is possible to modulate the temperature controller for 110 V voltage. Contact Oilon technical support for further assistance.
--	--

#### 4.10. Preheater limit thermostat settings

##### 4.10.1 Limit thermostat setting

The limit thermostat is adjusted at the factory and sealed with paint. Set value is +180°C .

The limit thermostat has a reset button. Use the reset when the limit thermostat is not energized.

 Note	Do not open the sealed locking screw. Breaking the seal voids warranty
--	--

#### 4.11. Compound regulator

The oil quantity to be burned is determined by nozzle size and oil pump pressure. The oil regulator controlled by the servomotor regulates the return oil flow according to the capacity demand.

At partial load the oil regulator is open so that the oil throughput in the valve is at maximum and return flow pressure and nozzle capacity are adequate.

At full load the oil regulator is closed whereupon the oil throughput is at minimum and the pressure at maximum. The air quantity is matched to the oil quantity to be burnt by means of the spring band on the adjustable cam disc (see "Adjustable Cam Disc").


The burner is preadjusted at the factory. Accurate adjustments to be made with a flow meter at site

<p><b>!</b> Note</p>	<p>Do a flue gas analyzis to verify adjustments</p>
----------------------	---



## 5. Maintenance

### 5.1. Burner maintenance

 <p><b>DANGER!</b></p>	<p>Cut off electric current from the burner and close manual shut-off valves always before any maintenance work. Cutting power is adequate when just inspecting the device.</p>
---	---

#### 5.1.1 To maintain flawless operation it is recommended to do the following at least once a year:

1. Check the burner head extension and change if necessary.
2. Check the diffuser disc and change if necessary.
3. Clean the ignition electrodes and check their setting.
4. Change the oil nozzle if it is worn or damaged.
5. Check the position, condition and cleanness of the flame detector.
6. Clean filters. Filters may have to be cleaned more often depending on circumstantial conditions.
7. Check the air dampers lock screws and the servomotor axle lock. Retighten if necessary.
8. Check and lubricate the joints on adjustment rods.
9. Check the oil pump capacity.
10. Clean your burner from dust and moisture.
11. Check regularly the combustion characteristics by flue gas measurements (after refilling of the storage tank or at least once a year).
12. Check if the oil tank needs to be cleaned. The oil tank must be cleaned at least every 4-5 years.

Correct installation and adjustments and regular maintenance ensure correct operation of the burner.

- Service the burner annually
- Use only original spare parts. When ordering spare parts please give the burner type and serial number indicated on the burner nameplate or manufacturing card

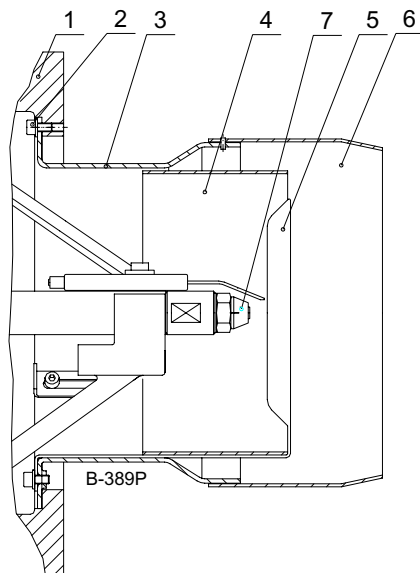
#### 5.1.2 Note!

The burner contains electric and electronic components. Adhere to rules and regulations from local authorities when disposing.

## 5.2. Dismounting the Combustion Head

### 5.2.1 Components

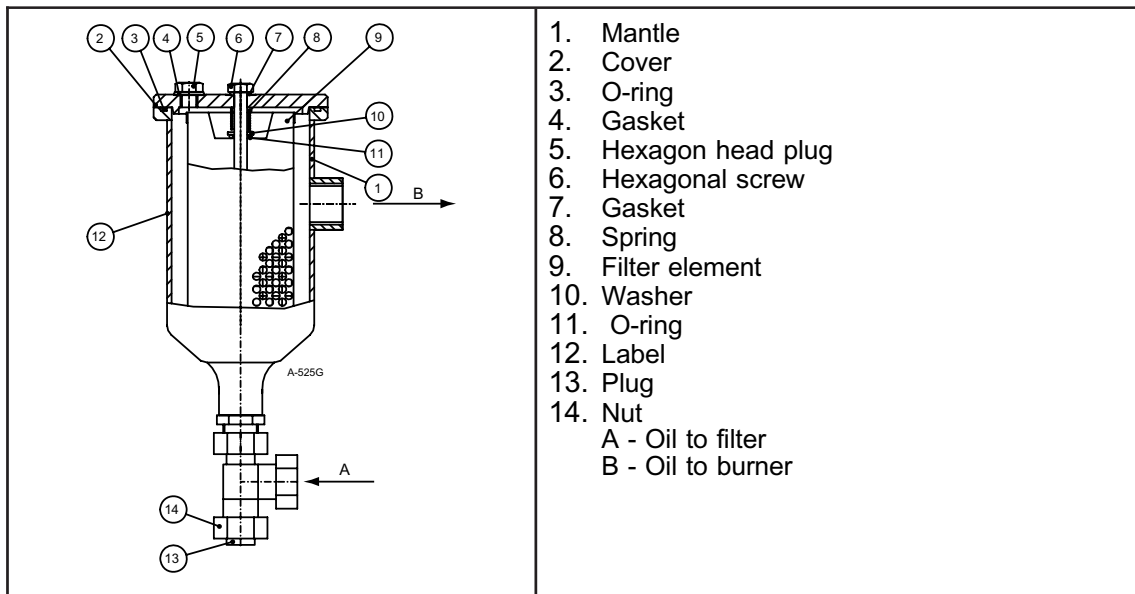
- Unscrew fixing screws of the combustion head and withdraw the combustion head. The combustion head extension is fixed with rivets to the combustion head guide.
- Reassemble in reverse order



1. Burner body
2. Fixing screw for combustion head
3. Combustion head guide
4. Adjustment ring
5. Diffuser disc
6. Combustion head extension
7. Nozzle

## 5.3. Oil Filter

### 5.3.1 Oil Filter components




### 5.3.2 Note!!

Before cleaning of the filter make sure, that oil does not flow to the filter.

