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TRIVAC[®]

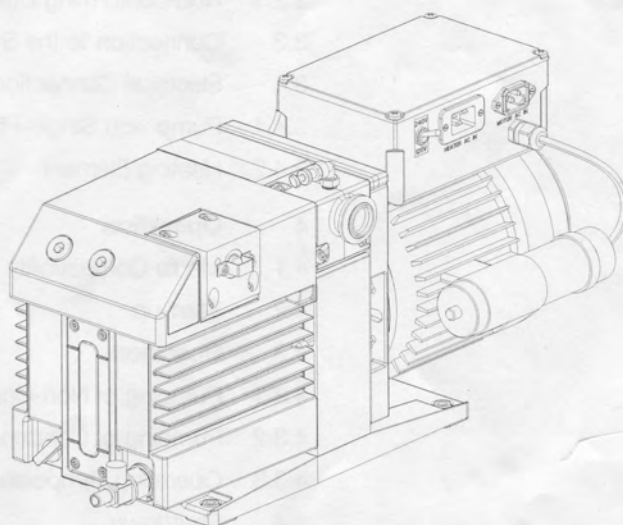
D 16 B

Rotary Vane Vacuum Pump
with Heater

Operating Instructions 300618246_002_C0

Part Nos.

160141V150
160141V150 -1



Contents

	Page
0 Important Safety Information	5
0.1 Mechanical hazards	5
0.2 Electrical hazards	5
0.3 Thermal hazards	6
0.4 Hazards caused by materials and substances	7
0.5 Danger of ignition	8
0.6 Hazard caused by noise	8
0.7 Risk of damaging the pump	9
1 Description	10
1.1 Function	13
1.2 Lubricants	15
1.3 Supplied Equipment	16
1.4 Technical Data	17
1.5 Accessories	20
2 Transport and Storage	21
3 Installation	22
3.1 Placement	22
3.2 Conforming Utilization	23
3.2.1 Non-conforming Utilization	24
3.3 Connection to the System	26
3.4 Electrical Connections	28
3.4.1 Pump with Single-Phase AC Motor	28
3.4.2 Heating Element	29
4 Operation	31
4.1 Media Compatibility	31
4.2 Start-up	31
4.3 Operation	32
4.3.1 Pumping of Non-Condensable Gases and Vapours	32
4.3.2 Pumping of Condensable Gases and Vapours	32
4.3.3 Operating Temperature	33
4.4 Shutdown	33
4.4.1 Controller/Mains Power Failure	34

5	Maintenance	35
5.1	Maintenance Plan	36
5.2	Leybold Service	37
5.3	Monitoring the Oil Level	38
5.3.1	Checking the Condition of the Oil	38
5.4	Oil Change	39
5.5	Cleaning the Inlet Screen	41
5.6	Removing and Fitting the Internal Demister	41
5.7	Disassembly and Reassembly of the Electric Motor	43
5.7.1	Checking the Coupling	44
5.8	Replacing the Shaft Seal	44
5.9	Removing and Remounting the Pump Module	47
5.9.1	Removing the Pump Module	47
5.9.2	Remounting the Pump Module	48
6	Troubleshooting	49
7	Wearing Parts and Original Spare Parts	51
8	Waste Disposal	51
	EU Incorporation Declaration	52

Safety information

NOTICE



Obligation to Provide Information

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

The Leybold **TRIVAC B** 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.

	⚠ DANGER Risk of electric shock and arc flash hazards. This unit has no reinforced insulation. Do not touch when mains connected. Disconnect mains before servicing.		IN O OUT
	⚠ WARNING Hot surface. Contact may cause burn. Allow to cool before servicing.		
	⚠ WARNING To avoid injury. You MUST read and understand technical manual before using or servicing this machine.		

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

The pump described hereinafter is considered as an incomplete machine according to the Machinery Directives. The pump serves the purpose as a component for the enclosed installation in a cabinet that is secured against access during operation. At any time the customer must ensure that the pump is neither operated outside of nor with the cabinet being open. Observe the installation notes for this custom model.

0.1 Mechanical hazards

- 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 B (including its accessories) is being operated should be such that angles over 10° from the vertical are avoided. Select the operating place so that all controls are easily accessible.
- 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 B always use the allowed means.

0.2 Electrical hazards

- 1 Housing parts must not be opened.
- 2 Connect the pump only to a properly and professionally mains outlet socket with protective earth connection.
- 3 Note the information on the IP type of protection: The pump is **not** protected against accidental contact (IP00). For personal security's reasons the according counter measures have to be applied. If a touch protection is only accomplished via the cabinet, the minimum protection class requirements of IP4x or IPxxd (IAW IEC 60529) have to be adhered to.

NOTICE



WARNING



WARNING



Safety information

- 4 There exists the risk of an electric shock, as the heating element is only equipped with a basic isolation. In case of failure there exists the risk of an electric shock when touching the heating element, the feed lines, or the pump housing.
- 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 Live parts are not protected against water intrusion. The customer must ensure that the pump is installed in a dry cabinet.
- 7 The pump is equipped with a voltage selector switch. Check the position of the selector switch of the motor before commissioning the pump and before changing the voltage supply. The mains supply must always correspond with the selector's position.

CAUTION



0.3 Thermal hazards

- 1 Under certain ambient conditions the TRIVAC B 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 an appropriate protective clothing. All work on the "pump still warm from operation" should only be done using suitable protection gloves.
- 2 Hot surface: The pump is equipped with an electrical heating element, heating parts of the pump to temperatures above 70 °C, **even when the motor of the pump is not being operated**. Always ensure that the pump has been left to cool down before touching the device.
- 3 Before servicing and maintenance work always leave the pump to cool down.
- 4 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 The pump is not suited for oxygen operation.
- 4 Before commissioning the TRIVAC B, 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 B 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.

Safety information

- 7 When cleaning a system in which a TRIVAC pump has been integrated, all parts in contact with the medium need to be compatible with the cleaning agent so as to prevent a chemical reaction. Residues of the cleaning agent within the pump must be avoided.
- 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.

CAUTION



0.5 Danger of ignition

- 1 The pumps of the TRIVAC version hereinafter described in these operating instructions are **not** suited for operation in explosion hazard areas.
- 2 The pump 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 dry 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.

CAUTION



0.6 Hazard caused by noise

The noise level produced by the pump at ultimate pressure without gas ballast is less than 65 dB(A). Suitable hearing protection measures must be introduced.

0.7 Risk of damaging the pump

- 1 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.
- 2 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.
- 3 This pump is suited for pumping water vapour within the specified water vapour tolerance limits.
- 4 Avoid vapours that can condense into liquids when being compressed inside the pump, if these substances exceed the vapour tolerance of the pump.
- 5 Before pumping vapours the TRIVAC B should have attained its operating temperature. This will be the case approximately 30 minutes after having started the heater. With voltages below the rated specs the warming-up phase may take up to an hour.
- 6 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.
- 7 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.
- 8 The entry of particles and fluids must be avoided under all circumstances.
- 9 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.).
- 10 Corrosion, deposits and cracking of oil within the pump are not allowed.
- 11 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.
- 12 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.

