



TRIVAC®B D 16 B / D 25 B

Rotary Vane Vacuum Pump

ATEX categories 3i and 3i/o with mineral oil

Operating instructions GA01217_002_C5

Part numbers

11266/76	3i
11325/35	3i
140160/V/170	3i/o
11333	
15130016V02CZO	
898199/199-1/698	
898229	
15130016V01CZO	
15130025V01CZO	



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We accept no liability for loss of profit, loss of market or any other indirect or consequential loss whatsoever.

Product warranty and limit of liability are dealt with in our standard terms and conditions of sale or negotiated contract under which this document is supplied.

You must use this product as described in this manual. Read the manual before you install, operate, or maintain the product. For manual enquiries, email documentation@leybold.com.

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Safety and compliance

1 Safety and compliance

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use. Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions.

The instruction manual is an important safety document that we often deliver digitally. It is your responsibility to keep the instruction manual available and visible while working with the equipment. Please download the digital version of the instruction manual for use on your device or print it if a device will not be available.

1.1 Definition of Warnings and Cautions

Important safety information is highlighted as warning and caution instructions which are defined as follows. Different symbols are used according to the type of hazard.

WARNING:

If you do not obey a warning, there is a risk of injury or death.

CAUTION:

If you do not obey a caution, there is a risk of minor injury, damage to equipment, related equipment or process.

NOTICE:

Information about properties or instructions for an action which, if ignored, will cause damage to the equipment.

We reserve the right to change the design and the stated data. The illustrations are not binding.

1.2 Trained personnel

For the operation of this equipment "trained personnel" are:

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

Safety and compliance

1.3 Safety symbols

The safety symbols on the products show the areas where care and attention is necessary.

The safety symbols that we use on the product or in the product documentation have the following meanings:

	Warning/Caution Risk of injury and/or damage to equipment. An appropriate safety instruction must be followed or a potential hazard exists.
	Warning - Automatic start up Risk of injury. The equipment can be started remotely and without warning.
	Warning - Corrosive substances Risk of injury or damage to equipment. Identifies the presence of corrosive gases, liquids or materials.
	Warning - Dangerous voltage Risk of injury. Identifies possible sources of hazardous electrical shock.
	Warning - Flammable material Risk of fire. Identifies possible sources of flammable gases, liquids or materials.
	Warning - Hot surfaces Risk of injury. Identifies a surface capable of inflicting burns through contact.
	Warning - Overhead or Suspended load Risk of injury or damage to equipment. Identifies an area where overhead or suspended items may lower or fall.
	Warning - Risk of explosion Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.
	Warning - Toxic material Risk of injury or damage to the environment. Identifies a source of toxic gases, liquid or material.
	Mandatory action symbol Failure to comply with this action may result in injury or damage to equipment.

Safety and compliance

	Warning - Wear protective gloves
	Warning - Wear protective respirator Risk of injury. Wear an appropriate protective respirator when performing the task.

Important safety information

2 Important safety information

2.1 Mechanical hazards



WARNING: OPERATION SAFETY

Risk of injury. Avoid exposing any part of the human body to the vacuum.



WARNING: AUTOMATIC START UP

Risk of injury. The equipment can be started remotely and without warning.



WARNING: RISK OF EXPLOSION

Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.

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 pump (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 overpressure 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 make sure that there are no obstructions.
8. When moving the pump always use the allowed means and follow the specified procedure. Use all lifting eyes when moving the pump body. Pay attention to the centre of gravity.

2.2 Electrical hazards



WARNING: DANGEROUS VOLTAGE

Risk of electric shock. Death or severe injury caused by an electric shock.

Important safety information

1. The electrical connection must only be provided by a trained person. Observe the national regulations in the country of use like EN 50110-1 for Europe, as an example.
2. Lethal voltages are present at the mains connections. Before you start 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.

2.3 Thermal hazards



WARNING: HOT SURFACES

Risk of injury. Identifies a surface capable of inflicting burns through contact.

-
1. Under certain ambient conditions the pump 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 information.

2.4 Hazards caused by materials and substances



WARNING: TOXIC MATERIAL

Risk of injury or damage to the environment. Identifies a source of toxic gases, liquid or material.



WARNING: FLAMMABLE MATERIAL

Risk of fire. Identifies possible sources of flammable gases, liquids or materials.

Important safety information



WARNING: CORROSIVE SUBSTANCES

Risk of injury or damage to equipment. Identifies the presence of corrosive gases, liquids or materials.



WARNING: RISK OF EXPLOSION

Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.

-
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.
 2. 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.
 3. Since not all application related hazards for vacuum systems can be described in detail in these Operating Instructions, we have a separate document (Safety Booklet) in which the hazards and general safety concepts for design, operation and maintenance of vacuum systems are explained.
 4. 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.
 5. The pump is not suited for oxygen operation.
 6. Before commissioning the pump, 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.
 7. When pumping toxic, chemical, radioactive and corrosive gases as well as pyrophoric substances, the operating company is under the obligation to comply with the national and international safety regulations and guidelines. Regarding the suitability of the pumps for special applications in which such gases, respectively substances shall be pumped, we should be consulted first.
 8. 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.
 9. When cleaning a system in which a 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.

Important safety information

10. 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.

2.5 Danger of ignition



WARNING: RISK OF EXPLOSION

Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.

-
1. Only those pumps which are equipped with an ATEX certified motor are suited for operation in the explosion hazard areas approved for the pumps. Please take note of the marking on the type plates and any additional information on the pump.
 2. The standard version of the pump B is not suited for operation in explosion hazard areas.
 3. The pumps including the accessories are fundamentally not suited for pumping of combustible and explosive gases or vapours. The pump including accessories is only suited within the scope of the ATEX guideline for pumping of explosive gases and 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 therefore derive the necessary safety measures which must be introduced.
 4. Provided ignitable or pyrophoric substances are present in the equipment you must:
 - Make sure that no air can enter into the equipment,
 - Make sure that the system is leak-tight,
 - With an inert gas purge (with dry nitrogen, as an 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.

2.6 Hazard caused by noise



WARNING: NOISE HAZARD

Risk of injury. Identifies a possible source of noise above the recommended safe level.

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

2.7 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.

Important safety information

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 pump should have attained its operating temperature. This will be the case approximately 30 minutes after having started the pump. During this warming up phase, the pump should be separated from the process, by a blocking valve in the intake line, for example.
7. In the case of wet processes we recommend the installation of liquid separators upstream and downstream of the pump as well as the use of the gas ballast.
8. The exhaust line should be laid so that it slopes down and away from the pump so as to prevent condensate from backstreaming into the pump.
9. The entry of particles and fluids must be avoided under all circumstances.
10. Reactive or aggressive substances in the pump chamber may impair the operating oil or modify it. In addition, such substances may be incompatible with the materials of the pump (Viton, grey cast iron, aluminium, steel, resins, glass etc.).
11. Corrosion, deposits and cracking of oil within the pump are not allowed.
12. Normal amounts of humidity within the range of the pump's water vapour tolerance will not significantly affect pump performance when the gas ballast is active.
13. When operating the pumps at gas throughput, it is urgently recommended to connect an exhaust filter or use a suitable exhaust line. Here, the exhaust line must slope down and away from the pump.
14. In the case of custom pumps please note the information provided in the supplementary sheets.

3 ATEX categories

3.1 TRIVAC B ATEX Categories 3i and 3i/o vacuum pump

Operating Instructions for operation in explosion hazard areas

The pumps are designed and constructed in such a way that the occurrence of foreseeable ignition sources during normal operation can be excluded. Operated in accordance with the parameters specified in the instructions for use, the pump provides a normal level of protection. It is therefore suitable for use in conditions where explosive atmospheres caused by gases, vapours or mists in the air are unlikely to occur or, if they do occur, this will be very rarely and only for a short period of time (Zone 2).



Note:

The pump is not suited for utilisation in dusty areas.

The pumps (part number: 140160, 140160V, 140170, 140180 and 140190) with appropriate marking on pump and motor may be installed and operated in explosion hazard areas.

Please observe the information on gas group, temperature class as well as restrictions on speed, temperature range and additional instructions on the pump.

The pumps (part number: 11266/76, 11325, 11335, 11286, 11296, 170285A and 170722S, 15130016V01CZO and 15130025V01CZO) have an ATEX approval only for the pump interior (the process gas side of the pump). These pumps are not suitable for installation in explosion hazard areas.

3.1.1 Classification and marking of the pump

The pumps (part number: 140160, 140160V, 140170, 140180 and 140190) are marked as follows:

	II 3/3G Ex h IIC T4 (50 Hz) Gc / Ex h IIC T3 (50 Hz) Gc 12 °C ≤ Ta ≤ 40 °C
--	---

The pumps (part number: 11266/76, 11325, 11335, 11286, 11296, 170285A and 170722S, 15130016V01CZO and 15130025V01CZO) are marked as follows:

	II 3/-G Ex h IIC T4 (50 Hz) Gc II 3/-G Ex h IIC T3 (60 Hz) Gc 12 °C ≤ Ta ≤ 40 °C
--	--

ATEX categories

Explanation of the symbols

Table 1. Explanation of the symbols

Symbol	Explanation	
	ATEX logo	
„ .. / .. ”	Means that the product has two different categories	
” - ”	Means that part of the product does not comply with the standard and is not intended for use in an explosion hazard area.	
II 3/-G (Gc)	The pump can extract gases from zone 2, but must be installed outside explosion hazard areas.	
(i)/(o)	Specifies the category/conditions under which the inside (i) (i.e. parts of the equipment in contact with the process gas flow) and the outside (o) of the equipment are classified, where these differ.	
G	For areas with potentially explosive atmospheres caused by gases, vapours or mists in the air.	
h	This code letter applies to all non-electrical devices, regardless of which type of protection is used; see DIN EN ISO 80079-37: Non-electrical equipment for explosive atmospheres - Non-electrical type of protection constructional safety "c", control of ignition sources "b", liquid immersion "k"	
IIC	Explosion Groups	
T4, T3	Temperature class Example: Pumps with temperature class T3 may only be used to pump gases with an ignition temperature of more than 200 °C.	
	Temperature class	Maximum surface temperature (°C)
	T1	450 °C
	T2	300 °C
	T3	200 °C
	T4	135 °C
	T5	100 °C
	T6	85 °C
50 Hz, 60 Hz	For temperature class T4 the maximum permissible frequency is 50 Hz, for temperature class T3 the maximum permissible frequency is 60 Hz.	
Gc	The marking has now been supplemented by the level of protection of the equipment. This Equipment Protection Level (EPL) consists of two letters. The first letter indicates the type of explosive atmosphere: G for gas, D for dust. The actual protection level is defined by the letters a, b or c.	
Ta	Permissible ambient temperature for operating the pump: +12 °C ≤Ta≤ +40 °C.	

ATEX categories

Overview of equipment groups, categories, zones, and equipment protection levels (EPL)

EN ISO 80079-36		Directive 2014/34/EU		EN IEC 60079-10-X
EPL	Group	Equipment group	Equipment category	Zones
Ma	I	I	M1	Not applicable
Mb			M2	
Ga	II	II	1G	0
Gb			2G	1
Gc			3G	2
Da	III		1D	20
Db			2D	21
Dc			3D	22

3.1.2 Protective measures

Protection by housing		
Symbol	Zone	Adequate safety
ta	20	For rarely occurring errors
tb	21	For predictable errors
tc	22	For normal operations

Classifications of dusts	
IIA	Combustible flyings
IIB	Non-conductive dust
IIC	Conductive dust

Hot Surfaces



WARNING: HOT SURFACES

Risk of injury. Identifies a surface capable of inflicting burns through contact.

During normal operation of the pump, compression of the gases causes the surfaces to heat up resulting in hot surfaces. Tests have shown in the case of conforming operation of the pump (in accordance with these instructions) that at the inside of the pump which might come into contact with a potentially explosive atmosphere attains during operation with a 50 Hz motor a maximum temperature of less than 135 °C and during operation with a 60 Hz motor a maximum temperature of less than 200 °C.

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.

The outside of the pump may attain under these conditions a surface temperature of over 80 °C. The maximum temperature is in the case of operation with a 50 Hz motor less than 135 °C and in the case of operation with a 60 Hz motor less than 200 °C.

ATEX categories



Note:

Higher maximum surface temperatures can occur when filling and operating the pump with types of oil which differ from our oil LVO100. This is due to the frequently worse lubrication and cooling properties of such oil.

Hot exhaust gases



WARNING: HOT SURFACES

Risk of injury. Identifies a surface capable of inflicting burns through contact.

Due to the compression of the gases, the pump will produce in the case of normal operation hot exhaust gases. The exhaust gas temperatures do not exceed the maximum surface temperatures stated for the pump.

