

Vacuum Solutions

Application Support

Service



LEYBOLD VACUUM

GA 02.200/8.02



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E and DK - Pumps

Rotary Piston Pumps
E 250, DK 200

Cat. No.
105 36
111 16
895 08
895 09
895 10
166 17
166 37

Operating Instructions

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Figures

The reference to diagrams, e. g. (1/2), consist of the Fig. No. and Item No. in that order.

Warning Indicates procedures that must be strictly observed to prevent hazards to persons.



Caution Indicates procedures that must strictly be observed to prevent damage to, or destruction of the pump.

Leybold Service

If a pump is returned to LEYBOLD, indicate whether the pump is free of substances damaging to health or whether it is contaminated.

If it is contaminated also indicate the nature of the hazard. LEYBOLD must return any pumps without a "Declaration of Contamination" to the sender's address.

A sample of the required form has been reproduced at the end of these Operating Instructions. A copy of the actual form is included with each pump.

Disposal of Waste Oil

Owners of waste oil are entirely self-responsible for proper disposal of this waste.

Waste oil from vacuum pumps must not be mixed with other substances or materials.

Waste oil from vacuum pumps (Leybold oils which are based on mineral oils) which are subject to normal wear and which are contaminated due to the influence of oxygen in the air, high temperatures or mechanical wear must be disposed of through the locally available waste oil disposal system.

Waste oil from vacuum pumps which is contaminated with other substances must be marked and stored in such a way that the type of contamination is apparent. This waste must be disposed of as special waste.

European, national and regional regulations concerning waste disposal need to be observed. Waste must only be transported and disposed of by an approved waste disposal vendor.

The right of alterations in the design and the technical data is reserved. The illustrations are not binding.

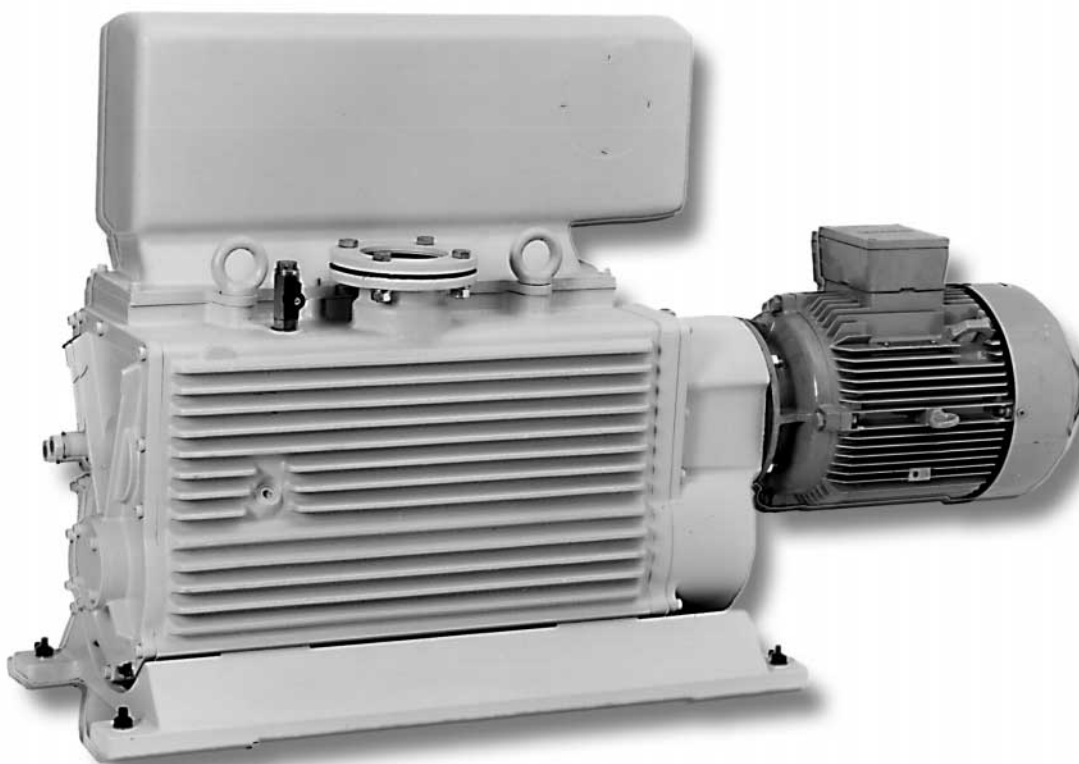


Fig. 1 Rotary Piston Pump E 250

1 Description

1.1 Design and Principle of Operation

The E series comprises single-stage rotary piston pumps, and the DK series consists of two-stage rotary piston pumps. Their pumping capacity ranges from 200 to 250 m³ · h⁻¹.

E and DK series pumps can pump gases and vapours and evacuate vessels or vacuum systems in the medium vacuum range. Those of standard design are not suitable for pumping higher than atmospheric concentrations of oxygen or extremely aggressive or corrosive media.

1.1.1 Principle of Operation

In the pump body (2/14), the piston (2/1) is guided by the eccentrically mounted cam (2/2) along the wall of the pumping chamber, without contacting it. The piston divides the chamber into two sections that change in size.

The piston has a hollow neck (2/11) with a slot on the side.

The gas being pumped comes through the inlet port (2/10) into the piston neck.

When the slot in the piston neck is opened by the slide valve (2/12), the gas flows into the expanding section of the pumping chamber (right-hand section in Fig. 2). The gas is encapsulated in the pumping chamber, then compressed during the next revolution of the piston (left-hand section in Fig. 2) and expelled at the exhaust valve (2/5).

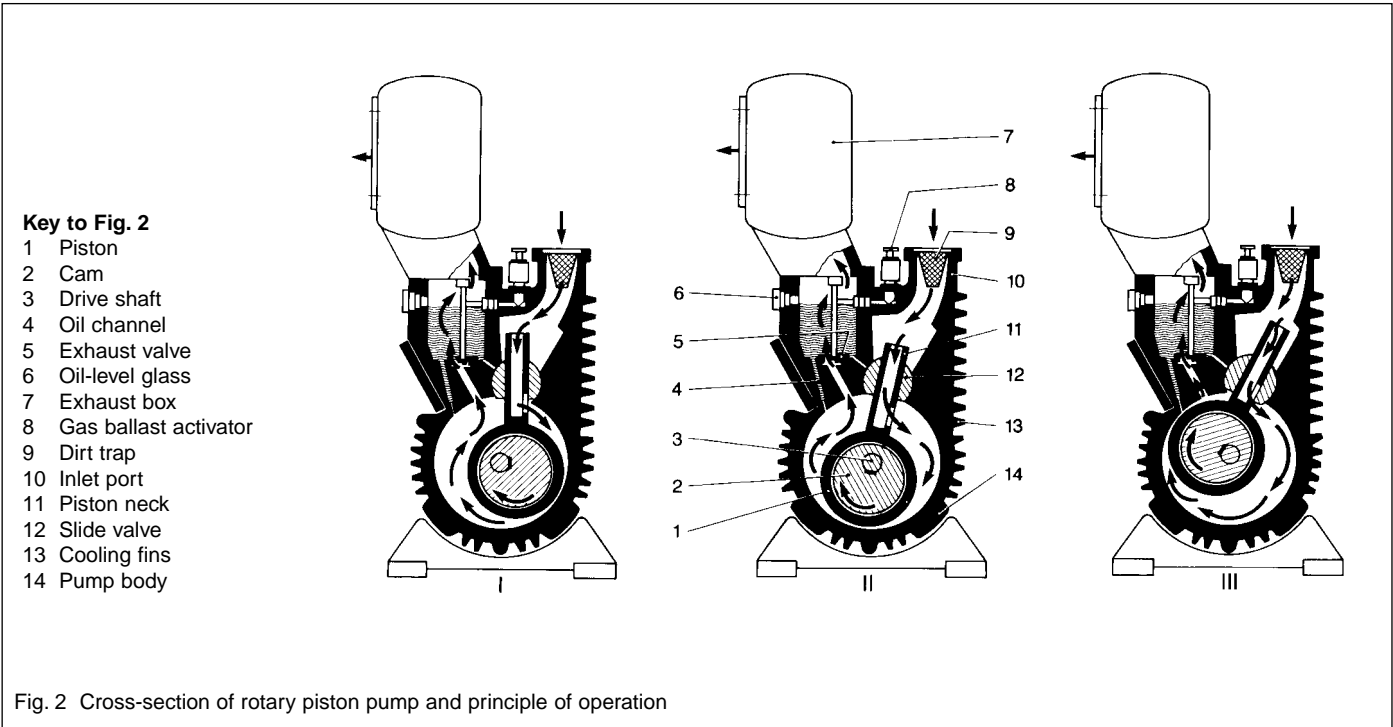


Fig. 2 Cross-section of rotary piston pump and principle of operation

1.1.2 Design

The E-250 has three pumping chambers operating in parallel.

The DK-200 has three, pumping chambers operating in series, with the larger chamber(s) on the intake side acting as the first pump stage, and the smaller chamber as the second pump stage.

Above the exhaust valves (2/5) is an oil reservoir, from which oil is injected into the pumping chamber via oil channels (2/4).

The oil is used for sealing, lubrication and cooling. Most of the oil entrained with the compressed gas is mechanically trapped in the exhaust box (2/7). The oil cycle is maintained by the difference between the pump's intake pressure and atmospheric pressure.

The rotary piston pumps are driven by a directly flanged motor. The pump's rotational speed is lower than that of the motor; the pump shaft and motor are interlinked by a toothed gear, which has its own oil reservoir.

The cams (2/2) or (3/1) and (3/11) and a ring gear are arranged on the pump shaft in such a way that the eccentrically rotating array is dynamically balanced.

The pumps are air-cooled. The required air flow is generated by the attached motor. A built-in reverse lock prevents the motor turning the pump shaft in the wrong direction.

All E and DK series pumps have a gas ballast device. When the gas ballast valve (2/8) is open, a dosed quantity of air – so-called "gas ballast" – is admitted into the pumping chamber.

This prevents condensation of vapours in the pump up to the vapour tolerance specified in the Technical Data.

In addition, a small amount of air is constantly admitted via the silencer nozzles so as to avoid loud running of the pump at ultimate pressure.