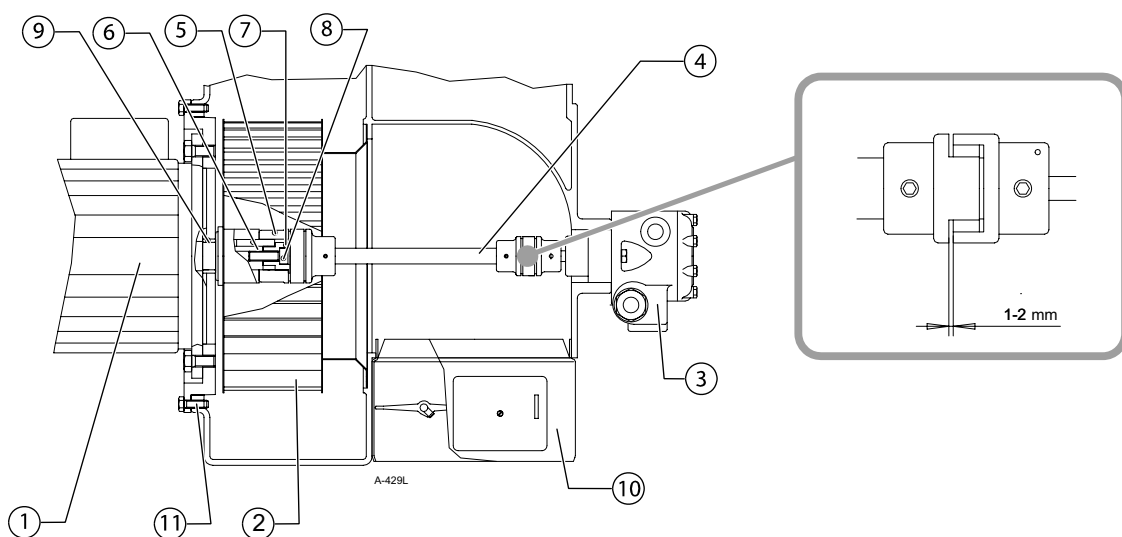
### 5.3.3 Cleaning

- Remove the plug by loosening the nut.
- Loosen the hexagonal screw and open the filter cover and remove the element. A suitable solvent and a soft brush, which does not damage the screen, can be used for cleaning of the element.
- If there is some dirt in the filter, it can be removed by for ex. vacuuming. Check the condition of O-rings as well as the condition of the washer.
- Lock the plug with nut.
- Place the filter element into the filter and then the cover.
- Fasten the fastening screw on the cover with a torque of 25 - 30 Nm.

## 5.4. Changing the burner motor

 <b>DANGER!</b>	<p>Switch off the electric power from the burner and ensure the motor is not under voltage. Remove motor fuses if necessary.</p>
---	--

### 5.4.1 Components



1. Motor
2. Fan wheel
3. Oil pump
4. Intermediate shaft
5. Coupling head
6. Wedge
7. Intermediate bushing
8. Fixing screw for fan wheel
9. Base bushing
10. Air dampers
11. Fixing screw for mounting flange

### 5.4.2 Dismounting the fan wheel

- Switch off the electric power from the burner.
- Disconnect the electric cable of the motor.
- Remove pressure pipe from the oil pump.
- Remove air dampers. Do not let the air dampers hang on servomotor cable!
- Unscrew screws of oil pump.
- Support with hand the intermediate shaft and withdraw the oil pump.
- Unscrew screws in the mounting flange of the motor and remove the motor (note the weight of the motor).

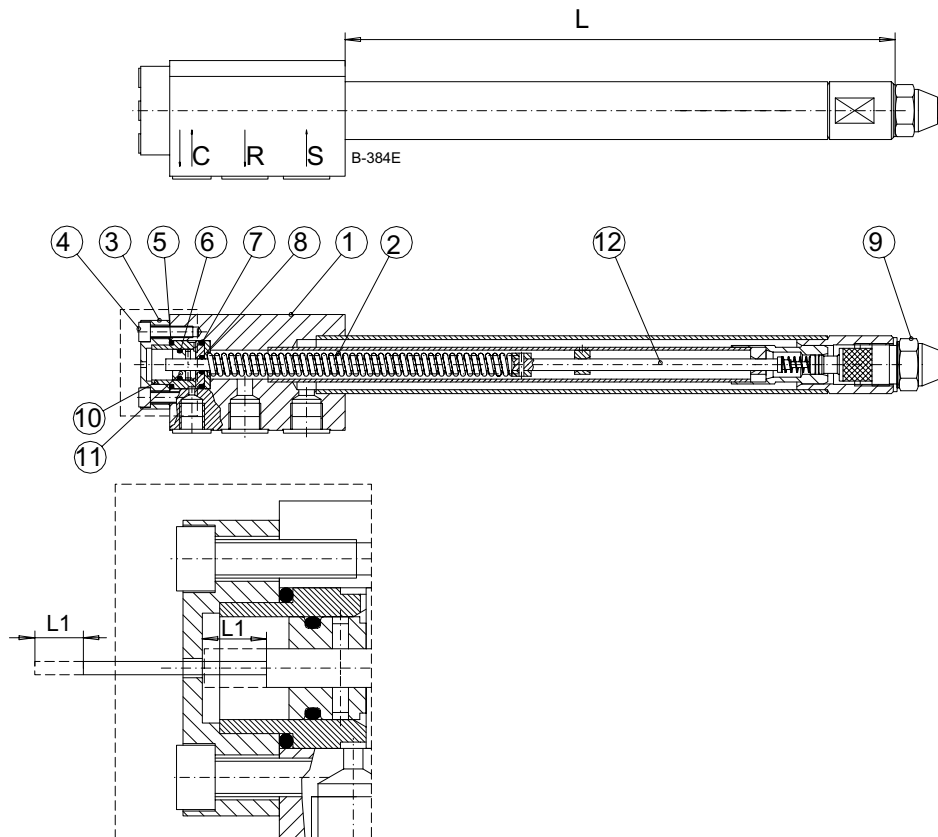
- Unscrew the fixing screw of the fan wheel.
- Remove intermediate bushing and coupling head.
- Withdraw the fan wheel from the motor shaft using an extractor.
- Loosen the wedge and the base bushing.

