Leybold

TRIVAC B
D 40 BCS / D 65 BCS

Rotary Vane Vacuum Pump

- with mineral oil
- with PFPE

Operating Instructions GA01301_002_C2

Part Nos.

113 88/89/98/98J/99
1129646

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Original installation and operating instructions.

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NOTICE

Obligation to Provide Information
Before installing and commissioning the TRIVAC BCS, carefully read these Operating Instructions and follow the information so as to ensure optimum and safe working right from the start.

The Leybold **TRIVAC BCS** has been designed for safe and efficient operation when used properly and in accordance with these Operating Instructions. It is the responsibility of the user to carefully read and strictly observe all safety precautions described in this section and throughout the Operating Instructions. **The pump must only be operated in the proper condition and under the conditions described in the Operating Instructions.** It must be operated and maintained by trained personnel only. Consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to our nearest office.

"Trained personnel" for the operation of this pump are

- skilled workers with knowledge in the fields of mechanics, electrical engineering and vacuum technology, and
- personnel specially trained for the operation of vacuum pumps.

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to notify users of installation, operation, programming or maintenance information that is important, but not hazard related.

Figures
The references to figures, e.g. (4/2) consist of the consecutive Fig. No. and the Item No. in that order.

We reserve the right to alter the design or any data given in these Operating Instructions. The illustrations are not binding.

Retain the Operating Instructions for further use.

0 Important Safety Information

0.1 Mechanical hazards

WARNING

1 Avoid exposing any part of the human body to the vacuum.

2 Never operate the pump without a connected intake line or without fitting a blank flange.

3 Do not operate the pump with any of the covers removed.
Serious injury may result.

4 The location at which the TRIVAC BCS (including its accessories) is being operated should be such that angles over 10° from the vertical are avoided.

5 The pump when filled with oil must only be moved in its vertical position. Spilled oil involves the risk of falling.

6 Make sure that the gas flow from the exhaust port is not blocked or restricted in any way.

7 If exhaust gases must be collected or contained, do not allow the exhaust line to become pressurised.The pressure in the oil box must not exceed 0.5 bar (g). An exhaust line which is too small in diameter or which is blocked can result in the formation of overpressures within the pump. Possible consequences can be a damaged or even burst open pump. Thus the exhaust line must be checked from time to time to ensure that there are no obstructions.

8 When moving the TRIVAC BCS always use the allowed means.

0.2 Electrical hazards

WARNING

1 The electrical connections must only be provided by a trained electrician as specified, for example, by the regulations EN 50110-1. Observe local regulations.

2 Lethal voltages are present at the mains connections. Before starting with any maintenance and service work, de-energise (lockout/tagout) the product first.

3 Lay connecting lines so that they cannot be damaged. Protect the lines against humidity and contact with water. Avoid any heat stress on the line due to unfavourable laying conditions.

4 Suitably support the connecting lines so that the pumps are not exposed to any major mechanical stress.

5 After a mains power failure the pump will run up automatically again. This also applies in the case of an emergency shutdown. In order to prevent the pump from running up automatically again, the pump must be integrated within a control arrangement such that it can only be switched on manually again after the mains power has returned.

6 Provide an adequate ground connection for the pump so as to avoid any electrostatic charging.

Safety information

0.3 Thermal hazards

CAUTION

1 Under certain ambient conditions the TRIVAC BCS may attain a temperature of over 70 °C (158 °F). There then exists the danger of receiving burns.
Note the symbols on the pump pointing to the hazards, and in the case of a hot pump wear the required protective clothing. All work on the “pump still warm from operation” should only be done using protection gloves.

2 Before servicing and maintenance work always leave the pump to cool down.

3 Note the warning information on the housing surface. If these warning notices have been removed, covered or obstructed, include corresponding additional warning notices.

0.4 Hazards caused by materials and substances

DANGER

1 The vacuum line and the exhaust line must be leaktight. Hazardous process gases may escape or the pumped gases can react with air or atmospheric humidity. After installation of the pump and after servicing work on the vacuum system, a leak search will always be necessary. When pumping hazardous gases we recommend a leak search on a regular basis. Leaks in the pump cannot be ruled out under all circumstances. When pumping hazardous gases, the operator must ensure that that leaks at the pump will not be a hazard.

2 Since not all application related hazards for vacuum systems can be described in detail in these Operating Instructions, Leybold has available a separate document (Safety Booklet) in which the hazards and general safety concepts for design, operation and maintenance of vacuum systems are explained.
When planning to pump hazardous substances with this pump, read the related chapters in the Safety Booklet and in these Operating Instructions first. You can download the Safety Booklet from our homepage.

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

4 Before commissioning the TRIVAC BCS, make sure that the media which are to be pumped are compatible with each other so as to avoid hazardous situations. All relevant safety standards and regulations must be observed.

5 When pumping toxic, chemical, radioactive and corrosive gases as well as pyrophorous substances, the operating company is under the obligation to comply with the national and international safety regulations and guidelines. Regarding the suitability of the TRIVAC BCS pumps for special applications in which such gases, respectively substances shall be pumped, Leybold should be consulted first.

6 If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection.

Before opening the pump, purge it for a longer period of time with an inert gas.
If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood. Firmly seal off the pump.
When shipping the contaminated pump for servicing, please also state the type of hazard. For this you must use a form which we have prepared for you

DANGER

7 For the TRIVAC BCS-PFPE:
When handling PFPE you should observe the following:
During thermal decomposition at temperatures over 290 °C toxic and corrosive gases are released. When handling PFPE keep it way from open fires. Do **not smoke** in the work area.
Touch the inner sections of the pumps only while wearing clean gloves, and use clean tools;
work in clean and dry rooms;
after having removed the pump from its packaging, start it up immediately;
as cleaning agents solvents based on hydrofluorether compounds may be used.

8 Contaminated parts can be detrimental to health and environment. Before beginning with any work, first find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

0.5 Danger of ignition

CAUTION

1 The standard version of the TRIVAC BCS is not suited for operation in explosion hazard areas.

2 The TRIVAC pumps including the accessories are fundamentally not suited for pumping of combustible and explosive gases or vapours. Mixtures of substances may, regarding the fire and explosion risk be critical or uncritical. The operating company is under the commitment to analyse this and rate the hazard potential accordingly so as to therefrom derive the necessary safety measures which must be introduced.

3 Provided ignitable or pyrophorous substances are present in the equipment you must:
- ensure that no air can enter into the equipment,
- ensure that the system is leak-tight,
- with an inert gas purge (with nitrogen, for example) dilute all ignitable gases or vapours which may enter into the pump through the pump's inlet and/or with an inert gas purge reduce the concentration of ignitable gases or vapours in the pump and in the exhaust line to less than a quarter of the lower explosion limit (LEL) published for the respective gases.

0.6 Hazard caused by noise

CAUTION

1 The noise level produced by the pump less than 60 dB(A). Suitable hearing protection measures must be introduced.

NOTICE

0.7 Risk of damaging the pump

1 Before starting up for the first time, the motor circuit must be equipped with a suitable protective motor switch. Please take note of the information in these Operating Instructions and on the electric motor (wiring diagram).

2 Do not allow the ingestion of small objects (screws, nuts, washers, pieces of wire, etc.) through the inlet port. For this reason always use the inlet screen which is supplied as standard.

3 Do not use the pump for applications that produce abrasive or adhesive powders or condensable vapours that can leave adhesive or high viscosity deposits. When planning to pump vapours other than water vapour please contact our sales or service department for advice.

4 This pump is suited for pumping water vapour within the specified water vapour tolerance limits.

5 Avoid vapours that can condense into liquids when being compressed inside the pump, if these substances exceed the vapour tolerance of the pump.

6 Before pumping vapours the TRIVAC BCS should have attained its operating temperature. This will be the case approximately 30 minutes after having started the pump. During this warming up phase, the pump should be separated from the process, by a blocking valve in the intake line, for example.

7 In the case of wet processes we recommend the installation of liquid separators upstream and downstream of the pump as well as the use of the gas ballast.

8 The exhaust line should be laid so that it slopes down and away from the pump so as to prevent condensate from backstreaming into the pump.

9 The entry of particles and fluids must be avoided under all circumstances.

10 Reactive or aggressive substances in the pump chamber may impair the operating oil or modify it. In addition, such substances may be incompatible with the materials of the pump (Viton, grey cast iron, aluminium, steel, resins, glass etc.).

11 Corrosion, deposits and cracking of oil within the pump are not allowed.

12 Normal amounts of humidity within the range of the pump's water vapour tolerance will not significantly affect pump performance when the gas ballast is active.

13 When operating the pumps at gas throughput, it is urgently recommended to connect an exhaust filter or use a suitable exhaust line. Here, the exhaust line must slope down and away from the pump.

14 In the case of custom pumps please note the information provided in the supplementary sheets.

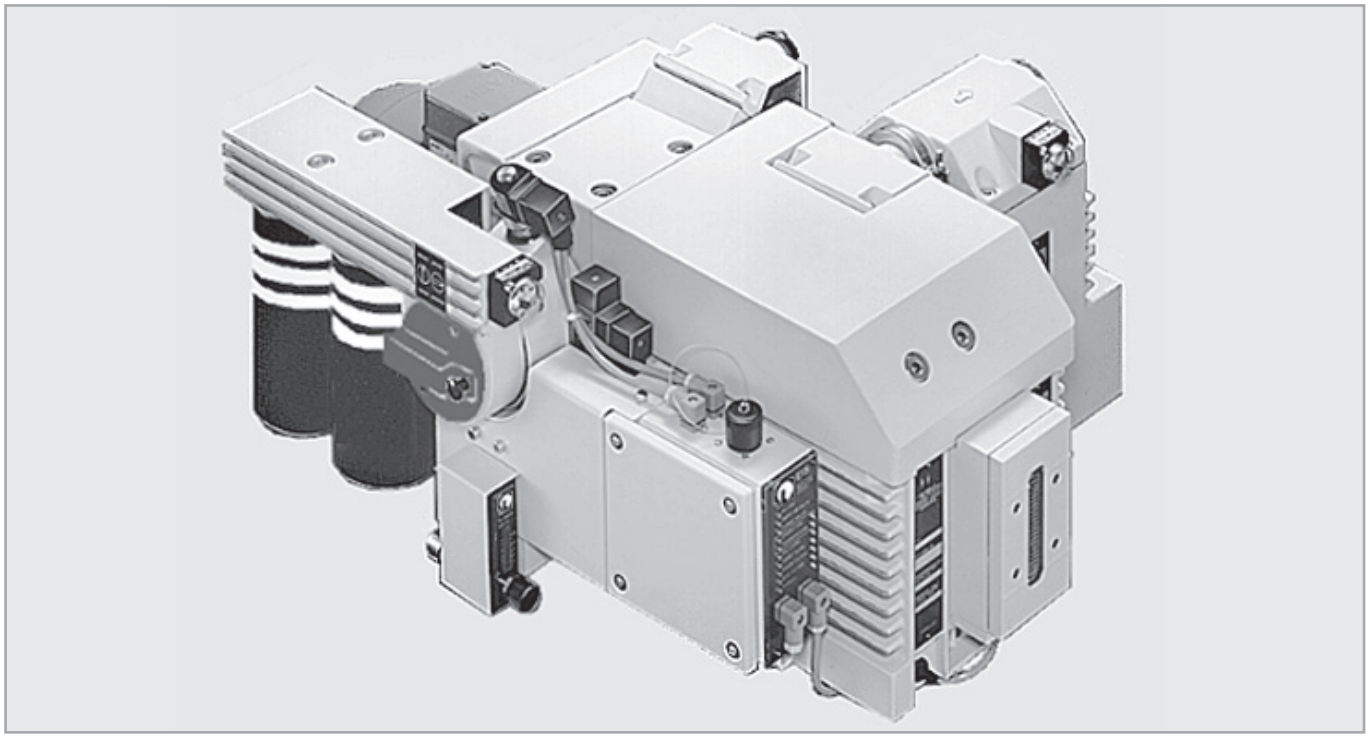


Fig. 1 TRIVAC BCS pump with accessories

1 Description

TRIVAC BCS pumps are oil-sealed rotary vane pumps. The TRIVAC D 40 BCS and D 65 BCS are dual-stage pumps. The number in the type designation (40 or 65) indicates the pumping speed in m3 · h^{-1}.

