

TRIVAC[®]

D 16 B Ex

Rotary Vane Vacuum Pump

IAW Directive 2014/34/EC (“ATEX”)

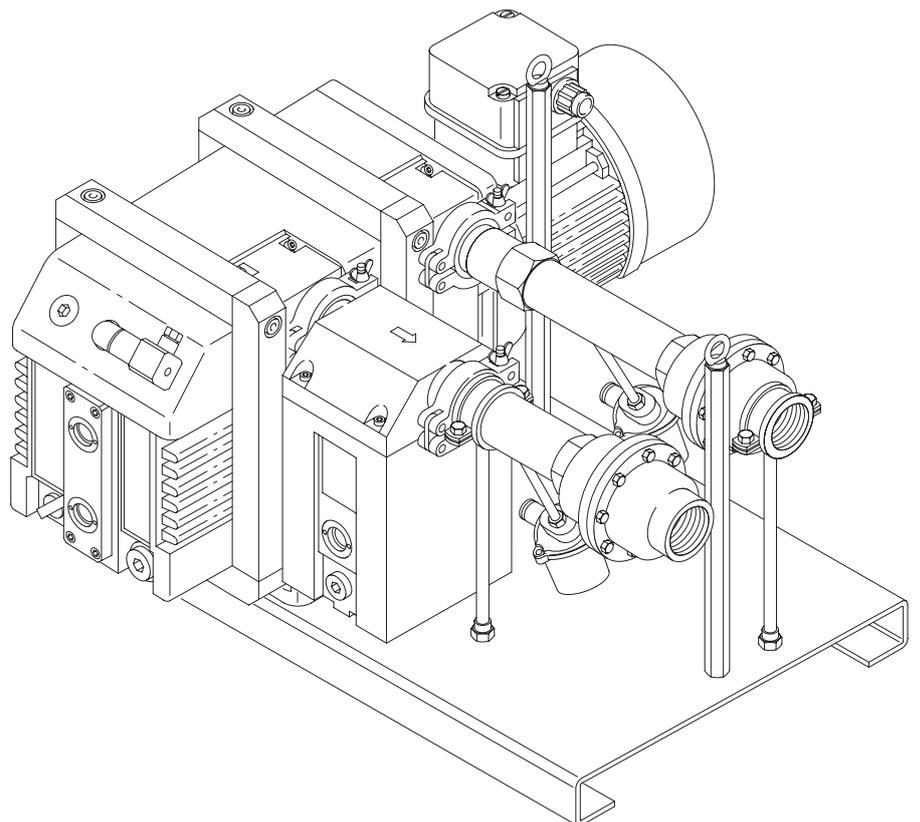
Explosion pressure resistant, two-stage oil-sealed rotary vane vacuum pump with exhaust filter, flame arresters, measurement facilities for temperature and pressure monitoring

Operating Instructions GA01212_002_C1

P/N

140091 Gas group IIB3

140092 Gas group IIC



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Safety Information

NOTICE



Obligation to Provide Information

Before installing and commissioning the TRIVAC D 16 B Ex, carefully read these Operating Instructions and follow the information so as to ensure optimum and safe working right from the start.

The Leybold **TRIVAC D16 B Ex** 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. This applies also to all other documentations enclosed in the scope of delivery for this pump (e.g. for motor, clutch, sensors, flame arresters, etc.). 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



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.

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

- 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 relative to the atmospheric pressure. 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.

WARNING



0.2 Electrical hazards

- 1 The electrical connection must only be provided by a trained person. Please observe the national regulations in the country of use like EN 50110-1 for Europe, for example.
- 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.

WARNING



Safety Information

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 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.

DANGER



0.4 Hazards caused by materials and substances

- 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.

- 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.

0.5 Danger of ignition

- 1 For the purpose of conforming utilisation of the vacuum pump in explosion hazard areas, Directive 1999/92/EC and additional regulations must be observed.
This directive provides for obligations of employers for the safety and health protection of workers potentially at risk from explosive atmospheres. Hereafter the operating company is under the commitment to draw up an explosion protection document, with classifying ex-hazard areas into zones.
The utilisation of the pump must be verified against corresponding equipment-categories, temperature classifications and gas groups. (cf. Section "Classification and Marking of the Pump" below).
- 2 The pump is **not** suited for pumping of mixtures of oxygen exceeding the concentration as found in the atmosphere. Furthermore the TRIVAC D 16 B Ex is **not** suited for pumping of acetylene, carbon disulphide or other chemically instable gases.
- 3 Any constructional alterations or modifications whatsoever compared to the delivery status of this pump or the monitoring systems and devices are prohibited and will void the EC Declaration of Conformity. With any service work (assembling, electrical installation, repair, opening the housing) it has to be ensured that
 - there is no explosion hazardous atmosphere,
 - the pump is disconnected from the mains supply (lock- / tag out),
 - the pump cannot run inadvertently.
- 4 Installation, usage of, and maintenance works on this pump must only be conducted by trained and duly authorised personnel.
Special attention must be paid to:
 - all technical data and information regarding the conforming utilisation (commissioning, environmental and operational conditions) contained in the operating instructions, the nameplate, and collateral product documentation.
- 5 The attached electrical apparatus must be installed explosion-proof and connected IAW the corresponding type of protection:
 - for the motor: Increased Safety 'e';
 - for the pressure sensor: Intrinsic Safety 'ia' (only for connections to certified intrinsically-safe circuits);
 - for the temperature sensor: PT100 passive sensor (only for connections to certified intrinsically-safe circuits).

CAUTION



Safety Information

- 6 During operation the handle of the pump must be pushed-in. In order to avoid an electrostatic charge at the handle of the pump and other surfaces made from plastic, it should only be cleaned using a moist piece of cloth.
- 7 Dust layers must be avoided to prevent a hazardous warming up of the pump's surfaces.

Classification and Marking of the Pump

The TRIVAC D16 B Ex is assigned to different equipment-categories regarding the pump's outside and the process gas side's interior parts.

The process gas side of the pump was specifically designed and constructed to comply with the safety requirements of equipment-group II, category 1 IAW Directive 2014/34/EC ("ATEX Guidelines") on the conforming utilization of equipment and protection facilities in explosion hazardous areas.

The pump's outside fulfills the requirements of equipment-group II, category 2.

The utilization of the pump must be verified by the operating company against corresponding equipment-categories, temperature classifications and gas groups as specified in the explosion protection document drawn up.

Pumps where the inside and the outside of the pump fulfil the basic safety requirements of the Directive, are supplied with an ATEX certified motor and have been marked as follows:

P/N 140 091

 II (inside) 1G IIB3 T4 X (50 Hz)
II (outside) 2G IIB T4 X (50 Hz) (12 °C < Ta < 40 °C)

P/N 140 092

 II (inside) 1G IIC (no C₂H₂, CS₂) T4 X (50 Hz)
II (outside) 2G IIC T4 X (50 Hz) (12 °C < Ta < 40 °C)

General Explanation of the Symbols

II Equipment-group II applies to all equipment for use in areas which can be endangered by an explosive atmosphere except in underground mining operations and their related above ground systems which can be endangered by mine gas and/or combustible dust.

(inside) / (outside) Specifies the category/conditions according to which the inside (i.e. sections of the equipment in contact with the process gas flow) and the outside of the equipment are classified provided these differ.

1 Equipment-category 1 applies to all devices for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours, mists or air/dusts mixtures are **highly likely** to occur and are present continuously, for long periods of time or frequently.

- 2** Equipment-category 2 applies to all devices for use in areas in which potentially explosive atmospheres caused by mixtures of air and gases, vapours, mists or air/dusts mixtures are **likely** to occur.
- G** For areas with an explosive atmosphere caused by gases, vapours or mists in the air. The pump is **not** suited for utilization in dusty areas.

IIB / IIC Gas groups: these are subdivisions for equipment belonging to Group II which is employed in connection with some protection types. This subdivision is based on the concept of the maximum experimental safe gap and the minimum ignition current of the explosive mixture. Refer to Annex A of the European Standard “EN 60079-0 Electrical apparatus for explosive atmospheres — General requirements”.

The hazardousness of an explosive atmosphere increases continuously between the gas groups IIA and IIC. The most dangerous gas group IIC incorporates the two “lower” groups IIB and IIA. Likewise, the more dangerous gas group IIB incorporates the “lower” IIA.

T4 Temperature class: classification of operating means depending on their maximum surface temperature, in agreement with the following table:

Temperature class	Max. surface temperature (°C)
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Pumps belonging to temperature class T4 must only be operated with gases or vapours which exhibit an ignition temperature of over >135 °C.

- Ta** Permissible ambient temperature for operating the pump
 $12\text{ °C} < T_a < 40\text{ °C}$.
- X** Special operating conditions need to be complied with! The special conditions and notes provided in the Operating Instructions apply.

Note the markings of the attached electrical apparatus, too.

0.6 Hazards caused by noise

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

NOTICE



CAUTION



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 B 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.