#### 5.4.3 Mounting the fan wheel

- Place the base bushing.
- Set the wedge into the shaft slot.
- Pull the fan wheel to its place using a binder plug. The fan wheel lies against the base bushing.
- Place the coupling head and the intermediate bushing.
- Fasten the fan wheel with fixing screws to the motor shaft.
- Place the motor and fasten the screws.
- Support with hand the intermediate shaft and install the oil pump. Fix the pump with locking screws.
- Check the axial gap of the coupling heads (1-2 mm). Adjust, if necessary.
- Place the air dampers.
- Fix the pressure pipe of the oil pump (remember to vent the oil pump).
- Connect the electrical cable to the motor.
- Fix the fuses and connect the burner to the mains (check direction of rotation in the motor).

## 5.5. Nozzle Valve RPL-1

### 5.5.1 RPL-1 Components



1. Body
2. Break spring
3. Rear cover
4. Hexagonal socket screw
5. O-ring for cover 18,72 x 2,62 Viton
6. O-ring for piston 12 x 2 Viton
7. O-ring for bottom plate 18,72 x 2,62 Viton
8. O-ring for spindle 6 x 2 Viton
9. Oil nozzle
10. Cylinder
11. Piston
12. Spindle

C Control circuit

R Return from nozzle

S Outlet to nozzle

L Nominal size of nozzle valve

L1 Nozzle open position (checking the spindle movement )

### 5.5.2 RPL-1 Operation principle

The opening of the nozzle valve is controlled by solenoid valves and oil pressure. The force of the oil pressure on the piston must exceed the force of the spring. The pressure of the spring closes the nozzle valve, when the oil pressure stops having effect on the nozzle valve. The needle valve of the nozzle closes. The needle in the nozzle valve is complete withdrawn when the oil pressure in the control circuit is approx. 1800 kPa (approx. 18 bar).

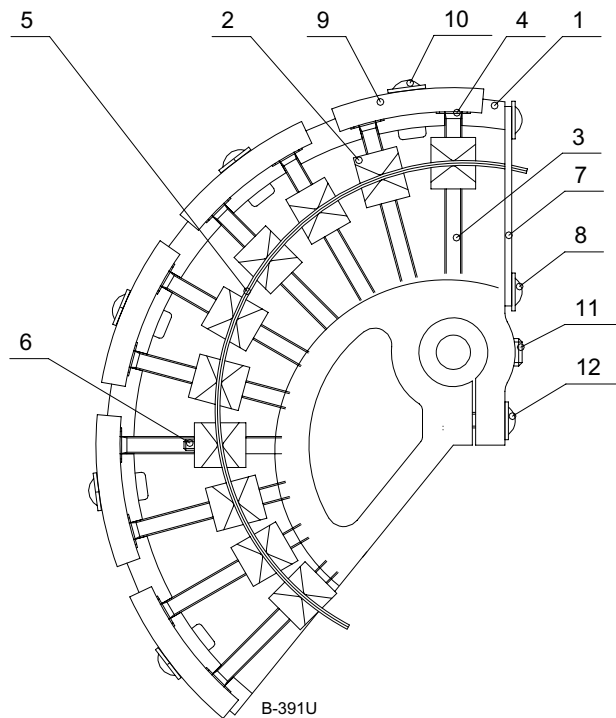
### 5.5.3 When to change nozzle

If the nozzle seems to be functioning improperly, you may clean the nozzle with diesel oil. If cleaning does not fix the problem, the properties of the nozzle have got worse and the nozzle has to be changed. The new nozzle has to be of same type as the original.

If there is an oil leak from the hole in the rear cover , change the nozzle or install a repair kit.

## 5.6. Adjusting cam

### 5.6.1 Adjusting cam components



1. Adjusting cam body
2. Adjusting guide
3. Adjusting screw
4. Cup spring
5. Spring band
6. Locking screw of spring band
7. Spring band guide
8. Fixing screw of guide
9. Locking plate
10. Hexagon socket-head screws (5 pcs)
11. Hexagon socket grub screw
12. Hexagon socket-head screw

### 5.6.2 Adjusting cam function

The adjusting cam regulates the air flow into the burner relative to the quantity of atomized fuel.


Profile of the spring band sets the dampers positions at any point within the adjusting range. The profile of the band can be shaped with the adjusting guide and the adjusting screws.

The air dampers are connected to the adjusting cam with the adjusting lever. The adjusting lever moves according to the profile of the spring band. Combustion values have to be verified by doing a flue gas analysis with every adjusting cam individually.



### 5.6.3 Adjusting the spring band

1. Loosen the locking screws (10) max.  $\frac{1}{4}$  of a turn
2. Adjust the spring band by turning the adjusting screws (3)
3. Retighten the locking screws (10)

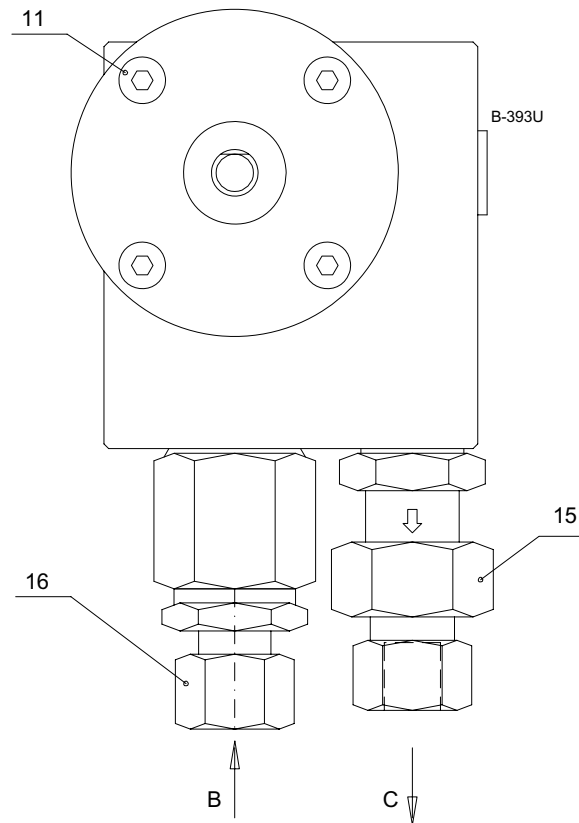
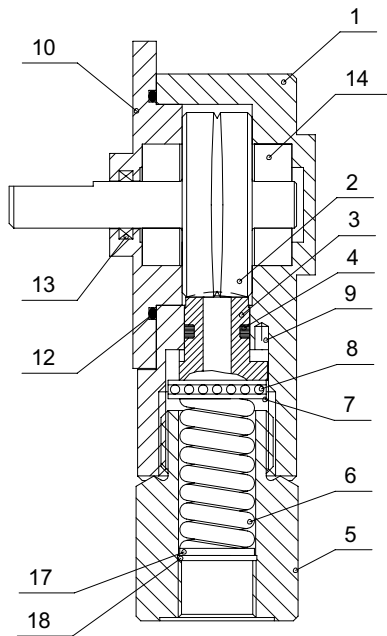
 <p><b>CAUTION</b></p>	The edges of the spring band are sharp. Unwary handling may cause slashes
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### 5.6.4 Changing the spring band

