

# SCREWLINE SP 250

Dry Compressing Screw Vacuum Pump

Operating Instructions GA02412\_002\_C0

P/N

115 001

115 003 ATEX 3i

115 006



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These Operating Instructions are the original instructions.

# Safety Information

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## NOTICE



### Obligation to Provide Information

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

The Leybold **SCREWLINE SP 250** have been designed for safe and efficient operation when used properly and in accordance with these Operating Instructions. It is the responsibility of the user to carefully read and strictly observe all safety precautions described in this Section and throughout the Operating Instructions. The pump **must only be operated in the proper condition and under the conditions described in the Operating Instructions**. It must be operated and maintained by trained personnel only. Also consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to our nearest office.

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## DANGER



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

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## WARNING



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

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## CAUTION



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

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## NOTICE



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

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

Retain the Operating Instructions for further use.

In order to avoid the destruction of systems and injury to operating personnel we urgently recommend to observe the information and installation information provided in these Operating Instructions.

# Safety Information

## 0 Important Safety Information

### Explanation of Warning Symbols

 <b>DANGER</b>	
	<b>Toxic gases</b> must not be pumped with this pump.
	<b>Danger of explosion</b> Explosive gases and vapours must not be pumped with this pump.
	<b>Fire danger</b> Combustible gases and vapours, gas mixtures with an oxygen share exceeding 21% and pyrophorous (self-igniting) substances must not be pumped with this pump.

 <b>WARNING</b>	
	<b>Hazardous voltage</b> Disconnect power before opening. Contact causes electrical shock.
	<b>Hot surface</b> Do not touch. Allow this area to cool before servicing <b>Burn hazard</b> Hot surface inside. Do not touch. Wear protective equipment.
	<b>Reactive or corrosive media</b> Reactive or corrosive gases may cause health problems . When the pump has been used to pump reactive or corrosive gases before, introduce corresponding safety precautions before opening it, e.g. wear gloves, breathing protection or protection clothing

# Safety Information

 <b>CAUTION</b>	
	<p><b>Purge gas</b> Check compatibility with applications.</p> <p><b>Overpressure in the discharge line</b> Components can be thrown in all directions. The pressure in the discharge line must not exceed atmospheric pressure by 200 mbar max. The discharge line must not be blocked or restricted</p>
	<p><b>Pumps with wheels</b> must only be placed and moved on levelled horizontal surfaces!</p>
	<p><b>Rotating parts</b> When operating the pump with open intake port, there is the risk of suffering injury by rotating parts. Never operate the pump with open intake port or fan cover, except from checking the direction of rotation.</p>
	<p><b>Vacuum</b> Avoid exposing any part of the human body to the vacuum.</p>
	<p><b>Machinery starts automatically</b> Connect the pump so that it not will restart automatically after a mains power failure, once the power returns.</p>
	<p><b>Overhead load</b> Transport the pump only at the two crane eyes or with a forklift secured on a suitable palette.</p>

## 0.1 Mechanical Hazards

- 1 When operated with an open intake flange, there exists a risk of suffering injury by rotating parts. Do not operate the pump with an open intake flange or fan cover except when checking the direction of rotation.
- 2 Avoid exposing any part of the human body to the vacuum.
- 3 The pump is intended for generating a vacuum only. If an overpressure can occur in the system then the pump must be protected against such an overpressure by an overpressure safety valve, for example.
- 4 We recommend to always operate the pump with a silencer or a connected discharge line. The pressure in the discharge line must not exceed atmospheric pressure by 200 mbar max.

Make sure that the gas flow at the discharge is not blocked or restricted in any way, even when the pumped out gases need to be collected or contained.

The discharge line must not be blocked or restricted. Before commissioning the pump, open all shutoff devices or valves in the discharge line.

In the case of processes involving much condensate, we recommend the installation of a condensate separator in the discharge line.

- 5 Select the location where the pump is installed so that all controls can be easily accessed. Deposit the pump only on a floor which is level. It can topple when it is tilted by more than 10° with respect to the vertical axis. When the pump is filled with oil an angle exceeding 2° is not permissible.

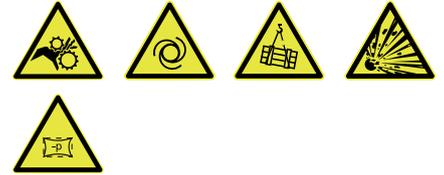
### For pumps on castors only

Because of the fitted castors, the pump must only be placed on a level floor capable of supporting the pump's weight, as otherwise there exists the risk of the pump rolling away. Moreover, the pump may only be moved on a level floor! Moving the pump along sloping paths or ramps is prohibited! The pump must only be transported with a forklift or a crane! At the installation location, secure against rolling away.

- 6 For transporting the pump use only approved transport means. When selecting the lifting and transport means take note of the total weight before transporting the pump. As standard, the pump has been equipped with two crane eyes. When transporting the pump with a forklift or alike, ensure that the pump has been secured on the supplied or a suitable palette.

The crane eyes of the screw pump must never be used to lift any pump combinations (Roots pump + backing pump).

### CAUTION



# Safety Information

- 7 Before beginning with any maintenance and servicing work always ensure that no gas can flow backwards through the pump since then the rotors might turn against the normal direction of rotation. For this reason vent the vacuum chamber to the exhaust pressure level or ensure through suitable valves that the vacuum chamber and the lines are reliably separated from the pump. When connecting several pump systems, pressure differences between inlet and discharge can give rise to uncontrolled turning of the pump's shafts.
- 8 Lay the electric feed lines so that there is no risk of tripping over these.
- 9 The warning information on the pump must not be covered.
- 10 When changing the oil remove any escaped oil as otherwise there is the risk of slipping.

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**DANGER**



## **0.2 Electrical Hazards**

- 1 The electrical connection must only be provided by a trained person. Please observe the national regulations in the country of use like EN 50110-1 for Europe, for example.
- 2 Lay the connecting lines so that they cannot be damaged. Protect the lines against humidity and contact with water. Avoid thermally stressing the lines due to unfavourable laying.
- 3 Note the information on the type of protection.
- 4 The pump must only be operated at the frequency specified for the motor even when operated off a frequency converter. When using frequency converters you must ensure an effective protection against overspeeding.
- 5 Always operate the pump with a properly connected protective earth conductor.
- 6 The pump must be integrated within the system controller such that the pump can not run up automatically when the pump has been shut down before due to an overloaded motor. This equally applies to any emergency shutdowns. After having removed the fault cause, the pump must be switched on manually again.
- 7 Before starting with any maintenance or servicing work reliably disconnect the pump from all sources of power (lockout/tagout).
- 8 High electric voltages! When touching parts at high electric voltages, there is the risk of suffering severe injuries by an electric shock! Covers marked with this symbol must only be opened by trained electricians after having reliably deenergised (lockout/tagout) the equipment.
- 9 Observe the manufacturer's information and the Operating Instructions for the respective frequency converter.
- 10 After having connected the motor and each time after having made changes to the wiring, check the direction of rotation. If the direction of rotation is wrong, the pressure can increase on the intake side. Moreover, the pump can suffer severe damage.

## 0.3 Thermal Hazards

- 1 With the pump warm from operation, the housing and oil temperature may exceed 70 °C. Protect hot parts against being touched. Let pump and oil cool down. Always wear protective gloves and protective goggles, also for protection against aggressive residues in the oil.
- 2 Handle the pump only while vented and after having let it cool down.
- 3 Take note of the warning information on the housing surface. If this warning information was removed, covered or obstructed, then provide corresponding additional warning information.
- 4 Never open the oil fill or oil drain plugs while the pump is running. There is the risk of suffering burns.

### CAUTION



## 0.4 Hazards Caused by Materials and Substances

- 1 The pump is **not** suited for pumping of:
  - combustible and explosive gases and vapours (except within the permissible scope for pumps certified in accordance with ATEX Category 3 inside)
  - radioactive and toxic substances
  - gas mixtures with an oxygen share exceeding 21%
  - pyrophorous (self-igniting) substances.

Moreover, the pumps are not suited for placement and operation within explosion hazard areas.

Please consult us first when planning such an application.

- 2 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.
- 3 Before operating the pump with a gas ballast or a purge gas (option) check the compatibility of the gas with the pumped media so as to avoid dangerous conditions during operation.
- 4 Pump with installed **purge gas unit**:  
When operating the pump with a purge gas valve, secure the purge gas supply so that in the event of a malfunction no overpressure can occur in the system.
- 5 When nitrogen is used as the purge gas or as the gas ballast, small quantities of nitrogen can escape to the surroundings. Ensure sufficient ventilation for the room in which to pump has been installed.
- 6 The vacuum line must be leaktight. Reactive or corrosive 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, a leak search will always be necessary.

Please note the special information on the pump's shaft seal given in the following.

### DANGER



# Safety Information

## 7 Shaft seal of the pump

Shaft seals are present only on the discharge side of the pump's rotors. The two shaft seals are non-contacting owing to a combination of piston ring and labyrinth seals, but are not hermetically tight. The seal in the direction of the atmospheric side and in the direction of the gear chamber is vented.

In the case of a low pressure in the discharge line there is the risk of adding small quantities of air via the shaft seal to the process gas.

When the discharge pressure on the process gas side exceeds atmospheric pressure, small quantities of processed gas can escape into the gear housing and also to the outside.

In order to prevent any process gas from escaping from the pump chamber, use purge gas for the shaft seal. The purge gas will reliably prevent any leaks between the gas chamber and the surroundings provided the correct quantity of purge gas is used within the specified limits.

Please consult us first when planning such an application.

- 8 When the pump has been used to pump harmful media before, introduce corresponding safety precautions before opening the intake or the discharge connections. Before opening the pump, purge it for a longer period of time with an inert gas. If necessary, wear gloves, breathing protection or protection clothing and work under a fume hood. Firmly seal off the pump. When shipping the decontaminated pump for servicing please also indicate the type of hazard. For this see Section 5.7 Service at Leybold.

When shipping contaminated pumps which require approval by the authorities, note the applicable regulations regarding packaging and shipping.

- 9 In special cases the composition of these substances may be relevant to safety. In these cases, the user must carefully review the effect of these substances and introduce suitable personnel protection measures.

You must also expect the gas to have a different composition at the inlet compared to the discharge. This must be included in the assessment of potential hazards.

- 10 In case of a malfunctioning pump, in particular because of a blocked discharge line or seized rotors due to hard deposits or foreign objects, the possibility of leaks in the casing cannot be ruled out. When pumping harmful gases, the operator must ensure that such a malfunction cannot occur, respectively that leaks at the pump will not be a hazard.

- 11 Leybold is not in a position to perform servicing (repairs) and waste disposal of radioactively contaminated pumps. Both needs to be ensured from the side of the user.
- 12 When disposing the pump, used lubricants and used oil filters observe the applicable environment regulations.

## 0.5 Ignition Risk

The pump is not suited for operation within explosion hazard areas. Please consult us first when planning such an operation.

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**DANGER**



## 0.6 Noise Hazard

The noise level of the pump during ultimate pressure operation with silencer or connected discharge line corresponds to the values stated in the Technical Data. In other operating modes and with other equipment or with several pumps at the same location, higher values must be expected.

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**CAUTION**



We recommend to wear hearing protectors ( earmuffs).

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**NOTICE****0.7 Risk of Pump Damage**

- 1 With the pump **filled with oil** it must be placed such that it will deviate by no more than 2° from the vertical axis as otherwise oil can enter into the sealing system. Before filling the pump with oil, align it. Transporting the pump filled with oil is not permissible.
- 2 Always use the intake screen which has been fitted as standard and clean it regularly. The intake screen serves to protect the pump. Small items (screws, welding beads, pieces of wire, etc.) which during installation work inadvertently fall into the intake line or are sucked in, are retained by the intake screen.  
  
The intake screen does not replace a filter. Prevent the intake of particles from the side of the process by fitting suitable filters. Upstream filters protect the pump against damage to the pump chamber.
- 3 When pumping dust containing media, install a dust filter in the process gas flow upstream with respect to the pump.
- 4 When connecting the pump, provide a suitable valve on the intake side for the purpose of shutting off the intake line so as to prevent the pump from turning backwards in the event of a power failure. Otherwise the pump may suffer damage or oil may contaminate the pump chamber by reverse venting via the shaft seals.
- 5 Lines and other vacuum connections should be clean and free of oil. Special attention must be paid here when oil-sealed pumps have been used on the vacuum side. Check the conditions before initial commissioning. In the case of deviations, the pump can suffer contamination with oil residues.
- 6 The pressure within a pump which has been switched off will increase to ambient pressure within a few seconds. In such a case the pump is vented through the discharge and the shaft seal drain. We recommend to fit a nonreturn discharge valve so as to prevent the pump from turning backwards.
- 7 The discharge line should be laid so that it slopes down and away from the pump so as to prevent condensed vapours from backstreaming into the pump.
- 8 In the case of wet processes we recommend the installation of liquid separators, upstream and downstream of the pump so as to avoid the influx of liquid into the pump.
- 9 During installation work on the intake and discharge lines do not subject flanges to any stresses. Check the rubber elements of the pump's feet as to any deformation.
- 10 Protect the electric motor against being overloaded:  
For proper connection, a suitable motor protection switch must be used. Set this motor protection switch in agreement with the information provided on the motor nameplate.  
Connect the pump to the correct mains voltage and mains frequency.

# Safety Information

- 11 The pump's motor is equipped with an overtemperature protection (PTC). Processing the PTC signal is a safety measure which in the case of inadequate cooling, a temporary mains power phase failure or in the case of frequency variations offers effective protection preventing costly damage to the motor coils.
- 12 The pump must only be operated with all covers in place so that adequate cooling of the pump is ensured.
- 13 If corrosive or reactive gases at low concentrations are being pumped, then operate the pump with **purge gas**. Consult us first as to which pumps are required for specific processes and applications.
- 14 Before pumping condensable vapours the pump should be at operating temperature. If a gas ballast is present, then it should be opened. The pump will attain its operating temperature approximately 30 minutes after having started the pump. During this warm-up phase, the pump should be left separated from the process by a valve in the intake line, for example.
- 15 With the pump warm from operation do not clean it from the outside with water. There is the risk of a rotor crash due to shock cooling.
- 16 If condensable vapours have been pumped, the pump should before switching off be purged with an inert gas or air (depending on the specific application) for approximately 15 minutes. This process should also be run before cleaning the pump chamber.
- 17 For shutting down the pump purge the pump before switching off with an inert gas or air (depending on the specific application) for approximately 15 minutes. Place desiccant onto the intake screen in the intake flange and into the discharge flange and blank off the flanges with a piece of foil. Disconnect the pump from the mains power. When storing the pump for a longer period of time, drain out the oil first. Package the pump airtight in polyethylene foil.
- 18 Improper maintenance or repair work can have an influence on the service life and the performance of the pump and will void any warranty claims.

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Pressures given in bar or mbar are absolute values. If exceptionally a gauge pressure is meant, a "g" is added (bar(g) = bar (gauge) = bar overpressure)

## For Part Number 115 003 **SP 250 ATEX Category 3i (inside) Vacuum Pump**

### Classification and Marking of the Pump

The SP 250 ATEX Category 3i (inside) fulfils for the inside, i.e. the process gas side of the pump, the fundamental safety requirements of the EC Directive 94/9/EG. The pump is marked as follows:

 II (inside) 3GD II T160 °C X (10 °C < Ta < 40 °C)

These pumps are **not** suited for placement (installation) in explosion hazard areas.

### Key to the Symbols

**II Equipment group II** applies to all equipment in areas which are potentially endangered by an atmosphere capable of exploding, except in underground mining operations and their above ground facilities which may be endangered by mine gas and/or combustible types of dust.

#### **(inside)/(outside)**

Specifies the category/conditions according to 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, provided there is a difference between them.

**3** Category 3 comprises equipment which is so designed that it can be operated in agreement with the characteristic quantities (operating parameters) specified by the manufacturer ensuring a normal degree of protection. Equipment belonging to this category is intended for operation in areas where it not needs to be expected that an explosive atmosphere occurs due to gases, vapours, mists or raising dust, but when it occurs, then with all probability only rarely and briefly. Equipment belonging to this category ensures during normal operation the necessary degree of safety.

**G** For areas with an atmosphere capable of exploding caused by gases, vapours or mists in the air.

**D** For areas with an atmosphere capable of exploding caused by explosive dusts.

#### **II, IIA, IIB or IIC**

Explosion groups: these are subdivisions for equipment belonging to Group II, which are used in connection with some protection types. This subdivision is based on the maximum experimental safe gap and the minimum ignition current of the explosive atmosphere. See EN 60079-0.).

Equipment marked with IIB is also suited for applications which require equipment marked with IIA.

Equipment marked with IIC is also suited for applications which require equipment belonging to explosion group IIA or IIB.

Equipment without indication of the explosion group may be used in explosive atmospheres of explosion groups IIA, IIB and IIC.

## T3, T4

Temperature class: classification of equipment within classes depending on their maximum surface temperature corresponding to the table given below:

Temperature class	Maximum surface temperature (°C)
T1	450
T2	300
T3	200
T3 (160 °C)	160
T4	135
T5	100
T6	85

The temperature class and the actual maximum surface temperature of the equipment includes a safety margin with respect to the minimum ignition temperature of the potentially explosive atmosphere as demanded by EN 13463-1.

**Ta** Permissible ambient temperature for operating the pump  
 $10\text{ °C} < T_a < 40\text{ °C}$ .

**X** Special operating conditions need to be complied with!  
 The special conditions and information provided in the Operating Instructions apply.

Modifying the supplied pump, voids the CE and ATEX Declaration of Conformity.

### Related Accessories

When using accessory components together with the pump it needs to be ensured that these accessories are suited for operation in explosion hazard areas.

### Operation in the Pump System

When operating the screw pump in a pump system, different ATEX categories or temperature classes may apply. You must ensure that the operating parameters comply with the stated technical data. You must run an ignition hazard assessment for the entire pump system.

### Areas of Application

The inside (process gas side) of this vacuum pump is so rated and designed that the occurrence of foreseeable ignition sources can be excluded during normal operation. Provided the pump is operated in accordance with the parameters specified in the Operating Instructions the pump will offer a normal degree of protection. For this reason it is suited for operation under conditions where it is unlikely that an atmosphere capable of exploding is created by gases, dusts, vapours or mists in the air or if such atmospheres do occur then this only rarely and only briefly (i.e. Zone 2).

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**DANGER**

The pump itself must not be installed and operated in explosion hazard areas.

Areas in which explosive atmospheres (gases, dusts, vapours or mists) can occur in the air are subdivided into three zones corresponding to the frequency and duration of occurrence of an explosive atmosphere. These zones are designated as 0, 1 and 2.

The definitions for these zones are described in Annex I of the "Atex Directive (Directive 99/92/EG) for improving the safety and health protection of workers potentially at risk from explosive atmospheres".

Information as to the classification of the areas with explosive atmospheres in the 3 Zones, is provided in the Directive 99/92/EG and the corresponding guide (COM (2003) 515) together with the European standard EN 60079-10 (Electrical apparatus for explosive gas atmospheres - Part 10: Classification of hazardous areas). Additionally, further information on the avoidance of explosions and on the topic of explosion protection can be found in the Directive 99/92/EG and the corresponding guide.

This information can be downloaded from the EC Internet site.

### **Gas Composition**

It is important to note that the composition of the gas at the intake on the suction side of the pump and at the discharge to the atmosphere may possibly differ. This may possibly have an influence on the zone assignments (EG Directive 99/92/EG).

### **Ignition Temperatures of Gases/Vapours**

The pumps are suited only for applications in which potentially explosive gas and vapour mixtures exhibit an ignition temperature of over 160 °C.

The ignition temperatures (sometimes also called self ignition temperature) of gases and vapours can be taken from the material safety data sheets.

The pump is not suited for operation in potentially explosive gas mixtures in which the oxygen concentration exceeds 21% or if reactive, aggressive or corrosive gases are present.

