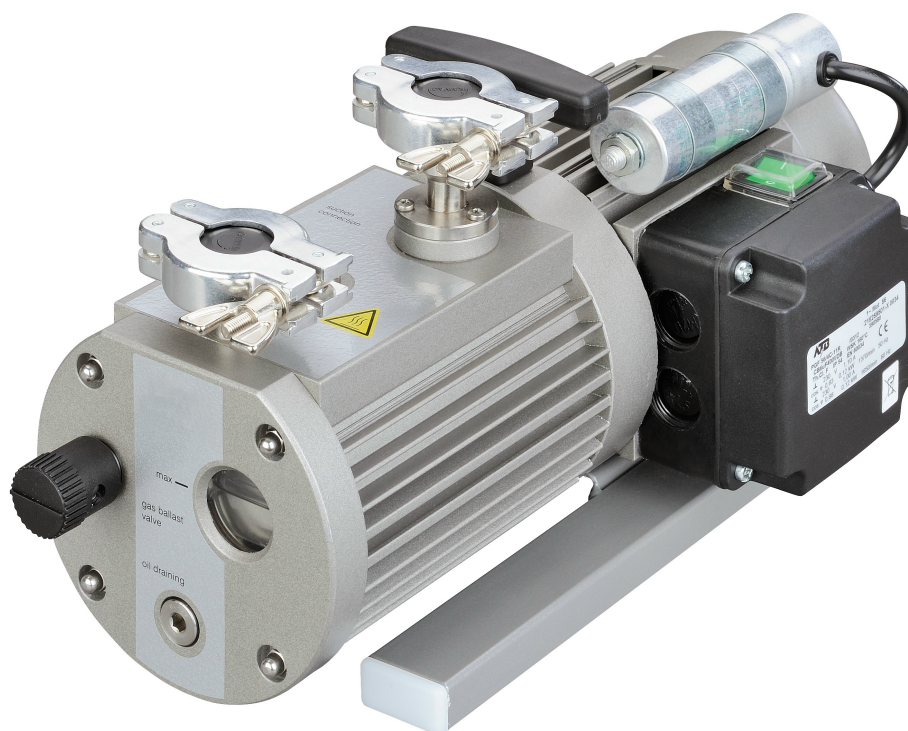


Operation Manual (EN)

WELCH
by Gardner Denver

Translation of the german original manual



Rotary Vane Pump – two-stage

Type PK 2 DC

We are constantly working on the further development of all our product types.
Reprinting or reproduction of this manual, including extracts, is not allowed without the prior written permission of Co. Gardner Denver Thomas GmbH.
All rights under the copyright laws are expressly reserved by Co. Gardner Denver Thomas GmbH.
We reserve the right to make changes and amendments.

Gardner Denver Thomas GmbH
Am Vogelherd 20
98693 Ilmenau
Germany
T +49 3677 604 0
F +49 3677 604 131
welch-ilmvace@gardnerdenver.com
www.ilmvac.com

Customer Support +49 3677 604 0

Contents

1	Important Information.....	5
1.1	General Information	5
1.2	Target Groups	5
1.3	Intended Use.....	5
1.4	Use for an Unauthorized Purpose	5
1.5	Safety Devices	6
1.6	Meaning of the Warning notes	6
1.7	Product Standards, Safety Regulations.....	6
2	Basic Safety Instructions	7
2.1	General Information	7
2.2	Electricity	7
2.3	Mechanical Systems	7
2.4	Hazardous Substances	8
2.5	High Temperatures	8
3	Description	9
3.1	Design	9
3.1.1	Advantages	9
3.2	Area of Application	10
3.3	Function	10
3.3.1	Working Principle	10
3.3.2	Pressure oil lubrication.....	11
3.3.3	Vacuum-tightness on switching off	11
3.3.4	Gas ballast	11
3.4	Scope of Delivery	12
3.5	Accessories optional	12
3.5.1	Overview and order numbers.....	12
3.5.2	Oil mist filter OME	13
3.5.3	Activated charcoal filter AKF.....	13
3.5.4	Condensate separator PT	13
3.5.5	Types of oil.....	14
3.5.5.1	Features and applications	14
3.5.5.2	Technical data.....	14
4	Technical Data.....	15
4.1	Dimensional drawing.....	15
4.2	Intake Pressure / Pumping Speed – Diagram	15
4.3	Device data	16
5	Installation and Operation.....	17
5.1	Unpacking	17
5.2	General references	17
5.3	Installation and Connection.....	17
5.4	Connecting to the electricity supply	18
5.4.1	Type of motor protection	18
5.5	Selecting the operating oil.....	18
5.5.1	Importance for the choice of the right oil.....	18
5.5.2	Oil for drawing off oxygen	19
5.6	Operation	20
5.6.1	Starting-up.....	20
5.6.1.1	Oil level	20
5.6.1.2	Operating temperature.....	20

Contents

5.7	Use of the gas ballast when switching on	20
5.7.1	Operation with gas ballast when drawing off condensable vapours	21
5.7.2	Closing down	22
5.8	Storage	22
5.9	Scrap Disposal	22
6	Maintenance and Servicing	23
6.1	Maintenance Performed by the User	23
6.1.1	Oil level control	23
6.1.2	Topping-up the oil	23
6.1.3	Oil check	24
6.1.4	Oil change	24
6.1.4.1	Draining the oil	24
6.1.4.2	Filling up with oil	25
6.1.4.3	Flushing	25
6.2	Changing the oil type	25
6.3	Maintenance by the Manufacturer	26
6.3.1	Servicing	26
6.4	Damage Report	26
7	Troubleshooting	27
8	Spare Parts Overview	28
8.1	Seal kit	28
8.2	Service kit	28
8.3	Exploded view	29
8.3.1	Spare parts list	30

EC Declaration of Conformity

1 Important Information

1.1 General Information

The Rotary Vane Pumps conform to the following directives:

2006/95/EC	Low Voltage Directive
2006/42/EC	Machinery Directive
2004/108/EC	Electromagnetic Compatibility Directive

The CE sign is located on the rating plate. Observe the binding national and local regulations when fitting the pump into installations!

Our products are sold worldwide and can therefore be equipped with the typical national plugs and for the various voltages. You will find more information about the available pump designs on our web page in the internet.

1.2 Target Groups

This Operating Manual is intended for the personnel planning, operating and maintaining Rotary Vane Pumps.

This group of people includes:

- Designers and fitters of vacuum apparatus
- Employees working on commercial laboratory and industrial vacuum technology applications and
- Service personnel for rotary vane pumps.

The personnel operating and maintaining the rotary vane pumps must have the technical competence required to perform the work that has to be done.

The user must authorize the operating personnel to do the work that has to be done.

The personnel must have read and understood the complete Operating Manual before using the rotary vane pumps.

The Operating Manual must be kept at the place of use and be available to the personnel when required.

1.3 Intended Use

- The layout of the rotary vane pump must be appropriate for the conditions of use. The user bears the sole responsibility for this.
- The rotary vane pump may only be operated under the conditions stated
 - in the "Technical Data" section
 - on the type plate and
 - in the technical specification for the order concerned

1.4 Use for an Unauthorized Purpose

It is forbidden to use the pump for applications deviating from the technical data stated on the type plate or the conditions stated in the supply contract, or to operate it with missing or defective protective devices.

Important Information

1.5 Safety Devices

Measures such as the following are for the safety of the operating personnel:

- electrical connection with a protective conductor (operating mode S1) and an earthing plug
- Motor protection device (thermal)
- "Hot Surface" label on the pump body - warning notice 

The rotary vane pump must not be operated without these elements.

1.6 Meaning of the Warning notes

Take note of the warning notes. They are in the following box:

	CAUTION ! / WARNING !
Hazard which may lead to serious injuries or material damage.	

1.7 Product Standards, Safety Regulations

Rotary Vane Pumps meet the following product standards:

DIN EN ISO 12100-1:2004	Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
DIN EN ISO 12100-2:2004	Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles
DIN EN ISO 13857:2008-06	Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs
DIN EN 1012-2	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps
DIN EN ISO 2151	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
DIN EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
DIN EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
DIN EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
DIN EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
DIN EN 50110-1	Operation of electrical installations
Directive 2012/19/EC	Electrical and electronics - old devices (WEEE)
Directive 2011/65/EC	Dangerous materials in electrical and electronics devices (RoHS)
China - RoHS	Environment protection law - China 2007-03

The following additional safety regulations apply in the FR Germany:

BGV A3	Electrical equipment and operating materials
VBG 5	Power-driven machines
BGR 120	Guidelines for laboratories
BGI 798	Hazard assessment in the laboratory
BGG 919 (VBG 16)	Accident prevention regulations for "compressors"
BGR 189 (BGR 195;192;197)	Use of protective working clothes

Observe the standards and regulations applying in your country when you use the rotary vane pumps.