NOTICE



Description

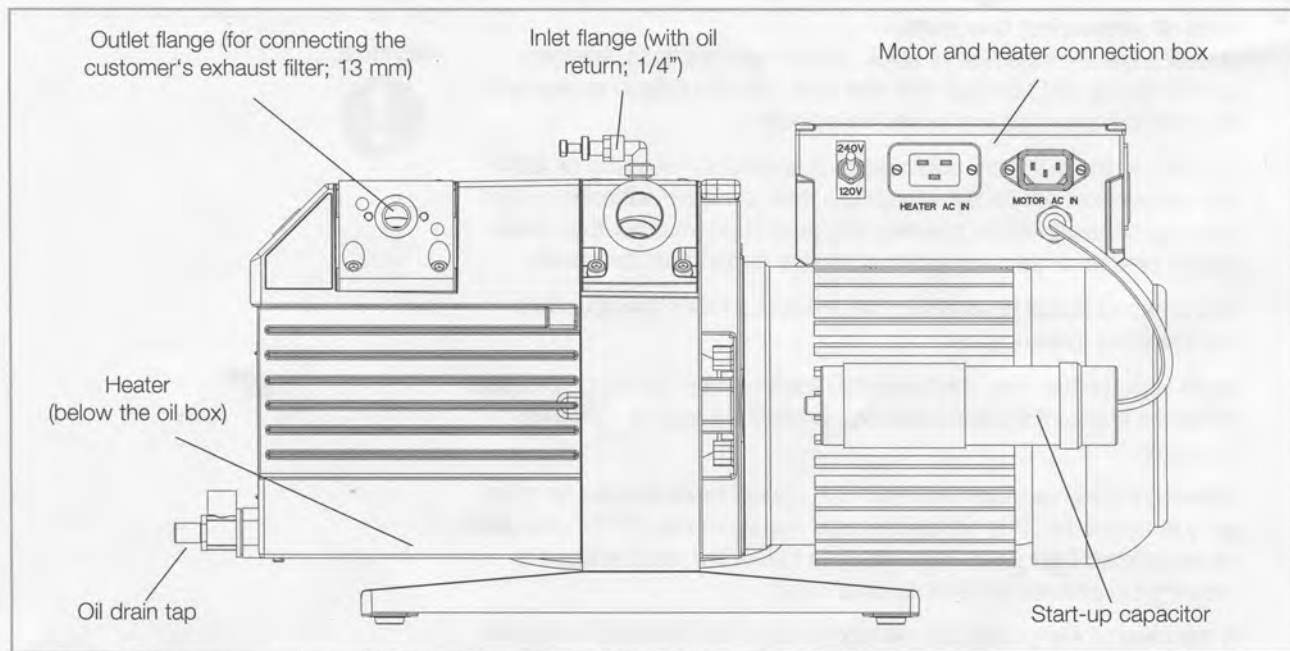


Fig. 1 TRIVAC D16B pump overview

1 Description

TRIVAC B pumps are oil-sealed rotary vane pumps. The TRIVAC D 16 B are dual-stage pumps. The number in the type designation (16) indicates the pumping speed in $\text{m}^3 \cdot \text{h}^{-1}$.

Areas of application

TRIVAC B pumps are capable of pumping gases and vapours and evacuating vessels or vacuum systems down into the medium vacuum range. The standard versions of the pump are not suited for pumping of oxygen exceeding the concentration as found in the atmosphere, and are also not suited for pumping of hazardous gases or extremely aggressive or corrosive media.

Process gas side

The inside (the process gas side) of this vacuum pump is so designed and rated that the occurrence of foreseeable ignition sources can be excluded during normal operation. Provided the pump is operated within the limits of the parameters specified in the Operating Instructions, the pump will offer a normal degree of protection. It is suited for operation under conditions under which it is unlikely that explosive atmospheres are caused by gases, vapours or mists in the air.

Drive concept

Via an intermediate flange the drive motor of the TRIVAC B 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.

The TRIVAC D16B with heater is considered as an **incomplete** machine according to the Machinery Directives, as the pump is **not** protected against accidental contact (IP00); operation is permitted **only** under full protection against contact conditions. If a touch protection is **only** accomplished via the cabinet, the minimum protection class requirements of IP4x or IPxxd (IAW IEC 60529) have to be adhered to.

WARNING



This pump shows the following fixtures:

- dual voltage motor with selector switch, supporting 110-120V / 200-240VAC for motor and heater
- independent mains connections for motor and heater
- integrated heating element below the oil reservoir
- customized outlet flange for connecting customer's exhaust filter systems
- customized inlet flange with oil return

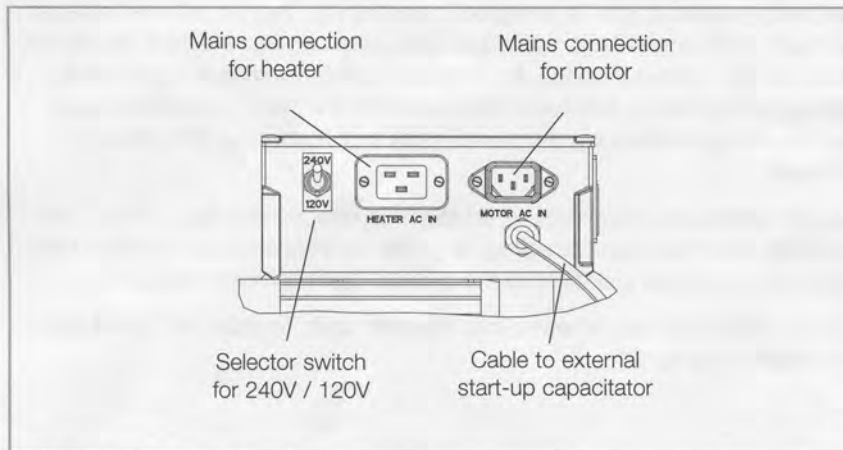


Fig. 1b TRIVAC D16B junction box

The heater has been built-in upon delivery and consists of two integrated heating elements with an output of 75W each and a rated voltage of 120V. The elements are connected in parallel or series depending on the position of the selector switch. When reaching temperatures above 150 °C, both heating circuits will be switched off by the integrated thermo switch.

Before starting the motor, the heater thus serves the purpose of warming-up the pump to operating temperatures. As a result, the required electrical motor torque and output is reduced compared to the standard version. At the same a high water vapour tolerance is ensured during the operating cycle.

For a safe start of the pump, let the heater warm-up the device for approx. 30 mins. before starting the motor. Otherwise there exists the risk of the pump not running up. To safely start the pump with voltages below the rated specs a warming-up phase of an hour may be required.

The heating elements and / or the motor may be damaged due to the selector switch in the wrong position.

Heating element

NOTICE



Description

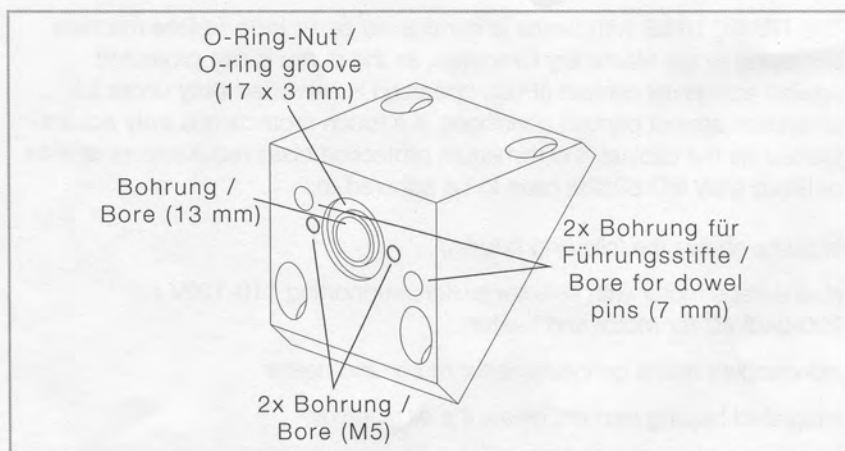


Fig. 1c TRIVAC D16B exhaust port

Exhaust port

The pump's exhaust port is designed in such a way that an external exhaust filter (with an O-ring (17x3)), and a palladium trap can be mounted directly by means of two screws (M5x90). For transport safety reasons a ripped insert, secured with a clamp, has been introduced into the port to prevent oil leakage. Before commissioning the pump make sure to remove the clamp and this insert.

Inlet port

The inlet port is equipped with an additional connection for the oil return line of the exhaust filter (quick coupling, 1/4"). This connection must be either kept closed or connected leak-tight to the exhaust filter's oil return line.

Oil drain port

There is an oil drain tap screwed into the drain port. To drain out the oil press and turn the tap by 90°.

