



Operating Manual

VARIAIR **DIRECT SCREW**



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1. Operating instructions

Safety instructions



Please observe the regulations for the prevention of accidents VBG 16 Compressors, in particular paragraph III c “Assembly” and IV “Operation”, as well as VBG 4 “Electric machinery and Equipment”.

Changes of design or modifications to the pump are subject to prior permission by the factory.

Field of use

The unit is used to produce negative pressure (vacuum) or to generate pressure.

The characteristics apply to heights of up to 800 m M.S.L.

The pump is unsuitable for transporting toxic or combustible media.

The operation is only intended for normal atmospheric air.

Transportation and storing

Store the vacuum pump in a dry place and protect it from shower water.

Lift and transport it only by using the bracket.

Assembly

Take into consideration that the pump should be easily accessible for later maintenance work.

In unobstructed dimensions, the space between the rear wall of the pump and neighbouring walls should be at least 50 cm and 80 cm for the side walls to ensure the unimpeded circulation of air for cooling purposes. In order to be able to open the doors at the front a minimum space of 80 cm is required.

The permissible ambient temperature (5 °C. .. 40 °C) must be respected.

Take measures to reduce structure-borne noise on site.

Make sure there is enough ventilation in the air intake area during pressure mode, because otherwise there is danger from a powerful vacuum pressure.

Installation

Be sure to have the right dimensions and clean pipes (no welding beads, chips or similar soiling). Use pipes whose minimal diameter corresponds to the nominal connection width of the air intake. In case the pipe length exceeds 2 m, choose the next bigger diameter.

Mount a compensator to avoid mechanical voltage on the suction side.

Keep connections free of oil, grease, water or other soiling.

Filling in oil



Use the oil brand BECKER LUBE G70 (or, alternatively, oil complying with ISO VG 68).

To fill in the oil, open the read plastic cap on the oil filler neck (figure 3).

Remove the protective caps at LA and SA (figure 1). Do not yet connect with the piping system.

Connecting the unit

Adhere to all the pertinent regulations in connecting the power supply. Observe EN60204 T1.

Have a specialist for electrical installations connect the unit in accordance with the connection diagram (in the terminal box), taking into account mains voltage, nominal current and frequency.



Start the motor briefly and check direction of rotation (arrow on housing). Change phase in case of a wrong direction of rotation.

Avoid more than 10 switches per hour.

Direction of rotation of the components (Page 7).

Initial operation

Vacuum unit

Connect the suction line at SA (figure 1).

Do not choke or lock the air escape LA and do not use it as a compressed-air supply.

Pressure unit

Connect the pressure line at LA (Fig. 1).

Do not throttle or block the air vent SA or use as vacuum connection.

Maintenance

Regular maintenance work will help optimise the operating results of the pump. The intervals depend on the use and the ambient conditions.



Before starting the maintenance work disconnect the unit and be sure to prevent an unintended restart.



After switching off the pump, allow the device to cool down, because otherwise there is a risk of burns under the hood (outlet manifold) and at the pump outlet flange.

General recommendation: Work with gloves.

Watch for damages to the protective grid and repair if necessary.

Soiled suction filters reduce the pumping capacity.



Clean fan hood, fan grid, oil cooler, cooling fins and surfaces of the unit to avoid overheating.

Oil and oil separation

Check the oil level regularly: During operation, the oil level may not drop below 2/3 of the view window MI (Fig. 2).

Change of oil and oil filters

- change oil and oil filters after 5000 operating hours

- at least once per year



Drain the waste oil by opening the ball valve of the oil pump (figure 2).

2. Control instructions VARIAIR DIRECT SCREW 1500

2.1 Operating modes of the rotary screw unit

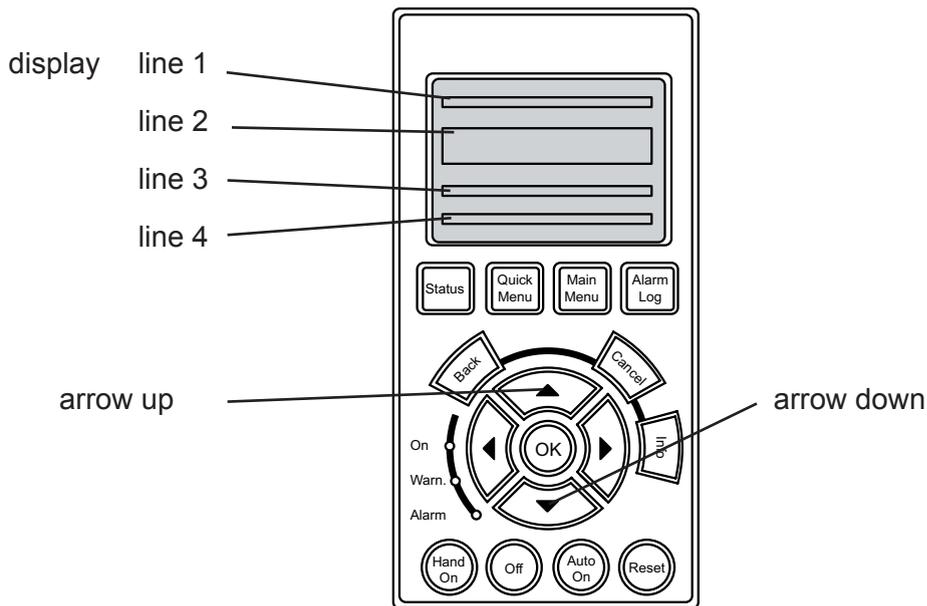
With SPS control:

- SPS requirements (terminal strip X6 3/4):
24 V SPS release signal
- feedback for SPS (terminal strip X6 1/2):
via relay output 04 on the control board of the FU
- Operation at fixed speed of rotation possible and adjustable in parameter 19-29 while the unit is running
- SPS operational mode with set rotation speed (terminal strip X6 6/7):
0-10 V signal of the set speed of rotation
Vacuum revolutions 110 (min.) - 200 Hz (max.)
Pressure revolutions 80 (min.) - 165 Hz (max.)

Without SPS control:

- Vacuum and pressure kept at a constant level by internal PI regulator.
Parameter 19-38 to 1
Nominal value can be set in parameter 19-37
Setting range: Vacuum 200-1000 mbar abs
Pressure 1000-2000 mbar abs
The parameters 19-32 to 19-34 have to be set according to the control mode.
- Operation with fixed speed or rotation adjustable and changeable in parameter 19-29 while the unit is running.
- Signal of the nominal speed 0-10 V by the connection of an external potentiometer at terminal strip X6 6/7 on e-plate.
Vacuum revolutions 110 (min.) - 200 Hz (max.)
Pressure revolutions 80 (min.) - 165 Hz (max.)
- Master-slave mode of operation required speed of rotation of the master screw will be passed on to the slave (at present not yet available)

2.2 Use of the frequency inverter display



Display modes of various operational data

The following operational data can be visualized on the display:

- I. System pressure display
“System pressure [mbar]”
[Numerical value]
 Data determined by:

in display line 2
in display line 4
1 [pressure transmitter]

- II. Electrical data of the unit at working point
 [Frequency in Hz], [voltage in V], current in [A]
 Data determined by

in display line 1
11 [frequency inverter]

The display can be modified by parameters 0-20, 0-21 and 0-22.

- III. Further operational data in menu group 19 or selection of parameters
 This data can be read out from menu group 19.
 Menu group is accessible by pressing the following combinations of keys:
 - a) key: **Main Menu**
 - b) key: **arrow up** or **arrow down**
 The menu groups are run through until “19-** Application Params” appears.
 - c) key: **OK**
 The menu group is opened.
 - d) Key: **arrow up** or **arrow down**
 Gives access to the parameters of the group in question until the desired parameter appears.

Access to the normal operational display mode described in 1 a) is gained by pressing the **STATUS** key twice.