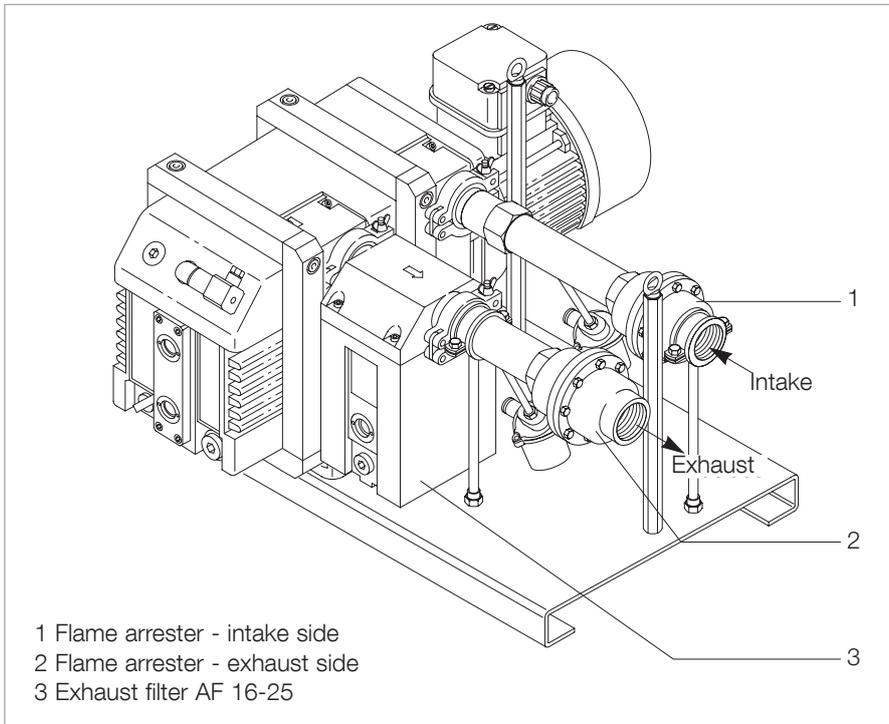


Fig. 1 TRIVAC D 16 B Ex

1 Description

The TRIVAC D 16 B Ex is an oil-sealed, two-stage vacuum pump of rotary vane design.

Via an intermediate flange the drive motor of the TRIVAC D 16 B Ex 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.

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 (2/6).

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 pinking 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.

Drive concept

Functional principle

Description

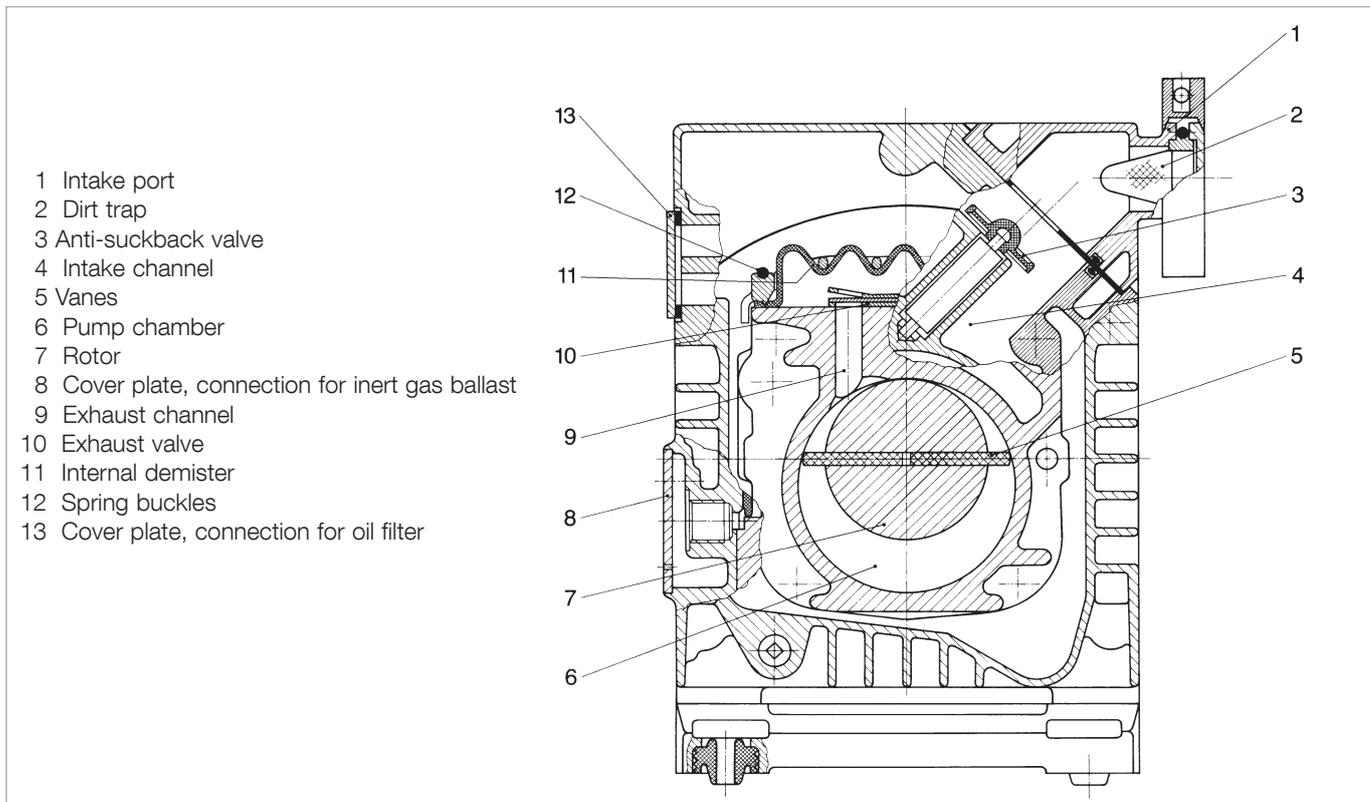


Fig. 2 Sectional drawing of the TRIVAC D 16 B Ex

Oil filter 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 D 16 B Ex through the exhaust port.

Gas ballast operation 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 water vapour tolerance as specified in the technical data for the pump.

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

Lube system To enable the TRIVAC D 16 B Ex 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.

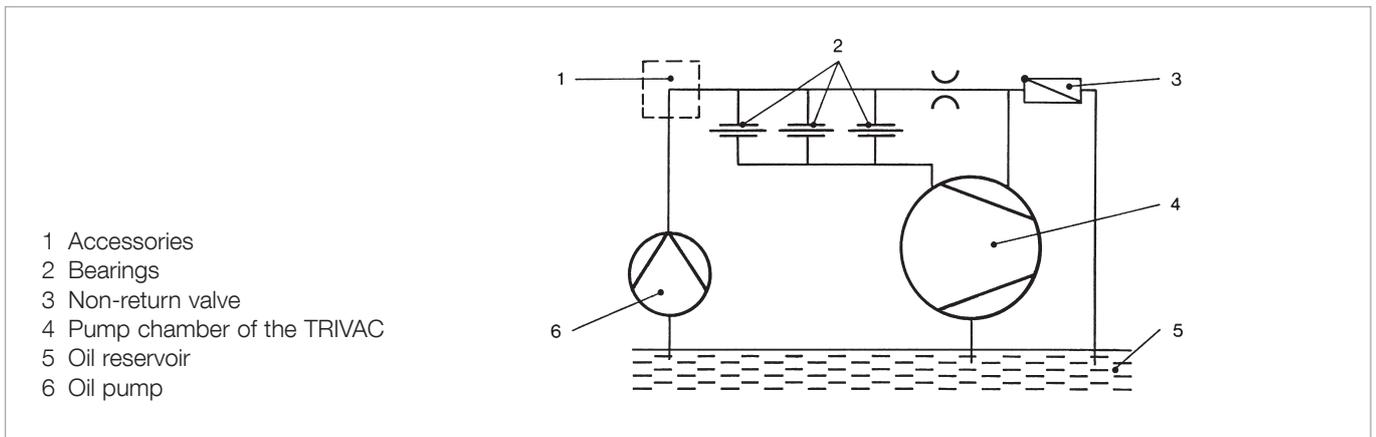


Fig. 3 Schematic of the lubricating system

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 (2/6) 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 D 16 B Ex 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 box. 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.

Seperation of oil and gas

The vacuum is maintained by the TRIVAC D 16 B Ex by an integrated hydro-pneumatic anti-suckback valve (2/3) which is controlled via the oil pressure.

Anti-suckback valve

During operation of the TRIVAC D 16 B Ex the control piston (4/3) remains sealed against a spring (4/2) by the oil pressure. The valve disc (4/6) of the anti-suckback valve is held at the lower position by its own weight (valve open). When the pump stops (because it has been switched off or because of a failure), the oil pressure drops and the spring (4/2) presses the control piston (4/3) up. Thus a connection is provided between the oil 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 box 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.

Description

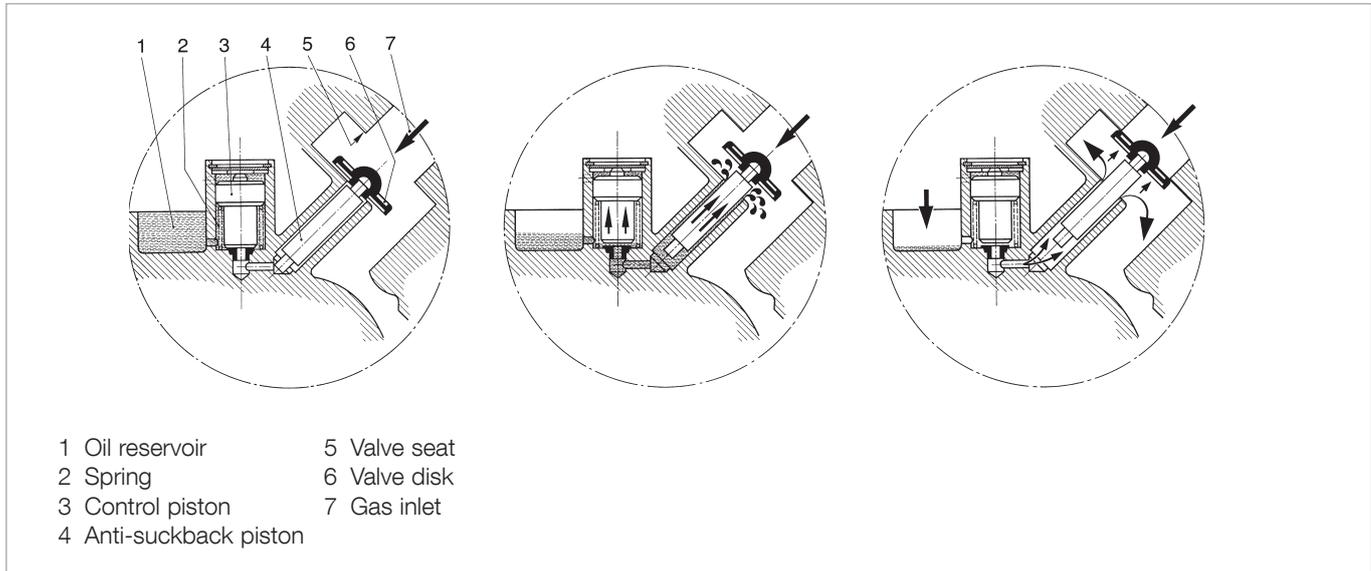


Fig. 4 Hydropneumatic anti-suckback valve

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 disk (4/6) against its seat. This effectively prevents backstreaming of oil. The anti-suckback valve (2/3) operates independently of the operating mode of the pump, i.e. also with gas ballast.