The TRIVAC BCS-PFPE have been prepared especially for operation with perfluoropolyther.

TRIVAC BCS pumps can pump gases and vapours, and evacuate vessels or vacuum systems in the fine vacuum range.

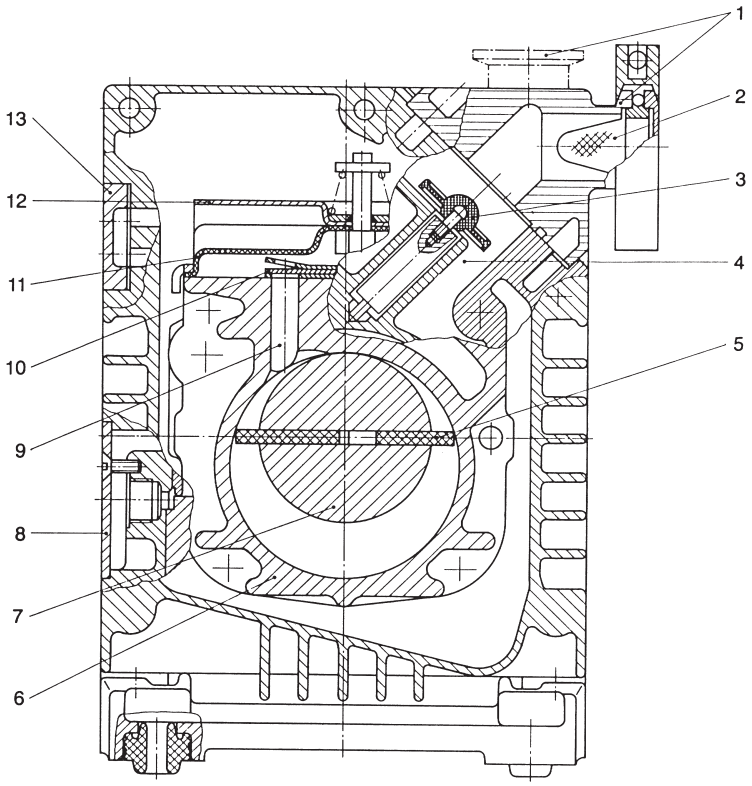
They have been designed particularly for use in connection with corrosive or aggressive media. Moreover, the pump has been prepared for the installation of an electric monitoring facility. Leybold have developed for the TRIVAC BCS a range of accessories which considerably extend the range of applications for this kind of pump. These accessories which in connection with the TRIVAC BCS vacuum pump make up the TRIVAC system, are described briefly in Chapter 1.5.

Via an intermediate flange the drive motor of the TRIVAC is mounted to 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.

Description



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 BCS

1.1 Function

The rotor (2/7), mounted eccentrically in the pump housing (2/6), 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 TRIVAC BCS-PFPE pumps do not have an internal demister. The gas leaves the TRIVAC BCS-PFPE 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. The gas ballast stops condensation of vapours in the pump chamber up to the limit of the water vapour tolerance as specified in the technical data for the pump.

The gas ballast valve is opened (position I) and closed (position 0) by turning the gas ballast knob (7/5) on the front.

The gas ballast facility of the TRIVAC BCS pump has been prepared for connecting the inert gas system IGS.

To enable the TRIVAC BCS 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 BCS 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 BCS through an integrated hydropneumatic anti-suckback valve (2/3) which is controlled via the oil pressure.

During operation of the TRIVAC BCS the control piston (4/3) remains sealed against a spring (4/2) by the oil pressure. The valve disk (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.

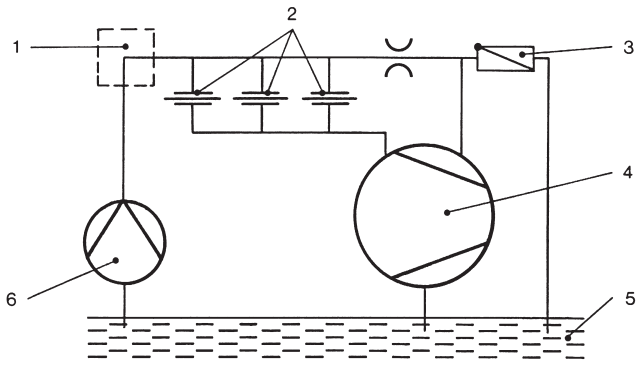
Due to the pressure difference between the oil case and the intake port the oil presses the piston (4/4) up and the valve plate (4/6) against the valve seat (4/5). The quantity of oil in the oil reservoir (4/1) prevents the entry of air into the intake port (2/1) at the beginning of this process.

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 or oil vapours. The anti-suckback valve (2/3) operates independently of the operating mode of the pump, i.e. also with gas ballast.

All aluminium surfaces of the TRIVAC BCS are surface protected and thus particularly capable of resisting aggressive chemicals. A thermocouple has been incorporated in the pump which is used in connection with the optional electrical monitoring facility. The thermocouple may be accessed through the built-in connector (7/8).

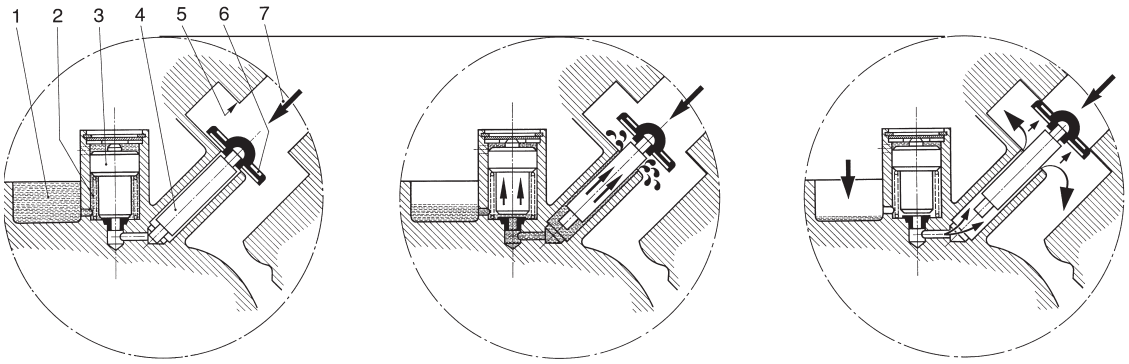
Via a second oil fill opening, an exhaust line may be connected for venting the oil case when using the inert gas purging facility.

Description



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



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 Lubricants

The standard TRIVAC BCS pumps are either ready for operation with mineral oil or with the special lubricant, perfluoropolyther (PFPE).

If mineral oil and PFPE come into contact they will emulsify. That's why the pumps must only be run with the type of lubricant specified for the pump. If you want to change the type of lubricant Leybold should do the change.

In case of operation of a TRIVAC BCS we instruct our vacuum pump oil LVO 100.

In case of operation of a TRIVAC BCS-PFPE we instruct our vacuum pump oil LVO 400.

When handling PFPE you should observe the following:
During thermal decomposition at temperatures over 290 °C toxic and corrosive gases are released. When handling PFPE keep it way from open fires. Do not smoke in the work area.
Please note the Material Safety Data Sheet (MSDS) for LVO 400.

Touch the inner sections of the pumps only while wearing clean gloves, and use clean tools;
Work in clean and dry rooms;
After having removed the pump from its packaging, start it up immediately.
Do not smoke during working with PFPE.
As cleaning agents solvents based on hydrofluorether compounds may be used.

CAUTION

1.3 Supplied Equipment

The equipment supplied with the TRIVAC-BCS pump includes:

Pump with motor,

1 centering ring,

1 centering ring with dirt trap,

2 clamping rings DN 40 KF,

Operating Instructions,

Spare Parts List ,

Plug without cable to protect the socket for the temperature switch.

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

The pump is contained with some silica gel in an air-tight plastic bag.

TRIVAC BCS for operatiom with mineral oil

Upon delivery from Leybold Cologne the pumps will be filled with LVO 100 oil.

TRIVAC BCS for operation with PFPE

The pumps will be supplied without lubricant. However, the pump will still contain residues (about 0.7 litres) of the LVO 400 lubricant.

The oil fill plugs have been removed and are supplied separately.

NOTICE

In the case of custom pumps please note the information provided on a separate sheet.

TRIVAC D65B ^{3}He for Helium Applications

Owing to the particularly stringent leak tightness requirements in connection with helium applications the TRIVAC D65B ^{3}He (P/N 1129646) is delivered without gas ballast facilities so as to prevent the admission of gas into the pump in the event of misoperation. The gas ballast facility has been blanked off with a closure screw.

The pump has been so designed that it may be evacuated down to a pressure of 50 mbar on its exhaust side for the purpose of avoiding any loss of expensive gases in the helium circuits. The TRIVAC D65B ^{3}He uses special gaskets and has been tested to a leak rate specification of <10-7 mbar·l/s.