Changing parameters

According to the parameter overview in section 2.6, only the “adjustable parameters” may be modified corresponding to the intended use of the unit. These parameters can be accessed as described in III. When the parameter to be changed appears in the display of the frequency inverter, it can be changed using the following combination of keys:

- a) key: **OK**
The parameter to be modified is highlighted by a flashing line.
- b) key: **left arrow** or **right arrow**
Direct access is gained to the digit position which shall be changed.
- c) Key: **arrow up** or **arrow down**
The numerical value of the parameter changes.
- c) key: **OK**
The value is acknowledged with OK.

2.3 Security devices

All protective devices installed in the unit are controlled by the frequency inverter. The critical parameters such as contacts, switches or critical system pressure are continuously updated while the unit is running and are monitored for eventual emergency or cases that require servicing.

Process air

The transported medium is monitored by the following sensor technology:

- [2] Non return valve: The non-return flap integrated in the suction line (for vacuum) or pressure line (for compressor) prevent back flowing when the device is switched off.
- [4] Relief valve: If the system pressure increases beyond the factory-set triggering value, then the solenoid valve opens in the bypass of the suction line (for vacuum) or the pressure line (for compressor). The open magnetic valve will close as soon as the system pressure exceeds the upper threshold value set by the factory.

Oil circulation

The oil cycle is protected by the following switches or auxiliary contacts.

- [14] Oil level switch: The oil level in the oil tank is monitored by an integrated floater below the driving motor. A critical decline in the oil level will result in a shutdown of the unit.
- [16] Oil pump: While in operation, the oil pump is monitored by a control contact connected to the motor contactor. This control contact is activated in case of a short circuit, overcharge or wire breakage, causing a shutdown of the entire unit.
- [20] Oil temperature switch: The oil temperature is monitored between the outlet of the oil cooler and the inlet of the oil distributor. The release value is 60°C. If the oil temperature exceeds that threshold value the unit will be shut down.
- [22] Oil filter control: The degree of soiling of the filter cartridge is monitored by the service contactor integrated into the housing of the oil filter. The message “Replace oil filter” will appear in the display of the frequency inverter in regular intervals. The unit will not shut down.
- [23] Oil pump relief valve: The valve is installed in the bypass between oil distributor and oil tank. It is equipped with a spring which can be adjusted to the desired opening pressure. The oil pump relief valve prevents the operating pressure of the oil exceeding the permitted value.
- [25] Oil pressure manometer: The manometer is installed between the distributor and the oil inlet on side a.
- [26] Oil pressure switch: The oil pressure switch features an adjustable switch point. It serves to catch a too low oil pressure and leads to a switch-off.

Other safeguards

- **Motor PTC resistor:** The driving motor is protected by an integrated PTC resistor. In case of overheating, it will cause a malfunction in the frequency inverter, which, in its turn, will result in a shutdown of the unit. The message "Motor Thermistor" will be displayed.
- **Control transformer:** The relevant protection is secured by an integrated motor contactor. The 230 V voltage serves, among others, to supply all the coils of the unit, which means that a failure of this component will bring all components driven by rotary current to a standstill. This will result in a shutdown of the unit.
- **Unit:** The integrated switch disconnecter activates the safety fuses in the event of malfunctioning or excess current intake, thus shielding the unit from the external power network.

2.4 Initial operation

Settings of the motor protection switches

Before starting the unit up, check the settings of the integrated motor contactors and, if necessary, adjust them. As a prerequisite for this procedure please check the input voltage of the unit.

consuming component	motor protection switch PKZ no.	Europe 400V / 50Hz nominal current [A]	USA 480V / 60Hz nominal current [A]
oil cooler fan	F2	0,45	0,69
oil pump	F3	1,1	1,3
cabinet ventilator 1	F4.1	0,64	0,84
cabinet ventilator 2	F4.2	0,64	0,84
control transformer	F6	0,45	0,54
external motor fan	F5	1,3	1,15

Checking the direction of rotation

Likewise, the direction of rotation of the following components must be checked before putting the entire unit into operation and, if applicable, must be adjusted by exchanging two phases:

In each of these cases, the direction of rotation is marked by an arrow attached on the outside of the respective.

consuming component	protection no.	rotation direction definition/check-up
oil cooler fan	K2	When looking at the fan motor: left
oil pump	K3	Pressure build-up and lowering of the oil level have to self-adjust.
cabinet ventilator 1	K4.1	When looking at the motor of the fan: right
cabinet ventilator 2	K4.2	see above

External motor fan:

Since the runner of the external motor fan has straight blades, this component does not require checking of the direction of rotation.

Driving motor:

Directly behind the flanged connection to the pump housing, the motor housing has openings for checking the direction of rotation of the motor. The latter has to correspond to the direction of the arrow affixed to the outside of the motor cabinet.

Should this not be the case, the direction of rotation can only be changed by exchanging two phases at the outlet of the frequency inverter. The clamps are marked as follows:

U 96, V 97 W 98

Starting up and shutting down the unit

Initial Operation of the unit

To supply the complete unit with power, the following necessary steps have to be taken; before the main switch can be turned on

- I. **Turn on all automatic motor protection switches**
- II. If not already done, turn **main switch** as far as it will go to the left, then to the right.

Starting up the vacuum pump or the compressor

After the complete installation has been connected as described in point 3 of the instructions for starting up the unit, the control or regulating program will be started.

- **Initialising the unit:** After two or three seconds, the message “**Initialising...**” appears in the first line of the display. At this point, you will have the opportunity to check, adjust or correct the edge conditions of the intended use of the unit. The adjustable edge conditions as well as their values and meaning are listed the table “**Adjustable parameters**” in **section 2.6 (Parameter overview)**. If the entire unit was disconnected, the point Initialisation will come up every time the unit is switched on.
- **Confirmation:** If all pre-settings have been made in accordance with the table, **press the [START] key once** to confirm your settings. The message “**Restart Y/N**” appears in the first line of the display.
- **Start/Stop without SPS:** If parameter 19-43 was set to “Without SPS”, pressing the **[START]** key once more will start the unit with the set speed of rotation along the pre-set slope. First, the oil pump will start and the highlighted text “**Starting screw pump...**” will be displayed. As soon as the minimal oil pressure is reached, the fans will turn on as well and the pressure/vacuum generator will start up. The unit can be stopped pressing the **[STOP]** key. In this case, the message “**Manual stop wait...**” appears in the display. The unit can be restarted as soon as the message “**Restart Y/N**” is displayed. If there is no restart of the unit the fans will switch off after another follow-up running time of 5 minutes.
- **Start/Stop with SPS:** The start cannot be commenced with set PLC until a release signal that is sent by the PLC is available at the terminal strip X6.3 and X6.4 at the frequency converter. Respectively, discontinuing the signal will cause the unit to stop, displaying the message “**SPS Stop wait...**”. In this case also, the SPS can only restart after the oil pump has been shut down and the message “**Restart Y/N**” appears in the display.

Note: A unit which has started automatically can be shut down during operation by pressing the **[STOP]** key. In this case also, the message “**Manual stop wait...**” will be displayed. However, switching back the unit to automatic mode now requires pressing the **[START]** key. If the SPS release signal is received at that time, the unit will restart.

Trouble-shooting in case of malfunction

- **Error diagnosis:** If an error has occurred and resulted in shutdown of the unit, the cause of the error should be investigated in accordance with the table shown in **section 2.5: (Error messages and troubleshooting)**. Only after doing so the unit should be restarted in accordance with the methods stated below.
- **Motor contactor:** If a malfunction has occurred due to activation of a motor contactor, an automatic restart will not occur until the switch is back in its starting position.
- **Temperature switch:** After a shutdown due to overheating, the unit can only be restarted after the switch has changed back to rest position.
- **Oil pressure switch:** If the switching point of the contact manometer has been activated, the screw pump has to be restarted by pressing the **[START]** key independently of the mode of operation.