1. Remove the servomotor along with its locking plate from the compound-regulator.
2. Release the first adjusting lever from compound-regulator
3. Release the adjusting flange
4. Release the locking screw of the spring band and the spring band guide.
5. Replace the damaged spring band
6. Reassemble the components by following these instructions in reverse order

## 5.7. The Oil regulator

### 5.7.1 Oil regulator components



- 1. Body
- 2. Dosing shaft
- 3. Dosing nozzle
- 4. O-ring 9,3 x 2,4 Viton
- 5. Fitting
- 6. Compression spring
- 7. Thrust washer
- 8. Roller bearing
- 9. Spring cotter
- 10. Front flange
- 11. Hexagonal socket screw
- 12. O-ring 45 x 2 Viton
- 13. X-ring 10,2 x 2,62 Viton
- 14. Ball bearing
- 15. Non-return valve
- 16. Coupling
- 17. Washer
- 18. Retaining ring

B Oil to valve

C Oil from valve

### 5.7.2 Oil regulator function

When the in indicator for swing angel is in position 0°, the dosing shaft is in open position. The return flow is at maximum and the return pressure at minimum. When the in indicator for swing angel is in position approx. 160°, the dosing shaft is in closed position. The return flow is at minimum and the return pressure at maximum.

The pressure gauge on the regulator shows the return pressure. There is a number on the dosing shaft and on the indicator which shows the size of the groove on the shaft.

## 5.8. Disassembling and assembling and the oil regulator

### 5.8.1 Detaching the oil regulator

These instructions illustrate detaching the oil regulator (B309Y10...Y30) from the body of heavy fuel oil burner for maintenance. Photographs are of a model RP 280 M-burner. Details may vary depending on the burner model. Spare parts may be found from the spare parts catalog.

**!** Note

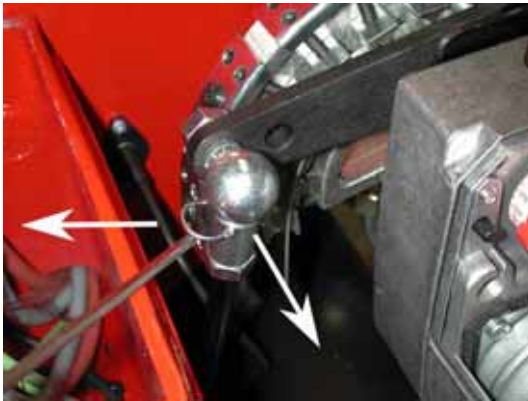
CUT OFF ELECTRICITY from the burner main switch and CLOSE OIL IN-LET to burner prior to disassembly.



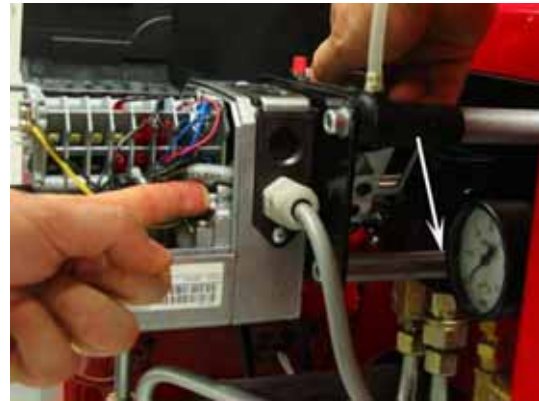
1. Needed tools



2. The oil regulator valve is located between servomotor and the burner body. See arrow.



3. Remove the locking pin and detach the swivels/adjusting rod from the adjusting lever.



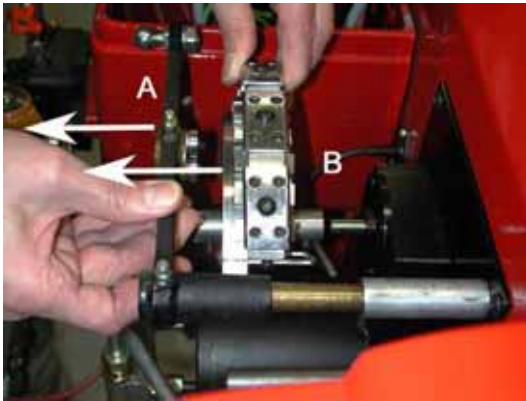
4. Release the servomotor shaft by pressing the release switch. Turn the adjusting lever so that you are able to loosen the shaft locking screws.



5. Unscrew the screws holding the servomotor mounting plate. Pull out the servomotor. Place and fasten the servomotor so that there is no stretching strain on the cables.



6. Loosen the locking screws on the oil regulator shaft.



7. Pull out the adjusting lever (A). Detach the adjustable cam disc (B). Notice the wedge on the shaft.



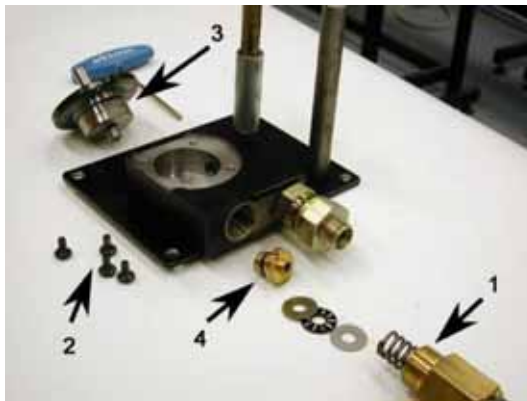
8. Open pipe nipples and detach the oil pipes from the oil regulator.