1.4 Technical Data

TRIVAC BCS		D 40 BCS two-stage	D 65 BCS two-stage
Nominal pumping speed [1]	m3 · h^{-1} (cfm)	46 (27.1)	75 (44.2)
Pumping speed[1]	m3 · h^{-1} (cfm)	40 (23.6)	65 (38.3)
Ultimate partial pressure without gas ballast[1]	mbar Torr	10^{-4} $0.75 \cdot 10^{-4}$	10^{-4} $0.75 \cdot 10^{-4}$
Ultimate total pressure without gas ballast[1]	mbar Torr	$< 2 \cdot 10^{-3}$ $< 1.5 \cdot 10^{-3}$	$< 2 \cdot 10^{-3}$ $< 1.5 \cdot 10^{-3}$
Ultimate total pressure with gas ballast [1]	mbar Torr	$< 5 \cdot 10^{-3}$ $< 3.8 \cdot 10^{-3}$	$< 5 \cdot 10^{-3}$ $< 3.8 \cdot 10^{-3}$
Water vapour tolerance[1]	mbar Torr	40 30	40 30
Water vapour capacity	g · h^{-1}	1184	1925
Oil filling, min./max.	l	1.7 / 2.6	2.0 / 3.3
Noise level to DIN 45 635 without/with gas ballast	dB (A)	57 / 59	57 / 59
Admissible ambient temperature[2]	°C	+12 ... +40	+12 ... +40
Weight	kg	68	80
Connections, intake and exhaust side	DN	40 KF	40 KF

TRIVAC BCS-PFPE		D 40 BCS-PFPE two-stage	D 65 BCS-PFPE two-stage
Nominal pumping speed[1]	m3 · h^{-1} (cfm)	46 (27.1)	75 (44.2)
Pumping speed[1]	m3 · h^{-1} (cfm)	40 (23.6)	65 (38.3)
Ultimate partial pressure without gas ballast[1]	mbar Torr	$< 8 \cdot 10^{-4}$ $< 6 \cdot 10^{-4}$	$< 8 \cdot 10^{-4}$ $< 6 \cdot 10^{-4}$
Ultimate total pressure with gas ballast[1]	mbar Torr	$< 5 \cdot 10^{-3}$ $< 3.8 \cdot 10^{-3}$	$< 5 \cdot 10^{-3}$ $< 3.8 \cdot 10^{-3}$
Oil filling, min./max. upon delivery ca.	l l	1.7 / 2.6 0.6	2.0 / 3.3 0.75
Noise level to DIN 45 635 without/with gas ballast	dB (A)	57 / 59	57 / 59
Admissible ambient temperature	°C	+12 ... +40	+12 ... +40
Weight	kg	71	83
Connections, intake and exhaust side	DN	40 KF	40 KF

[1] To DIN 28 400 and subsequent numbers

[2] The motor may accelerate with a delay when simultaneously an undervoltage is present at the motor and the pump is at the minimum permissible and ambient temperature. Under such operating conditions the motor protection switch may respond. In this case the motor may be started again. In the case of motor 6506961 and 110004011 the minimum permissible temperature is 15 °C at an undervoltage of 380 V -10% = 342 V and a mains frequency of 60 Hz.

Description

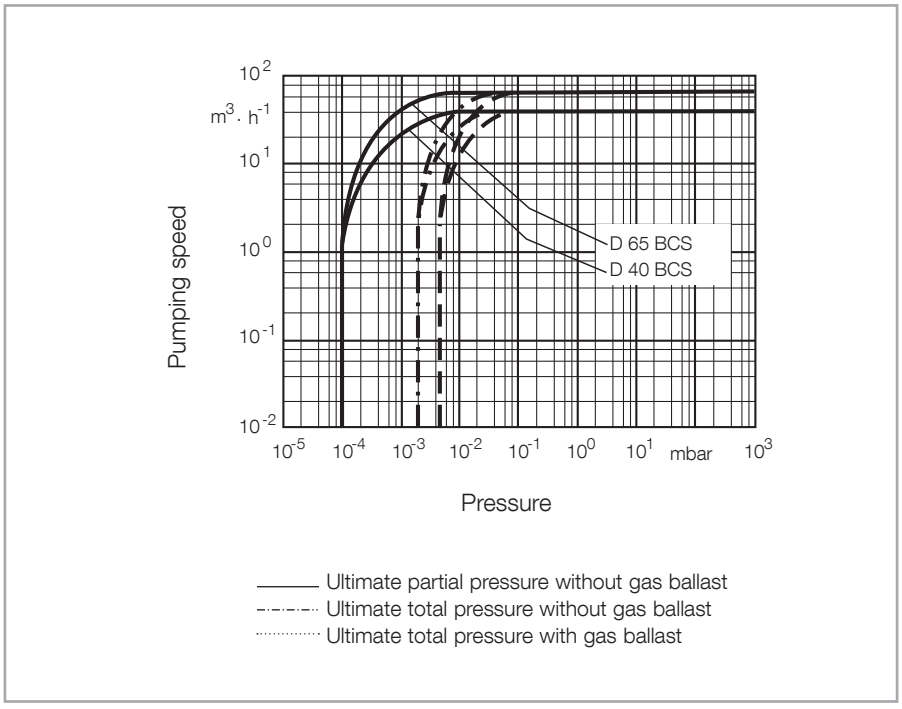
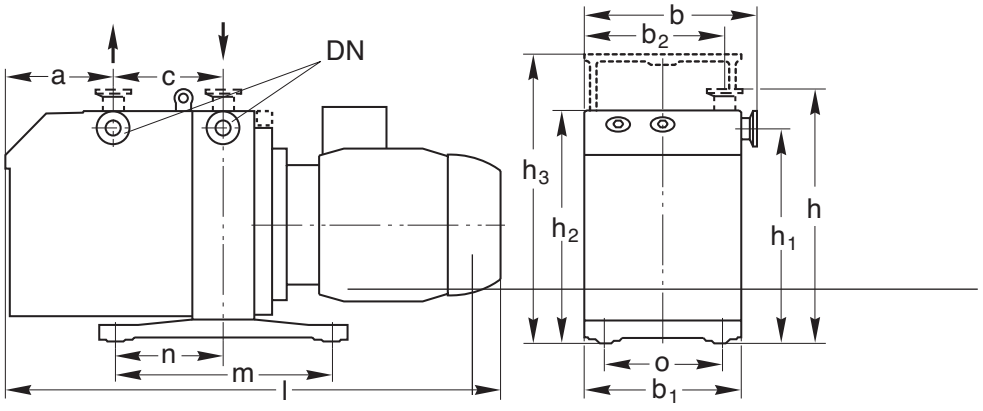


Fig. 5 Pumping speed characteristics for the TRIVAC BCS pumps (50 Hz operation, SI units)



Type	DN	a	b	b_1	b_2	c	h	h_1	h_2	m	n	o
D 40 BCS	40 KF	135	264	234	206	166	355	308	336	382	191	190
D 65 BCS	40 KF	213										
D 40 BCS-PFPE	40 KF	135	264	234	206	166	355	308	336	382	191	190
D 65 BCS-PFPE	40 KF	213										

Length l see following page.

Fig. 6 Dimensional drawings for the TRIVAC BCS pumps (dimensions a, l, b to b_2 and h_1 are approximate) (dimensions in mm 1inch = 25.4 mm)

Cat. Nos. of the pumps	**11388/89/98/99, 1129646**	**113 98J**
Motor type	**AMH 100L A4**	
Motor L/N	**6506961**	**6520731**
Compliance Certification number	CC#046A	
IP rating	IP55	
Operating mode IEC34 / Duty	S1	
Isolation class	F	
Phases	3~	
Nom. efficiency (η) at nom. voltage: 50 Hz and 100 % of nom. load 50 Hz and 75 % of nom. load 50 Hz and 50 % of nom. load 60 Hz and 100 % of nom. load 60 Hz and 75 % of nom. load 60 Hz and 50 % of nom. load	 86.7 % (at 400 V) 87.1 % (at 400 V) 86.0 % (at 400 V) 89.5 % (at 460 V) 88.5 % (at 460 V) 87.5 % (at 460 V)	 86.7 % (at 400 V) 87.1 % (at 400 V) 85.8 % (at 400 V) 89.5 % (at 460 V) 89.1 % (at 460 V) 86.5 % (at 460 V)
Efficiency class	IE3 Premium Efficiency Class	IE3 JIS
Manufacturer	Lafert SpA San Donà di Piave Italy	
Number of poles	4	
Nom. output power at 50 Hz Nom. output power at 60 Hz	2200 W 2200 W	
Nom. in frequency	50 Hz 60 Hz	
Nom. voltage range and nom. current at 50 Hz	200-240 V / 9.0 A 200 V / 9.0 A (IE3) 380-400 V / 4.5 A 380-400 V / 4.5 A (IE3)	180-220 V / 9.7 A 200 V / 9.7 A (IE3) 311-380 V / 5.6 A 346 V / 5.6 A (IE3)
Nom. voltage range and nom. current at 60 Hz	200-240 V / 8.8 A 208-240 V / 7.8 A (IE3) 400-480 V / 4.4 A 416-480 V / 3.9 A (IE3)	200-240 V / 8.8 A 220 V / 8.5 A (IE3) 342-418 V / 4.9 A 380 V / 4.9 A (IE3)
Tolerances of voltage range[1)]	±10 %	
Nom. speed at 50 Hz Nom. speed at 60 Hz	1460 rpm 1760 rpm	
Disposal	local directives have to be considered	
Max. altitude above sea level	1000 m (NHN)	
Max. ambient temp. w/ operating[1)]	40 °C	
T-board / plug	9 pins	
Certificates[2)] of the motor	CE RoHS ENERGY c UL us Energy Verified	CE RoHS
Length of the pump	720 mm (D 40 B) 797 mm (D 65 B)	

Description

[1]The motor may accelerate with a delay when simultaneously an undervoltage is present at the motor and the pump is at the minimum permissible and ambient temperature. Under such operating conditions the motor protection switch may respond. In this case the motor may be started again. In the case of motor 6506961 and 110004011 the minimum permissible temperature is 15 °C at an undervoltage of 380 V -10% = 342 V and a mains frequency of 60 Hz.

[2]Key to the certificate:

UL certification mark for energy efficiency for listed products and approved components for Canada and the USA.

NOTICE

Observe the data given on the motor name plate.
For special pumps please note the information contained in the supplemental sheet..

1.5 Accessories

	Part No.
Separator AK 40-65, DN 40 KF	188 16
Exhaust filter AF 40-65, DN 40 KF	189 16
Drain tap for condensate trap, exhaust filter, oil drain of the pump,	
vacuum-tight	190 90
oil-tight	190 91
Exhaust filter with lubricant return AR 40-65, DN 40 KF	189 22
Exhaust filter with lubricant return ARS 40-65, DN 40 KF	189 57
Dust filter: Filter housing FH 40-65	140 140T
Dust separator	186 16
Adsorption trap: Filterhousing FH 40-65	140 140T
Active carbon	178 10
Zeolite	854 20
Aluminium oxide	854 10
Oil filter OF 40-65	101 92
Chemical filter CF 40-65	101 97
Chemical filter CFS 40-65	101 77
Adaptor for RUVAC 151/251 Roots pumps	168 30
Adaptor for gas ballast port	
M 16 x 1.5 – DN 16 KF	168 40V01
M 16 x 1.5 – 3/8 inch NPT	99 175 011
Inert-gas-system 40-65	161 68V
Limit switch system 40-65	161 07

Use only the kind of oil specified by Leybold. As regards the conformity to EC directives and standards observe the documentation of the accessory components.

NOTICE

1.5.1 TRIVAC - System

Leybold has developed the TRIVAC system especially for processes which depend on the reliability of the pump under difficult conditions (pumping of aggressive gases or vapours, for example).

Moreover, the pump status may be monitored continuously through visual and electric indicators.

Description

The TRIVAC system consists of the TRIVAC BCS pump and the following accessories:

CFS 40-65 chemical filter with safety separating valve

Part No.: 101 77

The CFS is a main flow lubricant filter incorporating a safety separating valve which may be exchanged while the pump continues to operate. The status of the interchangeable filters is indicated.