2.5 Error messages and troubleshooting

Servicing messages

Text in display	Response from	Effect	Caused by	Remedy
"Configuration error"		warning message in the display	faulty parameterisation	check parameter setting
"Replace oil filter"	[22] differential pressure transmitter	warning message in display	oil filter cartridge blocked	Replace cartridge

Error-messages				
Text in display	Response from	Effect	Caused by	Remedy
"Oil cooler malfunction"	control contact motor contactor [F2]	shutdown and error message	voltage loss at F2	check electric line supplying oil cooler fan Check oil cooler fan for short circuit Remove from ventilator Check settings of motor contactor
"Oil pump malfunction"	control contact motor contactor [F3]	shutdown and error message	voltage loss at F3	Check electric line supplying oil pump Check oil pump for short circuit Clean suction neck of pump Check setting of motor contactor
"Ceiling ventilator malfunction"	control contact motor contactor [F4.1]; [F4.2]	shutdown and error message	voltage loss in F4.1 and/or F4.2	Check electric line supplying cabinet fan Check outside fan grid for damage Check fan for short circuit Remove alien bodies from fan already Check setting of motor contactor

(Note: The control contacts of both cabinet fans have a serial wire connection so that failure of one contactor generates an error message.)

Error-messages

Text in display	Response from	Effect	Caused by	Remedy
"Engine ventilator malfunction"	control contact motor protection switch [F5]	shutdown and error message	voltage loss in F5	Check electric line supplying external fan of driving motor Check ventilator for short circuit Remove from fan Check settings of motor contactor
"Control transformer malfunction"	control contact motor contactor [F6]	shutdown and error message	voltage loss in F6	Check control transformer for short circuit
"Excess temperature exhaust air" (Note: at present not yet available.)	[8] temperature switch for exhaust air	shutdown and error message	Excess temperature of vacuum exhaust air	
"VLT malfunction"	Internal FU bus message	shutdown and error message	Frequency converter malfunction	see Manual FC 302
"Lack of oil"	[14] oil level switch	shutdown and error message	Oil level in tank below minimum	Check oil circuit for leakage Check electrical wiring
"Excess temperature oil"	[20] oil temperature switch	shutdown and error message	Oil temperature above allowed maximum	Check functioning of oil cooler fan Lower refill oil, check and clean filter matt ambient temperature
"High oil pressure"	[26] oil pressure gauge	shutdown and error message	Upper threshold value of contact manometer	Check [23] oil pump relief valve and replace component if defect. Apply lower bias to valve spring Replace oil filter cartridge if necessary Check oil pipes for soiling
"Low oil pressure"	[26] oil pressure gauge	shutdown and error message	Lower threshold value of contact manometer	Check [23] oil pump relief valve and replace component if defect Apply higher bias to valve spring Check oil circuit for leakage Refill oil if necessary
"Vacuum too high" "Pressure too high"	[1] Pressure transmitter	shutdown and error message	Unit was opened after the set follow-up running time with the magnetic valve open	Open stop valve of suction line Check air filter (during vacuum mode)

Other malfunctions

Problem

Unit does not start-up when pressing **[START]** key

Unit does not start-up when running in automatic/SPS mode

System pressure in display line 2 is not displayed sensor

Cause

Parameter 19-43 "SPS Y/N" was set to the **value 1**

Previous manual stop
SPS release signal missing at clamp 18

Defect of wiring or pressure sensor
Display is not set to parameter 95

Remedial action

Change parameter 19-43 to **value -1**

Press **[START]** key
Check the electric wiring of the release line or SPS signal

Check wire connection to pressure
Change display to parameter 95

2.6 Parameter overview

Parameters relating to the operational data

(The numerical values are continuously updated in display line 4!)

parameter no.	text in display line 3	meaning
19-10	working hours [h]	FU working hours
19-11	motor hours [h]	working hours of the motor/level
19-12	frequency [Hz]	current frequency
19-13	mains voltage [V]	current mains voltage
19-14	motor current [A]	current consumption of motor at the moment
19-15	wattage [W]	current power consumption of unit
19-16	kWh-Counter	total unit kWh
19-17	Number of power line switches	number
19-19	software version	display software version

Parameters relating to the error log

(The numerical values are saved to display line 4 only in the actual event of an error!)

parameter no.	text in display line 3	meaning
19-20	wh_error [h]	working hours of the FU when the error occurred
19-21	mh_error [h]	working hours of the motor/level when the error occurred
19-22	f_error [Hz]	frequency when the error occurred
19-23	U_error [V]	mains voltage when the error occurred
19-24	I_error [A]	current consumption when the error occurred
19-25	P_error [kW]	power consumption when the error occurred
19-26	p_error [mbar]	system pressure when the error occurred
19-27	bp_error	clamp where the error occurred
19-28	kWh-counter	error kWh where the error occurred
19-49	error status	error code for modem monitoring
19-50...19-77		ring buffer error history

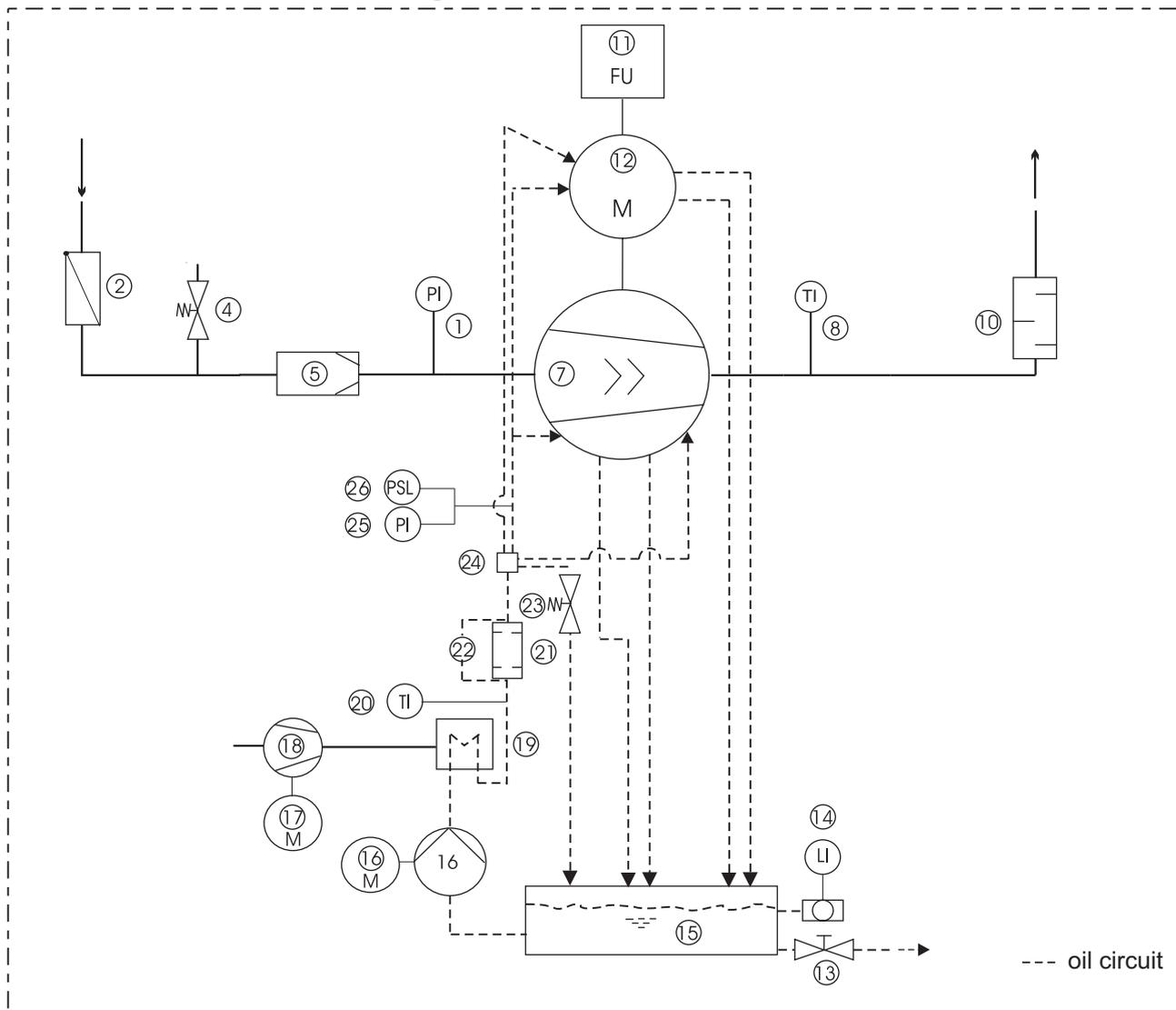
Annotations of the error codes in Parameter 19-27 (binding post_error)

binding post no.	meaning
1	Vacuum / Pressure Vacuum / Pressure too high
2	oil cooler fan oil cooler malfunction
3	oil pump oil pump malfunction
4	op fan top fan malfunction
5	control transformer control transformer malfunction
7	external motor fan external motor fan malfunction
16	oil pressure transmitter low oil pressure (lower threshold value)
19	oil temperature switch oil temperature too high
29	oil floater switch not enough oil in tank