### **Ignition Temperatures of Dusts**

In accordance with Directive 99/92/EG, the system operator is committed to provide a hazard assessment. For this reason the minimum glow point temperature and the minimum ignition temperature of the dust must be known to him.

Two calculations for determining two limit temperatures must be performed:

- a) Limit temperature 1 =  $\frac{2}{3}$  of the minimum ignition temperature
- b) Limit temperature 2 = minimum glow point temperature\* less 75 K

From these two calculated limit temperatures it will now be necessary to take into account the value which guarantees the higher degree of safety.

\*The value for the glow temperature applies to a dust thickness of 5 mm. In the case of even thicker dust deposits, the temperature safety margin should be increased even further.

## Potential Ignition Sources

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

Potential ignition sources	Remarks
Hot surfaces	inside and outside due to process gas inlet temperature and gas compression
Hot gases, adiabatic compression	Hot gases from the process which are being pumped, temperature increase owing to gas compression within the pump. Hot gases are ejected at the exhaust.
Mechanical sparks	Will not occur during normal operation
Electrical sparks	Outside of the pump due to motor, accessories
Static electricity	Will not occur during normal operation
Chemical reactions	Will not occur during normal operation

## Special Requirements for Safe Usage "X"

Conforming utilisation of this pump demands the connection of, and operation with purge gas for Category 3 (inside),

For particle, respectively dust filters, the use of a mesh of 40 µm max. will be mandatory in connection with ATEX applications so as to ensure the safe operation.

If dusts occur, then an approved dust filter must be used and must be electrically connected to ground correspondingly.

The pump must exclusively be filled and operated with the oil LVO 210 as the operating agent. The use of any other kind of oil may result in increased surface temperatures and cause severe damage to the pump.

During normal operation, the oil temperature must not exceed 70° C. A regular check will be necessary, see also Chapter 3.5 Oil Temperature.

The pump must be installed such that oil sight glass and SP-Guard are easily visible and cannot be damaged. The oil level must be checked regularly.

The pump must be installed so that only minimal quantities of dust can deposit themselves on the surfaces. In those cases where dust deposits form, measures must be introduced to remove these a regular basis.

The pumps must only be operated at an ambient temperature ranging between 10 °C and 40 °C.

The maximum gas admission temperature must not exceed 100 °C.

The maximum overpressure at the gas inlet must not exceed  $p_{amb} + 55$  mbar.

The maximum exhaust back pressure must not exceed  $p_{amb} + 200$  mbar.

## **Safety Measures**

### **Hot Surfaces**

Compression of the gases will during normal operation of the vacuum pump cause it to heat up resulting in hot surfaces. Tests have shown that during conforming operation of the pump (in accordance with these Operating Instructions) the process gas path which might come into contact with a potentially explosive atmosphere, attains during operation at a nominal frequency of 50 Hz or 60 Hz a maximum temperature below 160 °C.

The maximum temperatures are attained during constant operation at an inlet pressure below 300 mbar (absolute). The actually attained temperature depends on the inlet pressure.

### **Hot Gases**

Due to compression of the gases, the pump will produce during normal operation hot exhaust gases. The exhaust gas temperatures will not exceed the stated maximum surface temperatures of the pump. The exhaust gases need to be discharged through a suitable exhaust gas system.

### **Mechanical Sparks**

During normal operation no mechanically generated sparks are created.

The intake of particles into the pump must be prevented so as to prevent the formation of hot spots due to friction.

### **Electric Sparks**

These can be caused by the electric motor and the accessories supplied with the pump. Where the outside of the pump has been certified then motor and supplied accessories have the same classification. Follow the manufacturer's information.

## Static Electricity

The pump must be connected with a low impedance to ground so as to avoid charging with static electricity. This is attained by properly connecting the protective ground conductor at the point provided for it. During normal operation no dangerous creation of charges will occur.

In connection with ATEX usage, the electrically conducting link between all pump chamber cover, exhaust flange and gear housing is absolutely mandatory! After any assembly work on the pump chamber, this link must be checked. For this, use a resistance meter and measure the resistance of the link which must be less than 100 Ohm.

A filter on the intake side must be connected to ground in accordance with the Operating Instructions of the filter.

Use only the original spare parts from Leybold.

## Ground Connection

Between the M 8 tapped blind hole on the pump (see figure) and the frame ground/ground rail of the frequency converter, an EMC compliant ground connection (copper strap, for example) must be provided.

## Chemical Reactions

The pump shall not come in to contact and shall not be used in connection with reactive or corrosive gases which may cause an exothermal chemical reaction.



Connect ground strap here!

## Additional Safety Measures

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

Compliance with the operating parameters stated in these Operating Instructions must be ensured.

Run checks on a regular basis and comply with the maintenance schedule.

## Additional Maintenance Requirements

In those cases where dust may 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 ensure that the defined level of safety is maintained, only accessory parts and wearing parts from Leybold must be used.

# Description

## 1 Description

### 1.1 Design and Function

The SCREWLINE SP 250 is a dry compressing screw-type vacuum pump capable of a maximum pumping speed of  $270 \text{ m}^3 \cdot \text{h}^{-1}$  at 50 Hz and  $330 \text{ m}^3 \cdot \text{h}^{-1}$  at 60 Hz.

It has been developed specifically for the special requirements of industrial applications. Thus the ruggedness of the pump was a main design criterion.

**Screw rotors** The screw shaped rotors are fitted to two horizontally arranged shafts and revolve without making contact within the pump chamber. The shafts are synchronised by a toothed gear. The shafts are driven via a further gear stage by an electric motor.

In vacuum pumps, the seals and the bearings on the vacuum side are always a potential source for a breakdown. On the one hand lubricants may enter from the bearing into the vacuum process and on the other hand aggressive process media can endanger the bearings.

**Cantilevered bearing** These disadvantages are avoided by the “cantilevered” arrangement of the rotors. The SP 250 is equipped with two cantilevered screw type rotors which are guided by oversized shafts and bearings. The bearings are located both in the gear chamber of the pump.

A further advantage of the cantilevered arrangement is that the pump chamber is easily accessible without having to disassemble any bearings. Thus any possibly required cleaning operations necessary due to the influence of the process can be run easily.

The cantilevered rotors minimise the risk of bearing damage and also reduce on-site maintenance to a minimum.

**Shaft seal** Shaft seals are in the case of the SP 250 pump only required on the delivery side of the rotors. Owing to the small pressure difference between discharge and gear, simple and reliable seals can be provided. The two shaft seals consist of a combination of a piston ring and a labyrinth seal thus making almost no contact so that the seals will be almost free of wear.

**Purge gas** In standard applications no purge gas will be required at the seals. However, if demanded by the process conditions, a purge gas may be supplied to the seals. In the case of ATEX applications operation with purge gas is an absolute requirement.

**Cooling** The SP 250 is air-cooled, a radial fan supports the cooling effect for the housing which is equipped liberally with cooling fins.

Depending on requirements, the screw pumps may be combined with Roots pumps so as to attain higher pumping speeds at lower pressures.

## Principle of Operation

In the screw vacuum pumps of the SP 250 line the pump chamber is formed by two synchronised displacing rotors and the housing.

A pair of tightly intermeshing right-handed and left-handed threads is used to implement with only very few components a large number of stages and thus very low ultimate pressures.

Figures 1.1 and 1.2 show how by the two rotors and the housing several chambers are created which allow the gas to be compressed. Since the rotors turn in opposing directions, the chambers “move” steadily from the intake to the delivery side of the pump (fig. 1.2) so that the gas is conveyed in a low-pulsation manner.

The continuous pumping action for the gas without the need of having to deflect the gas will also allow pumping of particles entrained in the gas and also vapours to a limited extent.

As in the case of other dry compressing (slot sealed) vacuum pumps, also in the case of screw pumps very tight slots need to be maintained between the components. Otherwise the leaks caused by the pressure drop would have a negative effect on both pumping speed and attainable ultimate pressure. Moreover, the pump might heat itself up too much due to unfavourable thermodynamic processes.

During operation the design of the SP 250 ensures that the slots are maintained within the operational limits of the pump. In order to limit the temperatures attained by the components, the housing of the pump chamber is air-cooled. Also the rotors themselves are cooled: by oil which is pumped through bores in the rotor shafts and which also lubricates the bearings and the toothed wheels of the pump’s synchronising gear. Thus an even temperature spread is attained within the pump.

The amount of “inner compression” has a significant influence on the temperature level within a vacuum pump. In the case of a foreline pump, most of the work on compression is done while the gas is being ejected against the delivery pressure, i.e. in the last stages of the pump. For this reason in the case of the SP 250 the volume of the gas is already significantly reduced at pressures which are as low as possible so as to minimise this work done on compression. In this way the power requirement of the pump is reduced and less heat needs to be dissipated.

Fig. 1.3 shows the pV diagram of screw pumps: (a) without inner compression, (b) with inner compression against the face side of the pump chamber and (c) by reducing the chamber volume along the rotor. The surface areas enclosed in the pV diagram are in each case proportional to the power uptake of the pump. It is apparent that the most efficient method is to compress the gas which is to be pumped by reducing the axial pitch of the rotor from the inlet to the delivery side (fig. 1.2) so that the chamber volume is already reduced at low pressures (fig. 1.3c). In this way a power consumption can be attained which is comparable to that of rotary vane pumps.

## Gas compression

## Slots

## pV diagram

# Description

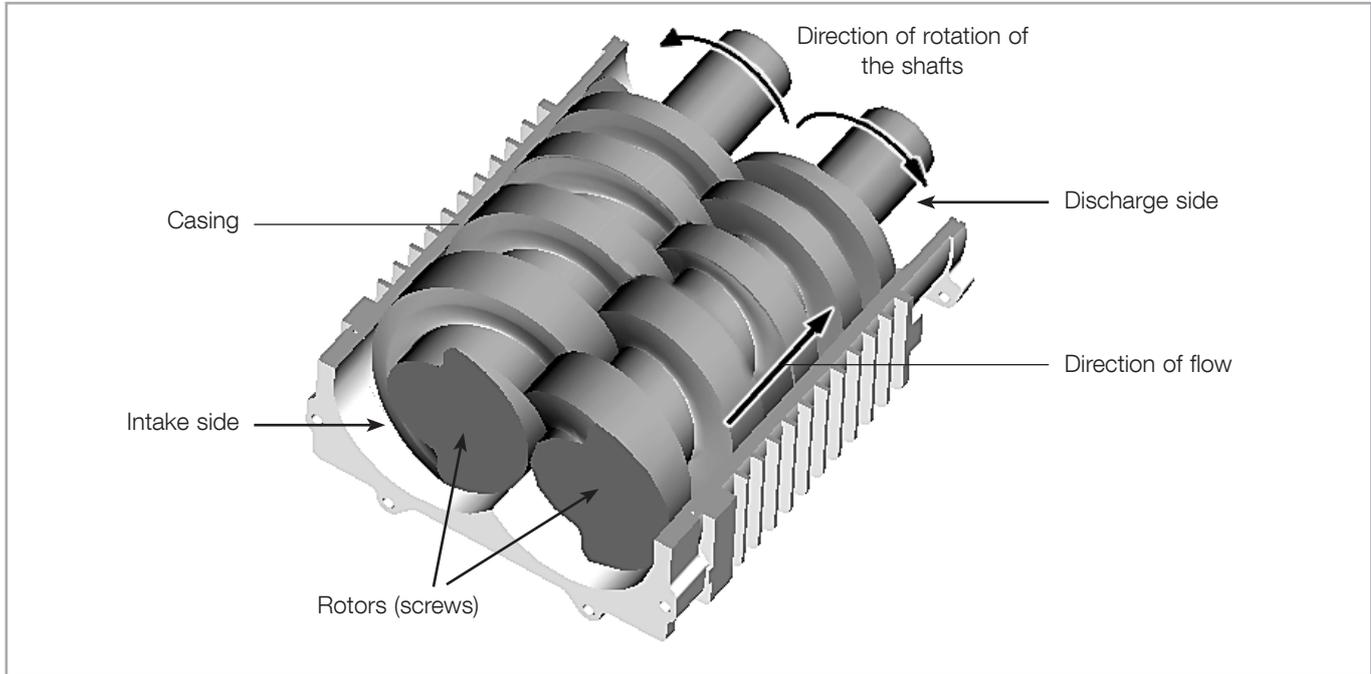


Fig. 1.1 Principle of operation of a screw pump

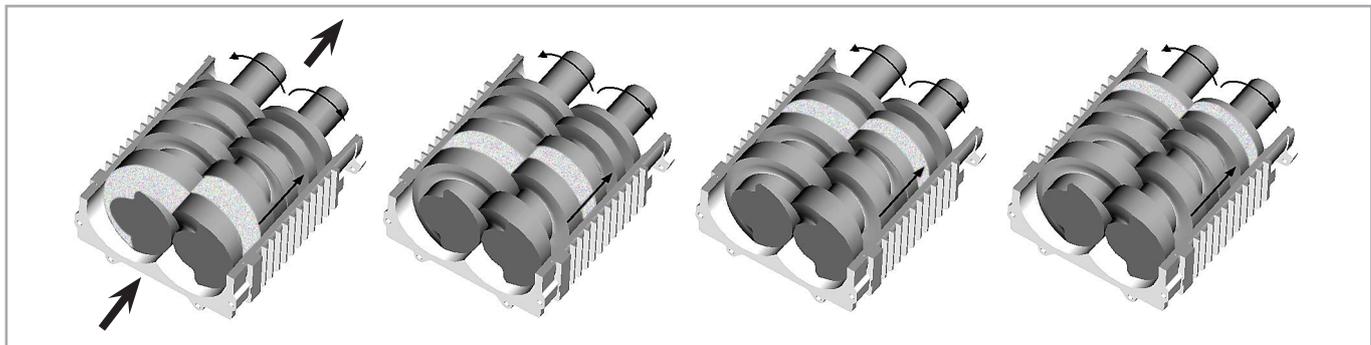


Fig. 1.2 Compression principle and the direction of pumping action within a screw pump

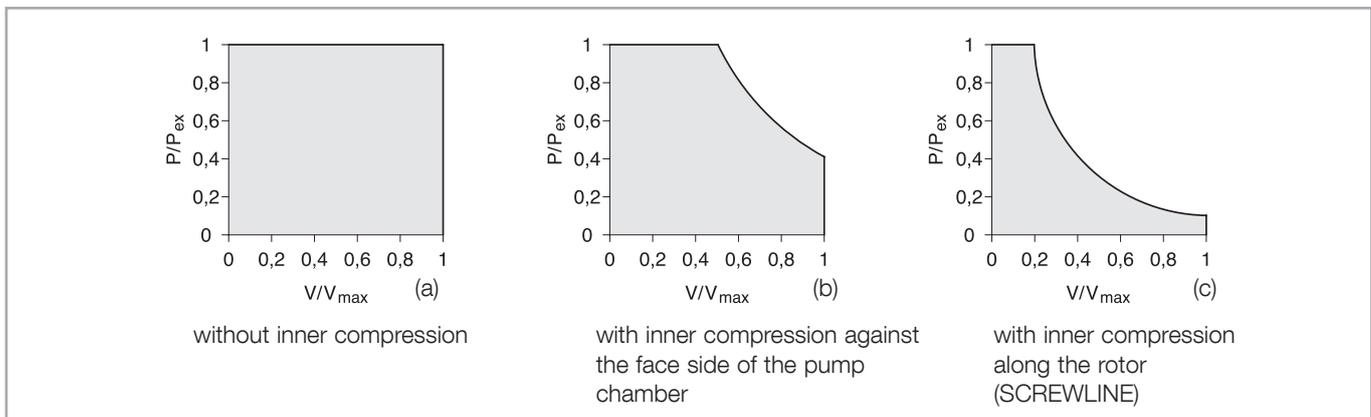


Fig. 1.3 pV diagrams of screw pumps

## 1.2 Technical Data

		SP 250 (50 Hz)	SP 250 (60 Hz)
<b>dry compressing screw vacuum pump</b>			
<b>Type</b>			
Effective pumping speed (- 5 %)	m <sup>3</sup> · h <sup>-1</sup>	270	330
Ultimate pressure, total	mbar	≤ 0.01	≤ 0.005
Permissible exhaust backpressure with reference to atmospheric pressure	mbar	+ 200 mbar - 50 mbar	+ 200 mbar - 50 mbar
Maximum permissible intake pressure	mbar	p <sub>amb</sub> +55	p <sub>amb</sub> +55
Maximum permissible intake temperature	°C	100	100
Noise level <sup>1)</sup> , k <sub>pA</sub> = 3 dB	dB (A)	≤ 68	≤ 72
Total weight, approx.	kg	450	450
Dimensions (L x W x H)	mm	1350 x 530 x 880	1350 x 530 x 880
Permissible ambient temperatures	°C	10 to 40	10 to 40
Contamination grade <sup>2)</sup>		3	3
Water vapour tolerance (with gas ballast)	mbar	60	75
Water vapour capacity (with gas ballast)	kg/h	10	18
Relative atmospheric humidity <sup>3)</sup>	%	max. 95	max. 95
Installation location		0 - 3000 m (above sea level)	0 - 3000 m (above sea level)
Pump monitoring for pumps equipped with an SP-Guard		Processing through system controller	Processing through system controller
<b>Motor</b>			
Speed	rpm	2910	3490
Nominal power rating	kW	7.3	9.2
Nominal power rating at ultimate pressure	kW	5.9	7.2
Nominal current at operating voltage and 50 Hz, ΔΔ		32 A / 200 V	--
Nominal current at operating voltage and 50 Hz, Δ		16 A / 400 V	--
Nominal current at operating voltage and 60 Hz, ΔΔ		--	31.5 A / 210 V
Nominal current at operating voltage and 60 Hz, Δ		--	15.5 A / 460 V
cos φ		0.88	0.85
Motor efficiency class calculated and configured acc. to EN 60034-30		IE2	IE2
Type of motor protection		IP 55	IP 55
Heat protection class		F	F
Temperature sensor in the motor coil		PTC 160 °C - 5 °C	PTC 160 °C - 5 °C
Operating mode		S1 (continuous operation)	S1 (continuous operation)
<b>Operating agents</b>			
Cooling		Air	Air
Approved type of oil: LVO 210	I	7	7

# Description

## Materials

Components in contact with the gas

Aluminium, aluminium anodised  
C steel, CrNi steel, grey cast iron,  
**FPM**

Seals

## Flanges

Intake flange

ISO 1609-1986 (E)-63 DN 63 ISO-K  
ASME B16.5 NPS 3 Class 150  
EN 1092-2-PN 6 - DN 65

Exhaust flange

ISO 1609-1986 (E)-63 (DN 63 ISO-K)

1) at ultimate pressure with connected discharge line without silencer, in accordance with ISO 4871 (acc. to DIN EN ISO 2151), KpA=3dB

2) in accordance with EN 61800-5-1

3) in accordance with EN 60721-3-3

### 1.2.1 Technical Data of the SP-Guard Monitoring System

Operating voltage	24 V DC
Power rating	5 W
Type of protection IEC 60259	IP 65
PLC output levels	PLC High approx. VCC -1 V PLC Low approx. GND +1
Current, continuous	< 40 mA
Max. power loss	5 W (all switching outputs added)
Current rating	40 mA

### 1.2.2 Technical Data of the Solenoid Gas Ballast Valve

(only for certain pump versions, see Section 1.4)

Permissible admission pressure	1 bar (rel.)
Media temperature	max. 80 °C
Operating medium	filtered, dry air on nitrogen, filter mesh 40 µm
Operating voltage	24 V DC +/- 10% normally closed
Power rating during operation	6 W
Power rating when being energised	80 W
Type of protection	IP 65 acc. to IEC 60259
Cable diameter	6-7 mm
Electrical connector with Varistor	Bürkert, type 8376 acc. to DIN 43650 Form A

## 1.2.3 Technical Data of the Purge Gas Facility

(only for certain pump versions, see Section 1.4)