9. Dismount the valve from burner by detaching the mounting plate from the body.

## 5.8.2 Disassembling

These instructions illustrate the disassembling of the oil regulator valve (B309Y10... Y30). Spare parts may be found from the spare parts catalog, group 16.



Uncover the components in numbered order

Be careful not to damage the brass coating on the dozing nozzle.



Regulator groove is marked on the shaft.

### 5.8.3 Assembling

Maintain tidiness during assembling. Use lubrication oil on components.

1. Assemble and screw down the valve shaft (3) and attach the screws (2)
2. Assemble the dozing nozzle (4). Note! There is opening in the nozzle for alignment.
3. Attach the washers and the plate needle bearing.
4. Attach the spring and the tube connector.
5. Check the shaft rotation. The shaft should roll 360° steady and smooth.

### 5.8.4 Attaching

1. Mount the assembly plate and the valve to burner body.
2. Attach the oil pipes.
3. Attach the adjustable cam disc and check that the locking screws are tightened
4. Attach the servomotor
5. Attach the adjusting levers
6. Release the servomotor by pressing the release switch and check that the air dampers move freely as the cam disc turns.

## 5.9. Trouble shooting

### 5.9.1 Basic checks

In the event of fault conditions the basic requirements for correct operation must be first examined:

1. Check the electric supply (control and supply voltages).
2. Check the fuse on the control unit by pressing the control unit reset button. If the fuse is intact this should cause a fault condition lockup.
3. Check that all regulating and control devices are correctly set.
4. Check that all the safety devices are in normal operating condition
5. Check is the burner getting fuel, are the valves in fuel line open, is there oil in the tank
6. Check is there sufficiently water in the heating system?
7. Check that the direction of motor rotation is correct

When it is established, that the fault is not due to above mentioned, the individual burner functions must be checked. Reset the burner control unit if it is in lockout position (signal lamp lights). Burner starts, when the sequence switch has run to its start position and other prerequisites for start are fulfilled (see chapter Burner Automation; Operation"). Observe the burner functions. **The symbol appearing above the reading mark indicates the possible kind of fault** (see chapter "Control Program under Fault Conditions and Lockout Indication"). Measuring instruments can be used for finding of the fault.

5.9.2 Start failure

CONDITON	POSSIBLE CAUSE	ACTION
Control loop closed, signal lamp for start limit is on, burner or the start-up program of the control unit does not start. The lockout indicator remains at symbol	Faulty control unit	Change the control unit
Control loop closed, burner or the start-up program of the control unit does not start. The lockout indicator remains at symbol ◀	The control unit (connector 8) is not receiving required start signal from servomotor (limit switch II)  <ol style="list-style-type: none"> <li>1. A break in control circuit</li> <li>2. Faulty servomotor</li> <li>3. Faulty control unit</li> <li>4. Air dampers are stuck</li> </ol>	<ol style="list-style-type: none"> <li>1. Clear the break</li> <li>2. Change the servomotor</li> <li>3. Change the control unit</li> <li>4. Release the dampers, lubricate</li> </ol>
Burner motor starts, program remains at pre- purge period ▲	Servomotor does not reach the position of full load of air dampers (limit switch I)  <ol style="list-style-type: none"> <li>1. faulty servomotor</li> <li>2. faulty limit switch in servomotor</li> <li>3. Faulty control unit</li> <li>4. jammed air dampers</li> <li>5. incorrect setting on cam switch</li> </ol>	<ol style="list-style-type: none"> <li>1. Change the servomotor</li> <li>2. Change the limit switch</li> <li>3. Change control unit</li> <li>4. Release the dampers, lubricate</li> <li>5. Correct the settings</li> </ol>
Burner motor starts, program remains at pre- purge period ▼.	Servomotor does not reach the position of ignition load of air dampers(limit switch III)  <ol style="list-style-type: none"> <li>1. faulty servomotor</li> <li>2. faulty limit switch in servomotor</li> <li>3. Faulty control unit</li> <li>4. jammed air dampers</li> <li>5. incorrect setting on cam switch</li> </ol>	<ol style="list-style-type: none"> <li>1. Change the servomotor</li> <li>2. Change the limit switch</li> <li>3. Change control unit</li> <li>4. Release the dampers, lubricate</li> <li>5. Correct the settings</li> </ol>



### 5.9.3 Motor failure

CONDITON	POSSIBLE CAUSE	ACTION
Burner motor does not start. Lockout occurs. Symbol 1	<ol style="list-style-type: none"> <li>1. Break in main circuit</li> <li>2. Motor overload relay triggered</li> <li>3. Fuse triggered</li> <li>4. Faulty motor contactor</li> <li>5. Faulty motor</li> <li>6. Break in the motor control circuit</li> <li>7. Faulty control unit</li> <li>8. Return pressure too high (pressure switch triggered)</li> <li>9. Faulty pressure switch max.</li> </ol>	<ol style="list-style-type: none"> <li>1. Repair break</li> <li>2. Check relay trigger level , reset or change</li> <li>3. reset or change fuse</li> <li>4. change</li> <li>5. change</li> <li>6. Repair break</li> <li>7. Change control unit</li> <li>8. Examine, isolate fault</li> <li>9. change the switch</li> </ol>

### 5.9.4 Ignition failure

CONDITION	POSSIBLE CAUSE	ACTION
Burner motor starts, control voltage from control unit to ignition transformer IS switched on, ignition does not happen and after a short time lockout occurs. Symbol1	<ol style="list-style-type: none"> <li>1. Dirty or worn ignition electrodes, insulator cracked</li> <li>2. Ignition electrodes too far apart</li> <li>3. Ignition cable damaged</li> <li>4. Faulty ignition transformer</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean or change</li> <li>2. Adjust according to instructions</li> <li>3. Change the cables</li> <li>4. Change the transformer</li> </ol>
Burner motor starts, control voltage from control unit to ignition transformer IS NOT switched on, ignition does not happen and after a short time lockout occurs. Symbol1	<ol style="list-style-type: none"> <li>1. Faulty control unit</li> <li>2. Connection joint of ignition transformer is loose or damaged</li> </ol>	<ol style="list-style-type: none"> <li>1. Change control unit</li> <li>2. Attach properly or change the joint</li> </ol>

