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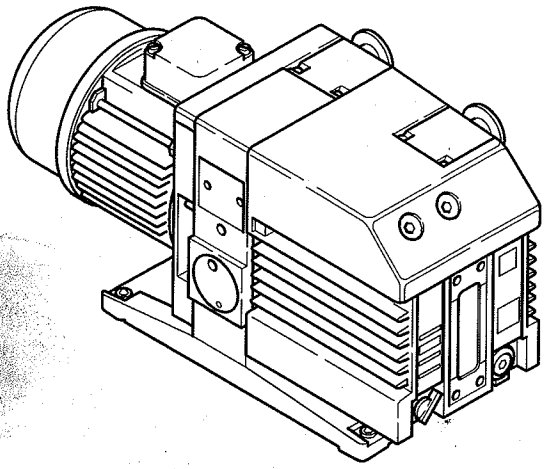
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Vacuum Solutions | Application Support | Service

LEYBOLD

LEYBOLD VACUUM

GA 01.201/8.02



TRIVAC® B

Rotary Vane Vacuum Pump S/D 4 / 8 B

Cat. No.

102 45/46/55/56

103 01/02/03/04/05/06/07
103 11/12/13/14/15/16/17

112 45/46/55/56

113 01/02/03/04/05/06/07/08
113 11/12/13/14/15/16/17/18

Operating Instructions

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The references to figures, e.g. (1/2) consist of the Fig. No. and the 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 equipment.

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.

Disposal of waste oil

Under the amended law relating to waste disposal dated November 1, 1986 (valid in the Federal Republic of Germany) the disposal of used oil is subject to new provisions. According to legislation relating to waste disposal the so-called principle of causality is applied. Hence, anyone in possession of used oil is responsible for its proper disposal.

Used oils coming from vacuum pumps must not be mixed with other substances.

Used oils from vacuum pumps (LH-oils on the basis of mineral oils) having been affected by normal contamination due to oxygen from the ambient air, increases in temperature and mechanical wear, must be disposed of as used oil in accordance with the regulations. Used oils from vacuum pumps that have been contaminated by other substances must be labelled, stored and disposed of as special waste with reference to the kind of contamination.

When disposing of used oil please observe the safety regulations that are valid in your country.

In many countries proof of were the oil has finally been left is required by Law and often shipping of such contaminated waste requires permission by the authorities. Waste disposal information is available through:

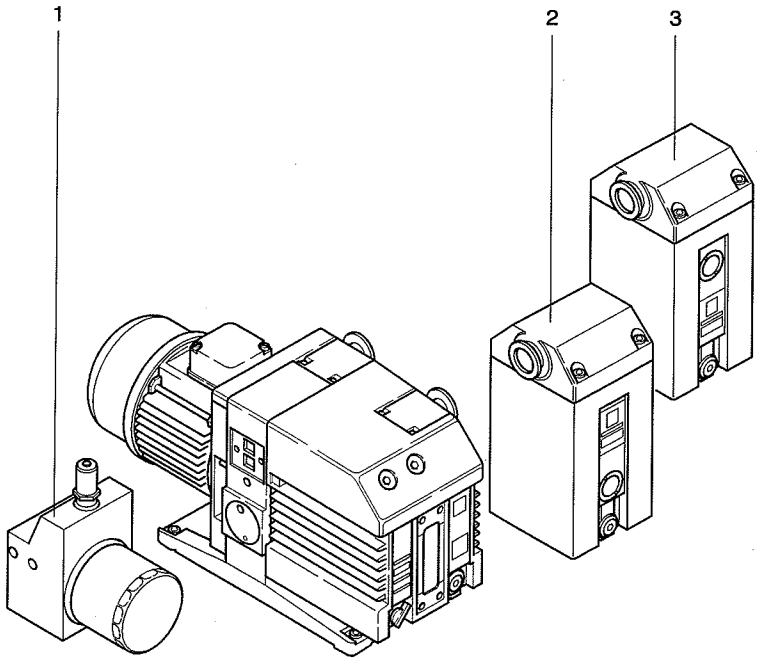
Bundesamt für Gewerbliche Wirtschaft (BAW)

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Key to Fig. 1
1 Oil filter OF 4-25
2 Exhaust filter AF 4-8
3 Condensate trap AK 4-8

Fig. 1 TRIVAC-B with accessories

1 Description

TRIVAC-B pumps are oil-sealed rotary vane pumps. The TRIVAC S 4 B and S 8 B are single-stage pumps, and the TRIVAC D 4 B and D 8 B are dual-stage pumps. The number in the type designation (4 or 8) indicates the pumping speed in $m^3 \times h^{-1}$.

TRIVAC-B pumps can pump gases and vapours and evacuate vessels or vacuum systems in the fine vacuum range. Those of standard design are not suitable for pumping greater than atmospheric concentrations of oxygen, hazardous gases, or extremely aggressive or corrosive media.

The drive motor of the TRIVAC-B is directly flanged to the pump at the coupling housing. The pump and motor shafts are directly connected by a flexible coupling. The bearing points of the pump module are force lubricated sliding bearings. All controls as well as the oil-level glass and the nameplate are arranged on the front. All connections are to be found at the sides of the pump. The oil-level glass is provided with prisms for better observation of the oil level.

The pump module consists of assembly parts which are pin-fitted so as to allow easy disassembly and reassembly. The pump module can be easily removed without special tools.

1.1 Function

The rotor (2/7), mounted eccentrically in the pump housing (2/6) (pump chamber), has two radially sliding vanes (2/5) which divide the pump chamber into several compartments. The volume of each compartment changes periodically with the rotation of the rotor.

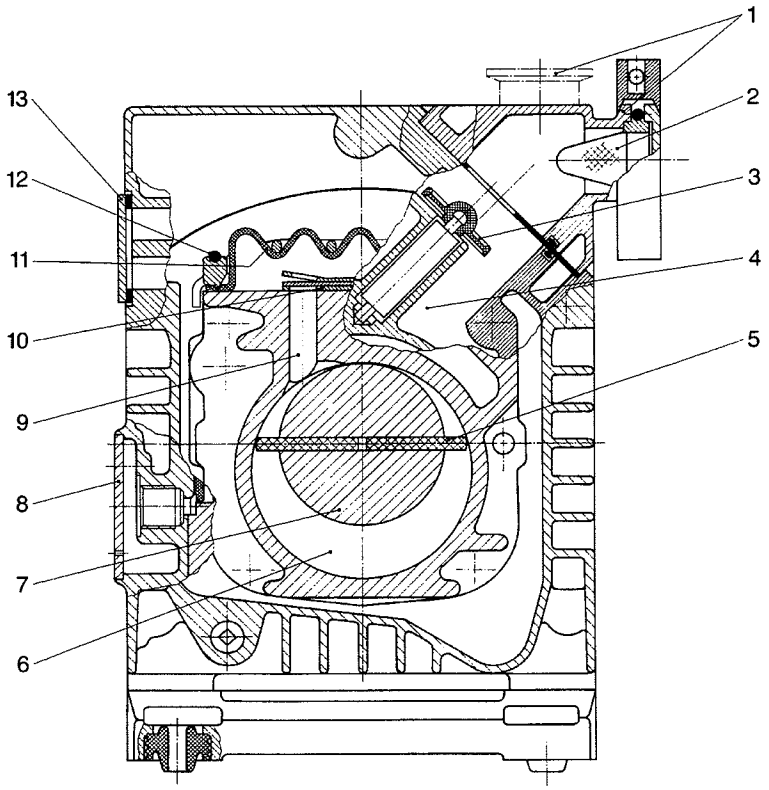
As a result, gas is sucked in at the intake port (2/1). The gas passes through the dirt trap sieve (2/2), flows past the open anti-suckback valve (2/3) and then enters the pump chamber. In the pump chamber, the gas is passed on and compressed, after the inlet aperture is closed by the vane.

The oil injected into the pump chamber is used for sealing and lubricating. The slap noise of the oil in the pump which usually occurs when attaining the ultimate pressure is prevented by admitting a very small amount of air into the pump chamber.

The compressed gas in the pump chamber is ejected through the exhaust valve (2/10). The oil entrained in the gas is coarsely trapped in the internal demister (2/11); there the oil is also freed of mechanical impurities. The gas leaves the TRIVAC-B through the exhaust port.

During compression, a controlled amount of air – the so-called gas ballast – can be allowed to enter the pump chamber by opening the gas ballast valve.

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Key to Fig. 2

1 Intake port
2 Dirt trap
3 Anti-suckback valve
4 Intake channel
5 Vanes
6 Pump chamber
7 Rotor
8 Cover plate, connection for inert gas ballast
9 Exhaust channel
10 Exhaust valve
11 Internal demister
12 Spring buckles
13 Cover plate, connection for oil filter

Fig. 2 Sectional drawing of the TRIVAC-B

The gas ballast stops condensation of vapours in the pump chamber up to the limit of vapour tolerance as specified in the technical data for the pump (the data refer to water vapour).

The gas ballast valve is opened and closed by turning the gas ballast knob (7/5) on the front.