2 Basic Safety Instructions

2.1 General Information

Warning notices must be observed. Disregarding them may lead to damage to health and property.

The Rotary Vane Pumps must be operated by personnel who can detect impending dangers and take action to prevent them from materialising.

The manufacturer or authorized authorised workshops will only service or maintain the Rotary Vane Pump if it is accompanied by a fully completed damage report. Precise information about the contamination (also negative information if necessary) and thorough cleaning of the Rotary Vane Pump are legally binding parts of the contract.

Contaminated Rotary Vane Pumps and their individual parts must be disposed of in accordance with the legal regulations.

The local regulations apply in foreign countries.

2.2 Electricity

Rotary vane pumps of operation mode S1 are supplied. Please note that the testing must be repeated in accordance with DIN EN 0105, DIN EN 0702 and BGV A 2 in case of portable devices of operation mode S1. The local regulations apply in foreign countries.

Please note the following when connecting to the electrical power supply system:

- The electrical power supply system must have a protective connector according to DIN VDE 0100-410 (IEC 60364-4-41).
- The protective connector must not have any breaks.
- The connecting cable must not be damaged.

2.3 Mechanical Systems

Improper use can lead to injuries or material damage. Observe the following instructions:

- Only operate the rotary vane pumps with the specified flange-mounting components.
- Hazardous substances must be separated out as far as this is technically possible before they reach the pump.
- External mechanical stresses and vibrations must not be transmitted to the pump. Only use flexible vacuum hoses for connecting Rotary Vane Pumps.
- The pump must not be used to suck up fluids. Lay the exhaust pipe so that it slopes downwards, so allowing condensate to flow out of the pump. Collect the condensate and dispose of it in an environmentally compatible manner.
- Maintain a space of least 20 mm between the pump and adjacent parts in order to enable the pump to cool.



CAUTION !

Solid particles in the pumping medium impair the pumping action and can lead to damage. Prevent solid particles penetrating into the pump!

Basic Safety Instructions

2.4 Hazardous Substances

	CAUTION !
The operating company bears the responsibility for the use of the rotary vane pump.	

Hazardous substances in the gases to be pumped can cause personal injuries and property damage. Pay attention to the warning notices for handling hazardous substances.

The local regulations apply in foreign countries.

Combustible and explosive Gases

Examine before switching on whether that can form gas combustible gas/air mixtures which can be promoted! Consider the regulations of the guideline 1999/92/EC.

It is not permitted to pump gases that are combustible or prone to explosion.

Aggressive gases

The rotary vane pumps are not certified according to ATEX guidelines 94/9/EC.

Poisonous gases

Use a separator when pumping poisonous or harmful gases. Prevent such substances from leaking out of the appliance or pump. Treat these substances according to the applicable environmental protection regulations.

Test the strength and leak-tightness of the connecting lines and the connected apparatus. Prevent environmental poisons, e.g. mercury, getting into the rotary vane pumps.

Fulfil the requirements, for example:

- German Hazardous Substances Regulation (GefStoffV) of 01. December 2010
- Regulations 2006/121/EC (classification, packaging and identification of hazardous substances),
- Manufacturer's safety data sheets on hazardous substances.

2.5 High Temperatures

The rotary vane pump may heat up as a result of the temperature of the gas being pumped and through intrinsic heating. The temperature of the rotary vane pump heads can reach 80 °C during operation.

Prevent the following maximum permissible temperatures from being exceeded.

- + 40 °C for the environment, and
- + 20 °C for the gas to be pumped.

The motor is protected against overload by a suitable protective device.

3 Description

3.1 Design

The PK 2 DC rotary vane pump is an oil-sealed, two-stage rotary vane vacuum pump. The effective pumping speed is 2 m³/h.

The drive motor is directly flange-mounted to the pump housing. The bearings of the internal components are sliding bearings with force-fed lubrication.

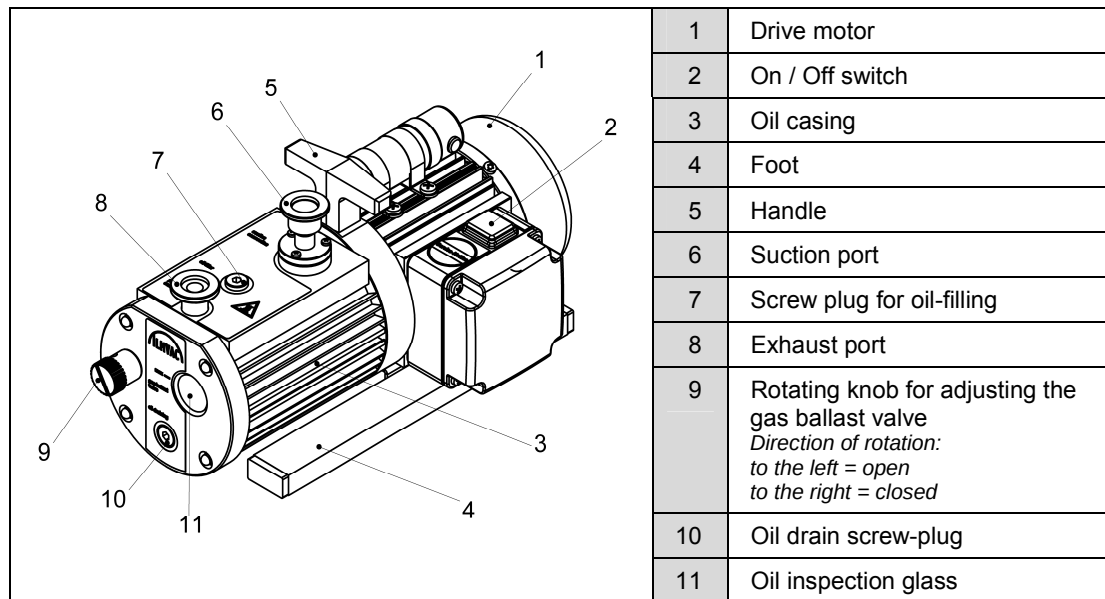


Fig. 1 Rotary Vane Pump PK 2 DC

3.1.1 Advantages

- extremely compact design and consequent small size and low weight
- automatic ventilation after switching off the pump (The pump is therefore not vacuum-tight when switched off, oil can flow back to suction port.)
- continuous operation even with high intake pressures
- quite running with low intake pressures
- the gas ballast valve enables condensable vapours to be pumped out, a high maximum tolerance of water vapour pressure is achieved
- the oil level can be checked on the oil inspection glass
- easy to service, all components can be replaced without problem.

Description

3.2 Area of Application

The range of application of our oil-sealed rotary vane pumps encompasses the entire field of vacuum technology, both for use in the laboratory and in industry.

The task is to create end pressures (partial) down to around $< 1 \times 10^{-2}$ mbar

- as a single pump
- as a fore-pump for oil diffusion pumps or as turbo-molecular pumps.

The rotary vane pump can pump out biological, toxic and radioactive gases and vapours, and evacuate containers or vacuum installations up into the high vacuum range.

	CAUTION !
The rotary vane pump must not be used for extracting explosive gases or vapours.	
The rotary vane pump must not be operated in rooms which might contain explosive gases.	

3.3 Function

3.3.1 Working Principle

Two pump stages (fore-stage and high-stage) are arranged in series in order to improve the end pressure and the pumping speed at lower pressures. The intake takes place in the first stage (high-stage), the compression and the outlet in the second stage (fore-stage).