1.2 Supplied Equipment

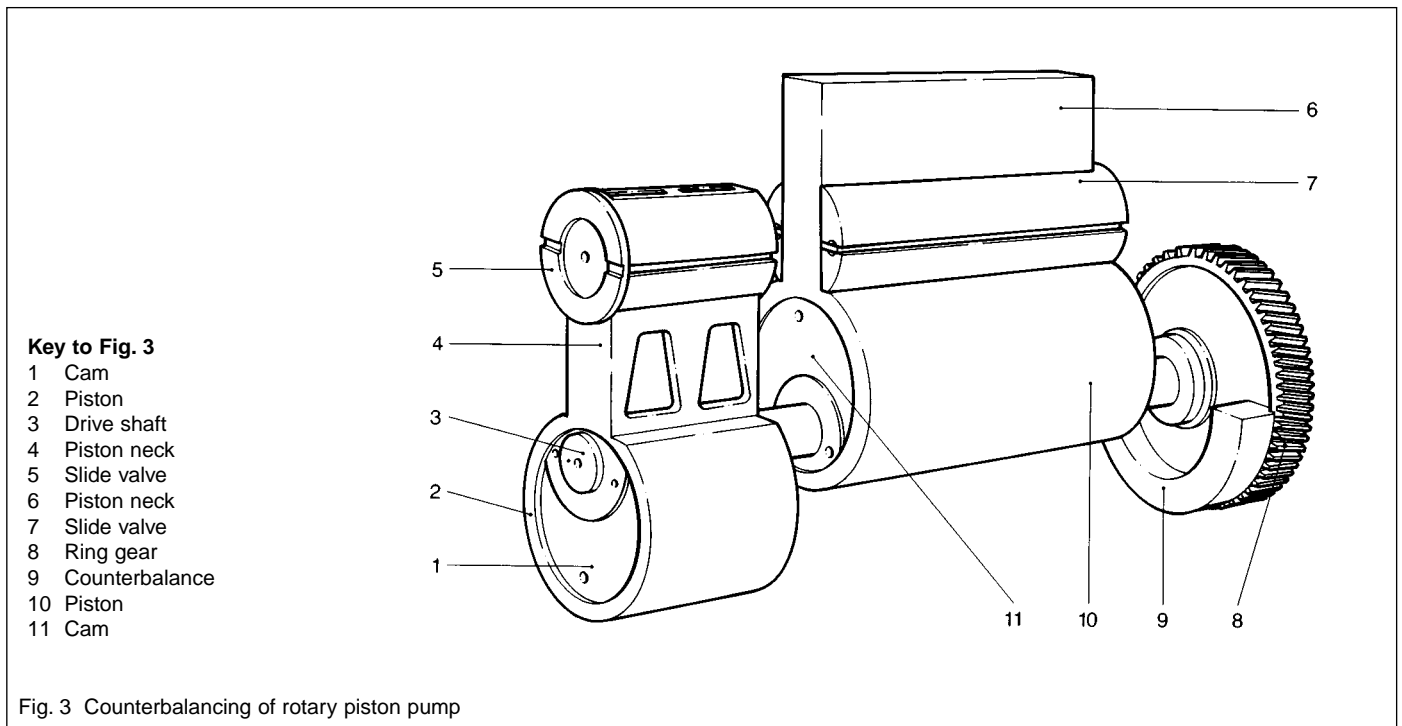
The pumps are supplied with small-flange (KF) and/or clamp-flange (ISO-K) connections (see Section 1.3 – Technical Data).

For each small-flange connection, a centering ring and a clamp ring are supplied. These connections are sealed with a rubber diaphragm.

For each clamp-flange connection, a sealing disk with collar flange and snap ring is supplied. These connections are sealed with cardboard disks.

The centering ring or sealing disk for the inlet flange contains a dirt trap.

The pump and gear housing are filled with N 62 oil.



1.2.1 Transporting

Caution • Pumps which are filled with operating agents must only be transported standing upright. Otherwise oil may come out of the pump. During transportation avoid any other orientations.

Warning • Check the pump for the possible presence of oil leaks. There exists the danger that someone may slip on spilled oil.
 • In order to lift the pump only use the eyes provided on the pump for this purpose and only use the required type of lifting equipment (see Operating Instructions, 7/4).



Make sure that the lifting equipment has is safe to operate. Use only suitable lifting gear. Make sure that all safety regulations are observed.

1.2.2 Shelving

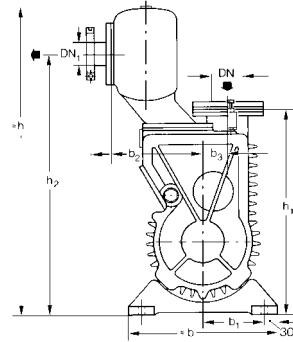
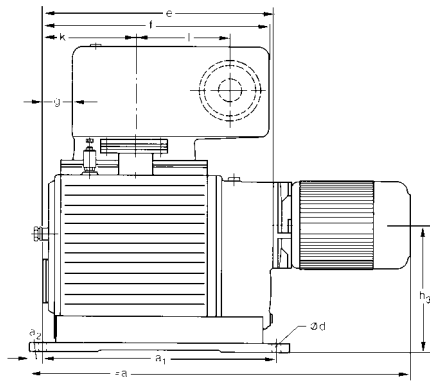
Caution • Before putting a pump into service once more, store it at a dry place, preferably at room temperature (20 °C). Before shelving a pump disconnect it properly from the vacuum system, purge it with dry nitrogen and do an oil change.

All inlet and discharge openings on the pump must be sealed with the shipping seals supplied with the pump.

Set the gas ballast switch to the "OFF" position; if the pump is to be shelved for a longer period of time you should place it in a PE bag containing some desiccant (silica gel) and the firmly seal the bag.

When shelving the pump for over one year, you should run maintenance on the pump and also do an oil change before putting the pump into service again. We recommend that to get in touch with Leybold Service in such a case.

Description



	DN	DN ₁	a ¹⁾	a ₁	a ₂	b	b ₁	b ₂	b ₃	ød	
E 250/DK 200	63 ISO-K	63 ISO-K	1190	780	30	340	140	202 ²⁾	52	14	
	DN	DN ₁	e	f	g	h	h ₁	h ₂	h ₃	k	l
E 250/DK 200	63 ISO-K	63 ISO-K	777	750	65	740	475	636	295	337	290

1) Dimension "a" applies only in connection with the standard type of motor used by us

2) Without adaptor

Fig. 4 Dimensional drawing

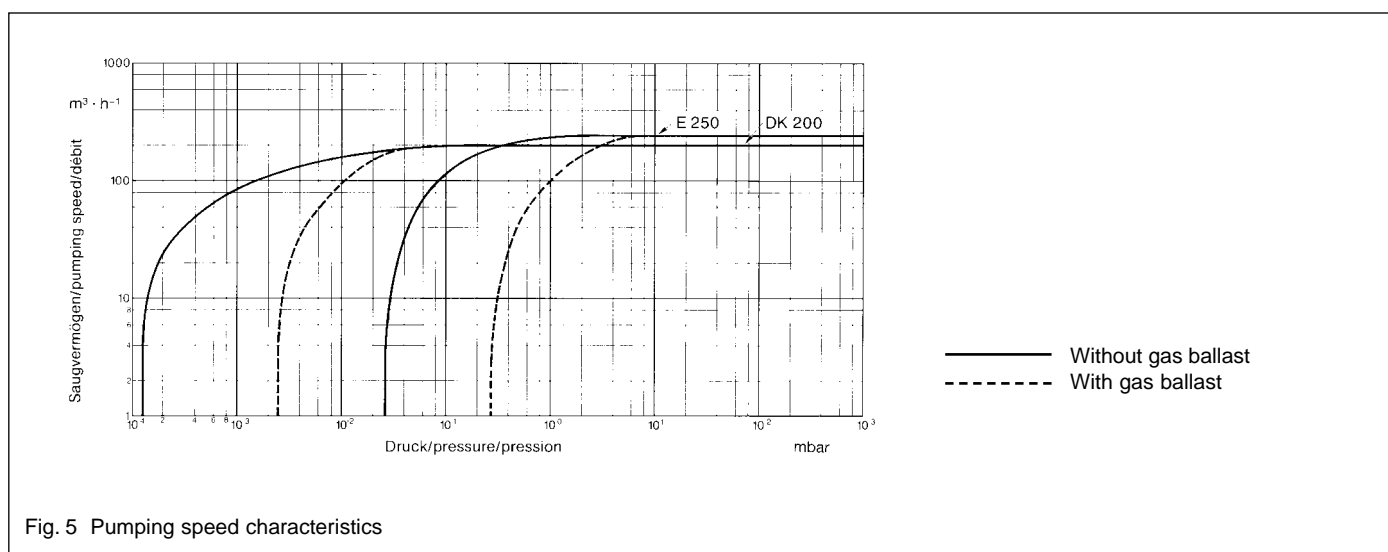
1.3 Technical Data and Accessories

Rotary Piston Pump		E 250			DK 200	
Nominal pumping speed ¹⁾	m ³ · h ⁻¹	290			225	
Pumping speed ¹⁾	m ³ · h ⁻¹	250			200	
Ultimate total pressure with gas ballast ¹⁾	mbar	< 5 · 10 ⁻¹			< 4 · 10 ⁻³	
Ultimate partial pres. without gas ballast ¹⁾	mbar	< 4 · 10 ⁻²			< 5 · 10 ⁻⁴	
Water vapour tolerance	mbar	60			26	
Intake port	DN	63 ISO-K			63 ISO-K	
Exhaust port	DN	63 ISO-K			63 ISO-K	
Oil filling, pump chamber	l	8			4	
Oil filling, gear	l	0,4			0,4	
Motor power at 230/380 V +/- 10 %	kW (Hz)	5.5 (50)	-	-	5.5 (50)	-
Motor power at 200-230 V/460 V +/- 10 %	kW (Hz)	-	-	5.5 (60)	-	5.5 (60)
Motor power at 460 V +/- 10 %	kW (Hz)	-	5.5 (50)	-	-	-
Nominal speed of the motor, 50 Hz	rpm	1500 / 50 Hz		1730 / 60 Hz	1500 / 50 Hz	1730 / 60 Hz
Nominal speed of the pump	rpm	540			540	
Motor protection	IP	54			54	
Weight with motor and oil filling	kg	375			375	
Cat. Nos.	166 37 without motor*				166 17 without motor*	
	105 36	895 08	895 09	111 16	895 10	

*Requirement for the motor: Maximum motor speed must not exceed 1500 rpm, motor power must be at least 5 kW.