To enable the TRIVAC-B to be used at intake pressures as high as 1,000 mbar, a special lubricating system was developed featuring force-lubrication of the sliding bearings.

An oil pump (3/6) pumps the oil from the oil reservoir (3/5) into a pressure-lubrication system which supplies oil to all bearing points (3/2). From there the oil enters the pump chamber area (3/4) of the vacuum pump.

The oil pump is fitted in the front end plate on the coupling side of the pump module. The oil suction line is placed low, resulting in a large usable oil reservoir.

The oil is separated from the gas in the TRIVAC-B in two steps as described above. First, small droplets are coalesced into large drops in the internal demister (2/11) fitted above the exhaust valve (2/10). Then, the large drops fall into the oil reservoir as the exhaust gas is diverted by the inner walls of the oil case. Thus a low loss of oil is obtained. This and the large usable oil reservoir ensure long intervals between oil changes even at high intake pressures.

The vacuum is maintained by the TRIVAC-B through an integrated hydropneumatic anti-suckback valve (2/3) which is controlled via the oil pressure.

During operation of the TRIVAC-B the control piston (4/3) remains sealed against a spring (4/2) by the oil pressure. The valve disc (4/6) of the anti-suckback valve is held at the lower position by its own weight (valve open). When the pump stops (because it has been switched off or because of a failure), the oil pressure drops and the spring (4/2) presses the control piston (4/3) up. Thus a connection is provided between the oil case or the oil reservoir (4/1) and the piston (4/4) of the anti-suckback valve. Due to the pressure difference between the oil case and the intake port the oil presses the piston (4/4) up and the valve plate (4/6) against the valve seat (4/5). The quantity of oil in the oil reservoir (4/1) prevents the entry of air into the intake port (2/1) at the beginning of this process.

After the oil has flowed out from the reservoir and when the valve plate rests on the valve seat, air follows in, which vents the pump chamber and forces the valve disc (4/6) against its seat. This effectively prevents backstreaming of oil. The anti-suckback valve (2/3) operates independently of the operating mode of the pump, i.e. also with gas ballast.

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Key to Fig. 3
1 Accessories
2 Bearings
3 Non-return valve
4 Pump chamber of the TRIVAC
5 Oil reservoir
6 Oil pump

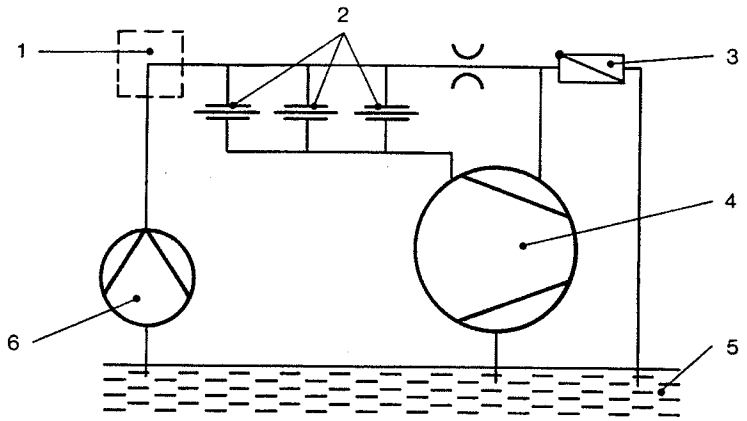
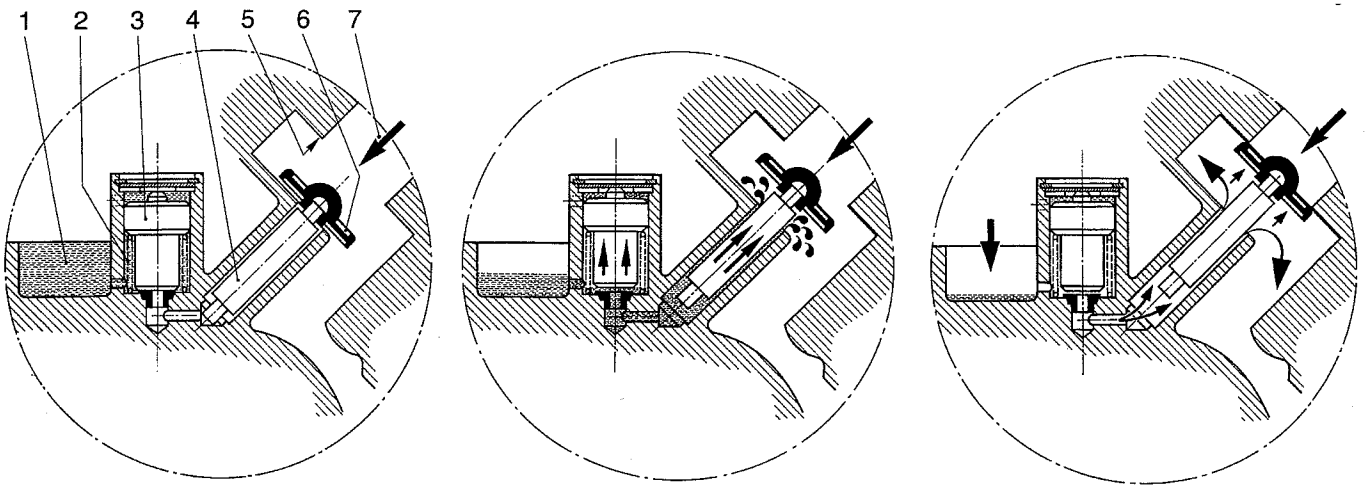


Fig. 3 Schematic of the lubricating system



Key to Fig. 4
1 Oil reservoir
2 Spring
3 Control piston
4 Anti-suckback piston
5 Valve seat
6 Valve disk
7 Gas inlet

Fig. 4 Hydropneumatic anti-suckback valve

1.2 Supplied Equipment

The equipment supplied with the TRIVAC-B pump includes:

Pump with motor, including initial filling of N 62, HE-200 oil or Arctic oil SHC 244

Ref. No. 200 28 229 (for Cat. No. 113 08 and 113 18)

1 centering ring,

1 centering ring with dirt trap,

2 clamping rings DN 16 KF.

As protection during shipment, the connection ports are each blanked off by rubber diaphragms and supporting rings.

TRIVAC-B pumps with single-phase AC motor are supplied ready to operate with switch, built-in thermal motor protection switch, mains cable (2 m) and mains plug.

For TRIVAC-B pumps with three-phase AC motor, the switch, motor protection switch, mains cable etc. are not included but can be delivered upon request with motor protection switch, mains plug and mains cable.

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1.3 Accessories

	Cat. No. / Ref. No.
Condensate trap AK 4-8, DN 16 KF	188 06
Exhaust filter AF 4-8, DN 16 KF	189 06
Drain tap for condensate trap, exhaust filter, oil drain of the pump, vacuum-tight	188 91
oil tight	188 90
Exhaust filter with lubricant return AR 4-8, DN 16 KF	189 20
Dust filter FS 2-4	186 05
Fine vacuum adsorption trap FA 2-4 (with zeolite)	187 05
Adsorption trap (with aluminium oxide)	854 14
(with cryo insert)	854 17
Cold trap TK 4-8	188 20
Oil filter OF 4-25	101 91
Chemical filter CF 4-25	101 96
Adapter for gas ballast port M 16 x 1.5 – DN 16 KF	168 40
M 16 x 1.5 – 3/8 inch NPT	99 175 011

Oil N 62	1l	177 01
	5l	177 02
	20 l	177 03
Arctic oil SHC 244	1l	200 28 229

(Order from LH Cologne, Germany)

Oil HE-200	1 qt	98 198 006
	12 qt case	98 198 049
	1 gal	98 198 007
	5 gal	98 198 008

(Order from LHVP, Export Pa., USA)

The oil grades N 62 and HE-200 are interchangeable. Special oils upon request.

Caution Only use the kind of oil specified by Leybold. Alternative types of oil are specified upon request.

1.4 Spare Parts

Set of gaskets		197 20
Pump module, complete	S 4 B	200 10 988
	D 4 B	200 10 989
	S 8 B	200 10 990
	S 8 B	200 10 990
	D 8 B	200 10 991
Module-gasket		200 10 730*)
Oil case gasket		200 10 733*)
Internal demister	S/D 4 B	390 26 010*)
	S/D 8 B	390 26 011*)

*) included in gasket set

1.5 Transportation

Caution

- Pumps which are filled with operating agents must only be moved while standing upright. Otherwise oil may escape. Avoid any other orientations during transport.

Warning



- Check the pump for the presence of any oil leaks, since there exists the danger that someone may slip on spilt oil.
- When lifting the pump you must make use of the crane eyes provided on the pump for this purpose; also use the recommended type of lifting device.