Connection thread/gas supply	G 1/8" - inside thread
Operating pressure	3 - 10 bar
Ambient temperature	+10 °C to + 40 °C
Media temperature	+10 °C to + 40 °C
Operating medium	Filtered, dry air or nitrogen of the quality class 5, free of oil, quality class 3 in accordance with ISO 8573-1 Filter mesh 40 µm
Operating voltage/valve	24 V DC +10 % / -20% normally closed
Power	2.5 W
Maximum power consumption	3.4 W
Protection type	IP 65 in accordance with IEC 60259
Cable diameter	< 6.5 mm
Purge gas pressure/system pressure to be set up	2.5 bar
Purge gas volume flow	20 Std. l/min

# Description

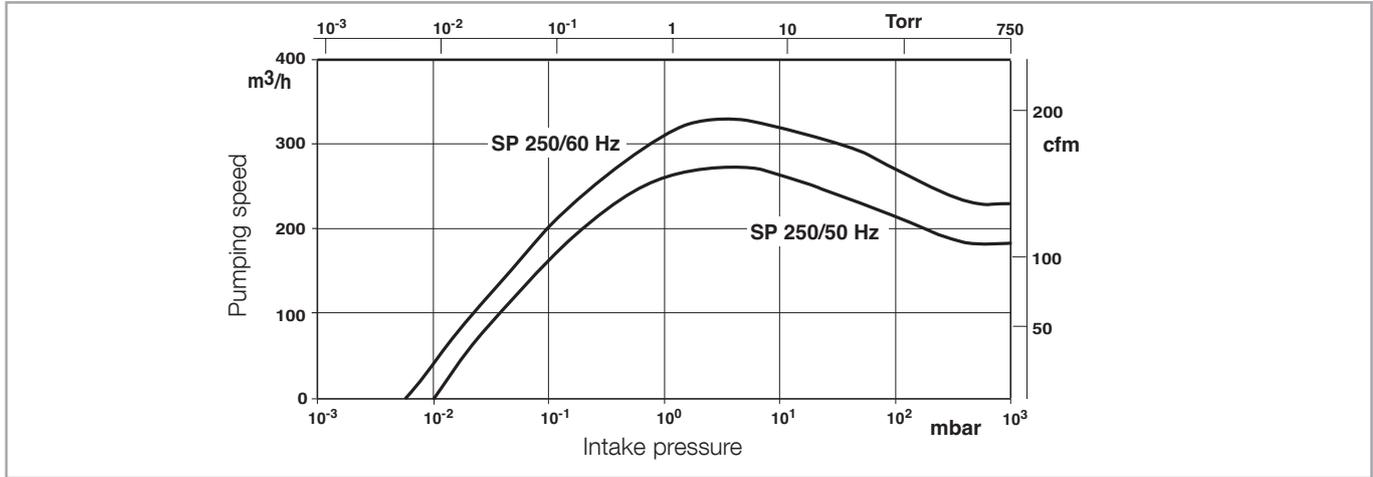


Fig. 1.4 Pumping speed curves

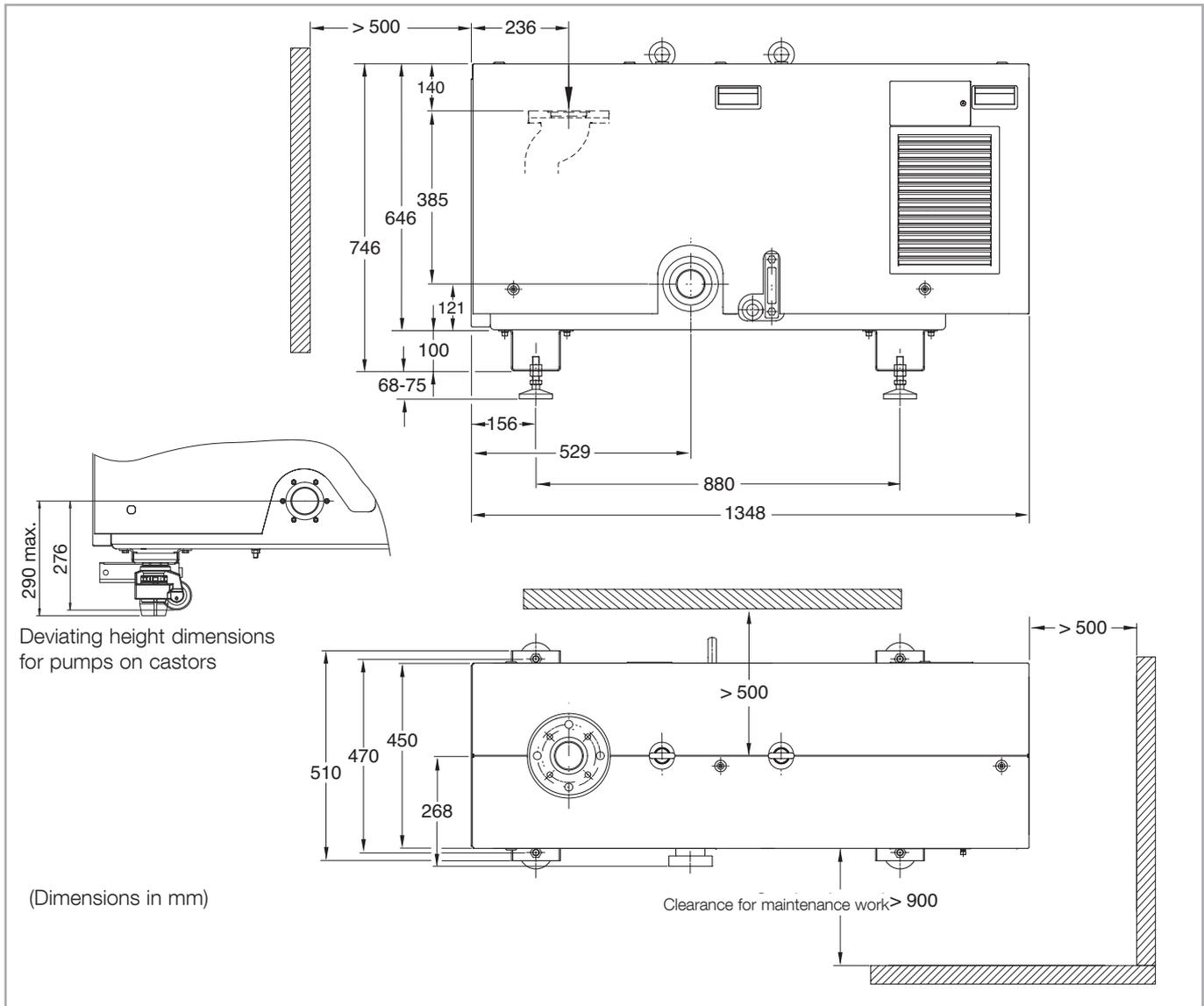


Fig. 1.5 Dimensional drawing

## 1.3 Supplied Equipment

Die SP 250 is supplied ready for installation and connection.

The pump is delivered with:

- An integrated motor.
- Installed SP-Guard with 20 meter connection cable.
- The required amount of gear oil (is supplied separately).
- An intake screen preventing the ingress of small objects into the intake of the pump.
- 2 crane eyes for transporting the pump.
- 2 cable fittings for the junction box
- Square key for disassembly/assembly of the cover and for opening the fan housing.
- Operating Instructions

Intake and discharge ports are sealed with foil. Remove this foil and also the desiccant inside before switching on the pump.

For the purpose of shipping the pump, the pump has been affixed to a special pallet. Retain this pallet in case the pump needs to be returned.

# Description

## 1.4 Built-in Accessories

### Monitoring System SP-Guard

The monitoring system SP-Guard monitors vibrations, oil temperature, oil level and exhaust pressure.

The output signals from the sensors are processed continuously by the SP-Guard. Should the SP-Guard detect an unsafe operating condition, then this is indicated through the error messaging output S2 to the connected system controller. This must cause an automatic shutdown of the pump provided the signal from the SP-Guard is processed as intended. Moreover, a message is also indicated on the display.

The SP-Guard is capable of detecting at an early stage critical operating conditions, and outputs warning messages for oil temperature, gas temperature and vibration levels of the pump to the warning messaging output S1.

The user has thus the option of introducing early enough suitable measures like cleaning the oil cooler, for example, so as to ensure trouble-free operation of the pump.

Implemented within the SP-Guard is a pump operating hours counter. The number of operating hours can be indicated on the display.

Analogue inputs are available for acquiring vibration data and temperatures. The warning and shutdown thresholds regarding these measured quantities are configured in the factory.

The signal inputs for oil level and exhaust pressure are of the digital type. In the case of the sensor for the exhaust pressure, the signal must be present for 10 seconds at a pressure of over 1200 mbar.

The following outputs are available:

- S1 - Warning messaging output
- S2 - Error messaging output
- S3 - Watchdog
- S4 - Pump ON

When the shutdown thresholds are exceeded, the reason for the failure will be indicated on the display. After having checked the likely fault causes the SP-Guard may then be reset to the monitoring mode using the reset key.

The service technician has the option of reading the most recently saved measured values from the internal memory of the SP-Guard. This information will help to analyse the reasons for the specific failure.

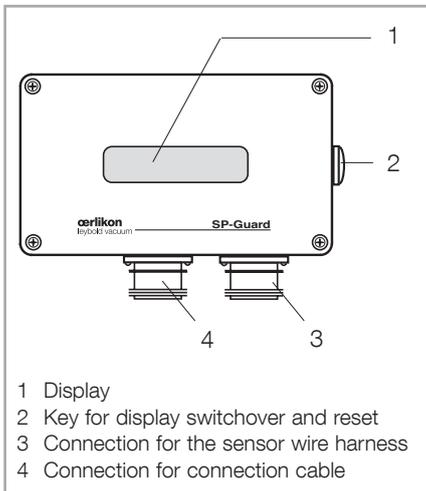


Fig. 1.6 SP-Guard

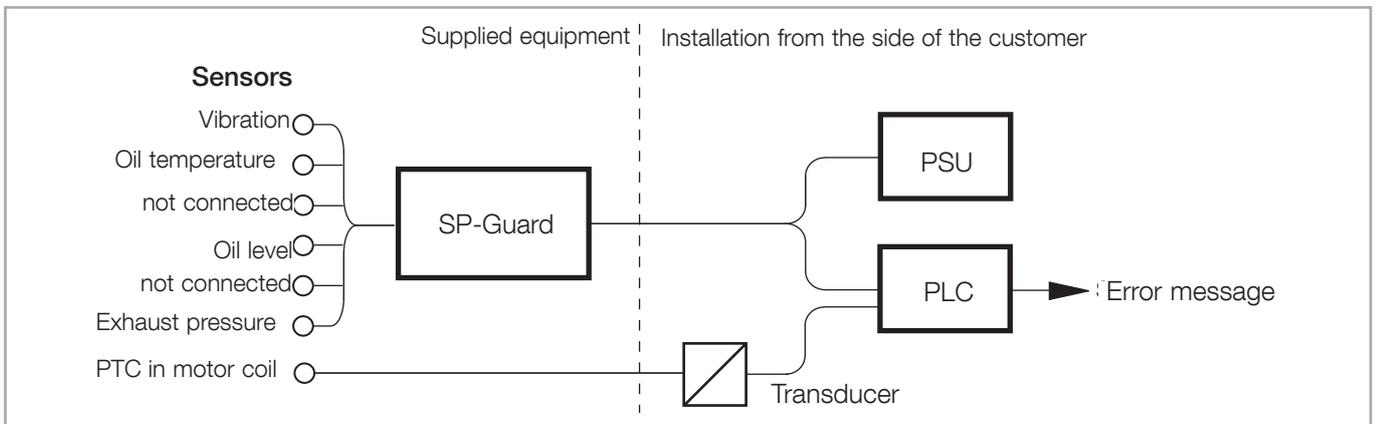


Fig. 1.7 Schematic depicting the operating principle of the monitoring system

### Manually operated or solenoid gas ballast valve

The gas ballast valve is used for the purpose of avoiding condensation within the pump.

### Purge gas facility

(only for certain pump versions)

Purge gas prevents that process gas escapes via the two shaft seals to the environment and protects components and seals against corrosion.

### Available Pump Versions: Overview

P/N, mains frequency	Pump versions	Required additional Operating Instructions
115 001 50 Hz/60 Hz	with manually operated gas ballast	
115 003 50 Hz/60 Hz	with solenoid gas ballast and purge gas for shaft seal ATEX 3i	
115 006 50 Hz/60 Hz	with manually operated gas ballast, Purge gas for shaft seal, Purge Vent Kit and 4 swivelling castors and integrated adjustable feet	300301758 Purge-Vent- Kit SP250

# Description

## 1.5 Accessories

	<b>Part No.</b>
■ Exhaust silencer with condensate drain	119 002
■ Serviceable silencer	119 003V
■ Non-return valve	119 011
■ Filter adapter 65 ISO-K	119 019
■ Roots pump adapter for RUVAC 1001/501	119 022
■ Kit for retrofitting the manual gas ballast with a 24 V DC valve	119 054V <sup>2)</sup>
■ Optional exhaust flange	119 023
■ Purge Vent Kit SP 250	119 061V
■ Purge gas monitoring <sup>1)</sup>	119 014V
■ Flushing kit <sup>1)</sup>	119 015
■ Purge gas facility	119 031
■ Set of movable castors with cross members	119 018V
■ SECUVAC valve (not suited for ATEX applications)	
24 V DC	215 205
100 - 115 V AC	215 206
200 - 230 V AC	215 207

Stability of the pump when using Leybold accessories is ensured. If other accessories are fitted then the user himself will be responsible for maintaining pump stability.

1) Only in connection with installed purge gas facility

2) 119 054V can only be used from Serial No. 31000530865.

Prior to this 119 052 must be used. 119 051 and 119 052 can only be used up to Serial No. 31000530864.

## 1.6 Wearing Parts and Original Spare Parts

- Maintenance kit level 1 (for gear oil change) EK 110000820

### Contents:

5 litres LVO 210, oil filter cartridge,  
O-ring for filter housing, gasket for oil sight glass,  
gasket for oil inlet and square key

Additional spare parts are available from the Leybold service offices.

# Transport and Storing

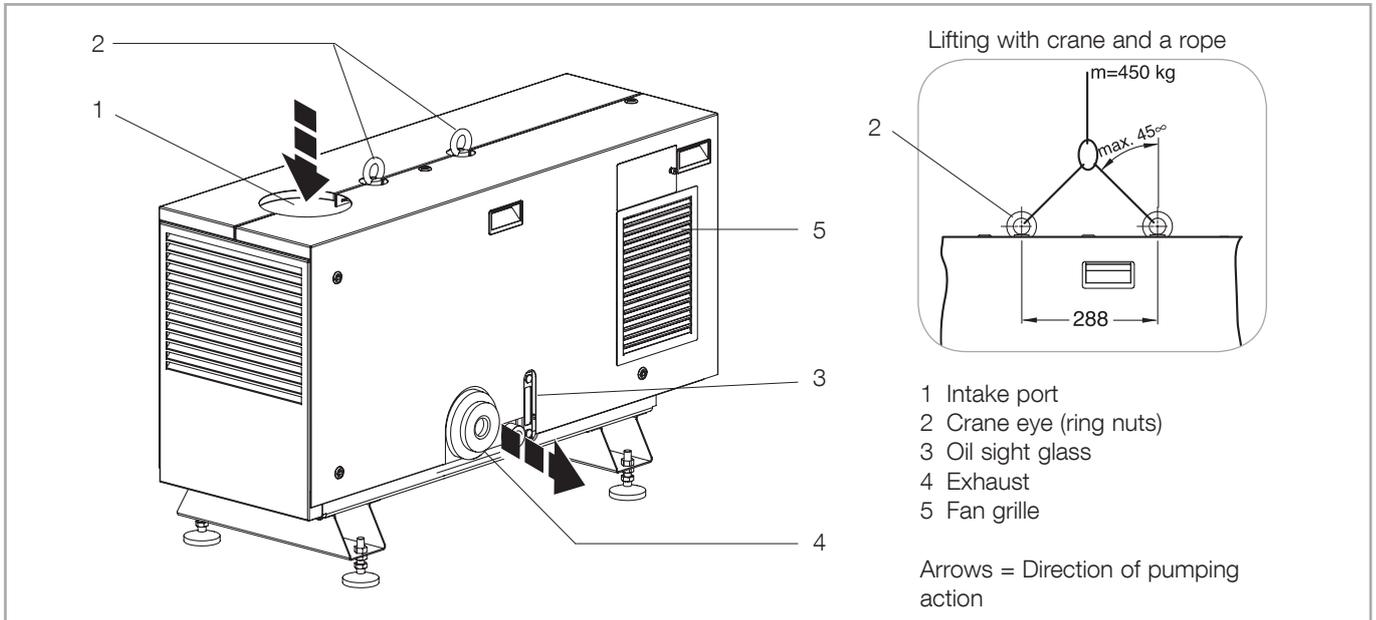


Fig. 2.1 Transport and connection components as well as inspection locations on the SP 250

## 2 Transport and Storing

Please note safety information 0.1.5 and 0.1.6.

Before transporting the pump always drain the gear oil out.

Located on the top side are as standard 2 crane eyes, in accordance with DIN 582-M16-C15N. Only these ring nuts may be used when lifting the pump with a crane. When using ropes to lift the pump at the ring nuts, please observe the maximum permissible angles as given in fig. 2.1

Transporting of pump combinations (like screw pump & RUVAC, for example) is not permitted, the ring nuts are not rated for such loads!

The ring nuts have been secured and must not be loosened.

When transporting the pump with fork lifters or alike, the pump must be secured on the supplied pallet or a suitable other pallet.

The frame of the pump has not been designed for use with fork lifters or alike since there is the risk that the pump may topple when accelerating or moving up ramps.

However, the pump's frame is rugged enough for attaching lifting means for the purpose of installing or positioning the pump within a system. When doing so note the risk of slipping and toppling.

If required secure the pump. For transporting, the silencer must be disassembled as otherwise there is the risk of toppling.

### CAUTION



### NOTICE



# Transport and Storing

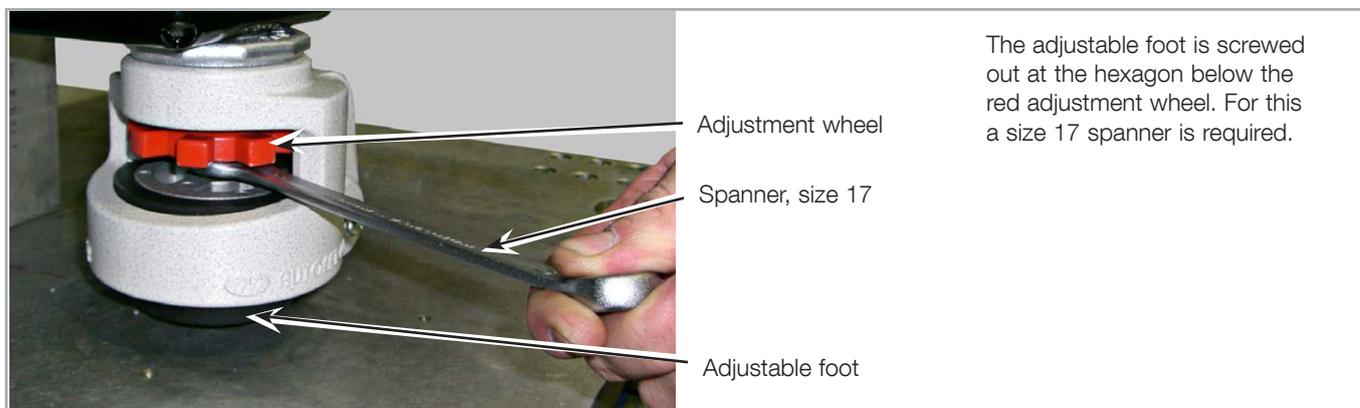


Fig. 2.2 Adjustable feet

## 2.1 Pumps with Castors

Some pump models are provided with a base frame equipped with four swivelling castors with an integrated adjustable foot and a device for fastening a drawbar.