ARS 40-65 exhaust filter with lubricant return

Part No.: 189 57

The ARS filter collects the droplets of lubricant entrained in the exhaust gas and returns the collected lubricant back into the pump by means of a float controlled valve. This reduces the consumption of lubricant by the pump to an insignificant level so that a daily oil check will no longer be necessary. The status of the filter element may be checked at any time through the differential pressure indicator.

IGS 40-65 inert-gas-system

Part No.: 161 68V

This accessory which may be controlled through a solenoid valve allows the definite injection of controlled quantities of gas into the TRIVAC BCS.

Thus it offers the possibility of effectively reducing contaminants in the lubricant of the system and the materials of the system itself.

LSS 40-65 limit switch system

Part No.: 161 07

This accessory consists of a package of limit switches and serves the purpose of monitoring the operation of the system.

Included with the limit switch system are one eac

- oil pressure switch (operating pressure)
- float switch (oil level monitoring)
- low switch (inert gas)
- differential pressure switch (chemical filter)
- pressure switch (exhaust filter)
- connection cable for the built-in temperature switch

2 Transport and Storing

CAUTION

To lift the pumps only use the crane eyes provided for this purpose, respectively use corresponding lifting facilities. When connecting or removing the pump, do not move under hoisted loads.

Fasten crane eyes only hand-tight.
Crane eyes must be screwed in properly with full contact to the pump surface.
Mounted crane eyes are only suitable for lifting the respective pump. They must not be used for other loads. Crane eyes must only be used IAW the conforming utilization.
Use crane eyes only with appropriate lifting devices.

If possible transport the pump in its original packaging, if not available exercise due care.

Pumps which are filled with operating agents must only be moved while standing upright. Otherwise oil may escape. Avoid any other orientations during transport. Check the pump for the presence of any oil leaks, since there exists the danger that someone may slip on spilt oil.

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 Section 5.4). We recommend that you contact the Leybold Service.

3 Installation

NOTICE

Instructions for the operating personnel
Before any kind of assembly work the personnel must be informed about to potential hazards. Observe Safety Information 0.1 to 06.

3.1 Placement

DANGER

Explosion risk
The standard pump is not suited for installation in the explosion hazard areas. When planning such an application please contact us first.
Observe Safety Information 0.5.

The TRIVAC BCS pump can be set up on a flat, horizontal surface. Rubber feet under the coupling housing ensure that the pump can not slip.
The location of the TRIVAC BCS should be such that all controls are easily accessible.

CAUTION

Risk of toppling
Max. tilt for the pump is 10° from the vertical.

If you wish firmly install the pump in place, use the M6 threads in the vibration elements.

NOTICE

The site chosen should allow adequate air circulation to cool the pump (keep front and rear unobstructed).
The oil-level glass must be visible.

NOTICE

Note the ambient conditions during operation
The ambient temperature should not exceed +40 °C (104 °F) and not drop below +12 °C (55 °F) (see Section 4.3.3).
For installation sites over 1000 m above sea level and/or a relative atmospheric humidity of over 90%, you must discuss this with Technical Sales.

3.2 Conforming Utilization

The TRIVAC BCS-PFPE have been prepared especially for operation with perfluoropolyther.

TRIVAC BCS pumps can pump gases and vapours, and evacuate vessels or vacuum systems in the fine vacuum range. They have been designed particularly for use in connection with corrosive or aggressive media.

They are not suited for operation in explosion hazard areas.

The pumps are suited for pumping water vapour within the specified water vapour tolerance limits. Avoid vapours that can condense into liquids when being compressed inside the pump, if these substances exceed the vapour tolerance of the pump. In the case of wet processes we recommend the installation of liquid separators upstream and downstream of the pump as well as the use of the gas ballast.

NOTICE

Pumping of dust or much contaminated media
The pumps are not suited for pumping of liquids or media which carry large quantities of dust. Corresponding protection devices need to be provided.

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

3.2.1 Pumping of Oxygen

The TRIVAC BCS PFPE pumps in their standard version are suited for pumping oxygen at concentrations exceeding the concentration of oxygen in the atmosphere.
Observe Safety Information 0.4 und 0.5.

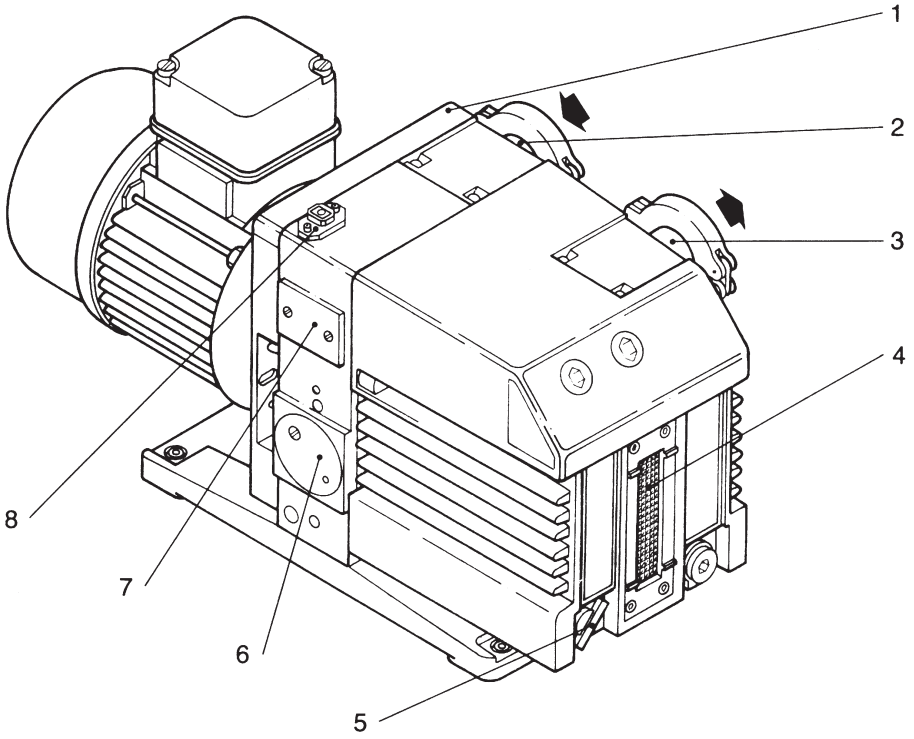
Before pumping oxygen (or other highly reactive gases) at concentrations exceeding the concentration in the atmosphere (over 21% for oxygen), it needs to be ensured that the TRIVAC BCS-PFPE pumps are free of all hydrocarbons. The freedom from hydrocarbons in the TRIVAC BCS-PFPE is ensured when the pumps are brand new.

Note the oxygen handling instructions (see BGI 617 „Umgang mit Sauerstoff“ (“Handling Oxygen” issued by the Trade Association of Industrial Safety in Germany) – Bulletin M 034; BGR 500; ASTM G128 – and NFPA 53), comply with local regulations which apply to oxygen.

Use PFPE and PFPE grease only.

Ensure that the entire pump is free of hydrocarbons (hydrocarbon concentration below 0.5 g/m2). Reliably exclude the possibility of an oxygen enrichment in the room exceeding 21% by volume.

Reliably exclude the possibility of an ingress of other oils, greases and rust particles also by the gas being pumped and via the gas ballast. Avoid potential ignition sources, risk of an explosion.



1 Eye bolt for moving the pump
2 Intake port
3 Exhaust port
4 Oil-level glass
5 Gas ballast knob (0 = OFF, I = ON)
6 Cover plate, connection for IGS
7 Cover plate, connection for CFS
8 Connector for temperature switch

Fig. 7 Connections and controls

Use exclusively original spare parts from Leybold in their original packaging. Do not use any second-hand parts. Keep lines, exhaust and other vacuum connections clean and free of oil. If required have the pump and spare parts cleaned by Leybold. Let only trained personnel do the maintenance work.

The temperature limit for PFPE of 150 °C (in accordance with BAM - Federal Institute for Materials Research and Testing in Germany) may be attained or even exceeded depending on the intake pressure present and at a gas ignition temperature exceeding 60 °C. In unclear cases monitor the temperature through the built-in temperature switch. For this integrate the temperature switch within the system controller so as to switch off the pump when the switching temperature is exceeded. Before restarting, determine and remedy the cause for overheating.

The TRIVAC BCS (PFPE) is not suited for pumping of:

- combustible and explosive gases or vapours
- Oxidant
- pyrophorous substances.

3.2.2 TRIVAC D65B ^{3}He for Helium Applications

The TRIVAC D65B ^{3}He (P/N 1129646) has been designed specially for helium applications and is not equipped with a gas ballast facility so as to avoid contaminating the gas in the event of misoperation.

The intake valve has also been removed so as to exclude the possibility of malfunctions since the pump may be operated with a partial vacuum (>50 mbar) in the oil box.

3.3 Connection to the System

NOTICE

When operating the pump with PFPE observe the information provided in Chapter 1.2.

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

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.

The maximum throughput of the pump is equivalent to the pumping speed of the pump.

CAUTION

Note the specified cross sections for the connection lines
If exhaust gases must be collected or contained, do not allow the exhaust line to become pressurised. The pressure in the oil box must not exceed 0.5 bar (g). An exhaust line which is too small in diameter or which is blocked can result in the formation of overpressures within the pump. Possible consequences can be a damaged or even burst open pump. Thus the exhaust line must be checked from time to time to ensure that there are no obstructions.

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

NOTICE

Avoid backflowing condensate
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.

CAUTION

Safely lead the exhaust gases away
Exhaust gases may, depending on the type of application, present a health hazard and/or may be detrimental to the environment.
The exhaust gases from the vacuum pump must be safely led 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, see Section 1.5). Depending on the type of application or the kind of pumped media, the corresponding regulations and information sheets must be observed.

NOTICE

When oil mist is to be removed from the exhaust flow we recommend the use of the exhaust filter with lubricant return (ARS) which is part of the TRIVAC system.

The maximum intake pressure must not exceed atmospheric pressure (1013 mbar).

When pumping aggressive media in particular in connection with PFPE as the lubricant, we recommend the use of the chemical filter with safety separating valve (CFS) which is part of the TRIVAC system. This will considerably extend the service life of the lubricant.

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 1.5).

In inlet pressure for the gas ballast should be about 1013 mbar (absolute) and sufficient quantities of gas must be available (about 1/10 of the pumping speed).

3.4 Electrical Connections

TRIVAC BCS pumps are supplied with three-phase motor but without accessories for 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.

Please observe the diagram at the motor.

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.

If the connector for the temperature switch is not used, the plug may remain connected at this socket to protect it.

The built-in temperature switch provides a signal when the pump gets too hot. We recommend that you access the signal available at this connector through the LSS and the EIS.

Otherwise you may access the signal at pins 1 and 2 (voltage 24 V DC max., power consumption 10 W).

In the case of custom pumps please note the information provided on a separate sheet.

DANGER

Risk due to high voltages
Death or severe injury caused by an electric shock!
The electrical connections must only be provided by a trained electrician as specified, for example, by the regulations EN 50110-1. Note the national regulations of the country in which the equipment is being operated.

During all connection work, the mains power supply lines must be de-energised (lockout/tag out). 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.
Observe Safety Information 0.2.