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1.6 Technical Data

	50Hz operation, SI units				
		S 4 B	D 4 B	S 8 B	D 8 B
Nominal pumping speed*	$m^3 \cdot h^{-1}$	4.8	4.8	9.7	9.7
Pumping speed*	$m^3 \cdot h^{-1}$	4.2	4.2	8.5	8.5
Ultimate partial pressure without gas ballast*	mbar	$< 4 \cdot 10^{-2}$	$< 1 \cdot 10^{-4}$	$< 4 \cdot 10^{-2}$	$< 1 \cdot 10^{-4}$
Ultimate total pressure with gas ballast*	mbar	< 1	$< 5 \cdot 10^{-3}$	< 1	$< 5 \cdot 10^{-3}$
Water vapour tolerance*	mbar	30	40	40	25
Connection ports	DN	16 KF	16 KF	16 KF	16 KF
Oil filling min./max.	cm^3	300/1000	300/800	300/800	300/900
Type of protection	IP	54	54	54	54
Weight[1)]	kg	15.7	18.7	18.7	21.2

* as per DIN 28 400 and following numbers
1) Weight for the version with single-phase motor 230 V, 50 Hz

Caution We can only guarantee that the pump will meet its specifications when using the type of lubricant which has been specified by us.

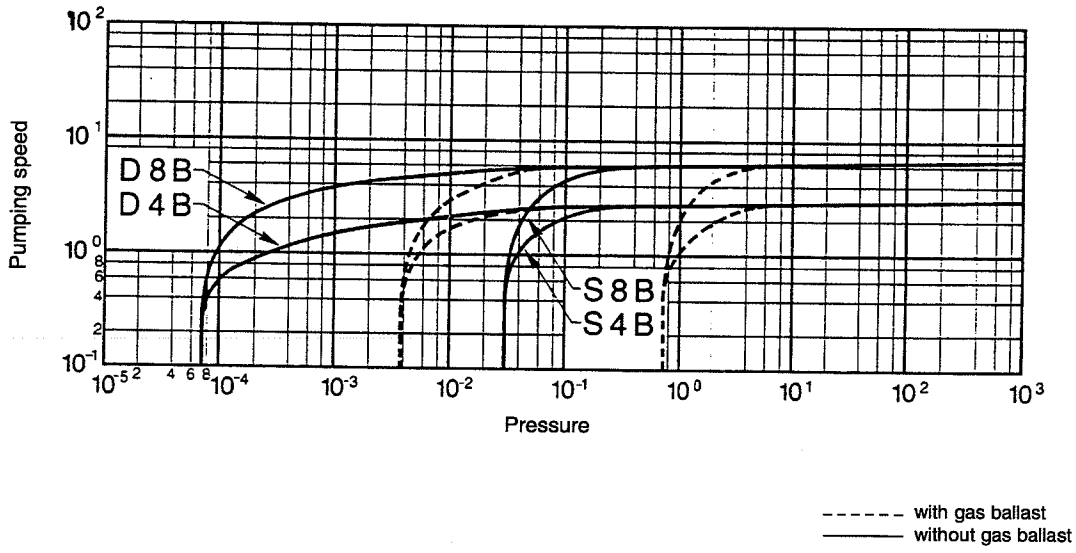


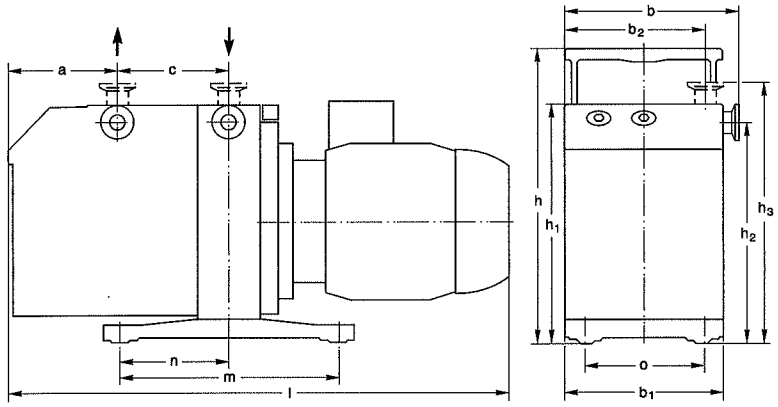
Fig. 5 Pumping speed characteristics of the TRIVAC S 4 B to TRIVAC D 8 B, 50 Hz operation, SI units

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Motor related data

S 4 B			D 4 B			S 8 B			D 8 B								
Cat. No.	l (mm)	W (kg)	Cat. No.	l (mm)	W (kg)	Cat. No.	l (mm)	W (kg)	Cat. No.	l (mm)	W (kg)	Motor connection voltage, frequency	Motor power	Rated current	Speed	Motor noise level	Order No. for the motor
102 45	430	15.7	–			–			–			1 ~ , 230 V, 50 Hz	180 W	2.5 A	1400	47 dB (A)	380 66 010
–			112 45	430	18.7	102 55	430	18.7	–			1 ~ , 230 V, 50 Hz	250 W	2.8 A	1400	47 dB (A)	380 66 007
–			–	430		–			112 55	455	21.2	1 ~ , 230 V, 50 Hz	370 W	2.9 A	1400	47 dB (A)	380 66 008
103 01	430	15.7	113 01	430	18.7	103 11	430	18.7	113 11	455	21.2	1 ~ , 220 V, 50 Hz / 60 Hz	370 W	3 A	1400/1660	49/51 dB (A)	200 10 401
103 02	430	15.7	113 02	430	18.7	103 12	430	18.7	113 12	455	21.2	1 ~ , 240 V, 50 Hz / 60 Hz	370 W	2.7 A	1380/1680	49/51 dB (A)	200 10 402
103 03	430	15.7	113 03	430	18.7	103 13	430	18.7	113 13	455	21.2	1 ~ , 115 V, 60 Hz	370 W	5.6 A	1700	51 dB (A)	200 10 403
103 04	470	19.7	103 04/08[1]	470	19.7	103 14	470	19.7	113 14/18[1]	495	25.2	1 ~ , 100 V, 50 Hz; 110 V, 60 Hz	370 W	8.7/6.1 A	1400/1700	53/56 dB (A)	200 10 404
102 46	430	13.4	–			–			–			3 ~ , 230/400 V, 50 Hz 250/440 V, 60 Hz	180 W	2.1/1.2 A 1.75/1 A	1400 1700	47 dB (A) 51 dB (A)	380 66 009
–			112 46	430	16.4	102 56	430	16.1	–			3 ~ , 230/400 V, 50 Hz 250/440 V, 60 Hz	250 W	2.25/1.3 A 1.9/1.1 A	1400 1700	47 dB (A) 51 dB (A)	380 66 005
–			–			–			112 56	455	18.6	3 ~ , 230/400 V, 50 Hz 250/440 V, 60 Hz	370 W	1.95/1.12A 1.73/1.0 A	1970 1680	46 dB (A) 50 dB (A)	380 66 006
103 05	430	13.4	113 05	430	16.4	103 15	430	16.1	113 15	455	18.6	3 ~ , 400 V, 50 Hz	370 W	1.12 A	1370	46 dB (A)	200 10 405
103 06	430	15.0	113 06	430	18	103 16	430	17.7	113 16	455	18.6	3 ~ , 230/400 V, 50 Hz	370 W	1.92/1.11A	1395	45 dB (A)	200 10 406
103 07	223	7.8	113 07	223	10.6	103 17	223	10.3	113 17	248	12.8	without motor	–	–	–	48 dB (A)	–

[1] Motor with UL cable NEMA 5-158 and 2.5 m long cable



	a	b	b_1	b_2	c	h	h_1	h_2	h_3	m	n	o
S/D 4 B	75	162	147	132	100	265	215	200	230	198	99	108
S 8 B	75	162	147	132	100	265	215	200	230	198	99	108
D 8 B	100	162	147	132	100	265	215	200	230	198	99	108

dimensions in mm

Fig. 6 Dimensional drawing for the TRIVAC rotary vane pumps (Dimensions a, l, b to b_2 and h_1 are approximate)

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Key to Fig. 7
1 Handle
2 Intake port
3 Exhaust port
4 Oil-level glass
5 Gas ballast knob
6 Threaded connection M 16 x 1.5 for inert gas ballast
7 Adapter
8 Cover plate
9 Cover plate; connection for oil filter

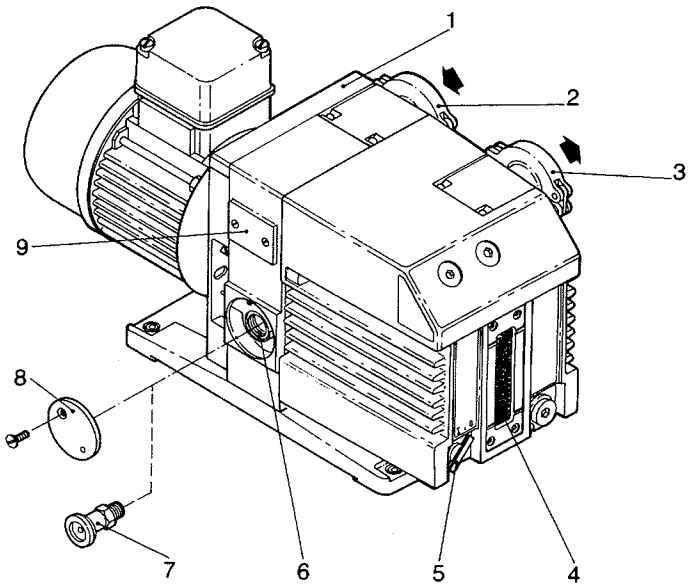


Fig. 7 Connections and controls

2 Operation

2.1 Installation

Warning



The standard pump (except the versions equipped with an explosion hazard rated motor) is not suited for installation in explosion hazard areas. When planning such an application please contact us first.