The pump is equipped with four swivelling castors for moving, but the pump must only be transported with a forklift or crane as described in Section 2. When moving the pump with a forklift or alike, ensure that the pump is secured on the supplied palette or a suitable palette.

The drawbar is not included in the delivery but is available as an accessory. The drawbar facilitates moving the pump in confined spaces. The pump must only be moved on a level floor!

Moving to pump along sloping paths or ramps is prohibited!

At the installation location unscrew with the adjustable feet so that the pump is maintained horizontally, see fig. 2.2.

## 2.2 Storing the Pump

Before putting the pump into storage, purge the pump before switching off with an inert gas or air (depending on the specific application) for approximately 15 minutes.

Place a bag with desiccant in the discharge flange and onto the intake screen in the inlet flange, and seal off the flanges with foil. Do not place the desiccant, without the intake screen, directly into the inlet flange.

When shelving the pump for prolonged periods, drain out of the oil from the pump.

Package in the pump air-tight in polyethylene foil.

### Storage conditions

Temperature	-20 °C to + 60 °C
Storage site	dry
Maximum atmospheric humidity	95 %, non-condensing

## 3 Installation

### 3.1 Placement

The pump is not suited for being installed in explosion hazard areas. Please contact us first when planning such an application. Before installing the pump it must be disconnected from all sources of electrical power and protected against being switched on inadvertently. Only trained staff may install the pump.

---

**CAUTION**

#### 3.1.1 Floor

The foundations carrying the pump must be rated as a minimum requirement at 10,000 N/m<sup>2</sup>.

An inclination of over 10 degrees from the vertical axis is not permissible because of the risk of toppling.

When operating the pump, an angle exceeding 2 degrees from the vertical axis is not permissible.

---

**CAUTION**

The pump should be placed on a flat and level surface. Pumps with castors must only be moved and placed on a level floor.

Screw the pump feet out to such an extent that the forces are uniformly distributed. Thereafter lock the hexagon nuts at the disc shaped feet against the bottom trough.

#### 3.1.2 Air Cooling and Pump Covers

The SP 250 is mostly cooled via its housing with cooling fins on most of its area and with the aid of a radial fan.

The location where the pump is installed must be selected so that an adequate supply and discharge of cooling air is ensured. The minimum clearances which need to be maintained are given in the dimensional drawing for the pump.

As standard the pump is equipped with covers. These ensure even cooling of the pump and have besides the protective function, also a silencing effect.

The noise level of the SP 250 corresponds at ultimate pressure with fitted silencers or connected discharge line to the values given in the Technical Data. In all other operating modes and with other equipment, higher values may be attained. Suitable hearing protection measures must be introduced.

---

**CAUTION**

# Installation



## CAUTION

Surfaces under the covers of the SP 250 may attain temperatures over 70 °C.

If during maintenance work the covers are removed, there is the risk of suffering burns.

Therefore always wear the required protective clothing.

With all covers in place there only remains the risk of suffering burns at the discharge port.

---

## NOTICE



Do not operate the pump with the covers only partly in place (when disassembling one side, for example) since this will impair the steadiness of the air flow cooling the pump.

Make sure that the air cooling arrangement is not impaired. When operating the pump do not leave any items (pieces of cleaning cloth, for example) on the cooling fins of the pump chamber. Clean the cooling fins when they are found to be very dirty.

The pump may be damaged if the cooling air flow is restricted..

---

### 3.1.3 Ambient Conditions

The pump may be operated under the ambient temperatures specified by the Technical Data.

At higher ambient temperatures or in the case of a dirty oil cooler, the temperature of the oil can increase to unacceptably high levels. In the case of high ambient temperatures or in the case of dusty ambient conditions the oil cooler should be checked more often (see Maintenance).

The pump must be installed such that the side of the discharge flange remains easily accessible. From this side all maintenance and installation work can be done.

For installation locations over 3000 m above sea level please consult us.

### 3.2 Conforming Utilisation

The SP 250 has been developed specifically for the special requirements of industrial applications.

Typical areas of application are: vacuum furnaces, metallurgical systems, brazing systems, coating technology, (freeze) drying, packaging, research and development etc.

The pumps have been designed to pump air or inert gases in the pressure range between atmospheric pressure and the ultimate pressure of the pump. If other gases are to be pumped with this pump, please consult Leybold first.

### For Part Number 115 003

The inside of the vacuum pump SP 250 ATEX Category 3i in contact with the process has been specially designed and manufactured to comply with the safety requirements of Equipment Group II, Category 3 of the “ATEX Directive (Directive 94/9/EG) on the conforming utilisation of equipment and protection facilities in explosion hazard areas”.

We recommend connecting the SP-Guard as the monitoring system to the

system controller.

The pump is not suited for pumping of toxic, corrosive, combustible and/or explosive gas mixtures (except within the permissible scope of pumps certified in accordance with ATEX Category 3 inside). 

Pumps without marking must not be operated with or in explosion hazard atmospheres.

Gas mixtures with an oxygen share of > 21 percent by volume must not be pumped. We offer special pumps for this purpose.

If mixtures which are not allowed shall be pumped or in case of doubt please contact Leybold.

The pumps have not been designed to pump liquids. Suitable protection devices must be provided.

### 3.3 Connection to the System

Before installing the pump it must be disconnected from all voltage sources and protected from being switched on inadvertently (lockout/tagout). Only trained staff may install the pump.

Observe all safety regulations.

The pump must not be operated with an open intake port (risk of suffering injury by rotating parts which are within reach).

When connecting several pump systems, pressure differences between the inlet and the exhaust can cause of the rotors to turn without control. Such operation can cause severe damage and, moreover, presents a risk potential during maintenance work. Here, if required, the non-return valve should be used. In the case of parallel operation and larger vacuum chambers, there exists the risk of backwards running over a longer period of time.

The materials for the connecting lines must be capable of sustaining the medium which is being pumped.

The pipe connections shall be connected to the pump free of any mechanical tensions.

---

#### DANGER



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#### NOTICE



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#### CAUTION



# Installation

## 3.3.1 Connections at the Intake Side

Remove protection foil and desiccant from the intake port.

The connecting flanges must be clean and undamaged so as to ensure a leaktight vacuum system

At the intake side of the pump, lines which are as short as possible having a minimum nominal width of DN 63 should be used. The same applies also to components like valves fitted in the lines.

The intake line should be clean and free of oil. Dirt, like welding beads or cinder must be removed with care from the intake line.

Support the pipe if required, in particular in those cases when other components like valves, separators etc. are installed upstream of the pump. The maximum permissible weight on the intake port of the SP 250 is 50 kg.

---

### NOTICE



Use always the intake screen built-in as standard.  
Note safety information 0.7.2.

---

### CAUTION



In connection with ATEX applications, the supplied intake screen alone will be inadequate. In order to prevent the creation of mechanical sparks, an additional dust filter with a mesh of 40 µm max. will be mandatory, if from the side of the system it cannot be ensured that the pump will pump exclusively gases or vapours.

## 3.3.2 Connections at the Delivery Side (Exhaust)

It is strongly recommended to always operate the pump with a connected and suitable discharge line or with a silencer. The discharge line should be laid so that it slopes down and away from the pump so as to prevent condensate in the discharge line from backstreaming into the pump.

Alternatively a condensate separator can be provided directly downstream of the discharge flange. The filling level of the condensate separator needs to be monitored regularly so that the gas may flow out of the discharge without being obstructed.

In the case of the optionally available exhaust silencer, the condensate separator has already been integrated.

The diameter of the discharge line should at least match the diameter of the connection at the pump.

When connecting the discharge side to a discharge gas collecting line, the installation of a non-return valve downstream of the discharge is recommended. This will reliably prevent any gases from flowing back through the discharge into the pump.

Remove protection foil and desiccant from the discharge flange.

---

### CAUTION



The pressure in the discharge line must not exceed 200 mbar above the ambient pressure. The discharge line must not be blocked or constricted.

## 3.4 Electrical Connection

Please note safety information 0.2. and 0.7.10 and 0.7.11

---

### WARNING



The pump has no switching devices of its own. All protection measures in connection with the power supply need to be implemented from the side of the plant in the full responsibility of the customer.

After a mains power failure the pump will restart automatically once the power returns.

If for this reason there results in connection with the application a danger potential it needs to be ensured that a restart can only be performed after a manual reset. This applies equally **emergency** shutdowns.

### 3.4.1 Motor Protection

The electric motor must be protected with a thermal overload protection of class 20 (in accordance with a IEC 60947-4). Motor protection switches which belong to class 20 respond with a delay, after 20 seconds at the latest.

A suitable type is, for example, for 400 V/50 Hz mains PKE-XTU-32 from the company Eaton Möller.

The setting for the motor protection switch which corresponds to the local requirements can be taken from the following U/I diagram (diagram 1) for  $\Delta$ -connection (applies analogously also for  $\Delta\Delta$ - connection).

When connecting the pump in a  $\Delta\Delta$ -circuit at U/2 the values read off from the diagram ( $\Delta$ -circuit) for  $2 \times U/2$  need to be doubled.

If briefly an unacceptably high temperature should occur in the motor coils, then this condition is detected by the integrated PTC resistor. The PTC resistor is connected to the terminals 10 and 11 in the junction box (see fig. 3.1 and 3.2). Connect these terminals exclusively via a corresponding actuator (for example Eaton Möller. EMT6DBK) with electrical isolation to the pump's control system, because the sensor in the motor is not reliably isolated from the mains power side.

The insulation of the sensor cable must not exhibit a higher value but should exhibit a minimum basic insulation.

The PTC resistor provides a means of protection which in the case of insufficient cooling, a temporary failure of a mains phase or in the case of frequency variations will offer effective protection and will prevent costly damage to the motor coils.

The number of operating hours of the pump is acquired through the SP-Guard.

The local connection conditions will possibly necessitate means for the purpose of reducing the surge currents upon switching the pump on.

# Installation

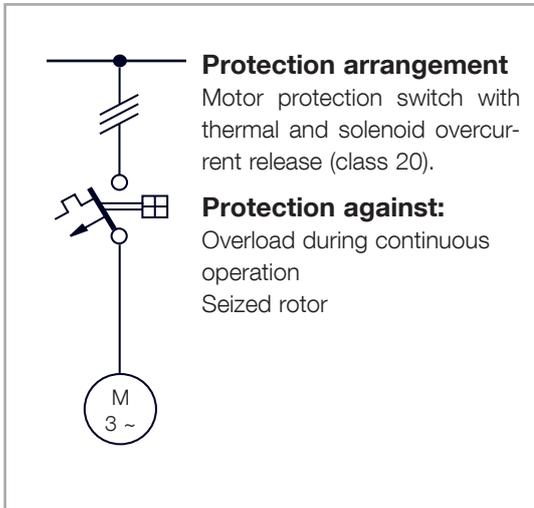


Fig. 3.1 Examples of motor protection circuits

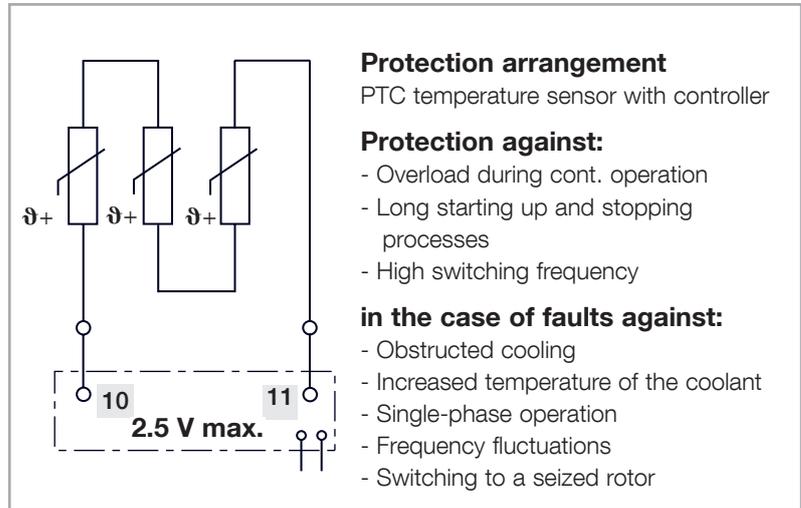


Fig. 3.2 Example for PTC temperature sensor circuit

### 3.4.2 Star/Delta Start-up Circuit

In the case of this circuit (star circuit) a lower voltage is applied to the motor coils upon switching on, resulting in a lower switch-on current.

During this phase also power and torque of the motor are lower.

In order to attain the operating levels for torque and power rapidly, the start-up phase should be as short as possible, approximately 4 to 5 seconds. Thereafter the switchover to continuous operation (delta circuit) should occur.

Here also a motor protection switch for heavy run-up (class 20) should be used.

### 3.4.3 Soft Start

In order to reduce the current taken up from the mains supply, the supply voltage to the motor may be electronically controlled during the start-up time.

Within the starting time, the motor must reliably reach its nominal values. The adjustable starting voltage should be 60% of the nominal voltage. The ramp time should be 15 seconds.

The highest switch on currents (140 A/400 V) must be taken account when selecting the soft starting unit (Siemens 3RW30, for example). In addition, note the installation instructions of the soft starter manufacturer.

### 3.4.4 Mains Connection

The mains power needs to be supplied via an external mains switch with ON/OFF key by the customer.

The mains connection needs to be provided in accordance with the type of motor protection. The mains supply must match the mains power rating of the motor.

The line cross-section for the mains power supply needs to be calculated in consideration of the cable length and the available mains circuit breaker. Using a mains power supply line having a cross-section of at least 4 x 6 mm<sup>2</sup> is recommended.

The connection cable and the two connection wires of the PTC thermistor must be rated for operation up to 105 °C.

In case the temperature resistance is lower (for example 80 °C) the individual wires in the junction box of the pump need to be protected using the enclosed silicon hose pieces against thermal stress.

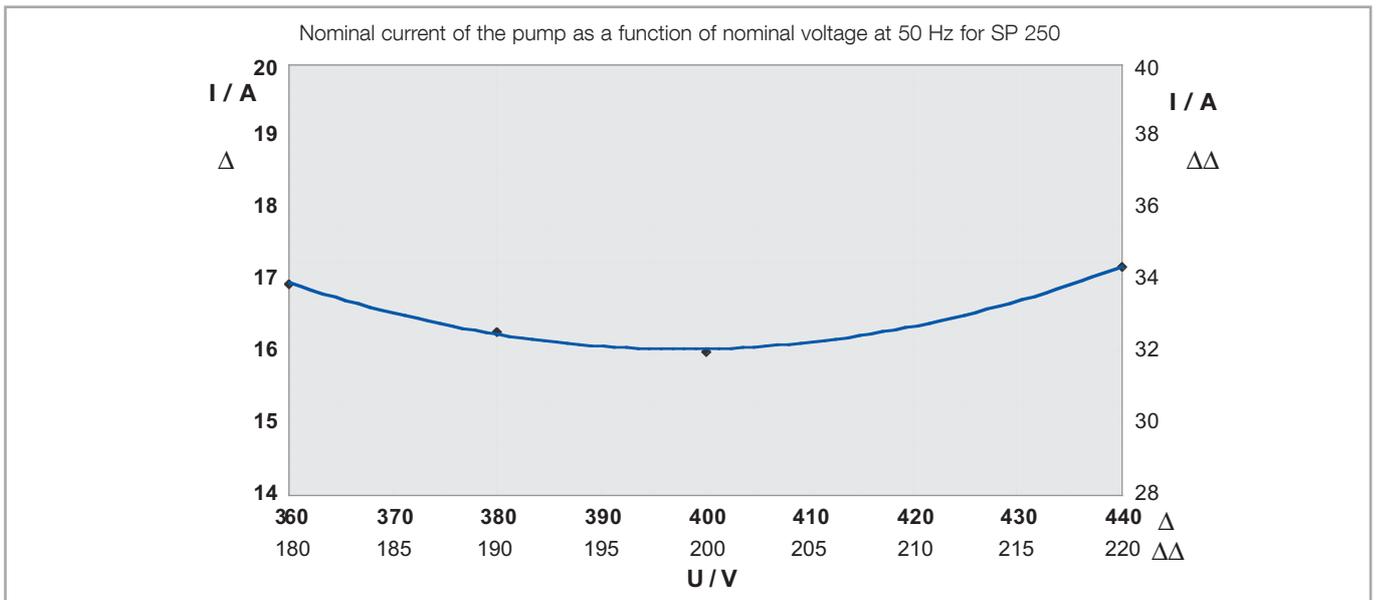


Diagram 3.1 Characteristic of the motor protection switch for delta circuit (Symbol  $\Delta$  respectively  $\Delta\Delta$ )

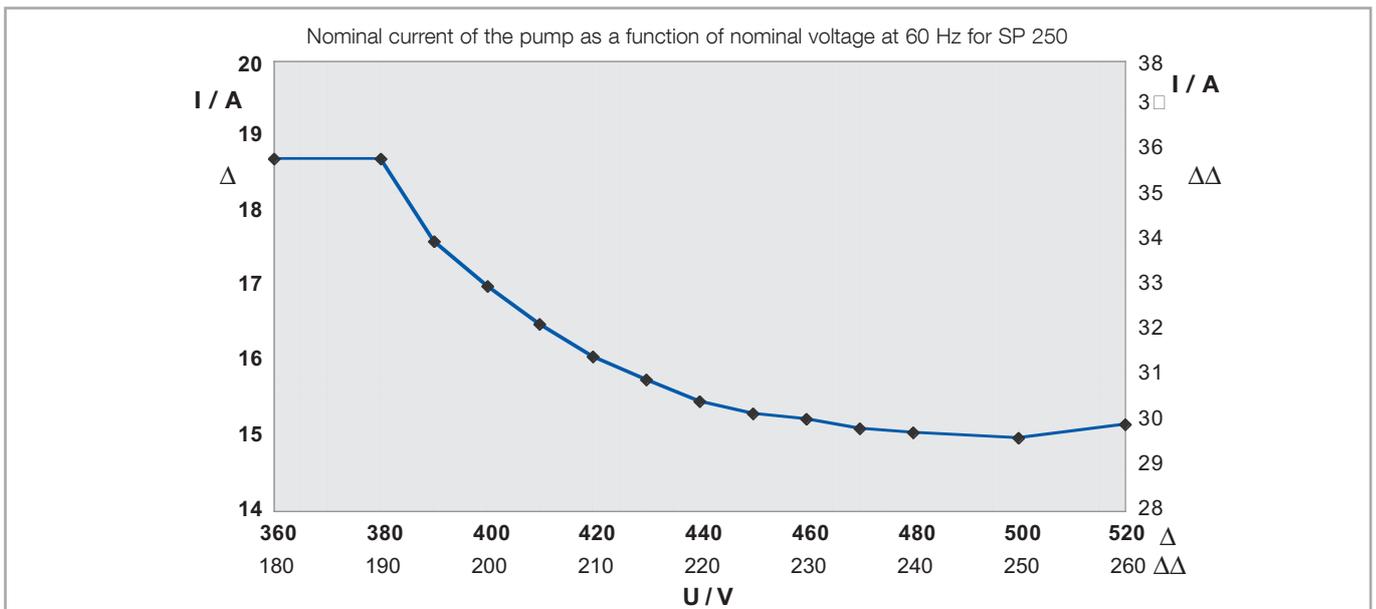


Diagram 3.1.1 Characteristic of the motor protection switch for delta circuit (Symbol  $\Delta$  respectively  $\Delta\Delta$ )