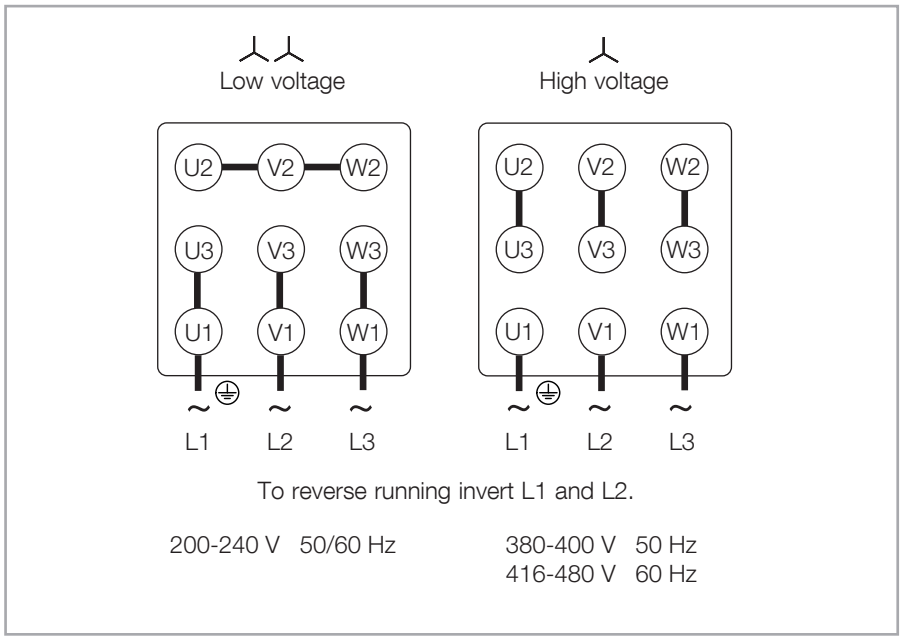


Fig. 8.1a Motor connection diagram (motor P/N: 6506961)

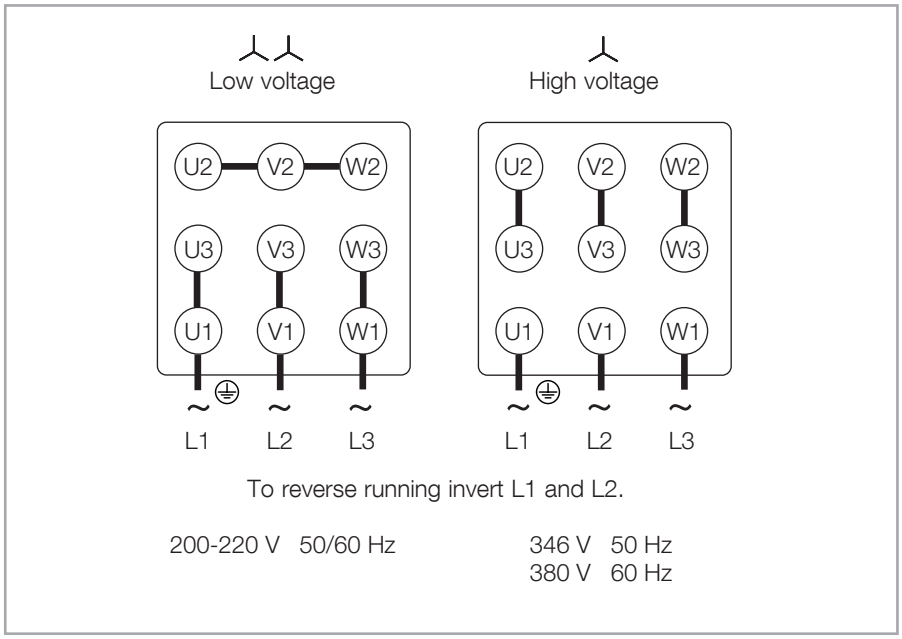


Fig. 8.1b Motor connection diagram (motor P/N: 6520731)

4 Operation

4.1 Media Compatibility

TRIVAC BCS pumps can pump condensable gases and vapours, provided that the gas ballast valve is open and the pump has attained its operating temperature.

In connection with the inert gas system (IGS) which is part of the TRIVAC System, TRIVAC BCS pumps may be operated with an inert gas ballast.

Since the IGS is intended for a reduced gas ballast for purging the pump, the water vapour tolerance of the pump is reduced depending on the settings to values in the 1 mbar range.

The inert gas supply needs to be opened before allowing the process gas to enter into the pump.

For operation with oxygen, see Section 3.2.1.

4.2 Start-up

NOTICE

Each time before starting up check the oil level. The pump must never be operated with an oil level below the minimum.

Open all valves blocking the exhaust lines. The pump must never be operated with a blocked or constricted exhaust line.

Check the direction of rotation before starting the pump for the first time and after each change in the electrical connection (see Chapter 3.4).

On initial start-up, after prolonged idle periods or after an oil change, the specified ultimate pressure cannot be attained 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.

If the chemical filter (CFS) has been installed on the pump the separating valve may be set to the position marked “Wechsel” during the first part of the run-up phase. When doing so, the relatively cold and thick lubricant will not have to be pumped through the interchangeable filter, thus removing some load from the pump’s motor. Thereafter, the separating valve is set to the position “Betrieb”.

WARNING

Use matching accessories only
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.

WARNING

Start up the pump only after it has been fully installed
Never operate the pump with an open intake port. Vacuum connections as well as oil feed and discharge openings must not be opened while the pump is operating. Avoid exposing any part of the human body to the vacuum. There is the risk of suffering injury.
Observe Safety Information 0.1

4.3 Operation

WARNING

If exhaust gases must be collected or contained, do not allow the exhaust line to become pressurised. The pressure in the oil box must not exceed 0.5 bar (g). An exhaust line which is too small in diameter or which is blocked can result in the formation of overpressures within the pump. Possible consequences can be a damaged or even burst open pump. Thus the exhaust line must be checked from time to time to ensure that there are no obstructions.

4.3.1 Pumping of Non-Condensable Gases and Vapours

If the process contains mainly permanent gases, the TRIVAC BCS may be operated without gas ballast (position 0), 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 and with dry inert gas in accordance with Section 4.3.2.

4.3.2 Pumping of Condensable Gases and Vapours

With the gas ballast valve open (position I) and at operating temperature, TRIVAC BCS 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.

NOTICE

Pumping of Vapours
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 properties and thus there is a risk of corrosion in the pump. Therefore, don't switch off the pump 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 BCS in this mode for about 30 minutes after completion of the process.

In cyclic operation, the TRIVAC BCS 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.

4.3.3 Operating Temperature

Proper operation of the TRIVAC BCS 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 BCS may lie over 70 °C (156 °F).

CAUTION

Beware of hot surfaces
There is the danger of receiving burns.
Observe Safety Information 0.3.

If – due to the ambient conditions – this temperature range is exceeded at either end of the range, contact Leybold Sales.

The motor may accelerate with a delay when simultaneously an undervoltage is present at the motor and the pump is at the minimum permissible and ambient temperature.
Under such operating conditions the motor protection switch may respond. In this case the motor may be started again.
In the case of motor 6506961 and 110004011 the minimum permissible temperature is 15 °C at an undervoltage of 380 V -10% = 342 V and a mains frequency of 60 Hz.

4.4 Shutdown

Since the TRIVAC BCS pump will commonly be exposed to aggressive and corrosive media, we recommend that you 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 and difficulties when re-starting the pump under conditions where the lubricant has been chemically modified.

NOTICE

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 Chapter 4.3.2).

If the TRIVAC BCS running with mineral oil 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

Pump and operating agents may be contaminated
If hazardous substances have been pumped, then these substances can escape from the pump and from the oil. Introduce adequate safety precautions; use gloves, face protection or a respirator, for example. Observe Safety Information 0.4.

Drain the oil (see Chapter 5.4).

Add clean oil until the oil-level is at the “min” mark 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.

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

Please also take note of the information given in Section 2 Transport and Storing.

4.4.1 Shutdown through Monitoring Components

CAUTION

When the pump has been switched off by monitoring components at the pump (e. g. thermal sensor), the pump must only be started manually after the pump has cooled down to the ambient temperature and after having removed the cause first.

4.4.2 Controller/Mains Power Failure

CAUTION

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.

5 Maintenance

DANGER

Danger by High Electric Voltages
Death or severe injury caused by an electric shock!
The electrical connections must only be provided by a trained electrician as specified, for example, by the regulations EN 50110-1. Note the national regulations of the country in which the equipment is being operated.

Disconnect the electrical connections before disassembling the pump. Make absolutely sure that the pump cannot be accidentally started. Observe Safety Information 0.2.

If the pump has pumped harmful substances, contrary to what has been stated in Section 3.2, ascertain the nature of hazard and take adequate safety measures. Observe Safety Information 0.4.

When operating the pump with PFPE observe the information provided in Chapter 1.2.

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

Due to the design concept, TRIVAC BCS 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 5.1.

NOTICE

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 and will void any warranty claims.

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

NOTICE

If the TRIVAC BCS 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 BCS has been pumping corrosive media we recommend that possibly planned maintenance work be carried out immediately in order to prevent corrosion of the pump while it is at standstill.

In case of special designs and variants please always indicate the serial number.

Maintenance

5.1 Maintenance Plan

No.	Rotary vane pumps TRIVAC D 45 BCS TRIVAC D 65 BCS	Measurement/test quantity Operating/auxiliary materials	Interval						Remarks
			VE	VP	t	6m	a	n-a	
1	Operate the pump for at least 1 h with gas ballast..				x				Condensed water is thus removed from the oil.
2	Check the oil level, if required change the oil.	Öl: LVO 100 or special and alternative oils see Chapter 1.2	x		x				Refill: Only after the pump has been switched off.
3	Check the quality of the oil, change the oil if required.	visually (all oils) chemically mechanically	x		x	 x x			Visually: normally light and transparent, oil change is required when discolorations increase. **Chemically:** to DIN 51558, when the neutralisation number exceeds 2; then an oil change will be required. **Mechanically:** when viscosity is 20 % abovethe one of fresh oil; then an oil change will be required.
4	Clean the inlet screen in the intake port, change it as required.	Suitable cleaning agent and compressed air.				x			■ Clean inlet screen with a cleaning agent and blow it out with compressed air under a suction hood ■ Replace the defective inlet screen.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 internal demister with 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 anydamages, change the couplingelement as required.						x		
7	Change the oil and	Oil: LVO 100					x		Oil change: ■ First oil change after 100 operating hours. ■ Pump switched off and cold. Exchange the oil while the pump is cold so as to avoid releasing adsorbed gases.
	clean the oil level glass.	Suitable cleaning agent and compressed air.							Clean the oil level glass with a cleaning agent and blow it out with compressed air under a suction hood. Use cleaning agents only corresponding to the national/international specifications. **Observe the safety regulations when using cleaning agents** **Quantity of oil:** see Technical data
8	Check the fan of the pump and motor as well as the cooling fins on the motor for deposits, and clean as required.	Brush and industrial vacuum cleaner.					x		Depending on the amount of dust check the pump and keep it clean. **Caution:** switch off the pump and ensure that it cannot run inadvertently (disconnect from the mains).