Accessories		E 250	DK 200
		-- Cat. Nos. --	
Vibration absorbing feet		101 55	101 55
Seal kit		192 63	192 63
Dust separator		178 02	178 02
Dust filter		278 17	278 17
Separator (intake side)		188 45	188 45
Elbow DN 63 ISO-K		268 67	268 67
Drain tap (vacuum tight/oil tight)		190 90	190 90
Separator (exhaust side)		188 45	188 45
Exhaust filter		189 45	189 45
Exhaust filter box		189 47	189 47
SECUVAC valve		283 15	283 15
Oil level regulator		101 37	101 37
Mechanical oil filtering facility		101 31	101 31

1) To DIN 28 400 and subsequent numbers



1.4 Lubricants

The same oil can be used for the pump and the gear.

The rotary piston pumps should be run with oil N 62. N 62 is a vacuum pump oil that meets many requirements:

- Low vapour pressure, even at high temperatures.
- Flat viscosity curve.
- Minimum water content and absorption.
- Good lubricating properties.
- Resistant to ageing under mechanical strain.

The use of other special-grade lubricants for specific applications is possible. Please consult us in such cases.

2 Operation

2.1 Installation

Warning The standard pump is not suited for installation in explosion hazard areas.



- Before starting up the pump for the first time make sure that the pump and the installed accessories meet the requirements of your application and that safe operation is ensured. If hazardous substances are to be pumped, ensure that all relevant safety regulations are observed.

- Avoid exposure of any part of the human body to a vacuum. There exists the danger of injury. Never operate the pump with its intake open. Vacuum connections as well as oil fill and oil drain openings must never be opened during operation.

The safety regulations which apply to the application in each case must be observed. This applies to installation, operation and maintenance (servicing) as well as waste disposal and transport.

Our technical sales staff are at hand should you have any questions in these matters.

Warning Before pumping oxygen (or other highly reactive gases) at concentrations exceeding the concentration in the atmosphere (> 21 % for oxygen) it will be necessary to use a special pump. Such a pump will have to be modified and de-greased, and an inert special lubricant (like PFPE) must be used.



The pump is not suited for processes and pumping of:

- 1 - Explosive gases or vapours.
- 2 - Oxidants (except the Formblin types, see Operating Instructions GA PFPE 07.009).
- 3 - Pyrophorous gases.
- 4 - The pumps are not suited for pumping of liquids or very dusty media. Corresponding protection measures must be introduced.

Our technical sales staff are at hand should you have any questions in these matters.

Install the pump on a flat, horizontal surface. The base of the pump must be supported evenly and horizontally at the four points of contact. If the pump stands on a level floor, it is not necessary to bolt it down unless the inlet and exhaust lines are rigidly connected. Always bolt the pump down when installing it in a frame or on a stand. For this we recommend using our vibration absorbing feet (see Accessories).

Caution The use of vibration absorbing feet does not prevent pump vibration, but merely reduces the vibrations transmitted to the supporting structure.

However, the inclination of the pump must not exceed 10° from the vertical.

The pump's ambient temperature should be between 12 °C and 40 °C. Lower temperatures necessitate additional measures when starting the pump (pre-heating the oil, larger motor); higher temperatures cause greater wear of the pump and require more frequent oil changes.

To permit adequate cooling of the pump leave about 0.5 m (20 inches) space between the pump and the wall. Always keep the air intakes at the motor fan clean.

2.2 Electrical Connections

Warning For all work on the wiring, disconnect the line cords from the mains.
The electrical connections must only be provided by a trained electrician in accordance with the regulations of the IEC 64 international series of standards.



Connect the pump's motor to the correct supply voltage via the terminals in the junction box.

Caution Only the PG fittings provided on the junction box may be used.

For proper connection, a suitable motor protection switch must be used.

Set the switch in accordance with the rating on the motor nameplate.

Caution After connecting the motor and every time you alter the wiring, check the direction of rotation (see marking on motor hood).
When connecting a condenser to the E 250 and DK pumps - without motor - it must be ensured under all circumstances that a speed of 1500 rpm is not exceeded and that at least 5 kW of motor power is available.

When checking the direction of rotation, the inlet and exhaust ports must be open. Switch on the motor briefly and then switch it off immediately. If the reverse lock prevents the pump from starting, disconnect the line cords from the mains and interchange two of the input leads at the motor junction box.

For checking the direction of rotation it is advisable to use a phase-sequence indicator.

If the pump has a built-in SECUVAC valve, connect it so that it closes when the pump is not running.

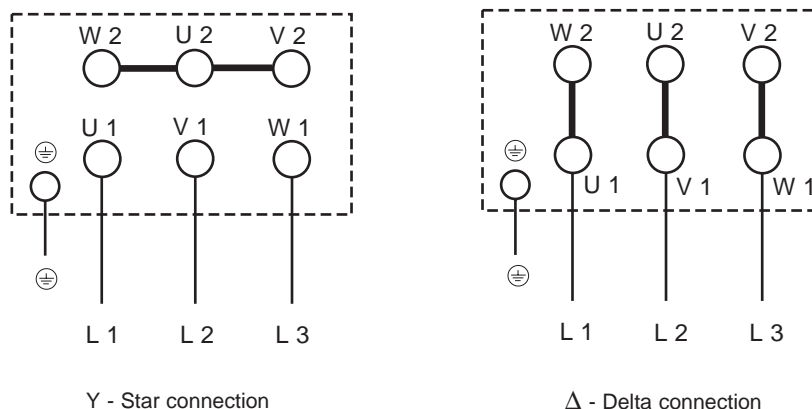


Fig. 6 Electrical connections

2.3 Connection to Vacuum System

(see Fig. 7)

If you have not already done so, remove the temporary covers from the inlet and exhaust ports.

Use flexible metal bellows to connect the intake and exhaust lines without straining them.

The lines and the sealing surfaces of the flange connections must be clean.

When pumping vapours, it is advisable to insert condensate traps on the intake and exhaust sides (see Section 1.3).

2.3.1 Intake Side

The cross-section of the intake line should be at least the same as that of the inlet port. If the intake line is too narrow, it reduces the pumping speed.

If the medium pumped contains dust, a dust filter should be installed upstream of the pump in addition to the dirt trap supplied.

We strongly recommend installing a SECUVAC valve between the vacuum system and the inlet port. This valve closes automatically when the pump is not running and thus protects the vacuum system against the entry of air and oil from the pump. The valve simultaneously vents the pump when it is not running.

2.3.2 Exhaust Side

Warning The exhaust gases must be lead away safely and - if required - subjected to suitable post-processing.



To prevent the room in which the pump is located from being contaminated by oil mist or the medium pumped, we strongly advise you to connect an exhaust line. This is always needed if the exhaust gas is noxious.

Warning Depending on the application of the pump and the medium pumped, please observe the relevant safety rules and specifications.



To remove oil mist from the pump's exhaust gas, it is recommended to install an exhaust filter or to replace the exhaust box by an exhaust filter box (AFK 1 / AFK 2, see Accessories).

The cross-section of the exhaust line should be at least the same as that of the pump's exhaust port. If the exhaust line is too narrow, excessive pressures may build up in the pump.

Install the exhaust line with a downward slope so as to prevent condensate flowing back into the pump. If this is not possible, insertion of a condensate trap is strongly recommended (see Section 1.3).

If several pumps are connected to a common exhaust line, ensure an adequate cross-section and a non-return valve at the exhaust of each pump.

Warning In order to avoid an inadmissible excess pressure in the exhaust line we generally recommend installing an overpressure protection facility when starting up the pump for the first time.



You can install either an excess pressure valve or a bursting disk (response pressure $p \leq 1500$ mbar, abs.). The corresponding safety device must be installed in a such a way to prevent any damages to property or persons.

On no account may the pump be operated with a blocked or restricted exhaust line. Make sure before start-up that any blinds or similar shut-off devices in the exhaust line on the pressure side are opened and that the exhaust lines are not obstructed by deposits.

The pressure in the exhaust line must be greater than 500 mbar (abs.) so that the pressure differential (in relation to the pumping chamber) needed for lubrication is maintained. It must, however, remain below 1300 mbar (abs.) during operation to avoid damage to the seals of the pump.

2.4 Start-up

The pumps are supplied with the necessary oil charge in ready-to-use condition.

The oil level of the pump can only be checked properly when the pump is running. It must then be in the middle of the oil-level sight glass (7/3).

The pump is designed for perfect start-up at temperatures over 12 °C as per PNEUROP.

Caution Each time after switching the pump on, the oil level must be checked.

2.5 Operation

Warning Rotary piston pumps can attain surface temperatures in excess of 80 °C. There thus exists the danger of receiving burns.



Note the warnings as to potential dangers given on the pump.

The rotary piston pumps can pump gases and vapours. To pump vapours, the gas ballast valve must be open and the pump must have reached its operating temperature.

2.5.1 Pumping of Non-Condensable Gases

If the pump system contains mainly permanent gases, the pump can be operated without gas ballast, provided that the saturation vapour pressure at operating temperature is not exceeded during compression.

If the composition of the gases to be pumped is not known and if condensation in the pump cannot be ruled out, we recommend that the pump be operated pursuant to Section 2.5.2 with the gas ballast valve open.

2.5.2 Pumping of Condensable Gases and Vapours

With the gas ballast valve open and at operating temperature (approx. 70 °C - 95 °C), the rotary piston pump can pump pure water vapour up to the values indicated in the Technical Data.

The gas ballast valve is opened manually (7/2). The running noise of the pump is slightly louder if the gas ballast valve is open.

When vapours are pumped, ensure that the pump has run up for approx. 15 min. with closed intake line and with gas ballast.

Caution Only when the pump has attained its operating temperature can vapour be pumped off up to the permissible limit .

One sign of condensation of vapours in the pump is a rise in the oil level during operation of the pump. At the same time the oil gets turbid, for example by the uptake of water.