1.1.1 Integrated monitoring facilities

Analog pressure transducer

NOTICE



As soon as the pressure in the oil box of the TRIVAC D 16 B Ex attains a pressure of 0.5 bar (g), the pump must be shut down through the signal of the pressure transducer and a corresponding controller from the side of the system. In this context the requirements for safety-related devices which are software-controlled have to be in accordance with Directive 2014/34/EC.

Dirt collecting in the flame arresters may also cause a pressure rise in the oil box.

Monitoring the temperature at the intake of the vacuum pump

NOTICE



The highest permissible temperature for the process gases at the intake of the vacuum pump is 60 °C.

If, for example, this temperature is exceeded by an ignition of the explosive gas mixture within the pump, the signal from the temperature sensor needs to be processed such that the pump is shut down while at the same time interrupting the connection between the pump intake and a system, for example by a gate valve.

Monitoring the temperature at the exhaust

At the exhaust of the vacuum pump there is an additional sensor for monitoring the exhaust temperatures. The highest permissible temperature here is max. 128 °C.

If this temperature is exceeded, the signal from the temperature sensor needs to be processed such that the pump is shut down, and the equipment as well as the process are brought into a safe condition (interruption of process gas supply). For more information on connecting the sensor cf. the manufacturer's specs.

NOTICE



1.1.2 Materials in contact with the medium

Materials of the pump and the exhaust filter in contact with the medium:

Viton

Steel, hardened steel, spring steel, stainless steel

Zinc

Aluminium and aluminium alloys

Felt

Grey cast-iron

Phenolic resin / glass

Silicone

Polyamide

For the materials used in the flame arresters and the pressure transducer please refer to the corresponding Operating Instructions.

1.2 Usage limitations

The rotary vane pump TRIVAC D 16 B Ex is suited for pumping materials as listed in the table belonging to explosion groups and temperature classes within the zones stated.

P/N	140 091	140 092
Equipment-group	II	II
Equipment-category	1 inside 2 outside	1 inside 2 outside
Zone	0 inside 1 outside	0 inside 1 outside
Gas group	II B3	II C
Temperature classification	T4	T4

Description

WARNING

Only such media may be pumped which are compatible with the materials of the pump, the exhaust filter, the flame arrester and the operating agent in contact with the medium.

Radioactive, aggressive as well as corrosive and toxic substances must not be pumped.

Gas mixtures in which the share of oxygen exceeds 21% by volume must not be pumped.

The pump is not suited for pumping of acetylene, carbon bisulphide or other chemically unstable gases.

1.3 Lubricants

By default, the TRIVAC D 16 B Ex vacuum pumps are ready for operation with LVO100 mineral oils. As alternatives the oils listed herinafter may be used:

- LVO 210 – ester oil
- LVO 240 – ester oil
- LVO 310 – PAO oil
- LVO 600 – white oil

WARNING

PFPE must not be used as lubricant.

1.4 Supplied equipment

The Trivac D16 B Ex is supplied fully assembled as a system with the following components:

Type designation	Flame arresters
P/N 140 091	intake side DA-G-T-1"-IIB3-Y8 exhaust side DA-G-1"-IIB3-Y7
P/N 140 092	intake side DA-G-T-1"-IIC-Y6 exhaust side DA-G-1"-IIC-Y6

Manufacturer: Braunschweiger Flammenfilter GmbH

Type designation of the explosion protected PT100 in the flame arrester on the intake side

P/N 140 091	TR10-C with protection tube; TW35 type
P/N 140 092	TR10-C with protection tube; TW35 type

Type designation explosion resistant pressure transducer

Typ IS-20-**S**-BBG-GD-AZGA4ZUX1-ZZZ

Type designation of the temperature sensor PT100 installed on the exhaust side

P/N 140 091	TR10-C with protection tube; TW35 type
P/N 140 092	TR10-C with protection tube; TW35 type

1.5 Technical data

P/N	140 091 / 140 092	
Nominal pumping speed ¹⁾	m ³ · h ⁻¹	18.9
Pumping speed ¹⁾	m ³ · h ⁻¹	16 / 15
Ult. partial pressure w/o gas ballast ¹⁾	mbar	< 1 · 10 ⁻⁴
Ultimate total pressure w/o gas ballast ¹⁾	mbar	< 2 · 10 ⁻³
Ultimate total pressure w/ gas ballast ¹⁾	mbar	< 5 · 10 ⁻³
Water vapour tolerance ¹⁾	mbar	25
Water vapour capacity	g · h ⁻¹	240 / 65
Oil filling, min./max.	l	0.55 / 1.3
Noise level to DIN 45 635, (w/o and w/ gas ballast)	dB (A)	54 / 56
Admissible ambient temperature ²⁾	°C	+12 ... +40
Weight (complete system)	kg	72
Intake port intake and exhaust side	DN	inside thread G 3/4" / G 1"
Coupling type	ROTEX® KTR 24	
Explosion protected temperature sensor PT100 in the flame arrester on the intake side		
Limitation of the max. rated input	25 mW	
Terminal socket	1 x PT100, 4 conductors	
Explosion protected temperature sensor PT100 in the flame arrester on the exhaust side		
Limitation of the max. rated input	25 mW	
Terminal socket	1 x PT100, 4 conductors	
Max. gas admission temperature	°C	60
Pressure transducer		
Output signal 4...20 mA, 2 conductors	cf. enclosed Operating Instructions for the pressure transducer	
Measurement range: 0...4 bar (relative)		
Electrical connection: angled connector DIN EN 175301-803, IP 65		
Highest permissible pressure in the oil box	bar (g)	0.5

¹⁾In acc. with DIN 28 400 et seq. valid for LVO 100. For other oils the ultimate pressure may differ.

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.