The exhaust gases need to be disposed of through a suitable exhaust gas system.

Mechanical sparks



WARNING: RISK OF EXPLOSION

Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.

During normal operation no mechanically produced sparks occur since the internal surfaces of the pump are covered with oil. The external fan and the fan cover are so designed that a sufficient clearance is maintained thereby excluding the possibility of a contact.



Note:

Sucking in of particles into the pump needs to be avoided so as to prevent the formation of hot spots due to friction.

Electric sparks



WARNING: DANGEROUS VOLTAGE

Risk of electric shock. Death or severe injury caused by an electric shock.

These can be caused by the electric motor and the accessories supplied with the pump. If the pump has been approved for operation in areas with an explosive atmosphere, then motor and supplied accessories have the same classification as the pump. Motor and accessories need to be installed and used in agreement with the enclosed manufacturer's information.

Static electricity



WARNING: DANGEROUS VOLTAGE

Risk of electric shock. Death or severe injury caused by an electric shock.

ATEX categories

The pump needs to be sufficiently grounded so as to avoid any electrostatic charging. This is attained when properly connecting the electric ground conductor to the motor. During normal operation no hazardous generation of charges will occur on the elastomer coupling or the fan. Wipe plastic parts on the pumps of category 3G outside only with a moistened piece of cloth. Only our original oil filters and gas inlet filters must be used since these have been designed such that proper connection to ground is ensured. Dust on the surfaces must only be removed using a moist piece of cloth so as to exclude the possibility of generating sparks.

Chemical reactions



WARNING: RISK OF EXPLOSION

Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.

The pump must not be used in connection with reactive or corrosive gases, which might result in an exothermal chemical reaction.

Additional safety measures

Overheating the pump can give rise to temperatures which exceed the maximum permitted surface temperature.

Maintain the correct oil level

In order to prevent overheating, installation and maintenance need to be done in accordance with the information provided in these Operating Instructions. Especially the correct oil level needs to be maintained.

The oil must be exchanged within the recommended interval or earlier if contaminated by the process gas.

Additional maintenance requirements

In those cases where dust can deposit itself on the pump or the motor surfaces, measures must be introduced which ensure that such deposits are removed on a regular basis.

In order to make sure that the defined safety level is complied with, use only our original spare parts.

In addition to the maintenance work described in the Operating Instructions every 15000 operating hours or every three years a complete refurbishment of the pump including a replacement of the bearings, the motor and the coupling element should be scheduled.

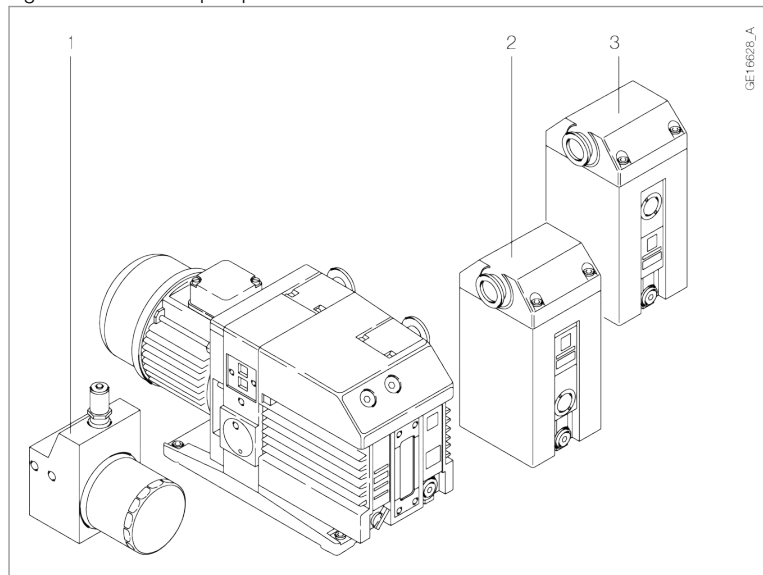
Description

4 Description

TRIVAC B pumps are oil-sealed rotary vane pumps. The TRIVAC D 16 B and D 25 B are dual-stage pumps. The number in the type designation (16 or 25) indicates the pumping speed in $\text{m}^3 \cdot \text{h}^{-1}$.

The vacuum pumps from the line TRIVAC B Category 3 have been designed and manufactured especially for the purpose of fulfilling the requirements of Equipment Group II, Category 3 of the "ATEX Directive" (2014/34/EU) for conforming utilisation of equipment and protection systems in explosion hazard areas".

Figure 1. TRIVAC B pump with accessories



- | | |
|----------------------------------|----------------------------|
| 1. Oil filter OF 4-25 | 2. Exhaust filter AF 16-25 |
| 3. Condensate Separator AK 16-25 | |

Area of application

Pumps are capable of pumping gases and vapours and evacuating vessels or vacuum systems down into with 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



WARNING: EXPLOSION HAZARD

Risk of injury or damage to the equipment. If only the inside of the pump (process side) has been certified for use in explosive atmospheres, then the pump itself must not be installed and operated within explosion hazard areas.

The inside (the process gas side) of this 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 therefore suited for operation under

Description

conditions under which it is unlikely that explosive atmospheres are caused by gases, vapours or mists in the air or should these occur then only rarely and for a short period of time (i.e. Zone 2). The same conditions apply to outside components of the pumps which have been certified.

Outside of the pump

Areas in which explosive atmospheres (gases, vapours or mists) in the air can occur are classified in three zones according to the frequency and the duration of the occurrence of an explosive atmosphere.

Zone 0, 1 and 2

These zones are designated as Zone 0, 1 and 2. The definitions for these zones are described in the Annex I of the "Atex Directives (Directive 99/92/EG) for the improvement of health protection and safety of staff which might be endangered by explosive atmospheres".

Responsibility of the operator

Conforming utilisation of the pumps and compliance with the statutory requirements of the ATEX operator directive (99/92/EG) is the responsibility of the operator.

Conforming utilisation of the D 40 B and D 65 B pumps and compliance with the statutory requirements of the ATEX operator directive (2014/34/EU) is the responsibility of the operator.

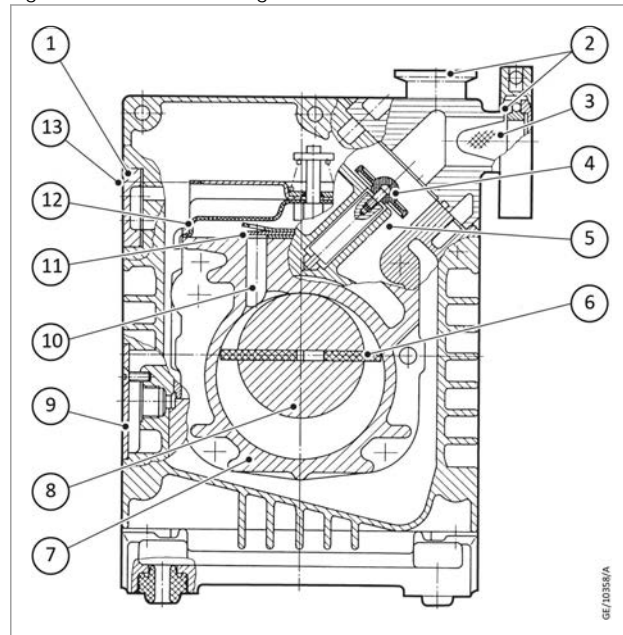
Drive concept

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

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

Description

Figure 2. Sectional drawing



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

4.1 Function

Refer to the [Figure: Sectional drawing of the pump](#). The rotor, mounted eccentrically in the pump housing, has two radially sliding vanes 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. The gas passes through the dirt trap sieve, flows past the open anti suckback valve 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. The oil entrained in the gas is coarsely trapped in the internal demister; there the oil is also freed of mechanical impurities. The gas leaves the pump 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 0) by turning the gas ballast knob ([Figure: Dimension drawings for the pumps](#)) on the front.

To enable the pump to be used at intake pressures as high as 1000 mbar, a special lubricating system was developed featuring force lubrication of the sliding bearings.

In the [Figure: Schematic of the lubricating system](#), an oil pump pumps the oil from the oil reservoir into a pressure lubrication system which supplies oil to all bearing points (2). From there the oil enters the pump chamber area of the 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 pump in two steps as described above. First, small droplets are coalesced into large drops in the internal demister ([Figure: Sectional drawing of the pump](#)) fitted above the exhaust valve. Then, the large drops fall into the oil reservoir as the exhaust gas is diverted by the inner walls of the oil case. Thus a low loss of oil is obtained. This and the large usable oil reservoir ensure long intervals between oil changes even at high intake pressures.

The vacuum is maintained by the pump through an integrated hydropneumatic anti suckback valve which is controlled via the oil pressure.

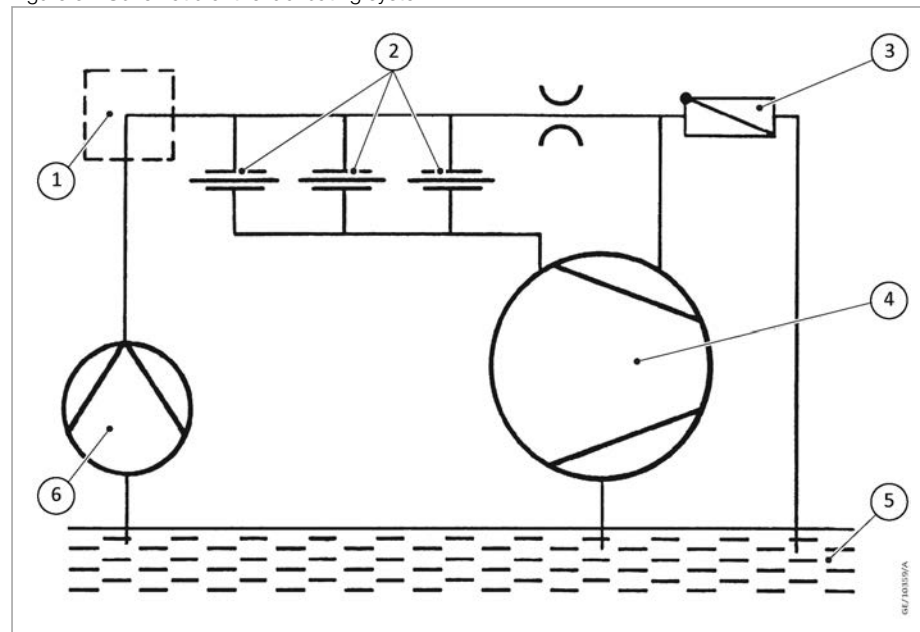
During operation of the pump the control piston ([Figure: Hydropneumatic anti-suckback valve](#)) remains sealed against a spring by the oil pressure. The valve disk of the anti- suckback valve is held at the lower position by its own weight (valve open). When the pump stops (because it has been switched off or because of a failure), the oil pressure drops and the spring presses the control piston up. Thus a connection is provided between the oil case or the oil reservoir and the piston of the anti suckback valve.

Due to the pressure difference between the oil case and the intake port the oil presses the piston up ([Figure: Hydropneumatic anti-suckback valve](#)) and the valve plate against the valve seat. The quantity of oil in the oil reservoir prevents the entry of air into the intake port ([Figure: Sectional drawing of the pump](#)) 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 ([Figure: Hydropneumatic anti-suckback valve](#)) against its seat. This effectively prevents backstreaming of oil or oil vapours. The anti-suckback valve ([Figure: Sectional drawing of the pump](#)) operates independently of the operating mode of the pump, i.e. also with gas ballast.

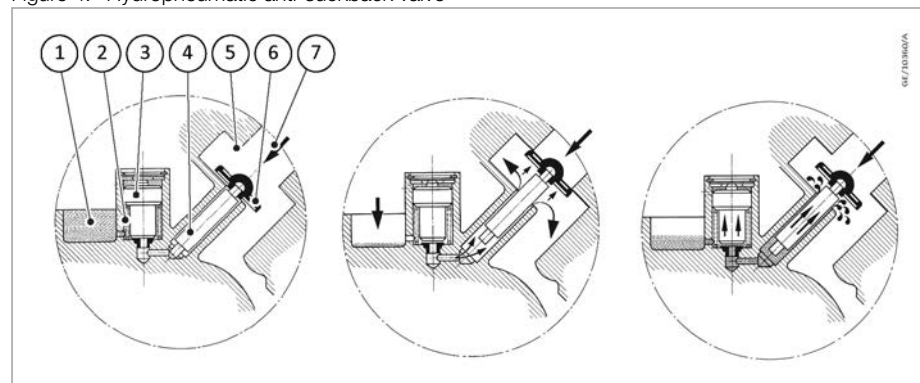
Description

Figure 3. Schematic of the lubricating system



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

Figure 4. Hydropneumatic anti-suckback valve



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

4.2 Lubricants

The standard pumps are ready for operation with mineral oil.