When vapours are pumped, the pump must not be switched off immediately upon completion of the process because the condensate dissolved in the pump oil may cause corrosion. To prevent this, the pump must continue to operate with open gas ballast valve and closed intake line until the oil is free of condensate. It is advisable to allow the pump to operate in this mode for at least 30 min. after completion of the process.

Caution When pumping vapours do not use an AFK 1/2. It is better to use an external AF 100-250.

Warning In cycle operation, the pump should not be switched off during the intervals between the individual working phases, but should continue to run (with low power consumption at ultimate pressure) with gas ballast valve open and inlet port closed (if possible via a valve).



Once all vapours have been pumped off from a process (e. g. during drying), the gas ballast valve can be closed in order to improve the attainable ultimate pressure.

2.6 Shutdown and Storage

Warning

- When the pump has been switched off while warm, it may not be switched on immediately again.
- If the pump has been pumping hazardous substances you must make sure that all relevant safety regulations are observed before opening the intake or exhaust flanges.

This applies equally to opening of the oil fill and oil drain plugs.

If required wear suitable protective clothing.



To shut down the pump, disconnect it from the vacuum system using a valve. If vapours or aggressive/corrosive media are pumped, let the pump run for at least another 30 min. with the gas ballast valve open. Then shut it down. The pump is automatically vented within 2 to 5 min.

When using the pump in processes with aggressive or corrosive media, it is advisable to let the pump continue to operate even during long non-working intervals (e. g. overnight) with the intake line closed and the gas ballast valve open. This avoids corrosion when the pump is not running.

If the pump is to be shut down for a prolonged period after having been used to pump aggressive or corrosive media, or if it is to be stored, proceed as follows:

Warning

If hazardous substances were pumped, take suitable precautions.



Drain the oil (see Section 3.3).

Fill the pump with fresh oil (see Section 3.3) and let it run for a while.

Drain the oil again and fill the pump with fresh oil once more (see Section 3.3).

Seal the connecting ports. Special preservation or slushing oils need not be used.

2.7 Switching off through Monitoring Facilities

Warning

When the pump has been switched off while warm by a motor protection switch, for example, you may only switch the pump on again manually after it has cooled down and after having removed the cause for the shut-down.



- When the pump has been switched off while warm, it may not be switched on immediately again.

- If the pump has been pumping hazardous substances you must make sure that all relevant safety regulations are observed before opening the intake or exhaust flanges.

This applies equally to opening of the oil fill and oil drain plugs.

If required wear suitable protective clothing.

3 Maintenance

Warning Disconnect the electrical connections for all disassembly work on the pump. Make absolutely sure that the pump cannot be accidentally started.



If the pump was used for hazardous substances, determine the type of hazard first and take suitable precautions.



Before beginning with any maintenance work you must decontaminate the pump first.



Observe all relevant safety regulations!



Never exchange the oil or the filters while the pump is still warm. Wear suitable protective clothing.



When disposing of used oil, please observe the applicable environmental protection regulations!



If you send a pump to Leybold for repair, please specify all hazardous substances in or around the pump. Please use the special form for this which has been included with these Operating Instructions.

Due to their design, the rotary piston pumps normally require very little maintenance. The necessary work is described in the sections below.

All work on the pump must be carried out by suitably trained personnel. Maintenance or repairs done by inexperienced personnel may affect the life and performance of the pump and may cause problems when filing warranty claims.

LV has practical courses on the maintenance, repair and troubleshooting of rotary piston pumps. Further details are available from LV upon request.

Caution If the pump is employed in highly contaminated ambient air, make sure that its air cooling and the gas ballast facility are not impaired.

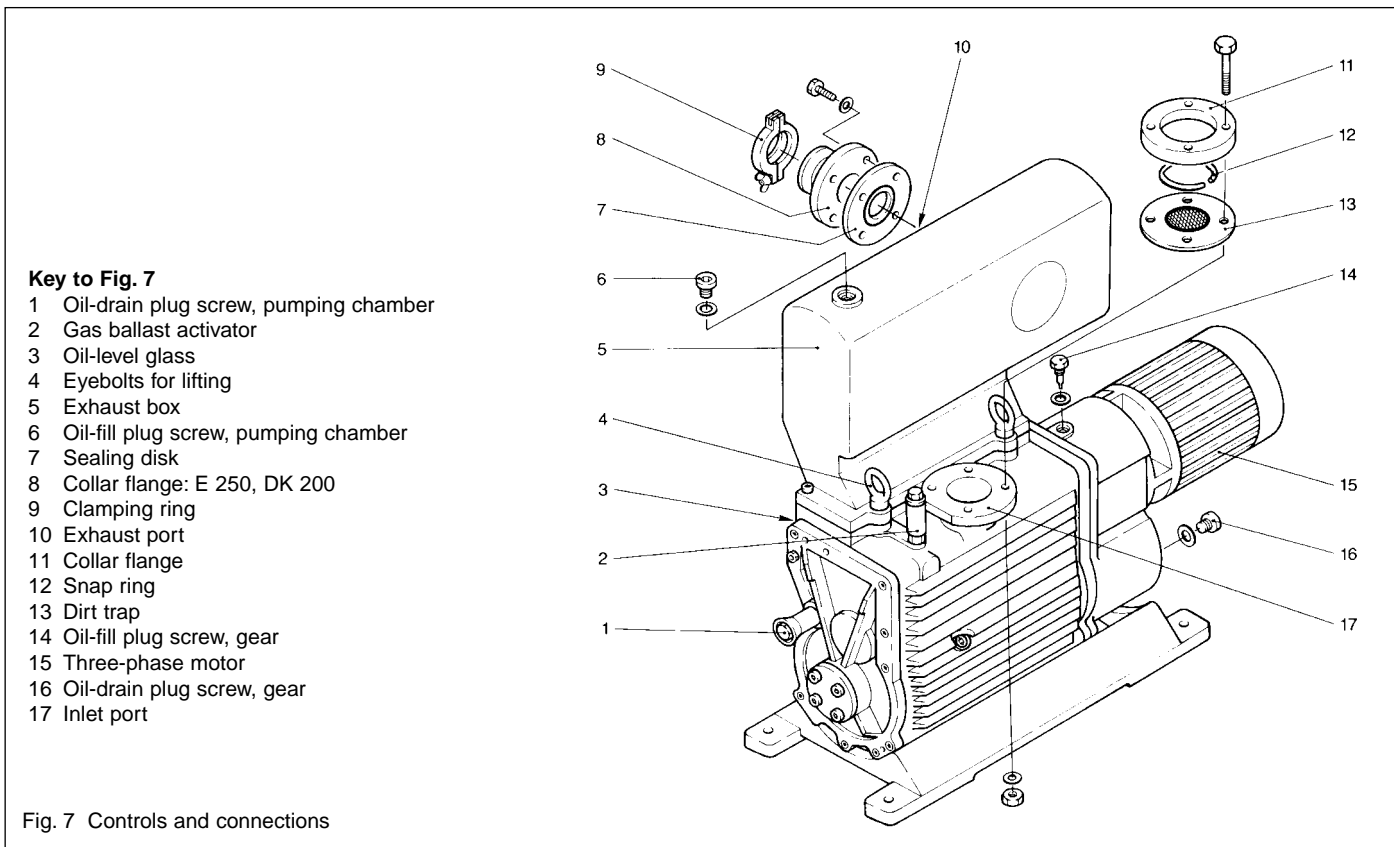
If the pump has been used for corrosive media, we recommend that any maintenance work be carried out immediately so as to avoid corrosion.

Treat all sealing surfaces of the pump with the utmost care.

3.1 Maintenance Schedule

The intervals stated in the maintenance schedule are approximate values for normal pump operation. Adverse ambient conditions and/or aggressive media may necessitate more frequent maintenance.

Maintenance work	Interval	Section
Check the oil level		
Pump	1 day	3.2
Gear	1 week	3.2
Check condition of the oil	depends very much on the process	3.2
1st oil change pump and gear	after 250 operating hours	3.3.1
Subsequent oil changes for the pump	depend very much on the process	3.2
Subsequent oil changes for the gear	1000 operating hours	3.3.2
Cleaning of the dirt trap	1 month	3.4
Cleaning of the valve chamber	6 months	3.5



3.2 Checking the Condition of the Oil and the Oil Level

The **oil level of the pump in operation** must always be between the bottom edge and the middle of the oil-level glass (7/3).

When necessary, shut down the pump and add oil (7/6).

The pump's oil consumption rises in the case of a high gas throughput or operation with open gas ballast valve.

During normal operating conditions, the **oil level in the gear housing does not change**. To check the oil level, shut down the pump. Drain the oil into a measuring beaker (7/16), check the quantity and pour it back in (7/14).

If an increase in the oil consumption is determined you should inform the Leybold Service.

Condition of oil N 62

Normally the oil is clear and transparent. If the oil darkens, it should be changed.

If gases or liquids dissolved in the oil deteriorate the ultimate pressure, the oil may be degassed by letting the pump run for approx. 30 min. with closed inlet port and open gas ballast valve.

When an oil sample is needed so as to determine whether an oil change is required, oil should be discharged via the oil-drain plug (7/1) into a beaker or similar vessel with the pump switched off but still warm.

3.3 Oil Change

3.3.1 Pumping Chamber

Always carry out the oil change when the pump is shut down but still warm.

If there is a risk of the oil being polymerised owing to the connected process, the oil should be changed immediately after operation of the pump.

Shut down the pump and wait for a while; the pump is automatically vented within 2-5 minutes.

Unscrew the oil-drain plug (7/1) and let the used oil drain into a suitable vessel.

When the flow of oil slows down, reinstall the oil-drain plug, briefly start the pump (max. 10 s) and then switch it off. Unscrew the oil drain plugs and drain the remaining oil.

Single-stage pumps (E series) only: Unscrew the oil-drain plug below the oil-level glass and drain the oil. Reinstall the plug with gasket.

Reinstall the oil-drain plug(s) (check the O-ring and gasket ring and replace them if necessary). Remove the plug (7/6) from the oil-fill port.

In the event of considerable contamination, the pump can be flushed as follows.

Caution Use only pump oil for flushing the pump; do not use solvent for this purpose.

