

DRYVAC

DV 200, DV 300, DV 500

Dry Compressing Vacuum Pumps
with synthetic oil or PFPE filling

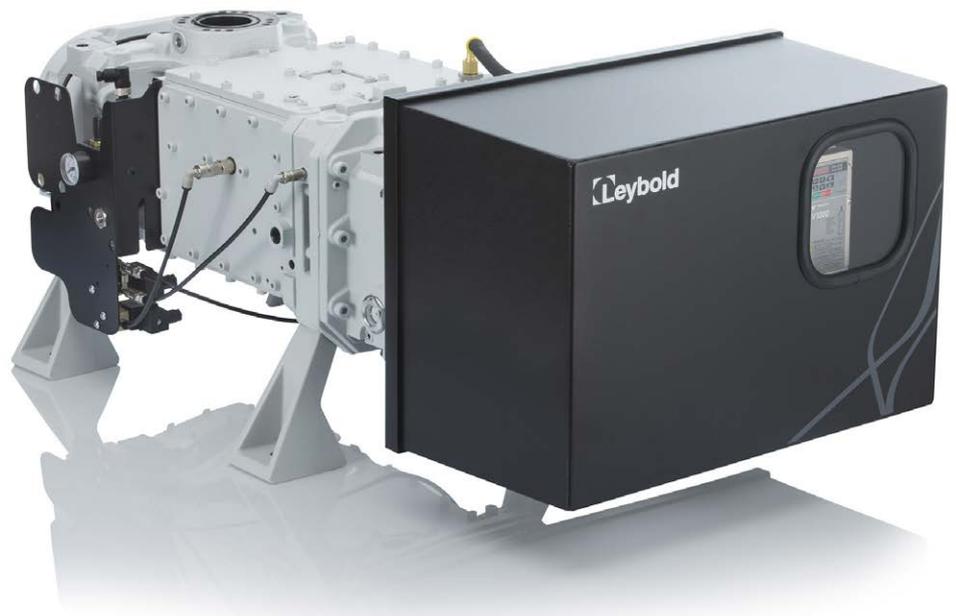
Operating Instructions 300750767_002_C3

Part Numbers

112020V15 /19 /25 /29

112030V11 /15 /19 /25 /29

112050V15 / V19



Contents

	Page
0 Important Safety Information	5
Explanation of Safety Symbols	5
0.1 Mechanical Hazards	6
0.2 Electrical Hazards	8
0.3 Thermal Hazards	8
0.4 Danger through materials and substances	9
0.5 Noise Hazard	9
ATEX directive implications	10
Classification and Marking of the Pump	10
Areas of Application	10
Conditions of safe use	10
1 Description	12
1.1 Design	12
1.2 Supplied Equipment	12
1.3 Technical Data	13
1.4 Ordering Information	17
1.4.1 Pumps	17
1.4.2 Accessories	17
2 Transport and Storage	18
3 Installation	20
3.1 Placement	21
3.2 Conforming Use	22
3.2.1 Non-conforming Use	22
3.3 Connecting the Intake and Exhaust Lines	23
3.3.1 Intake Lines	23
3.3.2 Exhaust Lines	24
3.4 Connecting Cooling Water	25
3.4.1 Water Quality	26
3.5 Connecting Purge Gas	27
3.6 Electrical Connection	29
3.7 Leak Search after Installation	35

4	Operation	36
4.1	Media Compatibility	37
4.2	Interfaces	37
4.2.1	Remote interface X103	37
4.2.2	RS-485 interface X104	37
4.2.3	Profibus Interface	40
4.3	Start-up	41
4.4	Operation	41
4.4.1	LED Display and Control Unit	42
4.4.2	Option: Changing the Speed of the Pump	45
4.4.3	Warning and Shut-off Thresholds	46
4.4.4	Gas Ballast Operation	47
4.4.5	Pumping of 100% Argon	47
4.5	Shut-off and Venting	47
4.6	Removing from Service	48
5	Maintenance	49
5.1	Leybold Service	49
5.2	Maintenance Intervals	50
5.3	Changing the Oil	50
6	Troubleshooting	52
6.1	Pump Malfunctions	52
6.2	Fault and Alarms Displayed at the Frequency Converter	53
7	Wearing Parts	60
8	Waste Disposal	60
	EU Declaration of Conformity	61

These Operating Instructions are a translation of the German original instructions 300750767_001_C3.

Safety Information



NOTICE

Obligation to Provide Information

Read and follow these installation and operating instructions carefully before installing and commissioning the pump to ensure optimum and safe operation right from the start.

Leybold **DRYVACs** guarantee safe and proper operation when used correctly and in accordance with the instructions contained in these operating instructions. Please read all safety instructions in this section and the rest of this manual carefully and make sure that these instructions are followed. The device **may be operated and maintained only by trained personnel in the proper condition and as described in the operating instructions. Also observe local and state requirements and regulations. If you have any questions regarding safety, operation or maintenance of the device, please contact our nearest subsidiary.**

“Trained personnel” for the operation of this pump are

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

DANGER



DANGER indicates a hazard with a high risk potential. If the danger is not avoided, it will result in serious injuries or death.

WARNING



WARNING indicates a hazard with an average hazard potential. Failure to follow the warning may result in serious injury or death.

CAUTION



CAUTION indicates a hazard with a low hazard potential which, if not avoided, may result in minor or moderate injury.

NOTICE



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

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

Keep the instructions for future use.

Safety Information

0 Important Safety Information

Explanation of Safety Symbols



General warning sign



Warning of counter-rotating rollers



Warning of automatic start-up



Warning of danger of slipping



Warning of electrical voltage



Warning of hot surface

Safety Information

NOTICE**0.1 Mechanical Hazards**

1 Loss of stability during transport. Uncontrolled movement due to incorrect attachment / lifting / carrying / rolling or movement of the vacuum pump.

Only use the attachment points and conveying means described in this manual for vertical and horizontal conveying.

WARNING

2 Ejection of parts through bursting of vacuum system as a result of excessive pressure caused by clogged or constricted exhaust. Pressure build-up in the vacuum system or exhaust pipes.

Do not start up or operate the vacuum system with the outlet closed or throttled.

3 Ejection of parts through bursting of vacuum system due to excessive pressure, caused by faulty function at the gas inlet into the vacuum system.

Pressure build-up in the vacuum system or inlet lines.

Check correct connection of inlet and outlet flanges before commissioning. The inlet pressure at the suction port of the vacuum system must not exceed atmospheric pressure. If seal gas or gas ballast from pressure vessels is used, secure the supply in such a way that no overpressure can occur in the vacuum system in the event of a fault or power interruption

4 Ejection of parts through bursting of vacuum system as a result of excessive pressure caused by the pump running backwards after it has been switched off under vacuum.

Danger of overpressure in the inlet lines and recipients as well as uncontrolled backward running of rotors.

In the event of a fault or during service, separate the vacuum pumps from the vacuum vessel and connecting lines before the inlet by means of suitable valves.

WARNING

5 Risk of cutting and cutting off by contact with moving parts such as couplings, shafts and rotors.

Risk of cutting and crushing when reaching into open flanges or covers.

Do not operate the vacuum pump with open flanges or covers. When installing, first mechanically connect the inlets and outlets, close the covers of rotating parts and then make the electrical connections.

Disconnect the vacuum pump from the power supply before servicing. Only use trained service personnel.

Safety Information

- 6 Failure or malfunction of the central control system (unexpected start-up) or danger of a pump restarting automatically after switching off due to a fault.

Risk of crushing, cutting or cutting off by touching moving parts due to recurring start command or power supply.

Before carrying out maintenance or service work, disconnect the pump from the power supply, secure it against being switched on again, determine that it is de-energised, ground and short-circuit it and cover / isolate adjacent live parts.

WARNING

- 7 Pulling into the vacuum system.

Pulling in of body parts and objects into the vacuum through open flanges.

Do not operate the vacuum pump with open flanges. When installing the vacuum pump, first mechanically connect the inlets and outlets and then make the electrical connections.

CAUTION

- 8 Danger due to incorrect connection of the pump to the system to be pumped out. Pressure build-up in the vacuum system.

Check correct connection of inlet and outlet flanges before commissioning. When using the pump with seal gas, protect the seal gas supply so that no overpressure can occur in the pump system in the event of a malfunction or power interruption.

- 9 Slipping, tripping or falling as a result of oil leaking from the pump. Oil can escape from the vacuum pump during pumping or depending on the work process. Risk of falling on oil spills!

Check the vacuum pump regularly for oil leaks. Take the appropriate safety measures

CAUTION

Safety Information



DANGER



0.2 Electrical Hazards

- 1 Electrical shock caused by direct or indirect contact with live parts. Electrical shock due to faulty electrical connection and possible residual voltage up to 5 minutes after disconnection from the mains. The electrical connection may only be carried out by a trained person. Observe the national regulations in the user country, e.g. for Europe EN 50110 - 1. Prior to servicing, disconnect the vacuum pump from the power supply.
- 2 Electrical shock due to interruption of the protective conductor system. In the event of a fault, life-threatening voltages may be present on electrically conductive components. Before commissioning, check the resistance of the earthing cable and the suitability of the assigned overcurrent protection device.
- 3 Lightning strike. Risk of fire and injury from lightning strike. Do not use pumps and pumping systems outside of buildings. The operator is responsible for assessing the hazard potential when used outside of buildings.

CAUTION



0.3 Thermal Hazards

- 1 Burns caused by touching hot surfaces. Burning of fingers, hands or arms on hot surfaces. Handle the pump only when ventilated and cooled down. Wear suitable protective equipment. Install a barrier around the pump to prevent accidental contact with hot surfaces. The barrier must only be removable with tools.
 - 2 Scalding by contact with hot equipment or lubricants. Danger of scalding when opening the hot pump with hot operating fluid or cooling water! Only open the outlet or inlet port for operating media if the operating medium has adapted to the room temperature. Wear suitable protective equipment.
-

0.4 Danger through materials and substances

- 1 Danger due to a sharp increase in pressure due to the decomposition of pumped gases. Uncontrolled emission of process gases by reaction products within the pump.
The pumping of reactive gases, vapours or gas mixtures is generally prohibited. The operator is responsible for assessing the hazard potential of the process media or mixtures.
- 2 Danger of escaping or emitting pumped hazardous gases, vapours or substances. Pumped process gases may escape from the exhaust and leaks in the vacuum system. The pumping of toxic / explosive / flammable / pyrophoric / radioactive / oxidizing / corrosive gases or gas mixtures, as well as oxygen of more than atmospheric concentration (21 %) is generally prohibited. The operator is responsible for assessing the hazard potential of the process media or mixtures.
- 3 Some pumps use perfluoropolyether (**PFPE**) as lubricant. When handling PFPE you should observe the following:
During thermal decomposition at temperatures over 290 °C toxic and corrosive gases are released. When handling PFPE keep it away from open fires. Do not smoke with PFPE on your fingers.
Touch the inner sections of the pumps only while wearing clean gloves, and use clean tools;
do the necessary work in clean and dry rooms;
after having removed the pump from its packaging, start it up as quickly as possible;
as cleaning agents solvents based on hydrofluorether compounds may be used.
- 4 Fluoropolymers are used as sealants (FKM) and as lubricants (PFPE) in the pumps. In case the pump suffers a severe mechanical failure, the possibility of hazardous substances being released owing to their thermal decomposition cannot be excluded. The hazards caused by such decomposition are described in the Material Safety Data Sheets for the materials, for example.

DANGER



0.5 Noise Hazard

- 1 Hearing loss due to high noise levels.
Depending on the operating conditions, higher noise levels can be reached than specified in the technical data. Take suitable hearing protection measures.

CAUTION



Pressure values in bar or mbar are absolute pressures, unless expressly stated otherwise (e.g. bar(g)).

For Part No. 112030V11 **ATEX directive implications**

Pumps which carry the ATEX mark are designed to meet the requirements of Group II Category 3G in respects to ignition sources internal to the pump. This classification is in accordance with Directive 2014/34/EU.

Classification and Marking of the Pump

The pump is marked as follows:

 II 3/- G Ex h IIC T3 Gc (5 °C ≤ Ta ≤ 50 °C)
(internal atmospheres only)

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

Key to the Symbols

	ATEX logo
.. / ..	Means that the product has two different categories
-	means that a part of the product does not comply with the directive and has not been intended for utilisation within an explosion hazard area.
II 3/- G (Gc)	The pump may suck off gases from Zone 2, is however to be installed outside explosion hazard areas.
h	The code letter "h" is valid for all nonelectric devices.
IIC	Explosion group
T3	Temperature class. Pumps belonging to temperature class T3 must only be operated with gases or vapors which exhibit an ignition temperature of over 200 °C.
Ta	Permissible ambient temperature for operation of the pump: 5 °C ≤ Ta ≤ 50 °C.

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, vapours or mists in the air or if such atmospheres do occur then this only rarely and only briefly (i.e. Zone 2).