**5.9.5 No flame establishment**

CONDITION	POSSIBLE CAUSE	ACTION
Burner motor starts, ignition is operational, after a short period of time a lockout occurs. Symbol 1	<ol style="list-style-type: none"> <li>1. Solenoid valve does not function</li> <li>2. faulty coil on solenoid valve</li> <li>3. damaged cable</li> <li>4. faulty control unit</li> </ol>	<ol style="list-style-type: none"> <li>1. Change the valve</li> <li>2. change the coil</li> <li>3. Change the cable</li> <li>4. Change the control unit</li> </ol>
Nozzle valve does not open	<ol style="list-style-type: none"> <li>1. nozzle needle does not open</li> <li>2. Nozzle valve piston is stuck</li> <li>3. Clogged throttle plug</li> </ol>	<ol style="list-style-type: none"> <li>1. Change the nozzle</li> <li>2. Change the piston or the O-ring</li> <li>3. Clean the plug</li> </ol>
No spray from nozzle	Oil atomizing pressure is inadequate The nozzle O-ring is faulty Suuttimen O-rengas on viallinen	See 'pump adjustments'. Change the O-ring
Main solenoid valve does not open	<ol style="list-style-type: none"> <li>1. Return oil pressure is too high</li> <li>2. Faulty return oil pressure switch (max.)</li> </ol>	<ol style="list-style-type: none"> <li>1. Examine, isolate fault, repair</li> <li>2. Change the pressure switch</li> </ol>

**5.9.6 Oil pump failure**

CONDITION	POSSIBLE CAUSE	ACTION
Supplies no oil or atomizing pressure is too low	<ol style="list-style-type: none"> <li>1. Dirty filter</li> <li>2. Leaking suction line of transfer pump</li> <li>3. Pump capacity decreased / pump is worn or faulty</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean or change filter</li> <li>2. Fix the leaks</li> <li>3. Change the pump</li> </ol>
Loud mechanical noise	<ol style="list-style-type: none"> <li>1. Pump is cavitating / insufficient in-let pressure to the burner</li> <li>2. In-let oil temperature too low</li> <li>3. In-let oil pipings connected incorrectly</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten joints, Clean the filter, check and adjust pressure</li> <li>2. Raise in-let oil temperature</li> <li>3. Check joints</li> </ol>

### 5.9.7 Lock out after flame establishment

CONDITION	POSSIBLE CAUSE	ACTION
Flame forms. When burner runs to full load, flame extinguishes, shutdown occurs and then re-start (wire link B cut away from the plug section of the control unit).	<ol style="list-style-type: none"> <li>1. Incorrect burner adjustment</li> <li>2. Dirty filters</li> <li>3. Clogged nozzle</li> </ol>	<ol style="list-style-type: none"> <li>1. Correct adjustments</li> <li>2. Clean filters</li> <li>3. Change the nozzle</li> </ol>
Flame establishes. Shutdown occurs and then re-start.	<p>Oil temperature is too low</p> <ol style="list-style-type: none"> <li>1. oil preheater is faulty o</li> <li>2. oil preheater's capacity is inadequate</li> <li>3. incorrect setting on low limit of oil temperature</li> </ol>	<ol style="list-style-type: none"> <li>1. Repair or change the preheater</li> <li>2. Check and adjust the inlet oil temperature</li> </ol>

### 5.9.8 Oil flows into the combustion chamber

CONDITION	POSSIBLE CAUSE	ACTION
Oil flows into the combustion chamber during burning period	Nozzle valve and main oil valve or nozzle valve and non-return valve do not close properly	Clean, repair or replace
Oil leaks to the boiler during purging period	valves are leaking	Clean, repair or replace
Constant oil leak from the nozzle valve when the nozzle is closed	A leak in non-return valve or main solenoid valve	Change the valve

**5.9.9 Flame monitoring fault (=lockout)**

CONDITION	POSSIBLE CAUSE	ACTION
Burner motor starts, flame establishes, and then a lockout	<ol style="list-style-type: none"> <li>1. Incorrect position of flame detector</li> <li>2. Flame detector is unclean</li> <li>3. The flame is too weak (not bright enough)</li> <li>4. Faulty flame detector (due to damage or age)</li> <li>5. Faulty control unit</li> <li>6. Incorrect flame signal due to extraneous light</li> </ol>	<ol style="list-style-type: none"> <li>1. Fix position</li> <li>2. Clean the flame detector</li> <li>3. Check burner adjustments</li> <li>4. Change the flame detector</li> <li>5. Change control unit</li> <li>6. Prevent extraneous light from reaching the flame detector</li> </ol>
Lockout during pre-purge	<ol style="list-style-type: none"> <li>1. Faulty flame detector</li> <li>2. Faulty control unit</li> <li>3. Incorrect flame signal due to extraneous light</li> </ol>	<ol style="list-style-type: none"> <li>1. Change the flame detector</li> <li>2. Change control unit</li> <li>3. Prevent extraneous light from reaching the flame detector</li> </ol>
Lockout during shutdown Symbol ◀	<ol style="list-style-type: none"> <li>1. Faulty flame detector (due to damage or age)</li> <li>2. Faulty control unit</li> <li>3. Incorrect flame signal due to extraneous light</li> <li>4. Oil or carbon deposits burn in combustion head</li> <li>5. Valves don not close</li> </ol>	<ol style="list-style-type: none"> <li>1. Change the flame detector</li> <li>2. Change control unit</li> <li>3. Prevent extraneous light from reaching the flame detector</li> <li>4. See section "Combustion head"</li> <li>5. Clean, repair or replace</li> </ol>

**5.9.10 Damage in burner head**

CONDITION	POSSIBLE CAUSE	ACTION
Diffuser disc burned-out		Change diffuser disc
Burner head extension damaged		Change burner head extension
Inside of the burner head is oily or has heavy carbon deposits	<ol style="list-style-type: none"> <li>1. Distance between dif-fuser disc and nozzle in-correct</li> <li>2. Combustion air settings are not correct</li> <li>3. Not enough supply air for constant combustion</li> <li>4. Nozzle incorrectly sized or of wrong type</li> <li>5. Nozzle is worn</li> </ol>	<ol style="list-style-type: none"> <li>1. Correct the adjustments</li> <li>2. Correct the adjustments</li> <li>3. Enhance air supply</li> <li>4. Replace with an appro-priate nozzle type of correct size</li> <li>5. Change the nozzle</li> </ol>