The TRIVAC-B pump can be set up on a flat, horizontal surface. Rubber feet under the coupling housing ensure that the pump can not slip.

If you wish firmly install the pump in place, insert bolts through bore holes in the rubber feet.

Caution Max. tilt for the pump (without further attachment) with possibly fitted standard accessories is 10° from the vertical.

The rubber feet act as vibration absorbers. They must therefore not be compressed by screws. When installing the TRIVAC-B pump, make sure that the connections and controls are readily accessible.

The site chosen should allow adequate air circulation to cool the pump (keep front and rear unobstructed). The ambient temperature should not exceed +40 °C (104 °F) and not drop below +12 °C (55 °F) (see Section 2.5.3).
The max. amount of heat given off approximately corresponds to the rated motor power.

2.2 Connection to the System

Before connecting the TRIVAC-B, remove the shipping seals from the connection flanges (7/2) and (7/3).

Caution Retain the shipping seals in case you need to store the pump in the future.

The pump is shipped with intake and exhaust flanges mounted for horizontal connection of the connecting lines. You can easily convert the ports for vertical connection by removing the four capscrews, rotating the flanges as required, and reinstalling the capscrews.

Connect the intake and exhaust lines with a centering ring and a clamping ring each. Use the centering ring with dirt trap for the intake port.

Connect the intake and exhaust line using anti-vibration bellows, without placing any strain on the pump.

The intake line must be clean. Deposits in the intake line may outgas and adversely affect the vacuum. The connecting flanges must be clean and undamaged.

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The maximum throughput of the pump is equivalent to the pumping speed of the pump (see Section 1.6).

Caution The cross-section of the intake and exhaust lines should be at least the same size as the connection ports of the pump. If the intake line is too narrow, it reduces the pumping speed. If the exhaust line is too narrow, overpressures may occur in the pump; this might damage the shaft seals and cause oil leaks. The maximum pressure in the oil case must not exceed 1.5 bar (absolute).

When pumping vapours, it is advisable to install condensate traps on the intake and exhaust sides.

Install the exhaust line with a downward slope (lower than the pump) so as to prevent condensate from flowing back into the pump. If this is not possible, insert a condensate trap.

The exhaust gases from the vacuum pump must be safely lead away and subjected to post-treatment as required. In order to reduce the emission of oil vapours we recommend the installation of an additional exhaust filter (Leybold accessory).

Depending on the type of application or the kind of pumped media, the corresponding regulations and information sheets must be observed.

The pumps may be operated with an inert gas ballast via a connection which is provided for this purpose. The cover plate (7/8) can be removed to gain access to this M 16 x 1.5 threaded port (7/6). Matching connectors are available (see Section 1.3).

In inlet pressure for the gas ballast should be about 1000 mbar (absolute) and sufficient quantities of gas must be available (about $^1/_{10}$ of the pumping speed).

Warning Never operate the pump with a sealed exhaust line. There is the danger of injury.



Before starting any work on the pump, the personnel must be informed about possible dangers first. All safety regulations must be observed.

2.3 Electrical Connections

Warning Before wiring the motor or altering the wiring, ensure that mains supply for the pump is off and that it can not be applied inadvertently.



In order to prevent the pump from running up unexpectedly after a mains power failure, the pump must be integrated in the control system in such a way that the pump can only be switched on again manually. This applies equally to emergency cut-out arrangements.

Electrical connections must be done by a qualified electrician as defined by VDE 0105 in accordance with the VDE 0100 guidelines.
Observe all safety regulations.

TRIVAC-B pumps are available with a single-phase or a three-phase AC motor.

2.3.1 Pump with Single-Phase AC Motor

Pumps equipped with a single-phase AC motor may be connected directly to the mains via the mains cord and the mains plug.

At 230 V use at least a 6 A slow-blow or a 10 A fast-blow fuse.

The direction of rotation need not be checked as it is fixed.

The motor is protected against overloading by a thermal overload switch with automatic resetting.

Warning If the thermal overload protector shuts off the pump, the motor will restart itself as soon as it cools. That's why the mains plug should be disconnected from the mains before starting with any work on the pump.



2.3.2 Pump with Three-Phase AC Motor

TRIVAC-B pumps with a three-phase motor are supplied without accessories for the electrical connection. They must be connected via the appropriate cable, and a suitable motor protection switch. Set the switch in accordance with the rating on the motor nameplate.

Fig. 8 shows the connection for pumps with 230/400 V, 50 Hz motors. Please also observe the motor wiring diagram in the junction box and the information given on the nameplate of the motor.

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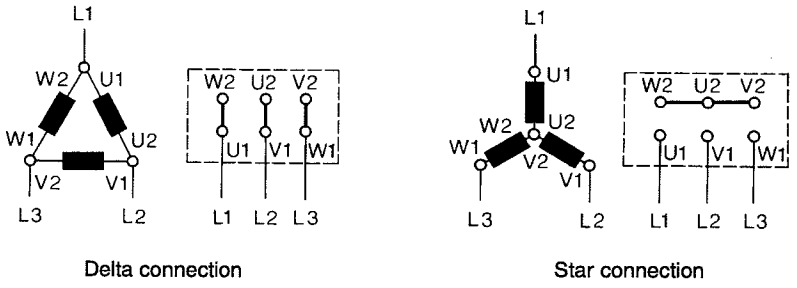


Fig. 8 Connection diagram for TRIVAC-B with 50 Hz 3-phase motor

Caution After connecting the motor and after every time you alter the wiring, check the direction of rotation. To do so, briefly switch on the motor and check whether a suitable cover (e. g. a blank flange) is sucked on at the intake port. If not, interchange two phases of the connection.
Observe the direction arrow on the coupling housing.

2.4 Start-up

Each time before starting up ensure that the oil level is visible in the oil level glass.

For pumps with 3-phase motors, check the direction of rotation before starting the pump

for the first time and after each change in the electrical connection (see Section 2.3.2).

On initial start-up, after prolonged idle periods or after an oil change, the specified ultimate pressure cannot be attained immediately until the oil is degassed. This can be done by running the pump for approx. 30 min. with the intake line closed and the gas ballast valve (7/5) open.

Warning Before starting the pump ensure that the pump and the fitted accessories meet the requirements of your application and that safe operation can be guaranteed.

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

Warning The safety regulations which apply to the application in each case must be observed. This applies to installation, operation and during maintenance (service) as well as waste disposal and transportation.
The standard pump is not suited for pumping of hazardous gases or vapours.

Our technical sales department is available for further advice in these matters.

2.4.1 Areas of Application

Warning The pump is not suitable for pumping of:

- ignitable and explosive gases or vapours
- oxidants
- pyrophorous gases.

Caution The pumps are not suitable for pumping of liquids or very dusty media. Suitable protective devices must be installed.

Our technical sales department is available for further advice in these matters.

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2.5 Operation

TRIVAC-B pumps can pump condensable gases and vapours, provided that the gas ballast valve (7/5) is open and the pump has attained its operating temperature.

2.5.1 Pumping of Non-Condensable Gases

If the process contains mainly permanent gases, the pump may 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, run the pump with the gas ballast valve open in accordance with Section 2.5.2.

2.5.2 Pumping of Condensable Gases and Vapours

With the gas ballast valve open and at operating temperature, TRIVAC-B pumps can pump pure water vapour up to the water vapour tolerance specified by the technical data. If the vapour pressure increases above the permissible level, the water vapour will condense in the oil of the pump.

When pumping vapours ensure that the gas ballast valve is open and that the pump has been warmed up for approximately 30 minutes with the intake line closed.

Caution Vapour phases may only be pumped up to the permissible limit after the pump has attained its operating temperature.

During pumping, vapours may dissolve in the oil. This changes the oil's properties and thus there is a risk of corrosion in the pump. Therefore, don't switch off the TRIVAC-B immediately after completion of the process. Instead, allow the pump to continue operating with the gas ballast valve open and the intake line closed until the oil is free of condensed vapours. We strongly recommend operating the TRIVAC-B in this mode for about 30 minutes after completion of the process.

In cyclic operation, the TRIVAC-B should not be switched off during the intervals between the individual working phases (power consumption is minimal when the pump is operating at ultimate pressure), but should continue to run with gas ballast valve open and intake 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 to improve the attainable ultimate pressure.

2.5.3 Operating Temperature

Proper operation of the TRIVAC-B is ensured in the ambient temperature range between 12 °C to 40 °C (55 °F to 104 °F).

At operating temperature, the surface temperature of the TRIVAC-B may lie between 40 °C and over 80 °C (104 °F and 176 °F), depending on the load.