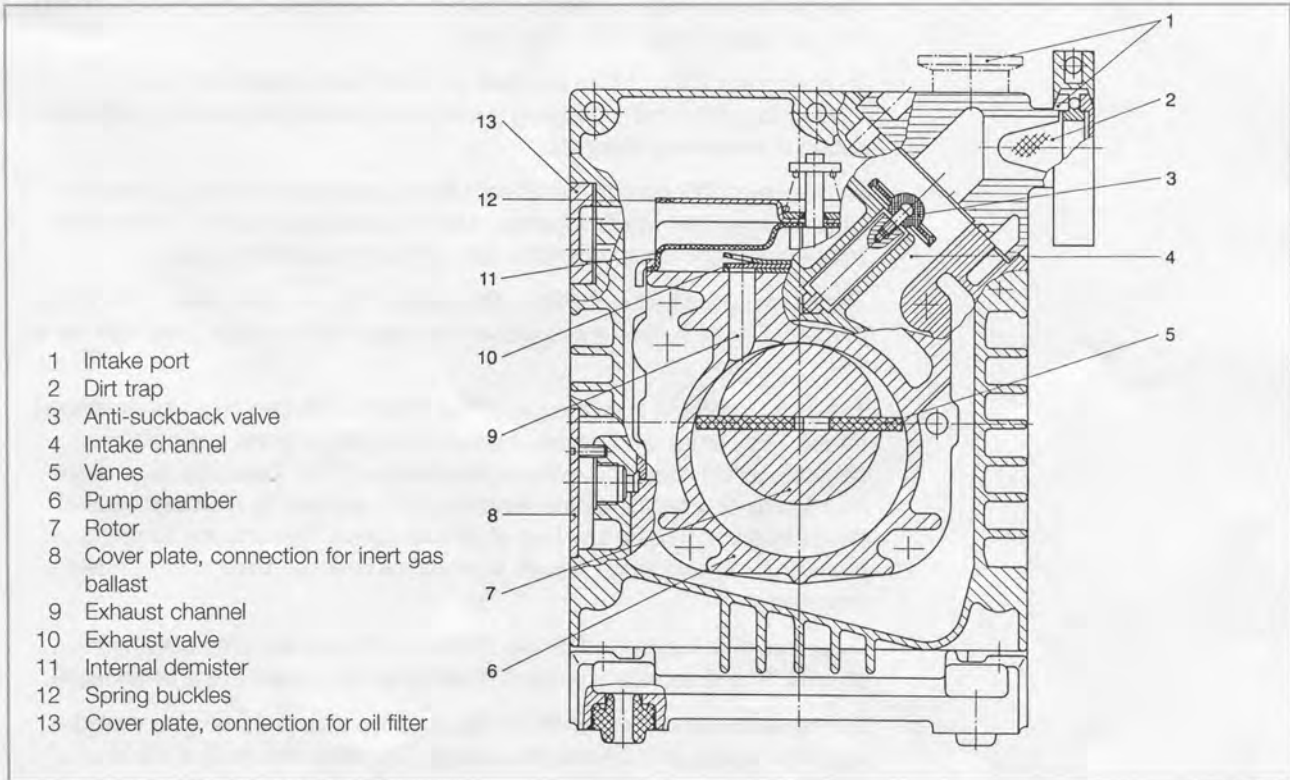


Fig. 2 Sectional drawing of the TRIVAC B

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 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. 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.

Description

The gas ballast valve is opened (position I) and closed (position O) 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 reservoir. 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 hydro-pneumatic 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 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 box or the oil reservoir (4/1) and the piston (4/4) of the anti-suckback valve.

Due to the pressure difference between the oil reservoir 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.

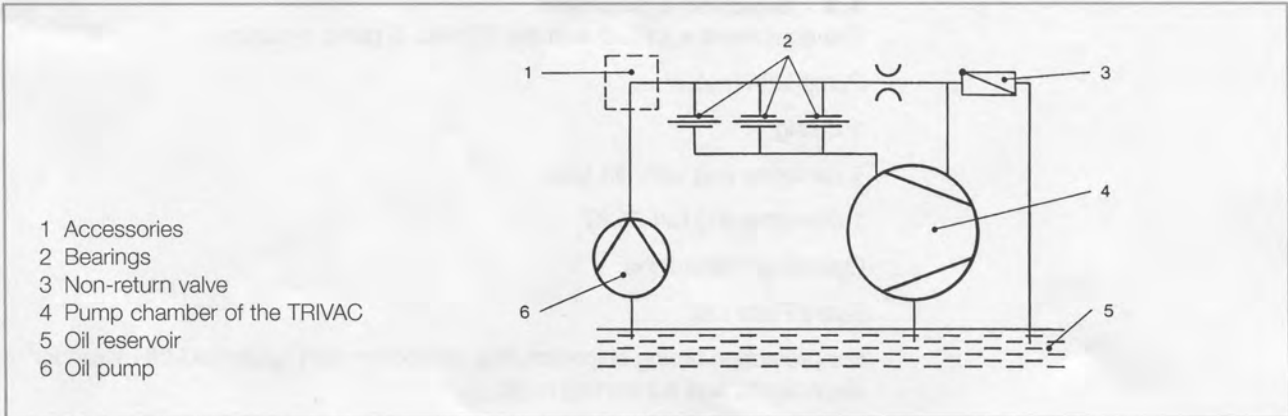


Fig. 3 Schematic of the lubricating system

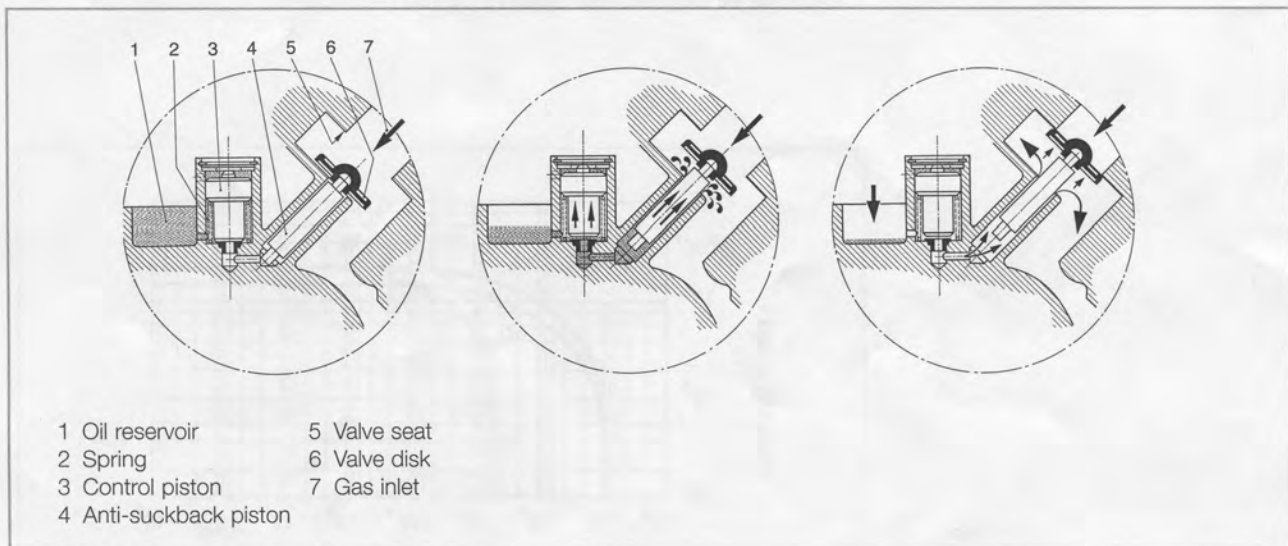


Fig. 4 Hydropneumatic anti-suckback valve

1.2 Lubricants

Leybold specifies the vacuum pump oils that are to be used with the TRIVAC D 16 B. In this case it is Dow Corning oil L1668FM. The pump variants differ as follows:

- The TRIVAC D 16 B with heater, P/N 160141V150, is delivered with oil filled in.
- With the TRIVAC D 16 B variant, P/N 160141V150-1, the oil is delivered separately and must be filled in before commissioning.

Description

1.3 Supplied Equipment

The equipment supplied with the TRIVAC-B pump includes:

- Pump with motor,
- 1 O-ring,
- 1 centering ring with dirt trap,
- 1 clamping ring DN 25 KF,
- Operating Instructions,
- Spare Parts List.

For protection during shipment, the connection port is blanked off by rubber diaphragms and supporting rings.

Additionally a ripped insert, secured with a clamp, has been introduced into the port to prevent oil leakage.

1 separate oil canister with pump P/N 160141V150-1.

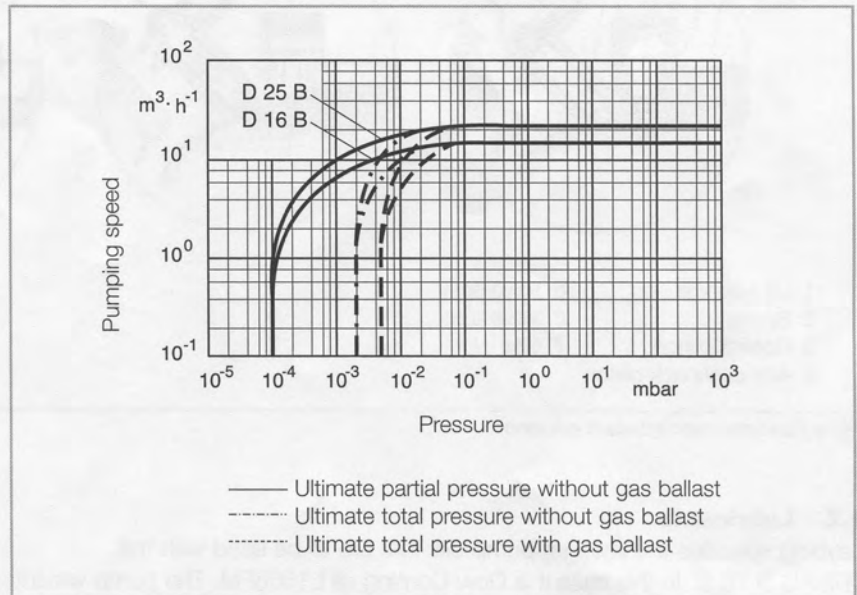


Fig. 5 Pumping speed characteristics for the TRIVAC B pumps (50 Hz operation, SI units)

1.4 Technical Data

	TRIVAC D 16 B two-stage	160141V150(-1)
Nominal pumping speed ¹⁾	m ³ · h ⁻¹	18.9
Pumping speed ¹⁾	m ³ · h ⁻¹	16.5
Ultimate partial pressure without gas ballast ¹⁾	mbar	10 ⁻⁴
Ultimate total pressure without gas ballast ¹⁾	mbar	< 2 · 10 ⁻³
Ultimate total pressure with gas ballast ¹⁾	mbar	< 5 · 10 ⁻³
Water vapour tolerance ¹⁾	mbar	25
Water vapour capacity	g · h ⁻¹	305
Oil filling, min./max.	l	0.45 / 1.0
Noise level to DIN 45 635 w/o / with gas ballast	dB (A)	<65
Admissible ambient temperature	°C	+18 – 40
rel. humidity (non-condensing)	%	10 – 90
max. altitude of installation site	m (NHN)	2,000
Ambient pressure	kPa	80 – 106
Weight w/o motor	kg	26
Connections, intake side	DN	25 ISO-KF
Exhaust pipe	mm	13
Rating		IP00
Heating element		
Power	W	150
Voltage (each resistor)	V	120
Rated current (each resistor)	mA	625
Isolation	VAC	1,500
max. operating temperature	°C	180
Thermal switch opens at	°C	150

¹⁾ In acc. with DIN 28 400 et seq. valid for the oil supplied. For other oils the ultimate pressure may differ.