Description

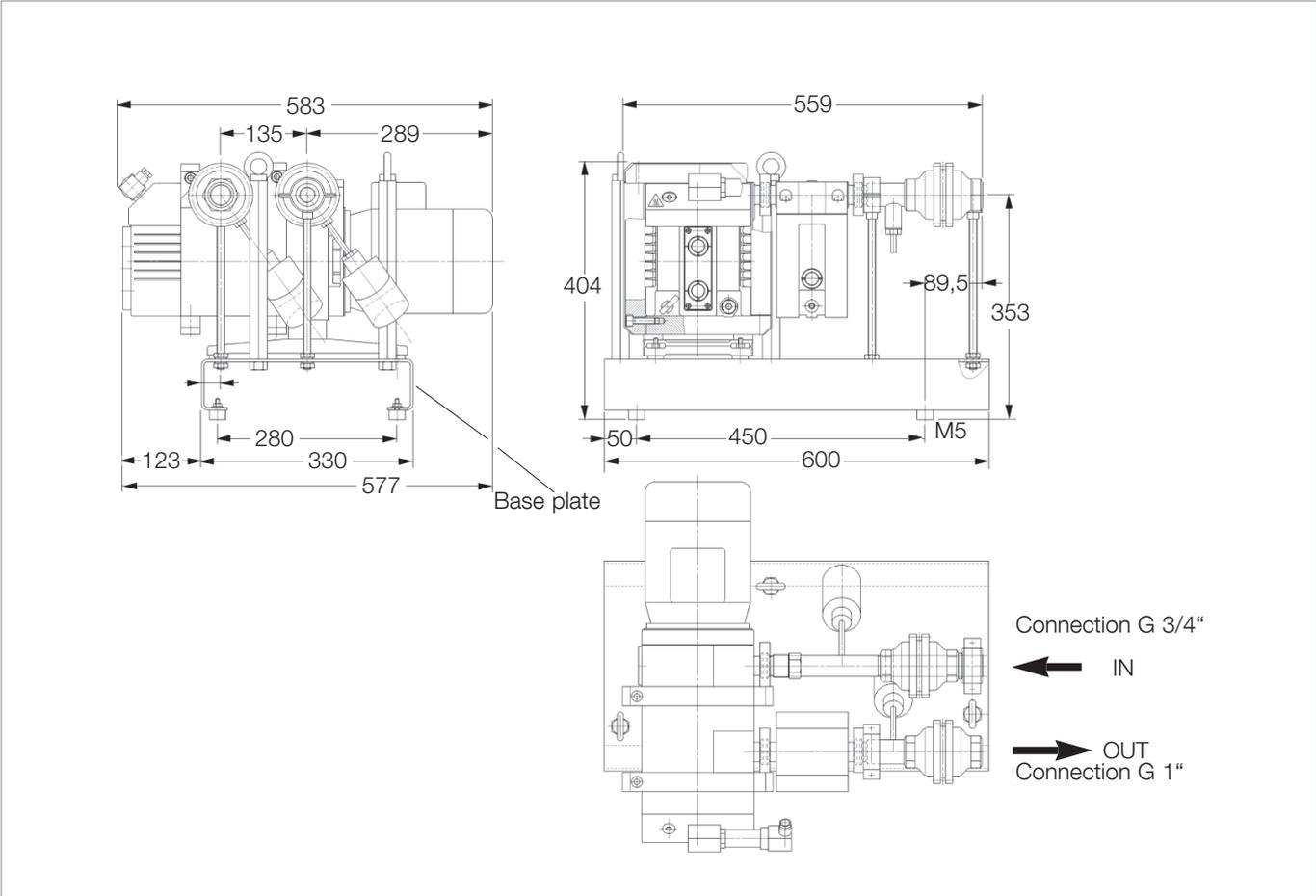


Fig. 5 Dimensional drawing of the TRIVAC-D 16 B Ex

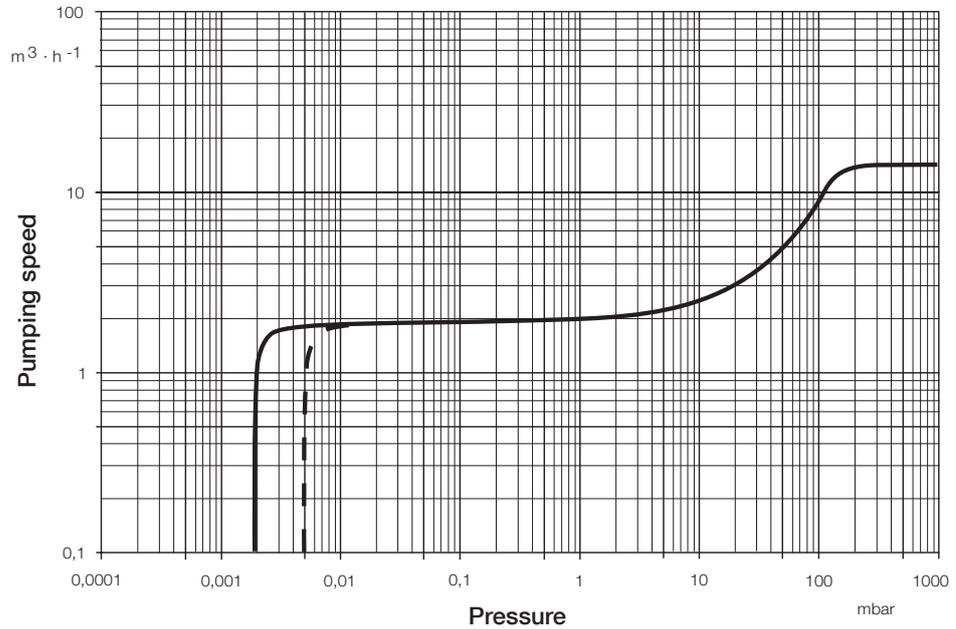
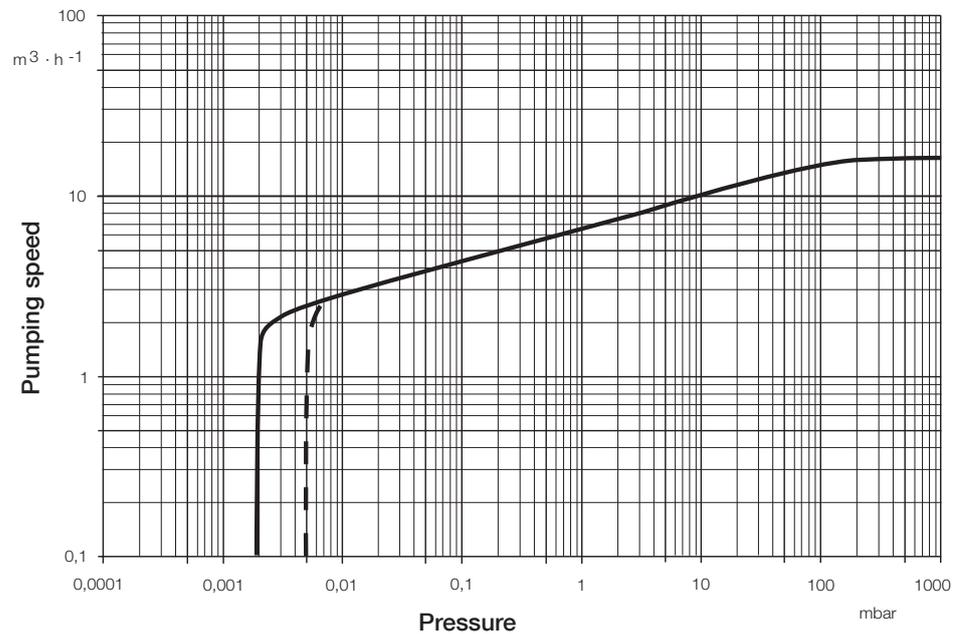


Fig. 6 Pumping speed curves of the TRIVAC D 16 B Ex, 50 Hz operation

Description

P/N of the pumps	140 091 / 140 092
Motor type	EeDA 80L/4a
Motor P/N	100002330
Compliance Certification number	PTB 02 ATEX 3115
IP code	IP55
Operating mode IEC34 / Classification	S1
Isolation class	F
Phases	3~
Manufacturer	Emod Motoren GmbH Bad Salzschlirf Germany
Number of poles	4
Nom. output power at 50 Hz	750 W
Nom. in-frequency	50 Hz
Nom. voltage range and nom. current at 50 Hz	219-242 V / 3.4 A 380-420 V / 1.95 A
Tolerances of nom. voltage range ¹⁾	±5 %
Operating speed at 50 Hz	1,405 min ⁻¹
Disposal	local directives to be considered
Installation location for pump (max.)	3,000 m (above sea level)
Ambient temp. when operating (max.)	40 °C
Altitude of installation site for motor (max.)	cf. documentation for the motor
Ambient temp. when operating (max.)	cf. documentation for the motor
Ambient humidity (max.)	< 90%
T-board / plug	6 pins
Classification / certificate	CE  II 2 G Ex e II T4
Length of the pump	583 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.

NOTICE



Observe the data given on the motor nameplate.

Transport and Storage

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.

The pump's handle must not be used for transportation.

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

CAUTION



The base plate (cf. Fig. 5) allows simple transportation of the system.

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.

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.

Installation

NOTICE

3 Installation

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.

DANGER

3.1 Placement

Pumps marked as

P/N 140 091

II (inside) 1G IIB3 T4 X (50 Hz)

II (outside) 2G IIB T4 X (50 Hz) ($12\text{ °C} < T_a < 40\text{ °C}$)

P/N 140 092

II (inside) 1G IIC (no C_2H_2 , CS_2) T4 X (50 Hz)

II (outside) 2G IIC T4 X (50 Hz) ($12\text{ °C} < T_a < 40\text{ °C}$)

are to be used in Zones 1 or 2.

For more information refer to the European Standards EN 60079-14 and EN 60079-17 („Electrical apparatus for explosive gas atmospheres – Part 14”; resp. “... – Part 17”).

Observe Safety Information 0.5.

The TRIVAC D 16 B Ex can be set up freely on a flat, horizontal surface. The base plate ensures that the pump can not slip.

When installing the TRIVAC D 16 B Ex, make sure that the connections and controls are readily accessible.

CAUTION**Risk of toppling**

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

NOTICE

The site chosen should allow adequate air circulation to cool the TRIVAC D 16 B Ex (keep front and rear unobstructed).

The oil-level glass must be visible.

3.2 Conforming utilization

This pump is specifically designed and constructed for industrial applications.

This pump must be operated and maintained by trained personnel only.

The pump's conforming utilization is the pumping of explosive atmospheres of different gas groups from Zone 0 (as stated on the nameplate), and the evacuation of vessels or vacuum systems between medium vacua and the atmospheric pressure in accord within the specifications as stated in the Technical Data Section.

The TRIVAC can pump vapours within the range of the pump's water vapour tolerance, provided that the gas ballast valve is open. Avoid vapours that can condense into liquids when being compressed inside the pump, if these substances exceed the vapour tolerance of the pump.

The TRIVAC D16 B Ex is assigned to different equipment-categories regarding the pump's outside and the process gas side's interior parts.

The process gas side of the pump was specifically designed and constructed to comply with the safety requirements of equipment-group II, category 1 IAW Directive 2014/34/EC ("ATEX Guidelines") on the conforming utilization of equipment and protection facilities in explosion hazardous areas.

The pump's outside fulfills the requirements of equipment-group II, category 2.

The utilization of the pump must be verified by the operating company against corresponding equipment-categories, temperature classifications and gas groups as specified in the explosion protection document drawn up.

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

3.2.1 Non-conforming utilization

CAUTION

The TRIVAC D 16 B Ex is **not suited** for pumping fo:

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

NOTICE

The pump is **not** suited for pumping of liquids or dusty media. Please provide the corresponding protective devices Schutzvorrichtungen vorsehen.

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.

Gas composition

It is important to note that the composition of the gas at the inlet of the pump and at the exhaust may possibly differ. This may possibly have effect on the zone divisions.