Fill the pump with at least half of the quantity of oil needed for operation (see Section 1.3) and let the pump run for approx. 5 min. with the inlet port closed. Then drain the oil. If necessary, repeat this flushing procedure.

Then fill in the oil quantity required for operation (see Section 1.3) and reinstall the oil-fill plug with gasket.

3.3.2 Gear

Shut down the pump.

Unscrew the oil-drain plug (7/16) and let the used oil drain into a suitable vessel. Reinstall the oil-drain plug (7/16) with gasket.

Unscrew the oil-fill plug (7/14), fill in approx. 0.1 ltr oil, reinstall the oil-fill plug and start the pump briefly.

Switch off the pump, drain the oil used for flushing and firmly reinstall the oil-drain plug (7/16) with gasket.

Unscrew the oil-fill plug (7/14) and fill in the required quantity of oil (see Section 1.3 – Technical Data).

Reinstall the oil-fill plug with gasket.

Caution Use only the original oil-fill plug or the proper spare. This plug contains a venting device for avoiding excessive pressure in the gear housing.

3.4 Cleaning the Dirt Trap

In the pump's inlet port there is a wire-mesh filter acting as a dirt trap for contaminants (7/13). It should be kept clean at all times in order to avoid a reduction of the pumping capacity.

For this purpose, disconnect the intake line, remove the dirt trap from the inlet port and rinse it in a vessel using a suitable solvent. Then thoroughly dry it with compressed air.

If the dirt trap is faulty, replace it.

The cleaning intervals depend on requirements. If large amounts of abrasive materials occur, a dust filter should be inserted in the intake line (see Section 1.3).

3.5 Cleaning the Pump

In the case of special operating conditions (intake of particles, high vapour loads, uptake of liquids or similar) we recommend preventive maintenance on the components and the exchange of wearing parts. The intervals for this depend very much on the type of process.

3.6 Disassembling and Reassembling the Pump

Warning This kind of work should be left to trained personnel. At this point we recommend our practical training courses. Please note especially the safety information given in Chapter 3 on page 13.



3.6.1 Preparations

Warning

- Wear suitable protective clothing.
- There exists the danger that someone may slip on spilt oil.
- Ensure compliance with the relevant safety and environmental regulations.
- Please note especially the safety information given in Chapter 3 on page 13.



Disconnect the motor.

Drain the oil (see Section 3.3).

Remove the pump from the vacuum system.

Place the pump in an oil pan to catch any residual oil from the pump during disassembly.

Torque for the screws in Nm

Pinion gear mount	M 10 x 35	55 Nm
Exhaust valve	M 8 x 50	30 Nm
Casing lid		
- left	M 8 x 30	30 Nm
- at the motor	M 8 x 25	30 Nm
Exhaust box	M 8 x 25	30 Nm
Casing lid (DK)	M 8 x 20	30 Nm
Gear box	M 8 x 50	30 Nm

3.6.2 Disassembling the Valves and Oil Level Glass

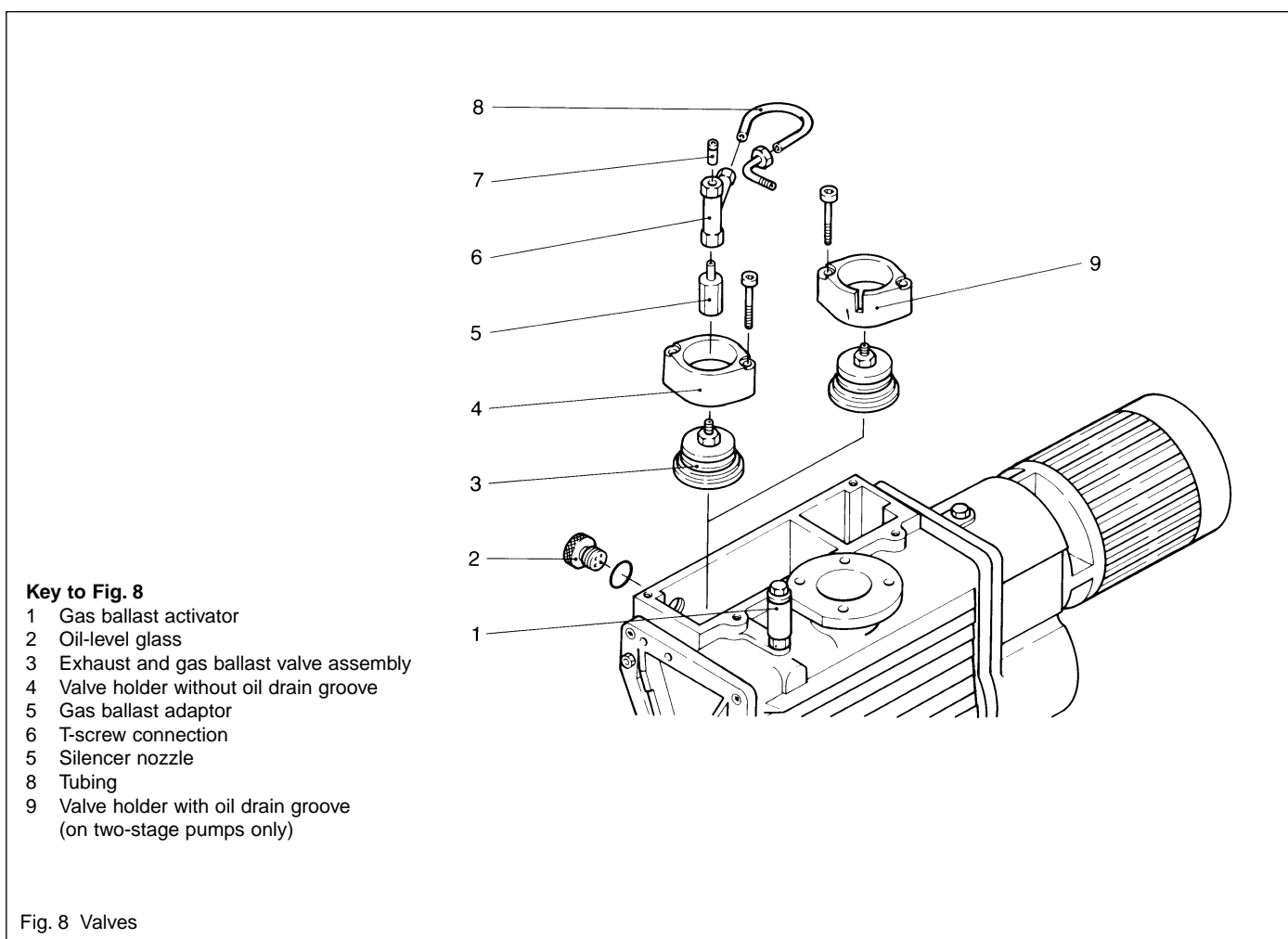
Remove the exhaust box (7/5).

Unscrew the T-screw connections (8/6), tubing (8/8) and adaptor for the gas ballast (8/5).

On single-stage pumps, each pumping chamber has an exhaust valve and a gas ballast valve with tubing. On two-stage pumps, each pumping chamber has an exhaust valve, but only the second stage has a gas ballast valve.

Unscrew the valve holder (8/4) (special tool 9) and remove the exhaust and gas ballast valve assembly (8/3).

Disassemble the oil-level glass (8/2) only if it is very dirty or damaged or has a leak. It can be unscrewed using a socket screw wrench.

**Key to Fig. 8**

- 1 Gas ballast activator
- 2 Oil-level glass
- 3 Exhaust and gas ballast valve assembly
- 4 Valve holder without oil drain groove
- 5 Gas ballast adaptor
- 6 T-screw connection
- 7 Silencer nozzle
- 8 Tubing
- 9 Valve holder with oil drain groove
(on two-stage pumps only)

Fig. 8 Valves

3.6.3 Disassembling the Motor End

(see Fig. 9)

Remove the motor (9/9).

Only if the pinion gear (9/11) is to be replaced: Remove the screw (9/13) and pull off the pinion gear (9/11) (special tool 5). Otherwise, the screw, pinion gear and spacer bushings (9/12) and (9/10) can be left on the drive shaft.

Remove the gasket (9/14).

Remove the gear housing (9/15).

Remove the gasket (9/16).

Remove the retainer ring (9/17).

Pull off the ring gear (9/18) (special tools 4 and 7).

Remove the spacer (9/19).

Note

If the parts (9/20) to (9/26) do not have to be replaced, mark them or place them in the right order for reassembly.

Unscrew the outer race (9/20).

Remove the inner race (9/22) with reverse lock (9/21).

Remove the shim(s) (9/23).

Remove the key from the shaft.

Pull off the ball bearing (9/24) (special tools 6 and 7).

Remove the retainer ring (9/25).

Remove the spacer (9/26).

Caution It is advisable always to replace the L-ring shaft seal (9/27) and the radial shaft seal (9/7).

Pull the L-ring shaft seal (9/27) off from the shaft.

Loosen two screws on the front end plate (9/8) and remove the plate with O-ring (9/5). If the plate cannot be moved, screw 2 nuts onto the protruding threads of the dowel pins and force the plate off.

Remove the radial shaft seal (9/7) from the front end plate.

Pull the slide valve (9/4) out of the pump body.

Pull the piston (9/1) off the cam.

Only if the piston bushings (9/2) are damaged: Force the bushings out of the piston.

Pull the cam (9/3) off the shaft (special tools 1 and 7).

To remove the piston and cam from the middle pumping chamber on E 250 and DK 200, see Section 3.6.5.