Description

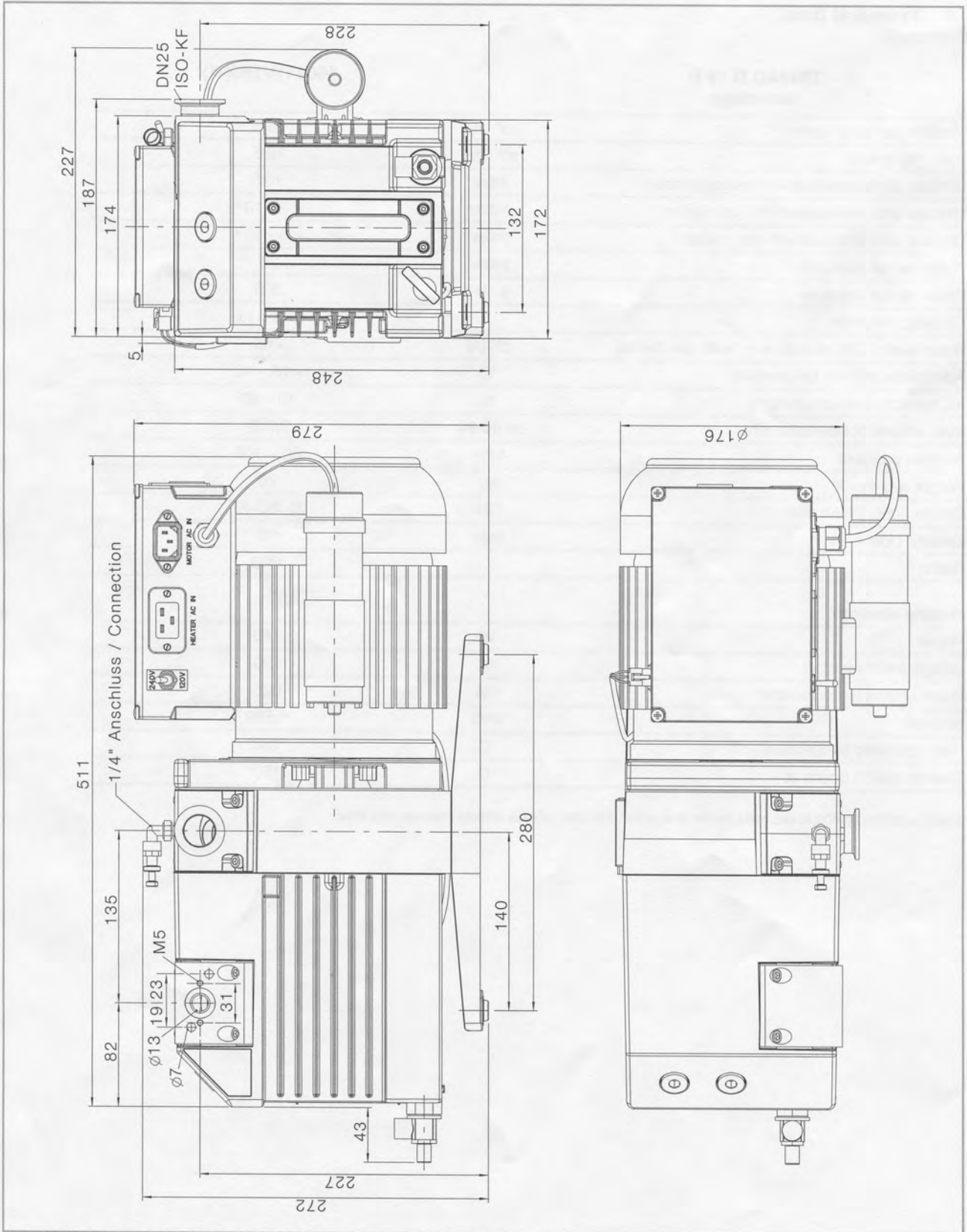


Fig. 6 Dimensional drawings for the TRIVAC B pumps (dimensions in mm; 1 inch = 25.4 mm)

Cat. Nos. of the pumps	160141V150
Motor type	E9SBC4AB-153
Motor L/N	6522821
Compliance Certification number	
Operating mode IEC34 / Duty	S1
Isolation class	F
Phases	1~
Manufacturer	Hanning Elektro-Werke GmbH & Co. KG, Holter Str. 90, D-33813 Oerlinghausen, Germany
Number of poles	2
Nom. output power at 50 Hz Nom. output power at 60 Hz	310 W/370 W
Nom. in frequency	50/60 Hz
Nom. voltage range and nom. current at 50 Hz	100-120 V/7.4 A 200 - 240 V/3.8 A
Nom. voltage range and nom. current at 60 Hz	100 - 120 V/5.3 A 200 - 240 V/2.7 A
Tolerances of voltage range ¹⁾	5%
Nom. speed at 50 Hz Nom. speed at 60 Hz	1,460/1,750 min ⁻¹
Disposal	local directives have to be considered
Max. altitude above sea level	2,000 m (NHN)
Max. ambient temperature when operating ¹⁾	40 °C
T-board / plug	IEC-60320 C14
Certificates of the motor	CE
Length of the pump	511 mm

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.

Description

NOTICE

Observe the data given on the motor nameplate.

NOTICE

1.5 Accessories

Use only the kind of oil specified by Leybold, i.e., Dow Corning L1668FM.

	Part No.
Separator AK 16-25	188 11
Exhaust filter AF 16-25	189 11
Drain tap for condensate trap, exhaust filter, oil drain of the pump, vacuum-tight	190 90
Exhaust filter with lubricant return AR 16-25	189 21
Exhaust filter with lubricant return ARS 16-25	189 56
Dust filter ¹⁾ : Filter housing FH 25	140125T
Dust filter element DF 16-25	140117S
Dust separator	186 11
Adsorption trap ¹⁾ : Filterhousing FH 25	140125T
Adsorption insert RF 16-25	140118A
Active carbon	178 10
Zeolite	854 20
Aluminium oxide	854 10
Oil filter OF 4-25	101 91
Chemical filter CF 4-25	101 96
Chemical oil filter with safety isolation valve CFS 16-25	101 76
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 16-25	161 76
Limit switch system 16-25	161 06
Electrical indicator system 16-25	160 96

¹⁾ Not approved for Atex applications

2 Transport and Storage

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.

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 spilled oil.

The storage temperature may vary in the range of $-10 - +60$ °C (14 - 140 °F).

The originally packed pump may be transported by lorry, ship or air in temperature ranges of $-40 - +70$ °C ($-40 - 158$ °F) with a relative humidity of 10 - 100%.

Preparation for storing

Switch-off the pump and the heater, and let it cool down.

De-energise pump and heater, before opening the cabinet.

Then open the cabinet.

Deinstall the pump.

Turn off the gas ballast.

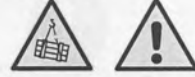
Deinstall customer's accessories.

Seal the exhaust and inlet ports, and the oil return line with the corresponding sealing plugs supplied.

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 Leybold Service.

CAUTION



3 Installation

NOTICE



Instructions for the operating personnel

Before conducting any kind of assembly work the personnel must be informed about potential hazards. Observe Safety Information 0.1 to 0.6.

WARNING



The pump described hereinafter is considered as an incomplete machine according to the Machinery Directives. The pump serves the purpose as a component for the enclosed installation in a cabinet that is secured against access during operation. At any time the customer must ensure that the pump is neither operated outside of nor with the cabinet being open.

3.1 Placement

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



Risk of toppling

Max. tilt for the pump is 10° from the vertical.

If you wish firmly install the pump in place, insert bolts through bore holes (Ø 7 mm) in the rubber feet

NOTICE



.The rubber feet act as vibration absorbers. They must therefore not be compressed by screws.