Warning The surface temperature of the TRIVAC-B pumps may rise above 80 °C.



There is the danger of receiving burns.



2.6 Switching Off/Shutdown

Under normal circumstances, all that you need do is to electrically switch off the TRIVAC-B.

No further measures will be required.

When pumping condensable media let the pump continue to operate with the gas ballast valve open and the intake line closed before switching off (see Section 2.5.2).

When pumping aggressive or corrosive media, 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 during idle periods.

If the TRIVAC-B is to be shutdown for an extended period after pumping aggressive or corrosive media or if the pump has to be stored, proceed as follows:

Warning When pumping harmful substances, take adequate safety precautions.



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Drain the oil (see Section 3.2).

Add clean oil until the oil-level is at the "min" mark (see Section 3.2) and let the pump operate for some time.

Then drain the oil and add clean oil until the oil level is at the "max." mark (see Section 3.2).

Seal the connection ports. Special conservation or anti-corrosion oils aren't necessary.

Caution Please also take note of the information given in Section 3.9 (storage and storage conditions).

2.6.1 Shutdown through Monitoring Components

Warning When the pump has been switched off due to overheating sensed by the motor coil protector, the pump must only be started manually after the pump has cooled down to the ambient temperature and after having removed the cause first.

2.6.2 Failure of the Control System or the Mains Power

Warning In order to prevent the pump from running up unexpectedly after a mains power failure, the pump must be integrated in the control system in such a way that the pump can only be switched on again manually. This applies equally to emergency cut-out arrangements.

3 Maintenance

Warning Disconnect the electrical connections before disassembling the pump. Make absolutely sure that the pump cannot be accidentally started.

If the pump has pumped harmful substances, contrary to what has been stated in Section 2.4, ascertain the nature of hazard and take adequate safety measures.
Observe all safety regulations.

If you send a pump to LEYBOLD for repair please indicate any harmful substances existing in or around the pump. A form is available from LEYBOLD for this purpose.

Caution When disposing of used oil, you must observe the applicable environmental regulations!

Due to the design concept, TRIVAC-B pumps require very little maintenance when operated under normal conditions. The work required is described in the sections below. In addition to this, a maintenance plan is provided in Section 3.11.

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

For the spare part numbers please refer to the enclosed spare parts list.
In case of special versions please always state the special number, model number and the serial number.

LEYBOLD offers practical courses on the maintenance, repair, and testing of TRIVAC-B pumps. Further details are available from LEYBOLD on request.

Caution If the TRIVAC-B is used in ambient air which is much contaminated, make sure that the air circulation and the gas ballast valve are not adversely affected.

When the TRIVAC-B has been pumping corrosive media, we recommend to perform any possibly planned maintenance work immediately in order to prevent corrosion of the pump while at standstill.

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3.1 Checking the Oil Level

During operation of the TRIVAC-B the oil level must always remain between marks (9/2) and (9/3) on the oil-level glass. The amount of oil must be checked and topped up as required.

Caution Fill in oil only after the pump has been switched off.

3.1.1 Checking the Condition of N 62 or HE-200 Oil

The amount of oil required for an oil check should be drained via the oil-drain port (9/4) into a beaker or similar container with the pump switched off but still at operating temperature.

- **Visual check**

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

- **Chemical check**

  The neutralisation number of N 62 oil is determined according to DIN 51558. If it exceeds 2, the oil should be changed.

- **Viscosity check**

  If the viscosity of N 62 oil at 25 °C exceeds 300 mPas, the oil should be changed.

If gases or liquids dissolved in the oil result in a deterioration of the ultimate pressure, the oil can be degassed by allowing the pump to run for approx. 30 min. with the intake port closed and the gas ballast valve open.

3.2 Oil Change

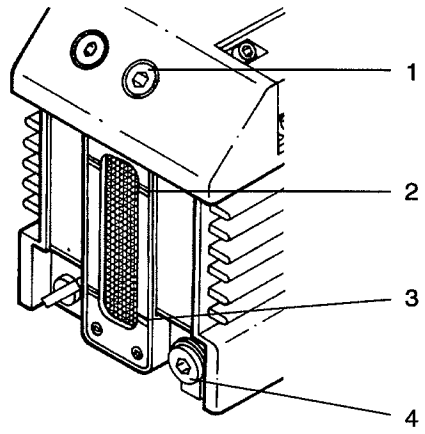
For proper operation of the pump, it is essential that the pump has an adequate supply of the correct and clean oil at all times.

The oil must be changed when it looks dirty or if it appears chemically or mechanically worn out (see Section 3.1.1).

The oil should be changed after the first 100 operating hours and then at least every 2,000 to 3,000 operating hours or after one year. At high intake pressures and intake temperatures and/or when pumping contaminated gases, the oil will have to be changed more frequently.

Further oil changes should be made before and after long-term storage of the pump.

If the oil becomes contaminated too quickly, install a dust filter and/or oil filter (see Section 1.3). Contact us for more information in this matter.



Key to Fig. 9
1 Oil-fill plug
2 Oil-level mark maximum
3 Oil-level mark minimum
4 Oil-drain plug

Fig. 9 Oil change

Caution Only change the oil after the pump has been switched off and while the pump is still warm.

Required tool: Allen key 8 mm.

Remove the oil-drain plug (9/4) and let the used oil drain into a suitable container. When the flow of oil slows down, screw the oil-drain plug back in, briefly switch on the pump (max. 10 s) and then switch it off again. Remove the oil-drain plug once more and drain out the remaining oil.

Screw the oil-drain plug back in (check the gasket and reinstall a new one if necessary).

Remove the oil-fill plug (9/1) and fill in with fresh oil.

Screw the oil-fill plug (9/1) back in.

Warning If there is the danger that the operating agent may present a hazard in any way due to decomposition of the oil, or because of the media which have been pumped, you must determine the kind of hazard and ensure that all necessary safety precautions are taken.



Caution We can only guarantee that the pump operates as specified by the technical data if the lubricants recommended by us are used.

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Key to Fig. 10
1 Oil case
2 Spring buckles
3 Demister
4 Frame for demister
5 Hex. socket screws
6 Silencing nozzle
7 Gasket

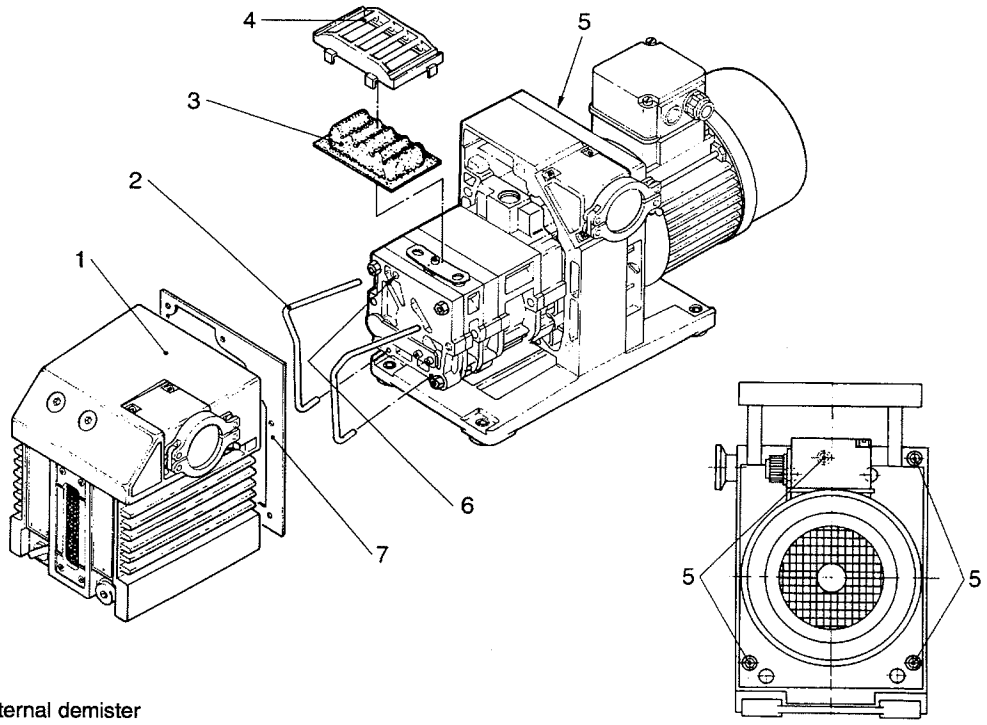


Fig. 10 Removal and fitting of the internal demister

3.3 Cleaning the Dirt Trap

A wire-mesh sieve is located in the intake port of the pump to act as a dirt trap for coarse particles. It should be kept clean to avoid a reduction of the pumping speed.

For this purpose, remove the dirt trap (2/2) from the intake port and rinse it in a suitable vessel with solvent. Then thoroughly dry it with compressed air. If the dirt trap is defective, replace it with a new one.

Caution The cleaning intervals depend on the application. If the pump is exposed to large amounts of abrasive materials, a dust filter should be fitted into the intake line.