## 6. Technical data

### 6.1. Technical data

#### 6.1.1 Burner technical data

Weight	RP-130 M : 140 kg RP-140 M : 139 kg RP-150 M : 167 kg RP-250 M : 195 kg RP-280 M : 196 kg
Capacity kW	RP-130 M : 390 - 1370 RP-140 M : 560 - 2040 RP-150 M : 680 - 2700 RP-250 M : 650 - 3200 RP-280 M : 900 - 3500
Capacity kg/h	RP-130 M : 34 - 121 RP-140 M : 50 - 180 RP-150 M : 60 - 240 RP-250 M : 58 - 282 RP-280 M : 80 - 308
Control unit	LAL 2.25 / LOK16 / PLC
Oil pump	RP-130 M : TA2 RP-140 M : TA2 RP-150 M : TA2 RP-250 M : TA3 RP-280 M : TA3
Oilhose connection (suction)	R ½"
Oilhose connection (return)	R ½"
Degree of protection	IP44
Control voltage	230 V (-15%... +10%), 50 Hz, 1-phase
Control voltage *on request*	230 V, 60 Hz, 1-phase
Control voltage *on request*	110 V, 50 Hz, 1-phase
Control voltage *on request*	110 V, 60 Hz, 1-phase
Supply voltage	380...420 V, 50 Hz, 3-phase
Supply voltage *on request*	440 V, 60 Hz, 3-phase
Supply voltage *on request*	690 V, 50Hz Hz, 3-phase
Supply voltage *on request*	690 V, 60Hz Hz, 3-phase

**6.1.2 Supply voltage option 380 V 50 Hz**

Burner motor output kW	RP-130 M : 3,2 RP-140 M : 4 RP-150 M : 5,5 RP-250 M : 7,5 RP-280 M : 7,5
Burner motor current IN [ A ]	RP-130 M : 6,3 RP-140 M : 7,9 RP-150 M : 10,5 RP-250 M : 14,7 RP-280 M : 14,7
Burner motor efficiency [ % ]	RP-130 M : 86 RP-140 M : 83,9 RP-150 M : 87,6 RP-250 M : 85,1 RP-280 M : 85,1
Burner motor speed r/min	RP-130 M : 2880 RP-140 M : 2840 RP-150 M : 2855 RP-250 M : 2915 RP-280 M : 2915
Preheater capacity kW	RP-130 M : 6 RP-140 M : 6 RP-150 M : 12 RP-250 M : 12 RP-280 M : 12
Preheater current A	RP-130 M : 8,7 RP-140 M : 8,7 RP-150 M : 17,4 RP-250 M : 17,4 RP-280 M : 17,4

### 6.1.3 Suply voltage option 440 V 60 Hz

Burner motor capacity kW	RP-130 M : 3,7 RP-140 M : 4,6 RP-150 M : 6,4 RP-250 M : 8,6 RP-280 M : 8,6
Burner motor current A	RP-130 M : 6,3 RP-140 M : 7,6 RP-150 M : 10,4 RP-250 M : 14,6 RP-280 M : 14,6
Burner motor speed r/min	RP-130 M : 3455 RP-140 M : 3440 RP-150 M : 3445 RP-250 M : 3430 RP-280 M : 3430
Burner motor efficiency %	RP-130 M : 86 RP-140 M : 85,8 RP-150 M : 87,6 RP-250 M : 86,5 RP-280 M : 86,5
Preheater capacity kW	RP-130 M : 7,2 RP-140 M : 7,2 RP-150 M : 14,4 RP-250 M : 14,4 RP-280 M : 14,4
Preheater current A	RP-130 M : 9,6 RP-140 M : 9,6 RP-150 M : 19,2 RP-250 M : 19,2 RP-280 M : 19,2

**6.1.4 Supply voltage option 690 V 50 Hz**

Burner motor output kW	RP-130 M : 3,2 RP-140 M : 4 RP-150 M : 5,5 RP-250 M : 7,5 RP-280 M : 7,5
Burner motor current A	RP-130 M : 3,5 RP-140 M : 4,3 RP-150 M : 5,7 RP-250 M : 8,1 RP-280 M : 8,1
Burner motor speed r/min	RP-130 M : 2893 RP-140 M : 2850 RP-150 M : 2855 RP-250 M : 2855 RP-280 M : 2855
Burner motor efficiency %	RP-130 M : 85,5 RP-140 M : 86 RP-150 M : 86,5 RP-250 M : 87 RP-280 M : 87
Preheater capacity kW	RP-130 M : 6 RP-140 M : 6 RP-150 M : 12 RP-250 M : 12 RP-280 M : 12
Preheater current A	RP-130 M : 5 RP-140 M : 5 RP-150 M : 10 RP-250 M : 10 RP-280 M : 10



### 6.1.5 Supply voltage option 690 V 60 Hz

Burner motor capacity kW	RP-130 M : 3,5 RP-140 M : 4,6 RP-150 M : 6,4 RP-250 M : 8,6 RP-280 M : 8,6
Burner motor current A	RP-130 M : 4,1 RP-140 M : 4,9 RP-150 M : 6,6 RP-250 M : 9,1 RP-280 M : 9,1
Burner motor speed r/min	RP-130 M : 3470 RP-140 M : 3450 RP-150 M : 3455 RP-250 M : 3455 RP-280 M : 3455
Burner motor efficiency %	RP-130 M : 86 RP-140 M : 87,4 RP-150 M : 87,5 RP-250 M : 85,6 RP-280 M : 85,6
Preheater capacity kW	RP-130 M : 6 RP-140 M : 6 RP-150 M : 12 RP-250 M : 12 RP-280 M : 12
Preheater current A	RP-130 M : 5 RP-140 M : 5 RP-150 M : 10 RP-250 M : 10 RP-280 M : 10