Key to maintenance plan

VE = Maintenance before switching on the system

VP = Maintenance before starting production

t = Daily maintenance

6m = Six monthly maintenance

a = Annual maintenance

n-a = Maintenance every n years

We recommend that you service the pump every two years covering the following:

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

This service should be run by the Leybold - Service.

5.2 Leybold Service

Whenever you send a pump to Leybold, indicate whether the pump is contaminated or is free of substances which could pose a health hazard. If it is contaminated, specify exactly which substances are involved. You must use the form we have prepared for this purpose; we will forward the form on request.

A copy of the form is printed at the end of these operating instructions: „Declaration of contamination of vacuum equipment and components“. Another suitable form is available from the Leybold homepage: www.leybold.com -> Downloads -> Download Documents

Attach the form to the pump or enclose it with the equipment.

This statement detailing the contamination is required to satisfy legal requirements and for the protection of our employees.

Pumps which are not accompanied by a contamination statement will be returned to the sender.

CAUTION

Use secure shipping packaging
Package the pump such that it will not suffer any damage when being shipped and so that no oil or hazardous materials can escape from the packaging

5.3 Monitoring the Oil Level

During operation of the TRIVAC BCS 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

Check and top up oil only after having shut down the pump first.
Please note the safety information given in Section 0.3 und 0.4.

Pumps which have not directly been delivered from Leybold, e.g. in systems, may have been filled with oils different from LVO 100. In this case a refill with LVO 100 may cause problems. Therefore check before the refill the kind of oil in the pump and fill in only suitable oil or change the oil.

When operating the TRIVAC BCS in connection with the exhaust filter with lubricant return (ARS 40-65) the checking intervals are extended.

When using the oil float switch (LSS) remote monitoring of the lubricant is possible.

5.3.1 Checking the Condition of LVO 100

The ageing process for the standard operating fluid LVO 100 respectively (see Section 1.2) will depend very much on the area of application for the pump.

There exist the following ways of checking the oil:

a) Visual check
Normally the oil is clear and transparent. If the oil darkens, it should be changed.

b) Chemical check
The neutralisation number of LVO 100 oil is determined according to DIN 51558. If it exceeds 2, the oil should be changed.

c) Viscosity check
If the viscosity of LVO 100 at 25 °C exceeds a level of 240 mPas (20 % higher than the viscosity of fresh oil) an oil change is recommended.

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.

When wanting to check the oil, switch off the pump first and drain out from the warm pump the required amount of oil through the oil drain (9/4) into a beaker or similar.

Please note the safety information given in Section 5.4.

5.3.2 PFPE

PFPE are practically inert against any kind of chemical and oxidative influence. Against Lewis acids (like boron trifluoride BF3, aluminium trichloride AlCL3, for example) they are not entirely inert. Here a reaction at temperatures of approximately 100 °C or more can be expected.

PFPE are thermally highly stable. A thermal decomposition can occur only at temperatures over 290 °C.

CAUTION

Perfluorinated polyethers will, when suffering thermal decomposition, release toxic and corrosive gases.

In the case of PFPE at least a visual check is recommended.

Normally the oil will be light and transparent. In the case of an increasing discoloration it is likely that the oil has taken up either liquid or solid process media, and an oil change is recommended.

5.4 Oil Change

WARNING

Pump and operating agents may be contaminated
Hazardous substances may escape from the pump and the oil. 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. Use gloves, face protection or a respirator, for example.
Observe Safety Information 0.3 und 0.4.

Change the oil while the pump is cold so as to avoid releasing adsorbed gases. If releasing adsorbed gases is no problem, change the oil after the pump has been switched off and while the pump is still warm

Risk of suffering burns
With the pump warm from operation, both pump and oil can get so hot that there is the risk of suffering burns. If required, wear gloves.

NOTICE

Check and top up oil only after having shut down the pump first.
When disposing of waste oil, observe the applicable environment protection regulations!
When changing the oil use the same type of oil which was previously in the pump. If you want to change the type of oil entirely please consult us first.

Mineral oil (LVO 100)
The oil should be changed after the first 100 operating hours and then at least every 2000 - 3000 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 much 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 1.5).

Contact us for more information in this matter.

PFPE (LVO 400)
PFPE lubricants are chemically almost inert. Thus they do not suffer ageing like mineral oils, for example.

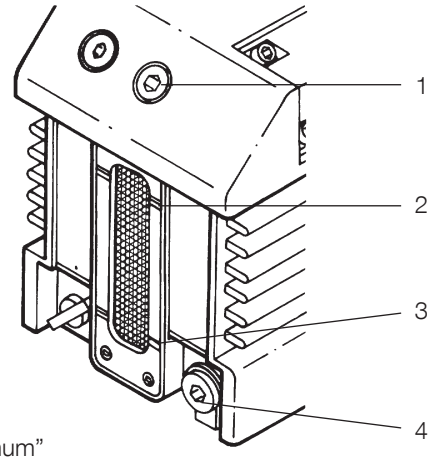
However, PFPE lubricants offer a reduced dispersing behaviour compared to that of mineral oils. For this reason, any contaminant particles entering into the pump may deposit themselves within the pump and cause damage. The ingress of process media can also cause impairments within the pump, for example through condensation and a reduction in the attainable ultimate pressure or by attacking components through aggressive media. In this case pumps with a filling of PFPE must always be operated in connection with a suitable oil filter facility.

When the oil filter facilities are changed early enough, it will only be required to exchange the PFPE rarely. In such cases we recommend to exchange the PFPE once a year to be on the safe side.

Shorter oil change intervals will be necessary in the case of

- inadequate oil filter facilities
- oil filter changes which are done too late
- when pumping contaminated gases
- when pumping extremely reactive substances.

How often a PFPE exchange will be necessary can only be decided on a case-by-case basis depending on the level and type of contamination.



1 Oil-fill plug
2 Oil-level mark “maximum”
3 Oil-level mark “minimum”
4 Oil-drain plug

Fig. 9 Oil change

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 fresh oil.

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

The tightening torque for the bolts (9/1) and (9/4) has been specified at 10 Nm.

When an exhaust filter with lubricant return has been installed on the pump please also exchange the oil there.

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

NOTICE

5.5 Cleaning the Inlet Screen

A wire-mesh sieve is located in the intake port of the pump to act as a dirt trap for foreign objects. 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. Replace the dirt trap with a new one.

NOTICE

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.

5.6 Removing and Fitting the Internal Demister

(not required for TRIVAC BCS-PFPE)

Required tools: Allen keys size 6 and 8

Gasket for oil case (10/5)	For material No., see spare parts list
Internal demister (10/3)	For material No., see spare parts list

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 Chapter 5.4).

Remove the six recessed screws (10/6) on the oil case (10/4). Don't remove the non-recessed screws; they hold the motor flange in place and need not be removed.

Pull the oil case forward off the pump.

Remove the gasket (10/5).

Unscrew screw (10/1).

Remove small washer (10/1), spring (10/1), large washer (10/1) and O-ring (10/1).

Lift off the frame (10/2) 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.

Torque for the screws (10/6) is 12.5 Nm.