3.4 Removing and Fitting the Internal Demister

Required tools:

Allen keys 5 mm and 8 mm

The internal demister is spring-mounted in a frame. When it is clogged, it rises periodically to reduce the pressure difference created.

The resultant noise at high intake pressures indicates that the internal demister is dirty.

Periodically clean or replace the internal demister; the maintenance interval depends on the application. Use a suitable solvent for cleaning.

Shutdown the pump and drain the oil (see Section 3.2).

Pull the handle upward.

Remove the four recessed screws (10/5) on the oil case (10/1). Don't remove the non-recessed screws; they hold the motor flange in place.

Pull the oil case forward off the pump.

Remove the gasket (10/7).

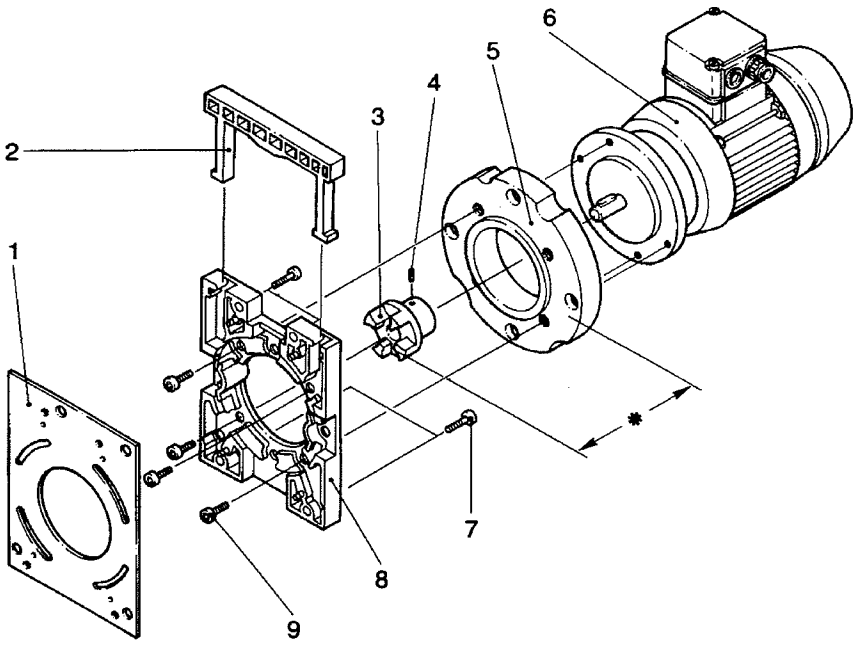
Press the spring buckles (10/2) sideways away from the frame (10/4). Lift off the frame (10/4) and remove the internal demister (10/3).

Clean all parts and check that they are in perfect condition; if not, replace them with new parts.

Reassemble in the reverse order.

Caution Torque for the screws (10/5) is 5 Nm.

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Key to Fig. 11
1 Gasket
2 Handle
3 Coupling
4 Threaded pin
5 Only for USA motors: adapter flange
6 Electric motor
7 Hex. socket screws
8 Intermediate flange
9 Hex. socket screw

Fig. 11 Disassembly and reassembly of the electric motor

3.5 Disassembly and Reassembly of the Electric Motor

Warning Before starting work, always disconnect the motor from the mains.
Disconnect the wires in the junction box of the motor (three-phase models only) or pull the mains plug.

Required tools:

Screwdriver 1.0 x 5.5 mm (for junction box), open-jaw wrenches 7 mm and 19 mm (for junction box), Allan keys 2.5 mm, 3 mm, 5 mm, 6 mm, possibly puller for coupling.

Disconnect the wires in the junction box of the motor (three-phase models only) or pull the mains plug.

Place the pump on its front side.

Unscrew the four non-recessed hex. socket screws (11/7).

Remove the intermediate flange (11/8) together with the electric motor.

Take off the gasket (11/1).

Remove the handle (11/2).

Loosen the threaded pin (11/4) and pull the coupling (11/3) off the motor shaft.

Unscrew the hex. socket screws (11/9).

Remove the electric motor (11/6) (and the adapter flange (11/5) in the case of the USA motors).

Clean all parts and check that they are in perfect condition; if not, replace them with new parts.

Reassemble in the reverse order.

Caution In the case of 60 Hz motors (USA versions) with adapter flange the coupling must not be pushed on to the shaft right up to the stop. On the other hand if it is not pushed on far enough the pump module may be damaged during operation. Push the coupling on in such a way that the distance between the front end of the coupling (11/3) and front side of the adapter flange (11/5) amounts to 41.3 ± 0.8 mm (1 $^{5}/_{8}$ ± $^{1}/_{32}$ inch) (see Fig. 11). The adapter flange (11/5) is screwed to the motor flange with four additional screws.

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Key to Fig. 12

1 Coupling element
2 Hexagon socket screw
3 Spring washer
4 Coupling (one half)
5 Key
6 Compression disc
7 O-ring
8 Bushing
9 Shaft seal
10 Centering disk
11 Hexagon socket screws

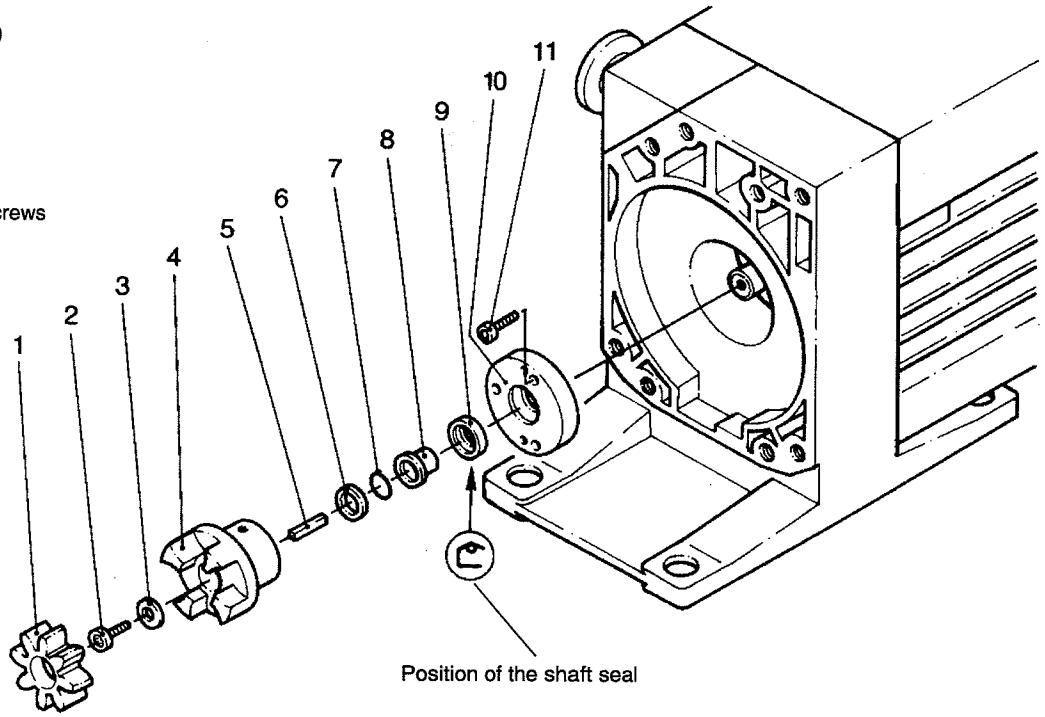


Fig. 12 Exchanging the outer shaft seal

3.6 Replacing the Outer Shaft Seal

Required tools:

Allen keys 3 mm, 5 mm, 8 mm, flat-nose pliers, plastic hammer, shaft seal driver, possibly puller for coupling.

The TRIVAC 4/8 B has two shaft seals; the outer one is subject to greater wear. Oil marks under the coupling housing are signs of a damaged outer shaft seal.

The outer shaft seal can be replaced without removing or disassembling the pump module.

Shutdown the pump.

Drain the oil (see Section 3.2) or place the pump on its front side.

Unscrew the four non-recessed hex. socket screws (11/7) and remove the motor (11/6) together with the intermediate flange (11/8).

Remove the gasket (11/1).

Pull off the coupling element(12/1).

Remove the hex. socket screw (12/2) and the spring washer (12/3).

Remove the coupling half (12/4).

Remove the key (12/5).

Pull off the compression disc (12/6) and the O-ring (12/7).

Unscrew the hex. socket screws (12/11) and pull off the centering disk (12/10) together with the bushing (12/8).

If the centering disk is stuck, screw the capscrews (12/11) into the jackscrew holes in the centering disk.

Pull the bushing out from the centering disc and force the shaft seal (12/9) out of the centering disk.

Caution We recommend the use of a new shaft seal, an O-ring and bushing for reassembly. Before insertion, moisten the new shaft seal slightly with a little vacuum pump oil.

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Using a suitable plastic or aluminium cylinder (shaft seal driver) and a plastic hammer, force the shaft seal (12/9) carefully and without bending it into the centering disk (for position of shaft seal, see Fig. 12).

If you do not have a shaft seal driver, place the shaft seal on the opening in centering disk and carefully force it in with light blows of the plastic hammer. The shaft seal must not be bent.