# Installation

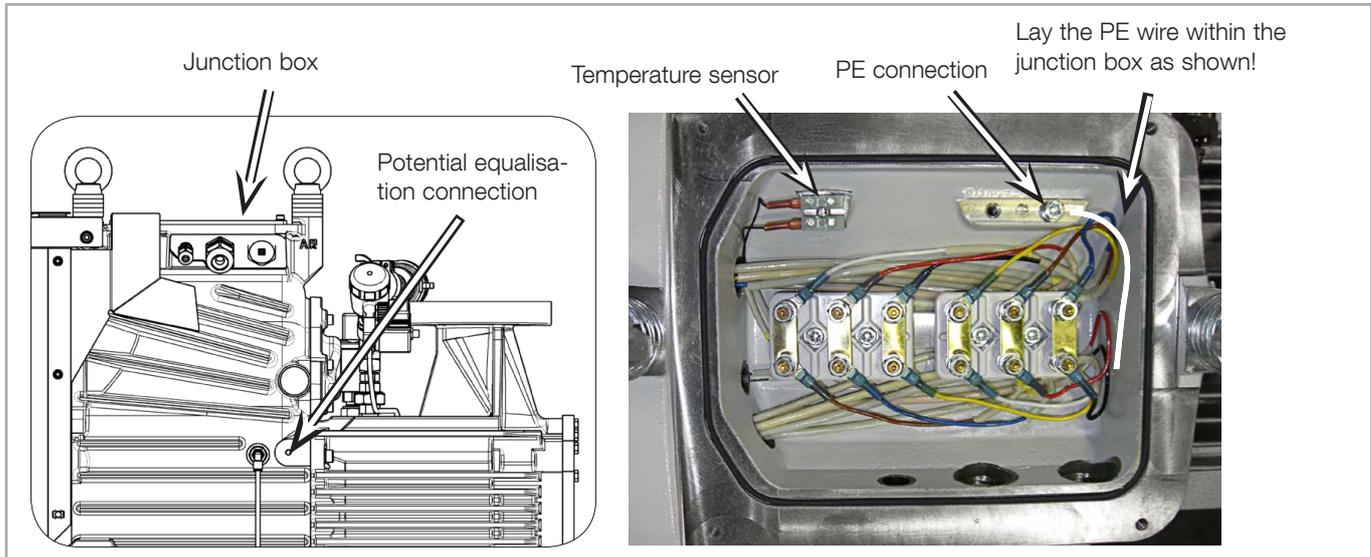


Fig. 3.3 Electrical connections in the junction box, the wires are protected by additional silicone sleeves

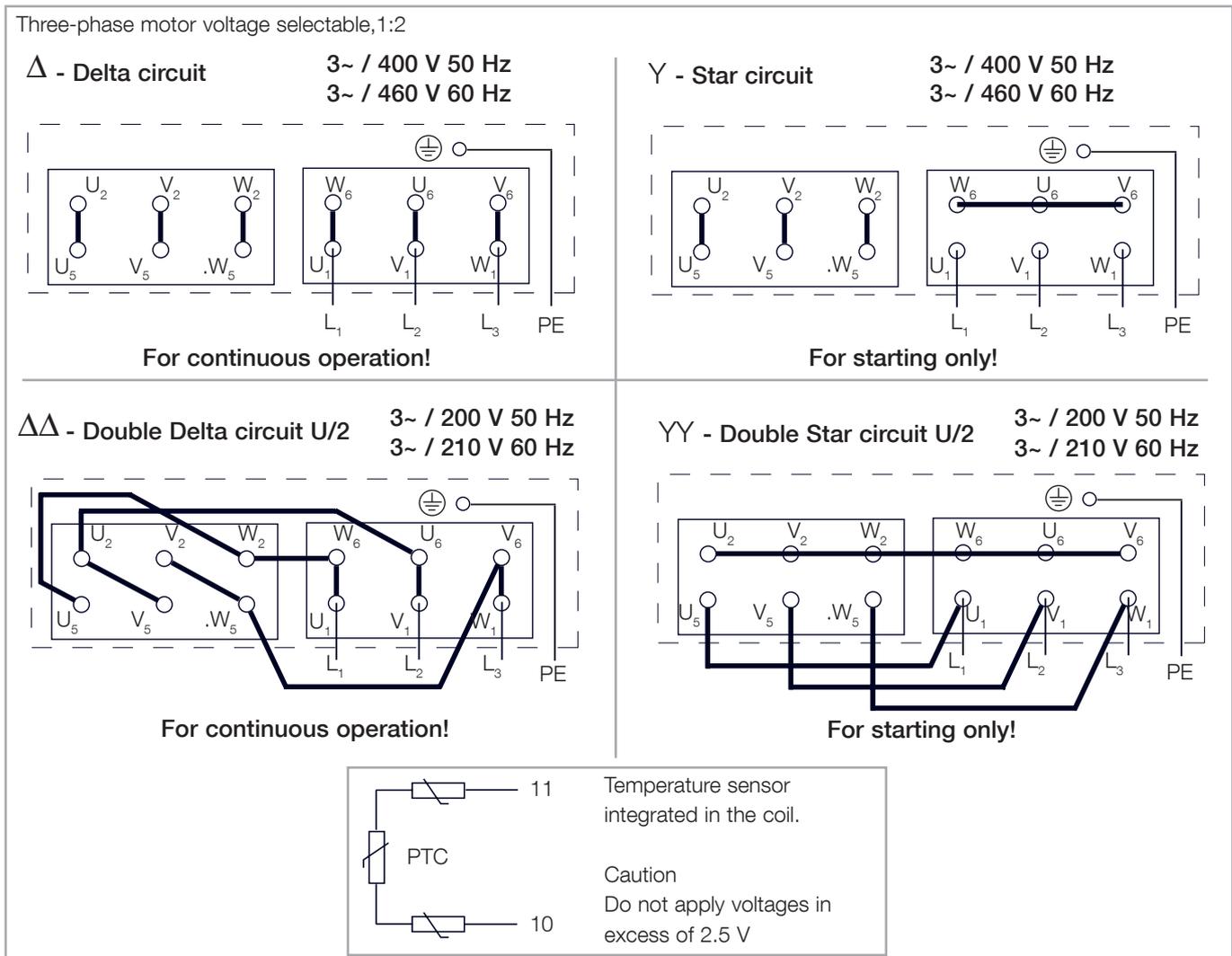


Fig. 3.4 Mains connection (connection diagrams in the junction box)

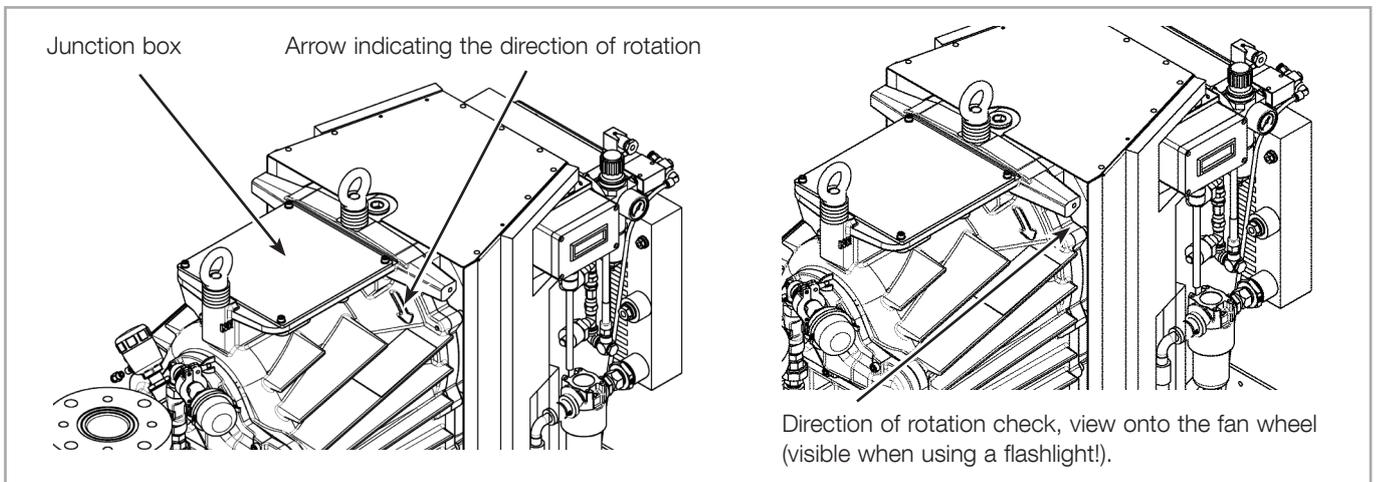


Fig. 3.5 Checking the direction of rotation

## Check the direction of rotation of the motor

During operation with an open intake flange there is the risk of suffering injury by rotating parts. For this reason do not check the direction of rotation with an open intake flange but instead vent the intake line through correspondingly switched valves.

With the fan housing open, there is the risk of suffering injury due to hot surfaces. Moreover, sufficient cooling of the pump is not ensured any more.

Except when checking the direction of rotation the pump must never be operated with its fan housing open.

Allowing the pump to run backwards with a closed intake line will immediately damage the pump. Letting the pump run backwards for over three seconds will damage the pump regardless of the conditions.

As a rule, the pumps are supplied turning in the clockwise direction on the load side, with the direction of rotation being anticlockwise for the ventilation side

For the power connecting lines from the side of the customer a clockwise rotating field needs to be ensured. Please check this with a direction of rotation measuring instrument.

The direction of rotation should be checked with two persons.

Vent in the intake line through correspondingly switched valves. Open the fan housing.

Let the pump run up briefly (for approximately 1 second) and then immediately switch it off again.

Observe the direction of rotation of the running down fan. The correct direction of rotation is indicated by an arrow in the junction box.

In the case of a wrong connection, rewire.

Close the housing again.

---

### CAUTION



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### NOTICE



---

### 3.4.5 Power Failure

**NOTICE**



When connecting the pump to a vacuum chamber, a suitable valve (electric shut-off valve, for example) needs to be connected on the intake side for interrupting the intake line so as to prevent the pump from running backwards in the event of a power failure. Otherwise the pump may suffer damage.

This valve needs to be controlled (normally closed) from the side of the system controller such that the intake line is interrupted in the event of a power failure. This prevents an uncontrolled flow through the pump.

---

### 3.4.6 Operation with a Frequency Converter (FC Operation)

FC operation serves the purpose of reducing the motors switch-on currents and serves the purpose of adapting the mains frequency to the nominal frequency of the pump.

---

**NOTICE**



During operation a frequency ranging from 30 Hz up to the nominal frequency of the pump must be set up. The nominal speed must not be exceeded. The run-up time to 30 Hz must not exceed 30 s.

As a rule, processing of the output from the temperature sensor in the motor is mandatory.

Depending on the level and quality of the output voltage from the frequency converter due to the additional heat produced by the coils, not all operating conditions may be set up continuously (back pressure and a simultaneous ambient temperature of 40 °C at maximum load, for example). For this reason, the output from the temperature sensor in the motor must be processed accordingly.

In connection with FC operation electromagnetic interference will have to be expected at significant levels. Here the personnel setting up the system must ensure that the limits laid down in the pertinent standards and guidelines are not exceeded. In order to reduce the level of electromagnetic interference, shielded motor cables, shielded cable feedthroughs, motor filters and EMC-compliant ground connections between FC and pump will be necessary.

Always also observe the information given in the Operating Instructions for the frequency converter.

### 3.5 Oil Temperature Sensor Pt 100

The temperature of the oil is influenced by the load on the pump, the ambient temperature and the cleanness of the oil cooler.

The temperature of the oil may be measured by the system controller using the standard temperature sensor Pt 100 and the SP-Guard. The Pt 100 measures the temperature of the oil downstream of the oil cooler.

The oil temperature must not exceed 70 °C.

At an oil temperature of 60 °C, the SP-Guard indicates a warning message. This message can be used for checks on a regular basis.

At an oil temperature of 70 °C, an error message is output.

If the temperature of the oil deviates during normal loads and ambient conditions from the process dependent standard values, the oil cooler should be checked to see if it has accumulated any dirt.

---

**NOTICE**

# Installation

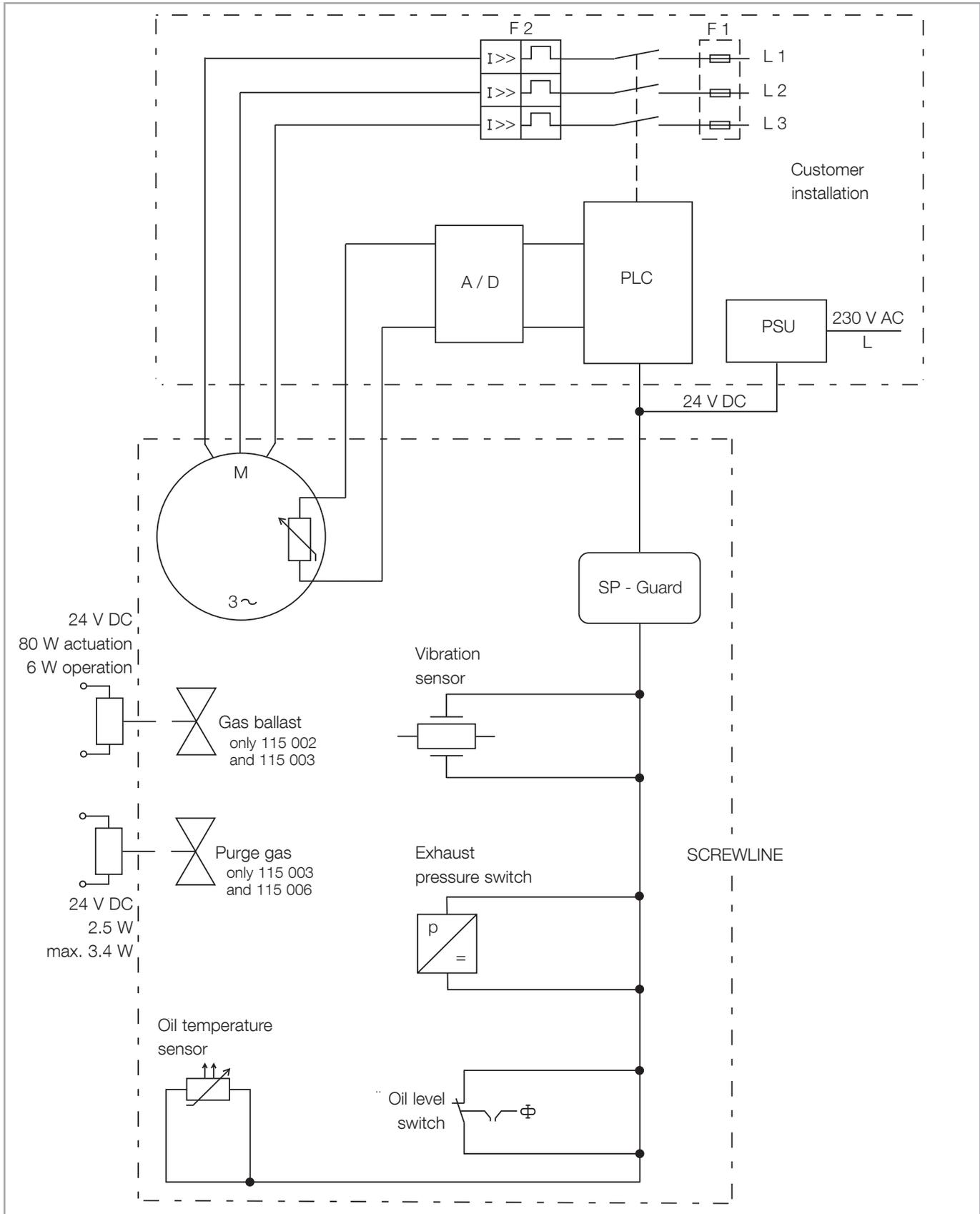


Fig. 3.6 Block diagram for the screw pump with accessories

## 3.6 Connecting the SP-Guard

Only such power supply units may be connected which comply with the requirements of protective extra low voltage with safe isolation in accordance with IEC 60364-4-41 (DIN VDE 0100-410) (PELV/SELV).

To connect the SP-Guard, the supplied connection cable must be used. The connectors must be properly locked.

The power supply unit is connected as depicted in fig. 3.8.

The SP-Guard has an internal 0.6 amp fuse. This fuse must only be replaced by Leybold personnel.

No leakage currents must be allowed to flow via the SP-Guard and the sensors. Leakage currents will be present especially in the vicinity of strong sources of electromagnetic interference like frequency converters, for example. To reduce leakage currents, an EMC compliant ground connection (copper strap, for example) must be provided between the M8 tapped blind hole at the pump and the ground rail of the plant or source of interference.

The limit of 10 V/m laid down in the pertinent standards for industrial systems must not be exceeded in the case of field-related interference.

### Pin Assignment Table for the Connection Cable

LIYCY 16 x AWG 26, black

1:	white	24 V ---
2:	brown	Housing
3:	--	Not connected
4:	green	0 V ---
5:	yellow	Run to unused terminal
6:	grey	Electronics GND
7:	pink	Run to unused terminal
8:	red	Run to unused terminal
9:	blue	Run to unused terminal
10:	black	Run to unused terminal
11:	violet	0 V (GND for PLC controller)
12:	grey/pink	Switching output S1 (warning)
13:	red/blue	Switching output S2 (error)
14:	white/green	Switching output S3 (watchdog)
15:	brown/green	Switching output S4 (pump on)
16:	yellow/brown	0 V (GND for PLC controller)
17:	--	Not connected
Shield		For connection, see fig. 3.8

### CAUTION

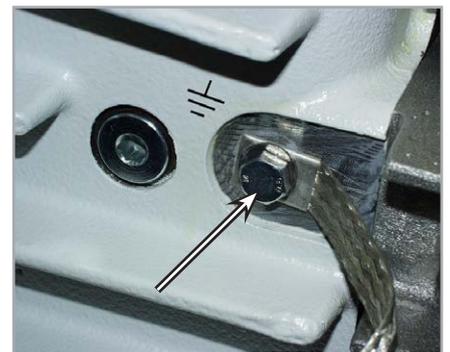


Fig. 3.7 Ground connection example

# Installation

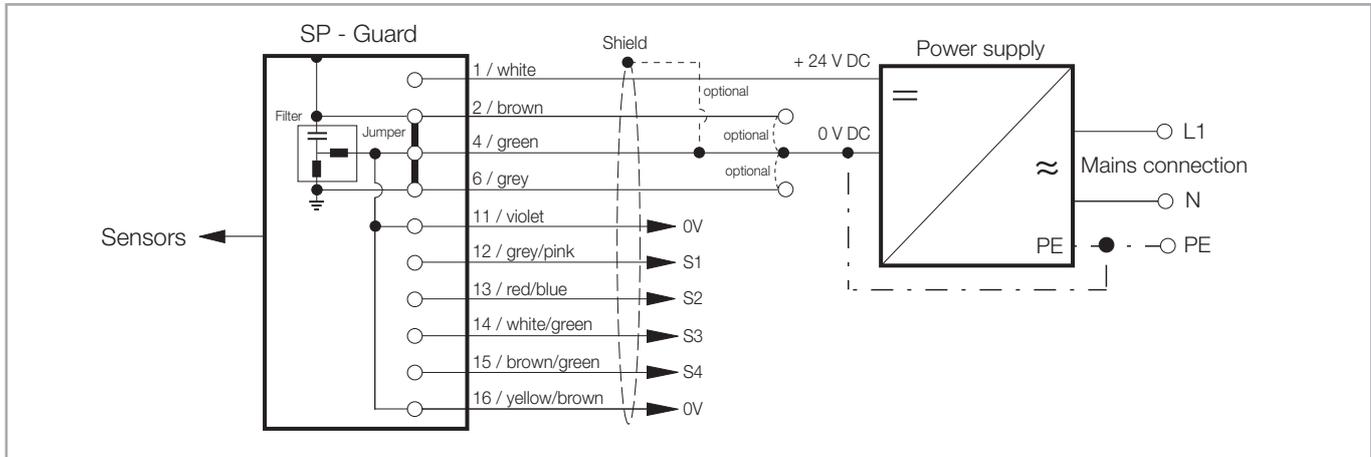


Fig. 3.8 Electrical connection - Power supply for status outputs

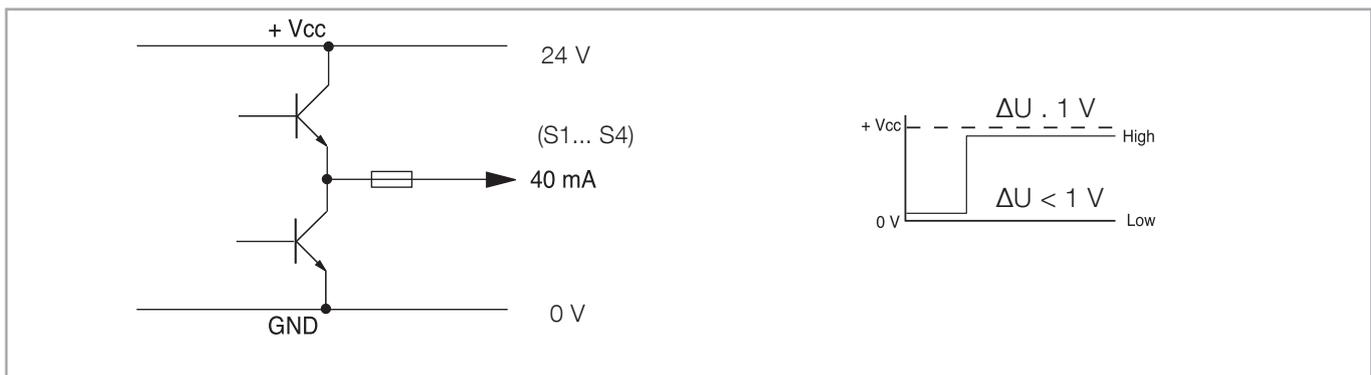


Fig. 3.9 Signal output diagram

## CAUTION



Do not unplug the connectors of the SP Guard while still being under voltage. There exists the risk of ignition!