For operating a pump we specify pump oils which are supplied with the pumps.

4.3 Supplied equipment

The equipment supplied with the pump includes:

- Pump with motor
- 1 centering ring
- 1 centering ring with dirt trap

Description

- 2 clamping rings DN 25 KF (for D 16 B and D 25 B pump)
- Operating Instructions
- Spare Parts List

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

Upon delivery from our Cologne, the pumps will be filled with the following type of oil:

Table 2. Types of oil supplied

Part number	Oil	Accessories
11266/76	LVO100	-
11325/35	LVO100	-
11333	LVO210	-
140160/170	LVO100	-
140160V	LVO210	-
15130016V02CZO	LVO310	Solenoid valve (2/2-way, 24 V, d.c.) for gas ballast with angled screw-in connection for 8 mm outside hose diameter, oil drain with G1/8 plug on 240 mm long plastic hose
898199/199-1	L-1668-FM	Oil drain tap, cable with custom plug and pin assignment, adapter under the intake port for connecting the oil return with thread 9/16-18UNF-2B
898229	LVO100	Oil drain tap, intake port (40 KF) for connecting the oil return with thread 9/16-18UNF-2B, cable with custom plug and pin assignment
898698	LVO100	Oil drain tap
15130016V01CZO	LVO130	-
15130025V01CZO	LVO130	-

Technical data

5 Technical data

Table 3. Technical data

Parameter	Units	D 16 B two-stage	D 25 B two-stage
Nominal pumping speed *	m ³ h ⁻¹ (cfm)	18.9 (11.1)	29.5 (17.4)
Pumping speed *	m ³ h ⁻¹ (cfm)	16.5 (9.7)	25.7 (15.1)
Ultimate partial pressure without gas ballast *	mbar	10 ⁻⁴	10 ⁻⁴
	Torr	0.75 10 ⁻⁴	0.75 10 ⁻⁴
Ultimate total pressure without gas ballast *	mbar	< 2 10 ⁻³	< 2 10 ⁻³
	Torr	< 1.5 10 ⁻³	< 1.5 10 ⁻³
Ultimate total pressure with gas ballast *	mbar	< 5 10 ⁻³	< 5 10 ⁻³
	Torr	< 3.8 10 ⁻³	< 3.8 10 ⁻³
Water vapour tolerance *	mbar	25	25
	Torr	18.8	18.8
Water vapour capacity	g h ⁻¹	305	476
Oil filling, minimum/maximum	l	0.45/1.0	0.6/1.4
Noise level to DIN 45635 without/with gas ballast	dB (A)	54/56	54/56
Admissible ambient temperature **			
With continuous operations	°C	+5 to +40	+5 to +40
At startup	°C	+12 to +40	+12 to +40
Relative atmospheric humidity	%	Maximum 90	Maximum 90
Mains fusing ***	A	16	16
Weight	Kg	26	32
Connections, intake and exhaust side	DN	25 KF	25 KF

* In accordance with DIN 28 400 et seq. valid for LVO100. For other oils the ultimate pressure may differ.

** The motor may accelerate with a delay when simultaneously an under voltage 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.

*** Europe

Technical data

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

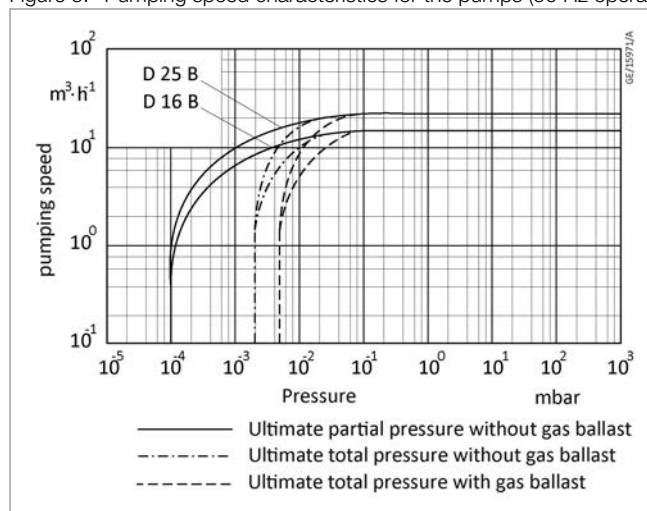
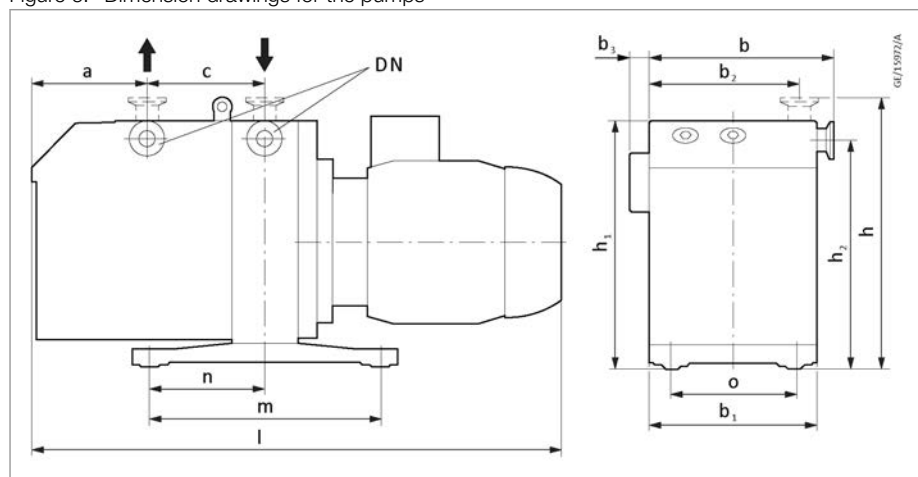


Figure 6. Dimension drawings for the pumps



All dimensions are in mm

Pump	DN	a	b	b ₁	b ₂	b ₃	c	h	h ₁	h ₂	m	n	o
D 16 B	25 KF	82	185	170	151	5.5	135	263	248	228	280	140	132
D 25 B	25 KF	142	185	170	151	5.5	135	263	248	228	280	140	132

Table 4. Pump motor data

Part number of the pumps	11266/76, 113 33	140 160/160V/170
Motor type	AMPH 80Z AA4	EeDA 80L/4
Motor L/N	6506939-IE3	100002330
Compliance certification number	CC#046A	PTB 02 ATEX 3115
IP rating	IP55	
Operating mode IEC34/Duty	S1	
Isolation class	F	

Technical data

Part number of the pumps	11266/76, 113 33	140 160/160V/170
Phase	3~	
Nominal efficiency (η) at nominal voltage:		
50 Hz and 100 % of nominal load	82.5 % (at 400 V)	-
50 Hz and 75 % of nominal load	83.0 % (at 400 V)	-
50 Hz and 50 % of nominal load	81.5 % (at 400 V)	-
60 Hz and 100 % of nominal load	85.5 % (at 460 V)	-
60 Hz and 75 % of nominal load	85.1 % (at 460 V)	-
60 Hz and 50 % of nominal load	83.1 % (at 460 V)	-
Efficiency class	IE3 Premium Efficiency Class	IE2 (Due to missing IE3 not for use in the US)
Manufacturer	Lafert SpA San Donà di Piave Italy	Emod Motoren GmbH Bad Salzschlirf Germany
Number of poles	4	
Nominal output power at 50 Hz	750 W	
Nominal output power at 60 Hz		
Nominal in frequency	50 Hz 60 Hz	50 Hz
Nominal voltage range and nominal current at 50 Hz	200-240 V / 3.8 A	-
	200 V / 3.8 A (IE3)	219-242 V / 3.4 A
	380-400 V / 1.9 A	-
	380-400 V / 1.9 A (IE3)	380-420 V / 1.95 A
Nominal voltage range and nominal current at 60 Hz	200-240 V / 3.8 A	-
	208-240 V / 3.4 A (IE3)	-
	380-480 V / 1.9 A	-
	416-480 V / 1.7 A (IE3)	-
Tolerances of voltage range*	±10 %	±5 %
Nominal speed at 50 Hz	1425 rpm	1405 rpm
Nominal m. speed at 60 Hz	1730 rpm	
Disposal	Local directives have to be considered	

Technical data

Part number of the pumps	11266/76, 113 33	140 160/160V/170
Maximum altitude above sea level	1000 m (NHN)	2000 m (NHN)
Maximum ambient temperature when operating*	40 °C	
T-board/plug	9 pins	6 pins
Certificates** of the motor		
Length of the pump	509 mm (D 16 B) 571 mm (D 25 B)	583 mm

Part number of the pumps	15130016V01CZO/ 15130025V01CZO	15130016V02CZO	11325/35
Motor type	LSES100L	E9SBC4AB-153	E9SF4AB3-100
Motor L/N	20015422	6533258	110001212
Compliance certification number	-		
IP rating	IP44	IP20	IP54
Operating mode IEC34/Duty	S1		H
Isolation class	F		
Phases	1~		
Manufacturer	Nidec, Moteurs Leroy-Somer 16015 Angoulême Cedex France	Hanning-Elektro-Werk GmbH & Co. KG 33813 Oerlinghausen Germany	
Number of poles	4	2	4
Nominal output power at 50 Hz	900 W	310 W	750 W
Nominal output power at 60 Hz	900 W	370 W	750 W
Nominal in frequency	50 Hz 60 Hz		
Nominal voltage range and nominal current at 50 Hz	230 V/5.5 A	100-120 V/7.4 A 200-240 V/3.8 A	208-252 V/5.7 A
Nominal voltage range and nominal current at 60 Hz	230 V/5.0 A	100-120 V/5.3 A 200-240 V/2.7 A	208-252 V/4.9 A
Tolerances of voltage range*	±5 %		

Technical data

Part number of the pumps	15130016V01CZO/ 15130025V01CZO	15130016V02CZO	11325/35
Nominal speed at 50 Hz	1470 min ⁻¹	1460 min ⁻¹	1420 min ⁻¹
Nominal speed at 60 Hz	1760 min ⁻¹	1750 min ⁻¹	1680 min ⁻¹
Disposal	Local directives have to be considered		
Maximum altitude above sea level	1000 m (NHN)	2000 m (NHN)	1000 m (NHN)
Maximum ambient temperature when operating*	40 °C		
T-board/plug	Mains cord (2 m) with shock-proof CEE plug	IEC-60320 C14	Multi-pin plug at the junction box Mains cord 20081091 (1.8 m) with Schuko plug CEE 7/7 (included in delivery) Mains cord 20081097 (1.8 m) with UK plug BS 1363 (optional) Mains cord 20081099 (1.8 m) with CH plug SEV 1011 (optional) Mains cord 20081141 (1.8 m) with US plug NEMA 6-15P (optional)
Certificates** of the motor	CE	CE	CE
Length of the pump	564 mm (D 16 B) 626 mm (D 25 B)	511 mm (D 16 B)	515 mm (D 16 B) 577 mm (D 25 B)

Part number of the pumps	898 199/199-1	898 229	898 698
Motor type	5K49PN4167	5K49UN4305AV	35R869R777G1
Motor L/N	72260135	72260156	72260187
Compliance certification number	-		
IP rating	-	-	IP44
Operating mode IEC34/Duty	Continuous		
Isolation class	B	F	
Phases	3~	3~	1~
Manufacturer	Marathon Electric Motors Wausau, WI 54401 USA		Baldor Electric Company Fort Smith, AR 72901 USA

Technical data

Part number of the pumps	898 199/199-1	898 229	898 698
Number of poles	4		
Nominal output power at 50 Hz	750 W	1100 W	750 W
Nominal output power at 60 Hz	750 W	1100 W	750 W
Nominal in frequency	50 Hz 60 Hz		
Nominal. voltage range and nominal current at 50 Hz	208-220 V	200-240 V/4.3-3.8 A	110 V/15 A
	380 V	380-415 V/2.5-2.4 A	220 V/7.5 A
Nominal voltage range and nominal current at 60 Hz	208-230 V/3.6 A	200-240 V/4.3-3.8 A	115 V/12.4 A
	460 V/1.7 A	380-415 V/2.5-2.4 A	208-230 V/6.3-6.2 A
Tolerances of voltage range*	±5 %		
Nominal speed at 50 Hz	1500 min ⁻¹	1425 min ⁻¹	1500 min ⁻¹
Nominal speed at 60 Hz	1725 min ⁻¹	1725 min ⁻¹	1800 min ⁻¹
Disposal	Local directives have to be considered		
Maximum altitude above sea level	1000 m above sea level	1000 m (NHN)	
Maximum ambient temperature when operating*	40 °C		
T-board/plug	Cable with custom plug	3 wires (L1, L2, L3) respectively Plug with assignment L1, L2, L3, GND	Multi-pin plug at junction box Mains cord (1.8 m) E72127877 with US plug NEMA 5-15P Mains cord (1.8 m) E72127878 with US plug NEMA 6-15P
Certificates** of the motor			
Length of the pump	536 mm (D 16 B)	610 mm (D 25 B)	582 mm (D 16 B)

* 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

Technical data

motor protection switch may respond. In this case the motor may be started again.