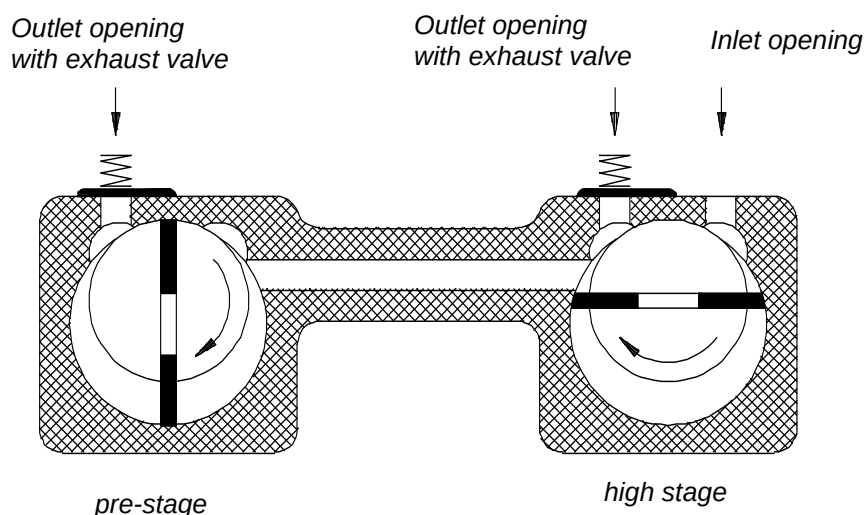


Fig. 2 Pre-stage / high stage

The pump body is subdivided into several chambers by the eccentrically arranged rotor which has two radically sliding vanes. The volume of each chamber changes cyclically as the rotor turns. This sucks the gas into the intake opening. The gas flows through the dirt filter, which is connected to the centring ring, into the pump body. After the intake opening is closed by the vane, the gas is transported onwards and compressed.

A dosed quantity of air (gas ballast) can be let into the pump body during the compression by opening the gas ballast valve. This prevents vapours condensing in the vacuum pump.

The maximum tolerance of water vapour pressure is 33 mbar.

Oil is injected into the pump body for sealing and lubrication. An oil pump pumps oil out of the oil reservoir into a pressure oil lubrication system that feeds all the bearings. The low-mounted oil suction pipe achieves a large usable oil reserve.

At the outlet valve, the compressed gas is pumped out of the pump body through the exhaust port. The oil carried along with the gas is separated out by a filter (accessory).

3.3.2 Pressure oil lubrication

Oil fulfils the following functions in the vacuum pump:

- Lubricating the sliding parts such as the rotor, vanes and shaft seals
- Sealing the moving parts against the stator wall to reduce internal leaks
- Transporting the heat of compression to the metal walls (cooling).

An overview of oil types for the various fields of application can be found *in chapter 3.5.5*.

3.3.3 Vacuum-tightness on switching off

If the suction port is to be closed vacuum-tight when shutting off then an electromagnetic suction port valve must be connected on the vacuum side.

3.3.4 Gas ballast

	CAUTION !
Condensable vapours may only be extracted when the gas ballast valve is open, when the vacuum pump is at operating temperature and within the limits of the maximum tolerance of water vapour pressure! Condensation occurs if the maximum water vapour pressure tolerance of 33 mbar is exceeded.	

When pumping condensable vapours, they may be compressed during the compression phase above the saturated vapour pressure and condense.

This causes considerable deterioration in the vacuum pump's performance:

- ultimate pressure is not achieved
- corrosion occurs
- heavy oil contamination and formation of emulsions.

Description

With the opening of the gas ballast valve (left) flowing air in the compression area. The air flowing in keeps the partial pressure of the condensable medium so low that the pressure needed to open the outlet valve is reached before the medium condenses.

	CAUTION !
Operating with gas ballast increases the operating temperature of the vacuum pump by 5 – 10 K.	

Should condensate form despite actuation of the gas ballast device, the suction port must be closed and the pump first operated with gas ballast for a lengthy period (about 2 hours).

3.4 Scope of Delivery

The scope of delivery is specified in the supply contract.

3.5 Accessories optional

3.5.1 Overview and order numbers

No.	Description	Order no.
1	Oil mist filter OME 10/16	700010
	Oil mist filter OME 10/25	700011
	Replacement cartridge for OME 10/16; OME 10/25	800160
2	Activated charcoal filter AKF 10/16	700190
	Activated charcoal filter AKF 10/25	700191
	Replacement cartridge for AKF 10/16; OME 10/25	800159
3	Condensate separator PT 16	700144
	Condensate separator PT 25	700145
4	KF Intermediate reducing piece DN 25/16 of:	
	- Stainless steel	701401
	- Aluminium	701420
5	KF Centering ring with Viton-O-Ring, DN 16	701071
	KF Centering ring with Viton-O-Ring, DN 25	701091
6	KF Normal-clamping ring DN 10/16	701011
	KF Normal-clamping ring DN 20/25	701013
7	Oil LABOVAC 10:	1 litre
		5 litres
		10 litres
		20 litres
		200 litres
	Further types of oil, see chapter 3.5.5	

3.5.2 Oil mist filter OME

The Oil mist filter is placed on the exhaust port of oil-combined vacuum pumps. This substantially eliminates the emission of oil mist.

The oil mist filter type OME 10/16 is provided for the PK 2 DC.

The transparent polyamide housing enables an easy check of the degree of contamination or saturation of the filter.

If the filter insert becomes blocked, an integrated pressure control valve opens automatically and reduces the built-up pressure immediately.

Worn out filter inserts can be replaced easily. They can be re-ordered from manufacturing firm.

3.5.3 Activated charcoal filter AKF

The Activated charcoal filter is placed on the exhaust port of oil-combined vacuum pumps and serves for filtering and binding poisonous and/or smell-intensive gases and steams.

Under special conditions the activated charcoal filter is applicable also as filters at the intake (entrance filter).

The activated charcoal filter type AKF 10/16 is provided for the PK 2 DC.

The transparent polyamide housing enables an easy check of the degree of contamination or saturation of the filter.

If the filter insert becomes blocked, an integrated pressure control valve opens automatically and reduces the built-up pressure immediately.

Worn out filter inserts can be replaced easily. They can be re-ordered from manufacturing firm.

3.5.4 Condensate separator PT

The condensate separator is equipped with a discharge screw and as a check of the level of liquid with two oil sight glasses.

During the **connection at the intakes** it prevents a sucking in of condensates from the recipient, whereby a slight concentration of sucked in steams is possible.

During the **connection at the pressure connecting** pieces the condensate separator prevents a retreating from condensates from the exhaust gas piping into the pump. When promoting steams (*No exhaust filter use!*) no condensation in the oil housing of the pump separate in the separator.

Description

3.5.5 Types of oil

3.5.5.1 Features and applications

LABOVAC Oils	Features	Use for pump types		Applications
		one stage	two stage	
LABOVAC 10	Mineral oil based vacuum oil	P-E-Pumps, PS -Pumps	P-Z-Pumps, P-Pumps, PK-Pumps	For all standard applications, that is for pumping out air, inert gases and water vapour, and also slightly acidic or basic vapours.
LABOVAC 11	Synthetic oil	PS -Pumps	Not usable!	for high operating temperatures of pumps used for low vacuums , that is intake pressures of < 50 mbar in continuous operation, and in case of short-time pressure load changes, LABOVAC 11 is therefore specifically intended for PS pumps.
LABOVAC 12S	Mineral oil based vacuum oil (paraffin oil)	-	P-Z-Pumps, P-Pumps, PK-Pumps	Special oil specially for use in two-stage pumps for plasma etching processes , a low-cost alternative to LABOVAC 13
LABOVAC 13	Synthetic oil (Fomblin, PFPE oil)	P-E-Pumps, PS -Pumps	P-Z-Pumps, P-Pumps, PK-Pumps	inert special oil for pumping oxygen and for plasma etching processes
LABOVAC 14	Synthetic oil	-	P-Z-Pumps, P-Pumps, PK-Pumps, chemvac-Pump Systems	Special low viscosity oil, chemically stable and with a good demulsifying power. Advantage of low viscosity: The pump can be started at an oil temperature of 10°C, therefore particularly suitable for pumping in plant construction, in mobile leak finders, laser cutting and welding devices, vacuum load devices, and many others. Advantage of chemical stability and good demulsifying power: especially suitable for drying, freeze-drying and distillation processes.

3.5.5.2 Technical data

Parameter	Unit	LABOVAC Oil				
		10	11	12 S	13	14
Ultimate pressure, total *)	mbar	$3 - 5 \times 10^{-3}$	1×10^{-2}	3×10^{-3}	5×10^{-3}	3×10^{-2}
Vapour pressure at 20 °C 40 °C 100 °C	mbar	10^{-5} 10^{-4} 10^{-3}	10^{-5} 10^{-4} 10^{-3}	10^{-8} 10^{-7} 10^{-4}	10^{-6} - 10^{-3}	$< 10^{-6}$ - -
Viscosity at 20 °C 40 °C 100 °C	cST	- 118 12.5	- 110 -	- 94 -	120 - -	103 47,9 7.4
max. permissible oil temperature in the vacuum pump	°C	100	> 150	100	> 150	125
Flash point	°C	270	260	260	not flammable	257
Density at 15 °C	g / ml	0.854	0.957	0.869	1.88	0.82

*) measured with two-stage rotary vane pump and Pirani vacuum gauge

The technical data and operating characteristics of Rotary vane pumps are only guaranteed if original LABOVAC Oils are used!