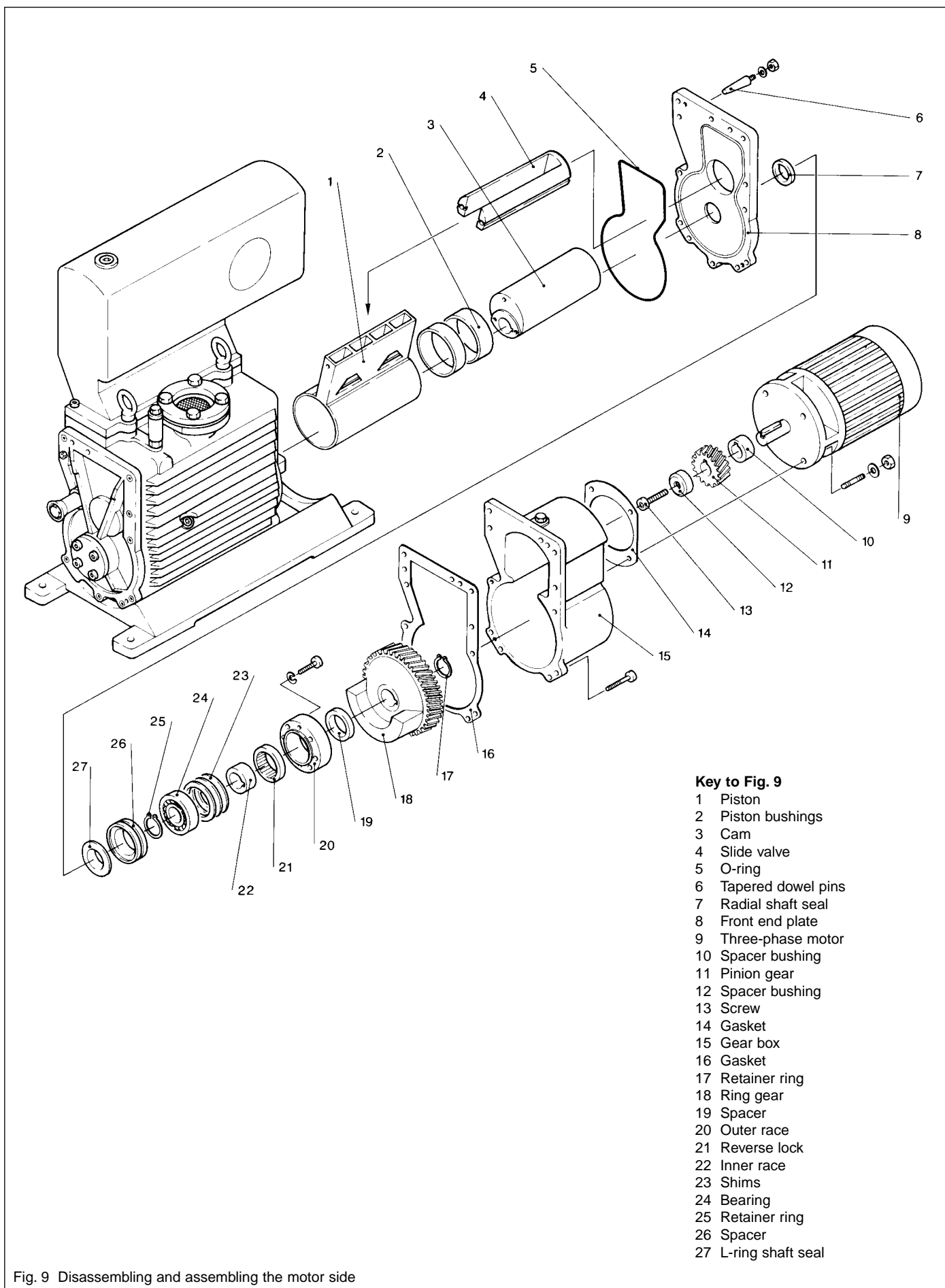


Fig. 9 Disassembling and assembling the motor side

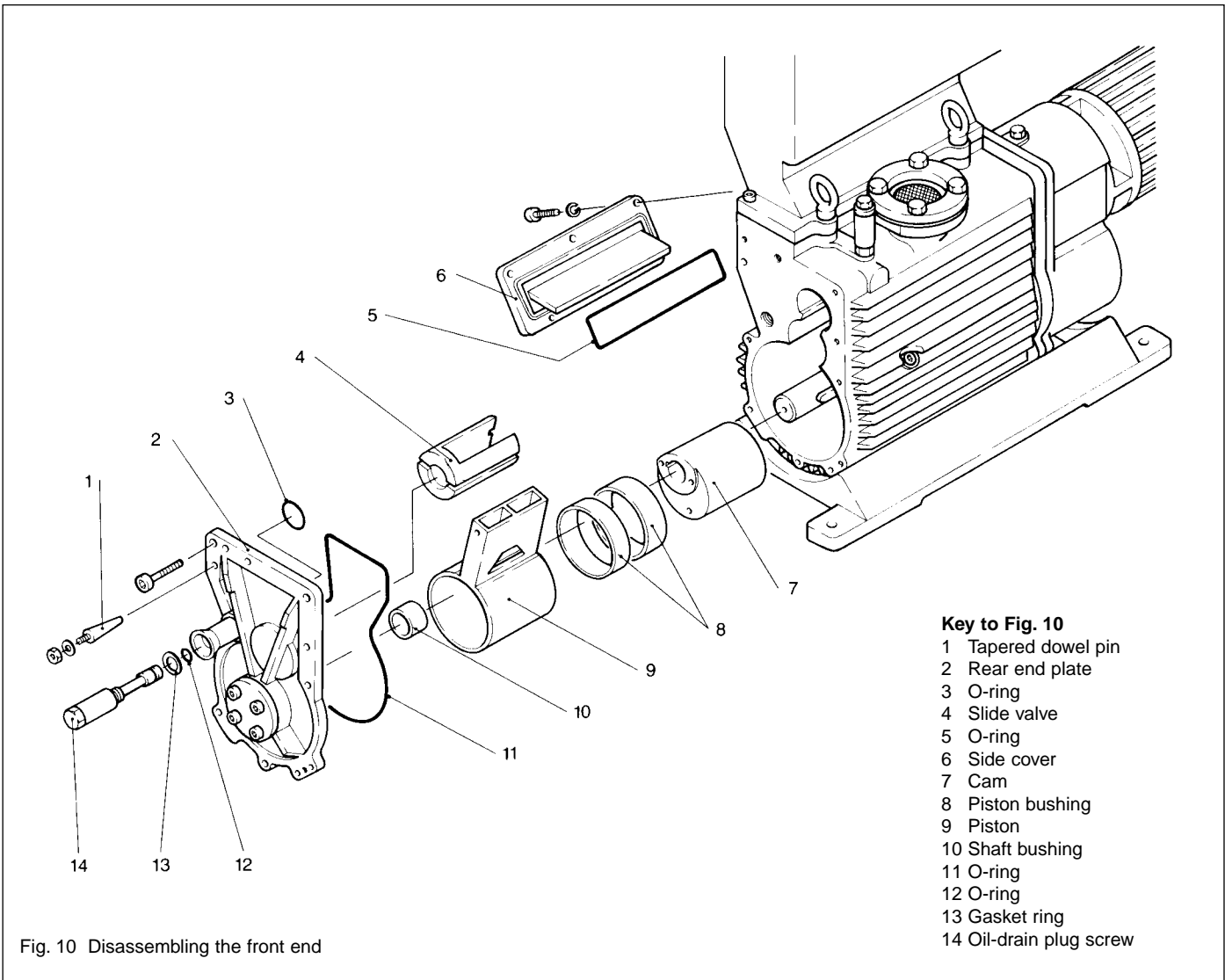


Fig. 10 Disassembling the front end

3.6.4 Disassembling the Front End

Remove the fastening screws of the rear end plate (10/2).

Tighten the nuts on the 2 tapered dowel pins (10/1) until the pins are loose.

Remove the rear end plate (10/2) with O-ring (10/11).

Pull out the slide valve (10/4).

Pull the piston (10/9) off the cam.

Only if the piston bushings (10/8) are damaged: Force the bushings out of the piston. They must be replaced if their Teflon coating is damaged.

Pull the cam (10/7) off the shaft (special tools 1 and 7).

If the shaft bushing (10/10) is damaged, force it out of the rear end plate.

Remove the side cover (10/6) with O-ring (10/5).

Key to Fig. 11

- 1 Shaft bushing
- 2 Intermediate plate
- 3 O-ring
- 4 Slide valve
- 5 Disk
- 6 Piston
- 7 Piston bushing
- 8 Cam
- 9 Loose intermediate plate
- 10 Piston bushing
- 11 Shaft
- 12 Key
- 13 Screw plug
- 14 Tapered pin
- 15 Foot

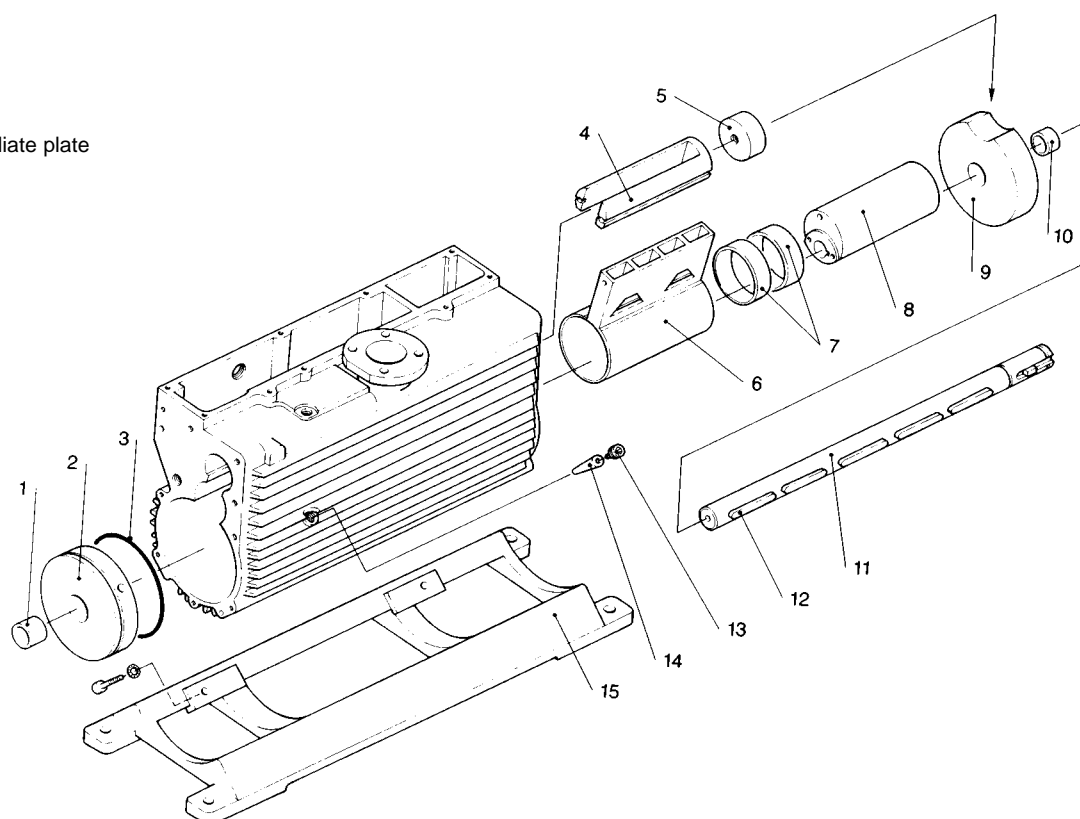


Fig. 11 Removing the shaft and intermediate plate(s); removing the middle piston and cam on E 250 and DK 200

3.6.5 Removing the Shaft and Intermediate Plate(s)

On E 250 and DK 200 only: These two pump types have 3 pumping chambers. The two chambers at the motor end are separated by a loose intermediate plate (11/9).