Potential ignition sources

An assessment of the ignition hazard was performed in accordance with the European standard EN 13463-1 ("Non-electrical equipment for use in potentially explosive atmospheres – Part 1: Basic method and requirements"). And based on this assessment the ignition sources listed in the following which may occur during operation of the pump, were determined:

Potential Ignition Sources	Relevant Yes / No	Protective Measures
Hot surfaces	Y	<p>Tests proved the compliance with the temperature classification if the conforming utilization is IAW these operating instructions.</p> <p>AC motor 4 pins max. 50 Hz: The maximum temperatures are attained during continuous operation at an inlet pressure ranging between 300 and 500 mbar. The actually attained temperature depends on the inlet pressure.</p> <p>Flame arresters are equipped with a temperature sensor for permanent monitoring.</p> <p>Temp signals from the PT100 must be evaluated by the system control of the operator as shutdown triggers for motor and vacuum pump.</p> <p>The maximum permissible temperature of the entering gas must not exceed 60 °C, and 128 °C for the pressure's side, respectively.</p>
Mechanical sparks	Y	<p>Explosion pressure resistant construction for sparks inside the pump.</p> <p>Sucking in of foreign particles into the pump's intake must be prevented.</p> <p>Coupling IAW EN 13463-5 Protection by constructional safety 'c'.</p> <p>The external fan is made of a non-sparking material.</p> <p>Motor IAW EN 60079-7 Increased safety 'e'</p>
Flames, hot gases	Y	<p>Due to the compression of the gases, the pump will produce in the case of normal operation hot exhaust gases. For this reason the exhaust gases need to be disposed of through a suitable exhaust gas system.</p> <p>Flame arresters are equipped with a temperature sensor for permanent monitoring.</p>
Electrical sparks	Y	<p>Motor IAW EN 60079-7 Increased Safety 'e'</p> <p>Pressure sensor with Ex-protection IAW EN 60079-11 Intrinsic Safety ia and ib ('Ex ia I/II C T6').</p> <p>Temperature sensor: PT100 passive sensor (only for connections to certified intrinsically-safe circuits).</p>
Static electricity	Y	<p>Vacuum pump and all corresponding parts must be included in the potential equalisation.</p> <p>During operation the handle of the pump must be pushed-in.</p> <p>Wipe plastic parts on the pump's surface only with a moistened piece of cloth.</p>
Adiabatic compression	Y	<p>Signals from the pressure transducer must be evaluated by the system control of the operator as shutdown triggers for the motor with pressures of 0.5 bar (g).</p>
Chemical reactions	Y	<p>Explosion pressure resistant construction for sparks inside the pump.</p> <p>The pump is not suited for pumping of acetylene, carbon disulphide or other chemically instable gases.</p> <p>Only such media may be pumped which are compatible with and not reactive to the materials of the pump.</p>
Potential ignition sources caused by incorrect use	Y	<p>Original spare parts of the manufacturer must be used only, for maintenance and repair of the vacuum pump IAW these operation instructions.</p> <p>Servicing has to be conducted on a regular basis as described in these operating instructions.</p>

Installation

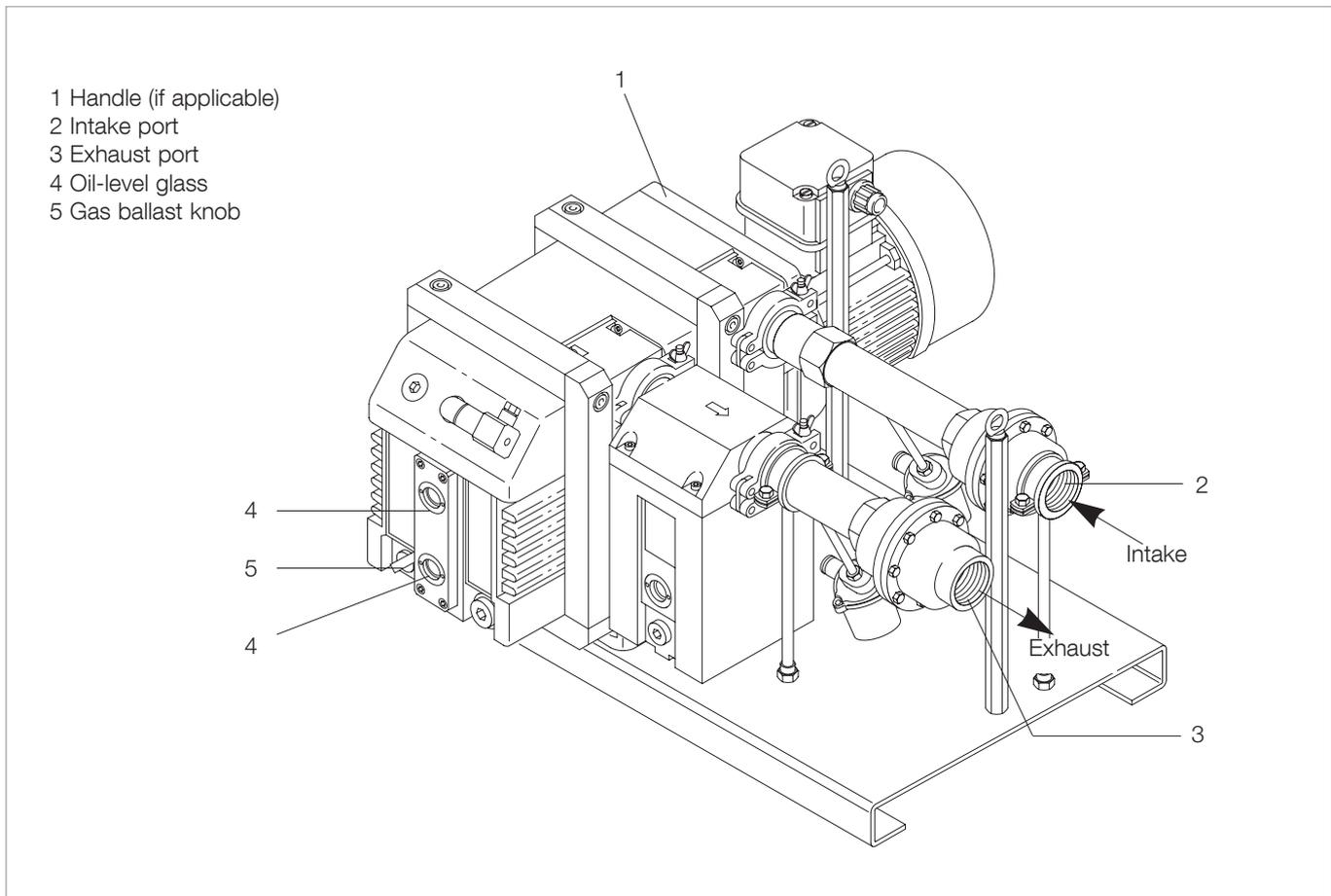


Fig. 7 Connections and controls

3.3 Connecting to the system

Before connecting the TRIVAC D 16 B Ex, remove the shipping seals from the connection flanges (7/2 and 7/3).

We recommend that you retain the shipping seals in case you need to store the pump in the future.

Connection port on the intake side - inside thread G 3/4".

Connection port on the exhaust side - inside thread G 1".

The inside threads (G 3/4" and G 1") of the flame arresters on the intake and the exhaust side must be sealed with Loctite 542 sealant when connecting these to the system. Here the entire length of the thread of the flame arresters must be utilised for accepting the mating thread from side of the system.

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

The intake line must be clean and free of welding beads and scales. Deposits in the intake line may outgas and adversely affect the vacuum. The connecting flanges must be clean and undamaged.

Use suitable intake filters, respectively suitable accessories on the pump

when wanting to operate the pump in connection with dust containing processes or processes in which condensable vapours are produced. When pumping condensable vapours, the gas ballast must be switched on and a post operation phase of approximately 0.5 hours with the gas ballast open and the intake port closed must be run. All sealing surfaces must be clean and maintained free of scratches.

The pumping speed curve of the TRIVAC D 16 B Ex is given in Fig. 6.

Note the cross-sections of the connection lines

If exhaust gases must be collected or contained, do not allow the exhaust line to become pressurised. The maximum pressure in the oil box must not exceed 0.5 bar (g) during normal operation of the pump. 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 on a regular basis to ensure that there are no obstructions.

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

Avoid backflowing condensates

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 which is suitable for usage in explosive atmospheres.

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

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.

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).

Further commitments of the operator relating to work safety can be found in Directive 1999/92/EC.

CAUTION



NOTICE



CAUTION



DANGER



3.4 Electrical connection

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.

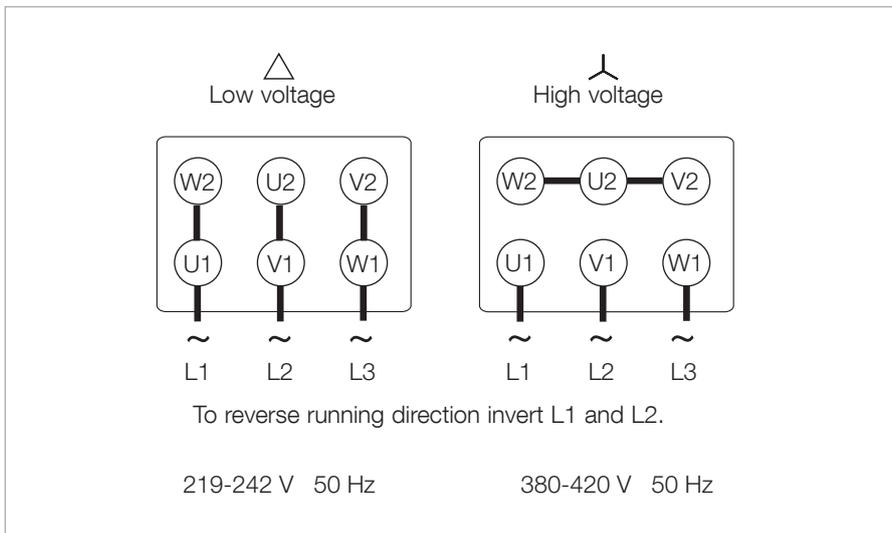


Fig. 8a Motor connection diagram (motor P/N: 20010409)

3.4.1 Pump with three-phase AC motor

The TRIVAC D 16 B Ex with a three-phase motor is supplied without accessories for electrical connection. The pump must be connected via the appropriate cable, and a suitable motor protection switch. This switch must be certified for the use in explosive atmospheres. The separators used must carry the appropriate ATEX certification.