4 Technical Data

4.1 Dimensional drawing

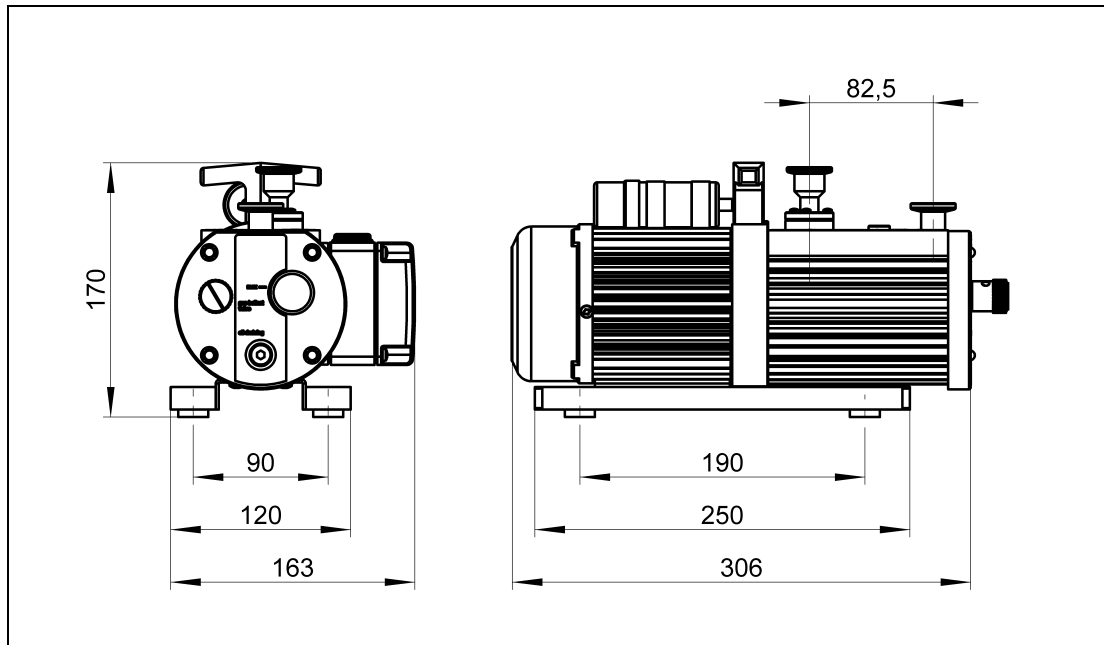


Fig. 3 Dimensional drawing

4.2 Intake Pressure / Pumping Speed – Diagram

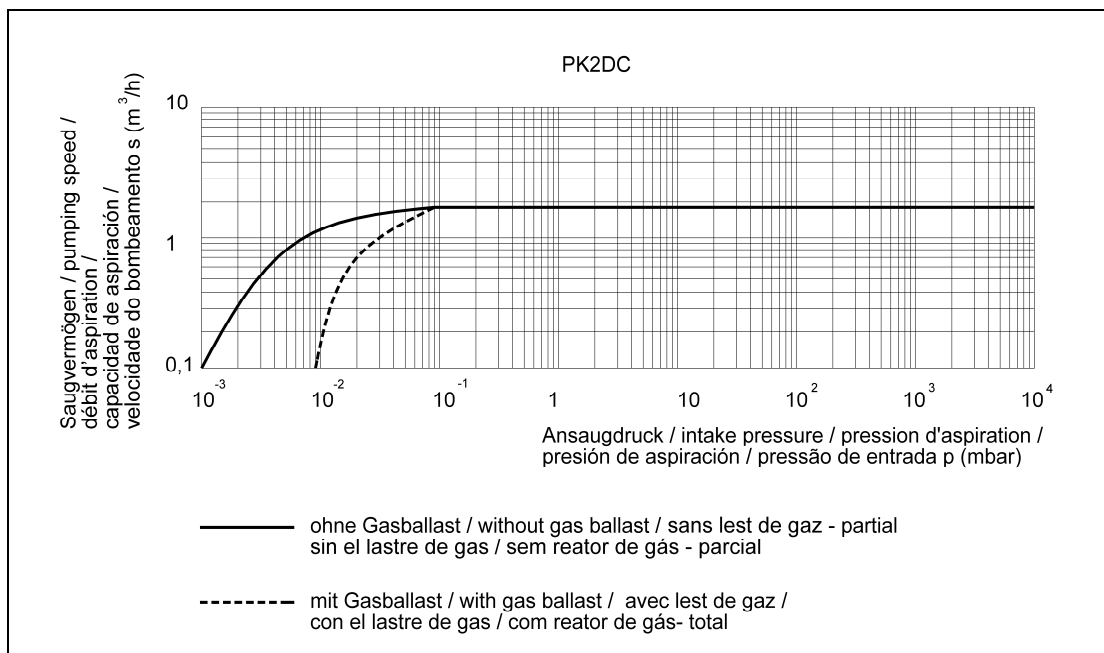


Fig. 4 Intake Pressure / Pumping Speed - Diagram

Technical Data

4.3 Device data

Parameter	Unit	Data
Pumping speed 50/60 Hz to DIN 28426, part 1 (pneurop)	m ³ / h ⁻¹	1.8 / 2.2
Ultimate pressure with rated speed 1500/min (50 Hz) to DIN 28426 (pneurop)	mbar	
- without gas ballast partial		$< 1 \times 10^{-3}$
- without gas ballast total		$< 1 \times 10^{-2}$
- with gas ballast total		0.5
Max. inlet pressure	bar	1
Max. outlet pressure		1
Connection flanges	-	DN 16 KF
Ambient temperature	°C	+ 20 to + 40
Max. operating gas temperature		+ 40
Reference surface sound pressure level DIN EN ISO 2151	dB (A)	< 40
Water vapour tolerance	mbar	33
Oil filling	ml	250
Voltage / Frequency (Different data upon customer request)	V, Hz	230, 50/60 / 115, 50/60
Motor power	W	120
Operating mode	-	S 1
Type of protection DIN EN 60529		IP 54
Class of insulation DIN EN 600034-1		F (160°C)
Dimensions (W/D/H)	mm	330 / 165 / 170
Weight	kg	8.0
Order numbers for :	-	
- PK 2 DC - 230 V <i>inclusive mains connection cables IEC with plug CEE, UK</i>		322001
- PK 2 DC - 115 V <i>inclusive mains connection cable IEC with plug US</i>		322001-03
- PK 2 DC - 100 V <i>inclusive mains connection cable IEC with plug J</i>		322001-04

* measured under full load at a height of 1.60 m and at a distance of 1 m in accordance with DIN EN ISO 2151:2001

5 Installation and Operation

5.1 Unpacking

Carefully unpack the rotary vane pump.

Check the pump for:

- Transport damage,
- Conformity with the specifications of the supply contract (type, electrical supply data),
- Completeness of the delivery.

Please inform us without delay if there are discrepancies between the delivery and the contractually agreed scope of delivery, or if damage is detected.

Please take note of the general terms of business of the manufacturing firm.

The pump must be returned in the original packaging in order to make a claim under warranty.

5.2 General references

According to its intended use the capacity of the vacuum pump depends on:

- the kind of assembly
- accessories
- the oil used
- additional connections
- vacuum piping system

In addition, fail-safe operation is determined by the mode of maintenance.

Elements such as valves, filters, condensers a.s.o. should be provided as early as in the conception.

The materials of the vacuum piping should be selected in such a way that they will be resistant to the media to be delivered!

5.3 Installation and Connection

1. Set the rotary vane pump on a flat and horizontal surface.
2. Remove the protective caps on the suction and pressure ports.
3. Close the vacuum connection on the suction port and the exhaust pipe on the pressure port. The suction and pressure ports must not be connected the wrong way round by mistake!
4. Connect the rotary vane pump to the electrical supply.

Regularly check and clean the air inlet of the motor ventilator.