Adjustable parameters

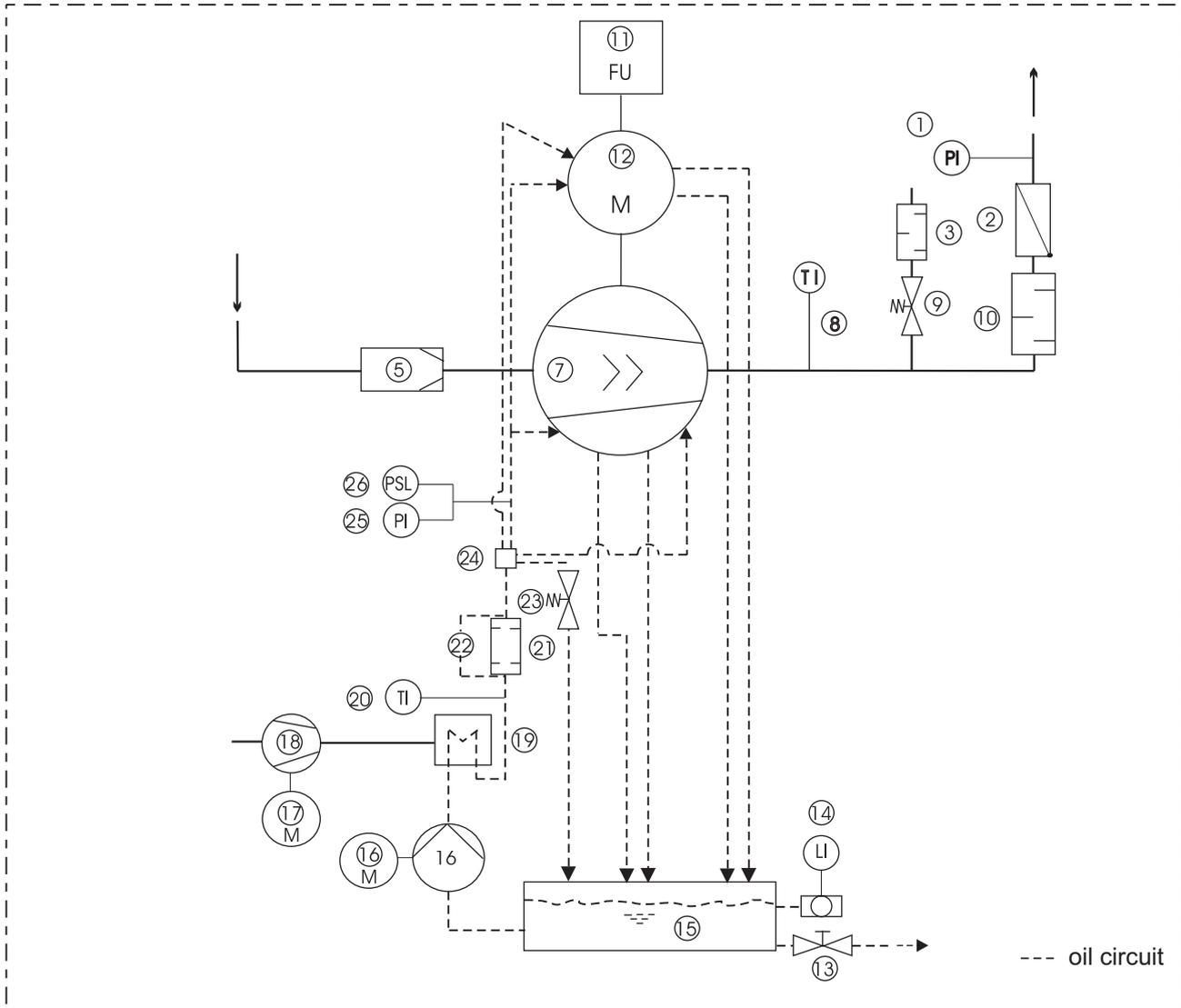
parameter no.	text in display line 1	settings in display line 2	
		range	function
19-29	required series f [Hz]	0-200	default speed of rotation for standard set
19-30	sensortype	0-3	Default sensor 1 Vakuum sensor 0-1 2 Pressure 1,0-2,6 3 Danfoss 0-4
19-31	operation p/v	-1 1	vacuum operation pressure operation
19-32	P factor	0-10000	proportional-factor
19-33	I factor	0-10000	integral-action factor
19-34	D factor	0-10000	differentiality factor
19-37	internal nominal value [mbar]	200-1000 1000-2000	vacuum operation pressure operation
19-38	process with/without	-1 1	without PI control with PI control
19-39	Series/Test	-1 1	test operation series operation
19-40	Valve open [mbar]	0-2000	opening the solenoid valve
19-41	Valve close [mbar]	0-2000	closing the solenoid valve
19-42	Switch-off time [min]	1-10	maximum time for the exceeding of the pressure limit
19-43	SPS y/n	-1 1	without external control with external control
19-44	SPS required value	-1 1	without external nominal value source with external nominal value source
19-45	SPS required value	-1 1	not invert nominal value signal invert nominal value signal

3. Vacuum principle diagram



1. Pressure transmitter
2. Non return valve
4. Vacuum relief valve
5. Suction filter
7. Screw pump
8. Temperature switch for exhaust air
10. Exhaust air silencer
11. Frequency inverter
12. Driving motor
13. Ball valve for oil drain
14. Oil level gauge glass/oil level switch
15. Oil tank
16. Oil pump,
- 16 M. Motor of oil pump
17. Motor for fan
18. Oil cooler fan
19. Oil cooler
20. Oil temperature
21. Oil filter
22. Differential pressure oil
23. Oil pump relief valve
24. Oil distributor
25. Oil pressure gauge
26. Oil pressure switch

3. Pressure principle diagram



1. Pressure transmitter
2. Non return valve
3. Silencer
5. Suction filter
7. Screw pump
8. Temperature switch for exhaust air
9. Blast air cooler
10. Exhaust air silencer
11. Frequency inverter
12. Driving motor
13. Ball valve for oil drain
14. Oil level gauge glass/oil level switch
15. Oil tank
16. Oil pump,
- 16 M. Motor of oil pump
17. Motor for fan
18. Oil cooler fan
19. Oil cooler
20. Oil temperature
21. Oil filter
22. Differential pressure oil
23. Oil pump relief valve
24. Oil distributor
25. Oil pressure gauge
26. Oil pressure switch