When operating the unit at its operational limits (at an ambient temperature of 12 °C and at undervoltage, for example) it may be necessary to protect the electric motor against high start-up currents by installing an overload protector (Class 20 in accordance with IEC 60947, for example). Set up according to the information provided on the motor nameplate to meet local requirements for the motor protection switch. The local requirements may specify measures for reducing the start-up current (soft start, for example).

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.

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

Installation

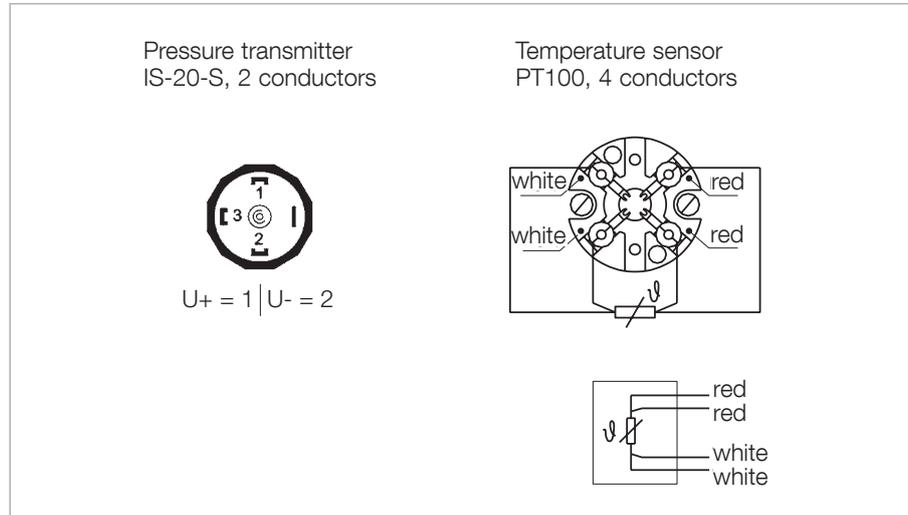


Fig. 8b Connection diagram (monitoring facilities)

3.4.2 Connecting monitoring facilities

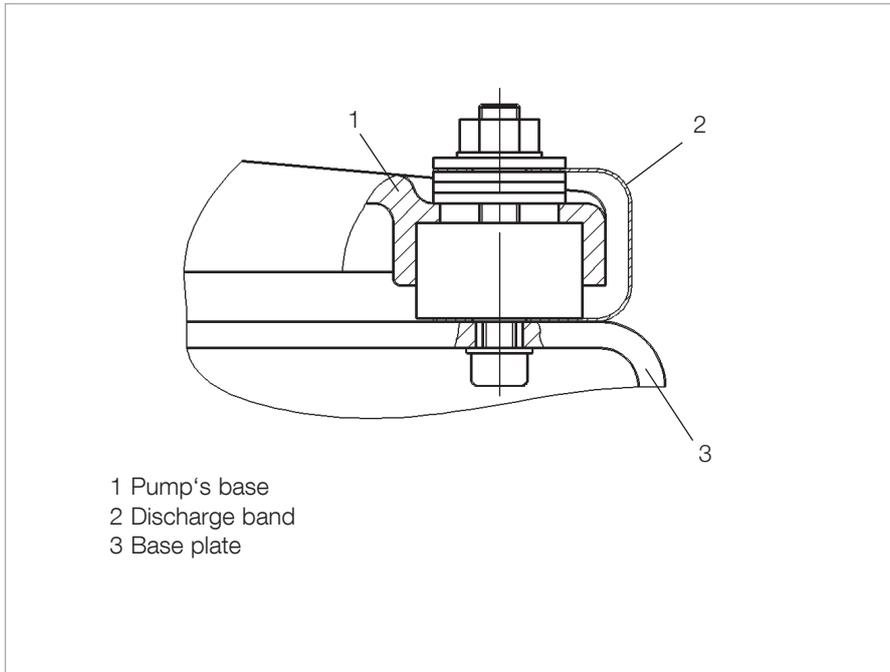
How to connect the monitoring devices (pressure sensor for monitoring the pressure in the oil box, the pump as well as the temperature sensors PT100 (on the intake and the exhaust sides)) is described in the enclosed manufacturer's information on the individual components. The separators used must be of the intrinsically-safe circuit-type and must carry the appropriate ATEX certification.

The signal from the pressure transducer needs to be processed by the system controller such that the motor is switched off at a pressure of 0.5 bar (g).

The PT 100 temperature signals need to be acquired by the operator of the system controller so as to produce the shutdown signal for the motor of the vacuum pump. The permissible temperature for the admitted gas must not exceed 60 °C; on the exhaust side a maximum temperature of 128 °C is permissible. The signals need to be processed in accordance with the information provided by the manufacturer of the sensor.

After switching off the pump it must be ensured that there is no further flow or backflow of media in either direction. If applicable provide for corresponding shut-off devices.

Use a cable diameter that is appropriate for the corresponding feedthrough. Ensure for a correct seating of the plug used, and that all sealings are undamaged and mounted. Tighten the fitting and re-check that all sealings are properly in place, to conform with the type of protection (IP54 IAW IEC 60 529). (The IP Codes specified apply only in the plugged condition with cable connectors (sockets) complying with the corresponding protection rating.) Make sure that no moisture can enter at the cable heads.



Sketch 1 Discharge band

3.4.3 Electrostatic discharge

Electrostatic charges between the pump and the bottom panel (sketch 1/3) are avoided through the use of the discharge band (sketch 1/2) at the pump's base (sketch 1/1).

Regularly check to see that the mounting bolt at the pump's base is firmly seated, to ensure an effective potential equalisation during all times. In order to avoid an electrostatic charge at the handle of the pump, it should only be cleaned using a moist piece of cloth.

CAUTION



4 Operation

4.1 Media compatibility

TRIVAC D 16 B Ex 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

NOTICE

Only when using the lubricants recommended by us can we guarantee proper operation of the TRIVAC D 16 B Ex. No PFPE oils must be used since the use of these lubricants will result in an unacceptably high temperature increase.

Each time before switching on, check the oil level.

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

During the first start-up and each time after having made changes to the electrical power connections, check the pump's direction of rotation (cf. Section 3.4.1).

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.

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

As is typical for rotary vane pumps the oil consumption may vary depending on the method of operation. The amount of oil must be checked regularly and topped up as required.

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 relative to the atmospheric pressure. 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.

NOTICE



4.3.1 Pumping of non-condensable gases and vapours

If the process contains mainly permanent gases, the TRIVAC D 16 B Ex 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 D 16 B Ex 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.

In cyclic operation, the TRIVAC D 16 B Ex 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.

Operation

4.3.3 Operating temperatures

Proper operation of the TRIVAC D 16 B Ex 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 pump 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.

4.4 Switching off / shutdown

If the TRIVAC D 16 B Ex 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.

NOTICE

When pumping condensable media, leave the pump to operate with the gas ballast valve open and the intake line closed before switching off the pump (see Section 4.3.2).

If the TRIVAC D 16 B Ex 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 Section 5.5.2).

- 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 facilities

When the pump has been switched off by the integrated monitoring devices, the pump must only be started manually after having removed the cause first.

4.4.2 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

Maintenance

DANGER



5 Maintenance

Make sure that there is no hazardous atmosphere **before** conducting any maintenance work.

Due to the design concept, TRIVAC D 16 B Ex 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



If the TRIVAC D 16 B Ex 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 D 16 B Ex 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.

5.1 Maintenance plan

TRIVAC D 16 B Ex IAW 2014/34/EC	Meas. / Test Qty. Op. / Aux. Materials	Interval	Remarks <small>(additionally check corresponding individual components)</small>
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: LVO 100 or special and alternative oils 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. Waste oil disposal: cf. Section 7.
Check the edges of the teeth on the coupling element for any damages, change the coupling element as required.		annually	
Changing the oil	Oil: LVO 100	annually	Oil change (cf. Section 5.4) ■ 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. Quantity of oil: cf. Technical data Section. Waste oil disposal: cf. Section 7.
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 even more often, if motor or pump temps are too hot; 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 outside only with a moistened piece of cloth, to avoid ignition through static discharge.
Visually check the flame arresters in adequate intervals, especially for accumulation of dirt and corrosion; clean or replace as required.		varies depending on the process	

It is required to service the pump every two years covering the following:

- Cleaning
- Checking all individual components
- Exchange of all seals and gaskets
- Functional check.

This service must only be run by the Leybold Service.

Maintenance

5.2 Leybold Service

Maintenance, servicing and repairs must only be conducted by authorized Leybold personnel.

Only the oil change, maintenance on the flame arresters, the pressure transducer, the PT100 temperature sensors and checks on the coupling may be done on the customer's side.

For safety reasons, every TRIVAC D 16 B Ex must be subjected every two years or in the case of a failure, to a revision at Leybold.

During the check every two years also all seals and filters of the pump are replaced.

The screws on the oil box of the pump and at the exhaust filter have been sealed.

In case you have any questions relating to this topic please contact the 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

Connect the form at the device or lay it to the device.

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 D 16 B Ex 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.

Check before the refill the kind of oil in the pump and fill in only suitable oil or change the oil.

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

Ensure that the oil-fill plug and the corresponding gasket are mounted properly.

5.3.1 Checking the condition of the oil

The ageing process for the standard operating fluid LVO 100 respectively (see Section 1.3) will depend very much on the area of application for the pump.

There are several ways of checking the oil's condition:

a) Visually

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

b) Chemically

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

c) Mechanically

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.

If you want 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.

CAUTION



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 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.

CAUTION



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.

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.