**** Key to the certificates:**

CSA certification mark for products certified in accordance with CSA for Canadian.	
UL certification mark for approved components for the USA.	
UL certification mark for energy efficiency for listed products and approved components for Canada and the USA.	

 Note:

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

6 Transportation and storage



WARNING: SUSPENDED LOAD

Risk of injury. 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 spilt oil.

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

The inlets and outlets of the pump must be sealed with the shipping seals which are provided upon delivery.

The gas ballast switch must be set to the "0" position and if the pump is to be shelved for a longer period of time it should be sealed in a PE bag containing some desiccant (silica gel).

When a pump is put into operation after it has been shelved for over one year, standard maintenance should be run on the pump and the oil should also be exchanged (see [Oil change](#) on page 53). We recommend that you contact our service team.

7 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 [Mechanical hazards](#) on page 10 to [Hazard caused by noise](#) on page 13.

7.1 Placement



CAUTION: TOPPLING HAZARD

Risk of toppling. The maximum tilt allowed for the pump is 10 degrees from the vertical. To firmly install the pump in place, insert bolts through bore holes (Ø 7 mm) in the rubber feet.

Pump marked as

	II 3/-G Ex h IIC T4 (50 Hz) Gc II 3/-G Ex h IIC T3 (60 Hz) Gc 12 °C ≤ Ta ≤ 40 °C
--	--

are not suited for installation in the explosion hazard areas.

Pumps marked as

	II 3/3G Ex h IIC T4 (50 Hz) Gc / Ex h IIC T3 (50 Hz) Gc 12 °C ≤ Ta ≤ 40 °C
--	---

may only be used in Zone 2.

If the pump (outside) has been certified for operation in areas with explosive atmospheres, the special information contained in the Operating Instructions for the electric motor for installation in explosive areas need to be complied with. Additional information is provided in the European standards EN 60079-14 "Electrical apparatus for explosive gas atmospheres Part - 14" and EN 60079-17 "Electrical apparatus for explosive gas atmospheres - Part 17".

Pay attention to the safety information [Danger of ignition](#) on page 13.

The pump can be set up on a flat, horizontal surface. Rubber feet under the coupling housing ensure that the pump can not slip. The site chosen should allow for a ready accessibility to connections and controls of the pump.



Note:

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 +12 °C (55 °F) (see [Operating temperature](#) on page 47).

For installation sites over 1000 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 maximum 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 overpressure to the pump's inlet. The maximum exhaust pressure must not exceed 0.5 bar (g).

7.2 Conforming utilization

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

Note:

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

Conforming utilisation of the D 16 B and D 25 B pumps and compliance with the statutory requirements of the ATEX operator directive (99/92/EG) is the responsibility of the operator.

Conforming utilisation of the D 40 B and D 65 B pumps and compliance with the statutory requirements of the ATEX operator directive (2014/34/EU) is the responsibility of the operator.

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

7.2.1 Non-conforming utilization

WARNING: HAZARDOUS SUBSTANCES



Risk of injury and damage to equipment. The pump is not suited for pumping radioactive and toxic substances, pyrophorous substances, corrosive gases & oxygen (or other highly reactive gases) at concentrations exceeding that of the atmosphere (> 21 % for oxygen).

Installation



CAUTION: MAINTENANCE SAFETY

Risk of injury and damage to equipment. The standard pump is not suited for pumping of hazardous gases or vapours.

When cleaning a system in which 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.



Note:

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

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.

Ignition temperatures of gases/vapours

- Pumps equipped with motors for 50 Hz operation are suited only for applications in which potentially explosive gas or vapour mixtures have an ignition temperature of over 135 °C.
- Pumps equipped with motors for 60 Hz operation, are suited only for applications in which potentially explosive gas or vapour mixtures have an ignition temperature of over 200 °C.
- The ignition temperatures of gases or vapours, sometimes also termed autoignition temperature can be taken from the material safety data sheets.
- The pump is not suited for operation with reactive, aggressive or corrosive gases, or gases with an oxygen share exceeding 21% by volume.

Potential ignition sources

An assessment of the ignition hazard was performed in accordance with the European standard EN ISO 80079-36 (EN ISO 80079-36 Non-electrical equipment for 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:

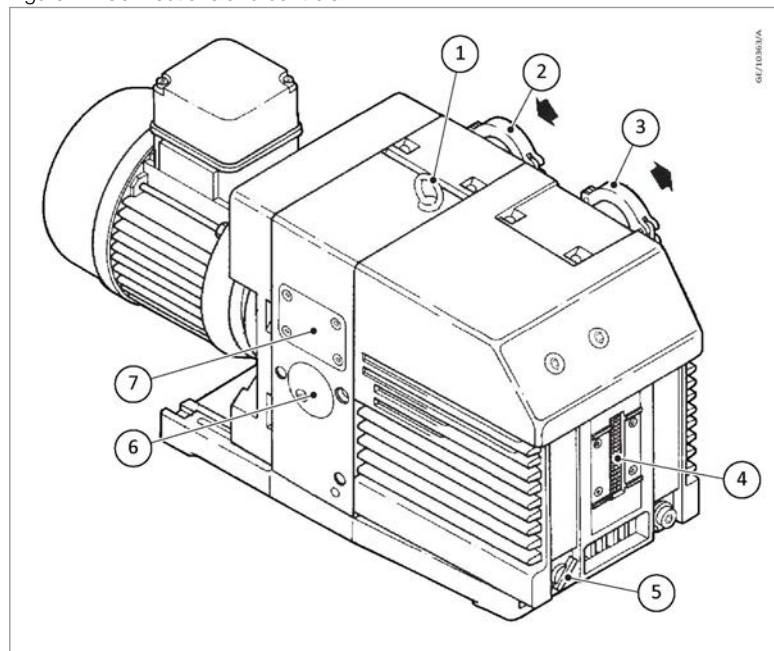
Table 5. Potential ignition source

Potential ignition sources	Remarks
Hot surfaces	Inside and outside due to gas compression, vane friction etc.
Hot gases	Are produced within the pump and ejected at the exhaust
Mechanical sparks	▪ Will not occur during normal operation - the surfaces within the pump are covered with oil, sufficient clearances outside the pump. ▪ For pumps with category 3/3G: Coupling according to EN ISO 80079-37 Protection by Design Safety "C".

Installation

Potential ignition sources	Remarks
Electric sparks	Outside the pump due to motor, accessories
Static electricity	▪ Possible, provided conducting parts of the pump are not connected to ground; ▪ Possible, by dry wiping of plastic parts. ▪ During operation the handle of category 3/3G pumps must be pushed-in.
Chemical reactions	Possible with the process liquid or the process gas.

Figure 7. Connections and controls



- | | |
|---------------------------------------|-----------------------------|
| 1. Eye bolt for moving the pump | 2. Intake port |
| 3. Exhaust port | 4. Oil-level glass |
| 5. Gas ballast knob (0 = OFF, I = ON) | 6. Connection for Inert gas |
| 7. Connection for CF, OF | |

7.3 Connection to the system

Before connecting the pump, remove the shipping seals from the connection flanges ([Figure: Connections and controls](#)).

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

The pump is shipped with intake and exhaust flanges mounted for horizontal connection of the connecting lines. You can easily convert the ports for vertical connection by removing the four cap screws, rotating the flanges as required, and reinstalling the cap screws. Connect the intake and exhaust lines with a centering ring and a clamping ring each. Use the centering ring with dirt trap for the intake port.

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

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

Installation

The maximum throughput of the pump is equivalent to the pumping speed of the pump (see [Technical data](#) on page 26).

Note the specified cross sections for the connection lines



WARNING: EXHAUST PIPELINE BLOCKAGE

Risk of injury and damage to the equipment. 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 make sure that there are no obstructions.

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

Avoid backflowing condensate



NOTICE: AVOID BACKFLOWING CONDENSATE

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

Safely lead the exhaust gases away



WARNING: EXHAUST EMISSION HAZARD

Risk of injury. 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 (see [Accessories](#) on page 69). Depending on the type of application or the kind of pumped media, the corresponding regulations and information sheets must be observed.



Note:

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 pump 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 ([Figure: Connections and controls](#)) can be removed to gain access to this M 16 x 1.5 threaded port. Matching connectors are available (see [Accessories](#) on page 69).

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).

7.4 Electrical connections

Risk due to high voltages



WARNING: DANGEROUS VOLTAGE

Risk of death or severe injury. 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 [Electrical hazards](#) on page 10.

7.4.1 Pump with single-Phase AC motor



WARNING: OPERATION SAFETY

Risk of damage to the pump. Pump* not equipped with an On/Off switch, must be used with the specified leak detection instrumentation.

** Pump P/N 15130016V02CZO is not equipped with On/Off switch.*

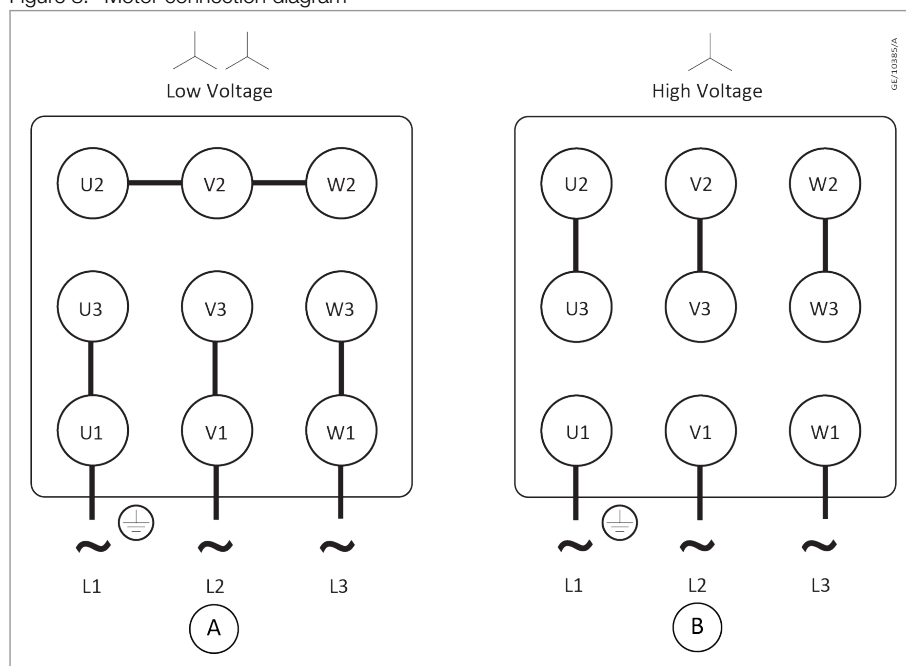
Pumps equipped with a single-phase AC motor may be connected directly to the mains via the mains cord and the mains plug. Fusing must always be done in accordance with the national and local regulations for single phase mains (in Germany 16 amps, for example). The direction of rotation need not be checked as it is fixed. The motor is protected against overloading by a thermal overload switch with automatic resetting.

Part number 898698 may be operated using the corresponding mains cord at a lower or higher voltage.