All connectors are protected against mechanical influences thanks to the housing covers. Do not operate the pump without its covers!

### Outputs at the SP-Guard (S1 - S4)

The outputs S1 - S4 of the SP-Guard are provided with push-pull driver output stages (transistor connection between +Vcc and GND). Correspondingly, the high level is at 1 V below the power supply voltage level and the low level is at approximately 1 V.

The maximum current rating is 40 mA.

The outputs are protected by means of semiconductor fuses.

## Status Table for the Switching Outputs

		Outputs			
	Designation	Warning	Failure	Pump on	Watchdog
	Abbreviation	S1	S2	S4	S3
	Plug contact	12	13	15	14
Status Failure/Warning	Status Rotor				
-/-	standstill	high	high	high	hi-lo-hi (1s)
-/-	turning	high	high	low	hi-lo-hi (1s)
Warning level exceeded	low	low	high	high	hi-lo-hi (1s)
Warning level exceeded	turning	low	high	low	hi-lo-hi (1s)
Failure level exceeded	standstill	low	low	high	hi-lo-hi (1s)
Failure level exceeded	turning	low	low	low	hi-lo-hi (1s)

switch logic = off (default)

The failure messaging output S2 is active (low) until being reset. The warning messaging output S1 remains active as long as the warning threshold is exceeded (no saving of the status).

During the start-up phase of the pump, the sensor signals are processed differently so that displayed values may exceed the parameter values stated in the table.

## Parameter values

Parameter	Default settings SP 250	Unit	Description
a	100	digits	Warning limit, vibrations
b	150	digits	Failure limit, vibrations
c	10	0,2 s	Hysteresis, vibration meas.
d	60	°C	Warning limit, oil temperature
e	70	°C	Failure limit, oil temperature
o	15	digits	“Pump on” threshold

# Installation

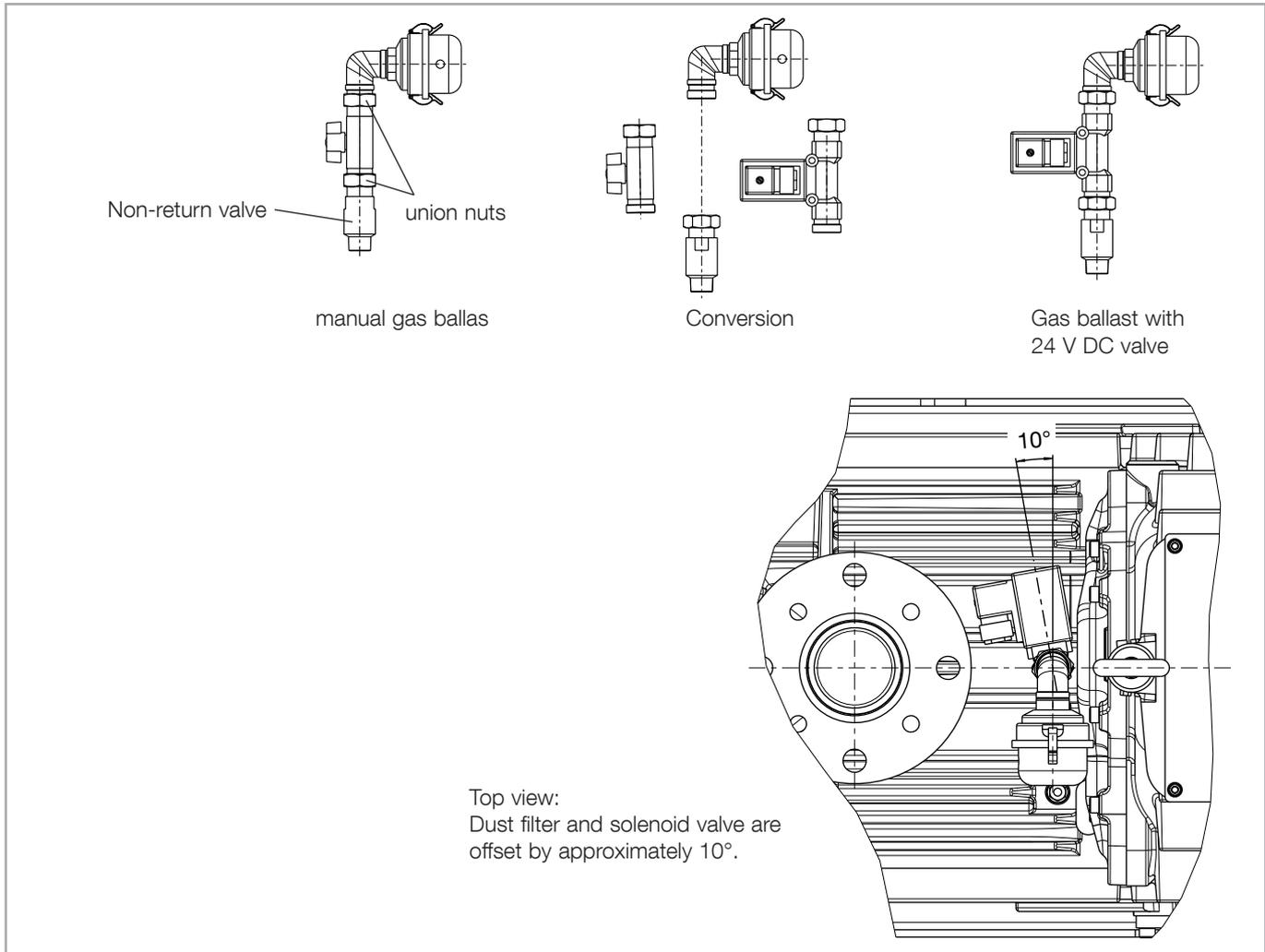


Fig. 3.10 Retrofitting the manual gas ballast with a 24 V DC valve

## 3.7 Retrofitting the Manual Gas Ballast with a 24 V DC Valve

(for variants delivered with manual gas ballast only)

### NOTICE



When loosening and tightening the union nuts, always use a second spanner above the union nut for holding back. No torque may be applied to the non-return valve. The non-return valve has been glued in ensuring a tight seal.

Unscrew the union nuts (30 mm spanner) and remove the manual gas ballast actuator.

Reassemble the entire unit with the solenoid actuator.

## 3.7.1 Connecting the Electro-pneumatic Gas Ballast Valve

(only for certain pump versions)

Connect the valve as shown in the Figs. below. The valve is normally closed.

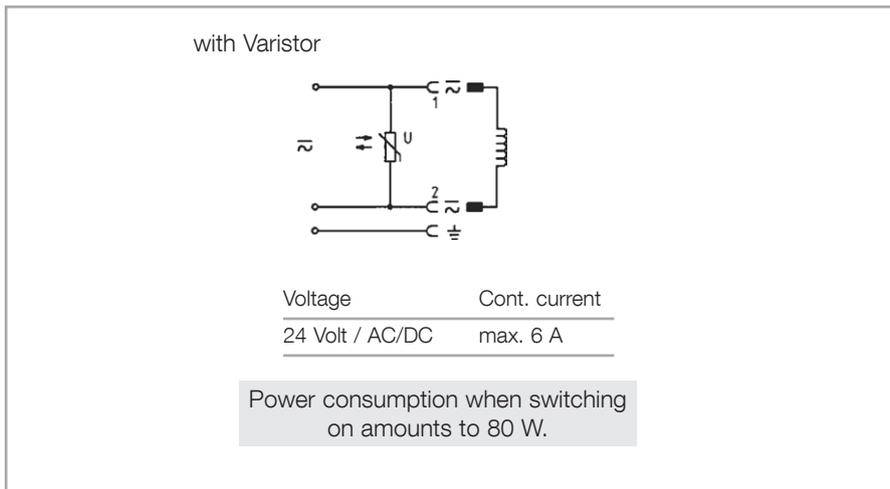


Fig. 3.11 Electrical connection at the solenoid valve

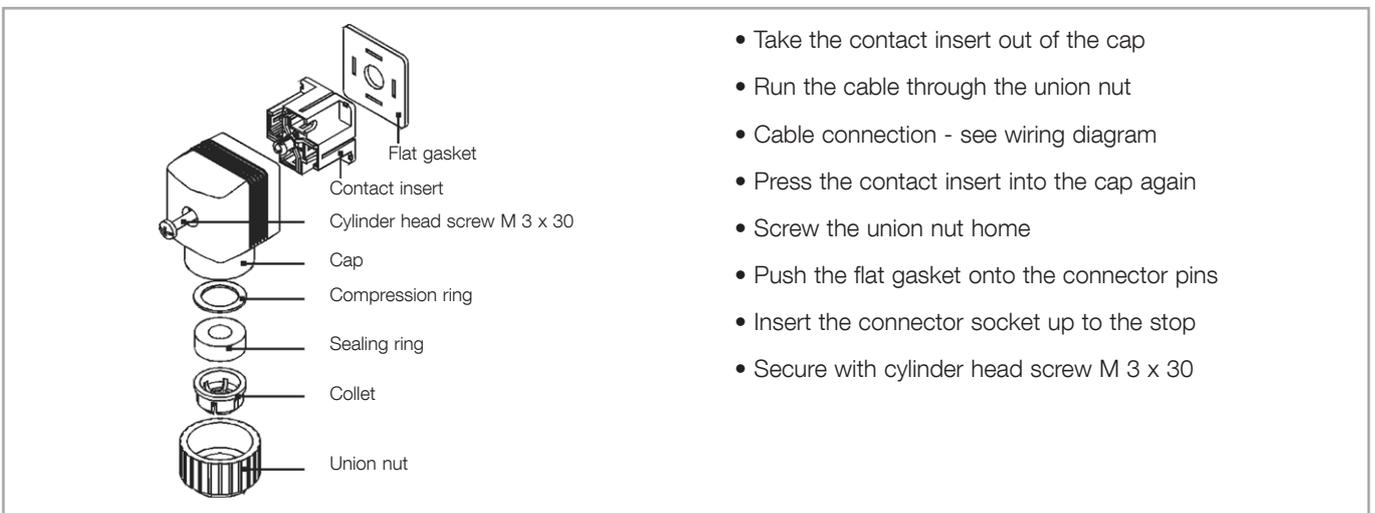


Fig. 3.12 Fitting the connector

# Installation

## 3.8 Connecting the Purge Gas Valve

(only for certain pump versions, see Section 1.4)

In the case of ATEX applications conforming utilisation requires mandatory operation with purge gas.

Connect the valve as shown in the Figs. below. The valve is normally closed.

Connect the purge gas: admission pressure into the pressure reducer 3-10 bar (to be provided from the side of the customer).

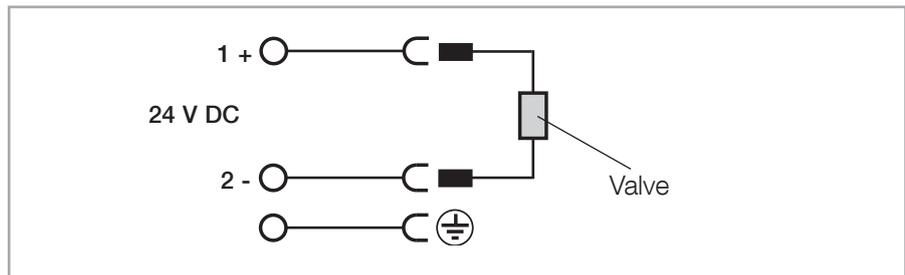


Fig. 3.13 Connection of the connector at the switch-on valve

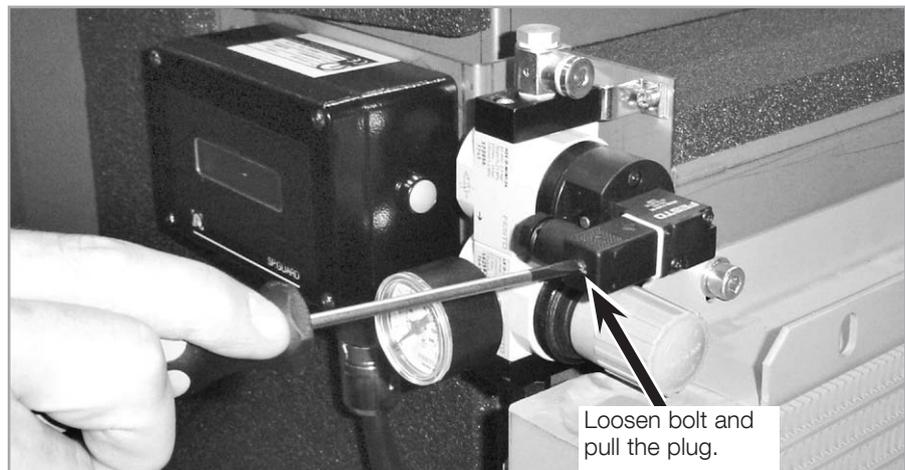


Fig. 3.14 Connecting the connector at the purge gas valve

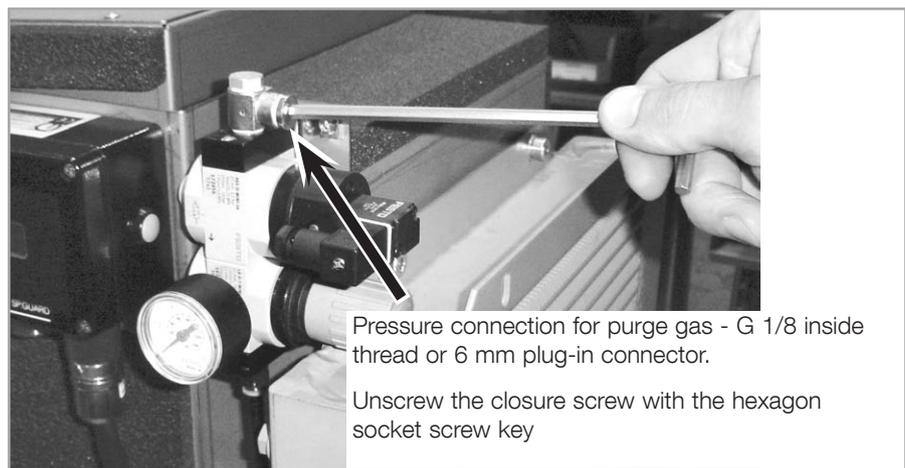


Fig. 3.15 Connecting the purge gas

## 4 Operation

### 4.1 Start-up

The pump must only be commissioned by trained staff.

---

**CAUTION**

#### 4.1.1 Oil Filling for the Gear

The SP 250 is supplied without oil in its gear. Before commissioning, the separately supplied gear oil must be filled into the gear.

---

**NOTICE**

When doing so make sure that all aids used are clean so as to avoid contaminating the oil.

Use only lubricating oil which has been approved by Leybold.

The gear oil should be filled in at room temperature. At lower temperatures, the oil is thicker so that there then is the risk of overfilling gear chamber with oil.

For filling in oil, the cover section on the discharge side must be disassembled see fig. 4.1. For this unlock the closure screws at the cover and remove the cover section.

For the closure screws you will require a special square key. This key is included in the delivery.

Remove the oil fill plug and fill in the lubricant. When doing so, make sure that the oil level, after filling, will be at the level of the maximum Mark during standstill (see fig. 4.2) of the pump.

The entire oil filling quantity amounts to 7 litres. Since after testing and draining the lubricant, some oil remains within the pump only approximately 4 litres of oil are filled in during initial commissioning and after the oil change.

Overfilling the gear chamber can result in leakages through the drain and also into the pump chamber.

Clean the oil fill port and screw the oil fill plug in again using a gasket which is in perfect condition.

The oil fill port must be sealed air-tight.

For checking the oil level and for changing the oil see Section 5.2.

When switching the pump on and off the oil level may fluctuate visibly. During operation of the pump the oil level will be between the maximum and the minimum mark. As soon as the oil level during operation of the pump drops to the minimum mark, oil must be topped up.

During operation the oil level will be approximately 15 mm below the standstill level.