DANGER



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

Conditions of safe use

The DRYVAC pump must be operated in accordance with the definitions of normal use and operational limits as specified within this manual.

Accessories and additional parts fitted to the DRYVAC must fulfil the requirements of the ATEX Directive 2014/34/EU regarding the equipment group and category and they must be applicable for use in explosive atmospheres of the respective gas group and temperature class.

The mandatory safety instruments specified in this manual must be used and must not be replaced with alternatives from other manufacturers without consultation with Leybold.

DRYVAC pumps must only be used on processes if their materials resist the mechanical and/or chemical influences and corrosion, under the respective operating conditions, so that the explosion protection is always maintained.

Do not clean the pump by means of dry cloths in order to avoid electrostatic charge on non-dissipative materials. Processes generating intensive charge must not be operated close to the DRYVAC.

Means for preventing backflow of the pumped media must be used if backflow can result in process hazards.

Opening the DRYVAC is only permitted with the pump switched off, isolated from the electrical supply and in the absence of explosive atmosphere.

Description

1 Description

1.1 Design

The DRYVAC DV 200, DV 300, and DV 500 are single-stage dry compressing screw vacuum pumps. They have optimized pumping speeds even at pressures > 100 mbar. These models are especially suited for short cycle operation, e.g. load lock applications.

DRYVAC pumps are equipped as standard with all the typical features required for applications in the process industry. For example, they have a gas ballast device.

DRYVAC pumps are designed to provide reliability in harsh process duties. They are optimized for handling typical gases from the production in the PV and FPD industry. They excel through their robust design and meet industrial safety requirements. They are equipped with a purge gas system that makes possible rotor purge and shaft seal purge.

The DV 200 and DV 300 have the same motor. The required frequency converter is installed at the pump.

All DRYVAC pumps have been prepared for direct fitting of a RUVAC roots pump.

The pumps are water cooled. They are lubricated either with synthetic oil or PFPE.

NOTICE



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

1.2 Supplied Equipment

- Pump as described in Sections 1.1 and 1.4.1.
- The pumps are filled with lubricant:
Synthetic oil LEYBONOL LVO 210 **or** PFPE LEYBONOL LVO 410
- The pumps are purged with nitrogen for protection against corrosion. The pump flanges have been blanked off with a sealing cap.
- 4x crane eyes M16
- Plug for purge and gas ballast valve
- Plug for purge gas pressure switch

1.3 Technical Data

DRYVAC DV	200	300	500	Tolerance
Maximum pumping speed without gas ballast	210 m ³ /h	280 m ³ /h	460 m ³ /h	± 5 %
Ultimate partial pressure with purge gas for shaft seal inlet & outlet with gas ballast	< 0.05 mbar < 0.8 mbar		< 0.01 mbar < 0.5 mbar	
Maximum permissible inlet pressure		1,050 mbar		
Max. perm. discharge pressure (relative to ambient)		+200 mbar		
Integral leak rate		< 10 ⁻⁴ mbarl/s		
Water vapour tolerance with purge and gas ballast		50 mbar > 20 NI/min		
Water vapour capacity		5 kg/h		
Permissible ambient temperature		+5 to +50 °C		
Storage temperature		-30 to +60°C		
Contamination grade with/without purge		2/3		
Overvoltage category		3		
Noise level with silencer, at ultimate pressure (acc. to DIN EN ISO 2151)		65 dB(A)		KpA = 0.3 dB
Noise level with rigid exhaust pipe, at ultimate pressure (acc. to DIN EN ISO 2151)		65 dB(A)		KpA = 0.3 dB
Relative atmospheric humidity		95%, non-condensing		
Installation location		up to 2000 m (NHN) *		
Cooling		Water		
Mains voltage ¹⁾²⁾		380-460 V or 200-240 V		± 10 %
Frequency		50/60 Hz		± 5 %
Phases		3-ph		
Rated power (motor shaft)		7.5 kW	11 kW	± 0.5 kW
Max. current at 380/ 400 /460 V at 200/ 240 V		13.2 / 12.4 / 11.1 A 23.0 / 20.2	14.5 / 13.8 / 12.3 A 28.7 / 23.2	21.5 / 20.9 / 18.5 A 42.2 / 37.5
Motor efficiency class calculated and configured acc. to EN 60034-30		IE3		
Power consumption at ultimate pressure		4.1 kW	4.5 kW	4.4 kW
Mains fusing / characteristic at 400 V at 200 V		16 A (C type) 32 A (C type)	32 A (C type) 50 A (C type)	
Short-circuit interrupting capacity ³⁾		< 30 kA _{eff}		
Connectable conductor cross-section, max.		6 mm ²	10 mm ²	
Switching frequency of the frequency converter		max. 15 kHz		

Description

DRYVAC DV	200	300	500	Tolerance
Speed	6,600 rpm		7,500 rpm	
Min. permissible speed ⁴⁾		1,200 rpm		
Protection class		IP 54***		
Lubricant filling		LVO 210 or LVO 410		
Total lubricant quantity		1.0 l		
Intake flange		DN 63 ISO-K		
Discharge flange	DN 40 ISO-KF		DN 63 ISO-K	
Materials		Grey cast iron, graphite cast iron, FKM, steel, stainless steel		
components in contact with gas in the pump chamber				
Materials sealing the pump off in the pump chamber towards the outside		FKM, grey cast iron, steel, stainless steel, PTFE		
Weight, approx.	370 kg		490 kg	

Water

Water connection	G1/2"
Water temperature	5 °C – 35 °C
Minimum supply pressure	2 bar(g)**
Maximum supply pressure	7 bar(g)**
Nominal flow	8 l/min

Purge

Connection	Ø D10	
Nominal setting pressure Purge gas (at nominal flow, valves open)	2.2 to 3.0 bar(g)**	± 5 %
Permissible setting pressure Purge gas (at purge gas flow)	2.2 to 3.5 bar(g)**	± 5 %
Permissible supply pressure Purge gas	4.0 to 10.0 bar(g)**	± 5 %
Purge gas flow shaft seal / rotor	6 l/min	± 10 %
Max. Gas ballast flow ($P_{inlet} < 10 \text{ mbar}$) ⁵⁾	100 l/min	± 10 %

Notes to the technical data

* The frequency converter standard ratings are valid for an installation altitude up to 1000 m.

If the altitude exceeds 1000 m both the input voltage and the rated output current must be derated for 1% per 100 m.

1) In the case of mains voltage drops or interruptions (brownouts) up to two seconds, operation is maintained and no error message is output. For mains voltages over 460 V this duration may be shorter.

2) Mains power grids: TN Systems, TT systems (earthing at the star point); for other types of mains power grid please consult us.

3) The pump is not suited for electric circuits capable of delivering a current in excess of 30 kA (rms) at maximum mains voltage.

4) The minimum permissible speed is relevant for the oil lubrication of bearings and gears. Running the pump at less than the minimum speed for more than 1 hour can cause damage to the pump due to a lack of lubrication.

5) The gas ballast flow may vary due to different conditions!

The gas ballast flow through the DV pump is much dependent on the inlet pressure!