Installation

For motor P/N: 6506939

Figure 8. Motor connection diagram



To reverse running invert L1 and L2

A. 200-240 V 50/60 Hz

B. 380-400 V 50 Hz, 416-480 V
60 Hz

7.4.2 Pump with Three-Phase AC Motor

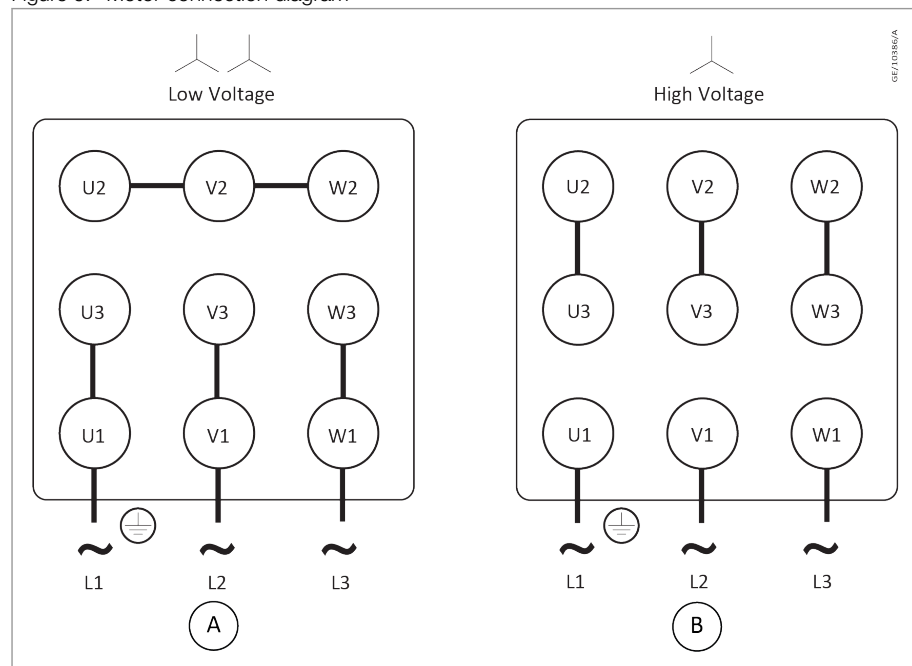
Pumps with a three-phase motor are supplied without accessories for electrical connection. They must be connected via the appropriate cable, and a suitable motor protection switch.

When operating the unit at its operational limits (at an ambient temperature of 12 °C and at under voltage, 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, frequency controlled start-up, 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 (example: a blank flange) is sucked on at the intake port. If not, interchange two phases of the connection. Observe the direction arrow on the intermediate flange. In the case of custom pumps please note the information provided on a separate sheet.

For motor P/N: 6520730

Figure 9. Motor connection diagram



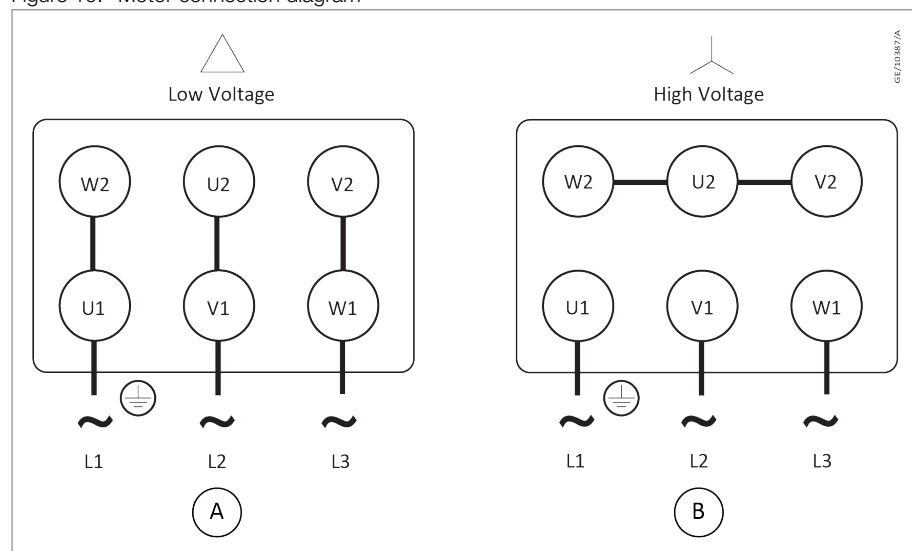
A. 200-220 V 50/60 Hz

B. 346 V 50 Hz, 380 V 60 Hz

To reverse running invert L1 and L2

For motor P/N : 100002330

Figure 10. Motor connection diagram



A. 219-242 V 50 Hz

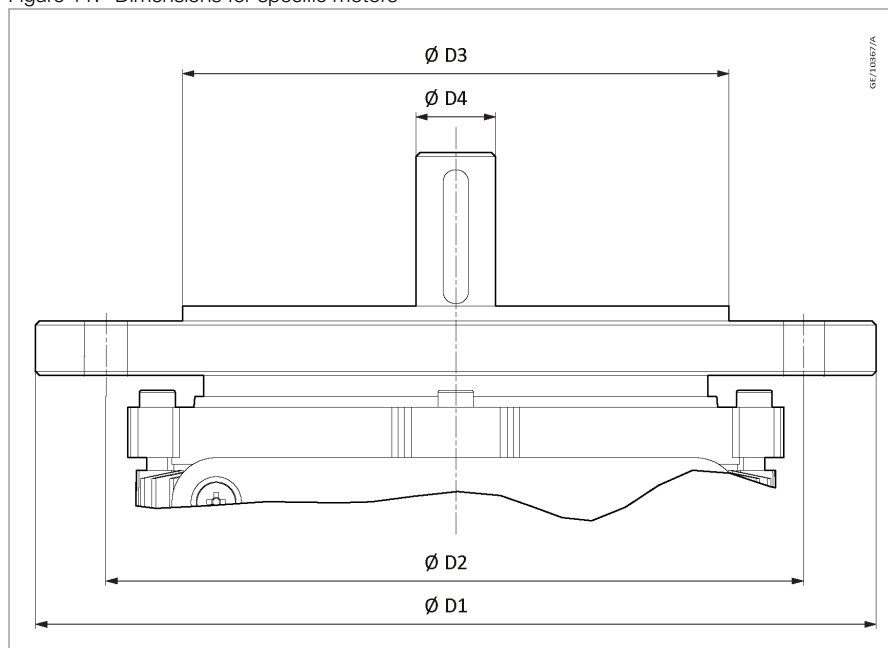
B. 380-420 V 50 Hz

To reverse running invert L1 and L2

Part numbers 898199, 898199-1, and 898229 are equipped with custom plugs and for this reason must be connected only to the systems specifically specified for these pumps.

Installation

Figure 11. Dimensions for specific motors



All dimensions are in mm

7.5 Connecting the ATEX motor

NOTICE: INSTALLATION SAFETY



When a motor is fitted by the customer, the operator will be responsible for selecting and operating the motor. Mounting the motor has an influence on the operation and reliability of various pump components, especially the coupling. Not complying with the technical data and installation information given hereinafter will void CE and ATEX conformity resulting in a rejection of any warranty claims.

Pumps can also be ordered without a connected motor.

The ATEX category for the outside area can change depending on the type of motor. Use only such motors which are approved for the respective category.

Table 6. Specific motor data

Specific motor data	Indicator	Units	D16B	D25B
Type			1-ph./3-ph.motor	1-ph./3-ph.motor
Model*			IM B14	IM B14
Size*			80	80
Flange				
Nominal power rating**	P	kW	0.55/0.75	0.75
Maximum rpm	n	1/min	1500 (T4)/1800 (T3)	1500 (T4)/1800 (T3)
Flange outside $\varnothing$	D1	mm	160	160

Installation

Specific motor data	Indicator	Units	D16B	D25B
Pitch circle $\varnothing$ screws	D2	mm	130	130
Screw size	M	-	M8	M8
Number of screws	N	-	4	4
Centering $\varnothing^{**}$	D3	mm	110j6	110j6
Shaft Journal, motor**	D4	mm	19j6	19j6

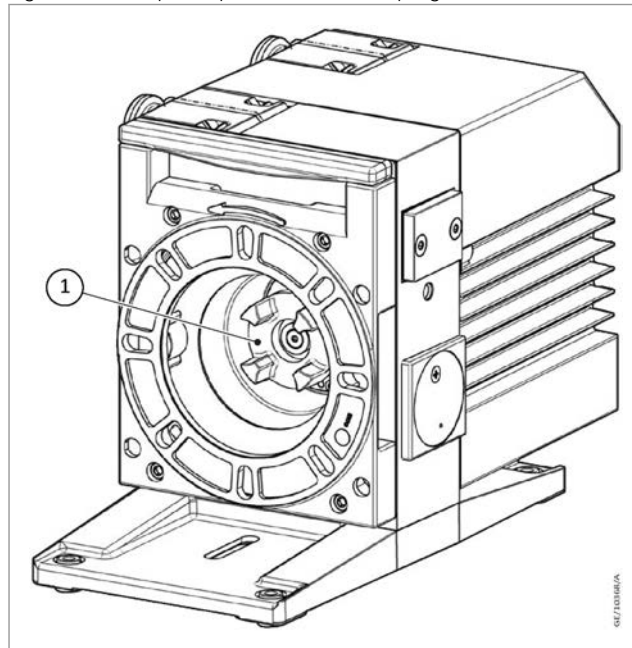
* Motor IAW EN 60034-1, EN 60034-7

** Motors with standardized dimensions and power ratings IAW EN 50347.

The fitting of a motor has to comply with the regulations of EN 60204-1 "Safety of machinery

Electrical equipment of machines - Part 1: General requirements".

Figure 12. Pump with pre-assembled coupling half



1. Coupling half, pre-assembled

7.5.1 General Installation Information

Make sure that the respective motor complies with the information given in the corresponding Table (see [Figure: Dimensions for specific motors \(cf. table below\)](#)).

For mounting the motors only use original parts supplied by us.

- Intermediate flange and gasket
- Motor coupling half
- Coupling element
- Screws

Installation

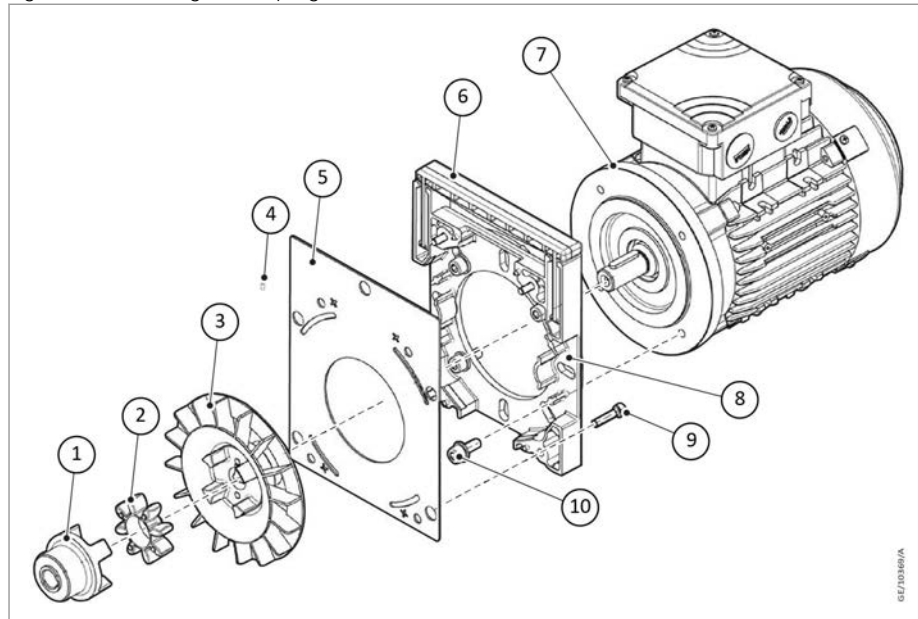


Note:

All mating surfaces and centering surfaces must be clean, undamaged and free of any paint residues.

Only air cooled motors must be used. The fan on the side of the motor is also required to cool the pump housing. If this air cooling arrangement is not present, then the surface temperatures may under certain circumstances exceed the permissible temperature range for the pump (T3, T4).

Figure 13. Mounting the coupling half at the motor



- | | |
|---------------------------------------|------------------------|
| 1. Pump coupling half (pre-assembled) | 2. Coupling element |
| 3. Motor coupling half with fan | 4. Set screw M5 |
| 5. Gasket | 6. Handle |
| 7. Motor | 8. Intermediate flange |
| 9. Screw M6 (5.5 Nm) | 10. Screw M8 (12.5 Nm) |

7.5.2 Fitting the coupling



CAUTION: MECHANICAL SPARK

When not complying with this requirement there exists the likelihood of a mechanical contact and thus the creation of sparks between the coupling halves.

The pump is supplied by us with the coupling (see [Figure: Pump with preassembled coupling half](#)) pre-assembled on the pump's shaft. Enclosed there are the coupling half (see [Figure: Mounting the coupling half at the motor](#)) for the motor side and the coupling element. Some pump types show a fan wheel at the coupling half of the motor side.

Tighten the M8 screws to mount the intermediate flange to the motor flange. Check to make sure that the handle has been correctly fitted within the intermediate flange. Fit the gasket (see [Figure: Mounting the coupling half at the motor](#) as well as for the torques).

Check the shaft journal and the shim ring for any damage.

Lightly grease shaft journal and the bore in the coupling half.