Remove the disk (11/5).

Pull the loose intermediate plate (11/9) out of the pump body (special tools 1 and 7).

If the shaft bushing (11/10) is damaged, force it out of the loose intermediate plate.

Pull the slide valve (11/4) out of the pump body.

Pull the piston (11/6) off the cam (11/8).

Pull the cam off the shaft (special tools 1 and 7).

If the piston bushings (11/7) are damaged, force them out of the piston (11/6).

For all pump types:

Remove the key (11/12) and pull the shaft (11/11) out toward the motor end.

Unscrew the screw plug (11/13) and pull out the tapered pin (11/14) (special tool 2).

Place the pump body on its side.

Unscrew the foot (11/15).

Unscrew two more screw plugs under the pump and pull out two tapered dowel pins.

Pull out the intermediate plate (11/2) with O-ring (11/3) (special tool 8).

If the shaft bushing (11/1) is damaged, force it out of the intermediate plate.

Key to Fig. 12

- 1 L-ring shaft seal (8/27)
- 2 Oil flow holes
- 3 Circular spring on ID of radial shaft seal
- 4 Radial shaft seal (8/7)
- 5 Bottom surface of bearing well
- 6 Spacer (8/26)
- 7 Front end plate (8/8)
- 8 Retainer ring (8/25)
- 9 Bearing (8/24)
- 10 Ring gear (8/18)
- 11 Shims (8/23)
- 12 Retainer ring (8/17)
- 13 Key
- 14 Inner race (8/22)
- 15 Spacer (8/19)
- 16 Reverse lock (8/21)
- 17 Outer race (8/20)

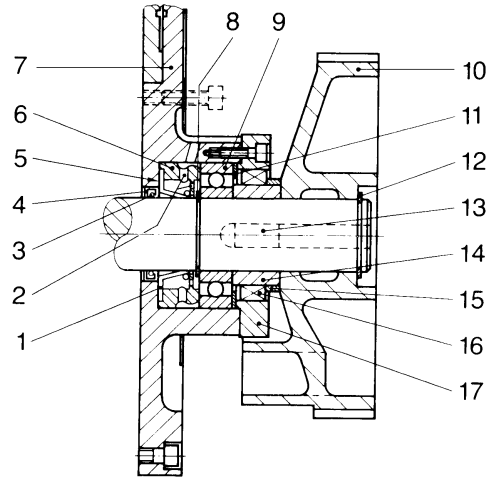


Fig. 12 Cross-section of the bearing in the motor lid (see also Fig. 9)

3.6.6 Cleaning the Parts and Checking for Wear

Inspect all surfaces for scratches, marks, running-in tracks or other damage. If possible, carefully smooth the surfaces with emery paper.

Caution If the parts are considerably damaged, especially sealing surfaces or keyways, replace them. In the case of seals and O-rings always use new parts.

Using suitable wires, ensure that all oil channels are clear of dirt. Blow compressed air through the channels and clean all parts with a suitable solvent and then dry them thoroughly with compressed air.

Check that all keys are clean and fit snug in their keyways and that the cams and the ring gear can be pushed without difficulty onto the shaft with its keys. If necessary, rub the parts with emery paper and then clean them again.

Unscrew and clean the gas ballast valve. All parts, including gaskets and O-rings needed for assembly, should be moistened with pump oil.

3.6.7 Reassembling the Pump

Reassemble the pump in the reverse sequence.

Observe the following:

Inserting the intermediate plate

When pulling the intermediate plate (12/2) back in (special tool 8), ensure that the O-ring (12/3) is not damaged.

Counterbalancing

When installing the ring gear and cams, make sure that the cams and ring-gear counterbalance are fitted alternately at the top and bottom so that the pump remains counterbalanced (see Fig. 3).

Inserting the radial shaft seal

Using a suitable tool, force in the radial shaft seal from the interior side of the front end plate (for position of radial shaft seal, see Fig. 12).

Selecting the shims

One or more shims (9/23) have to be inserted between the ball bearing (9/24) and the outer race (9/20). To determine the correct thickness, proceed as follows:

As a trial, mount one or more 1 mm thick shims.

Attach the outer race, but tighten the screws only by hand.

Using a thickness gauge, measure the gap between the front end plate and outer race.

The correct thickness of the shims is obtained as follows:
1.00 mm minus gap measured plus 0.10 mm

Remove the 1 mm thick shims mounted for trial purposes and insert shims of the thickness calculated.

Example: Gap measured is 0.70 mm

Thickness of shim(s) required:

$$1.00 \text{ mm} - 0.70 \text{ mm} + 0.10 \text{ mm} = 0.40 \text{ mm}$$

Mounting the front end plate (9/8) and rear end plate (10/2)

Before sliding the front end plate with radial shaft seal onto the shaft and mounting the L-ring shaft seal, push the sleeve tool (special tool 3) onto the shaft.

Place the O-ring (9/5) or (10/11) into the groove of the end plate and secure it with some vacuum grease, if necessary. Remove the nuts and washers from the tapered dowel pins (9/6) or (10/1) and fit the pins in the end plate.

Carefully push on the end plate with radial shaft seal over the sleeve tool. Install the fastening screws of the end plate without tightening them fully. Carefully drive in the pins and tighten the fastening screws.

Inserting the L-ring shaft seal (9/27) and spacer (9/26)

Carefully slide the L-ring shaft seal over the sleeve tool. The end of the seal with the larger diameter should face the center of the pump.

When withdrawing the sleeve tool, hold the L-ring shaft seal tight.

The spacer (9/26) has an oil channel, which must point upward when installed.

Inserting the reverse lock

Secure the screws of the outer race (9/20) with Loctite 271 and tighten them crosswise.

The shoulder of the reverse lock (9/21) faces outward. Looking from the motor end, the shaft must only turn counterclockwise.

If it can be turned in both directions, the reverse lock is faulty; if it can be turned clockwise only, the reverse lock is the wrong way round.

Inserting the ring gear (9/18)

The side of the ring gear bearing with the lead weight faces the center of the pump.

Do not force on the ring gear with a hammer. It can be carefully warmed to make it easier to mount (150 °C max.).

The shaft has a hole into which a bolt can be screwed for forcing on the ring gear. After attaching the retainer ring (9/17), draw back the ring gear as far as this ring (special tool 4).

Fitting the valve

Place the gas ballast valve (8/3) on the valve seat without exposing it to mechanical strain. The threaded holes for attaching the valve holder (8/4) must be free of grease and clean. Fit the valve holder with the valve. The hex. socket screws used to attach the valve holder must be degreased and cleaned before they are inserted. Finally apply Loctite 271 to the threads.

Screw in the hex. socket screws. The amount of torque is given in the Table on page 16.

Caution Do not mechanically stress the valve holder on one side. If this is not observed the pump may be completely damaged.

Before starting up the pump you must fill the gear space and the pump chamber with oil.

3.7 Leybold Service

If a pump is returned to LEYBOLD, indicate whether the pump free of substances damaging to health or whether it is contaminated.

If it is contaminated also indicate the nature of the hazard. For this you must use the form which has been included at the end of these Operating Instructions.

A copy of this form is reproduced at the end of these Operating Instructions: "Declaration of Contamination of Vacuum Instruments and Components".

Please attach this form to the pump or enclose it with the pump.

This declaration of contamination is required to meet German law and to protect our personnel.

LEYBOLD must return any pumps without a "Declaration of Contamination" to the sender's address.

Warning The pump must be packed in such a way, that it will not be damaged during shipping and so that any contaminants are not released from the package.