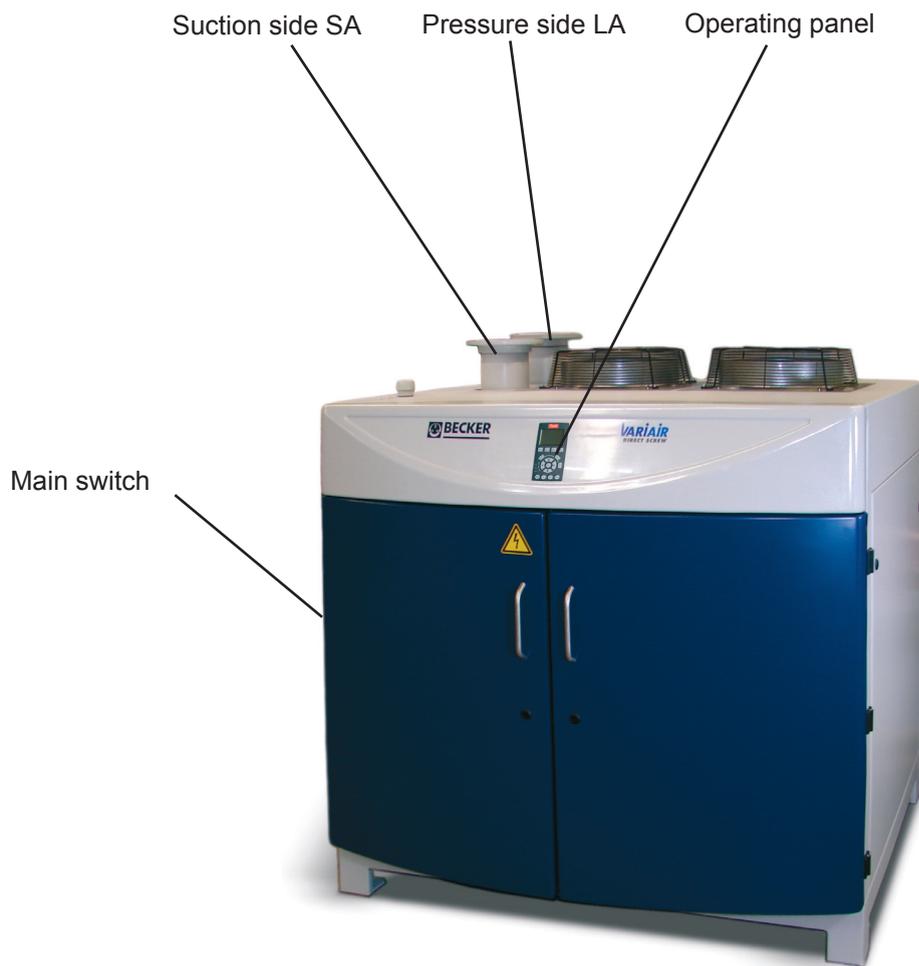


Figure 1

VADS 1500 45 KW

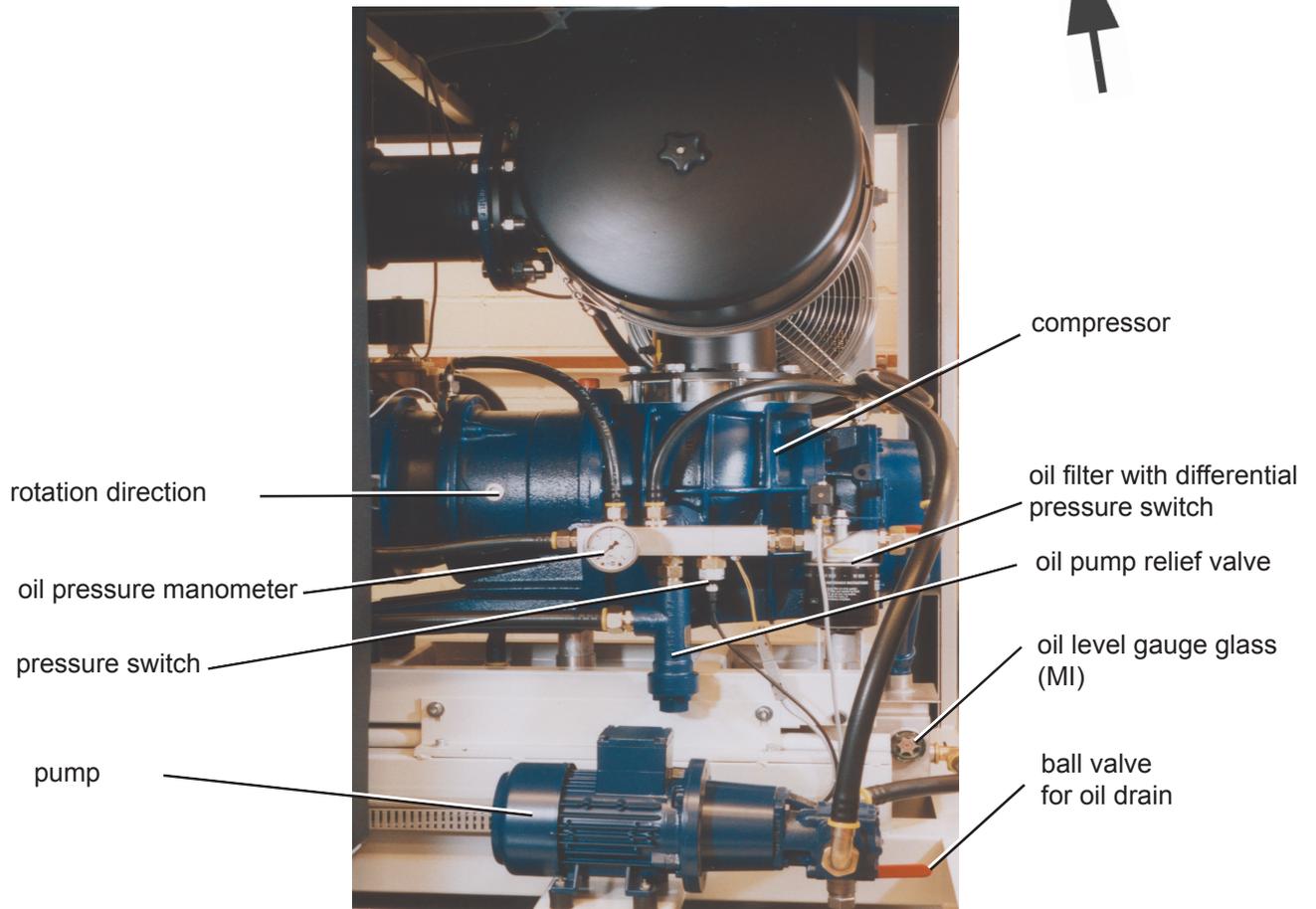


Figure 2



VADS 1500 45 KW

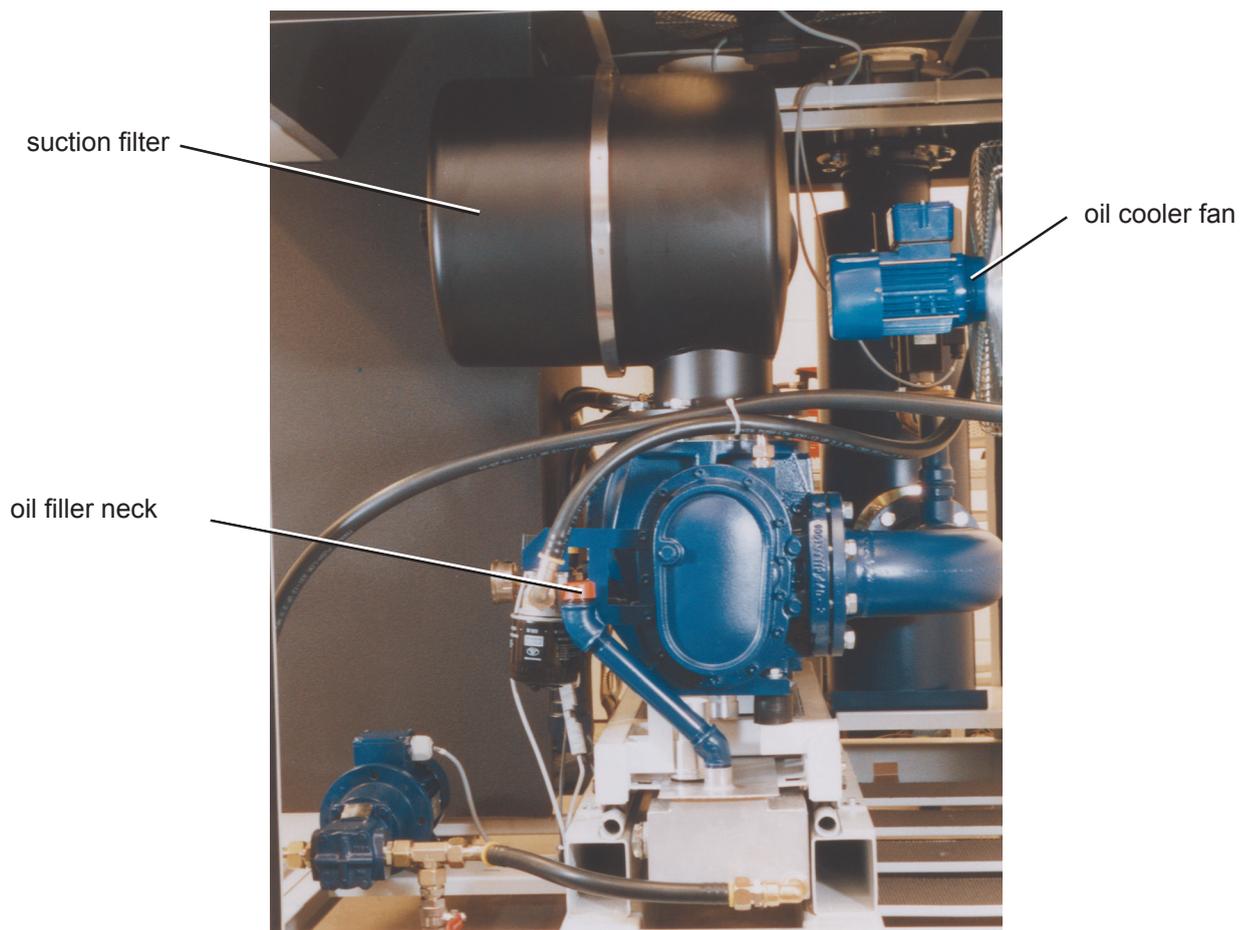


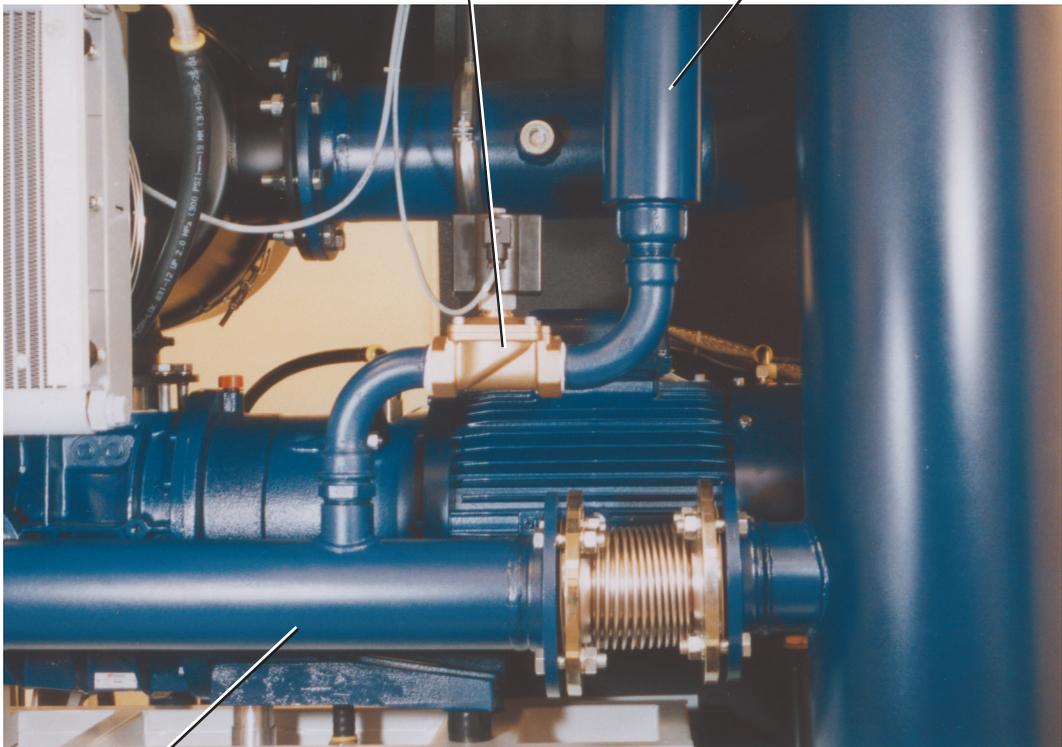
Figure 3



VADS 1500 45 KW

magnetic bypass valve

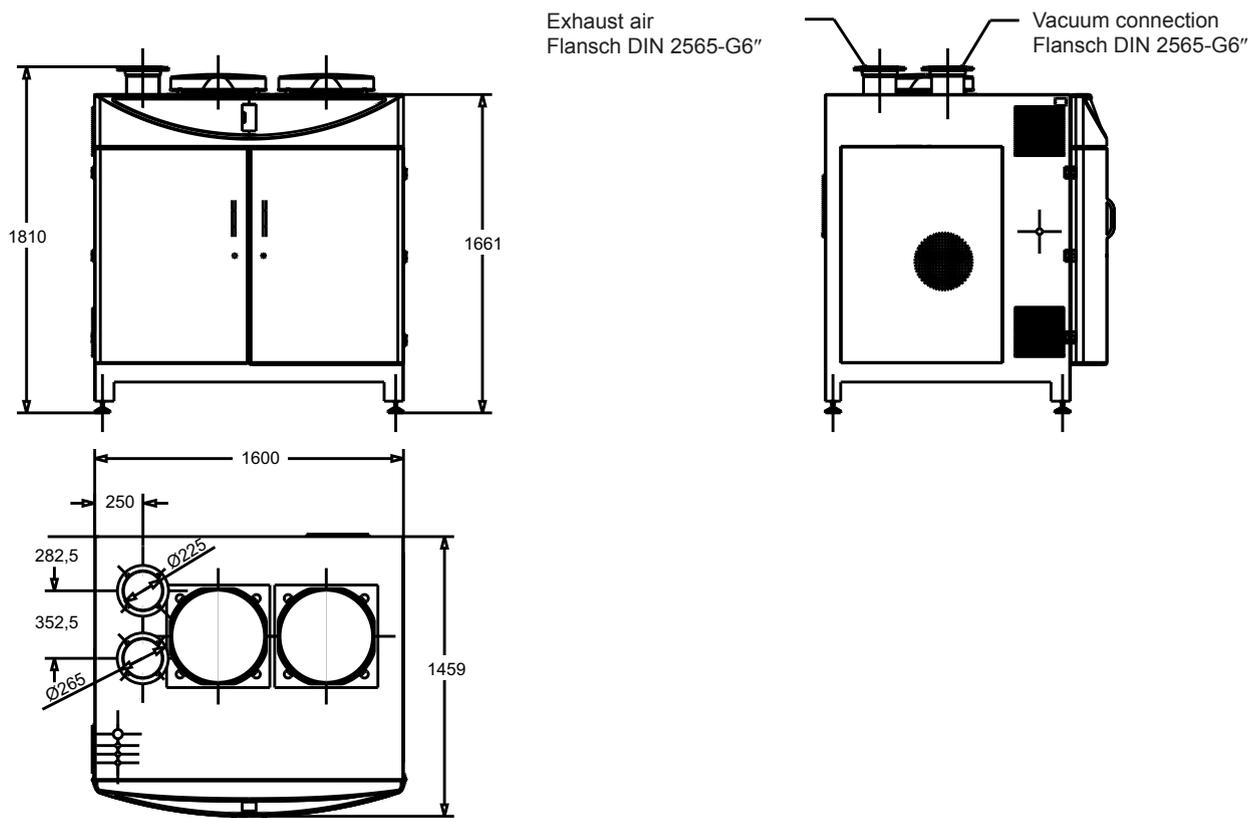
exhaust silencer



pressure pipe

Figure 4

8. Technical specification



Vakuumpumpe / Vacuum Pump VADS 1500

Saugvermögen / Suction Capacity	750 – 1415 m ³ /h
Betriebsvakuum (Dauerbetrieb)	
Operating Vacuum (Continuous Operation)	200 mbar abs.
Installierte Motorleistung	
Installed Motor Capacity	37 KW
Verdichterdrehzahl / Pumpspeed	6600-11900 min ⁻¹
Schallpegel / Noise Level	≤ 80 db(A)
Länge / Length	1600 mm
Breite / Width	1460 mm
Höhe / Height	1810 mm
Gewicht / Weight	ca. 1200 Kg
Sauganschluß / Vacuum Connection	DN 150 / PN 6
Abluftanschluß / Exhaust Air Connection	DN 150 / PN 6