The structural elements used on the inlet and outlet sides must be resistant to the media to be pumped. The pressure on the outlet side must not exceed 0.5 bar!

A pressure that is slightly below the air pressure helps to avoid pollution of gases, and reduces corrosion.

Installation and Operation

5.4 Connecting to the electricity supply

The standard pump is supplied with complete electrical wiring. It is connected via an appliance cable and a power supply plug.

	WARNING !
Should the user change the electrical connection, for example for fitting into a system, then this may only be performed by a electronics expert under observance of the accident prevention regulations.	

- It is generally suggested to protect the motor by 120 per cent of its rated power in consideration of the starting and switch-on response.
- Device connection cables and plugs must comply with the requirements of the line disconnection devices (current, output).
- The customer/user shall install the main and emergency stop switches.

5.4.1 Type of motor protection

All A.C. motors are provided with a thermal overload protection ex works, protecting the motor and vacuum pump from damage or destruction, respectively.

5.5 Selecting the operating oil

5.5.1 Importance for the choice of the right oil

	WARNING !
We recommend the use of LABOVAC Oils. These special oils are not harmful to health when used properly!	

The oil fulfils the following functions in the vacuum pump:

- Lubricating the sliding parts, such as rotor, vane, radial shaft seals
- Sealing the moving parts against the stator wall to reduce leaks
- Conducting the heat of compression to the metal walls (cooling).

The oil transports the polluted particles and corrosive media and thus effects continuous cleaning of the internal surfaces.

Selecting the correct oil is decisive for attaining a good ultimate vacuum.

This depends upon:

- the type of medium to be pumped,
- the corrosion of the vacuum pump and the accessories,
- the sealing of the vacuum installation.

The vacuum pump does not attain the same ultimate vacuum with all the oils.

This depends upon:

- the saturation pressure,
- the viscosity,
- the gas absorption of the oil.

You will find an overview of the types of oil for the various areas of application, together with the technical data of the **LABOVAC** Oils, *in chapter 3.5.5.*

The vacuum pump is delivered filled with **LABOVAC 10** Oil and can therefore be used for pumping out neutral gases and vapours. If the particular application requires special oil, then a change of the oil type must be carried out.

5.5.2 Oil for drawing off oxygen

For drawing off oxygen containing mixtures or pure oxygen the following must be taken into consideration:

- Mineral oils are inflammable.
- The more they oxidise, the quicker they lose their properties.
- For this reason they only can be used up to an oxygen percentage of maximum 30 per cent in the medium to be delivered.

Use **LABOVAC 13** synthetic oil if the O₂ content exceeds 30 percent.

In order to prevent any accumulation of oxygen in the discharge space, neutral gas such as nitrogen may be let in through a special inlet assembly. The percentage of oxygen is being reduced. The added amount of gas should be at least times as much as the percentage of oxygen.



WARNING !

There is a risk of explosion when pumping oxygen at a concentration above 30 percent.

Installation and Operation

5.6 Operation

Observe the basic safety instructions when using the pump.

5.6.1 Starting-up

	CAUTION !
Check the oil level and oil temperature prior to switching on the vacuum pump!	

5.6.1.1 Oil level

The oil level must always lie in the centre of the oil sight glass. If it lies underneath the edge of oil sight glass, oil must be absolutely refilled.

In cold condition, the viscosity in case of PFPE oils (**LABOVAC 13**) is higher than in case of mineral oils.

	CAUTION !
Never operate a vacuum pump filled with PFPE below 18 °C.	

5.6.1.2 Operating temperature

The function of the vacuum pump filled with **LABOVAC 10** standard oil is guaranteed between ambient temperatures of 12 °C and 40 °C. The lowest starting temperature is 12 °C according to DIN 28426, part 1, the pump must be vented on the suction-side (suction port open).

If the demands of usage make it impossible to keep to the specified starting conditions, there is a possibility of using **LABOVAC 14** oil. The pump can be started with this oil at 12°C even if the suction-side is not vented.

	WARNING !
In dependence on the operation mode, the casing temperature can reach 80 °C. Make sure that the vacuum pump has not been installed in an accessible area, and make provision for a guard against contacts!	

5.7 Use of the gas ballast when switching on

The principle of the gas ballast is described in *chapter 3.3.4*.

Condensates could have collected in the vacuum pump if:

- the vacuum pump is new,
- it has not been used for long periods,
- the oil has been changed,
- the pump's maximum tolerance of water vapour pressure has been exceeded.

5.7.1 Operation with gas ballast when drawing off condensable vapours

Do not start pumping out condensable vapours until the pump has reached operating temperature, the gas ballast valve must be open and the maximum tolerance of water vapour pressure must not be exceeded.

We suggest operation with the gas ballast valve open, provided that the composition of gas in the vacuum pump to be drawn off is not known and cannot be ruled out.

If condensable gas and vapours are to be delivered, the latter or their condensates will mix with the oil. As a result of this, the technical parameters of the vacuum pump will be deteriorated.

Take the following indications into consideration:

- If admitted by the connection parameters required, single-stage vacuum pumps are to be preferred. For the reason of their technical conception, they are delivering more easily and more rapidly the condensates from the vacuum pump chamber or oil casing, respectively.
- Choose a type of oil that is only slow-mixing with the medium delivered.

In order to emit the condensable matter, proceed as follows:

- let the vacuum pump run hot for about 30 minutes, the suction port being closed and the gas ballast valve open,
- after the operating temperature of 70 °C to 80 °C has been reached, let the vacuum pump operate for another half an hour in dependence on the degree of oil contamination,
- close the gas ballast valve,
- Check the ultimate pressure (total) of 1×10^{-2} mbar.
Repeat the procedure if this is not achieved.



WARNING !

Use LABOVAC 14 special oil with continuous gas ballast operation and the associated 5 to 10 K increase in the operating temperature of the vacuum pump.

- Overpressure is to be avoided at the exhaust, therefore:
 - use a condensate separator instead of an oil mist filter.
 - avoid laying the pipes vertically as condensate collects there, and can flow back into the vacuum pump if there is not an upstream condensate separator,
 - install the outlet pipe!
- Ensure that the gas ballast valve is open, and note that the vacuum pump must run up to operating temperature with the suction pipe closed for about 30 minutes.
- Check the oil level during operating. It rises, if the condensate is not discharged.
- After completion of the work, the vacuum pump must run for another 30 to 60 minutes with the intake side closed and the gas ballast open in order for the oil to regenerate.
- After switching off the vacuum pump, inspect the oil for condensate. Inspection is through the oil sight glass or immediately with a low, drained amount of oil. If the oil is clean, check the level and top up fresh oil.
- The harmful action of aggressive gases and vapours can be reduced by gas purging the pump and the oil. Nitrogen or another inert gas should be used as the purging gas. Dried air may also be used if the oxygen in the air is compatible with the aggressive pumping gas.

Installation and Operation

5.7.2 Closing down

In normal use, it is sufficient to switch the vacuum pump off electrically. Additional measures are not required.

If condensable media have been pumped, the vacuum pump must be run after pumping with the gas ballast valve open and the intake pipe closed, see *section 5.7.1*. If the vacuum pump is not going to be used for a some time after pumping aggressive or corrosive media, or if it not going to be used for a long time, then proceed as follows:

- Oil change, see *chapter 6.1.4*
- close connecting ports

Special preservation or corrosion-inhibited oils are required.

	WARNING !
Take appropriate safety measures in case of having delivered dangerous media!	

5.8 Storage

The pumps are to be stored in a low-dust, interior room within the temperature range from + 5 to + 40 °C and at a relative air humidity < 90 %.

Leave the protective elements on the suction and pressure ports. Another equally good protection may be used.

5.9 Scrap Disposal

	CAUTION !
The diaphragm pumps must be disposed of in accordance with the 2012/19/EC guideline and the specific national regulations. Contaminated diaphragm pumps must be decontaminated according to the laws.	

6 Maintenance and Servicing

6.1 Maintenance Performed by the User

Under normal operating conditions, maintenance of the rotary vane pump is restricted to:

- external cleaning
- checking running noises
- checking the level and quality of the oil
- regular oil changes

These maintenance intervals must be specified according to the prevailing operating conditions and adhered to. We recommend performing maintenance after every 1,000 hours.

The bearings of the drive motors are life-long lubricated and so maintenance-free.



CAUTION !

**Only perform the work that is described here, and that which is permitted to be done by the user.
All other maintenance and service work may only be performed by the manufacturer and/or company authorized by him.
Beware of the pump parts being possibly contaminated by hazardous substances.
Wear protective clothing if there is contamination.**

6.1.1 Oil level control



CAUTION !