4 Troubleshooting

Fault	Possible cause	Remedy	Repair note
Pump does not start.	<p>Motor is connected incorrectly. Reverse lock prevents start-up.</p> <p>Blocked exhaust line. Operating voltage does not match motor rating. Motor protection switch is set incorrectly. Motor is malfunctioning. Oil temperature below 12 °C.</p> <p>Oil is too thick. Installed exhaust filter or exhaust line is clogged. Too much oil has entered motor from gear housing.</p> <p>Gear or bearings are obstructed or malfunctioning. (See fault "Pump is seized up").</p>	<p>Connect the motor correctly (wiring diagram in junction box). Interchange two of the input leads at motor junction box or install the reverse lock correctly. Remove the blockage. Replace the motor. Set the motor protection switch correctly. Replace the motor. Heat the pump and pump oil or use different oil. Change the oil. Replace the filter, clean the exhaust line. Repair the shaft seal on the motor, fill correct oil quantity into gear housing. Repair the pump. Repair the pump.</p>	
Pump does not reach ultimate pressure.	<p>Pump is too small. Measuring technique or gauge is unsuitable. External leak 1). Installed SECUVAC valve closes. Exhaust valve is malfunctioning. Oil is unsuitable. Gas ballast lines in valve chamber have a leak. Gaskets at oil-drain plug (9/14) are faulty. Inadequate lubrication of pumping chamber due to clogged oil lines. L-ring shaft seal and/or radial shaft seal is faulty. Inadequate lubrication of pump due to - insufficient oil - clogged optional oil filter. Internal pump parts are excessively worn. Oil reservoir has not been mounted correctly. Improperly fitted pistons and vanes after a repair.</p>	<p>Check process data, possibly change the pump. Use correct method of measurement and instruments. Repair pump. Repair valve. Repair valve. Change the oil (possibly degas). Repair gas ballast lines. Replace gaskets. Clean the pump.</p> <p>Repair the pump.</p> <p>Top up oil. Clean the filter. Repair the pump, replace worn parts. Install the oil reservoir correctly. Repair the pump.</p>	
Pumping speed of the pump is too low.	<p>Dirt trap in the inlet port is clogged.</p> <p>Installed dust filter is clogged. Installed exhaust filter is clogged. Connecting lines are too narrow or long (throttling).</p> <p>Pump is too cold. Internal pump parts are excessively worn. Leak in the intake line.</p>	<p>Clean the dirt trap; Precaution: install a dust filter in intake line.</p> <p>Clean the filter. Replace the filter elements. Use adequately wide and short connecting lines. The diameter of the connecting line should be the same as for the connections at the pump. Let the pump run warm with open gas ballast valve. Repair the pump; replace the worn parts. Leak detection and removal of the leak.</p>	
After switching off the pump under vacuum, pressure in system rises too fast.	<p>System has a leak. SECUVAC valve is not installed or is obstructed.</p>	<p>Check the system. Install a SECUVAC valve or repair it.</p>	
Pump is unusually noisy.	<p>Silencer nozzle is clogged due to - too much oil in the valve chamber - contamination Parts are worn. (shaft bushing, cam, ring gear, pinion lammellae and piston). Cam or ring gear not properly mounted. Motor bearing faulty. Motor fan scrapes along the fan cowl. Foot of the pump is loose. Valve disc faulty. Grooves in the shaft and the cam are worn out. Connecting screw for the oil filter facility has a leak. Wrong balancing (faulty ring gear).</p>	<p>Drain oil. Clean nozzle. Repair the pump.</p> <p>Repair the pump. Exchange the motor. Exchange the fan cowl or repair. Fix the foot of the pump. Exchange the valve. Exchange the faulty components. Seal the connecting screw (O-ring). Repair the pump.</p>	

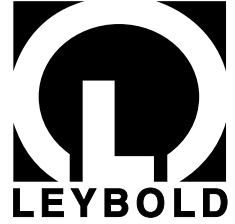
Fault	Possible cause	Remedy	Repair-note
Pump gets hotter than previously observed.	Air intake or discharge surfaces of the cooler are obstructed or dirty. Ambient or intake temperatures are too high. Oil cycle is not working. Oil has broken down or is contaminated. Incorrect oil level, not enough oil in the pump. Installed exhaust filter or exhaust line is obstructed. Exhaust valve is malfunctioning. Continuous intake pressure > 200 mbar. Gas ballast lines have a leak. Excessive internal friction due to faulty parts. Continuous intake pressure > 500 mbar (absolute). - Insufficient lubrication.	Set up the pump correctly or clean the cooler. 40 °C max. are permissible. Clean or repair the oil lines and channels. Change the oil. Top up oil, note correct oil level. Replace the exhaust filter or clean the exhaust line. Repair the valve. Change the operating conditions, continuous intake pressure < 200 mbar. Repair the lines. Repair the pump. Change the operating conditions, continuous intake pressure < 500 mbar.	
Oil consumption is too high, oil mist in the exhaust.	Installed exhaust filter is clogged or damaged. Too much oil. Intake pressure is too high. Vacuum system or lines have a leak. Exhaust valve is faulty.	Replace the exhaust filter. Drain the excess oil. Alter the operating conditions. Find the leak and seal it. Replace the valve.	
Oil in the intake line or vacuum vessel.	Oil comes from vacuum system. SECUVAC valve is not installed or is obstructed. Sealing surfaces of SECUVAC valve are damaged or dirty. Motor turns in the wrong direction. Too much oil. Vapour pressure of oil is too high. Excessive pressure in exhaust line. Oil-drain plug or its O-ring is faulty.	Check the system. Install a SECUVAC valve or repair it. Clean or repair the valve. Interchange two of the input leads at motor junction box; replace the reverse lock. Drain the excess oil. Change the oil. Clear the exhaust line or clean the installed exhaust filter. Replace the oil-drain plug or O-ring.	
Oil is turbid.	Condensation in the pump due to - too much vapour - pump too cold. Exhaust line is not installed correctly.	Degas the oil or change the oil and clean the pump; precaution: open gas ballast valve or insert a separator. Check the operating conditions ahead and after the pump Install the exhaust line with a downward slope or install a condensate trap. Check operating conditions (vapour tolerance).	
Oil is unusually dark.	Oil has broken down. Oil is too hot.	Change the oil. Change the oil (see fault "Pump gets hotter than previously observed."). Check operating conditions.	
Pump loses oil.	Radial shaft seal is faulty. Too much oil in gear housing. Oil-drain plugs are not tight. Gaskets are damaged. Impact panel in the exhaust box is faulty	Repair the pump. Drain the oil, fill in correct oil quantity. Replace the gaskets of oil-drain plugs or the oil-drain plugs. Replace the gaskets. Repair the impact panel.	
Pump is seized up.	Oil has broken down due to oil not being changed often enough or to pump overheating. Corrosion of metal surfaces due to condensation in pump. Oil has become resinified. Inadequate lubrication of pumping chamber due to clogged oil channels. Foreign particles in the pump.	Repair the pump; precaution: change the oil more often or do not let the pump get so hot (see fault "Pump gets hotter than previously observed."). Repair the pump; precaution: run the pump with gas ballast or install a condensate trap. Repair the pump; precaution: install an oil filter or use different oil. Repair the pump. Use an intake filter.	

*) This column refers to the section in the Operating Instructions that contains the applicable repair information.

1) Bubble test. Let the pump run at operating temperature with degassed oil, without gas ballast and with closed inlet port. Immerse the exhaust line in a vessel with water. If a steady flow of bubbles appears, the pump has an external leak.



EC Declaration of Conformity



We - Leybold Vacuum GmbH - herewith declare that the products defined below meet the basic requirements regarding safety and health of the relevant EC directives by design, type and the versions which are brought in to circulation by us.

In case of any products changes made without our approval, this declaration will be void.

The products conform to the following directives:

- EC Directive on Machinery (98/37/EG)
- EC Directive on Low-Voltages (73/23)+(93/68/EWG)
- EC EMC Directive (89/336/EWG)
(91/263/EWG) + (92/31/EWG) + (93/68/EWG)

Designation of the products: Rotary piston pump

Types: E 250;
DK 200

Cat. Nos.:

105 36
111 16
895 08
895 09
895 10
166 17
166 37

Applied harmonised standards:

- | | |
|--------------------------|-------|
| • DIN EN 292 Part 1 | 11.91 |
| • DIN EN 292 Part 2 | 06.95 |
| • DIN EN 1012 Part 2 | 07.96 |
| • DIN EN 60 204 Part 1 | 11.98 |
| • DIN EN 50 081 - Part 1 | 03.93 |
| • DIN EN 50 081 - Part 2 | 03.94 |
| • DIN EN 50 082 - Part 1 | 11.97 |
| • DIN EN 50 082 - Part 2 | 02.96 |

Applied national standards and technical specifications:

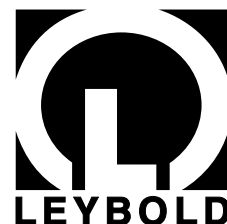
- | | |
|--------------|------------|
| • DIN 31 001 | April 1983 |
|--------------|------------|

Cologne, October 28, 2002

Hauck, BU Head SPS
Division Industrial

Cologne, October 28, 2002

Dr. Beyer, Development Head SPS
Division Industrial



EEC Manufacturer's Declaration

in the sense of the Directive on Machinery 89/392/EEG, Annex IIb

We – Leybold Vacuum GmbH – herewith declare that operation of the incomplete machine defined below, is not permissible until it has been determined that the machine into which this incomplete machine is to be installed, meets the regulations of the EEC Directive on Machinery.

Designation of the products: Rotary piston pump

Types: E 250;
DK 200

Cat. Nos.: 166 17
166 37

Applied harmonised standards:

- DIN EN 292 Part 1 11.91
- DIN EN 292 Part 2 06.95
- DIN EN 1012 Part 2 07.96
- DIN EN 60 204 Part 1 11.98
- DIN EN 50 081 Part 1 03.93
- DIN EN 50 081 Part 2 03.94
- DIN EN 50 082 Part 1 11.97
- DIN EN 50 082 Part 2 02.96

Applied national standards and technical specifications:

- DIN 31 001 April 1983

Cologne, October 28, 2002

Hauck, BU Head SPS
Division Industrial

Cologne, October 28, 2002

Dr. Beyer, Development Head SPS
Division Industrial



Declaration of Contamination of Compressors, Vacuum Pumps and Components

The repair and / or servicing of compressors, vacuum pumps and components will be carried out only if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer can refuse to accept any equipment without a declaration. A separate declaration has to be completed for every single component.

This declaration may be completed and signed only by authorised and qualified staff.

Customer/Dep./Institute: _____
Address: _____

Person to contact: _____
Phone: _____ **Fax:** _____
Order number of customer: _____

Reason for returning the item/s

A. Description of the equipment (machine or component)

Type: _____
Catalogue number: _____
Serial number: _____
Type of oil used: _____

Ancillary equipment

B. Condition of the equipment (machine or component)

	Yes	No	Not known
1. Has the equipment been used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Drained (product/service fluid)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. All openings sealed airtight	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Purged:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cleaning agent: _____			
Method of cleaning: _____			

C. Description of processes / substances (Please fill in absolutely)

1. What substances have come into contact with the equipment:
 Trade name, chemical name of service fluids and substances processed, properties of the substances according to safety data sheet (toxic, inflammable, corrosive, radioactive)

	Trade name:	Chemical name:	Properties:
a)			
b)			
c)			
d)			

2. Are these substances harmful? Yes No Not known
 3. Dangerous decomposition products when thermally loaded Yes No Not known

Which: _____

Components contaminated by micro biological, explosive or radioactive products will not be accepted without written evidence of decontamination.

D. Legally binding declaration

I/we hereby declare that the information supplied on this form is accurate and sufficient to judge any contamination level.

Name of authorised person (block letters): _____

_____ date

_____ signature of authorised person

_____ firm stamp

Copies: Page 1 (white) to manufacturer or representative - Page 2 (yellow) attach to consignment packaging securely - Page 3 (blue) copy for file of sender

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