Installation

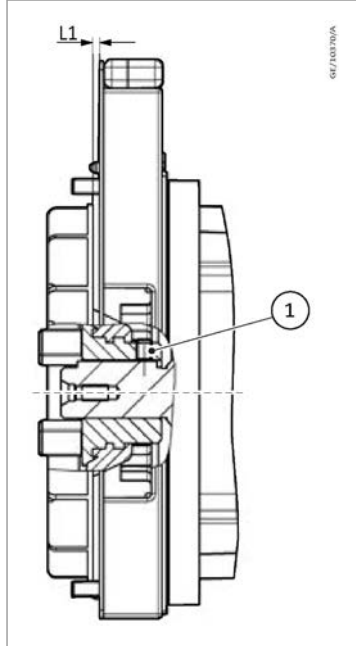
Warm the coupling half (to approximately 80 °C) and push, respectively press it on to the shaft journal.

The bores in the coupling are manufactured to tolerance class H7, the shaft journals of the motor to tolerance classes j6 resp. k6.

The axial distance L1 needs to be maintained (see [Figure: Checking the axial distance of the coupling](#)).

Affix the coupling half with the M5 set screw (torque = 2 Nm).

Figure 14. Checking the axial distance of the coupling



1. Set screw M5 / Torque 2 Nm

$L1 = 2.4 \pm 0.2$ mm axial distance between fan and gasket

7.5.3 Motor installation

- The bolts which must be used have been enclosed with the pump.
- Insert the coupling element into the coupling half of the pump side.
- Align the coupling halves and mount the intermediate flange (with motor), ensuring that the flange surfaces run in parallel. Any tilt of the motor axis will lead to an increased wear of the spider.
- Fit and tighten the bolts (see [Figure: Mounting the coupling half at the motor](#) for torque).

7.5.4 Electrical Connection

Connect the motor according to section [Electrical connections](#) on page 39 and to the information of the manufacturer of the respective motor.

8 Operation

8.1 Media compatibility

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

8.2 Start-up



WARNING: OPERATION SAFETY

Risk of injury or damage to the pump. Before starting the pump make sure that the pump and the fitted accessories meet the requirements of your application and that safe operation can be guaranteed.



WARNING: VACUUM HAZARD

Risk of exposure to the vacuum. 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 [Mechanical hazards](#) on page 10.

Check the direction of rotation before starting the pump for the first time and after each change in the electrical connection (see [Electrical connections](#) on page 39). 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 approximate 30 minutes with the intake line closed and the gas ballast valve ([Figure: Connections and controls](#)) open.

Note:

Each time before starting up check the oil level. The pump must never be operated with an oil level below the minimum. Open all valves blocking the exhaust lines. The pump must never be operated with a blocked or constricted exhaust line.

8.3 Operating media and temperature

Pumps can pump condensable gases and vapours, provided that the gas ballast valve ([Figure: Dimension drawings for the pumps](#)) 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 over pressures 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 make sure that there are no obstructions.

8.3.1 Pumping of non-condensable gases and vapours

If the process contains mainly permanent gases, the pump 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 [Pumping of condensable gases and vapours](#) on page 47.

8.3.2 Pumping of condensable gases and vapours

With the gas ballast valve open (position I) and at operating temperature, 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 make sure that the gas ballast valve is open and that the pump has been warmed up for approximately 30 minutes with the intake line closed.

Pumping of Vapours



Note:

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 pump in this mode for about 30 minutes after completion of the process.

In cyclic operation, the pump 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 (example, during drying), the gas ballast valve can be closed to improve the attainable ultimate pressure.

8.3.3 Operating temperature



WARNING: HOT SURFACE

Risk of burns. Do not touch the pump when it is in operation. Few surfaces of the pump can reach a temperature of up to 80 °C (176 °F). Check for warning labels on the pump. Observe Safety Information [Thermal hazards](#) on page 11.

Proper operation of the pump 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).

If due to the ambient conditions this temperature range is to be exceeded at either end of the range, contact our sales.

The motor may accelerate with a delay when simultaneously an under voltage 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.

Operation

8.4 Shutdown



CAUTION: OPERATION SAFETY

Risk of damage to the equipment. 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 [Pumping of condensable gases and vapours](#) on page 47).

If the pump was exposed to aggressive and corrosive media, we recommend that you let the pump continue to operate even during long non- working intervals (example: 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.

If the pump 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



WARNING: HAZARDOUS SUBSTANCES

Risk of injury or damage to the pump. 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 [Hazards caused by materials and substances](#) on page 11.

Drain the oil (see [Oil change](#) on page 53).

- 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 "maximum" mark.
- Seal the connection ports. Special conservation or anti-corrosion oils are not necessary.
- Please also take note of the information given in Section [Transportation and storage](#) on page 33.

8.4.1 Controller/mains power failure



WARNING: AUTOMATIC RESTART AFTER VOLTAGE FAILURE

Risk of injury or damage to equipment. 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.

9 Maintenance



WARNING: DANGEROUS VOLTAGE

Risk of electric shock. 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 [Electrical hazards](#) on page 10.
- 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 10000 h (life cycle category B according 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 [Confirming utilization](#) on page 35, ascertain the nature of hazard and take adequate safety measures. Observe Safety Information [Hazards caused by materials and substances](#) on page 11.

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

Due to the design concept, 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 [Maintenance plan](#) on page 50.



Note:

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.

We offer practical courses on the maintenance, repair, and testing of pumps. Further details are available from us on request.



Note:

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

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

Maintenance

9.1 Maintenance plan

Table 7 Maintenance plan

Action	Measure / Test Quantity Option / Auxiliary Materials	Interval	Remarks
Operate the pump for at least 1 hour with gas ballast.		Daily	Condensed water is thus removed from the oil
Check the oil level, if required change the oil.	Oil: LVO100 or special and alternative oils see Lubricants on page 24	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	▪ 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. ▪ 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.

Maintenance

Action	Measure / Test Quantity Option / Auxiliary Materials	Interval	Remarks
Check the edges of the teeth on the coupling element for any damages, change the coupling element as required.	-	Annually	-
Change the oil.	Oil: LVO100	Annually	Oil change: - First oil change after 100 operating hours. - Pump switched off and cold. Exchange the oil while the pump is cold so as to avoid releasing adsorbed gases.
Clean the oil level glass.	Suitable cleaning agent and compressed air.	Annually	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 on page 26
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 make sure 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 should be done by our service team.

Maintenance

9.2 Monitoring the oil level



CAUTION: MAINTENANCE SAFETY

Risk of damage to the equipment. Check and top up oil only after having shut down the pump first. Please note the safety information given in Sections [Thermal hazards](#) on page 11 and [Hazards caused by materials and substances](#) on page 11.

During operation of the pump the oil level must always remain between marks ([New Topic \(115\)](#) on page 54) on the oil-level glass. The amount of oil must be checked and topped up as required.

Pumps which have not directly been delivered from us, example: in systems, may have been filled with oils different from LVO100. In this case a refill with LVO100 may cause problems. Therefore check before the refill the kind of oil in the pump and fill in only suitable oil or change the oil.

P/N 15130016V02CZO is delivered with PAO oil LVO310.

When operating the pump 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.

9.2.1 Checking the condition of the oil

The ageing process for the standard operating fluid (see [Lubricants](#) on page 24) 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 LVO100 oil is determined according to DIN 51558. If it exceeds 2, the oil should be changed.

c) Viscosity check

If the viscosity of LVO100 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 approximate 30 minutes 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 ([New Topic \(115\)](#) on page 54) into a beaker or similar.

Please note the safety information given in Section [Oil change](#) on page 53.

9.3 Oil change

WARNING: HAZARDOUS SUBSTANCES



Risk of injury or damage to the pump. 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 make sure that all necessary safety precautions are taken. Use gloves, face protection or a respirator, for example: Observe Safety Information [Thermal hazards](#) on page 11 and [Hazards caused by materials and substances](#) on page 11.

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.



WARNING: HOT SURFACE

Risk of burn. 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.

Note:

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.

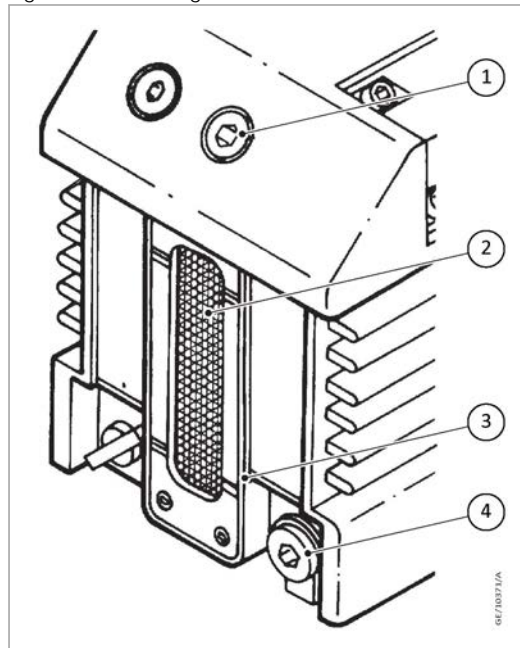
The oil should be changed after the first 100 operating hours and then at least every 2000 – 3000 operating hours or after one year. At high intake pressures and intake temperatures and/or when pumping contaminated gases, the oil will have to be changed much more frequently.

Further oil changes should be made before and after long-term storage of the pump. If the oil becomes contaminated too quickly, install a dust filter and/or oil filter (see [Accessories](#) on page 69).

Contact us for more information.

Maintenance

Figure 15. Oil change



- | | |
|-----------------------------|-----------------------------|
| 1. Oil-fill plug | 2. Oil-level mark "maximum" |
| 3. Oil-level mark "minimum" | 4. Oil-drain plug |

Required tool: Allen key 8 mm.

- Remove the oil-drain plug, [New Topic \(115\)](#) on page 54 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 (maximum 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, and fill in fresh oil.
- Screw the oil-fill plug, back in.
- The tightening torque for the bolts, 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.

 Note:

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

9.4 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 [Figure: Sectional drawing of the pump](#) 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.

**Note:**

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.

9.5 Removing and fitting the internal demister

Required tools: Allen keys size 5 and 8 mm

- Required spare parts:

Gasket for oil case	For material number, see spare parts list
Internal demister	For material number, see spare parts list

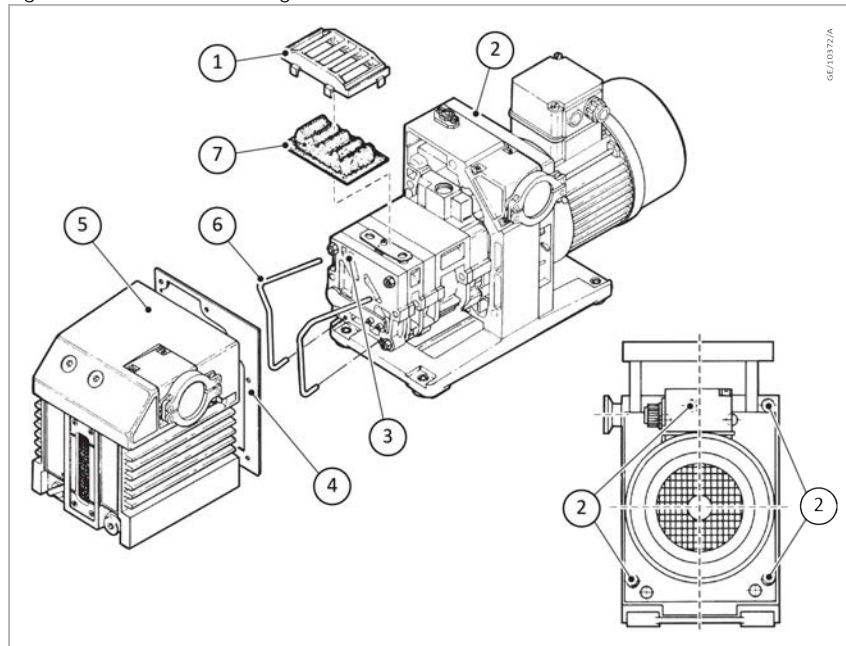
The internal demister is spring-mounted in a frame. When it is clogged, it rises periodically to reduce the pressure difference created. The resultant noise at high intake pressures indicates that the internal demister is dirty.

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 [Oil change](#) on page 53).
- Remove the four recessed screws on the oil case ([Figure: Removal and fitting of the internal demister](#)). Do not remove the non-recessed screws; they hold the motor flange in place and need not be removed.
- Pull the oil case forward off the pump.
- Remove the gasket.
- Press the spring buckles sideways away from the frame.
- Lift off the frame and remove the internal demister.
- 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 is 8 Nm.