The site chosen should allow adequate air circulation to cool the pump (keep front and rear unobstructed).

The oil-level glass must be visible.

Note the ambient conditions during operation

The ambient temperature should not exceed +40 °C (104 °F) and not drop below +18 °C (64.4 °F) (see Section 4.3.3).

For installation sites over 2,000 m (NHN) and/or a relative atmospheric humidity of over 90 %, you must discuss this with Technical Sales.

When failing, capacitors may heat up excessively and generate smoke. Therefore the pump must be placed with a sufficient clearance from inflammable or combustible material. There exists the risk of fire! The max. amount of heat given off approximately corresponds to the rated motor power.

Install the pump such that only minimal quantities of dust can deposit themselves on the surfaces. In those cases where dust deposits form, measures need to be introduced which ensure that these are removed on a regular basis.

The maximum gas inlet temperature must not exceed 60 °C.

The maximum pressure at the inlet must not exceed atmospheric pressure (approximately 1013 mbar). Never apply overpressures to the pump's inlet.

The maximum exhaust pressure must not exceed 0.5 bar (g).

NOTICE

3.2 Conforming Utilization

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

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.

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.

NOTICE

The pump is designated for connections to single-phase mains with neutral conductor.

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

3.2.1 Non-conforming Utilization

CAUTION



The TRIVAC B is not suited for pumping of:

- radioactive and toxic substances
- pyrophorous substances
- corrosive gases
- oxygen (or other highly reactive gases) at concentrations exceeding that of the atmosphere (> 21 % for oxygen).

NOTICE



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

CAUTION



The standard pump is not suited for pumping of hazardous gases or vapours.

When cleaning a system in which a TRIVAC pump has been integrated, all parts in contact with the medium need to be compatible with the cleaning agent so as to prevent a chemical reaction. Residues of the cleaning agent within the pump must be avoided.

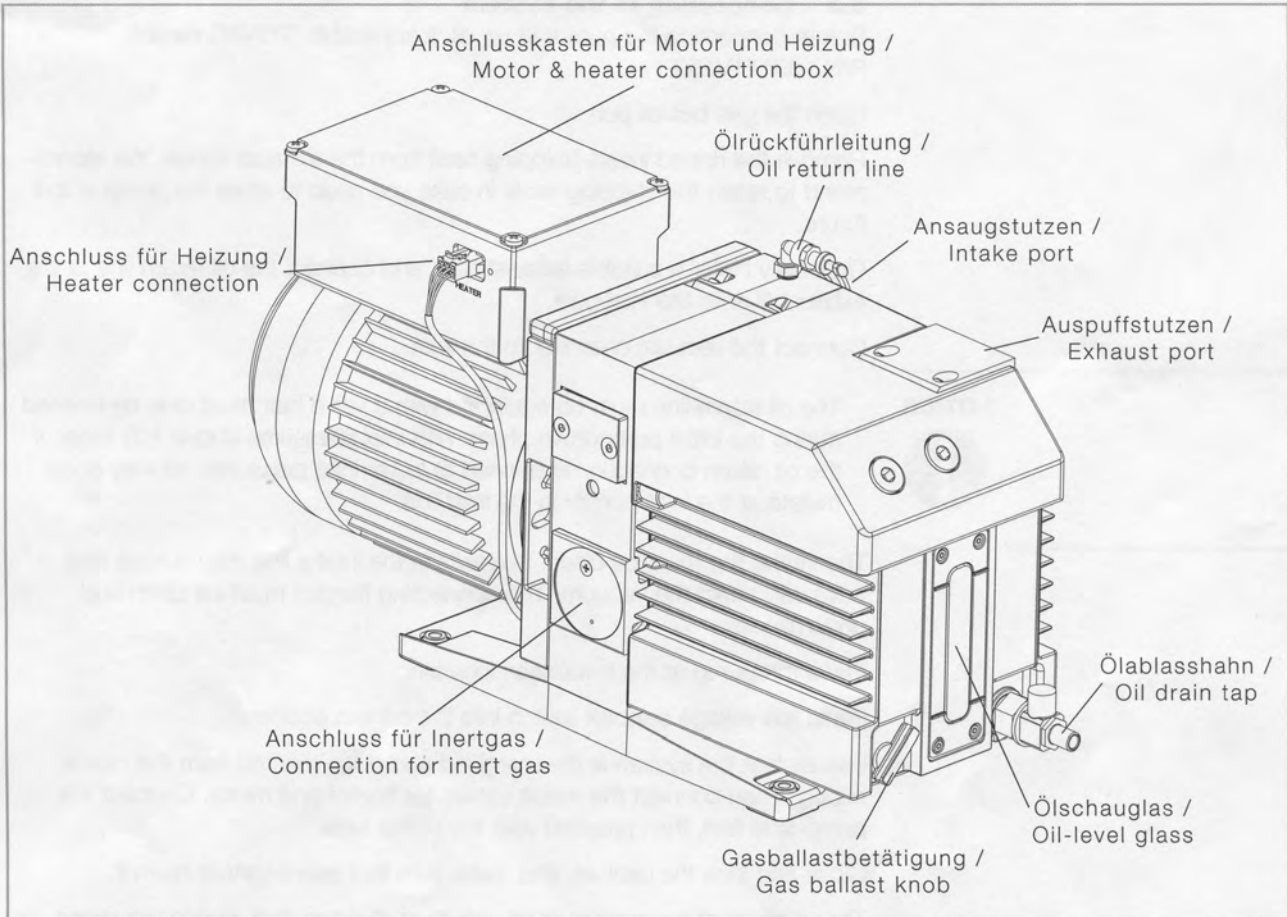


Fig. 7 Connections and controls

3.3 Connection to the System

Before connecting the pump, fill up oil, if applicable (TRIVAC variant P/N 160141V150-1).

Open the gas ballast port.

Remove the ripped insert (shipping seal) from the exhaust flange. We recommend to retain the shipping seals in case you need to store the pump in the future.

Optionally install a suitable exhaust filter, and connect the oil return line of the exhaust filter to the inlet port.

Connect the vacuum chamber to the inlet.

NOTICE



The oil return line must be equipped with a valve that must only be opened during the initial pumpdown phase with inlet pressures above 100 mbar. If the oil return connection is opened at lower inlet pressures, oil may accumulate at the inlet port or in the inlet line.

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.

Place the pump at the installation location.

Place the voltage selector switch into the correct position.

Ensure that the system is de-energized and disconnected from the mains supply. Then connect the mains cables for heater and motor. Connect the pump side first, then proceed with the mains side.

Close and lock the cabinet, and make sure that users cannot open it.

The operator of the system must ensure at all times that, during the pump being energised, pump, heater, and feed lines and cables cannot be touched.

It must be ensured that electrical supply lines and fuses are IAW the descriptions given in Section Electrical Connections.

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.

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.

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.

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).

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).

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).

NOTICE



CAUTION



NOTICE



DANGER



3.4 Electrical Connections

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.

The pump is **not** protected against accidental contact (IP00) and **must only** be operated within the closed cabinet. The customer must provide a supply circuit disconnecting device for the pump, to allow for safe maintenance works.

3.4.1 Pump with Single-Phase AC Motor

The pump is equipped with a single-phase AC motor and designated for single-phase mains with neutral conductor.

Pumps equipped with a single-phase AC motor may be connected directly to the mains via the mains cord and the mains plug. The following fuse types must be used:

100 – 120V: Rating: $\leq 16A$, type B;

200 – 240V: Rating: $\leq 10A$, type B

Additionally, fusing must always be done IAW the national and local regulations for single phase mains (in Germany 16 amps, for example). The direction of rotation needs not be checked as it is fixed. The motor is protected against overloading by a thermal overload switch with automatic resetting.

P/N 160141V150(-1) is equipped with a voltage selector switch.

WARNING



Two power cords must be used with the pump: one for supplying the heater, and the other for operating the pump's motor (cf. Fig. 8). Due to the internal wiring, the heating element will be switched off automatically, to prevent overheating. For a safe start of the pump, let the heater warm-up the device for approx. 30 mins before starting the motor.

The necessary power cords are **not** enclosed with the pump; the cords must be provided with the following plug types:

Heating: C19 IAW IEC-60320

Motor: C13 IAW IEC-60320

Notice the correct plug configuration (cf. Fig. 8).