**bar(g): bar (gauge) is the overpressure, i.e. atmospheric pressure = 0 bar(g)

*** equivalent

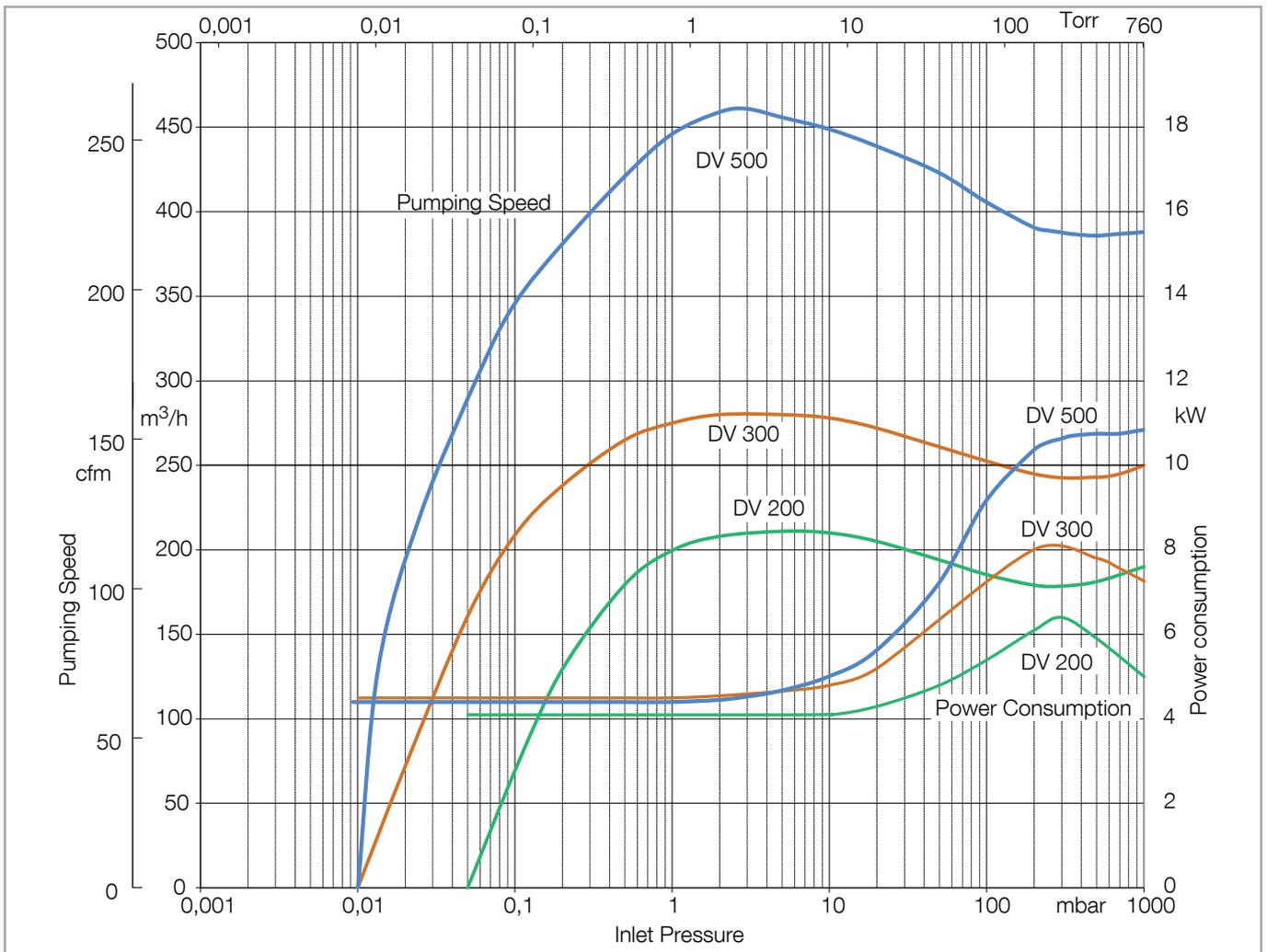


Fig. 1.1 Pumping speed curves DV 200, DV 300, and DV 500

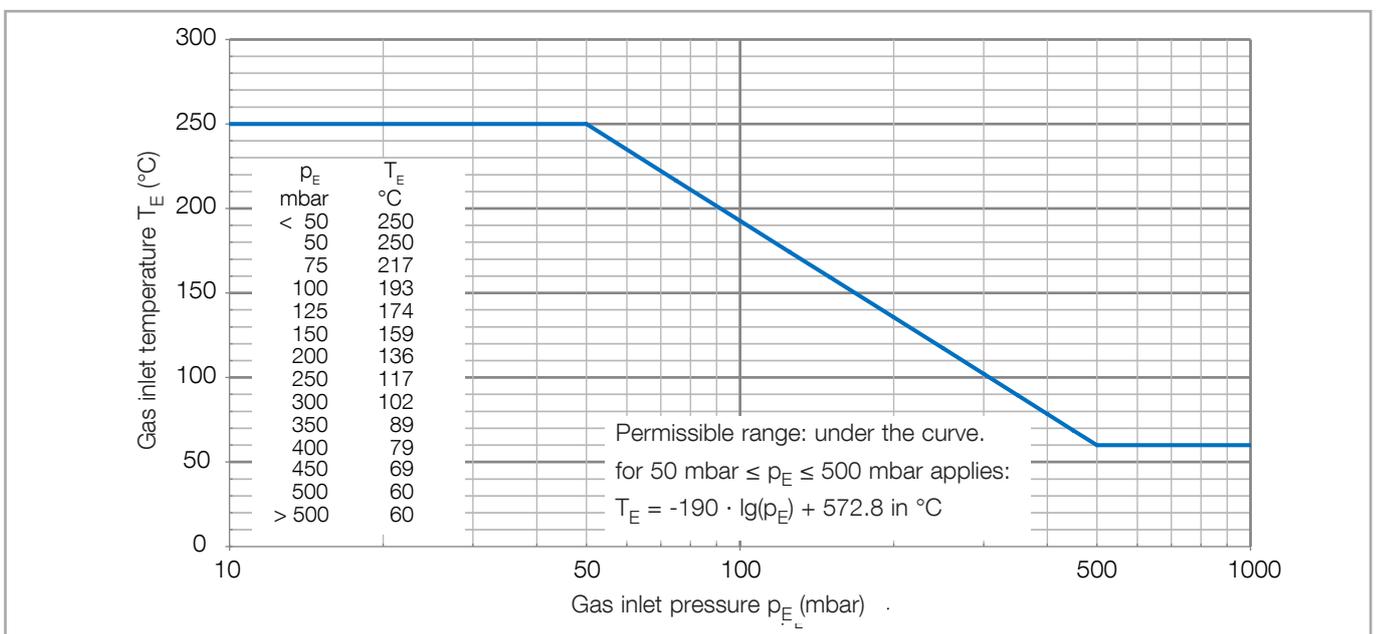


Fig. 1.2 Permissible gas inlet temperature as function of the inlet pressure

Description

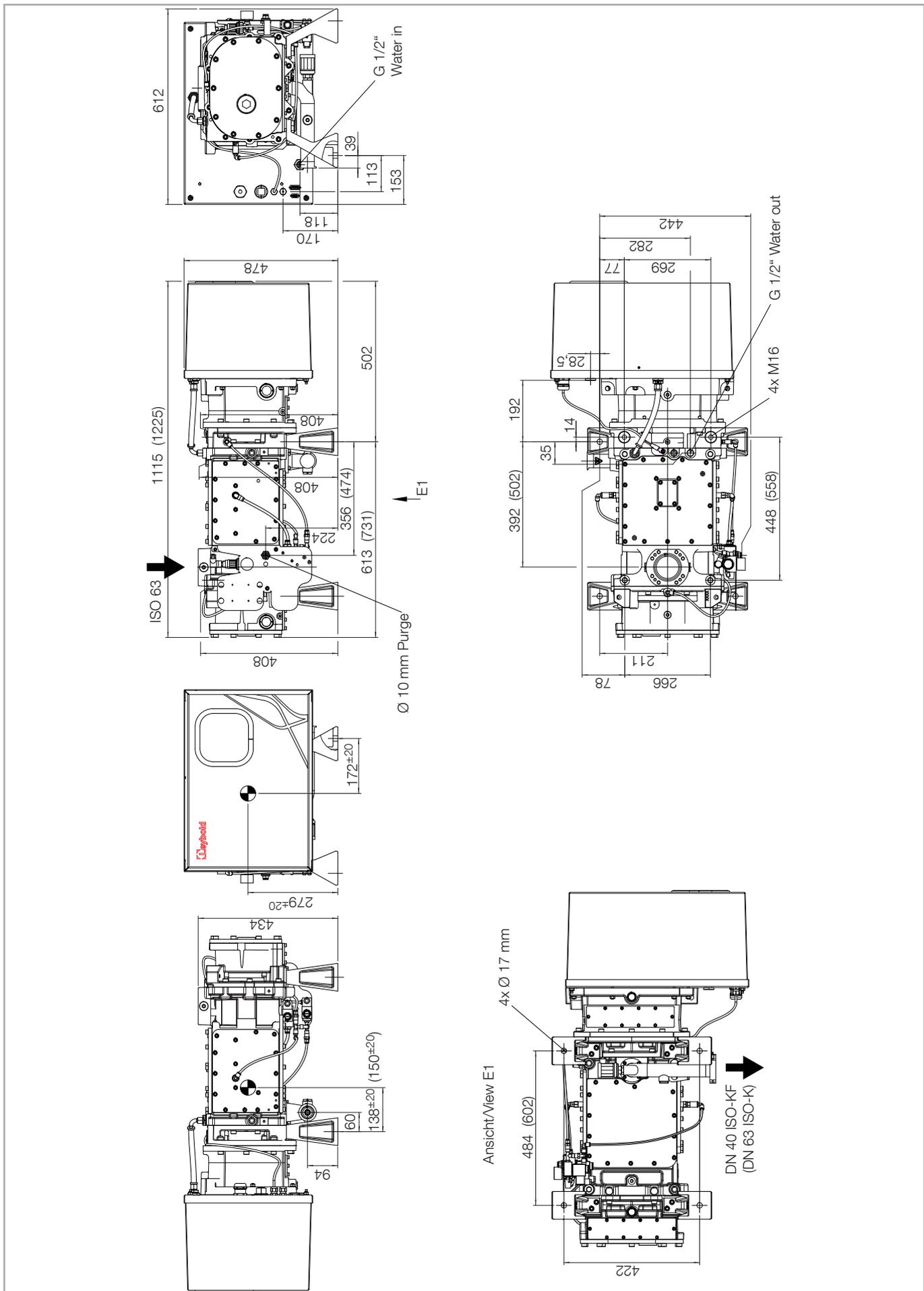


Fig. 1.3 Dimensional drawing DV 200, DV 300 & (DV 500), dimensions in mm

1.4 Ordering Information

1.4.1 Pumps

DRYVAC Industrial (synthetic oil)	ATEX	Part No.
DV 200, 400 V	—	112020V15
DV 200, 200 V	—	112020V19
DV 300, 400 V	Cat. 3i	112030V11
DV 300, 400 V	—	112030V15
DV 300, 200 V	—	112030V19
DV 500, 400 V	—	112050V15
DV 500, 200 V	—	112050V19

DRYVAC PFPE	Part No.
DV 200, 400 V	112020V25
DV 200, 200 V	112020V29

1.4.2 Accessories

	Part No.	
	DV 200/300	DV 500
Synthetic ester oil, LEYBONOL LVO 210, 5 litres	L21005	
PFPE LEYBONOL LVO 410, 1 litre	L41001	
Profibus module for DRYVAC DV / DV-r	155212V	
ProfiNet module for DRYVAC DV / DV-r	112005A35	
EtherCAT module for DRYVAC DV / DV-r	112005A36	
Relay module (digital output) for DV / DV-r	112005A01	
Ethernet module (dual port) for DRYVAC DV / DV-r	112005A02	
RS485/USB cable for interface X104, 1.8 m	161820USB	
Adapter for RUVAC WHx501/WH700	112004A03	112003A03
RUVAC Wx(U)1001	112004A04	112003A04
RUVAC Wx(U) 2001	112004A05	112003A05
RUVAC WH(U) 2500	112004A07	112003A07
RUVAC WH(U) 4400/7000		112003A10
Non-return valve DRYVAC, DN 40 KF (must only be installed vertically)	115005A01	112003A14
Elbow 90° DN 40 KF, stainless steel	88464	—
Silencer, DN 40 KF	115005A21	—
Flush-Kit / SV	112004A33	
Inlet Purge Kit / SV	112004A34	
GSD file and manual for the Profibus interface see Leybold homepage		

Transport and Storage

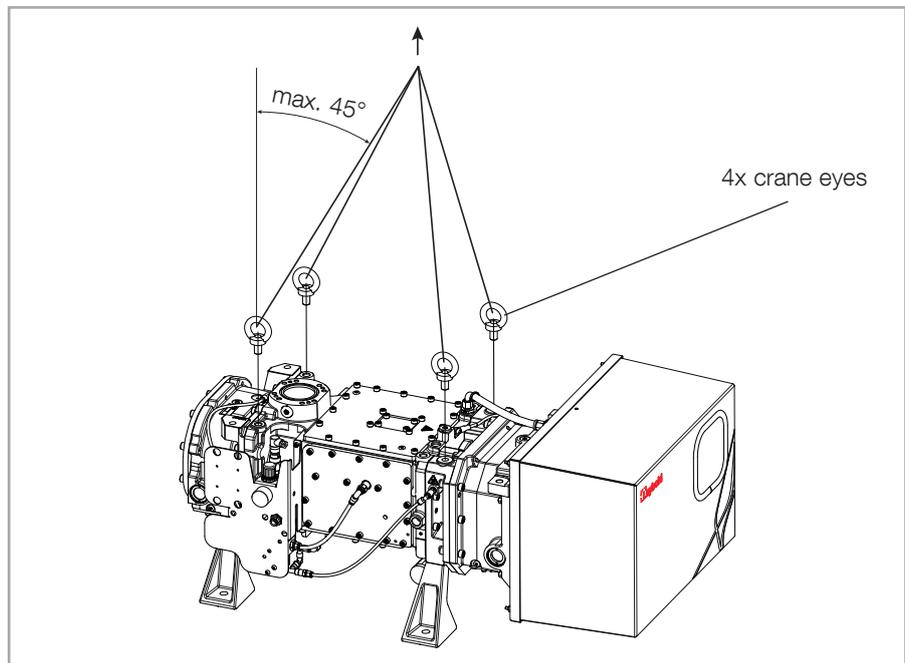


Fig. 2.1 Lifting the DRYVAC

2 Transport and Storage

DANGER



Loss of stability during transport.

Uncontrolled movement due to faulty attaching/lifting/carrying/rolling or moving the vacuum pump.

For vertical and horizontal transport, use only the attachment points and transport means described in this manual.

NOTICE



The pumps are supplied filled with synthetic oil or PFPE. For this reason they should, while being transported or shipped, not be subjected to much tilting (10° max.). Store the pumps only horizontally standing on their feet.

Lift the pump at the crane eyes. Use all crane eyes, see Fig. above. The pump can also be transported with a fork lift. Ensure that it cannot tip over.

Storage

Store the pumps only horizontally standing on their feet.

Open the pumps only immediately before installing them.

NOTICE



If there is the danger of frost, the cooling water must be drained, see Section 4.6 Removing from Service .

Transport and Storage

You may use a water glycol mixture of up to 30 % .

Temperature (only for storage without cooling water!) $-30\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C}$

Storage site dry

Maximum atmospheric humidity 95 %, non-condensing

The pump must be stored at the most for one year only. Longer storing without turning the rotors will damage the bearings. Connect the pump to operate it briefly and then decommission it as described in the following sections. (The intake flange can stay sealed during this brief operation, the exhaust flange must be opened.)

Capacitor forming – What has to be observed when an inverter was in storage for more than 2 years?

If an inverter has been stored for a time longer than two years, it should not be connected directly to the power line. Doing so might permanently damage the capacitors.

Instead the DC bus of the inverter should be connected to a DC power source –including a current limiting resistor and the voltage should be raised slowly. This kind of process is called capacitor forming.

In case a DC power source is not available, the DC bus of a second inverter connected to a variable AC power supply could be used to supply the –variable DC voltage.