## 6.2. Control unit technical Data

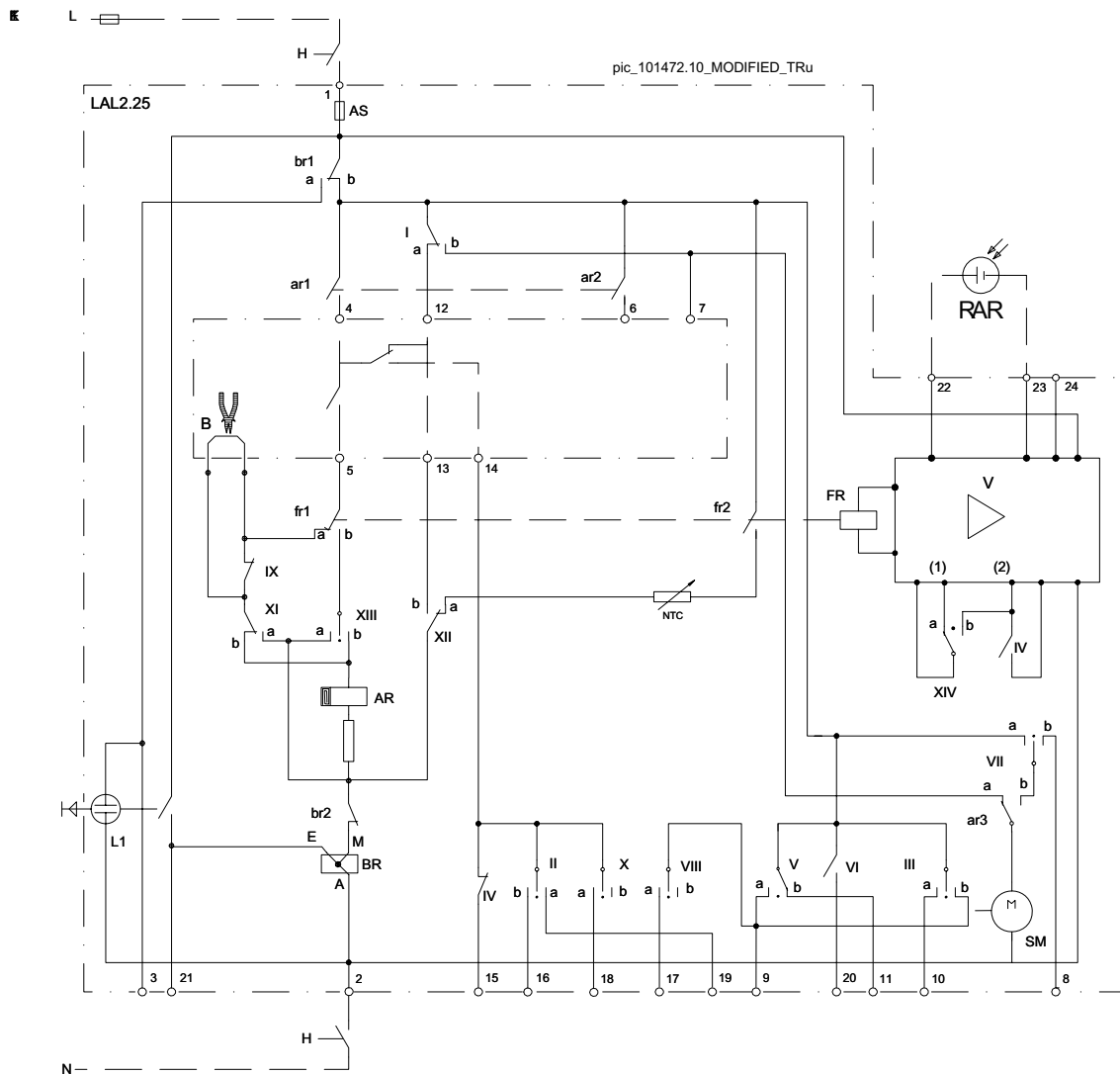
### 6.2.1 Technical data (LAL 1.25 and 2.25)

Mains voltage	230 VAC -15 / +10%
Mains frequency	50 – 6%...60 Hz +6%
Power consumption	3,5 VA
Fuse, built-in	T6,3H250V, IEC 127
Fuse, external	max 10 A
Electromagnetic compatibility EMC	89/336
Permissible inlet current to terminal 1	5 A continuous; instantaneous max. 20 A

Permissible load of control terminals	4 A continuous; instantaneous max. 20 A, in total max 5 A
Required switching capacity of switching devices	1 A between terminals 4 and 5
Degree of protection	IP 40
Permissible ambient temperature	-20...+60 °C

### 6.3. Control unit LAL 2.25

#### 6.3.1 Internal Circuitry LAL2.25



### 6.3.2 Diagram legend LAL 2.25

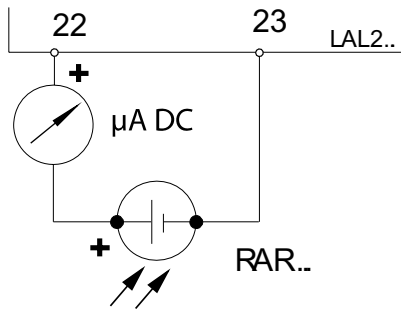
AR	Main relay (load relay) with contacts "ar"
AS	Control unit fuse
B	Wire link (on the plug section of the control unit) *)
BR	Lockout relay with contacts "br"
EK	Lockout reset button
FR	Flame relay with contacts "fr"
H	Main switch
L	Lockout warning lamp
RAR	Flame detector
SM	Motor of sequence switch
V	Flame signal amplifier
NTC	NTC-thermistor

\*) The wire link B has been cut away at the factory. This allows an automatic repetition of start-up sequence, if the flame extinguishes during burner operation. If the wire link B has not been cut away, lockout occurs, if the flame is extinguished during burner operation.

## 6.4. Flame Detector

### 6.4.1 Technical data

TYPE	RAR...
Min. required detector current with 230 VAC	6,5 $\mu$ A
Max. permissible detector current without flame	—
Max. possible detector current	25 $\mu$ A
Instrument's +pole to terminal	22
Cable run to detector in the same cable as control lines	not perm.
Cable run to detector with a separate cable in cable duct	RAR7: 30 m
Shielded cable (insulated shielding)	RAR8: 100 m
Shielding to terminal	





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