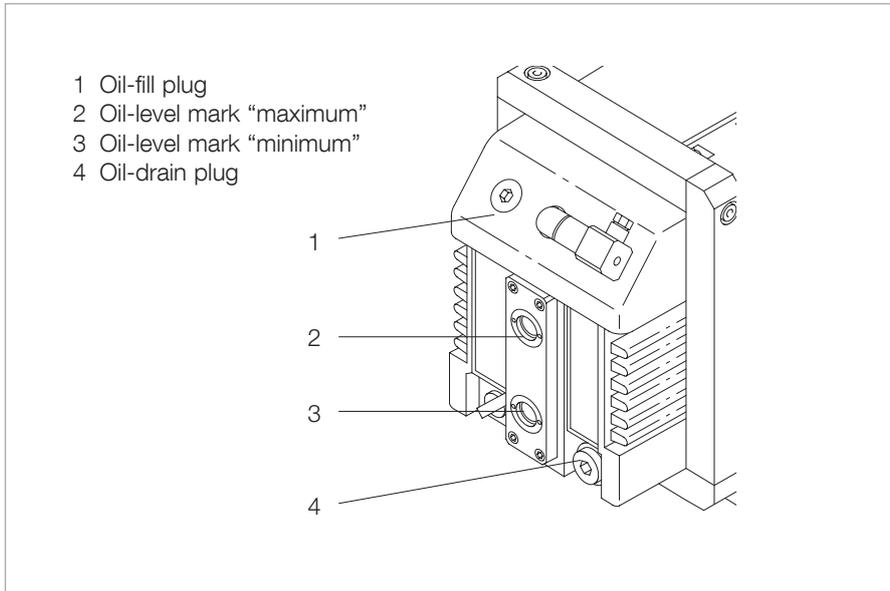


Fig. 9 Oil change

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.

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

NOTICE



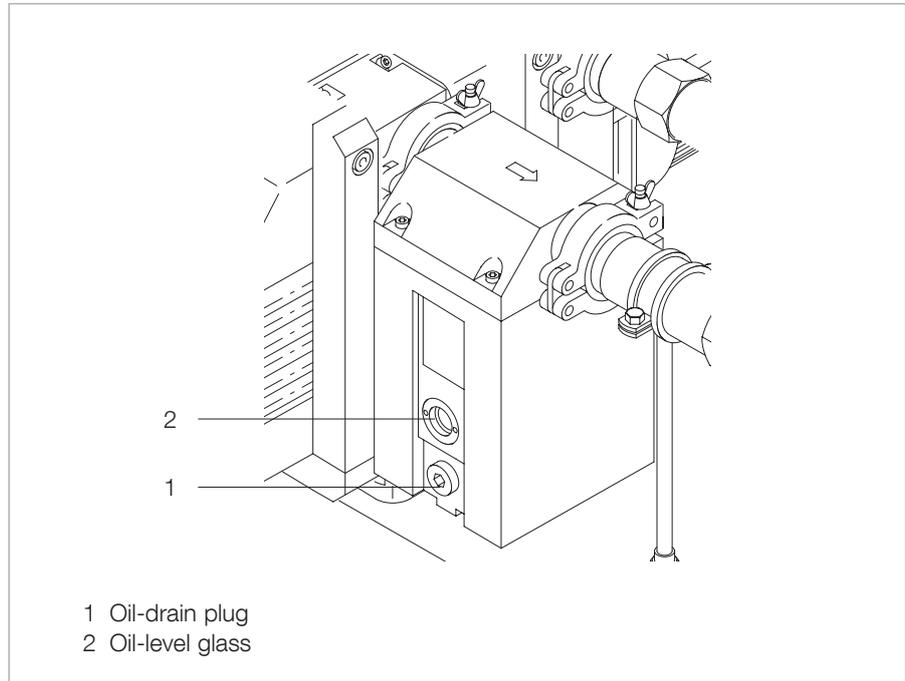


Fig. 10 Exhaust filter

5.5 Exhaust filter

5.5.1 General information

The gas pumped by the vacuum pump flows through the filter element of the exhaust filter whereby the entrained minute droplets of oil and the particles are retained by the filter element. The separated oil droplets collect in the exhaust filter.

Dirt and cracked products of the oil may clog the filter elements during operation.

Exhaust filter elements must only be changed by the Leybold Service.

5.5.2 Draining out the oil

Depending on the pump's application and process regularly drain out the filtered oil from the exhaust filter's collector.

CAUTION



The oil level must not increase above the middle of the level indicator (10/2), as otherwise the filter elements will be soaked.

Because of the gas flow, then droplets of oil may be entrained in the gas flow.

Unscrew the oil-drain plug (10/1) and drain out the filtered oil.

Then screw in the oil-drain plug using a new gasket.

Torque for the oil-drain plug: 10 Nm

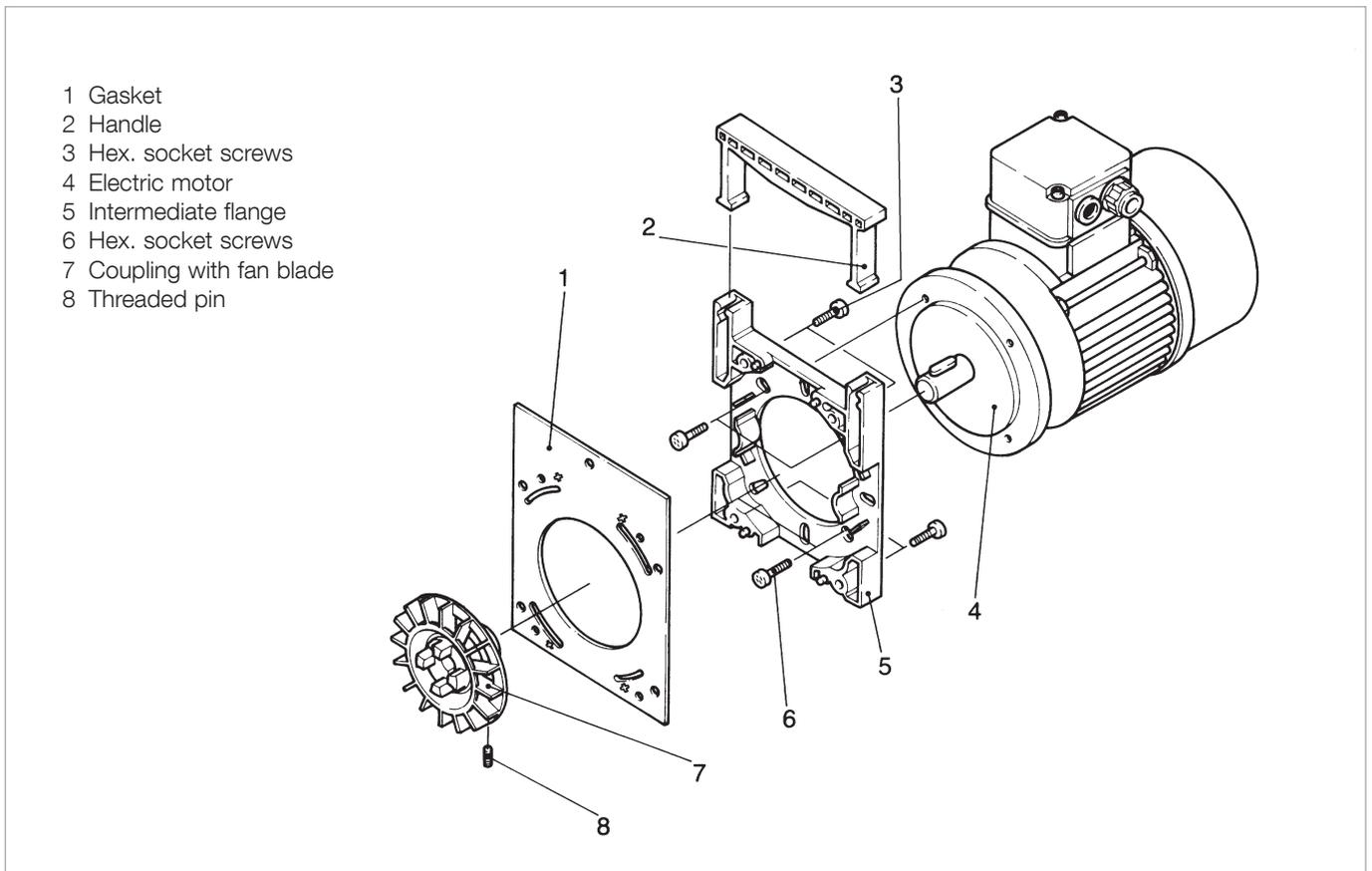


Fig. 11 Disassembly and reassembly of the electric motor

5.6 Disassembly and reassembly of the electric motor

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.

Before starting work, always disconnect the motor from the mains. Pull the mains plug. Observe safety information 0.2.

If hazardous substances have been pumped – in inconsistency with the recommendations given in Section 3.2 – the type of hazard has to be determined, and appropriate safety measures must be taken. Observe safety information 0.4.

DANGER



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.

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

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

Maintenance

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.

5.6.1 Checking the coupling

Required tools:

Allan key 5 mm, possibly a puller for the coupling.

The coupling is of the ROTEX®-type size 24. Checking the coupling may be conducted by the operator.



NOTICE

For the duration of the coupling check, the motor must be reliably disconnected from its source of electrical power and protected against being switched on.