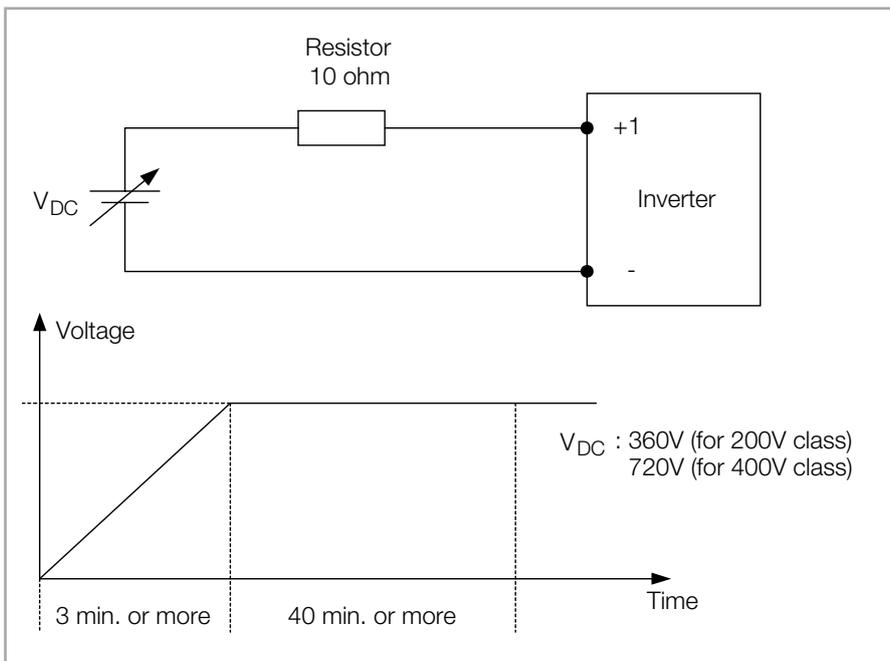


Fig. 2.2 Capacitor forming

Installation

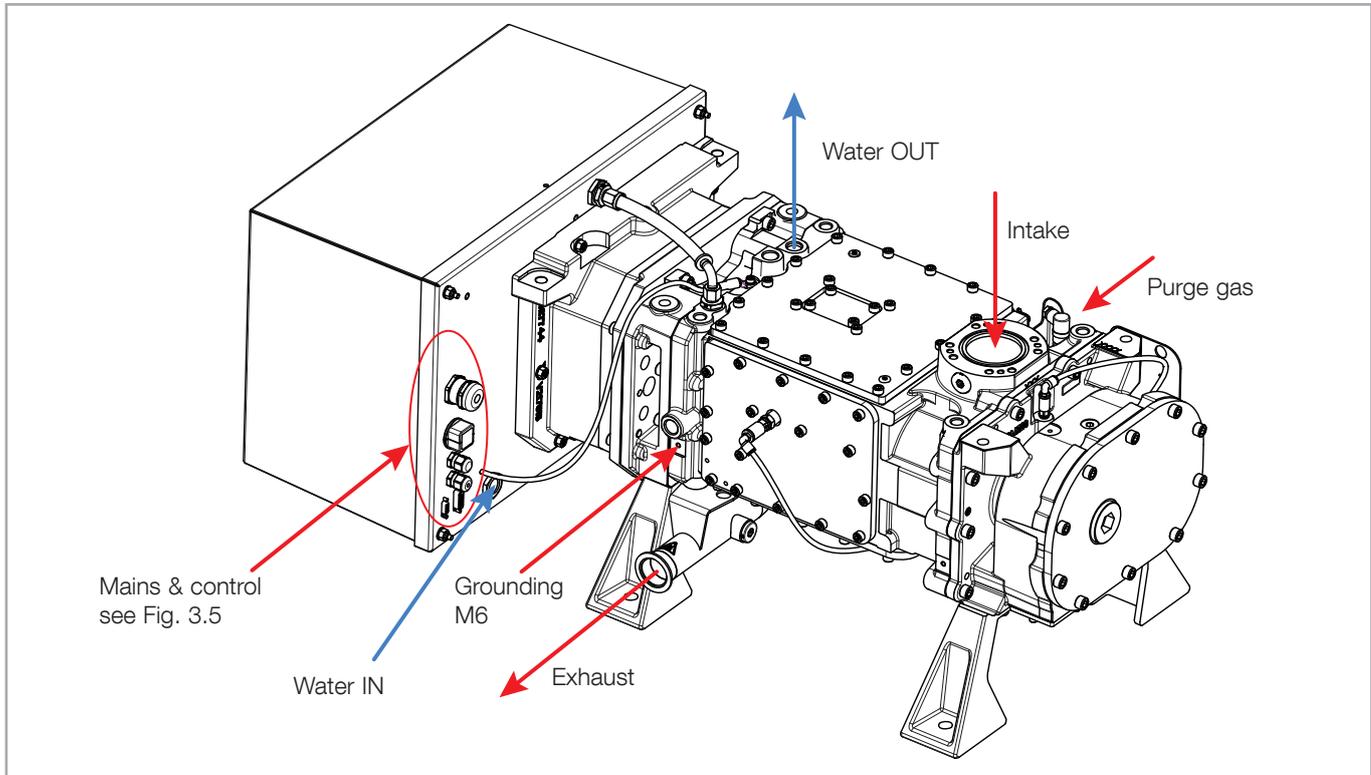


Fig. 3.1 Connections to the DRYVAC DV 200/300/500

3 Installation

WARNING



Risk of cutting and cutting off by contact with moving parts such as couplings, shafts and rotors.

Risk of cutting and crushing when reaching into open flanges or covers. Do not operate the vacuum pump with open flanges or covers. When installing, first mechanically connect the inlets and outlets, close the covers of rotating parts and then make the electrical connections. Disconnect the vacuum pump from the power supply before servicing. Only use trained service personnel.

WARNING



Ejection of parts through bursting of vacuum system due to excessive pressure, caused by faulty function at the gas inlet into the vacuum system.

Pressure build-up in the vacuum system or inlet lines.

Check correct connection of inlet and outlet flanges before commissioning. The inlet pressure at the suction port of the vacuum system must not exceed atmospheric pressure. If seal gas or gas ballast from pressure vessels is used, secure the supply in such a way that no overpressure can occur in the vacuum system in the event of a fault or power interruption.

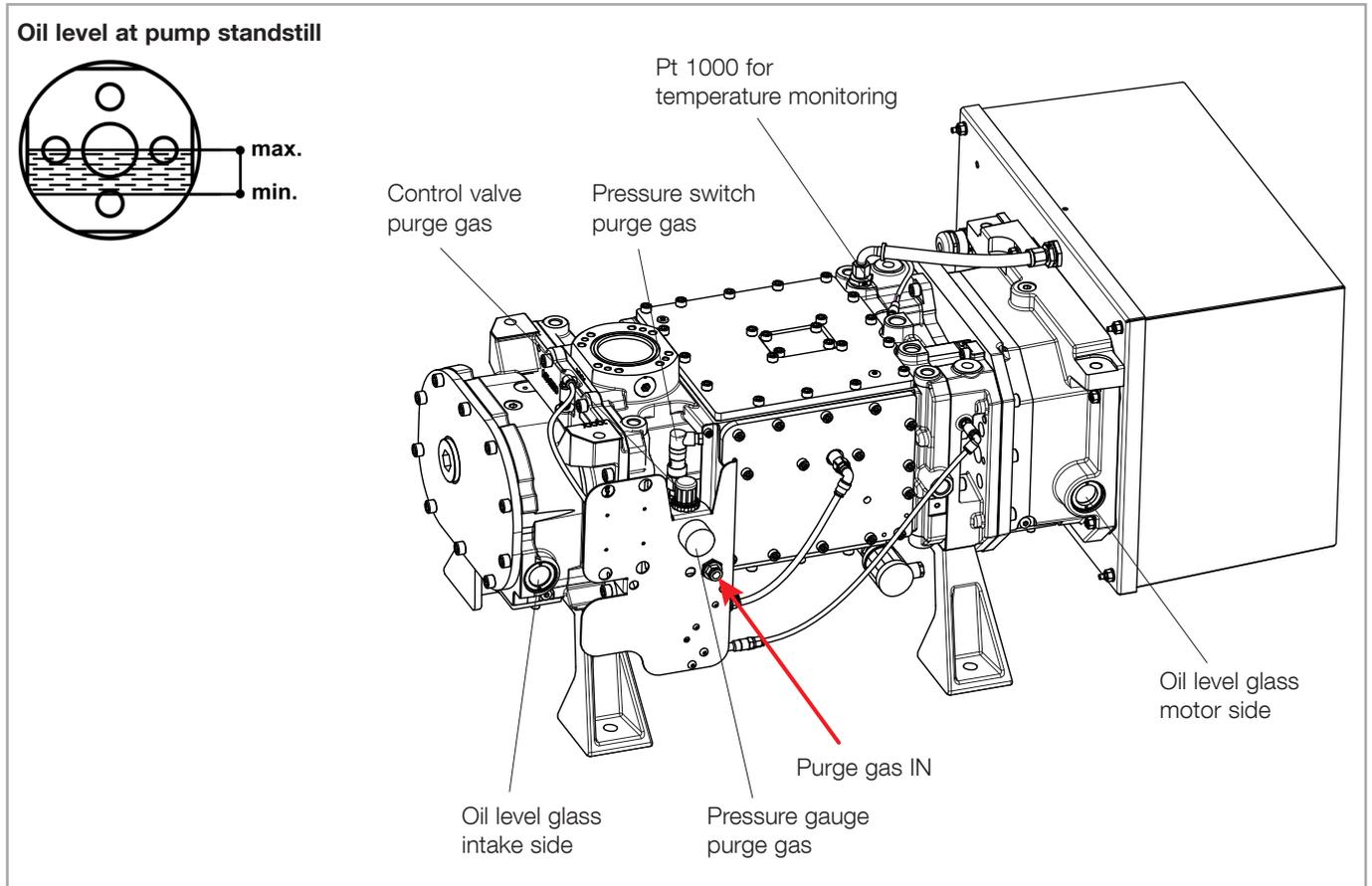


Fig. 3.2 Connections and controls

3.1 Placement

Place the pump system on a flat and level surface.

The pump is designed for operation in buildings.

We recommend leaving the crane eyes screwed in.

Remove the covers and blank flanges on the pump just before fitting the pump so that the assembly work can be performed under the cleanest conditions.

Check whether there is any desiccant present in the intake area. If required remove it.

The pumps are supplied filled with synthetic oil or PFPE. Nothing will have to be refilled. Check the oil levels through both oil level glasses.

If one of the oil levels is found to be incorrect, please contact us.

Install a barrier around the pump to prevent accidental contact with hot surfaces. The barrier must only be removable with tools.

3.2 Conforming Use

DRYVAC pumps are screw vacuum pumps developed for deployment in connection with medium to rough applications.

The pumps have been designed for applications in the process industry, for thin film coating, R&D and rough vacuums.

All DRYVAC pumps are generally leak tight and may for this reason be utilised for pumping toxic and potentially flammable gases outside their ignition range. When using the pumps in connection with oxidising or corrosive gases, check media compatibility first. Media compatibility and the thus resulting hazards of each substance used and also of each substance mixture need to be reassessed on a case-by-case basis.

When planning to pump hazardous substances always consult Leybold first.

3.2.1 Non-conforming Use

Non-conforming use of the pump includes:

- Operation with limit parameters which are not programmed by Leybold, particularly the maximum speed.
- Pumping of gases and vapours for which the materials of the pump are not suited. Consult Leybold. For a list of materials in contact with the process gases, see the Technical Data.
- Pumping of substances and mixtures (gases, liquids and solids) which are rated as being explosive.
- Pumping of ignitable gas mixtures
- The use of pump and frequency converter in explosion hazard areas
- Use in systems and pump systems in which the exhaust pressure may increase over 1.2 bar abs.
- Operation with an inadequately affixed pump.
- Operation at impermissibly high gas temperatures
- Operation on movable systems or system components (e.g. locks or mobile pumping stations).
- Removing, covering or obstructing warning notices.
- Operation outside of buildings.
- Conversions, manipulations and maintenance work by persons not authorised by Leybold.
- Accessories which have not been specified by Leybold.

The DRYVAC DV200/300/500 may be damaged by the following:

- Standstill or storing of pump and drive electronics without suitable sealing and drying. When stored in a humid atmosphere corrosion can occur.
- Use of pump, fitted ad-on components, drive electronics, flanges and cables to climb onto the system.
- Use in systems where pump, frequency converter and cables are subjected to impact stresses.
- Non-compliance with the described maintenance and service intervals.

- Pumping of process gases which form hard or sticky deposits which may cause the pump to seize.
- Pumping of liquids
- Pumping of dusts and solids without suitable screens and filters, consult Leybold.
- Pumping of condensable vapours without adequately controlling the temperature of the pump. Upon compression in the pump, these vapours may condense or form deposits, consult Leybold.

3.3 Connecting the Intake and Exhaust Lines

3.3.1 Intake Lines

Connect the intake line to the pump. We recommend using bellows (vibration dampers) between the pump and the intake line.

The intake lines must be supported.

Align the bellows. Do not overstress the bellows. Too much stress on the bellows will cause premature wear and thus leaks in the system.

The intake lines must be clean.

Ensure that no items like **welding beads**, bolts, nuts, washers, pieces of wire, enter into the pump through the inlet.

Connect the intake flange with a centering ring without outer ring.

NOTICE



NOTICE



Installation

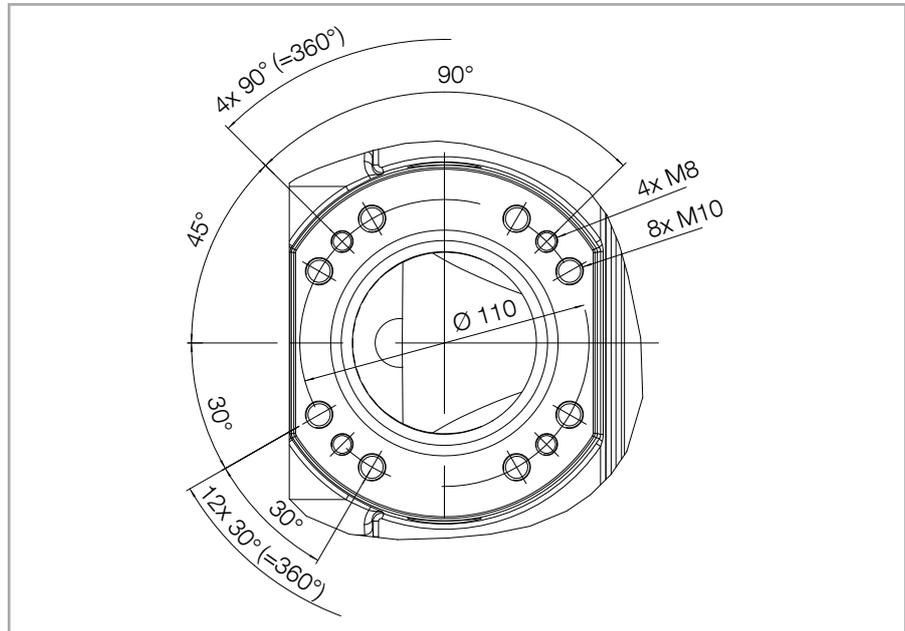


Fig. 3.3 Intake flange

3.3.2 Exhaust Lines

Always operate the pump with a connected exhaust line. The exhaust line must be designed for the specific kind of application. Lay permanent piping to the outside or connect it to a suitable exhaust gas abatement system.