Maintenance

Figure 16. Removal and fitting of the internal demister



- | | |
|-----------------------|-----------------------|
| 1. Frame for demister | 2. Hex. socket screws |
| 3. Silencing nozzle | 4. Gasket |
| 5. Oil case | 6. Spring buckles |
| 7. Demister | |

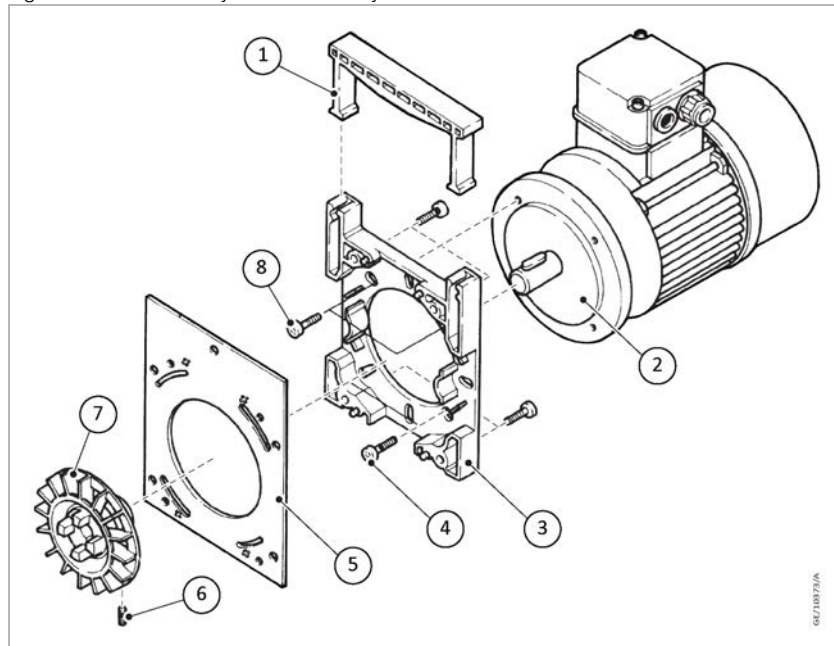
9.6 Disassembly and reassembly of the electric motor



WARNING: DANGEROUS VOLTAGE

Risk of electric shock. Before starting work, must disconnect the motor from the power supply. Observe safety information given in [Electrical hazards](#) on page 10 .

Figure 17. Disassembly and reassembly of the electric motor



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

Required tools

Tool	Size
Screwdriver	1.0 x 5.5 mm (for junction box)
Open-jaw wrenches	7 mm and 19 mm (for junction box)
Allen keys	3 mm, 5 mm and 6 mm
Possibly a puller for the coupling	-

- Place the pump on its front side.
- Disconnect the pump from the mains.
- Unscrew the four non-recessed hex. socket screws ([Figure: Disassembly and reassembly of the electric motor](#)).
- Remove the intermediate flange together with the electric motor.
- Remove the handle.
- Loosen the threaded pin and pull the coupling with the fan blade off the motor shaft.
- Remove the gasket.
- Unscrew the hex. socket screw.
- Remove the electric motor.
- Clean all parts and check that they are in perfect condition; if not, replace them with new parts.
- Reassemble in the reverse order.

9.6.1 Checking the coupling

Here the backlash between coupling cams and the flexible spider must be checked by a feeler gauge (see [Figure: Checking the wear limit](#)).

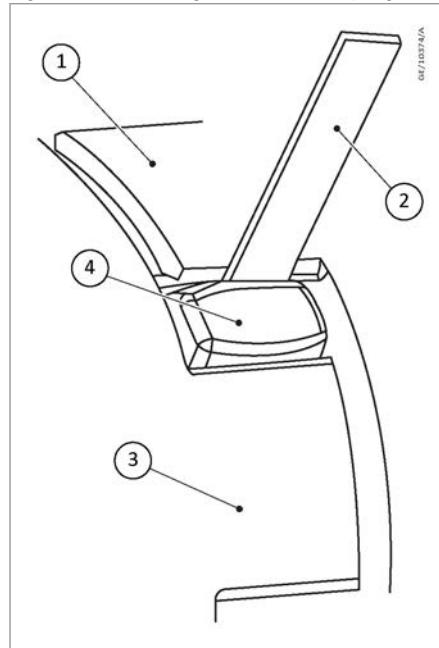
Maintenance

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

The wear limit 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 attached Operating Instructions of the manufacturer.

Figure 18. Checking the wear of coupling



- 1. Hub 1
- 3. Hub 2

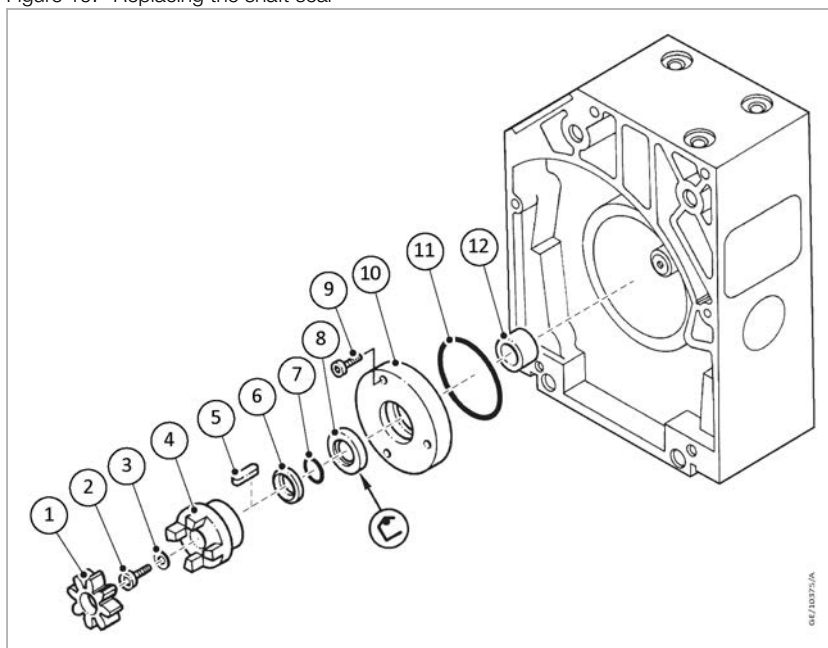
- 2. Feeler gauge
- 4. Spider

9.7 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

Figure 19. Replacing the shaft seal



- | | |
|---------------------|------------------------|
| 1. Coupling element | 2. Cylinder head screw |
| 3. Spring washer | 4. Coupling (one half) |
| 5. Key | 6. Compression ring |
| 7. O-ring | 8. Shaft seals |
| 9. Screws | 10. Horn centre |
| 11. O-ring | 12. Bush |

Note the position of the shaft sealing ring

Required spare parts:

Parameter	Value
1x Shaft seal Figure: Replacing the shaft seal on page 59	For material number, see spare parts list
Bushing	For material number, see spare parts list

The pump 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 as follows:

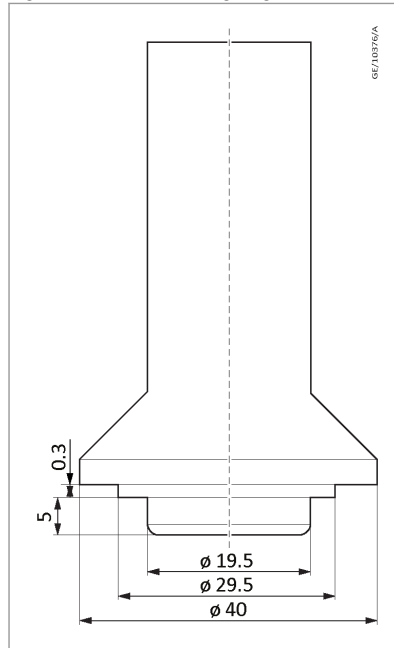
- Shutdown the pump.
- Drain the oil (see [Oil change](#) on page 53).
- Support the motor.
- Unscrew the four non-recessed hex. socket screws ([Figure: Disassembly and reassembly of the electric motor](#)) and remove the motor.
- Remove gasket.
- Remove coupling element.
- Unscrew screw ([Figure: Replacing the shaft seal](#) on page 59) and remove the spring washer.
- Pull off the coupling half.
- Remove key.
- Pull off the compression ring and O-ring.

Maintenance

- Unscrew the hex. socket screws and pull out the centering disc.
- If the centering disc does not come loose, use the forcing thread into which screws can be screwed in.
- Remove the O-ring.
- Force the shaft seal out of the centering disk.
- Pull off the bushing from the shaft.

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

Figure 20. Shaft sealing ring driver



All dimensions are in mm.

Bottom: centering disk with shaft sealing ring

Shaft sealing ring drive

Before fitting the new shaft seal, moisten it slightly with a little vacuum pump oil. Using a suitable plastic or aluminium cylinder (shaft seal driver) and a plastic hammer, force the shaft seal ([Figure: Replacing the shaft seal](#) on page 59) carefully and without bending it into the centering disk (for position of shaft seal, see [Figure: Replacing the shaft seal](#) on page 59).

- The shaft seal must not be bent.
- Push the bushing ([Figure: Replacing the shaft seal](#) on page 59) on to the shaft.
- Insert the O-ring into its groove.
- Carefully push the centering disk with the shaft seal onto the shaft and up against the end plate; fasten it with the screws.
- Push the O-ring and the compression disc on to the shaft.
- Insert the key.
- Check the coupling, replace if required. To check the coupling note the information provided in Section [Checking the coupling](#) on page 57.
- Mount the pump-half of the coupling on the shaft.
- Install the spring washer and tighten the screw.
- Insert the coupling element into the coupling and mount the motor, refer to [Disassembly and reassembly of the electric motor](#) on page 56.

9.8 Removing and remounting the pump module

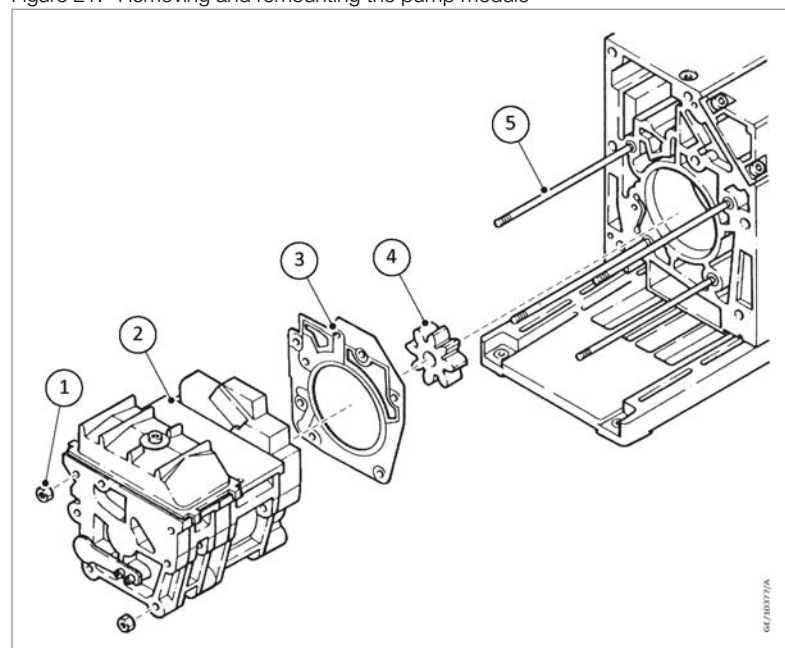
Required tools:

- Allen keys size 3, 4, 6 and 8 mm.
- Box wrench size 8 and 13.
- Possibly pliers, torque wrench.

Required spare parts:

Parameter	Value
Gasket Figure: Removing and remounting the pump module	For material number, see spare parts list

Figure 21. Removing and remounting the pump module



- | | |
|--------------|---------------------|
| 1. Hex. nuts | 2. Pump module |
| 3. Gasket | 4. Coupling element |
| 5. Tie rods | |

9.8.1 Removing the pump module

- Drain the oil and remove the oil case (see [Removing and fitting the internal demister](#) on page 55 and [Removing and fitting the internal demister \(D 40 B and D 65 B pumps\)](#)).
- Unscrew the hex. nuts (see [Figure: Removing and remounting the pump module](#)).
- Pull the entire pump module forward off the tie rods.

Note:

When doing so, make sure 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 (see [Figure: Removing and remounting the pump module](#)).
- Remove the coupling element.

Maintenance

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.

9.8.2 Remounting the pump module

- When installing a new pump module, it is also advisable to use a new gasket (see [Figure: Removing and remounting the pump module](#)).
- Check the coupling element 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 onto the tie rods, push the coupling element onto one coupling half.
- Push the entire pump module (new or repaired) onto the tie rods.



Note:

Screw on the hex. nuts and carefully cross-tighten them (torque 8 Nm in D 16 B and D 25 B pumps & 17.5 in D 40 B and D 65 B pumps).

Mount the oil case together with the gasket. Fill in oil.