# Operation

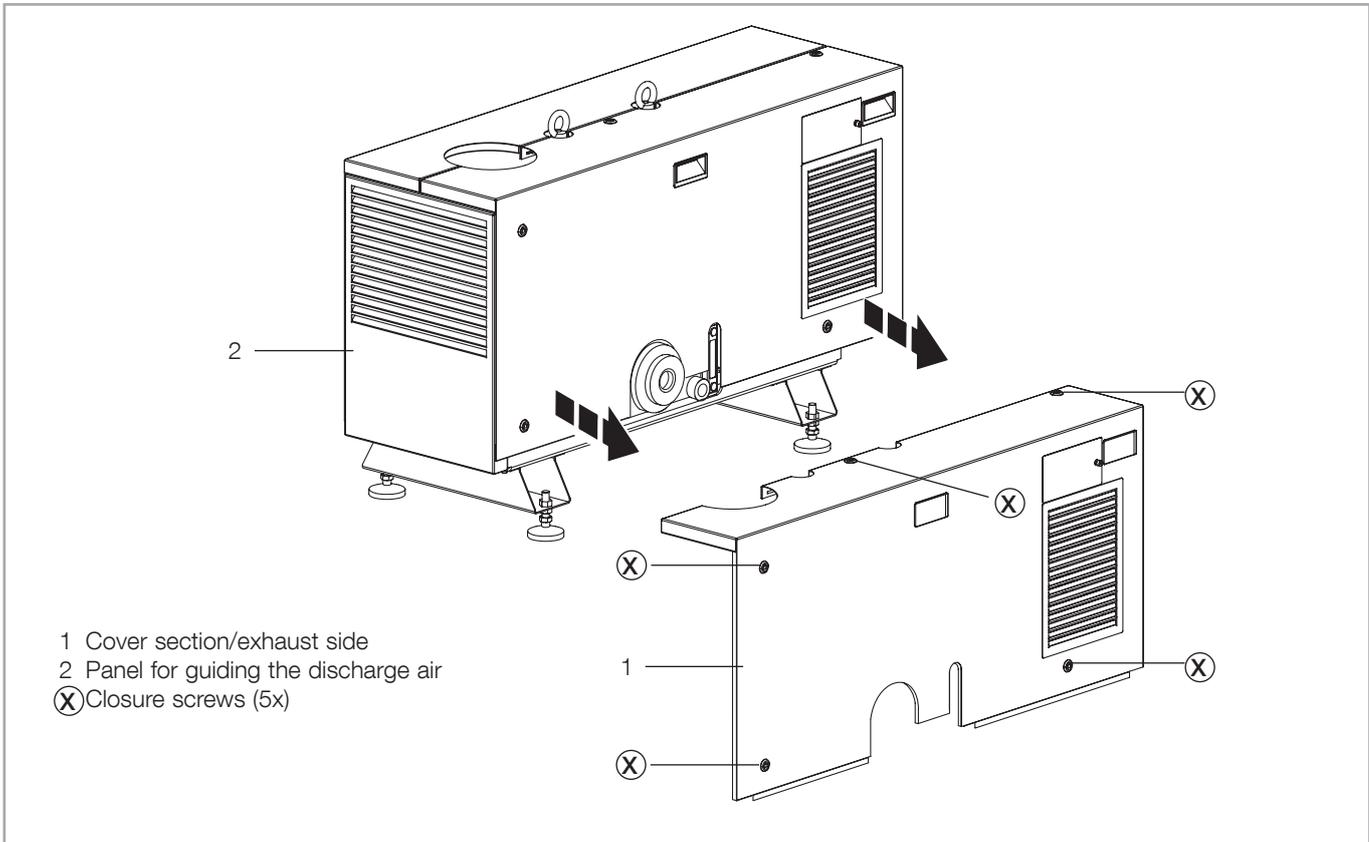


Fig. 4.1 Unlocking the closure screws and removing the cover section

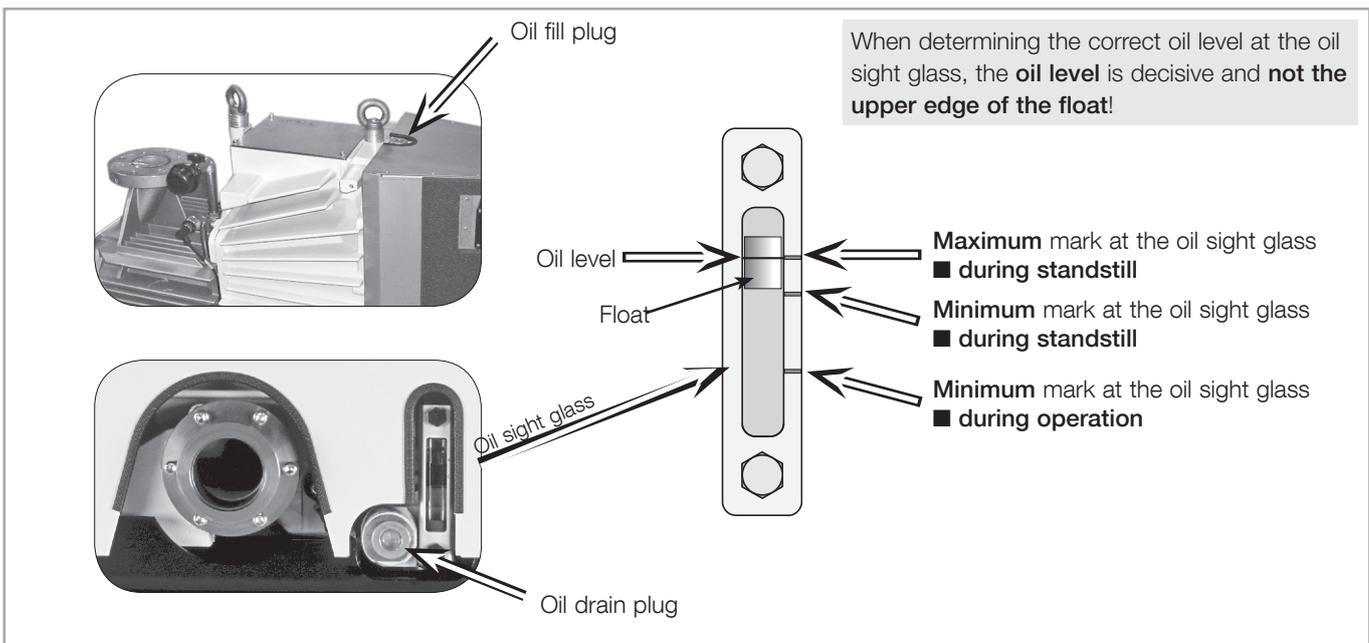


Fig. 4.2 Oil level at the oil sight glass after the SP 250

After having filled in the oil, the cover must be fitted once more.

The two cover sections are fitted in the reverse order. Here the EU-shaped profile needs to engage in the chamfer of the bottom trough. This will ensure that the cover halves are properly seated.

#### 4.1.2 Switching the Pump On

The pump may only be switched on after it has been completely assembled and with the fan's housing closed.

Operation without intake line and discharge line or silencer is not allowed.

In the discharge line no pressure  $> p_{dis} = p_{amb} + 200 \text{ mbar}$  must be allowed to build up even if the discharged gases need to be collected or contained.

Make sure that the gas flow at the discharge is not blocked or restricted in any way.

Depending on the pump version switch on

- power supply for the SP-Guard
- gas ballast
- purge gas.

Then switch on the pump.

Start the pump only six times per hour at the most so as to avoid overloading the motor.

Between pumping chamber and gear, the pump has been equipped with non-contacting seals. These seals have been provided with a vent at the side of the pump. Small quantities of gear oil can escape from this vent. This will in no way influence safe operation of the pump.

Please note safety information 0.4.7.

The gear housing is vented in the vicinity of fan wheel through two channels on the side opposite the exhaust. By design, small amounts of gear oil may escape through this vent. This will not adversely affect operation of the pump.

---

#### CAUTION



---

#### NOTICE



## 4.2 Operation

The pump should normally be operated continuously. If possible do not switch the pump off for less than one hour. In the case of process interruptions preferably operate the pump with the inlet shut off, since during operation at ultimate pressure power consumption will be minimal.

The pump will have attained its operating temperature about 30 minutes after starting.

Before pumping condensable vapours the pump should have attained its operating temperature first.

---

### NOTICE



The highest permissible intake pressure is 55 mbar above ambient pressure.

The permissible pressure at the discharge flange is

$p_{\text{dis}} = p_{\text{amb}} + 200 \text{ mbar} / - 50 \text{ mbar}$ . Make sure that the gas flow at the discharge is in no way blocked or restricted and that no pressure can build up.

---

After having commissioned the pump and after the pump has been at standstill for a longer period of time, the pump may generate more noise than usual. This noise is caused by the low viscosity of the oil at low oil temperatures. As the oil temperature increases the noise level will drop. The increased noise level will not adversely affect the operational reliability of the pump.

### 4.2.1 Operation with SP-Guard

During constant pump operation, the vibration levels will commonly range between 40...60 digits.

During the switching on process, these values may be exceeded considerably for the few seconds. This has been taken into account by the SP-Guard and will not cause a shutdown of the pump.

The SP Guard receives a “pump running” signal from the vibration sensor. With overriding the “limit pump on” threshold the sensor outputs the “pump running” signal. This is when the hours counter starts.

With a faulty vibration sensor or connection the pump may be running without corresponding feedback signals from the SP Guard. Thus we recommend to synchronize the “pump on” signal of the higher-level control with the “pump running” signal of the SP Guard and output a corresponding warning or error message, if necessary.

**In the case of ATEX operation** an error message must be output, which results in shutting down the pump.

### Resetting the SP-Guard

A reset will only be possible after the fault cause has been remedied.

In order to reset the SP-Guard after a malfunction, operate the pushbutton located on the right-hand housing side as follows: Press the pushbutton - long (3 seconds), and then short twice. A confirmation of the resetting process will be indicated on the display for approximately 5 seconds.



Fig. 4.3 Manually operated gas ballast valve

## Status Messages on the Display of the SP-Guard

The number of operating hours is constantly indicated on the display.

Through the display selector key it is possible to query either the oil temperature (**Oil temp**), the power supply voltage (**Power Sup.**) and the vibration signal (**Vibration**).

In the case of a shutdown, the reason for the shutdown is displayed.

## 4.2.2 Gas Ballast Operation

(only for certain pump versions, see Section 1.4)

The gas ballast valve is used for the purpose of avoiding condensation within the pump. To be effective, this requires the pump to attain its operating temperature.

When actuating the gas ballast valve wear gloves since increased temperatures are present within the cover.

In case the power supply for the pump fails or if the pump is to be shut down, a possibly present external gas feed from the side of the system must be stopped.

Observe safety informations 0.4.4 and 0.4.5.

### CAUTION

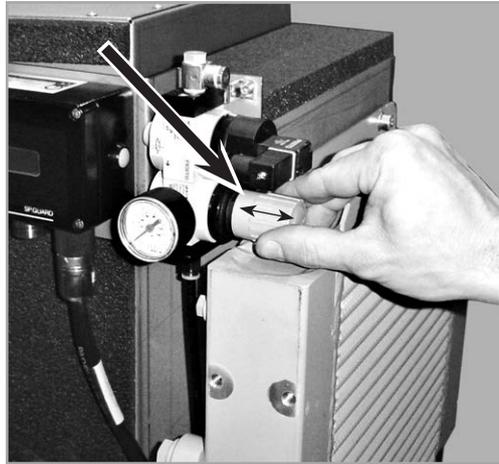


## Manually operated gas ballast valve

A 90° turn of the knob will suffice for completely actuating the gas ballast valve, the gas ballast valve is either open or closed, see fig. on top.

## Electro-pneumatic gas ballast valve

See Fig. 3.11 to 3.12. The valve is normally closed.



To adjust, pull the blue adjustment knob to the right, set to 2.5 bar, and for the purpose of securing the adjustment knob, push it to the left and arrest it.

Fig. 4.4 Adjust the pressure reducer

### 4.2.3 Purge Gas Operation

(only for certain pump versions, see Section 1.4)

In order to ensure full protection by the purge gas, the inlet pressure of the purge gas into the pressure reducer must be within the range of 3 to 10 bar.

At the pressure reducer, a system pressure of 2.5 bar needs to be set up. At this setting there results a purge gas flow of approximately 20 Std. l/min.

Always switch on the purge gas first and then the pump.

After having switched off the pump, the seals should be purged at least for one further hour with purge gas. Depending on the type of process gas which was pumped, an even longer purging time may be required.

**VORSICHT**



During the purging time, the blocking facilities installed in the exhaust line must be open, as otherwise and unacceptably high pressure might build up within the pump.

At the maximum permissible pressure difference between the exhaust of the pump and atmosphere of +200 mbar, a maximum purge gas flow of 8 Std. l/min may escape into the environment.

When using nitrogen as the purging gas, ensure sufficient ventilation of the location where the pump is installed.

Operation with purge gas does in no way influence the pumping speed of the pump.

The purge gas flow is continuously monitored while the SP Guard is supplied with voltage. Therefore the SP Guard displays an error message when the pump is at a standstill and there is no gas flow. Thus we recommend the following power-off sequence: pump, SP Guard, purge gas. Switch on the pump in reverse order.

An error message will be displayed (and must be acknowledged), if the purge gas will be turned off prior to the SP Guard or turned on after the SP Guard.

## 4.2.4 Regular Checks

(Note also Section 5 “Maintenance”)

Reliable and safe operation is ensured when running the following checks regularly:

- Oil level check
- Check on the oil cooler for accumulated dirt
- Emptying the condensate separator (optional)
- Checking the readings on the SP-Guard (temperatures and vibration levels)
- Cleaning the filter at the gas ballast valve (optional)
- Cleaning the intake screen
- Checking the dust filter (optional) and cleaning as required

**In the case of ATEX applications** we recommend keeping a log on the regular checks. Stop operating the pump when the SP-Guard displays a warning.

A wire-mesh filter is located in the pump's intake port to act as an intake screen for foreign items. It should be kept clean at all times in order to avoid reduction of the pumping speed.

For this purpose, disconnect the intake line, remove the intake screen from the intake port and clean it in a suitable way. If the intake screen is defective, replace it.

The cleaning intervals depend on requirements. If large amounts of abrasive materials occur, a suitable dust filter should be fitted into the intake line.

The interval between the regular checks will depend on the ambient conditions and the process in each case and needs to be defined based on experience gained during operation. The temperature of the oil and the dirt accumulated on the oil cooler will have to be checked more frequently when the pump is being operated in a dusty environment. If much condensate is collected, the condensate separator will have to be checked regularly.

## 4.3 Switching Off/Shutting Down

Close the intake line

Switch the pump off

The pressure in a pump which has been switched off will increase within a few seconds to the level of the discharge pressure (normally = ambient pressure). The SP 250 is not equipped with any means to protect the vacuum. For this reason use, if needed, a valve (anti-suckback valve) fitted in the intake line which will automatically close the intake port of the pump upon standstill of the pump (for example, SECUVAC valve).

---

### NOTICE



In order to prevent damage due to standstill of the pump, a post operation phase of at least 15 minutes with the gas ballast open is recommended after termination of the process, if the process gas contains corrosive, condensable substances or substances which tend to form deposits.

In the case of prolonged standstill times (over three weeks) further measures besides letting the pump run idle need to be introduced for the purpose of avoiding corrosion due to standstill, see Section 2 "Storing".

For this please contact Leybold for advice.

---

Depending on the pump version switch off

- power supply for the SP-Guard
- gas ballast
- purge gas

## 5 Maintenance

During all maintenance and servicing work on the pump, the pump must be disconnected from all sources of electrical power. The pump must be reliably prevented from running up inadvertently (lockout/tag out).

All work within the pump should be left to suitably trained staff. In this context we would like to inform you about practical seminars offered by Leybold in which maintenance, repair and testing of the SP 250 are covered by qualified instructors. Improperly performed maintenance or repair work will void the CE and ATEX conformity and void any warranty claims.

In the case of ATEX applications, an electrically conducting link between pump chamber cover, discharge flange and the housing is absolutely mandatory! After having worked on the pump chamber this connection must be checked. For this use a suitable measuring instrument and measure the resistance of the connection which must be less than 100 Ohm.

Gas must not flow backwards through the pump since this might cause the rotors to turn. For this reason always vent the vacuum chamber to exhaust pressure or ensure, by installing suitable valves, that the vacuum chamber and the lines will be separated reliably from the pump.

If the pump has been pumping harmful substances, determine the nature of hazard and introduce suitable safety measures.

Never operate the pump with an opened pump chamber or fan cover. There is a risk of suffering injury.

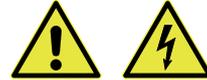
Note that the surface of the pump can get hot. Leave the pump to cool down or wear suitable protective clothing.

When disposing of waste oil and used oil filters observe the applicable environment protection regulations.

Use only original spare parts from Leybold.

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### WARNING



### NOTICE



## 5.1 Checking the Oil Level

The intervals between the regular checks should be based on the ambient conditions and your experience.

Upon switching the pump on and off, the oil level may fluctuate visibly.

With the pump at standstill the oil level must be between the maximum and the minimum mark (see fig. 4.2). As soon as the oil level during operation of the pump drops to the minimum mark for operation, oil must be topped up.

When determining the correct oil level at the oil sight glass, the oil level itself is decisive and not the upper edge of the float!

### 5.1.1 Oil Change and Oil Filter Change



#### CAUTION

While it is still warm, the oil can cause burns. Use the necessary protection equipment.

Change the oil while it is still warm and only while the pump is at standstill. Place a sufficiently large collecting vessel (about 20 litres) under the pump.

When disposing of the waste oil observe the applicable environment protection regulations.

#### NOTICE



Use only lubricants approved by Leybold.

---

To change the oil, the cover section on the discharge side needs to be disassembled, see fig. 4.1.

Unscrew the oil drain plug and the oil fill plug and drain out the oil.

Clean the sealing surface and firmly screw in the oil drain plug using a gasket which is in perfect condition. Wipe off any oil residues on the housing.

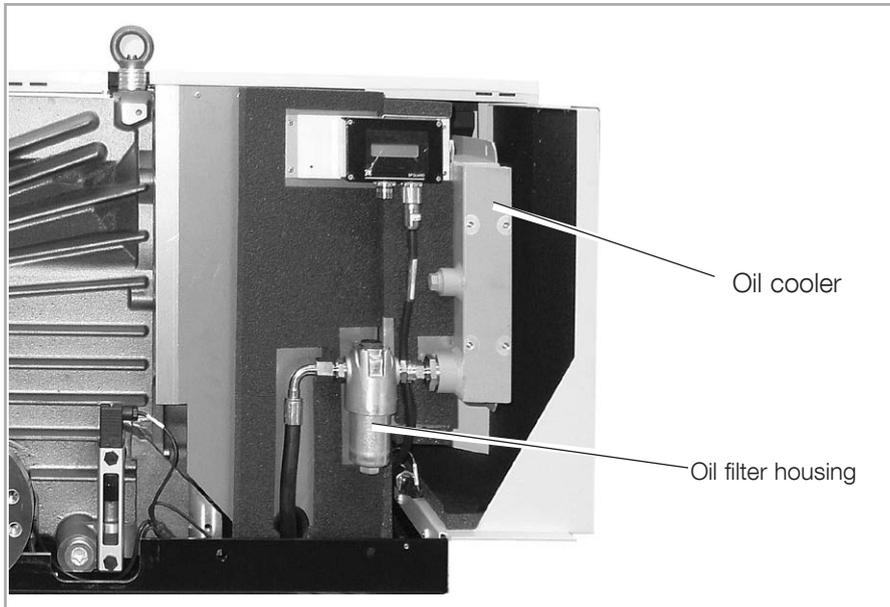


Fig. 5.1 Replacing the oil filter

## Replacing the Oil Filter

Place a vessel (having a volume of over 1 litre) underneath and unscrew the oil filter housing, let the oil drain out.

Pull the filter insert out.

Push the new filter insert on until it positively engages.

Replace the O-ring of the filter housing.

Screw the filter housing on up to the stop and tighten.

## Exchanging the Oil

Fill in the fresh gear oil.

---

### NOTICE



When doing so, make sure that the aids used are clean so as to avoid contaminating the oil.

---

Clean the oil fill opening and screw in the oil fill plug using a gasket which is in perfect condition. Wipe off any oil residues from the housing.

---

### NOTICE



The oil fill opening must be sealed off air-tight.

With the pump at standstill the oil level must be at the maximum for standstill.

After having exchanged the oil, the cover section on the exhaust side must be fitted once more, see fig. 4.1.

---

## What to do when too much Oil has been filled in

If too much oil was filled in then there is the risk that the oil may spill into the bottom trough and the pump chamber.

1. With the pump at standstill, drain out so much oil that the oil level drops below the maximum mark.
2. Operate the pump for at least one hour.
3. Check the oil level once more and remove possibly escaped oil from the bottom trough.
4. It is to be expected that the pump will continue to lose small quantities of oil from the drain openings.

---

## 5.2 Cleaning the Oil Cooler

### CAUTION



Switch the pump off and ensure that it can not be started up inadvertently.

When blowing out with compressed air, protect your eyes and wear protective goggles.

---

Regularly check the oil cooler to see if it has accumulated dirt.

The interval between the regular checks will depend on the ambient conditions and the process in each case and needs to be defined based on experience gained during operation.

For this perform a visual inspection by removing one cover section.

A dirty cooler may cause increased oil and pump temperatures and impair operation and reduce the service life of the pump.

The oil cooler can be cleaned with an industrial vacuum cleaner after having removed one cover section.

In the case of highly adhesive dirt at the cooler lamellae, the cooler can be disassembled and cleaned as follows:

- Remove both side covers.
- Disassemble the rear panel.
- At the cooler remove the 4 mounting screws.
- Fold the cooler down onto a suitable rest.
- Clean the cooler with compressed air, (wear protective goggles).

Make sure that the lamellae are not damaged.

Installation is performed in the reverse order.

### 5.3 Draining Out Condensate

(optional)

To drain the condensate out, the pump must be separated from the process by a valve. Please note that process gases and condensate may present a hazard to health.

---

**CAUTION**



The optional silencer has a condensate drain. Possibly present liquid collected in the silencer can be drained out through the condensate drain.

The silencer must be checked regularly especially if much condensate is collected. Drain out condensate if required.