Verdichter / Compressor VADS 1500

Liefermenge / Free Air Flow	750 – 1200 m ³ /h
Betriebsdruck (Dauerbetrieb)	
Operating Pressure (Continuous Operation)	2 bar abs.
Installierte Motorleistung /	
Installed Motor Capacity	45 KW
Verdichterdrehzahl / Pumpspeed	4800-10000 min ⁻¹
Schallpegel / Noise Level	≤ 80 db(A)
Länge / Length	1600 mm
Breite / Width	1460 mm
Höhe / Height	1810 mm
Gewicht / Weight	ca. 1200 Kg
Ansauganschluß / Air Inlet Connection	DN 150 / PN 6
Druckanschluß / Pressure Connection	DN 150 / PN 6

VADS 1500 37 KW

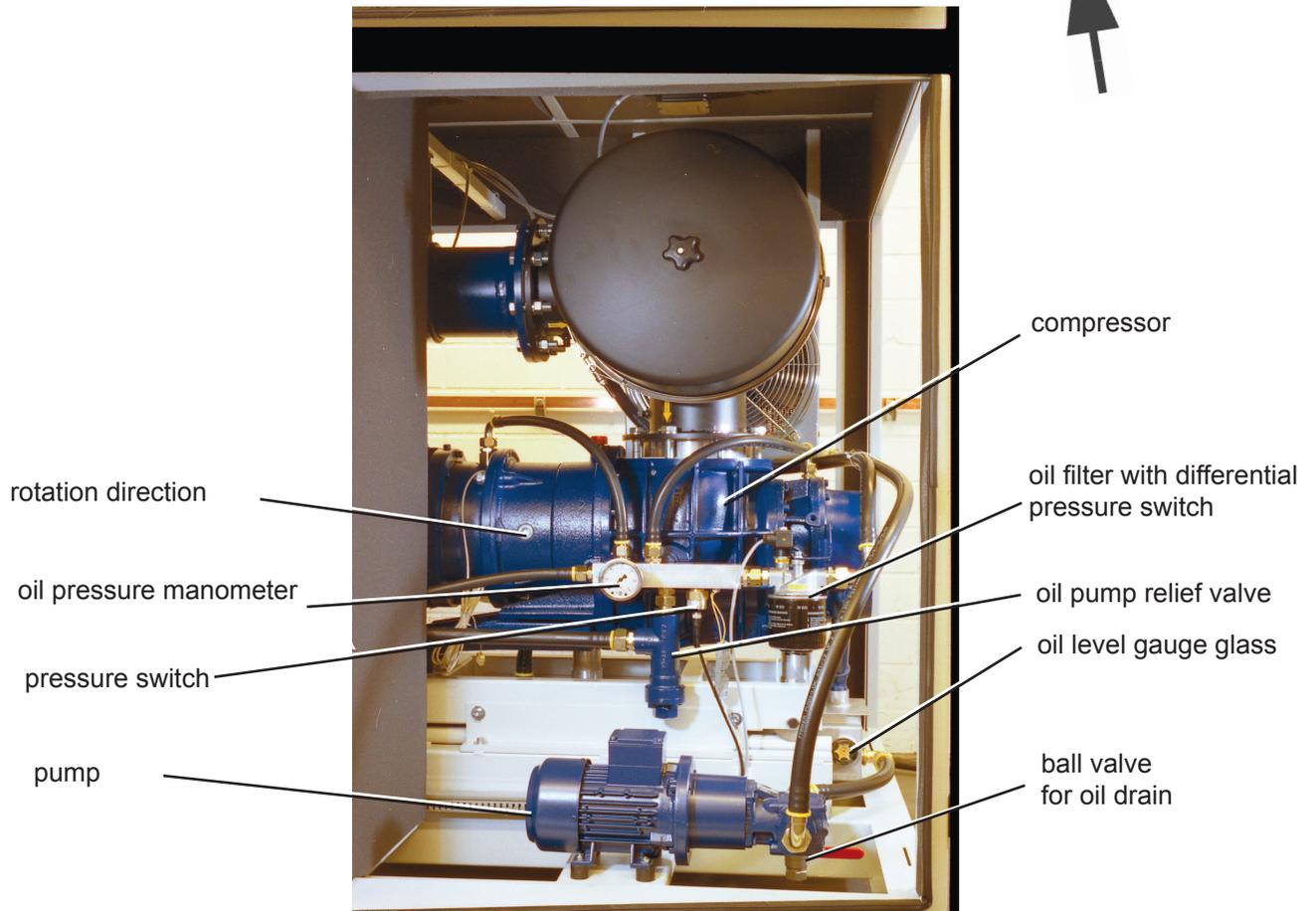


Figure 5



VADS 1500 37 KW

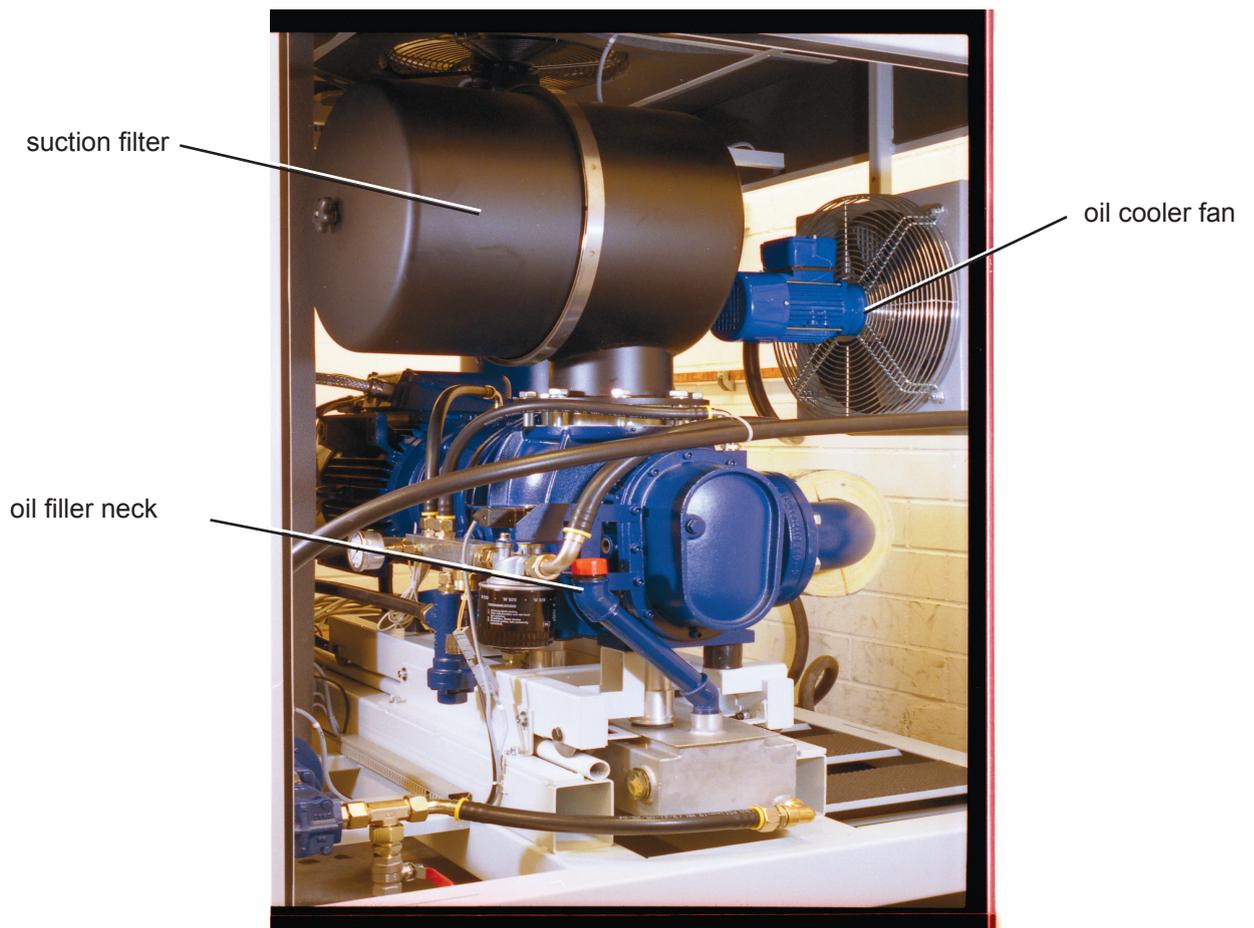
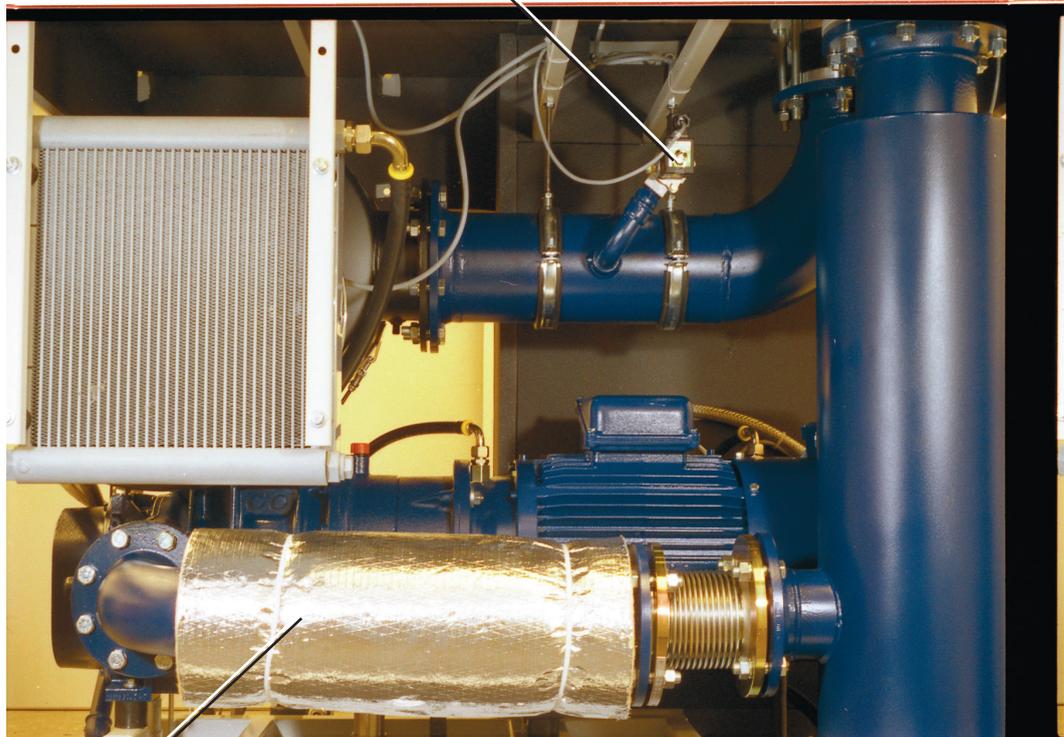