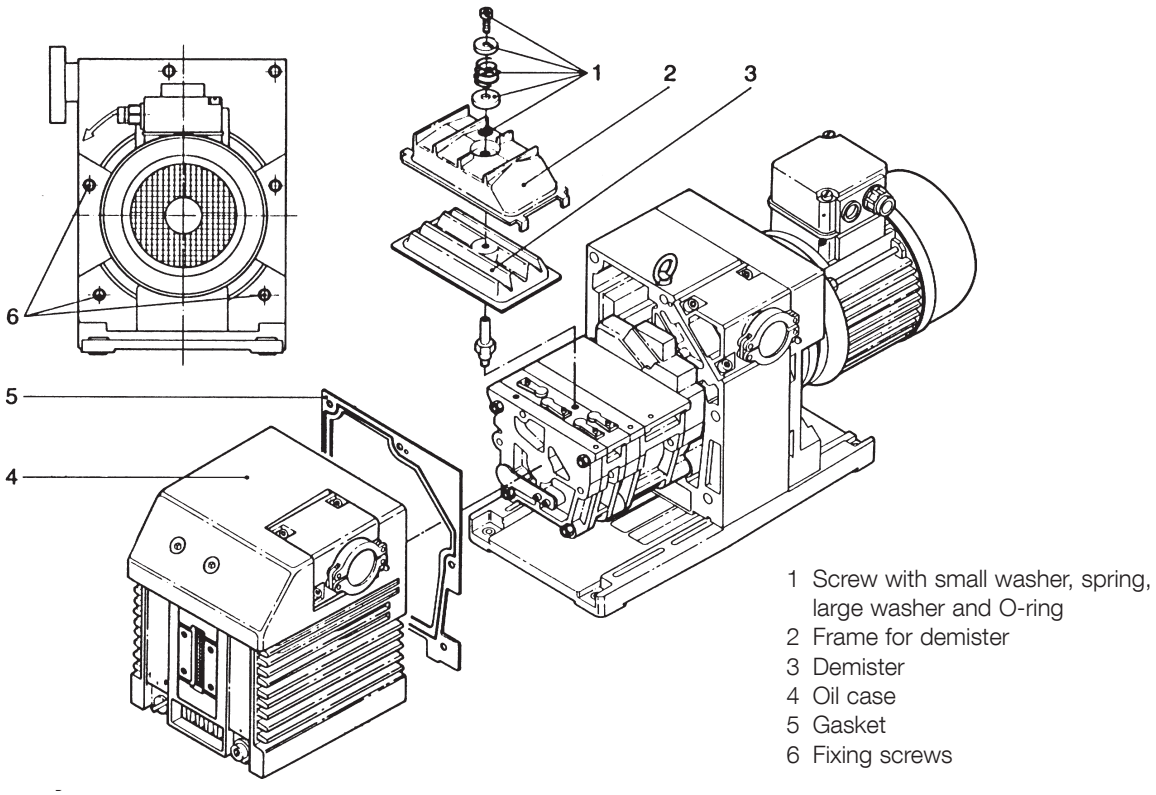


Fig. 10 Removal and fitting of the internal demister

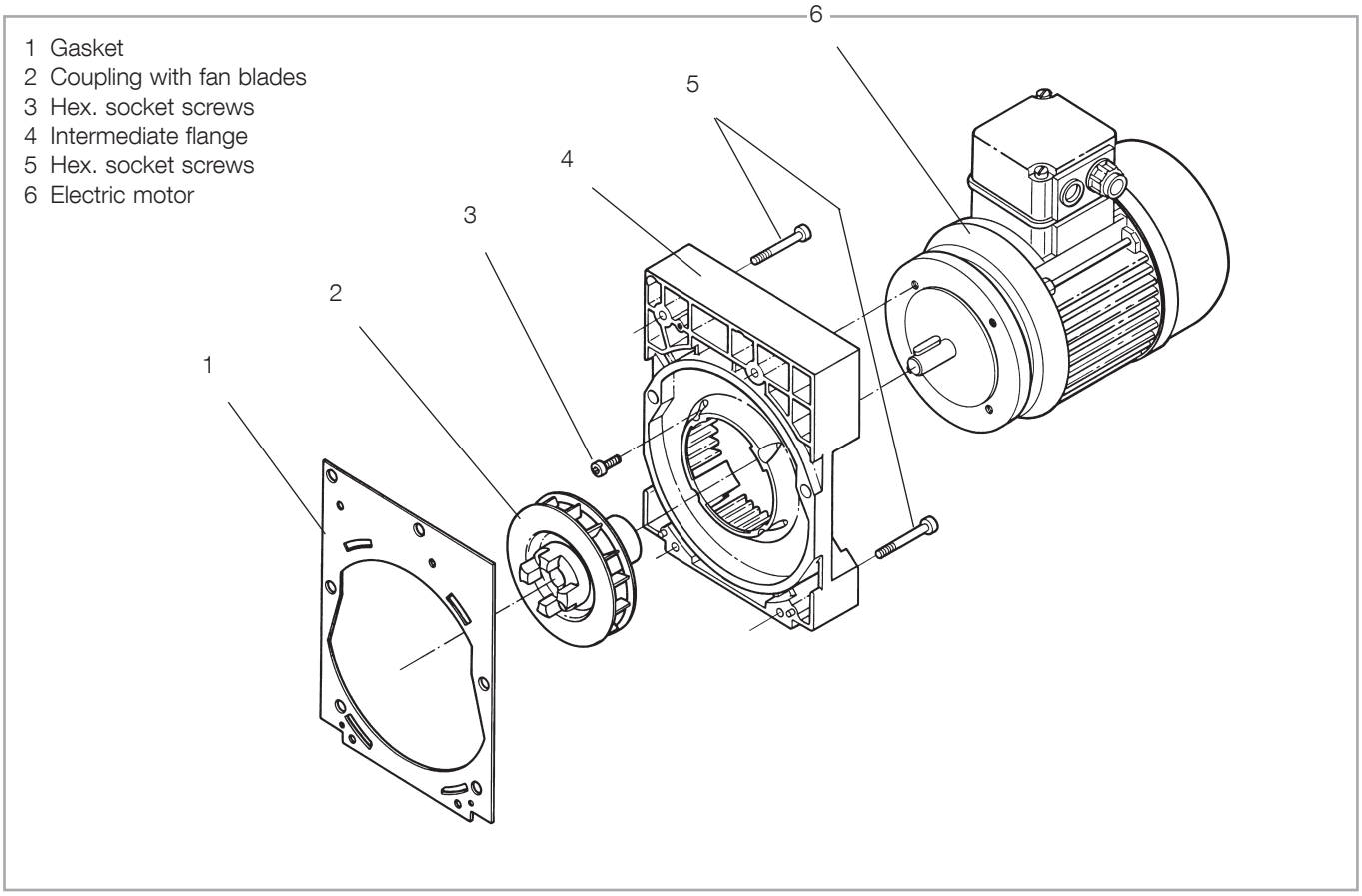


Fig. 11 Disassembly and reassembly of the electric motor

5.7 Disassembly and Reassembly of the Electric Motor

DANGER

Risk due to high voltages
Death or severe injury caused by an electric shock!
Before starting work, always disconnect the motor from the mains. Pull the mains plug. Observe Safety Information 0.2.

Required tools:

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

Disconnect the mains connection.

Support the motor.

Unscrew the four non-recessed hex. socket screws (11/5).

Remove the intermediate flange (11/4) together with the electric motor (11/6).

Remove the gasket (11/1).

Loosen the threaded pin and pull the coupling with the blade wheel (11/2) off the motor shaft.

Unscrew the hex. socket screws (11/3.

Remove the electric motor (11/6).

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

Reassemble in the reverse order.

5.8 Replacing the Shaft Seal

This does not apply to the part number 1129646. Please contact the Leybold Service.

Required tools:

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

Required spare parts:

2x Shaft seal (12/9)	For material No., see spare parts list
Bushing (12/12)	For material No., see spare parts list

The TRIVAC BCS has two shaft seals. Oil marks under the coupling housing are signs of a damaged shaft seal.

The shaft seal (12/9) can be replaced without removing or disassembling the pump module.

Shutdown the pump.

Drain the oil (see Section 5.4).

Support the motor.

Unscrew the four non-recessed hex. socket screws (11/5) and remove the motor (11/6) with the intermediate flange.

Remove gasket (11/1).

1 Coupling element
2 Cylinder head screw
3 Spring washer
4 Coupling (one half)
5 Key
6 Compression ring
7 O-ring
8 Holding plate
9 Shaft seals
10 Centering disk
11 O-ring
12 Bushing
13 Bolts

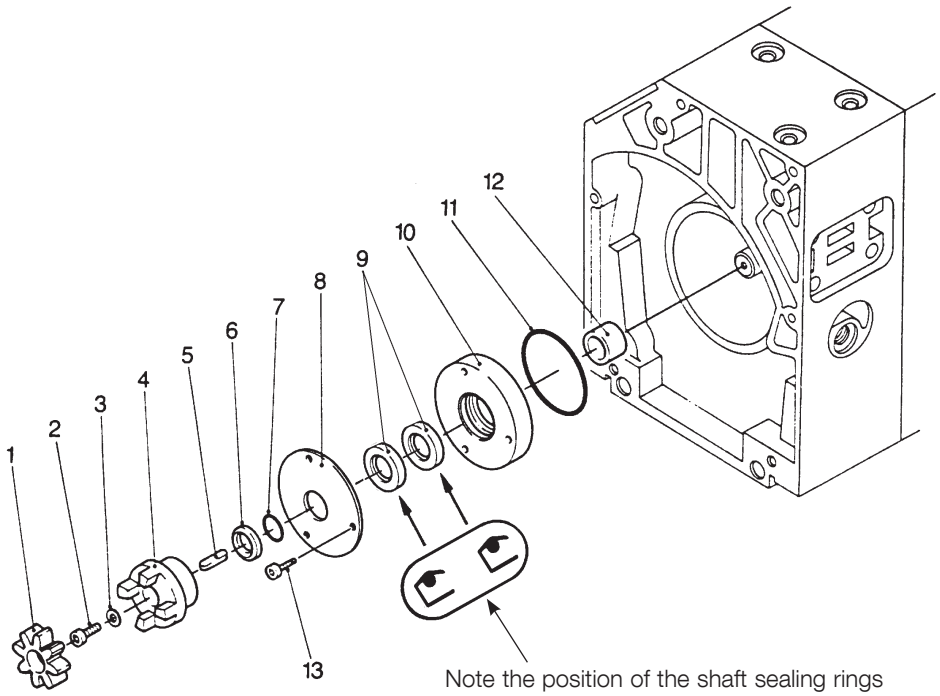


Fig. 12 Exchanging the shaft seal

Remove coupling element (12/1).

Unscrew screw (12/2) and pull off the spring washer (12/3).

Pull off the coupling half (12/4).

Remove key (12/5).

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

Unscrew the hex. socket screws (12/13) and pull out the centering disc (12/8).

Pull the centering disk (12/10) out.

If the centering disc does not come loose, use the forcing thread into which screws (12/13) can be screwed in.

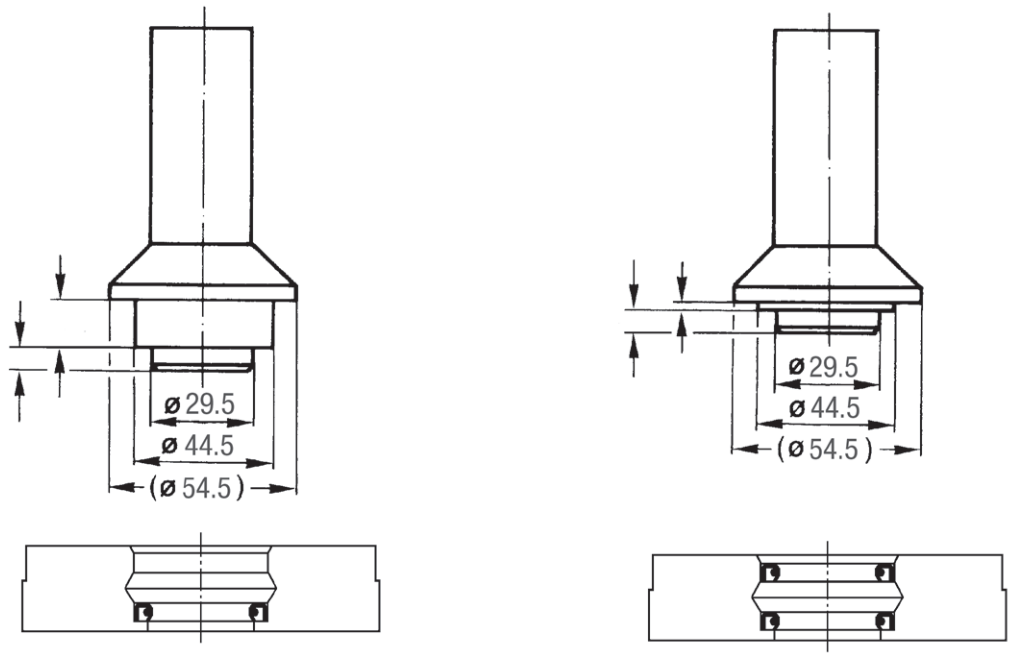
Remove the O-ring (12/11).

Force the shaft seal (12/9) out of the centering disk.

Pull off the bushing (12/12) from the shaft.

We recommend the use of a new shaft seal and bushing for reassembly.

Before fitting the new shaft seal, moisten it slightly with a little vacuum pump oil.



left: driver for the inner sealing ring
right: driver for the outer sealing ring
bottom: centering disk with shaft sealing ring

Fig. 13 Shaft sealing ring driver (this does not apply to part number 1129646)

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).

The shaft seal must not be bent.

Fill the space between the sealing rings with the grease LVO 842.

Insert the O-ring (12/11) into its groove.

Carefully push the centering disk (12/10) with the shaft seal onto the shaft and up against the end plate.

Push the holding panel (12/8) on and tighten with bolts (12/13).

Insert the bushing (12/12) carefully at the center of the centering disk.

Push the O-ring (12/7) and the compression disk (12/6) on to 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 screw (12/2).

Insert the coupling element (12/1) into the coupling and mount the motor (see Chapter 5.7).