Carefully push the bushing (12/8) into the shaft seal.

Push the centering disk (12/10) with the shaft seal and bushing onto the shaft and up against the end plate; fasten it with the hex. socket screws (12/11).

Push the O-ring (12/7) and the compression disc (12/6) onto the shaft.

Insert the key (12/5).

Mount the pump-half of the coupling (12/4) on the shaft.

Install the spring washer (12/3) and tighten the hex. screw (12/2).

Insert the coupling element (12/1) into the coupling and mount the motor (see Section 3.5).

3.7 Removing and Remounting the Pump Module

Required tools:

Allen keys 3 mm, 5 mm, 8 mm, box wrench 10 mm, possibly pliers.

3.7.1 Removing the Pump Module

Drain the oil and remove the oil case (see Section 3.4).

Unscrew the hex. nuts (13/1).

Pull the entire pump module (13/2) forward off the tie rods (13/6).

Caution When doing so, ensure that the individual pin-fitted parts are not loosened. Further disassembly of the pump module should only be carried out by a trained service engineer.

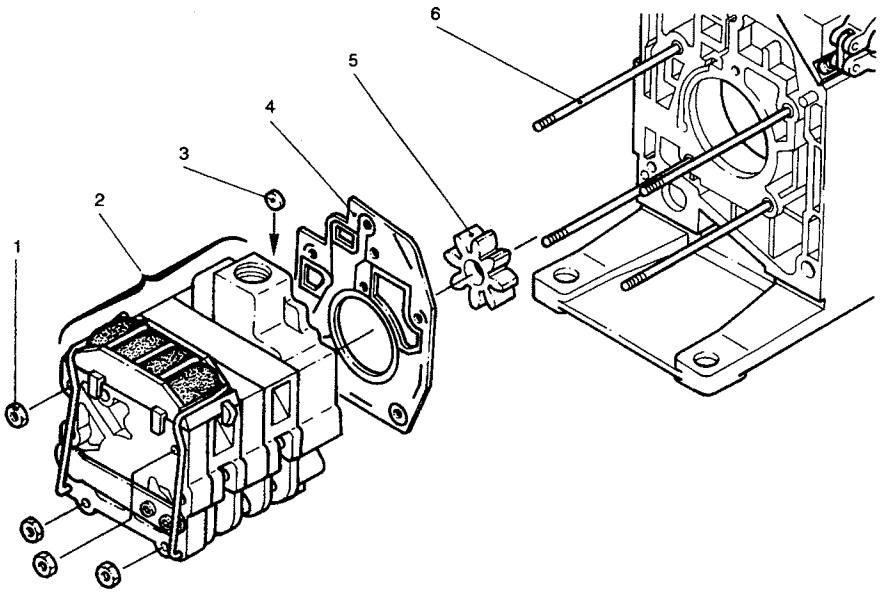
Remove the gasket (13/4).

Take the coupling element (13/5) off the coupling.

Caution After removing the protective shipping materials, handle the new pump module with care.

Before installing a new pump module, remove the four tie rods from the new module and insert them in the old one for protection during shipment.

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Key to Fig. 13
1 Hex. nuts
2 Pump module
3 Washer
4 Gasket
5 Coupling element
6 Tie rods

Fig. 13 Removing and remounting the pump module

3.7.2 Remounting the Pump Module

When installing a new pump module, it is also advisable to use a new gasket (13/4).

Check the coupling element (13/5) for damage; if necessary, install a new one.

Use the tie rods supplied with the new pump module only if the old ones are damaged. To do so, unscrew the old tie rods with lock nuts, and screw in the new ones. With the aid of the lock nuts, tighten the tie rods. Then remove the lock nuts.

Before mounting the pump module, make sure that sealing disc (13/3) fits correctly in its bore.

Push the gasket (13/4) onto the tie rods (13/6). Push the coupling element (13/5) onto

one coupling half.

Push the entire pump module (new or repaired) onto the tie rods.

Caution Screw on the hex. nuts (13/1) and carefully cross-tighten them (torque 7.5 Nm).

Mount the oil case together with the gasket (see Section 3.4).

Fill in oil.

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3.8 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 a form which has been prepared by us which we will provide upon request.

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.



3.8.1 Waste Disposal of Used Pump Materials

The corresponding environmental and safety regulations apply. This applies equally to used filters and filter elements (oil filter, exhaust filter and dust filter).

Warning





- In the case of hazardous substances determine the kind of hazard first and observe the applicable safety regulations. If the potential hazard still persists, the pump must be decontaminated before starting with any maintenance work. For professional decontamination we recommend our Leybold service.
- Never exchange the oil or the filters while the pump is still warm. Let the pump cool down to uncritical temperatures first. You must wear suitable protective clothing.

3.9 Storing the Pump

Caution Before putting a pump into operation once more it should be stored in a dry place preferably at room temperature (20 °C). Before the pump is shelved it must be properly disconnected from the vacuum system, purged with dry nitrogen and the oil should be changed too.

The inlets and outlets of the pump must be sealed with the shipping seals which are provided upon delivery.
The gas ballast switch must be set to the "0" position and if the pump is to be shelved for a longer period of time it should be sealed in a PE bag containing some desiccant (silica gel).

When a pump is put into operation after it has been shelved for over one year, standard maintenance should be run on the pump and the oil should also be exchanged (see Operating Instructions). We recommend that you contact the Leybold service.

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3.10 Troubleshooting

Fault	Possible cause	Remedy	Repair*
Pump does not start.	Wiring is malfunctioning. Motor protection switch incorrectly set (3-phase motors only). Operating voltage does not match motor. Motor is malfunctioning. Oil temperature is below 12 °C. Oil is too viscous. Exhaust filter/exhaust line is clogged. Pump is seized up (sign: pump is jammed).	Check and repair wiring. Set motor protection switch properly. Replace the motor. Replace the motor. Heat the pump and pump oil or use different oil. Change the oil. Replace the filter or clean the exhaust line. Repair the pump.	– 2.3 3.5 3.5 2.5.3/3.2 3.2 – Service
Pump does not reach ultimate pressure.	Measuring technique or gauge is unsuitable. External leak[1]. Anti-suckback valve is malfunctioning. Exhaust valve is malfunctioning. Oil is unsuitable. Intake line is dirty. Pump is too small.	Use correct measuring technique and gauge. Measure the pressure directly at pump's intake port. Repair the pump. Repair the valve. Repair the valve. Change the oil (degas it, if necessary). Clean the intake line. Check the process data; replace the pump, if necessary.	– Service Service Service 3.2 – –
Pumping speed is too low.	Dirt trap in the intake port is clogged. Exhaust filter is clogged. Connecting lines are too narrow or too long.	Clean the dirt trap; Precaution: install a dust filter in intake line. Install a new filter element. Use adequately wide and short connecting lines.	3.3 – 2.2
After switching off pump under vacuum, pressure in the system rises too fast.	System has a leak. Anti-suckback valve is malfunctioning.	Check the system. Repair the valve.	– Service
Pump gets hotter than usually observed.	Cooling air supply is obstructed. Ambient temperature is too high. Process gas is too hot. Oil level is too low. Oil is unsuitable. Oil cycle is obstructed. Exhaust filter/exhaust line is obstructed. Exhaust valve is malfunctioning. Pump module is worn out. Deviating mains voltage.	Set pump up correctly. Set pump up correctly. Change the process. Add oil. Change the oil. Clean or repair the oil lines and channels. Replace the exhaust filter, clean the exhaust line. Repair the valve. Replace the pump module. Check the motor voltage and the available mains voltage.	2.1 2.1/2.5.3 – 3.1 3.2 Service – Service 3.7
Oil in the intake line or in vacuum vessel.	Oil comes from the vacuum system. Anti-suckback valve is obstructed. Sealing surfaces of anti-suckback valve are damaged or dirty. Oil level is too high.	Check the vacuum system. Clean or repair the valve. Clean or repair the intake port and anti-suckback valve. Drain the excess oil.	– Service Service 3.1
Oil is turbid.	Condensation.	Degas the oil or change the oil and clean the pump. Precaution: open the gas ballast valve or insert a condensate trap.	2.5.2/3.2
Pump is excessively noisy.	Oil level is much too low (oil is no longer visible). Silencing nozzle is clogged. Intake pressure is too high. Internal demister is clogged. Coupling element is worn. Vanes or bushings are damaged.	Add oil. Clean the silencing nozzle or replace it. Lower the intake pressure. Clean or replace demister. Install new coupling element. Repair pump.	3.1/3.2 Fig. 10 – 3.4 3.5/3.6 Service

* Repair information: refer to the Section in the Operation Instruction stated here.
1) Bubble test: The warm pump with degassed oil is running without gas ballast and the intake blanked off. The exhaust line is lead into a vessel with water. If a an evenly spaced line of bubbles appears, then the pump has an external leak.