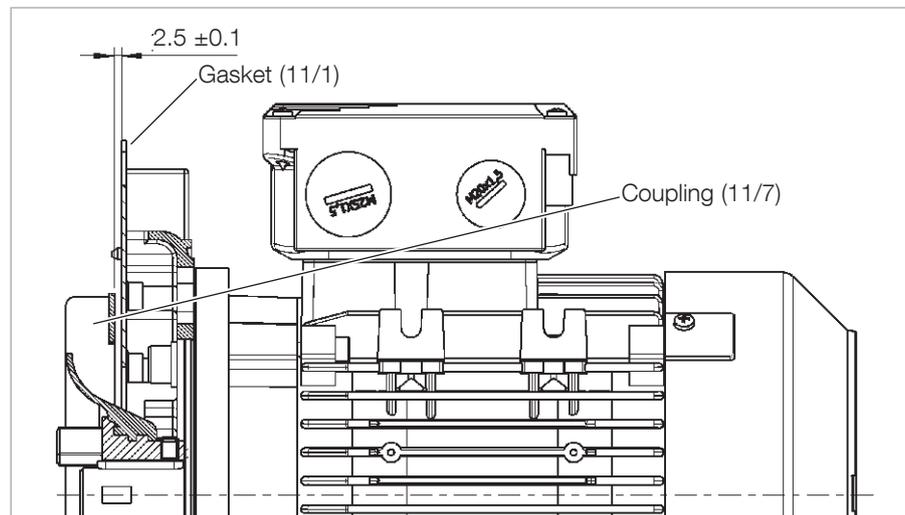
Under all circumstances comply with the information relating to usage and maintenance of the elastic coupling between motor and pump. For the purpose of avoiding hazards the revision intervals specified by the manufacturer of the coupling needs to be observed.

To visually check the coupling, unscrew and slowly pull off the motor to the rear. Inspecting the coupling must be conducted in accordance with the enclosed manufacturer's Operating Manual.

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

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

Pls. observe the information in the enclosed manufacturer's Operating Manual.



Sketch 2 Axial position of the coupling

5.7 Flame arrester and temperature sensor

Please note the maintenance information provided in the assembly and operating instructions for the flame arresters and the temperature sensor. Pls. observe the accompanying manuals enclosed.

Any accumulation of dirt in the flame arrester can cause a pressure increase within the oil box.

5.8 Pressure transducer

(Relative pressure gauge)

There are no maintenance works to be conducted on the pressure transducer.

With replacing this component please observe the following: After the installation of the transducer check for its flawless function. This operational test comprises of 2 parts: The first part is the area up to the plug's interface at the transducer; and the second part is the area from the plug's interface additionally integrating the system control. Both areas **must** be checked by the operator after the component has been replaced.

The first part is carried out by connecting the pressure transducer according to the manufacturer's installation instructions. Then increase the pressure inside the oil box (up to 4 bar (g) (max.)).

This is done, as described hereinafter:

- Switch-on the pump.
- Block the pump's intake side.
- Evacuate the inlet pressure of the pump (intake side) to < 0.1 mbar.
- Block the pump's exhaust side.
- Open the gas ballast, to increase the pressure inside the oil box.
- With a pressure of 0.5 bar (g) in the oil box, the pressure transducer is to generate and output the corresponding trigger signal.
- Close the gas ballast.
- Switch off the pump.

if the corresponding output signal is present at the pressure transducer, the operational test can be terminated.

Troubleshooting

6 Troubleshooting

Fault	Possible cause	Remedy	Repair*
Pump does not start.	Wiring is malfunctioning.	Check and repair wiring.	-
	Motor protection switch incorrectly set.	Set motor protection switch properly.	3.4
	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.	Have LV replace the filter element, or clean the exhaust line.	Service -
	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.	Have LV to clean the inlet screen. Have LV replace the filter element.	Service Service
	Exhaust filter is clogged.	Use adequately wide and short connecting lines.	3.3
	Connecting lines are too narrow or too long.		
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.	Service -
	Exhaust valve is malfunctioning.	Repair the valve.	Service
	Pump module is worn out	Replace the pump module.	Service
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. Reconsider the process.	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.	5.6
	Vanes or bearings are damaged.	Repair pump.	Service

Waste Disposal

7 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.

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	Rotary vane pump
Type designation:	TRIVAC D16 B Ex	TRIVAC D16 B Ex
Part numbers:	140091	140092, 140092P
Marking:	 II 1G c IIB3 T4 / 2G c IIB T4 X 12°C<Ta<40°C	 II 1/2G c IIC(no C2H2, CS2) T4 X 12°C<Ta<40°C
CE 0637		
EU-typ examination certificate:	IBExU03ATEX1017 X	IBExU03ATEX1016 X
IBExU, Freiberg, reg. no. 0637		

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)

ATEX equipment directive (2014/34/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
EN 13463-1:2009	Non-electrical equipment for use in potentially explosive atmospheres — Part 1: Basic method and requirements
EN 13463-5:2011	Non-electrical equipment intended for use in potentially explosive atmospheres — Part 5: Protection by constructional safety 'c'
EN 1127-1:2011	Explosive atmospheres — Explosion prevention and protection Part 1: Basic concepts and methodology

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Cologne, September 01, 2016



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/P / Head of Product Lines

Cologne, September 01, 2016



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

Dokument Nr.: 300303826_001_A6

Contamination Declaration

Tips for declaring correctly



Why such a declaration?

Our customers operate in a variety of sectors and with the related applications. Furthermore, there are a large number of applications and internal uses, which in some cases are not known to us. On the other hand, the handling of different materials and substances can result in hazards for our employees.

A. Description of the device

You will make it easier for us to repair or service the device if you enter all the information required here. In particular in the case of justified claims under warranty, we can then settle the matter quickly. The details are also necessary for our own process organisation: for procuring spare parts and storing relevant components.

B. Ambient conditions

For inexpensive repairs it is important to know what the pump has been used for so far. If for example – the best-case scenario for us – the pump has not been in operation, there is no need for cleaning. For severely soiled devices or mounted parts we can then ensure consistent component quality.

C. Description of process substances

1. Which substances has our pump been in contact with?
2. Are these substances harmless?
3. If the pump has been warmed or heated, other hazards are possible.

By telling us the applications you are aware of, you make it easier for us to select the protective measures (technical, organisational, personnel) in our service centers. We can then try to prevent any risk to the health of our staff or at least reduce it to a minimum.

D. Binding signature

You complete the declaration by adding your legally binding signature. You thus assure us that you are acting in good faith and will not expose our staff to any unnecessary risk.

Hazards due to chemicals

The relevant legislation has divided chemicals into various categories of risk, with different symbols for different hazardous substances (see above). For continued use it is important to indicate known hazards, so as to avert injury to repair staff when they open or later repair the pump. This can be crucial if you are going to send us a soiled pump. Airlines for instance refuse to transport devices in case of inflammable gases or adhesion of toxic substances.

Important note for transport

For the pump to be transported safely it must be free of residues, properly sealed and well packed. Reusable packaging materials are available for the purpose. This can be crucial if you are going to send us a soiled pump. Airlines for instance refuse to transport devices in case of inflammable gases or adhesion of toxic substances.

Important note for returns

In order to obtain an appraisal of the general conditions, please complete and add the cover note on the outside in fully legible form.

Other useful hints

Please note that your employees must in certain cases use personal protective equipment when they are packing or handling our pumps. A carry-over or dispersion of hazardous substances or oils is dangerous, and it is costly to remove them.

If your staff injure themselves when using or handling your pump, or if there is the possibility of a „near miss“ accident, please let us know. We too are concerned to reduce accidents and develop means of improvement.

Many thanks for your understanding.

Declaration of Contamination of Compressors, Vacuum Pumps and Components

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

A separate declaration has to be completed for each single component.

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

Customer/Dep./Institute : _____ Address : _____ _____ Person to contact: _____ Phone : _____ Fax: _____ End user: _____	Reason for return: <input checked="" type="checkbox"/> applicable please mark Repair: <input type="checkbox"/> chargeable <input type="checkbox"/> warranty Exchange: <input type="checkbox"/> chargeable <input type="checkbox"/> warranty <input type="checkbox"/> Exchange already arranged / received Return only: <input type="checkbox"/> rent <input type="checkbox"/> loan <input type="checkbox"/> for credit Calibration: <input type="checkbox"/> DKD <input type="checkbox"/> Factory-calibr. <input type="checkbox"/> Quality test certificate DIN 55350-18-4.2.1
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A. Description of the Leybold product: Material description : _____ Catalog number: _____ Serial number: _____ Type of oil (ForeVacuum-Pumps) : _____	Failure description: _____ Additional parts: _____ Application-Tool: _____ Application- Process: _____
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------

B. Condition of the equipment	No¹⁾	Yes	No		Contamination :	No¹⁾	Yes
1. Has the equipment been used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→	toxic	<input type="checkbox"/>	<input type="checkbox"/>
2. Drained (Product/service fluid)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		corrosive	<input type="checkbox"/>	<input type="checkbox"/>
3. All openings sealed airtight	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		flammable	<input type="checkbox"/>	<input type="checkbox"/>
4. Purged	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		explosive ²⁾	<input type="checkbox"/>	<input type="checkbox"/>
If yes, which cleaning agent					radioactive ²⁾	<input type="checkbox"/>	<input type="checkbox"/>
and which method of cleaning					microbiological ²⁾	<input type="checkbox"/>	<input type="checkbox"/>
¹⁾ If answered with "No", go to D. ←					other harmful substances	<input type="checkbox"/>	<input type="checkbox"/>

C. Description of processed substances (Please fill in absolutely)

1. What substances have come into contact with the equipment ?
 Trade name and / or chemical term of service fluids and substances processed, properties of the substances
 According to safety data sheet (e.g. toxic, inflammable, corrosive, radioactive)

X	Tradename:	Chemical name:
a)		
b)		
c)		
d)		

2. Are these substances harmful ? No Yes ←

3. Dangerous decomposition products when heated ? No Yes ←

If yes, which ? _____

²⁾ Components contaminated by microbiological, explosive or radioactive products/substances will not be accepted without written evidence of decontamination.

D. Legally binding declaration

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

Name of authorized person (block letters) : _____

_____ Date

_____ signature of authorized person

 firm stamp

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