Connect the exhaust line to an abatement system with sufficient throughput, if required by the process. The DRYVAC pumps will be switched off because of overpressure if the abatement system is too small.

Connect the exhaust lines to the pump system's exhaust connections. Use bellows to eliminate mechanical tension in the line.

The exhaust line should have the same or larger diameter than the exhaust flange and 2.0 mm min. wall thickness.

The exhaust line must be able to withstand 1.3 bar and 150 °C.

Keep the exhaust line free of deposits. If the exhaust flow becomes restricted, deposits could collect in the DRYVAC. In order to prevent deposits in the exhaust lines it may be necessary to heat the exhaust lines.

Avoid connecting the pump system together with oil-sealed pumps to one central exhaust system. Using a common exhaust line could result in condensate back streaming into the DRYVAC or in dust adhering in the exhaust line.

NOTICE



In the case of wet processes avoid the ingress of any liquid into the pump. Regularly check the tightness of the exhaust lines!

3.4 Connecting Cooling Water

Connect the cooling water and ensure that the cooling water discharge is not constricted in any way.

Select the lines in view of the temperatures and pressures which are to be expected. Select a nominal width which is as wide as possible so as to avoid pressure losses especially for the discharge (flow velocity below 2 m/s).

The temperature of the discharged cooling water must not exceed 50 °C as otherwise the lines will tend to calcify.

Ensure an adequate cooling water flow in accordance with the technical data.

With the pump warm from operation do not suddenly supply very cold cooling water; there is the risk of a crash due to shock cooling.

NOTICE



Cooling water data for the pump

Materials in the cooling circuit of the pump	AISI 304, red brass, brass, EPDM, epoxy paint,
Feed temperature	5 °C – 35 °C
Feed pressure	2 – 7 bar (g)

Type	Power loss to be dissipated by the cooling water kW	Cooling water demand at feed temperature (assuming a constant discharge temp. of 50 °C)			
		30°C...35°C l/min	25°C...30°C l/min	20°C...25°C l/min	<20°C l/min
DV 200/300/500	4	10.0	8.0	6.0	4.0

Do **not** connect the cooling water using self-sealing quick locks or shut off the feed and discharge lines with valves.

If work on the water cooling system becomes necessary and in the case of a longer standstill or transportation, completely drain out all cooling water and completely dry the lines (e.g. with nitrogen).

Block or label the area of the cooling water and exhaust lines to prevent accidents through tripping.

Installation

3.4.1 Water Quality

In order to ensure long trouble-free operation the cooling water must not contain any oils, greases and suspended solids. Moreover, we recommend compliance with the following limit values:

Appearance	Clear, free of oils and greases
Suspended matter	< 250 mg/l
Particle size	< 150 µm
Electrical conductivity	< 700 µS/cm
pH value	7.0 to 9.0
Total hardness (total alkaline earths)	< 8 °dH
Aggressive carbon dioxide	None, not detectable
Chloride	< 100 mg/l
Sulfate	< 150 mg/l
Nitrate	≤ 50 mg/l
Iron	< 0.2 mg/l
Manganese	< 0.1 mg/l
Ammonium	< 1.0 mg/l
Free chlorine	< 0.2 mg/l

8 °dH (degrees German hardness) = 1.4mmol/l
= 10 °e (degrees English hardness)
= 14 °f (degrees French hardness)

If there is the danger of frost, you may use a water glycol mixture of up to 30 %.

DS water can be used for cooling the pump, if the pH value corresponds to the range indicated above.

3.5 Connecting Purge Gas

The pump must be operated with purge gas. The purge gas is distributed in the pump via flow restrictors

- to the shaft seal on the exhaust side
- into the pumping chamber (rotor purge)
- to the shaft seal on the inlet side.

The flow restrictors ensure that the gas flow to the shaft seal on the high vacuum side becomes very low at ultimate pressure.

The purge gas on the shaft seals provides an air cushion under the shaft seals and thus prevents premature wear.

Use nitrogen or compressed air as purge gas.

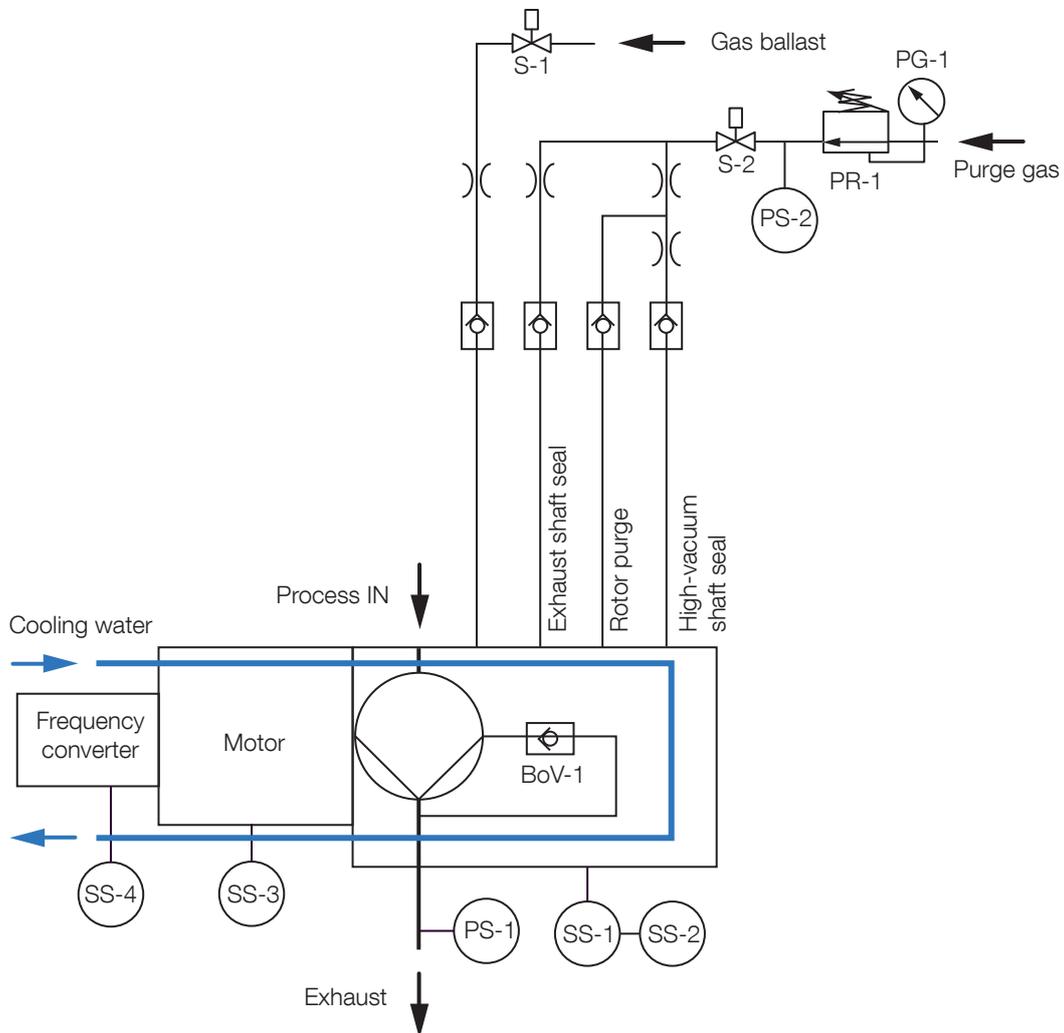
Medium temperature	0 to +50 °C.
Filter size	40 µm
Max. condensate volume	22 cm ³
Operating medium	filtered, dry air or nitrogen of quality class 5, oil-free, quality class 3 according to ISO 8573-1, filtration rating 40 µm
Purge intake side	0.01 to 2 l/min depends on the intake pressure, few purge at low intake pressure, higher purge at high intake pressure
Purge pressure side	6 l/min
Rotor purge	6 l/min
Gas ballast (ambient air)	100 l/min
Pressure setting purge gas	2.2 to 3 bar

Operation without sufficient purge gas leads to premature wear of the shaft seals.

NOTICE



Installation



S-1	Solenoid valve ambient air gas ballast
S-2	Solenoid valve purge gas
PG-1	Pressure gauge purge gas
PR-1	Pressure regulator purge gas
PS-1	Pressure switch exhaust
PS-2	Pressure switch purge gas
BoV-1	Blow off valve
SS-1	Temperature sensor (Pt 1000) pump warning
SS-2	Temperature sensor (Pt 1000) pump trip
SS-3	Thermal switch motor
SS-4	Thermal switch frequency converter
	Flow restrictor
	Non-return valve

Fig. 3.4 Schematic for purge gas and switches

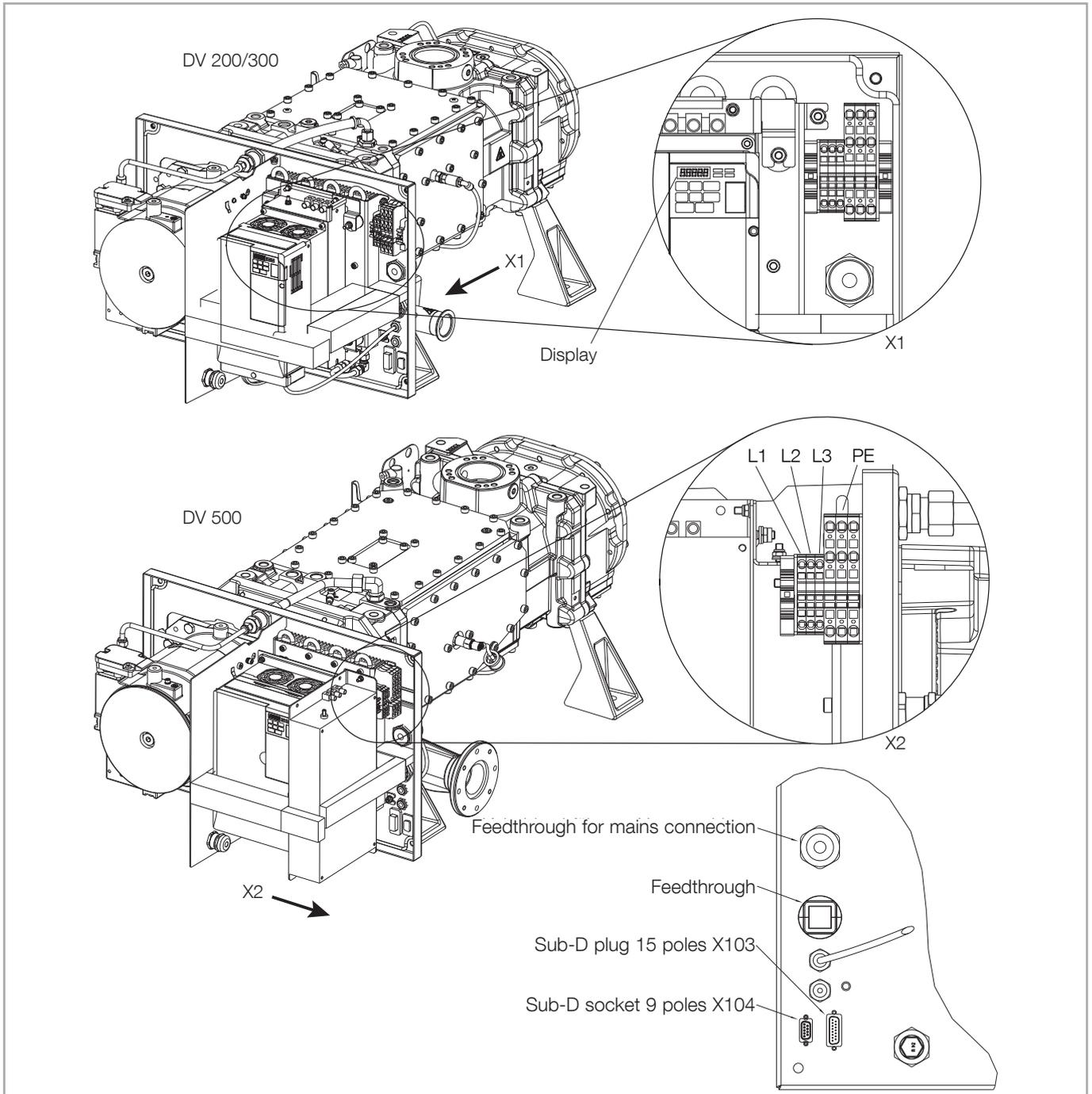


Fig. 3.5 Frequency converter without covers

3.6 Electrical Connection

Take note of the information provided in the Operating Instructions “Quick Start Guide” enclosed with the frequency converter. Read these Operating Instructions and make yourself comfortable with the contents before installing and operating the frequency converter or before doing maintenance work on it. The frequency converter must be installed in agreement with the information given in these Operating Instructions and in agreement with the locally applicable regulations. Non-compliance with the safety information can result in severe or even deadly injuries or may damage the products or facilities and systems operated in connection with the product.