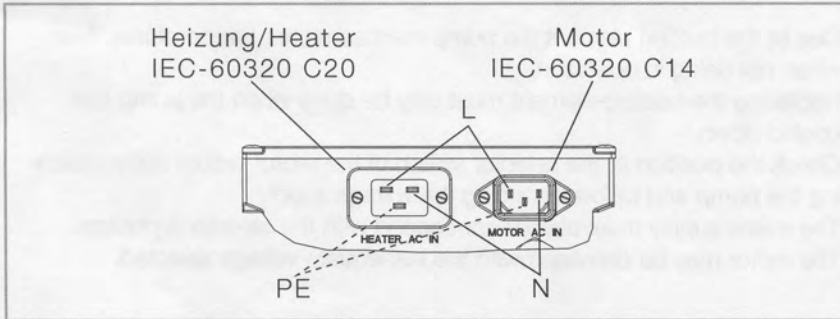


Fig. 8 Electrical connection and plug configuration details

3.4.2 Heating Element

The heater has been built-in upon delivery and consists of two integrated heating elements with an output of 75W each and a rated voltage of 120V. The elements are connected in parallel or series depending on the position of the selector switch. When reaching temperatures above 150 °C, both heating circuits will be switched off by the integrated thermo switch (cf. the connecting diagram below).

The heating elements may overheat and become damaged due to the selector switch in the wrong position, or an interchanged wiring.

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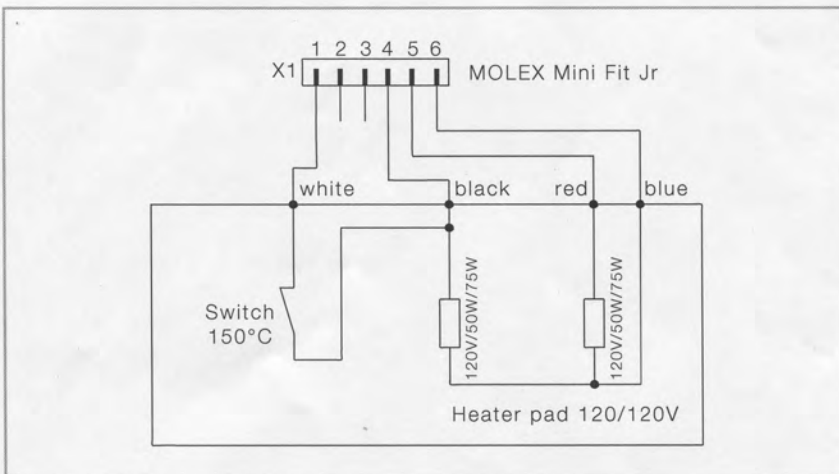


Fig. 9 Heating element connecting diagram

Installation

CAUTION



Due to the heating element the pump reaches higher temperatures, even when not being in operation.

Replacing the heating element must only be done when the pump has cooled down.

Check the position of the selector switch of the motor before commissioning the pump and before changing the voltage supply.

The mains supply must always correspond with the selector's position.

The motor may be damaged with the inadequate voltage selected.



4 Operation

4.1 Media Compatibility

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

4.2 Start-up

Each time before starting up check the oil level, fill up oil, respectively with TRIVAC variant P/N 160141V150-1! 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 position of the selector switch of the motor before commissioning the pump and before changing the voltage supply (see Section 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.

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.

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.

NOTICE



WARNING



NOTICE

4.3 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.

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 B 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 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.

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 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.

4.3.3 Operating Temperature

Proper operation of the TRIVAC B is ensured in the ambient temperature range between 18 °C to 40 °C (64.4 °F to 104 °F).

At operating temperature, the surface temperature of the TRIVAC B may lie over 70 °C (158 °F).

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 to be 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, or when the pump's warming up phase was too short to reach its operational temperature.

Under such conditions the fuse on the mains side or the motor's thermal protection switch may respond. In this case eliminate the faults, and restart the pump.

4.4 Shutdown

If the TRIVAC B pump was 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.

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 4.3.2).

If the TRIVAC B 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:

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.

CAUTION



CAUTION



WARNING



Drain the oil (see Section 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 Controller/Mains Power Failure

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.

CAUTION



5 Maintenance

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.

Make sure that there is no potentially explosive atmosphere before conducting any maintenance work.

Capacitors of security class P2 (IAW EN 60252) are used with the pump's one-phase AC motors. The capacitor's life cycle is 10,000 h (life cycle category B acc. to EN 60252). Therefore we recommend to replace motor or capacitor before reaching the end of its life cycle.

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 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 5.1.

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 will void any warranty claims.

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

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 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.

DANGER



NOTICE



NOTICE



Maintenance

5.1 Maintenance Plan

TRIVAC D 16 B	Meas. / Test Qty. Op. / Aux. Materials	Interval	Remarks
Operate the pump for at least 1 h with gas ballast.		daily	Condensed water is thus removed from the oil
Check the oil level, if required change the oil.	Oil: DC L1668FM see Section 1.2	daily, before switching on the system	Refill: Only after the pump has been switched off.
Check the quality of the oil, change the oil if required.	visually (all oils)	daily, before switching on the system	Visually: normally light and transparent, oil change is required when discolorations increase.
	chemically	six monthly	Chemically: to DIN 51558, when the neutralisation number exceeds 2; then an oil change will be required.
	mechanically	six monthly	Mechanically: when viscosity is 20 % above the one of fresh oil; then an oil change will be required.
Clean the inlet screen in the intake port, change it as required.	Suitable cleaning agent and compressed air.	six monthly	<ul style="list-style-type: none"> ■ 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.
Clean the internal demister, change it as required.	Suitable cleaning agent.	annually	Already clean before the maintenance interval has elapsed when the noise level interval has elapsed when the noise level increases. <ul style="list-style-type: none"> ■ 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.
Check the edges of the teeth on the coupling element for any damages, change the coupling element as required.		annually	
Change the oil	Oil: DC L1668FM	annually	Oil change: <ul style="list-style-type: none"> ■ 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.
and 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
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.	annually	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). Wipe plastic parts on the pumps of category 3G outside only with a moistened piece of cloth.

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/ -> Documents -> Download Documents.

Attach the form to the device or enclose it with the return consignment.

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.

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.

CAUTION



5.3 Monitoring 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



Check, top up, or change oil only after having shut down and de-energized the pump first.

Please note the safety information given in Sections 0.3 and 0.4.

P/N 160141V150(-1) is delivered with Dow Corning oil L1668FM. The use of other oil is **not** approved.

When operating the TRIVAC B in connection with the exhaust filter with lubricant return (AR or ARS) the checking intervals are extended.

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

5.3.1 Checking the Condition of the Oil

The ageing process for the standard operating fluid 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 the oil is determined according to DIN 51558. If it exceeds 1, the oil should be changed.

c) Viscosity check

If the oil's viscosity at 40 °C exceeds a level of 75 mm²/s (approx. 10 % 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 tap (s. Fig. 1) into a beaker or similar.

Please note the safety information given in Section 5.4.

5.4 Oil Change

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 and 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.

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.

The oil should be changed after the first 100 operating hours and then at least every 2,000 – 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 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.

WARNING



NOTICE



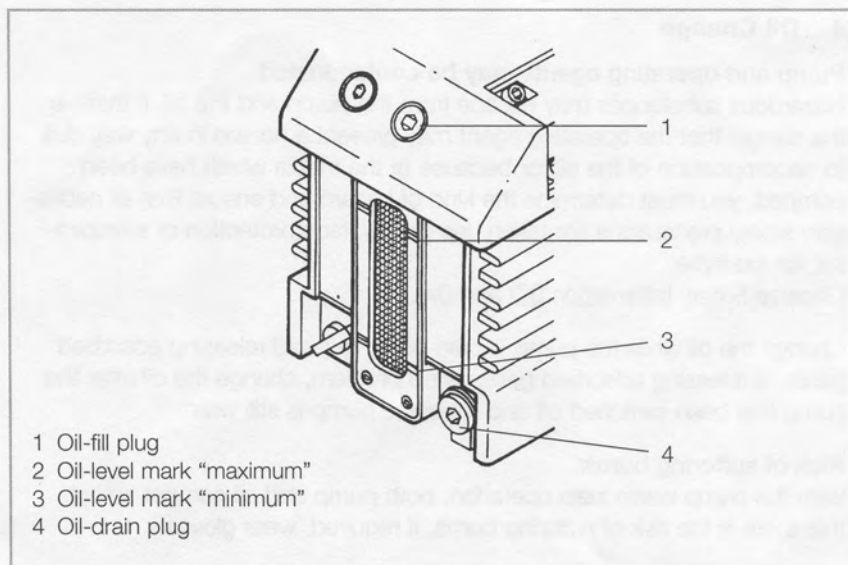


Fig. 9 Oil change (Note: oil drain tap is not depicted)

Required tool: Allen key 8 mm.

Press and turn the oil-drain tap by 90° (cf. Fig. 1) and let the used oil drain into a suitable container.

Close the oil-drain port.

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 bolt (9/1) 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.

NOTICE



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

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.

If the dirt trap is defective, replace it with a new one.

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.

NOTICE



5.6 Removing and Fitting the Internal Demister

Required tools: Allen keys size 5 and 8 mm

Required spare parts:

Gasket for oil reservoir (10/7)	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 Section 5.4).

First, disconnect the cable of the heating element (7).