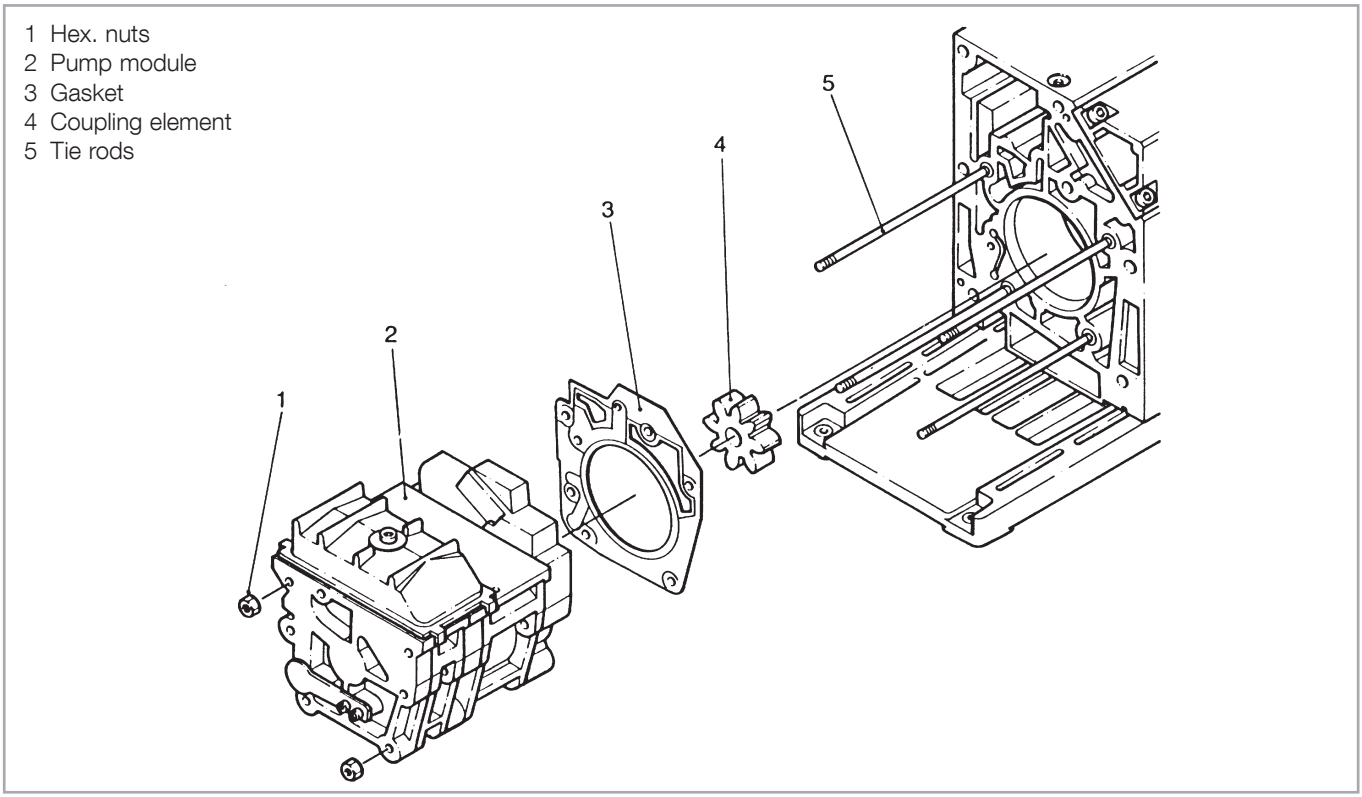


Fig. 14 Removing and remounting the pump module

5.9 Removing and Remounting the Pump Module

Required tools:

Allen keys size 3, 4, 6 and 8 mm, box wrench size 13, possibly pliers, torque wrench.

Required spare parts:

Gasket (14/3)	For material No., see spare parts list

5.9.1 Removing the Pump Module

Drain the oil and remove the oil case (see Chapter 5.6).

Unscrew the hex. nuts (14/1).

Pull the entire pump module (14/2) forward off the tie rods (14/5).

NOTICE

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 (14/3).

Remove the coupling element (14/4).

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.

5.9.2 Remounting the Pump Module

When installing a new pump module, it is also advisable to use a new gasket (14/3).

Check the coupling element (14/4) 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.

Push the gasket (14/3) onto the tie rods (14/5), push the coupling element (14/4) onto one coupling half.

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

Screw on the hex. nuts (14/1) and carefully cross-tighten them (torque 17,5 Nm).

NOTICE

Mount the oil case together with the gasket (see Chapter 5.6).

Fill in oil.

Troubleshooting

6 Troubleshooting

Fault	Possible cause	Remedy	Repair*
Pump does not start.	Wiring is malfunctioning.	Check and repair wiring	-
	Motor protection switch incorrectly set (three-phase motors only).	Set motor protection switch properly.	3.4
	Operating voltage does not matchmotor.	Replace the motor.	5.7
	Motor is malfunctioning.	Replace the motor.	5.7
	Oil temperature is below 12 °C.	Heat the pump and pump oil or use a different oil.	4.3.3/5.4
	Oil is too thick.	Change the oil.	5.4
	Exhaust filter/exhaust line is clogged.	Replace the filter or clean the exhaust line.	-
	Pump is seized up (sign: pump is jammed).	Repair the pump.	Service
Pump does not reach ultimate pressure.	Measuring technique or gauge is unsuitable.	Use correct measuring technique and gauge. Measure the pressure directly at the pump's intake port.	-
	External leak[1].	Repair the pump.	Service
	Anti-suckback valve is malfunctioning.	Repair the valve.	Service
	Exhaust valve is malfunctioning.	Repair the valve.	Service
	Oil is unsuitable.	Change the oil (degas it, if necessary).	5.4
	Vacuum lines are dirty.	Clean the vacuum lines.	-
	Pump is too small.	Check the process data, replace the pump, if necessary.	-
Pumping speed is too low.	Inlet screen in the intake port is clogged.	Clean the inlet screen. Precaution: install a dust filter in the intake line.	5.5
	Exhaust filter is clogged.	Install new filter element.	-
	Connecting lines are too narrow or too long.	Use adequately wide and short connecting lines.	3.3
After switching off the pump under vacuum, pressure in the system rises too fast.	System has a leak.	Check the system.	-
	Anti-suckback valve is malfunctioning.	Repair the valve.	Service

* Repair: Refer to the stated section in these Operating Instructions.

1) Bubble test: The warm pump with degassed oil is running without gas ballast and the intake is blanked off. The exhaust line is led into a vessel with water.
If an evenly spaced line of bubbles appears then the pump has an external leak.

Fault	Possible cause	Remedy	Repair*
Pump gets hotter than usually observed.	Cooling air supply is obstructed.	Set pump up correctly.	3.1
	Ambient temperature is too high.	Set pump up correctly.	3.1/4.3.3
	Process gas is too hot.	Change the process.	-
	Oil level is too low.	Add oil.	5.3
	Oil is unsuitable.	Change the oil.	5.4
	Oil cycle is obstructed.	Clean or repair the oil lines and channels.	Service
	Exhaust filter/exhaust line is obstructed.	Replace the exhaust filter, clean the exhaust line.	-
	Exhaust valve is malfunctioning.	Repair the valve.	Service
	Pump module is worn out.	Replace the pump module.	5.9
Oil in the intake line or in the vacuum vessel	Oil comes from the vacuum system.	Check the vacuum system.	-
	Anti-suckback valve is blocked.	Clean or repair the anti-suckback valve.	Service
	Sealing surfaces of the anti-suckback valve are damaged or dirty.	Clean or repair intake and anti-suckback valve.	Service
	Oil level is too high.	Drain out excess oil.	5.3
Oil is turbid.	Condensation.	Degas the oil or change the oil and clean the pump. Precaution: open the gas ballast valve or fit separator.	4.3.2/5.4
Pump is excessively noisy.	Oil level is much too low (oil level is no longer visible).	Add oil.	5.3/5.4
	Silencing nozzle is clogged.	Clean the silencing nozzle or replace it.	Service
	Intake pressure is too high.	Lower the intake pressure.	-
	Internal demister is clogged.	Clean or replace demister.	Service
	Coupling element is worn.	Install new coupling element.	-
	Vanes or bearings are damaged.	Repair pump.	Service

Disposal

7 Wearing Parts and Original Spare Parts

The spare parts for your vacuum pump are listed in the spare parts list enclosed with the product.

8 Waste Disposal

The equipment may have been contaminated by the process or by environmental influences. In this case the equipment must be decontaminated in accordance with the relevant regulations. We offer this service at fixed prices. Further details are available on request..

WARNING

Risk of injury and environmental damage
Contaminated parts can be detrimental to health and environment. Before beginning with any work, first find out whether any parts are contaminated.

Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts; For example wear gloves, face protection or breathing protection.

Separate clean components according to their materials, and dispose of these accordingly. We offer this service. Further details are available on request.

When sending us any equipment, observe the regulations given in Section “5.2 Leybold Service”.

Disposal of Waste Oil

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

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

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

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

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

PFPE

PFPE from vacuum pumps may be regenerated, if required, and provided the quantities are large enough. For this, please contact us for assistance

EU Declaration of Conformity

(Translation of original Declaration of Conformity)

The manufacturer:

Leybold GmbH
Bonner Strasse 498
D-50968 Köln, Germany

herewith declares that the products specified and listed below which we have placed on the market, comply with the applicable EU Directives. This declaration becomes invalid if modifications are made to the product without agreement of Leybold GmbH.
Optional accessories are not covered by this declaration. Please check the accessory documentation in case of usage.

Product designation:	Rotary vane pump
Type designation:	TRIVAC D40BCS; D40BCS-PFPE; TRIVAC D65BCS; D65BCS-PFPE
Catalogue No.:	**11388; 11389; 11389V3; 11398; 11398J; 11399; 11399V3, 140141; 140142**

The products complies to the following Directives:

Machinery Directive (2006/42/EC)

The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Appendix 1 No. 1.5.1 of Machinery Directive 2006/42/EC.

Electromagnetic Compatibility (2014/30/EU)

The following harmonized standards have been applied:

EN 1012-2:1996+A1:2009	Compressors and vacuum pumps — Safety requirements Part 2: Vacuum pumps
EN 60204-1:2006	Safety of machinery — Electrical equipment of machines Part 1: General requirements
EN 61000-6-2:2005/AC:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4:2007/A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

Documentation officer:

Herbert Etges
T: +49(0)221 347 0
F: +49(0)221 347 1250
documentation@leybold.com

Cologne, September 01, 2016

ppa. Martin Tollner
VP / Head of Product Lines

Cologne, September 01, 2016

ppa. Dr. Monika Mattern-Klosson
Head of Quality & Business Process Management

Document-No.: 300303852_002_A4 09/2016

Leybold

CE

EU Declaration of Conformity

(Translation of original Declaration of Conformity)

The manufacturer:

Leybold GmbH
Bonner Strasse 498
D-50968 Köln, Germany

herewith declares that the products specified and listed below which we have placed on the market, comply with the applicable EU Directives. This declaration becomes invalid if modifications are made to the product without agreement of Leybold GmbH.

Product designation:	Rotary vane pump
Type designation:	TRIVAC D40B; TRIVAC D65B
Catalogue No.:	**1128612; 1129646**

The products complies to the following Directives:

Machinery Directive (2006/42/EC)

The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Appendix 1 No. 1.5.1 of Machinery Directive 2006/42/EC.

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EN 61000-6-4:2007/A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

Documentation officer:

Herbert Etges
T: +49(0)221 347 0
F: +49(0)221 347 1250
documentation@leybold.com

Cologne, September 01, 2016

ppa. Martin Tollner
VP / Head of Product Lines

Cologne, September 01, 2016

ppa. Dr. Monika Mattern-Klosson
Head of Quality & Business Process Management

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Notes

Leybold

Pioneering products. Passionately applied.

Leybold GmbH
Bonner Strasse 498
50968 Cologne
GERMANY
T: +49-(0)221-347-0
info@leybold.com
www.leybold.com

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