DANGER



Installation

Electrical shock caused by direct or indirect contact with live parts.
Electrical shock due to faulty electrical connection and possible residual voltage up to 5 minutes after disconnection from the mains. The electrical connection may only be carried out by a trained person. Observe the national regulations in the user country, e.g. for Europe EN 50110 - 1. Prior to servicing, disconnect the vacuum pump from the power supply

Electrical shock due to interruption of the protective conductor system. In the event of a fault, life-threatening voltages may be present on electrically conductive components.

Before commissioning, check the resistance of the earthing cable and the suitability of the assigned overcurrent protection device.

Lightning strike.

Risk of fire and injury from lightning strike.

Do not use pumps and pumping systems outside of buildings. The operator is responsible for assessing the hazard potential when used outside of buildings.

Wiring the Main Circuit Input

Consider the following precautions for the main circuit input.

- Use fuses recommended in Main Circuit only, see technical data. Do not use a motor protection switch.
- If using a ground fault circuit breaker, make sure that it can detect both DC and high frequency current.
- The pump has no circuit breaker. Therefore install a circuit breaker in the system. Arrange the circuit breaker in such a way that it is easy for the operator to reach and mark it in such a way that it can be identified as a disconnecting device for the DRYVAC.

Ground Connection

Take the following precautions when grounding the frequency converter.

- Always connect the frequency converter to ground in accordance with the international and local regulations for equipment exhibiting an increased leakage current.
- Keep the ground wires as short as possible. **The frequency converter produces leakage currents** (typically less than 10 mA). In the case of unbalanced mains power supplies, the leakage current may exceed 10 mA. In this case the protective ground conductor must exhibit a cross-section of at least 10 mm². Or connect a further protective ground conductor having at least the same cross-section as the connection cable. A connection point is provided, see Fig. 3.1.

- When using more than one frequency converter, do not loop the ground wire.
- For compliance with IEC 61010-1 it is mandatory to connect the additional protective earth conductor.

Notes Relating to Electromagnetic Compatibility (EMV)

By maintaining the operational conditions specified this product complies with the EMC emission limits for industrial production environments. The frequency converter may, when deployed in residential areas, cause high-frequency interference. In such a case the operator of the unit will have to introduce additional measures for the purpose of suppressing high-frequency interferences.

Control Circuit Wiring Precautions

Consider the following precautions for wiring the control circuits:

- Always separate control circuit wiring from main circuit wiring and other high-power lines.
- For external control power supply use a UL Listed Class 2 power supply.
- Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults.
- Ground the cable shields with the maximum contact area of the shield and ground.
- Cable shields should be connected on both cable ends.

Main Circuit Terminals

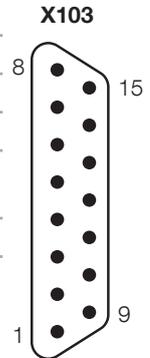
Terminal	Type	Function
R/L1, S/L2, T/L3	Main circuit power supply input	Connects line power to the frequency converter via line filter
U/T1, V/T2, W/T3	Drive output	Connects to the moto
B1, B2	Braking resistor	For connecting an optional braking resistor
+1, +2	DC reactor connection	Linked at shipment. Remove the link to install a DC choke.
+1, -	DC power supply input	For connecting a DC power supply
 (2 terminals)	Erdungsanschluss	For 200 V class: Ground with 100 Ω or less For 400 V class: Ground with 10 Ω or less

Installation

Remote Connector

Type: Sub-D 15 pole male

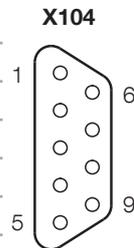
Pin no.	Function	Description	Remarks
1	Baseblock Input	low active ref. digital ground	must be activated before Run
2	Digital Ground	reference for 1, 3, 4	
3	Run / Stop	low active ref. digital ground	
4	2nd Speed	low active ref. digital ground	function not activated contact supplier for details
5	Digital Ground	reference for 1, 3, 4	
6	Warning Output	Optocoupler output open collector (supply only through a resistor, max current 10mA) low active ref. Optocoupler ground	
7	Failure Output	Optocoupler output open collector (supply only through a resistor, max current 10mA) low active ref. Optocoupler ground	
8	Warning/Fail Common	Optocoupler ground reference for 6, 7	
9	Analog Input	4-20mA / 0-10V ref. Analog ground	function not activated contact supplier for details
10	Analog Ground	reference for 9, 11, 15	function not activated contact supplier for details
11	+10V Analogue Voltage	+10V ref. Analog ground	function not activated contact supplier for details
12	Digital Ground	reference for 14, 15	
13	N.A.		
14	Reset Input	low active ref. digital ground	
15	Normal Output	0 /10V output max 10 mA ref. to analog ground	



Communication Modbus RTU Connector

Type: Sub-D 9 pole female

Pin No.	Function
1	n.c.
2	n.c.
3	n.c.
4	n.c.
5	Ground
6	n.c.
7	TxD+ / RxD+
8	TxD- / RxD-
9	n.c.



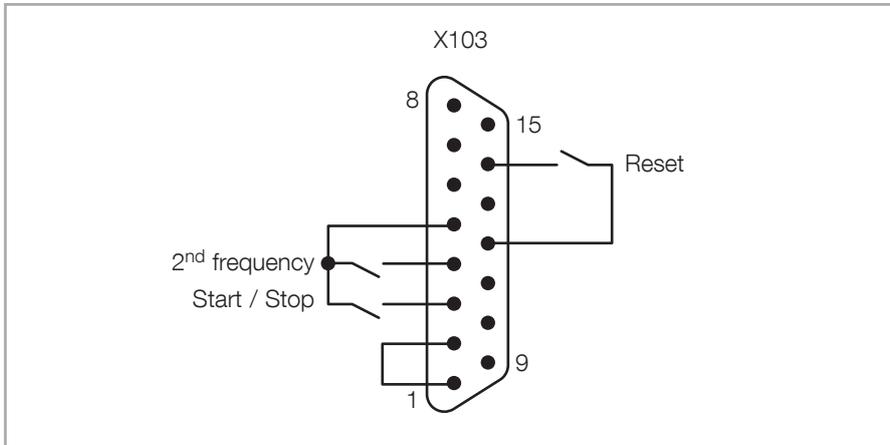


Fig. 3.6 Control I/Os

Control with I/Os

The DRYVAC can be controlled via digital inputs and outputs. To do so, change the parameter b1-01 from 0 (RUN and STOP buttons) to 1 (digital inputs), see Section 4.2 Interface Description.

X103-5 = earth

Connect X103-5 with X103-3 to start the DRYVAC. The ramp-up time to nominal speed is about 200 seconds. Open X103-5 and X103-3 to stop the DRYVAC.

Connect X103-12 with X103-14 to reset an error message. Reset will not function as long as the error message is active. In addition, the start signal must be set to "0" before the reset.

To set a 2nd frequency see Section 4.4.4.

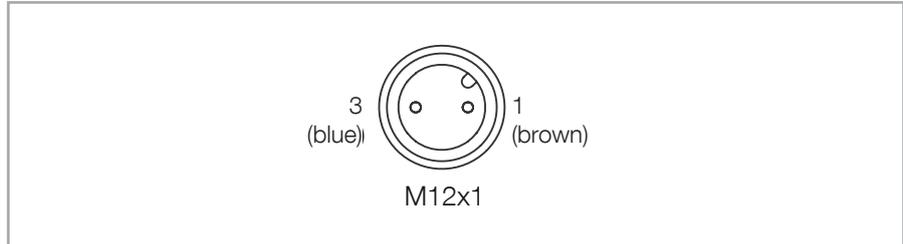


Fig. 3.7 Purge gas pressure switch connection

Connecting the Purge Gas Module Electrically

- Connect the purge gas pressure switch
- and solenoid valves

to your system control.

Purge gas pressure switch

Voltage	max. 42 V
Switching capacity	100 VA
Type of protection	IP 67
Cable screw connection	M12x1
Mating connector	M12x1 DIN EN 61076-2-LF
NC contact (2 connection contacts)	

The pressure switch requires no auxiliary power (no separate power supply).

Connect the solenoid coils for the purge gas valves to your system control. The plugs are on the coils on delivery.

Data for the solenoid coils

Voltage	24 V DC
Power consumption	8 W
Type of protection (DIN 40050)	IP 65
Cable screw connection	Pg 9

Connect the mains cable

Remove the cover from the frequency converter. The cover is connected to the PE terminals with a PE cable. Do not interrupt this cable.

Connect the mains cable as shown in Fig. 3.4. Use the M32 cable fitting for that purpose. The terminals are designed for 10 mm² max. cable diameter.

Remount the cover on the frequency converter.

Establishing Potential Equalisation

An M 6 thread is provided at the motor housing for connecting the external potential equalisation cable, see Fig. 3.1.

3.7 Leak Search after Installation

On delivery, the pump is leak tight to $< 10^{-4}$ mbar·l/s (integral, leak-checked).
Leak-check all relevant connections after having installed the pump.



4 Operation

DANGER



Danger as a result of sharp increase in pressure due to decomposition of pumped gases. Uncontrolled emission of process gases by reaction products within the pump.

The pumping of reactive gases, vapours or gas mixtures is generally prohibited. The operator is responsible for the assessment of the hazard potential of the process media or mixtures.

Dangers through escaping or emitting transported hazardous gases, vapours or substances. Process gases may escape from the exhaust and from leaks in the vacuum system.

The transport of poisonous / explosive / flammable / pyrophoric / radioactive / oxidizing / corrosive gases or gas mixtures, as well as oxygen of more than atmospheric concentration (21 %) is generally prohibited. The operator is responsible for the assessment of the hazard potential of the process media or mixtures.

WARNING



Ejection of parts by bursting of the vacuum system due to excessive pressure caused by clogged or constricted exhaust.

Pressure build-up in the vacuum system or exhaust pipes.

Do not operate the vacuum system with the outlet closed or throttled.

Ejection of parts by bursting of the vacuum system due to excessive pressure caused by the pump running backwards after it has been switched off under vacuum.

Danger of overpressure in the inlet lines and recipients as well as uncontrolled backward running of rotors.

In the event of a fault or during service, separate the vacuum pumps from the vacuum container and connecting lines before the inlet by means of suitable valves.

CAUTION



Pulling into the vacuum system.

Pulling body parts and objects into the vacuum through open flanges.

Do not put the vacuum pump into operation with open flanges. During installation of the vacuum pump first mechanically connect the inlets and outlets, and only then make the electrical connections.



Hazard of slipping, tripping or falling due to oil leakage from the pump.

During transport or depending on the work process, oil may escape from the vacuum pump. Risk of falling on oil spills!

Check vacuum pump regularly for oil leaks. Take appropriate safety measures!



Burns due to contact with hot surfaces.

Burning of fingers, hands or arms on hot surfaces. Handle the pump only when ventilated and cooled down. Wear suitable protective equipment.

Hearing loss due to high noise level.

Depending on the operating conditions, higher noise levels can be achieved than specified in the technical data. Take suitable hearing protection measures.



4.1 Media Compatibility

See Section 3.2 Conforming Use. For a list of materials in contact with the process gas, see Section 1.3 Technical Data.

If you use the system on an application for which it is not suitable, you may invalidate your warranties. If in doubt, contact Leybold.

4.2 Interfaces

4.2.1 Remote interface X103

The connection is described in Section 3.6.

4.2.2 RS-485 interface X104

For pin assignment, see Section 3.6.

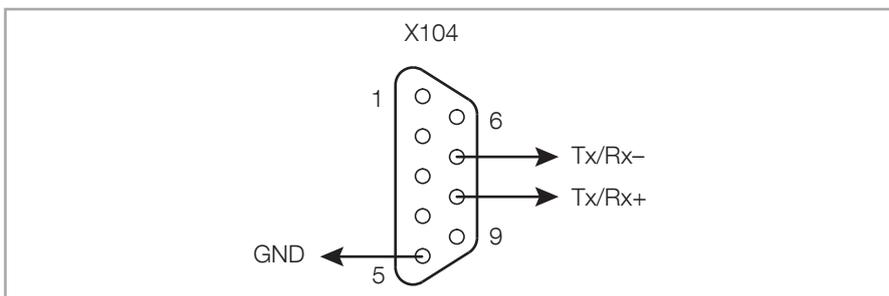


Fig. 4.1 RS-485 interface

Alternatively, the RS 485 interface X104 can be used to operate the pump, giving access to additional operational parameters for the frequency converter.

The user can access the operational parameters using MEMOBUS (a protocol closely related to MODBUS).

For the MEMOBUS protocol, the following connection parameters are used:

Baudrate:	9600 bps
Data length:	8 bit
Parity:	No parity
Stop bit:	1 bit
Address:	31

Operation

A cable for the connection of the pump to a PC via USB is available at Leybold. The necessary drivers are available at <https://www.leybold.com/downloads/download-software/>.