Remove the four recessed screws (10/5) on the oil reservoir (10/1). Don't remove the non-recessed screws; they hold the motor flange in place and need not be removed.

Pull the oil reservoir 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 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 (10/5) is 8 Nm.

Maintenance

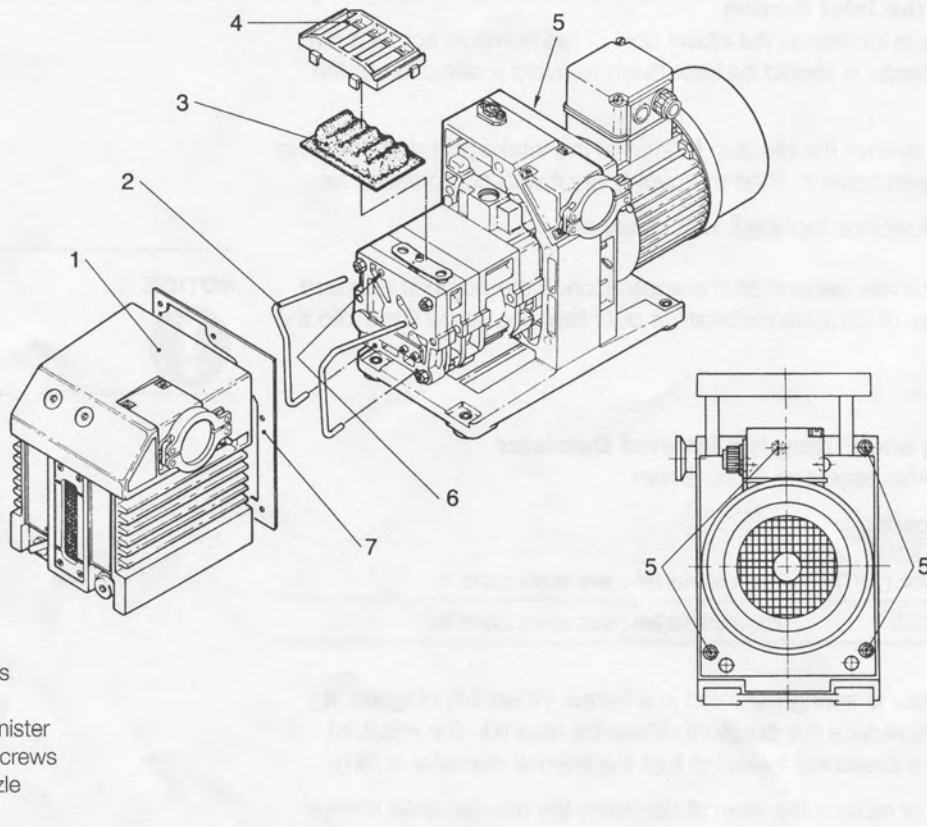


Fig. 10 Removal and fitting of the internal demister

- 1 Gasket
- 2 Handle
- 3 Hex. socket screws
- 4 Electric motor
- 5 Intermediate flange
- 6 Hex. socket screws
- 7 Coupling with fan blade
- 8 Threaded pin

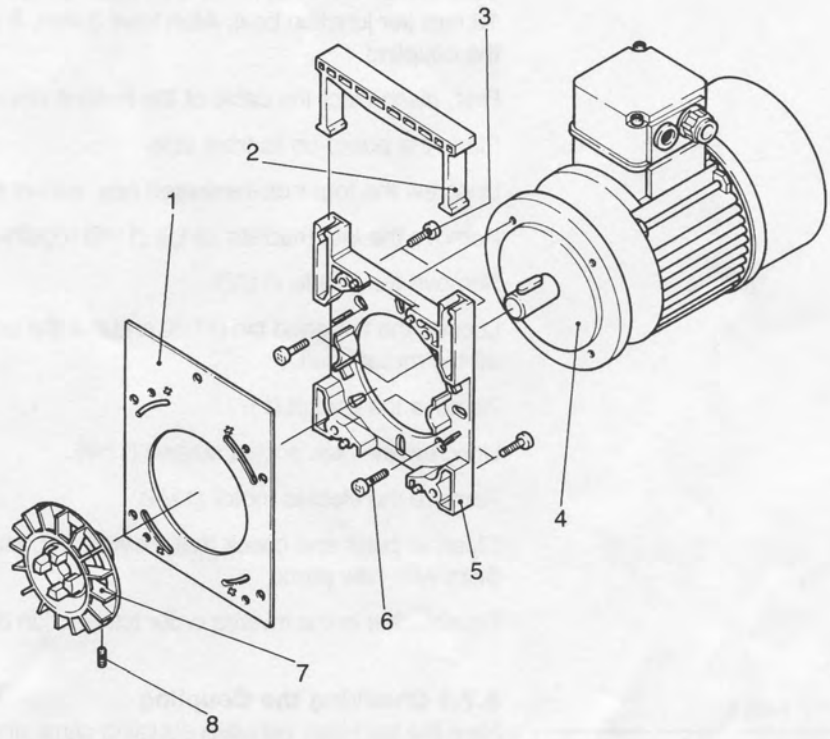


Fig. 11 Disassembly and reassembly of the electric motor

5.7 Disassembly and Reassembly of the Electric Motor

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.

DANGER



Maintenance

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 3 mm, 5 mm, 6 mm, possibly a puller for the coupling.

First, disconnect the cable of the heating element (7).

Place the pump on its front side.

Unscrew the four **non-recessed** hex. socket screws (11/3).

Remove the intermediate flange (11/5) together with the electric motor (11/4).

Remove the handle (11/2).

Loosen the threaded pin (11/8) and pull the coupling (11/7) with the fan blade off the motor shaft.

Remove the gasket (11/1).

Unscrew the hex. socket screws (11/6).

Remove the electric motor (11/4).

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

Reassemble in the reverse order (cf. Section 3.5).

5.7.1 Checking the Coupling

Here the backlash between coupling cams and the flexible spider must be checked by a feeler gauge (see sketch 1).

When reaching the limit of wear of max. friction, the spider must be exchanged immediately, independent of the inspection intervals.

The wear limit is at 3 mm!

In addition a visual inspection as to the presence of any damage needs to be done. If damaged, the coupling must be replaced.

Observe the information in the enclosed manufacturer's Operating Manual.

5.8 Replacing the Shaft Seal

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:

1x Shaft seal (12/8) For material No., see spare parts list

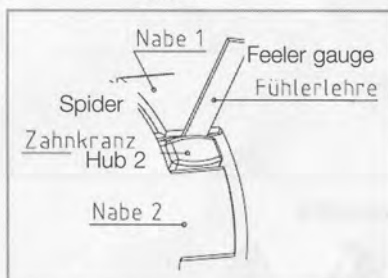
Bushing (12/12) For material No., see spare parts list

The TRIVAC B has one shaft seal. Oil marks under the coupling housing are signs of a damaged shaft seal.

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

Shutdown the pump.