Figure 6



VADS 1500 37 KW

magnetic bypass valve

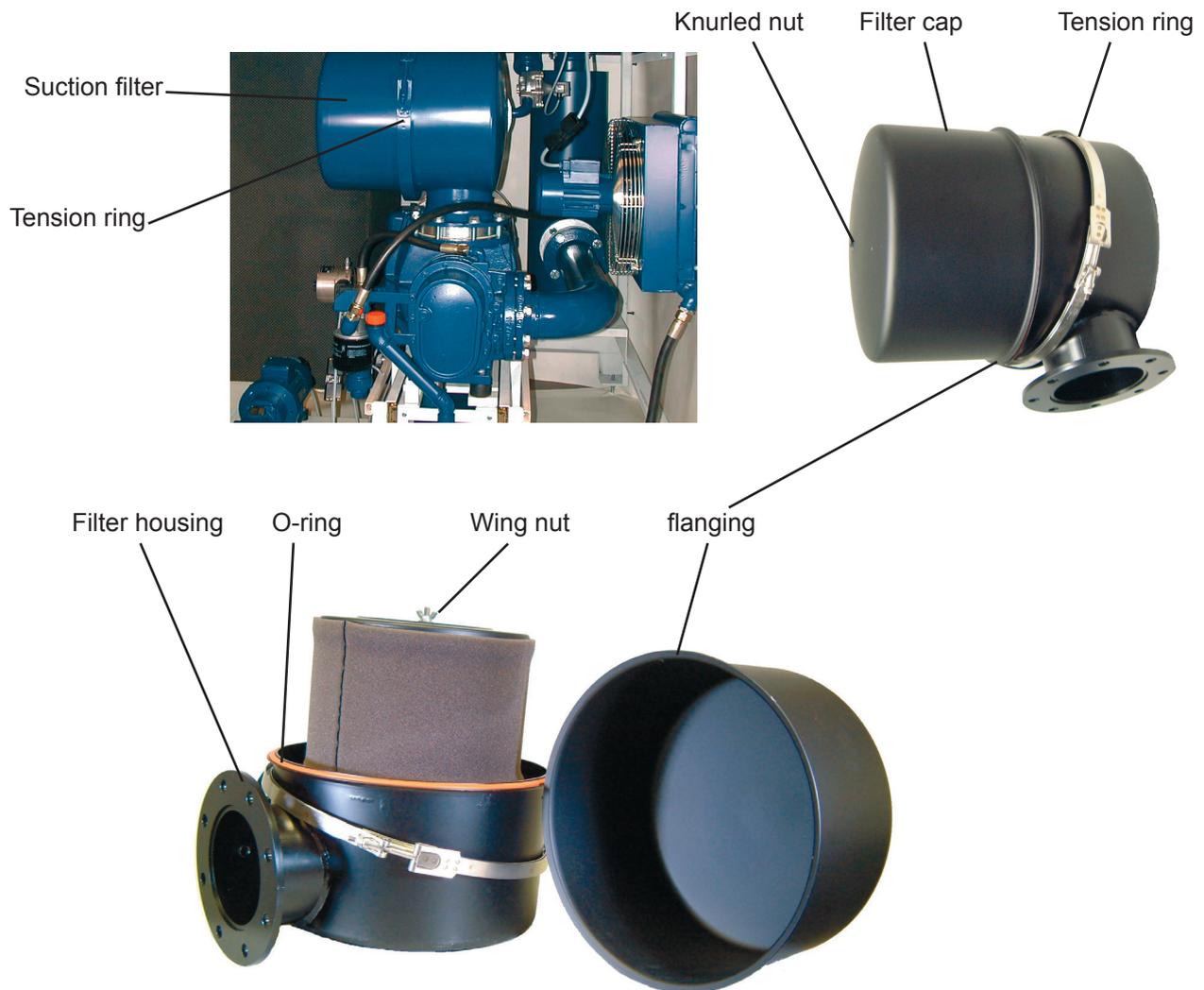


exhaust pipe

Figure 7

Maintenance of the filter cartridge

The filter cartridge of the suction filter (Part-No.: 709580) must be exchanged when pressure difference values are too high. Otherwise the system will overheat. The soiling of the filter cartridge depends on the individual conditions under which the unit is working. We, as the manufacturer suggest to check the degree of soiling within the filter cartridge on a 14-day-basis.



Dismantling:

Unscrew knurled nut from the filter cover and loosen the tension ring. Push the tension ring back. Lift the filter cap at the front and turn off the wing nut of the filter cartridge.

Mounting: If possible this should be done by two people. Place the filter cap exactly onto the O-ring. Make sure the spacing of the flanging between the filter cap and the filter housing is constant. Push the tension ring back into its original position and tighten it. Check the tension ring for correct position and tight fit.

When mounting the filter cap attention must be paid that it is firmly locked in its position. Otherwise the filter cap may blow off uncontrollably should the unit malfunction. We, as the manufacturer recommend to operate the unit only with the closed doors.