By default, the pump is set such that it can be started/stopped manually or via the X103 interface, while only the operational parameters can be read out via the X104 interface.

If the pump is to be operated via the X104 interface, the parameter b1-02 "Run Command Selection 1" (Hex Addr. 0181H) must be switched from "1" (Digital Input Terminals) to "2" (MEMOBUS communication).

By writing the value 0 in the register 0900h the change is written into the EEPROM (permanently), or when using the register 0910h it is confirmed in the RAM.

Once this has been done, the pump's operating state can be controlled using bit 0 of register 0001H (0=stop, 1=run).

In this mode ("MEMOBUS"), the pump can no longer be controlled manually or using the X1 interface. In order to be able to do so, b1-02 must first be reset to "1".

Find more parameters relevant to remote control in the tables "ModBus Register (pump operation)" and "ModBus Register (monitor values)".

Some parameters are only taken over after a restart.

Table: ModBus register (pump operation)

Hex address	Register	Designation	Description
0001h		Operation Signals and Multifunction inputs	bit 0: 0 = Stop, 1 = Run bit 1 Reserved bit 2 External Fault (EF0) bit 3 Fault Reset bit 4 - F Reserved
0002h		Frequency Reference	Configure drive frequency reference, when b1-01 is set to 2. Frequency is set in steps of 0.01 Hz.
0180h	b1-01	Frequency Reference Selection 1	Selects the frequency reference input source. 0: Operator - Digital preset speed d1-01 to d1-17. 1: Terminals - Analog input terminal A1 or A2. 2: MEMOBUS communications
0181h	b1-02	Run Command Selection 1	Selects the run command input source. 1: Digital input terminals 2: MEMOBUS communications
0280h	b1-01	Frequency reference	Configure drive frequency reference, when b1-01 is set to 0. Frequency is set in steps of 0.01 Hz.

Hex address	Register	Designation	Description
0900h		Enter Command Type (EEPROM)	Write the value 0 to write data (permanently) into the EEPROM of the drive and simultaneously activate the data in the RAM. Parameter changes are retained even when the voltage is switched off and on again.
0910h		Enter Command Type (RAM only)	Write the value 0 to write data into the RAM only..

Table: ModBus register (monitor values)

Reg. No.	Const. No.	Display	Base	Dig-its	Decimal	Unit	Size	Sign	DIV	Warning Lower limit	Warning Upper limit	Note
40H	U1-01	Frequency Reference	DEC	5	01-03	Hz	UWORD		01-03	80	215	Nominal speed = 210 Hz
41H	U1-02	Output frequency	DEC	5	01-03	Hz	WORD	y	01-03	0	215	Nominal speed = 210 Hz
42H	U1-03	Output current	DEC	5	1	A	UWORD		10	0	12	Motor current
45H	U1-06	Output Voltage Reference	DEC	5	1	VAC	UWORD		10	0	254	
46H	U1-07	DC Bus Voltage	DEC	5	0	VDC	UWORD		1	0	360	
47H	U1-08	Output Power	DEC	5	1	kW	WORD	y	10	0	2	Drive power
49H	U1-10	Input terminal status	BIN	5	0		UWORD		1			
4AH	U1-11	Output Terminal Tstatus	BIN	5	0		UWORD		1			
4BH	U1-12	Drive Status	BIN	5	0		UBYTE		1			Operating status of the drive
66H	U1-19	MEMOBUS Error Code	BIN	5	0		UWORD		1			
4DH	U1-25	Software No. (Flash)	DEC	5	0		UWORD		1			
5BH	U1-26	Software No. (ROM)	DEC	5	0		UWORD		1			
80H	U2-01	Current Fault	HEX	5			UWORD					Present Fault
81H	U2-02	Previous Fault	HEX	5			UWORD					Previous Fault
83H	U2-04	Output Frequency at Previous Fault	DEC	5	2	Hz	WORD	y	100	0	215	Output Frequency at Previous Fault
84H	U2-05	Output Current at Previous Fault	DEC	5	1	A	UWORD		10	0	12	Output Current at Previous Fault
8CH	U2-13	Drive Operation Status at Previous Fault	BIN	5	0		UBYTE		1			Operating Status of the Drive at the Previous Fault
8DH	U2-14	Cumulative Operation Time at Previous Fault	DEC	5	0	h	UWORD		1	0	100,000	Upper limit is "none" or here set to 100,000
90H	U3-01	Most Recent Fault	DEC	5	0		UWORD		1			
94H	U3-11	Cumulative Operation Time at Most Recent Fault	DEC	5	0	h	UWORD		1	0	100,000	Upper limit is "none" or here set to 100,000
4CH	U4-01	Accumulated Operation Time	DEC	5	0	h	UWORD		1	0	100,000	Counts the time while voltage is applied. Upper limit is "none" or here set to 100,000

Operation

Reg. No.	Const. No.	Display	Base	Dig-its	Decimal	Unit	Size	Sign	DIV	Warning Lower limit	Warning Upper limit	Note
75H	U4-02	Number of Run Commands	DEC	5	0		UWORD		1	0	none	Number of start-up commands
67H	U4-03	Cooling fan operation time	DEC	5	0	h	UWORD		1	0	100,000	Counts the time during which the frequency converter delivers output and thus also during which the fan of the frequency converter is running. Upper limit is "none" or here set to 100,000
68H	U4-08	Heatsink Temperature	DEC	5	0	°C	UWORD		1	5	120	Cooling Surface Temperature

UBYTE = 8bit unsigned

BYTE = 8bit signed

UWORD = 16bit unsigned

WORD = 16bit signed

4.2.3 Profibus Interface

For installation and operation of the optional bus interfaces, please refer to the instructions of YASKAWA enclosed with the module and the Operating Instructions "300802431 Bus Interfaces for DRYVAC DV and RUVAC WH".

4.3 Start-up

Checks before every Start-up:

Check if the pump system is leak tight.

Close all protective covers.

Open the exhaust lines.

Open the purge gas supply if connected.

Open the cooling water return and supply.

Switch on the main switches.

Check messages on the frequency converter display.

Start the pump. It is ready for operation after 2 minutes.

Dry the pump, if required by the process. To do so turn on the pumping system and run it at ultimate vacuum for a period 60 minutes with a dry nitrogen shaft seal purge before opening it to the process.

4.4 Operation

Depending on the connection, the pumps are operated through the remote control or the Profibus. For the remote control refer to Section 3.6, for the Profibus to Section 4.2.

In the event of a power failure, the pump will continue to operate for a period of up to 2 seconds without outputting an error message.

For troubleshooting and testing the frequency converter is equipped with LEDs and keys.

Operation

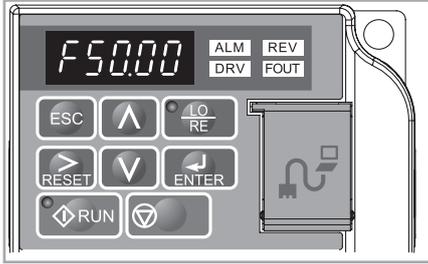


Fig. 4.2 LED display and control unit

4.4.1 LED Display and Control Unit

The LED display and control unit is used to program the frequency converter and to display fault information. The LEDs indicate the frequency converter status.

After switching on, the display indicates alternating every three seconds the monitoring parameters U1-02 (output frequency) and U7-03 (Pt 1000 temperature). The units of measurement are not displayed. When the output frequency is indicated, then simultaneously the LED FOUT will come on and two digits after the decimal point are displayed. Example:

120.00 (FOUT-LED on)	U1-02 = 125.00 Hz
50 (FOUT-LED off)	U7-03 = 50 °C

Keys and Functions		
Display	Name	Function
	Data Display Area	Displays the frequency reference, parameter number, etc.
	ESC Key	Returns to the previous menu.
	RESET Key	Moves the cursor to the right. Resets a fault.
	RUN Key	Starts the drive in the LOCAL* mode. The Run LED - is on, when the drive is operating the motor. - flashes during deceleration to stop or when the frequency reference is 0. - flashes quickly the drive is disabled by a DI, the drive was stopped using a fast stop DI or a run command was active during power up.
	Up Arrow Key	Scrolls up to select parameter numbers, setting values, etc.
	Down Arrow key	Scrolls down to select parameter numbers, setting values, etc.
	STOP Key	Stops the drive.
	ENTER Key	Selects modes, parameters and is used to store settings.
	LO/RE Selection Key	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE)*. The LED is on when the drive is in the LOCAL mode (operation from keypad).
	ALM LED Light	Flashing: The drive is in the alarm state. On: The drive is in a fault state and the output is stopped
	REV LED Light	On: The motor rotation direction is reverse. Off: The motor rotation direction is forward
	DRV LED Light	On: The drive is ready to operate the motor. Off: The drive is in the Verify, Setup, Parameter Setting or Auto tuning mode
	FOUT LED Light	On: The output frequency is displayed on the data screen Off: Anything else then the output frequency is displayed on the data screen
* The pump is not intended for LOCAL mode. Default is REMOTE		

Fig. 4.3 Keys and functions

Power On

Before turning on the power supply:

- Make sure all wires are connected properly.
- Make sure no screws, loose wire ends or tools are left in the frequency converter.

After turning the power on, the frequency converter mode display should appear and no fault or alarm should be displayed.

- Connect X103-1 with X103-2 to activate, see Section 3.6.
- Connect X103-3 with X103-5 to start.

The frequency converter is programmed specifically for this pump. The parameter access is therefore limited. The default output frequency can be changed in the programming mode between 0 Hz and 110 Hz (DV 200), or 125 Hz (DV 300), or 250 Hz (DV 500).

Description	Parameter in Programming mode	Leybold setting
Standard output frequency reference	d1-01	110 Hz for DV 200 125 Hz for DV 300 250 Hz for DV 500

The pre-set limiting parameters, in particular the maximum speed, must not be changed. Note Safety Information in Section 0.2.

Do **not** run any auto-tuning on the frequency converter, since the pre-set motor parameters are then lost.

NOTICE



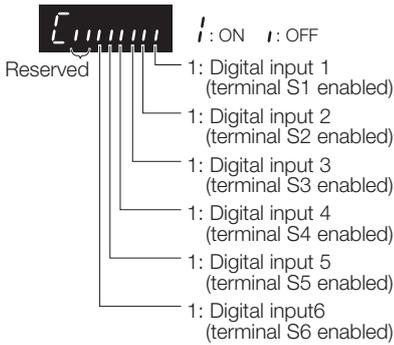
Operation

Monitor Parameter Table

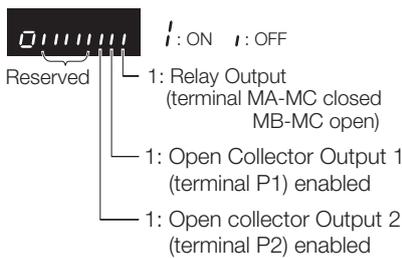
The table shows the the most important monitoring parameters to inform about the frequency converter status and faults (monitoring mode).

Monitor Description

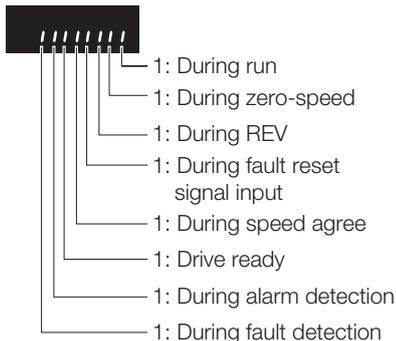
U1-01	Frequency Reference (Hz)
U1-02	Output Frequency (Hz)
U1-03	Output Current (A)
U1-05	Motor Speed (Hz)
U1-06	Output Voltage Reference (Vac)
U1-07	DC Bus Voltage (Vdc)
U1-08	Output Power (kW)
U1-09	Torque Reference (% of motor rated torque)
U1-10	Input Terminal Status



U1-11 Output Terminal Status



U1-12 Drive Status



Monitor Description

U1-13	Terminal A1 input level
U1-14	Terminal A2 input level
U1-16	Soft Starter Output (freq after accel/decel ramps)
U1-18	OPE Fault Parameter
U1-24	Pulse Input frequency
U7-03	Pump temperature
U7-04	Actual current limit
U7-05	Base block counter

Fault Trace

U2-01	Current Fault
U2-02	Previous Fault
U2-03	Frequency Reference at Previous Fault
U2-04	Output Frequency at Previous Fault
U2-05	Output Current at Previous Fault
U2-06	Motor Speed at Previous Fault
U2-07	Output Voltage at Previous Fault
U2-08	DC Bus Voltage at Previous Fault
U2-09	Output Power at Previous Fault
U2-10	Torque Reference at Previous Fault
U2-11	Input Terminal Status at Previous Fault
U2-12	Output Terminal Status at Previous Fault
U2-13	Drive Operation Status at Previous Fault
U2-14	Cumulative Operation Time at Previous Fault
U2-15	Soft-Starter Speed Reference at Previous Fault
U2-16	Motor q-Axis Current at Previous Fault
U2-17	Motor d-Axis Current at Previous Fault

Fault History

U3-01 to U3-10	Lists the 10 most recent faults
U3-11 to U3-20	Operation times that belong to the tenth most recent faults

* The following faults are not recorded in the error log: CPF00, 01, 02, 03, UV1, and UV2.