Hub 1



Sketch 1 Checking the wear limit

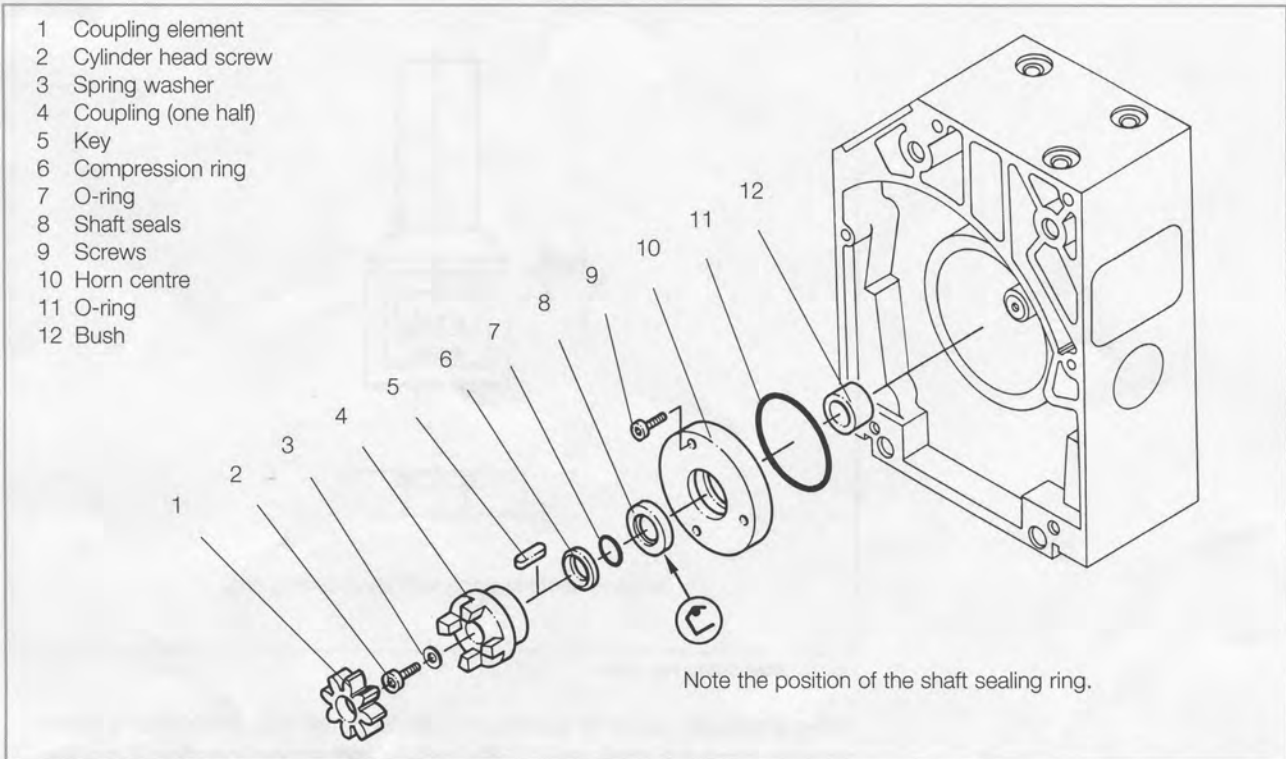


Fig. 12 Exchanging the shaft seal

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).

Remove gasket (11/1).

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 (12/9) and pull out the centering disc (12/10).

If the centering disc does not come loose, use the forcing thread into which screws (12/9) can be screwed in.

Remove the O-ring (12/11).

Force the shaft seal (12/8) 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.

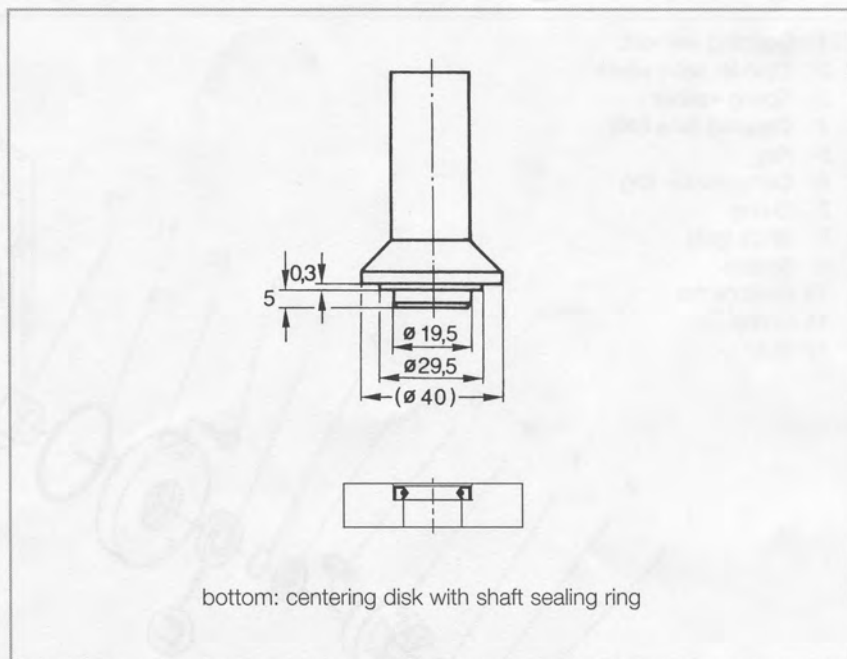


Fig. 13 Shaft sealing ring driver

Using a suitable plastic or aluminium cylinder (shaft seal driver) and a plastic hammer, force the shaft seal (12/8) carefully and without bending it into the centering disk (for position of shaft seal, see Fig. 12).

The shaft seal must not be bent.

Push the bushing (12/12) on to the shaft.

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; fasten it with the screws (12/9).

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

Insert the key (12/5).

Check the coupling, replace if required. To check the coupling note the information provided in Section 5.7.1.

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 Section 3.5).

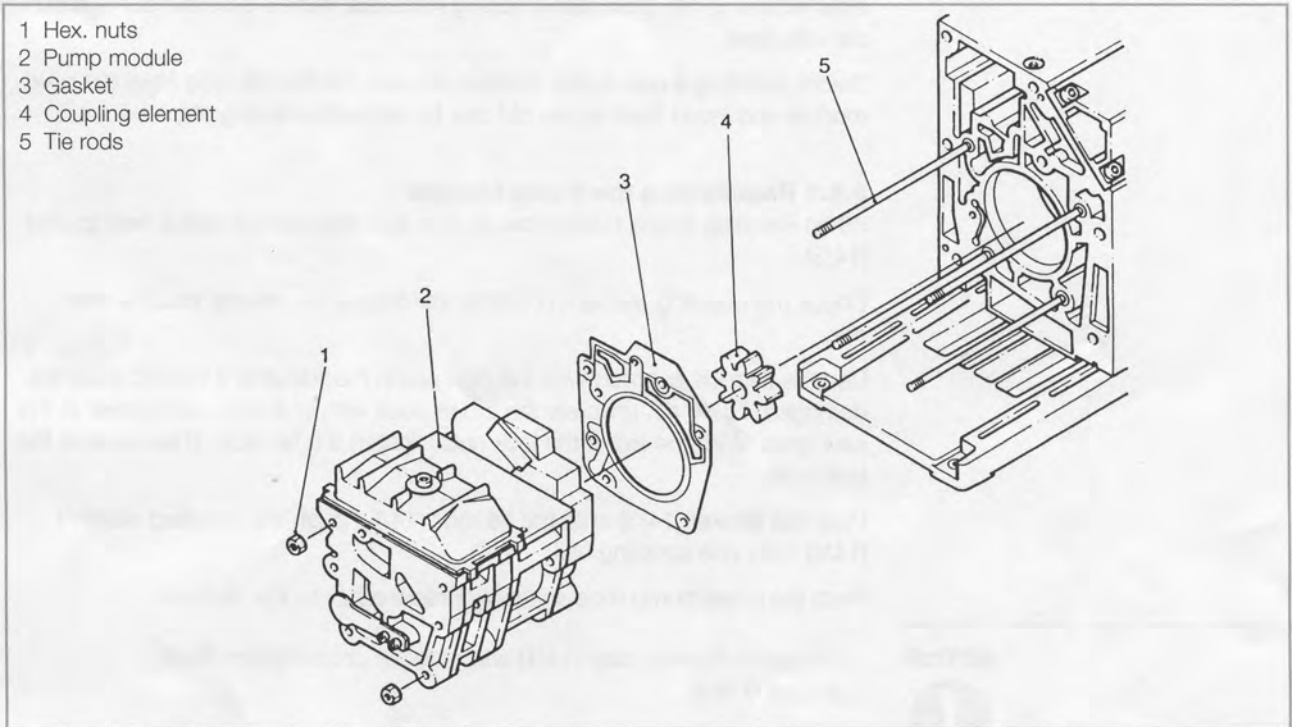


Fig. 14 Removing and remounting the pump module

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 reservoir (see Section 5.6).

Unscrew the hex. nuts (14/1).

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

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).

NOTICE



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.

NOTICE



Screw on the hex. nuts (14/1) and carefully cross-tighten them (torque 8 Nm).

Mount the oil reservoir together with the gasket (see Section 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 match motor.	Replace the motor.	5.7
	Motor is malfunctioning.	Replace the motor.	5.7
	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
	Wrong selector switch position. Insufficient warming-up phase.	Select the proper voltage. Let the pump preheat for at least 30 mins. (60 mins. with undervoltages).	
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.

Troubleshooting

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
Wrong voltage.	Select the proper voltage.		
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

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.

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:

WARNING





EU Declaration of Incorporation

(Translation of original Declaration of Incorporation)

The manufacturer: Leybold GmbH
Bonner Straße 498
D-50968 Köln
Germany

herewith declares that the following product:

Product designation: Rotary vane pump
Type designation: Trivac D16B
Part number: 160141V150, 160141V150-1

complies with the following fundamental requirements of the **Machinery Directive (2006/42/EC)**:
Annex I, Paragraph 1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.2, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.5.1, 1.5.2, 1.5.4, 1.5.8,
1.5.13, 1.6.1, 1.7.1, 1.7.2, 1.7.3 and 1.7.4

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.

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
Part1: General requirements

The incomplete machine may only be put into operation after it has been determined that the machine into
which the incomplete machine shall be installed complies with the regulations laid down in the EC
Machinery Directive (2006/42/EC).

The manufacturer commits himself to make the special documentation on the incomplete machine
electronically available to national authorities upon request.

The special engineering documentation belonging to the machine was compiled in accordance with
Annex VII Part B.

Cologne, December 16, 2016

Cologne, December 16, 2016

ppa. Martin Tollner
Head of Product Lines

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