10 Fault Finding

Fault **Table: Fault finding**

Table 8. Fault finding

Condition
<i>Pump does not start</i> on page 63
<i>Pump does not reach ultimate pressure</i> on page 64
<i>Pumping speed is too low</i> on page 64
<i>After switching off the pump under vacuum, pressure in the system rises too fast</i> on page 64
<i>Pump gets hotter than usually observed</i> on page 64
<i>Oil in the intake line or in the vacuum vessel</i> on page 65
<i>Oil is turbid</i> on page 65
<i>Pump is excessively noisy</i> on page 65

Fault **Pump does not start**

Cause	Wiring is malfunctioning.
Remedy	Check and repair wiring.
Cause	Motor protection switch incorrectly set (three-phase motors only).
Remedy	Set motor protection switch properly.
Cause	Operating voltage does not match motor.
Remedy	Replace the motor.
Cause	Motor is malfunctioning.
Remedy	Replace the motor.
Cause	Oil temperature is below 12 °C.
Remedy	Heat the pump and pump oil or use a different oil.
Cause	Oil is too thick.
Remedy	Change the oil.
Cause	Exhaust filter/exhaust line is clogged.
Remedy	Replace the filter or clean the exhaust line.
Cause	Pump is seized up (pump is jammed).
Remedy	Repair the pump.

Fault Finding

Fault Pump does not reach ultimate pressure	
Cause	Measuring technique or gauge is unsuitable.
Remedy	Use correct measuring technique and gauge. Measure the pressure directly at the pump's intake port.
Cause	External leak*.
Remedy	Repair the pump.
Cause	Anti-suckback valve is malfunctioning.
Remedy	Repair the valve
Cause	Exhaust valve is malfunctioning.
Remedy	Repair the valve
Cause	Oil is unsuitable.
Remedy	Change the oil (degas it, if necessary).
Cause	Vacuum lines are dirty.
Remedy	Clean the vacuum lines.
Cause	Pump is too small.
Remedy	Check the process data, replace the pump, if necessary.

Fault Pumping speed is too low	
Cause	Inlet screen in the intake port is clogged.
Remedy	Clean the inlet screen. Precaution: install a dust filter in the intake line
Cause	Exhaust filter is clogged.
Remedy	Install new filter element.
Cause	Connecting lines are too narrow or too long.
Remedy	Use adequately wide and short connecting lines.

Fault After switching off the pump under vacuum, pressure in the system rises too fast	
Cause	System has a leak.
Remedy	Check the system.
Cause	Anti-suckback valve is malfunctioning
Remedy	Repair the valve.

Fault Pump gets hotter than usually observed	
Cause	Cooling air supply is obstructed.
Remedy	Set pump up correctly.

Fault Finding

Cause	Ambient temperature is too high.
Remedy	Set pump up correctly.
Cause	Process gas is too hot.
Remedy	Change the process.
Cause	Oil level is too low.
Remedy	Add oil.
Cause	Oil is unsuitable.
Remedy	Change the oil.
Cause	Oil cycle is obstructed.
Remedy	Clean or repair the oil lines and channels.
Cause	Exhaust filter/exhaust line is obstructed.
Remedy	Replace the exhaust filter, clean the exhaust line.
Cause	Exhaust valve is malfunctioning.
Remedy	Repair the valve.
Cause	Pump module is worn out.
Remedy	Replace the pump module.

Fault	Oil in the intake line or in the vacuum vessel
Cause	Oil comes from the vacuum system.
Remedy	Check the vacuum system.
Cause	Anti-suckback valve is blocked
Remedy	Clean or repair the anti-suckback valve.
Cause	Sealing surfaces of the anti-suckback valve are damaged or dirty.
Remedy	Clean or repair intake and anti-suck- back valve.
Cause	Oil level is too high.
Remedy	Drain out excess oil.

Fault	Oil is turbid
Cause	Condensation.
Remedy	Degas the oil or change the oil and clean the pump. Precaution: open the gas ballast valve or fit separator.

Fault	Pump is excessively noisy
Cause	Oil level is much too low (oil level is no longer visible)
Remedy	Add oil.

Fault Finding

Cause	Silencing nozzle is clogged.
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Remedy	Clean the silencing nozzle or replace it.
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Cause	Intake pressure is too high.
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Remedy	Lower the intake pressure.
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Cause	Internal demister is clogged.
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Remedy	Clean or replace demister.
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Cause	Coupling element is worn.
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Remedy	Install new coupling element
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Cause	Vanes or bearings are damaged.
--------------	---------------------------------------

Remedy	Repair pump.
--------	--------------

** 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.

11 Disposal



WARNING: CONTAMINATION HAZARD

Risk of Contamination. 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.

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.

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 [Service](#) on page 68.

Disposal of waste oil

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

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

Waste oil from pumps (our 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 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.

12 Service

12.1 Wearing parts and original spare parts

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

12.2 Return the equipment or components for service

Before you send your equipment to us for service or for any other reason, you must complete a Declaration of Contamination Form. The form tells us if any substances found in the equipment are hazardous, which is important for the safety of our employees and all other people involved in the service of your equipment. The hazard information also lets us select the correct procedures to service your equipment.

If you are returning equipment note the following:

- If the equipment is configured to suit the application, make a record of the configuration before returning it. All replacement equipment will be supplied with default factory settings.
- Do not return equipment with accessories fitted. Remove all accessories and retain them for future use.
- The instruction in the returns procedure to drain all fluids does not apply to the lubricant in pump oil reservoirs.

Download the latest documents from leybold.com/en/downloads/download-documents/declaration-of-contamination/, follow the procedure in HS1, fill in the electronic HS2 form, print it, sign it, and return the signed copy to us.

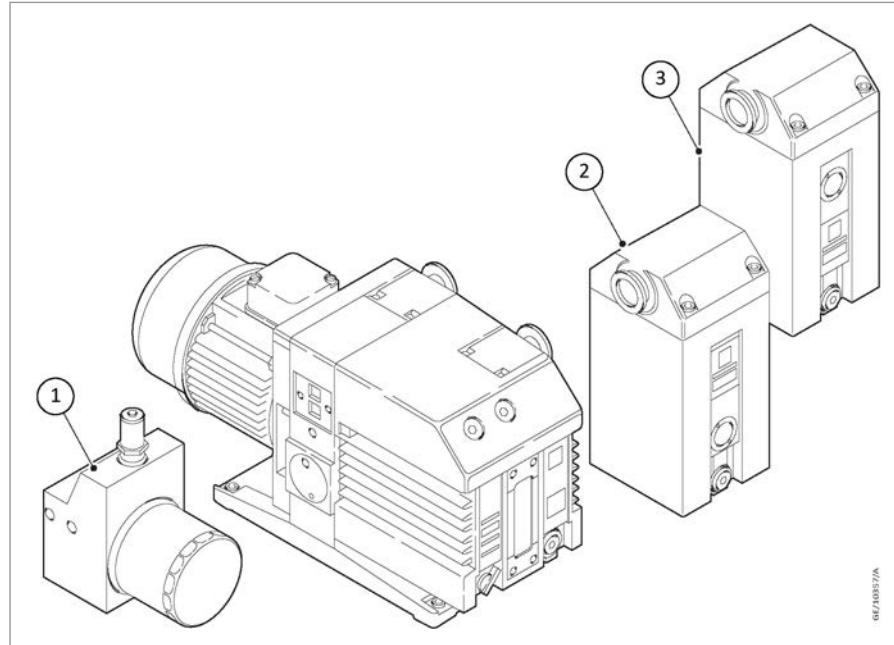


NOTICE:

If we do not receive a completed form, your equipment cannot be serviced.

13 Accessories

Figure 22. Pump with accessories



1. Oil filter OF 4-25
2. Exhaust filter AF 16 – 25
3. Condensate Separator AK 16-25



WARNING: EXPLOSION HAZARD

Risk of explosion. When using other accessories with the pump, it needs to be ensured that these are suited for operation in explosion hazard areas.

Our accessories listed below for this pump, like inlet screen, for example, are also suited for operation in explosion hazard areas. The same conditions as for the pump apply.

Table 9. Accessories

Part	Part number
Separator AK 16-25	18811
Exhaust filter AF 16-25	18911
Drain tap for condensate trap, exhaust filter, oil drain of the pump, vacuum-tight	19090
Exhaust filter with lubricant return AR 16-25	18921
Exhaust filter with lubricant return ARS 16-25	18956
Dust filter*	
Filter housing FH 25	140125T
Dust filter element DF 16-25	140117S
Dust separator	18611
Adsorption trap*: Filter housing FH 25	140125T

Accessories

Part	Part number
Adsorption insert RF 16-25	140118A
Active carbon	17810
Zeolite	85420
Aluminium oxide	85410
Oil filter OF 4-25	10191
Chemical filter CF 4-25	10196
Chemical filter with safety isolation valve CFS 16-25	10177
Adapter for gas ballast port	
M 16 x 1.5 - DN 16 KF	16840V01
M 16 x 1.5 - 3/8 inch NPT	99175011
Inert gas system 16-25 (For BCS Versions)	16176
Limit Switch System 16-25	16106

** Not approved for ATEX applications*



Note:

Use only the kind of oil specified by us.

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EU Declaration of Conformity

This declaration of conformity is issued under the sole responsibility of the manufacturer:

Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

Documentation Officer
T: +49(0) 221 347 0
documentation@leybold.com

The product specified and listed below:

- **Product:** *Two stage oil sealed rotary vane pump with motor*
- **Model:** *TRIVAC D16B; TRIVAC D25B*
- **Pump family codes:**
 - **Single* Phase Motors:** *15130016V02CZO*
 - **Three Phase Motors:** *11333; 11406; 11410; 1127618*

Is in conformity with the relevant Union harmonisation legislation:

2006/42/EC	Machinery directive <i>Note: The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Annex 1 No. 1.5.1 of this directive.</i>
2011/65/EU	Restriction of certain hazardous substances (RoHS) directive as amended by Delegated Directive (EU) 2015/863
2014/30/EU*	Electromagnetic compatibility (EMC) Class A Emissions, Industrial Immunity

Based on the requirements of relevant harmonised standards and technical documentation:

EN 1012-2:1996+A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 60204-1:2018	Safety of machinery. Electrical equipment of machines. General requirements
EN 61000-6-2:2005*	Electromagnetic Compatibility (EMC) - Part 6-2: Generic Industrial Immunity Standard
EN 61000-6-4:2007*	Electromagnetic Compatibility (EMC) - Part 6-4: Generic Industrial Emission Standard

*: Only valid for pumps with single phase motors as indicated above

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: **2025-04-28**

You must retain the signed declaration for future reference

This declaration becomes invalid if modifications are made to the product without prior agreement.



Andries De Bock – Vice President Engineering
Industrial Vacuum Division
Cologne



Jan Večeřa – General Manager
Product Company Lutin

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU): Industrial equipment

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

RoHS (EU): Material Exemption Information

This product is compliant with the following Exemptions

Annex III:

- 6(a) **Lead** as an alloying element in steel for machining purposes and in galvanised steel containing up to 0.35 % lead by weight
- 6(b) **Lead** as an alloying element in aluminium containing up to 0.4% by weight
- 6(c) Copper alloy containing up to 4% **lead** by weight

REACH (EU)

This product is a complex article which is not designed for intentional substance release. To the best of our knowledge the materials used comply with the requirements of REACH. The product manual provides information and instruction to ensure the safe storage, use, maintenance and disposal of the product including any substance based requirements.

Article 33.1 Declaration (EU)

This product contains Candidate List Substances of Very High Concern above 0.1%ww by article as clarified under the 2015 European Court of Justice ruling in case C-106/14.

- Lead (Pb)
This substance is present in certain steel / aluminium / brass components.

WASTE FRAMEWORK DIRECTIVE (EU)

SCIP Number: b24e1657-95ab-488d-b25c-281809e211a7

Compliance Information – incorporated products and assemblies

Motors

Regulation (EU) No 2019/1781 electric motors and variable speed drives

Based on the requirements of harmonised standard:

EN 60034-30:2009: Rotating electrical machines -- Part 30: Efficiency classes of single-speed, three-phase, cage-induction motors (IE-code)

Additional Applicable Requirements

The product is in scope for and complies with the requirements of the following:

2012/19/EU

Directive on waste electrical and electronic equipment (WEEE)

材料成分声明
China Material Content Declaration

部件名称 Part name 	有害物质 Hazardous Substances					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr VI)	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
铸铝及铝合金制品 Aluminium alloys	X	O	O	O	O	O
钢合金制品 Steel alloys	X	O	O	O	O	O
铜管管件 Brass pipe fitting	X	O	O	O	O	O
O: 表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求。 O: Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572. X: 表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 标准规定的限量要求。 X: Indicates that the hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T26572.						

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Pioneering products. Passionately applied.

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