The interval between the regular checks will depend on the ambient conditions and the process in each case and needs to be defined based on experience gained during operation.

### 5.4 Cleaning the Dust Filter in the Intake Line

(optional)

The dust filters which are installed upstream of the pump need to be checked regularly for contamination and cleaned as required.

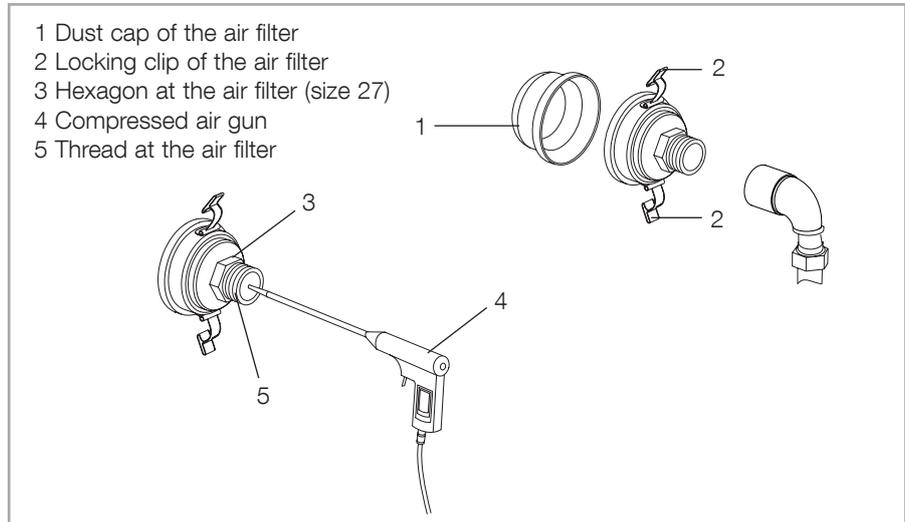


Fig. 5.2 Maintenance on the air filter at the gas ballast valve

## 5.5 Checking and Cleaning the Gas Ballast Filter

For maintenance on the air filter, the cover half will have to be disassembled, see Fig. 4.1.

Open the locking clips at the air filter and remove the dust cap from the air filter.

Use dry compressed air to blow out the filter.

### CAUTION



When blowing out with compressed air, protect your eyes and wear protective goggles.

Apply an open jaw spanner (size 27) to the hexagon and unscrew the filter element.

Blow out the filter element from the threaded side with compressed air. Re-seal the thread with Teflon tape and fit the filter element once more.

Fit the dust cap again and affix it with the locking clips.

The cover is fitted in the reverse order as described in Section 4.1.1.

## 5.6 Replacing the Throttle in the Purge Gas Device

The throttle must be replaced every 2.5 years.

Remove the pump's cover (see Fig. 4.1).

Pull the hose line off from the throttle at the gear housing. Press the ring against the plug-in connection and pull the hose line off.

Unscrew the throttle with a 14 mm spanner.

Connect the new throttle to the hose line. Insert the hose right up to the stop.

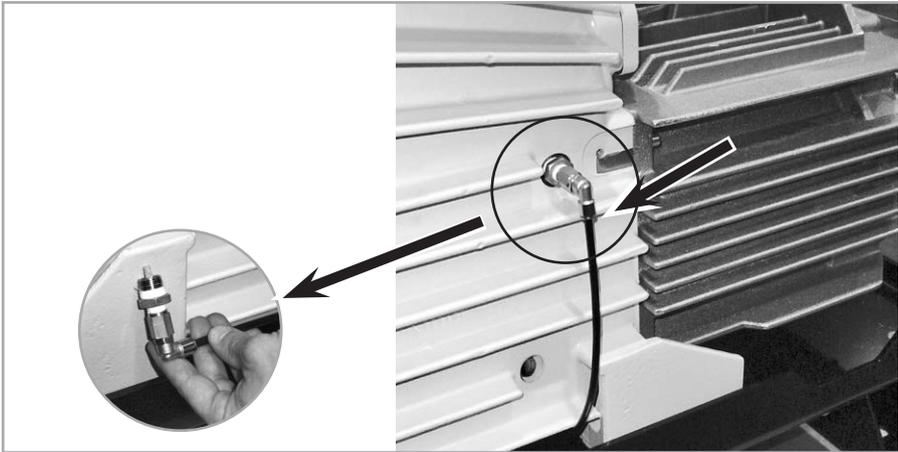


Fig. 5.4 Pull the hose line off from the throttle



Fig. 5.5 Unscrew the throttle

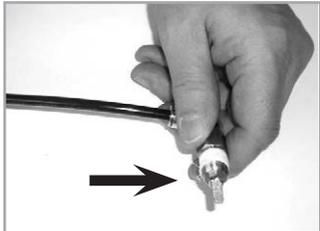


Fig. 5.6 Check the new throttle

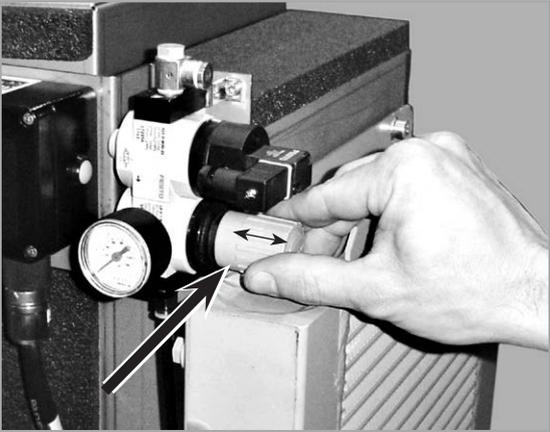


Fig. 5.7 Set up the pressure at the supply unit

- Apply pressure to the supply unit and open the switch-on valve. Check to see that gas comes out at the new throttle. The flowing gas must be easily audible.
- Close the switch-on valve (de-energise).
- Pull the hose line off from the throttle (press the ring against the connector).
- Use Teflon tape to seal off the threads of the throttle.
- Screw the throttle into the gear housing.
- Again insert the hose line into the throttle right up to the stop.
- Fit the pump cover again.

## 5.7 Service at Leybold

If you send a pump to Leybold indicate whether the pump is free of substances damaging to health or whether it is contaminated.

If it is contaminated also indicate the nature of the hazard. To do so, you must use a preprinted form which we shall send to you upon request.

A copy of this form is reproduced at the end of these Operating Instructions: "Declaration of Contamination of Compressors, Vacuum Pumps and Components". Moreover, you may download a suitable form from the Internet: [www.leybold.com](http://www.leybold.com) → Documents → Download Documents.

Please attach this form to the pump or enclose it with the pump.

This "Declaration of Contamination" is required to meet the requirements of German Law and to protect our personnel.

Leybold must return any pumps without a "Declaration of Contamination" to the sender's address.

Before packaging (respectively shipping) the pump it should, if possible, be purged with inert gas, but as a minimum requirement it should be completely emptied of all pumped substances.

This may also apply to all parts belonging to the pump system, like coolers, vessels, etc.

---

### CAUTION



Package the pump so that it will not be damaged during shipping and so that no hazardous substances can escape from the packaging.

Before transporting the pump, drain out the oil!

---

For transporting, the pump has been fitted on to a special pallet, please retain this pallet in case the pump needs to be returned.

## 5.8 Maintenance Schedule

The stated intervals apply only provided the signals from the SP-Guard are processed and evaluated.

Maintenance Work	Interval	Carried out by, Where to do	Spare parts	Remarks
<b>SP 250</b>				
Gas ballast facility, cleaning filter	Periodical/if required, at the latest after 40,000 h or every 5 years	Operator, on site		
Oil cooler, check, clean	Periodical/if required, at the latest after 40,000 h or every 5 years	Operator, on site		
Oil level, check	Periodical/if required	Operator, on site		
Oil change and oil filter change	at the latest after 20,000 h or 2.5 years	Operator or Leybold service, on site	EK 1100000820 (EK 1100000837)	no gear or oil is included in EK 110000837
Inspection of the screw rotors and the pump housing	Periodical/if required, at the latest after 40,000 h or every 5 years	Leybold service, on site	EK 1100000821	Rotor inspections can only be done by the authorised after sales service. Check ground connection after rotor inspection.
Full service	At the latest after 40,000 h or every 5 years	Leybold service, authorised service centre		
<b>Accessories</b>				
Exhaust silencer, check, empty	Periodical/if required	Operator, on site		See Operating Instructions exhaust silencer
Dust filter, check, clean, empty	Periodical/if required	Operator, on site		See Operating Instructions dust filter
Non-return valve, do a function test, clean, replace O-rings	Periodical/if required	Operator, on site	EK 110000828	See Operating Instructions non-return valve
Ruvac adapter, replace O-rings, replace inlet screen (elastic parts)	Periodical/if required	Operator, on site	EK 110000835 (EK 1100002677)	See Operating Instructions Ruvac adapter (replace elastic parts only if defective)
Purge gasket, function test, replace purge gas connection	after or 2.5 years	Operator, on site	EK 110000834	See Operating Instructions purge gas kit

# Troubleshooting

## 6 Troubleshooting

Before starting any troubleshooting, you should check the following simple things:

- Have all connectors been properly plugged in and secured at the SP-Guard and at all sensors?
- Has the DC power supply been provided to the SP-Guard?

Malfunction / SP-Guard display	Possible cause	Remedy	Responsibility
Failure oil temp	Oil temperature has exceeded the error threshold.	After switching off the pump open the cooling unit and clean the heat exchanger with compressed air.	Maintenance personnel
	Temporary temperature increase during shutdown due to reduced cooling.	Wait for the cooling down phase to complete.	Operator
Failure vibration	Vibration level has exceeded the error threshold.	Check whether there is in the immediate vicinity of the pump a different vibration source.	Operator and maintenance personnel
	There are foreign objects or deposits in the pump.	Contact our service technician.	
Failure exhaust pressure	Exhaust pressure exceeds the max. permissible pressure of 1200 mbar.	Check to see if the exhaust line is blocked. Remove blockage.	Operator and maintenance personnel
Failure oil level	Oil level drops below the minimum.	With the pump at standstill top up oil until the oil level is again within the optimum range. Note any visible losses of oil and if required contact our service.	Maintenance personnel
vibration > 20 with the pump at standstill.	Inadequate potential equalisation causes leakage currents via the SP-Guard.	Separate power supply output GND / 0V from PE to stop leakage currents. Note the local regulations regarding installation and operation of safety extra-low voltage (SELV) systems. If required, connect the pump to ground through additional ground connections.	Maintenance staff
	Emitted interference	For the purpose of complying with the maximum permissible limits for a emitted interferences, shielded cables between frequency converter and screw pump must be used, if required.	Maintenance staff
	Conducted interference	In order to reduce conducted interferences, use a motor filter at the output of the frequency converter, if required.	Maintenance staff
	Loose connector	The power supply connector at the SP-Guard must be checked to ensure that it is firmly seated.	Maintenance staff
Display is dark and difficult to read.	Ambient temperature is too high.	Let the SP-GUARD cool down and keep the ambient temperature below 40 °C.	Operator

# Troubleshooting

Malfunction	Possible cause	Remedy	Responsibility
Pump does not start up.	Defective wiring.	Check wiring and repair it.	Electrician
	Motor protection switch incorrectly set up.	Correctly set up motor protection switch.	Electrician
	Supply voltage does not match motor specs		
	Defective motor.		Service
	Pump has seized.	Repair pump.	Service
	Links in the motor junction box.	Change links according to wiring diagram.	Electrician
Motor protection switch has tripped.	Motor protection switch set wrongly.	Set the motor protection switch correctly.	Electrician
	Pumping chamber soiled, rotors do not turn freely.	Disassemble and clean the pump.	Service or trained Staff
	Bearing or gear damage.	Repair pump.	Service
	Motor defective.	Check if rotors turn freely, measure motor resistance, replace motor if required.	Electrician, Service
	Notice: Do not restart the pump after the motor protection switch has tripped without having repaired the cause of the tripping.		
Pump does not attain its ultimate pressure.	Unsuitable measurement method or measuring instrument.	Use correct method of measurement and measuring instrument. Measure the pressure directly at the inlet port of the pump.	-
	External leak.	Repair pump.	
	Degassing caused by water residues.	Operate the pump for 30 minutes if possible with gas ballast, check process.	
	Severe contamination of the pump owing to the process.	Disassemble pump and clean it. Check the inside of the silencer and if required replace silencer.	Service or trained staff
	Contaminated discharge line.	Clean discharge line and thereafter operate the pump with the gas ballast running, if possible.	
	Caution: if previously oil-sealed pumps were used, use only clean and oil free pipes.		
	Exhaust pressure is too high (+ 200 mbar maximum above ambient pressure).	Optimise the cross-section of the discharge line (if required clean discharge line).	
Pump temperature is too low.	Leave the pump to run warm (> 1 h).		
Pumping speed of the pump is too low.	Clogged intake screen in the intake port.	Clean intake screen.	
	Connection line too narrow or too long.	Install sufficiently wide connecting lines which are as short as possible. Precaution: install a dust filter in the intake line. Replace filter element.	
	Discharge backpressure is too high.	Optimise the cross-section of the discharge line.	
	Nominal pumping speed is too low.	Check application.	
After switching the pump off in the presence of a vacuum the pressure in the system increases too rapidly.	Leaky system.	Check system.	
	Missing valve for shutting off the intake port (automatically upon pump standstill).	Fit a valve to shut off the intake port.	
	Valve at the intake port is not closed.	Close the valve at the intake port.	

# Troubleshooting

<b>Malfunction</b>	<b>Possible cause</b>	<b>Remedy</b>	<b>Responsibility</b>
Pump gets hotter than previously observed.	Cooling airflow is obstructed.	Install the pump properly.	Electrician
	Ambient temperature is too high.	Install the pump properly (< 40 °C).	
	Process gas is too hot.	Change process, cool if required.	
	Deviation from the nominal mains voltage.	Check motor connection voltage and mains voltage.	
	Exhaust pressure is too high.	Optimise the cross-section of the discharge line.	
	Contaminated oil cooler.	Clean the oil cooler with compressed air.	
Pump is extremely loud.	Bearing damage.	Repair pump.	Service
	Thick particle deposits.	Clean pump, respectively perform maintenance.	Service or trained staff
	Defective silencer.	Repair silencer.	
	High gas throughput with the discharge line open, without silencer.	Install discharge line or silencer.	
Oil film in the junction box.	Oil ingress after longer operation.	No need for action.	
Purge gas gauge does not indicate any pressure.	Valve has not switched.	Check valve, if required connect correctly.	Electrician
	Purge gas supply has failed.	Ensure a proper purge gas supply.	

## 7 Waste Disposal

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

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.

---

**WARNING**



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

When sending us a pump, observe the regulations given in Section “5.7 Leybold Service”.

### Disposal of Waste Oil

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

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

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

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

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

# EU Declaration of Conformity

(Translation of original Declaration of Conformity)

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

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

**Product designation:** Screw Type Vacuum Pump

**Type designation:** SP 250

**Part numbers:** 115001, 115006, 115019

## The products complies to the following Directives:

Machinery Directive (2006/42/EC)

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

Electromagnetic Compatibility (2014/30/EU)

## The following harmonized standards have been applied:

EN 1012-2:1996+A1:2009 Compressors and vacuum pumps - Safety requirements  
Part 2: Vacuum pumps

EN 60204-1:2006 Safety of machinery - Electrical equipment of machines  
Part1: General requirements

EN 61000-6-2:2005/AC:2005 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards -  
Immunity for industrial environments

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

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Cologne, September 01, 2016

Cologne, September 01, 2016



ppa. Martin Tollner  
VP / Head of Product Lines



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

Document No.: 300304180-002-A4

# EU Declaration of Conformity

(Translation of original Declaration of Conformity)

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

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

**Product designation:** Screw Type Vacuum Pump  
**Type designation:** SP 250 ATEX cat. 3i  
**Part numbers:** 115003  
**Marking:**  II 3/- G IIC T160°C X  
II 3/- D IIIB T160°C X  
10°C<Ta<40°C

## The products complies to the following Directives:

Machinery Directive (2006/42/EC)

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

Electromagnetic Compatibility (2014/30/EU)

ATEX-Directive (2014/34/EU)

## The following harmonized standards have been applied:

EN 1012-2:1996+A1:2009	Compressors and vacuum pumps - Safety requirements Part 2: Vacuum pumps
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines Part1: General requirements
EN 13463-1:2009	Non-electrical equipment for use in potentially explosive atmospheres — Part 1: Basic method and requirements
EN 61000-6-2:2005/AC:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4:2007/A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

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Cologne, September 01, 2016

Cologne, September 01, 2016



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VP / Head of Product Lines



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

Document No.: 300304175-002-A5



## Declaration of Contamination of Compressors, Vacuum Pumps and Components

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

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

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

Customer/Dep./Institute : _____ Address : _____ _____ Person to contact: _____ Phone : _____ Fax: _____ End user: _____	Reason for return: <input checked="" type="checkbox"/> applicable please mark <b>Repair:</b> <input type="checkbox"/> chargeable <input type="checkbox"/> warranty <b>Exchange:</b> <input type="checkbox"/> chargeable <input type="checkbox"/> warranty <input type="checkbox"/> Exchange already arranged / received <b>Return only:</b> <input type="checkbox"/> rent <input type="checkbox"/> loan <input type="checkbox"/> for credit <b>Calibration:</b> <input type="checkbox"/> DKD <input type="checkbox"/> Factory-calibr. <input type="checkbox"/> Quality test certificate DIN 55350-18-4.2.1
--	--

<b>A. Description of the Leybold product:</b> Material description : _____ Catalog number: _____ Serial number: _____ Type of oil (ForeVacuum-Pumps) : _____	<b>Failure description:</b> _____ <b>Additional parts:</b> _____ <b>Application-Tool:</b> _____ <b>Application- Process:</b> _____
--	---

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

<b>C. Description of processed substances (Please fill in absolutely)</b>											
<b>1. What substances have come into contact with the equipment ?</b> Trade name and / or chemical term of service fluids and substances processed, properties of the substances According to safety data sheet (e.g. toxic, inflammable, corrosive, radioactive)											
X	<table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">Tradename:</td> <td style="width:70%;">Chemical name:</td> </tr> <tr> <td>a)</td> <td></td> </tr> <tr> <td>b)</td> <td></td> </tr> <tr> <td>c)</td> <td></td> </tr> <tr> <td>d)</td> <td></td> </tr> </table>	Tradename:	Chemical name:	a)		b)		c)		d)	
Tradename:	Chemical name:										
a)											
b)											
c)											
d)											
<b>2. Are these substances harmful ?</b>	<table style="width:100%;"> <tr> <td style="width:50%; text-align:center"><b>No</b></td> <td style="width:50%; text-align:center"><b>Yes</b></td> </tr> <tr> <td style="text-align:center"><input type="checkbox"/></td> <td style="text-align:center"><input type="checkbox"/></td> </tr> </table>	<b>No</b>	<b>Yes</b>	<input type="checkbox"/>	<input type="checkbox"/>						
<b>No</b>	<b>Yes</b>										
<input type="checkbox"/>	<input type="checkbox"/>										
<b>3. Dangerous decomposition products when heated ?</b> If yes, which ? _____	<table style="width:100%;"> <tr> <td style="width:50%; text-align:center"><b>No</b></td> <td style="width:50%; text-align:center"><b>Yes</b></td> </tr> <tr> <td style="text-align:center"><input type="checkbox"/></td> <td style="text-align:center"><input type="checkbox"/></td> </tr> </table>	<b>No</b>	<b>Yes</b>	<input type="checkbox"/>	<input type="checkbox"/>						
<b>No</b>	<b>Yes</b>										
<input type="checkbox"/>	<input type="checkbox"/>										

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

### D. Legally binding declaration

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

Name of authorized person (block letters) : _____ _____ _____	_____ _____ _____	<div style="border: 1px dashed black; height: 80px; width: 100%;"></div> firm stamp
Date	signature of authorized person	

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