Check the oil level regularly!

The oil consumption varies according to the vacuum pump's operating conditions.

In order to keep the vacuum pump at all times in an optimum operating condition, the oil level must be inspected at the oil sight glass. The oil level must always lie in the center of the oil sight glass. If it lies underneath the edge of oil sight glass, oil must be refilled.

6.1.2 Topping-up the oil

- Remove the oil filling plug
- Pour oil in until it reaches the center of the inspection glass
- Screw in the oil filling plug together with the seal once again
- Switch on the vacuum pump and allow it to run for about two minutes
- Check the oil level when the pump is switched off, repeat if necessary

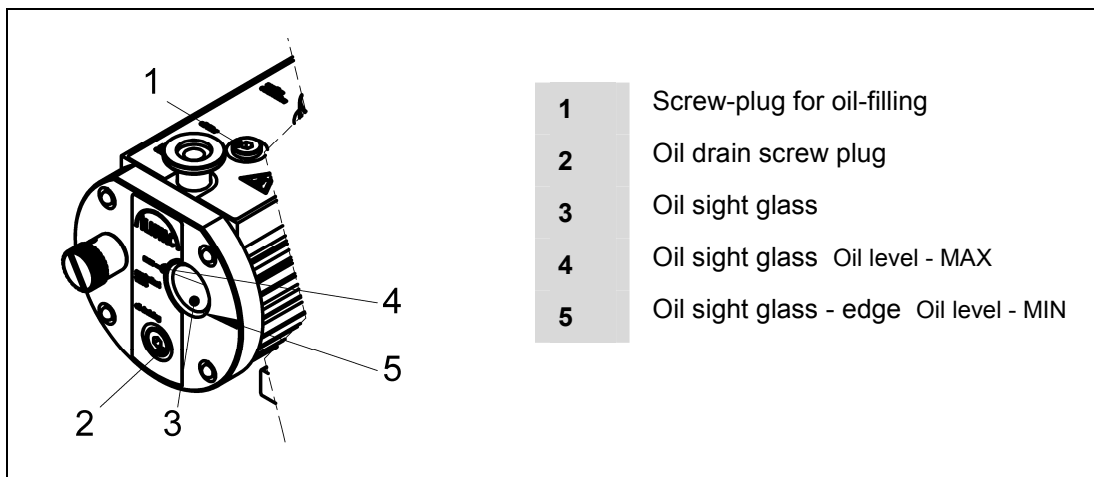


Fig. 5 Oil level control

6.1.3 Oil check

	WARNING !
The condition and quality of the pump oil have a substantial effect upon the performance and operational readiness of the vacuum pump!	

The degree of contamination of the pump oil may be estimated by comparing the color of a sample of the pump oil with that of fresh oil.

You obtain the oil needed for testing from the oil drain aperture with the vacuum pump switched off and at operating temperature.

If the oil appears slightly cloudy, e.g. because of water droplets, it can be regenerated with the aid of the gas ballast, *see chapter 5.7.1.*

Brown or black oil, or oil smelling as if it has burnt must be removed from the vacuum pump. Flush the vacuum pump and fill up with fresh oil.

6.1.4 Oil change

	WARNING !
If the vacuum pump has been used to pump media which are dangerous to health then all measures must be taken to protect the service and operating personnel!	

6.1.4.1 Draining the oil

- Unscrew the oil drain plug from the pump casing while the pump is at operating temperature.
- Tilt the vacuum pump slightly, catch the oil in a suitable vessel and dispose of it in accordance with the applicable regulations.



WARNING !

Avoid skin contact with the oil!

Dispose of the oil in accordance with the valid environmental protection regulations!

6.1.4.2 Filling up with oil

- Remove the oil filling plug
- Pour oil in until it reaches the centre of the inspection glass
- Screw in the oil filling plug together with the seal once again
- Switch on the vacuum pump and allow it to run for about two minutes
- Check the oil level when the pump is switched off, repeat if necessary

6.1.4.3 Flushing

If the oil is heavily contaminated, the vacuum pump must be flushed, e.g.

- heavy clouding by condensates
- suspended particles such as dust, fibres, abraded particles
- dark coloration of the oil

The flushing liquid should be the type of oil which is currently being used.

Procedure:

After the vacuum pump has been filled with fresh oil, allow it to warm up by running it with the suction port closed.

If you have established that the old oil, which you have previously drained, was contaminated by condensate (e.g. water) then the gas ballast valve must be open.

Drain the flushing oil. If the oil still appears heavily contaminated, the flushing procedure must be repeated.

6.2 Changing the oil type

The vacuum pump is tested and supplied with **LABOVAC 10** mineral oil as standard.

If you want to use another type of oil, please note the following:

Compatible oils

Mineral oils may be exchanged among each other:

- Drain the oil, see *chapter 6.1.4.1*
- Flush the vacuum pump with new oil, see *chapter 6.1.4.3*
- Fill the vacuum pump with new oil, see *chapter 6.1.4.2*

Replacing synthetic oil by a mineral oil is performed in the same manner.

Maintenance and Servicing

Non-compatible oils

These oils cannot replace each other, that is they cannot be mixed.

LABOVAC 10 and **LABOVAC 13** are examples which can be named here. Even complete disassembly and cleaning of the vacuum pump always involves the risk of small quantities of oil remaining. We therefore recommend asking the manufacturer directly about vacuum pumps with a special oil filling, for example **LABOVAC 13**.

6.3 Maintenance by the Manufacturer

Repairs and maintenance going beyond the extent of the work described *in chapter 6.1* or reconditioning or modification may only be performed by the manufacturer or authorized workshops.

Drain the oil before dispatching the pump and dispose of the oil according to the regulations.

The prerequisites for a handover are a complete and factually correct damage report, and a clean pump.

Clean the pump aggregate and the pump housing after pumping radioactive or other media which are harmful to health and the environment.

Fill up with sufficient oil to protect against corrosion during transport!

6.3.1 Servicing

	WARNING !
During repair or maintenance work which could endanger people because of moving or electrically live components, the vacuum pump must be made safe by removing the mains supply plug from the socket or by switching off the main contractor and preventing it from being switched on again!	

The vacuum pump must be disassembled if heavily soiled or after an operating fault. This is to be performed by the Service Department of manufacturing firm.

6.4 Damage Report

You find the form of the damage report to the Download on our web page in the menu "ser-vice" and "Downloads". www.ilmvac.com

If you should not have an entrance to the Internet, you can request the form also gladly with us, under phone +49 3677 604 0.

	WARNING !
Incomplete or incorrectly completed damage reports may endanger the service personnel! Provide full information about contamination, and clean the pump thoroughly before handing it over to third parties. The user shall be liable for the consequences of an incorrect damage report or a contaminated pump. The statements in the damage report are legally binding.	

7 Troubleshooting

Only manufacturing firm and authorized service workshops may work on the pump and their accessories during the warranty period.

Trouble	Cause	Action
Vacuum pump does not start	No power supply	Electrical connections to be checked by a qualified electrician (e.g. mains cable, circuit breaker etc.)
	Motor defective	Exchange of motor by service department
	Coupling defective	Exchange or repair by service department
	Starting temperature too low	Put vacuum pump in a warm place corresponding to the starting temperature
	Oil is resinous after too long storage	Cleaning by service department (cleaning also possible by user)
Vacuum pump does not generate a vacuum	Ultimate pressure few mbar or atmospheric pressure oil shortage	Top-up oil
	Oil is dirty	Operate with gas ballast, or perform oil change with flushing
	Work or pressure control valve defective	Exchange by service department
	Oil supply to pump unit interrupted or reduced	Repair or cleaning by service department (cleaning also possible by user)
	Gas ballast valve open	Close gas ballast valve
	Shaft seals defective	To be exchanged by service department
	Built-up pressure in the oil housing too high because of exhaust gas pipe or oil mist filter	Check exhaust pipe, change filter insert
Pump runs very loudly	Motor defective, rotary vanes defective, rotary vane spring broken, shaft seal rings defective	Exchange or repair by service department
Vacuum pump runs hot	Vacuum pump oil supply interrupted	Repair by service department
	Oil with too low a viscosity used	Oil change
	Ambient temperature round vacuum pump too high	Change location
	Motor defective	Exchange by service department
	Built-up pressure in the oil housing too high (> 0,5)	Check exhaust pipe, change filter insert
Heavy loss of oil	Through oil mist emission: work or pressure control valve defective	Exchange by service department (can also be done by user)
	Because of leak from oil housing: shaft seal defective, oil housing seals defective	Repair by service department, exchange of the oil housing seals can also be done by user
Vacuum pump is not vacuum-tight when switched off <i>(Caution ! this point is only valid if a suction port valve or other shut-off device is present)</i>	Intake valve defective	Repair by service department (can also be done by user)
Oil flowing back up into the suction port	Automatic aeration of the pump body defective	Repair can only be made by service department

Spare Parts Overview

8 Spare Parts Overview

The spare parts list contains all the spare parts and all the information necessary for ordering.