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3.11 Maintenance Plan (Recommendation)

No	Rotary vane pumps TRIVAC S/D 4 B TRIVAC S/D 8 B	Measurement/test quantity Operating/auxiliary materials	Interval						Remarks
			VE	VP	t	6m	a	n-a	Refer also to the Operating Instructions – Section: individual components.
1	Operate the pump for at least 0.8 hours with gas ballast.				x				Condensed water is thus removed from the oil.
2	Check the oil level, change the oil if required.	Oil: N 62 or special and alternative oils	x		x				Refill: only after the pump has been switched off.
3	Check the quality of the oil, change the oil if required.	visually chemically viscosity	x		x	 x x			**Visually:** normally light and transparent, oil change is required when discolorations increase. **Chemically:** to DIN 51558 when the neutralization number exceeds 2; then an oil change will be required. **Viscosity:** when dynamic viscosity at 25 °C exceeds 300 mPas; then an oil change will be required. Disposal of waste oil: see Section 3.8.1 and 5.2.
4	Clean the dirt trap in the intake port, change it as required.	Suitable cleaning agent and compressed air.				x			❑ Clean dirt trap with a cleaning agent and blow it out with compressed air under a suction hood. ❑ Replace the defective dirt trap. Use a cleaning agent which complies with the national / international specifications. **Observe the safety regulations when using cleaning agents.**
5	Clean the internal demister, change it as required.	Suitable cleaning agent.					x		Already clean before the maintenance interval has elapsed when the noise level increases. ❑ Clean the internal demister using a cleaning agent. ❑ Replace the defective internal demister. ❑ Dispose of the defective internal demister as special waste. Cleaning agent according to national / international specifications. **Observe the safety regulations when using cleaning agents.**
6	Check the edges of the teeth on the coupling element for any damages, change the coupling element as required.						x		

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No	Rotary vane pumps TRIVAC S/D 4 B TRIVAC S/D 8 B	Measurement/test quantity Operating / auxiliary materials	Interval						Remarks
			VE	VP	t	6m	a	n-a	Refer also to the Operating Instructions – Section: individual components.
7	Change the oil – and clean the oil level glass.	Oil: N 62 or special and alternative oils. Suitable cleaning agent and compressed air.					x		Oil change: • First oil change after 100 operating hours. • Pump switched off and cold. Change the oil when the pump is cold in order to avoid releasing absorbed gases. ❑ Clean the oil level glass with a cleaning agent and blow it out with compressed air under a suction hood. Cleaning agent according to national / international specifications. **Observe the safety regulations when using cleaning agents.** **Quantity of oil:** see Operating Instructions, Section 1.6. **Waste disposal of oil:** see Operating Instructions, Section 3.8.1.
8	Check the fan of the pump and the motor as well as the cooling fins on the motor for deposits and clean as required.	Brush and industrial vacuum cleaner.					x		Already clean before the maintenance interval has elapsed when the pump or the motor gets to warm. **Caution:** switch off the pump and ensure that it can not run up inadvertently (disconnect from the mains).

Key to the maintenance plan

VE = Maintenance before switching on the system
VP = Maintenance before starting production
t = Daily maintenance
w = Weekly maintenance
2w = Twice weekly maintenance
m = Monthly maintenance
3m = Three monthly maintenance
6m = Six monthly maintenance
a = Annual maintenance
n-a = Maintenance every n years.

We recommend servicing the pump every two years covering the following:

- Cleaning
- Checking of the individual components
- Exchange of all seals
- Functional check

This check should be run by the Leybold service.

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EEC Declaration of Conformity

LEYBOLD

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

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

Designation of the products: Rotary vane pump, single and dual stage

Types: TRIVAC B;
S/D 4-8 B

Cat. Nos.:

102 45; 103 01; 103 02; 103 03; 103 04; 102 46;

103 05; 103 06; 104 04; 112 45; 113 01; 113 02;

113 03; 113 04; 112 46; 113 05; 113 06;

102 55; 103 11; 103 12; 103 13; 103 14;

102 56; 103 15; 103 16; 112 55; 113 11;

113 12; 113 13; 113 14; 112 56

113 15; 113 16

113 08; 113 18; 113 19; 113 20

The products conform to the following directives:

- EEC Directive on Machinery (89/392/EWG) and subsequent 91/368/EWG
- EEC Directive on Low-Voltages (73/23/EWG)

Applied harmonised standards:

- EN 292 Part 1 and Part 2 Nov. 1991
- pr. EN 1012 Partl 2 1993
- EN 60 204 1993

Applied national standards and technical specifications:

- DIN 31 001 April 1983

Cologne, December 6, 1994

Dr. Henn, Business Area Manager
Forevacuum pumps

Cologne, December 6, 1994

Frings, Design Department Manager
Forevacuum pumps

LHK.GV0006.01.12.94

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LEYBOLD

VDMA

Declaration of Contamination of Vacuum Equipment and Components

The repair and/or service of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer could refuse to accept any equipment without a declaration.
This declaration can only be completed and signed by authorized and qualified staff.

1. Description of Vacuum Equipment and Components

- Equipment type/model: _____
- Code No.: _____
- Serial No.: _____
- Invoice No.: _____
- Delivery date: _____

2. Reason for Return

_____
_____
_____
_____
_____
_____

3. Condition of the Vacuum Equipment and Components

- Has the equipment been used?
  yes ❒ no ❒
- What type of pump oil/liquid was used? _____
- Is the equipment free from potentially harmful substances?
  yes ❒ (go to Section 5)
  no ❒ (go to Section 4)

4. Process related Contamination of Vacuum Equipment and Components:

- toxic	yes ❒	no ❒
- corrosive	yes ❒	no ❒
- explosive*)	yes ❒	no ❒
- biological hazard*)	yes ❒	no ❒
- radioactive*)	yes ❒	no ❒
- other harmful substances	yes ❒	no ❒

*) Vacuum equipment and components which have been contaminated by biological explosive or radioactive substances, will not accepted without written evidence of decontamination!

Please list all substances, gases and by-products which may have come into contact with the equipment:

Trade name Product name Manufacturer	Chemical name (or Symbol)	Dangerous material class	Measures if spillage	First aid in case of human contact
1.				
2.				
3.				
4.				
5.				

5. Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate. The despatch of the contaminated vacuum equipment and components will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of organisation or company: _____

Address: _____ Post code: _____

Tel.: _____

Fax: _____ Telex: _____

Name: _____

Job title: _____

Date: _____ Company stamp:

Legally binding signature: _____

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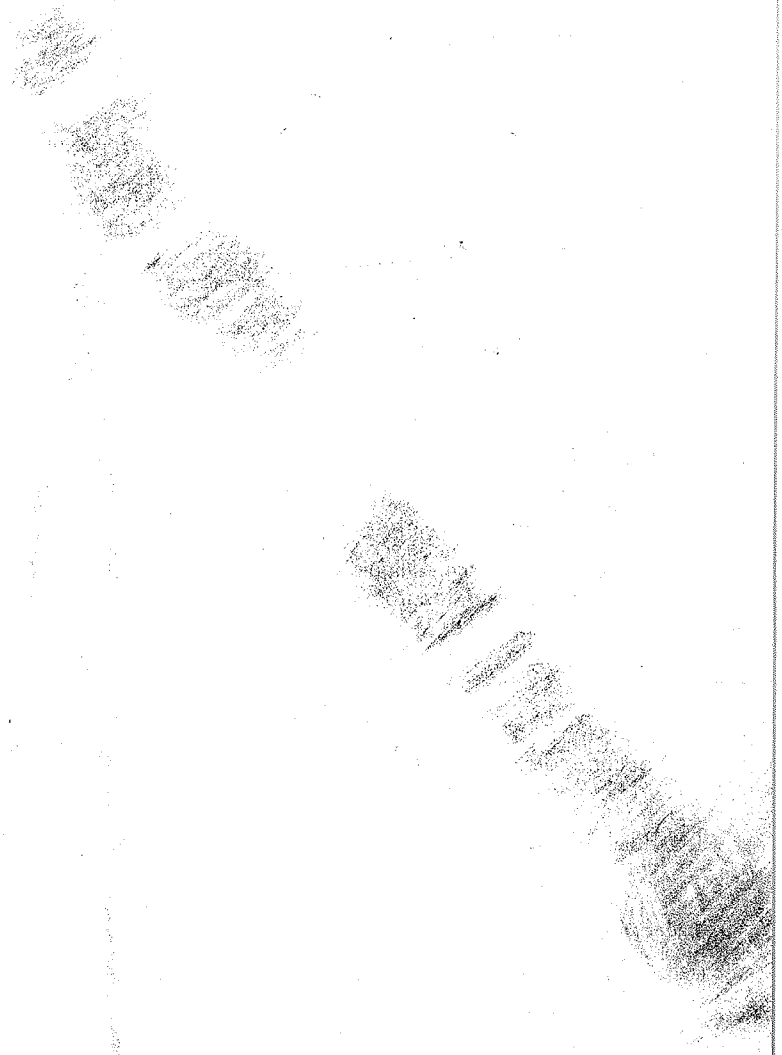
Order No.: 2121

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SAMPLE

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

We reserve the right to modify the design and the specified data. The illustrations are not binding.



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