When ordering, please quote the description, quantity, serial number and order number!

	CAUTION !
We are not liable for any damage caused by the installation of any parts not supplied by the manufacturer.	

8.1 Seal kit

Order no. 302011

A seal kit contains all the seals which must be exchanged during a preventive maintenance or repair.

Designation	Usage	Piece	Order no.
O-ring Ø 82.14 x 3.53	Housing seal	2	829286
O-ring Ø 48 x 2	Pump housing – bearing cover	4	829265
O-ring Ø 29.82 x 2.62	Oil sight glass	1	829227
O-ring Ø 12 x 2	Gas ballast valve	1	829217
O-ring Ø 9.93 x 2.62	Suction port	2	829215
O-ring Ø 3.68 x 1.78	Pumpen housing – pre-stage	1	829187
O-ring Ø 8 x 2	Oil-filler, oil-drain	2	829210
O-ring Ø 5 x 2	Gas ballast valve	1	829196
O-ring Ø 4 x 2	Gas ballast valve	1	829188
Shaft seal ring Ø 12 x 18 x 3	Intermediate bearing	2	829408
Rubber plate	Valve – high-stage	1	300816
Rubber plate	Valve – pre-stage	1	300816-1

8.2 Service kit

Order no. 302012-1

The service kit contains, in addition to the seals, all the spare parts which are subject to high wear and tear and therefore have to be replaced.

Designation	Usage	Piece	Order no.
Seal kit	<i>see above</i>	1	302011
Rotary vane	High-stage	3	300799-1
Rotary vane	Pre-stage	3	300800-1
Valve plate	Pump housing – pre-stage	1	300065-1
Plug with female hexagon M10 x 1	Oil-filler, oil-drain	2	824102
Rotary vane	Oil pump	1	300830
Compression spring	Rotary vane VS	3	824977-01

8.3 Exploded view

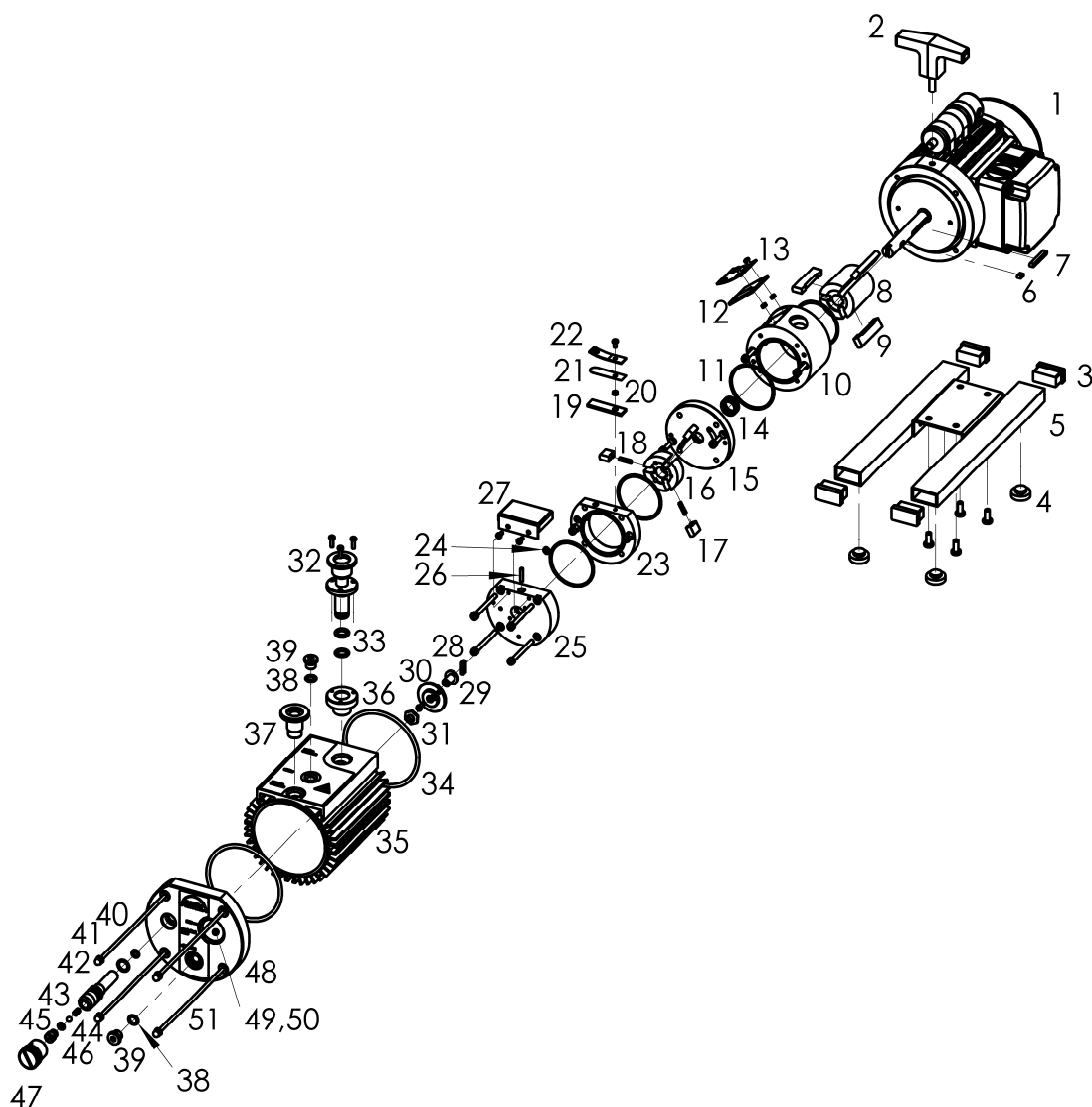


Fig. 6 Exploded view PK 2 DC

Spare Parts Overview

8.3.1 Spare parts list

Item no.	Designation	Piece	Order no.
1	Alternating-current motor 230V	1	826454
	Alternating-current motor 100-115V	1	826454-2
-	Mains connection cable IEC with plug CEE (D)	1	825885
	Mains connection cable IEC with plug BS (UK)	1	825878
	Mains connection cable IEC with plug NEMAS-15 (US)	1	825903
	Mains connection cable IEC with plug JIS (J)	1	525911
2	T-handle	1	828608-1
	Threaded pin	1	300845
-	Foot complete <i>(consisting of item no. 3 – 5)</i>	2	320020
3	- Plug	2	828818
4	- Rubber foot	2	829101
5	- Foot	1	320020-01
6	Feather key 4 x 4 x 32	1	824953-5
7	Feather key 4 x 4 x 8	1	824953-3
8	Rotor high-stage	1	300794-1
9	Rotary vane high-stage	3	300799-1
10	Pump housing high-stage	1	300770
11	O-ring Ø 48 x 2	4	829265
12	Rubber plate high-stage	1	300816
13	Holder high-stage	1	300815
14	Shaft seal ring Ø 12 x 18 x 3	2	829408
15	Intermediate bearing	1	300773
16	Rotor pre-stage	1	300795-1
17	Rotary vane pre-stage	3	300800-1
18	Compression spring 0,5 x 4 x 10,5 x 14	3	824977-01
19	Rubber plate pre-stage	1	300816-1
20	Valve socket	3	300814
21	Valve plate	1	300065-1
22	Holder pre-stage	1	300815-1
23	Pump housing pre-stage	1	300771
24	O-ring Ø 3.68 x 1.78	1	829187
25	Bearing cover	1	300829
26	Nozzle	1	300911
27	Oil splash sheet metal	1	300820
28	Rotary vane - oil pump	1	300830
29	Adjusting plunger	1	300368-1
30	Cover - oil pump	1	300370-1
31	Hexagonal nut	1	300075
32	Suction port	1	300449-1
33	O-ring Ø 9.93 x 2.62	2	829215
34	O-ring Ø 82.14 x 3.53	2	829286
-	Oil casing complete <i>(consisting of item no 35 - 39)</i>	1	300803
35	- Oil casing	1	300801
36	- Bushing	1	300976
37	- Pressure port	1	300798
38	- O-ring Ø 8 x 2	2	829210
39	- Oil-filling screw M10 x 1	2	824102
-	Gas ballast valve complete <i>(consisting of item no. 40 - 47)</i>	1	300806
40	- O-ring Ø 5 x 2	1	829196
41	- O-ring Ø 12 x 2	1	829217
42	- Gas ballast valve	1	300788
43	- Compression spring 0.28 x 4.5 x 7.5 x 11	1	824975
44	- Ball	1	800114
45	- O-ring Ø 4 x 2	1	829188
46	- Valve core	1	300790
47	- Rubber cup	1	827320-3
-	Cover oil casing complete <i>(consisting of item no. 48 - 51)</i>	1	300819
48	- Cover oil casing	1	300774
49	- Oil sight glass	1	828964-3
50	- O-ring Ø 29.82 x 2.62	1	829227
51	- Stud bolt	4	300821

EG - Konformitätserklärung

EC Declaration of Conformity / CE Déclaration de Conformité

DIN EN ISO / IEC 17050

(de) Hiermit erklären wir	 WELCH by Gardner Denver	Gardner Denver Thomas GmbH Am Vogelherd 20 98693 Ilmenau Germany	T +49 3677 604 0 F +49 3677 604 131 welch-ilmvac@gardnerdenver.com www.ilmvac.com
unter eigener Verantwortung, dass nachstehendes Produkt aufgrund seiner Konzipierung und Bauart sowie in den von uns in Verkehr gebrachten Unterlagen den nachfolgend aufgeführten EG-Richtlinien und Normen entspricht. Bei einer nicht mit uns abgestimmten Änderung des Produkts verliert diese Erklärung ihre Gültigkeit.			
(en) We (Gardner Denver Thomas GmbH) herewith declare under our sole responsibility that the product described below is in accordance with the following Directives standards and other technical specifications regarding design and version when delivered from our factory. This declaration becomes invalid whenever the product has been modified without our consent.			
(fr) Nous (Gardner Denver Thomas GmbH) certifions par la présente, que le produit décrit ci-après est conforme, tant dans sa conception que dans sa réalisation, aux normes de sécurité et d'hygiène exigées par les standards de la CE. En cas de modification du produit sans notre accord, cette déclaration devient caduque.			

Bezeichnung des Produkts (Pumpen / Pumpstände) Description of product (pumps / pump systems) Description du produit (pompes / pompe systèmes)	Drehschieberpumpen zweistufig / Rotary vane pumps two-stage / Pompes à vide à palettes bi-étagée PK 2 DC
Artikel-Nr. / Fabrication No. / No. de fabrication	322001, 322001-03, 322001-04
Baujahr / Year of manufacture / Année de fabrication	2016

Das Produkt entspricht folgenden Richtlinien und Normen: / The product is in conformity with the following Directives and standards: / Le produit est conforme aux directives et standards suivants:		
X	2006/42/EG	Maschinenrichtlinie / EC machinery directive / directive CE sur les machines (17.05.2006)
	94/9/EG	ATEX-Richtlinie für Verwendungen in explosionsgefährdeten Bereichen, Anhang III / ATEX Guideline for use in potentially explosive atmospheres, Appendix III / ATEX Directive for applications in hazardous areas, Annex III
X	2004/108/EG	Elektromagnetische Verträglichkeit / EC Electromagnetic Compatibility Directive / Directive CE relative à la compatibilité électromagnétique (15.12.2004)
X	2011/65/EU	Gefährliche Stoffe in Elektro- und Elektronikgeräten (RoHS) / Dangerous materials in electrical and electronics devices (RoHS) / Substances dangereuses dans les appareils électriques et électroniques (RoHS)
X	2012/19/EU	Elektro- und Elektronik - Altgeräte (WEEE) / Electrical and electronics - old devices (WEEE) / Électro et électronique - appareils de contrôle (WEEE)
X	China - RoHS	Umweltschutzgesetz - China 2007-03 / Environment protection law / Loi sur la protection de l'environnement

Angewandte harmonisierte Normen: / Applied harmonized standards: / Standards appliqués et harmonisés:		
	DIN EN 1127-1:2011-10	Explosionsfähige Atmosphären - Explosionsschutz - Teil 1: Grundlagen und Methodik / Explosive atmospheres - Explosion prevention and protection - part 1: Basic concepts and methodology / Atmosphères explosives - Protection contre les explosions - partie 1: prescriptions et méthodologie
	DIN EN 13463-1:2009-07	Nicht-elektrische Geräte für den Einsatz in explosionsgefährdeten Bereichen - Teil 1: Grundlagen und Anforderungen / Non-electrical equipment for use in potentially explosive atmospheres - part 1: Basic method and requirements / Appareils non électriques destinés à être utilisés en atmosphères explosives - partie 1: prescriptions et méthodologie
	DIN EN 13463-5:2011-10	Nicht-elektrische Geräte für den Einsatz in explosionsgefährdeten Bereichen - Teil 5: Schutz durch konstruktive Sicherheit „c“ / Non-electrical equipment for use in potentially explosive atmospheres - part 5: Protection by constructional safety „c“ / Appareils non électriques destinés à être utilisés en atmosphères explosives - partie 5: protection par sécurité de construction « c »
X	DIN EN ISO 12100:2010	Sicherheit von Maschinen - Allgemeine Gestaltungsgrundsätze Risikobeurteilung und Risikominderung / Safety of machinery - General principles for design - Risk assessment and risk reduction / Sécurité des machines - / Principes généraux pour l'évaluation des risques et la réduction des risques
X	DIN EN ISO 13857:2008	Sicherheit von Maschinen - Sicherheitsabstände gegen das Erreichen von Gefährdungsbereichen mit den oberen und unteren Gliedmaßen / Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs / Sécurité des machines - Distances de sécurité empêchant les membres supérieurs et inférieurs d'atteindre les zones dangereuses
X	DIN EN 1012-2:1996	Kompressoren und Vakuumpumpen - Sicherheitsanforderungen - Teil 2: Vakuumpumpen / Compressors and vacuum pumps - Safety requirements - part 2: Vacuum pumps / Compresseurs et pompes à vide - Exigences de sécurité - partie 2: pompes à vide
X	DIN EN ISO 2151:2008	Akustik - Geräuschmessnorm für Kompressoren und Vakuumpumpen - Verfahren der Genauigkeitsklasse 2 / Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2) / Acoustique - norme de mesure des émissions pour les compresseurs et les pompes à vide - Procédé de classe de précision 2
X	DIN EN 60204-1:2006	Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen / Safety of machinery - Electrical equipment of machines - part 1: General requirements / Sécurité des machines - Equipement électrique des machines - partie 1: Prescriptions générales
X	EN 61000-6-2:2005	Elektromagnetische Verträglichkeit (EMV) - Teil 6-2: Fachgrundnormen - Störfestigkeit für Industriebereiche / Electromagnetic compatibility (EMC) - part 6-2: Generic standards - Immunity for industrial environments / Compatibilité électromagnétique (EMV) - partie 6-2: Normes génériques - Immunité pour les environnements industriels
X	EN 61000-6-4:2007	Elektromagnetische Verträglichkeit (EMV) - Teil 6-4: Fachgrundnormen - Störaussendung für Industriebereiche / Electromagnetic compatibility (EMC) - part 6-4: Generic standards - Emission standard for industrial environments / Compatibilité électromagnétique - partie 6-4: Normes génériques - Emissions de parasites pour les activités industrielles
X	DIN EN 50110-1	Betrieb von elektrischen Anlagen / Operation of electrical installations / Fonctionnement des installations électriques
X	DIN EN 61010-1	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte - Teil 1: Allgemeine Anforderungen / Safety requirements for electrical equipment for measurement, control and laboratory use - part 1: General requirements / Consignes de sécurité pour les appareils électriques de mesure, de commande, de régulation ou de laboratoire - partie 1: Prescriptions générales

Datum / Data	2016-01-06
Qualitätsbeauftragter / Quality representative / Délégué de qualité	Name / Name / Nom Gerd Reinhardt
Produktmanager / Product manager / Directeur de produit	Name / Name / Nom Oliver Fickert