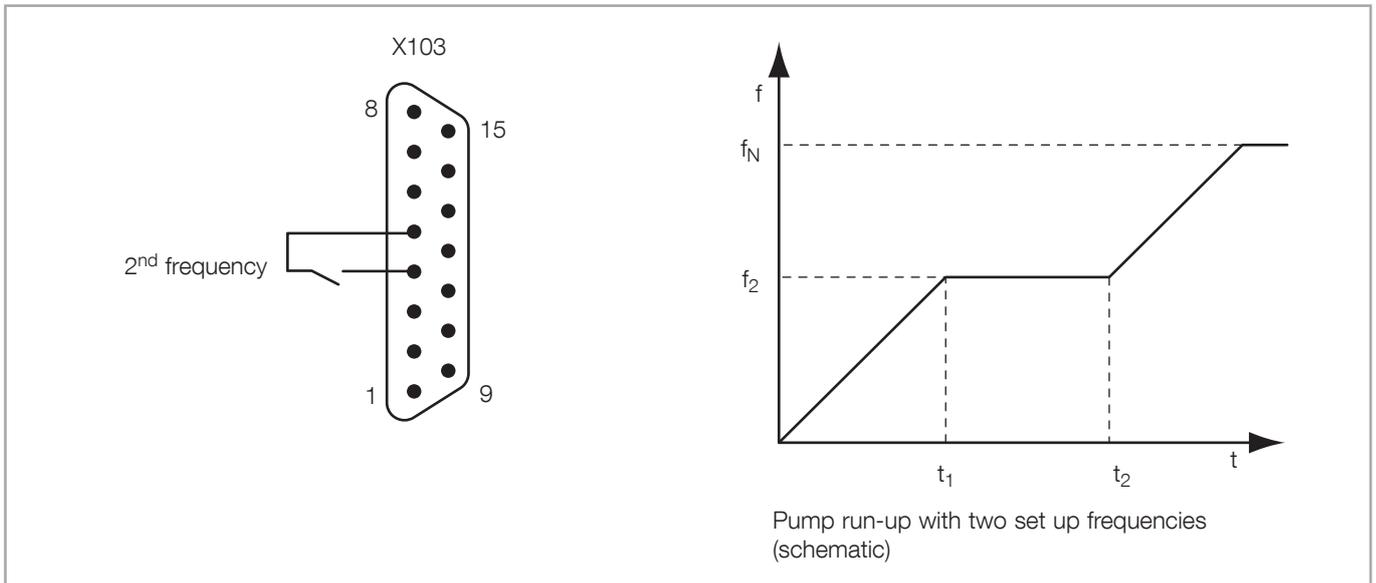


Fig. 4.4 Changing the speed of the pump

4.4.2 Option: Changing the Speed of the Pump

The frequency converter permits the following:

- Entering of a second setpoint frequency and selecting it as required. This allows gentle running up of the pump for a sensitive vacuum chamber, for example.
- Changing the speed of the pump through an input at the analogue input.

Connections here must only be provided by a trained person. Please note the national regulations in the country of use, for example EN 50110-1 in Europe.

We urgently recommend that you consult us first.

The pump must not be operated for more than one hour at frequencies below 20 Hz.

NOTICE



Setting up the Second Setpoint Frequency

Enter the desired second frequency through the parameter d1-03 (default 0 Hz, allowed input range 0 Hz to max. pump frequency). Closing of the switch between the digital input X103-4 and X103-5 will enable the second frequency.

The input signal at X103-4 can be controlled through a timer relay or through the PLC.

Operation

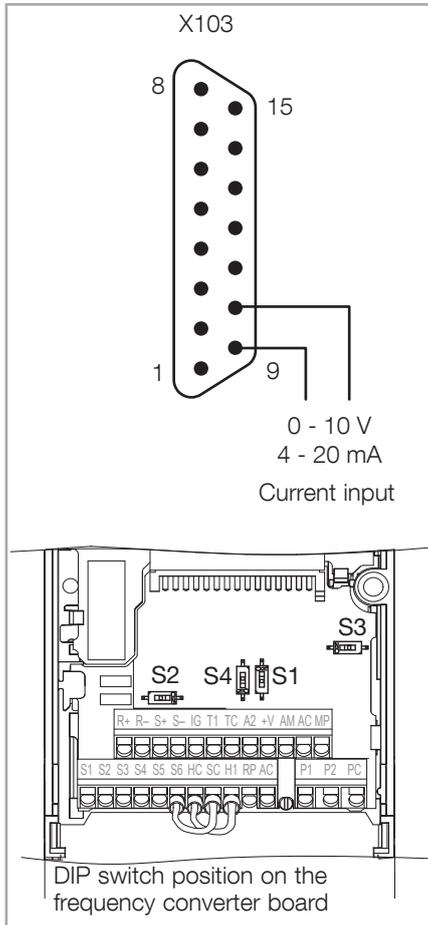


Fig. 4.5 Changing the speed of the pump

Controlling the Speed through a Voltage Input

Set parameter b1-01 to 1 (0 default). Through this, the analogue input terminal becomes the main frequency reference.

Set DIP switch S1 to the bottom position V (voltage).

DIP switch S4 must remain at its default position: top, multifunction input.

Set parameter H3-09 to 0. Through this, the input signal type is set to "0-10 VDC with lower limit". Make sure that parameter H3-10 has been set to the default value 0.

Connect the control voltage to terminals X103-9 and X103-10. 0 to 10 V, 0 V corresponds to 0 Hz, 10 V corresponds to 110/125/250 Hz for DV 200/300/500, linear increase.

Controlling the Speed through a Current Input

Set parameter b1-01 to 1 (0 default). Through this, the analogue input terminal becomes the main frequency reference.

DIP switch S1 must be at its default position: top, position I.

DIP switch S4 must be at its default position: top, multifunction input.

Parameter H3-09 must be at its default value 2, input signal type "4-20 mA"). Make sure that parameter H3-10 has been set to the default value 0.

Connect the control current to terminals X103-9 and X103-10. 4 to 20 mA, 4 mA corresponds to 0 Hz, 20 mA corresponds to 110/125/250 Hz for DV 200/300/500, linear increase.

4.4.3 Warning and Shut-off Thresholds

	Designation	Warning threshold	Shut-off threshold	Processing by	Fault display
Exhaust pressure (Pressure difference to ambient pressure)	PS-1		250 +/- 50 mbar	frequency converter	EF2
Purge gas supply pressure	PS-2	—	2.2 bar(g)	customer PLC	—
Temperature pump motor side (temperature sensor Pt 1000)	SS-1 SS-2	90 °C	100 °C	frequency converter	100A1 / 100FT
Temperature motor	SS-3	—	70 °C	frequency converter	EF3
Frequency converter temperature	SS-4	105 °C	110 °C	frequency converter	oH oHi

4.4.4 Gas Ballast Operation

The gas ballast is used to avoid condensation within the pump. The prerequisite is that the pump has reached its operating temperature.

4.4.5 Pumping of 100% Argon

For operation with high argon concentrations close to 100%, please contact Leybold.

4.5 Shut-off and Venting

When operation is finished, switch the pump off. Proceed as follows:

- Isolate the pump from the chamber but keep it running.
- When pumping **condensable media** (water, for example) continue to operate the pump at a gas throughput, which is as high as possible, for at least 30 minutes to dry it.
- Continue running the pump for 15 minutes with purge gas to ensure that it is free of process gases.
- Then switch off the pump.

Low purge gas flow during shut-off may damage the pump.

The pump must only be vented such that **atmospheric pressure is never exceeded**.

After switching off, maintain the cooling water flow for further 10 minutes, then shut off the cooling water feed.

Open the vacuum system only in the completely vented state and only as short as possible. Otherwise humidity will collect on the inner surfaces. This will then, during subsequent evacuation, result in significantly longer pump-down times until attaining the desired ultimate pressure.

If during longer downtimes the system is to remain conditioned for a rapid pumpdown, we recommend venting the system with dry nitrogen to atmospheric pressure and maintaining it in this condition without opening it.

NOTICE



Emergency measures for pump recovery after pump failure

In the event of a process pump stopping during a process step there is risk that the pump could contain hazardous materials. The following procedure should therefore be followed in order to minimise the risk to people and property.

NOTICE



If the pump has previously pumped hazardous gases observe Safety Information in Section 0.4 and in the Safety Booklet.

- Interlock the process valve to close when the process pump stops.
- Vent the system with the respective purge gas to atmospheric pressure.
- Vent the system to atmospheric pressure using the respective purge gas.
- Purge the system for at least 15 minutes by opening all installed purge gas valves. With no purge gas connected to the pump, use a gas flow from the process side or a separate gas cylinder to purge the pump for at least 15 minutes.
- In no event drain the lubricant.
- Shutting off the purge.
- Disconnect the pump exhaust and inlet and fit a metal ISO / NW blanking plate made of metal.
- Disconnect the purge gas supply and seal.
- The pump can now be removed to a workshop for decontamination and repair.

4.6 Removing from Service

Shut off and vent the pump system as described in Section 4.5.

Clean the pump system of any substances which may lead to corrosion. (e.g. by extended purge).

Drain cooling water

Flood it with nitrogen or dry purge gas, add desiccant and seal it.

Remove the cooling water from the pump system.

Remove the cooling water hoses from the pump and drain the cooling water. Blow out the cooling water coils with compressed air or Nitrogen (**max. 4 bar**). Blow into the cooling water inlet port.

Even when storing the pump for longer periods of time the lubricant remains in the pump.

5 Maintenance

Failure or malfunction of the central control system (unexpected start-up) or danger of a pump restarting automatically after switching off due to a fault. Crushing, cutting or cutting off by touching moving parts due to recurring start command or power supply. Before carrying out maintenance or service work, disconnect the pump from the power supply, secure it against being switched on again, determine that it is de-energised, ground and short-circuit it and cover/isolate adjacent live parts.

Scalding by touching hot equipment or lubricants. Danger of scalding when opening the hot pump with hot operating fluid or cooling water! Open outlet or inlet port for operating fluids only if the operating fluid has adapted to the room temperature. Wear suitable protective equipment.

Danger due to incorrect connection of the pump to the system to be pumped out. Pressure build-up in the vacuum system. Check correct connection of inlet and outlet flanges before operation. When using the pump with seal gas, protect the seal gas supply so that no overpressure can occur in the pump system in the event of a malfunction or power interruption.

5.1 Leybold Service

Whenever you send us in equipment, indicate whether the equipment is contaminated or is free of substances which could pose a health hazard. If it is contaminated, specify exactly which substances are involved. You must use the form we have prepared for this purpose.

This form is available from
www.leybold.com —> Downloads —> [Download Documents](#).

Attach the form to each pump.

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

We must return to the sender any equipment which is not accompanied by a contamination statement.

WARNING



CAUTION



5.2 Maintenance Intervals

See the table for the recommended maintenance intervals for the pumps. We recommend a service contract with Leybold.

We recommend to inspect the pump system and all components after approximately 6 months under the process conditions. The inspection of the components shall let corrosion attacks become apparent at an early stage and indicate possible deposits of process dust. Depending on the findings, changed maintenance and replacement intervals can become necessary for specific components.

Service work	Interval
Check the oil level	1 week
Check the water hoses	6 months
Check the purge gas hoses	6 months
Oil change for synthetic oil	1 year
Oil change for PFPE	not required
Replace the blow off valve	1 year
Complete overhaul in Leybold service centre	4 years or 32,000 operating hours
Leak check the entire pump system	after all maintenance and assembly work and upon request

5.3 Changing the Oil

When using PFPE as intended, PFPE is not subject to ageing. For this reason, it will not have to be exchanged. For safety reasons we recommend not to change the PFPE, since in the event of damage like mechanical failures, for example, hazardous decomposition products may form. Only topping up PFPE will make sense and is possible should the lubricant level be too low after improper transportation, for example.

The synthetic oil must be changed more frequently when pumping corrosive vapours or when large amounts of dust occur.



Before removing the oil-drain or oil-fill plug always switch off the pump first and vent to atmospheric pressure.

When the pump has become warm during operation the casing and the oil temperature may exceed 80 °C.

Leave the pump to cool down. Always wear protective gloves also to protect yourself against aggressive residues in the oil.

Unscrew the oil-drain plugs and the oil-fill plugs and drain the oil.

Clean the sealing surface and firmly reinstall the oil-drain plugs using a gasket which is in perfect condition. Wipe off any oil residues from the casing.

Fill in new oil at a pump temperature of 15 °C to 25 °C. For this use a clean funnel.

Make sure to use the right kind of oil. Only use Leybold oil.

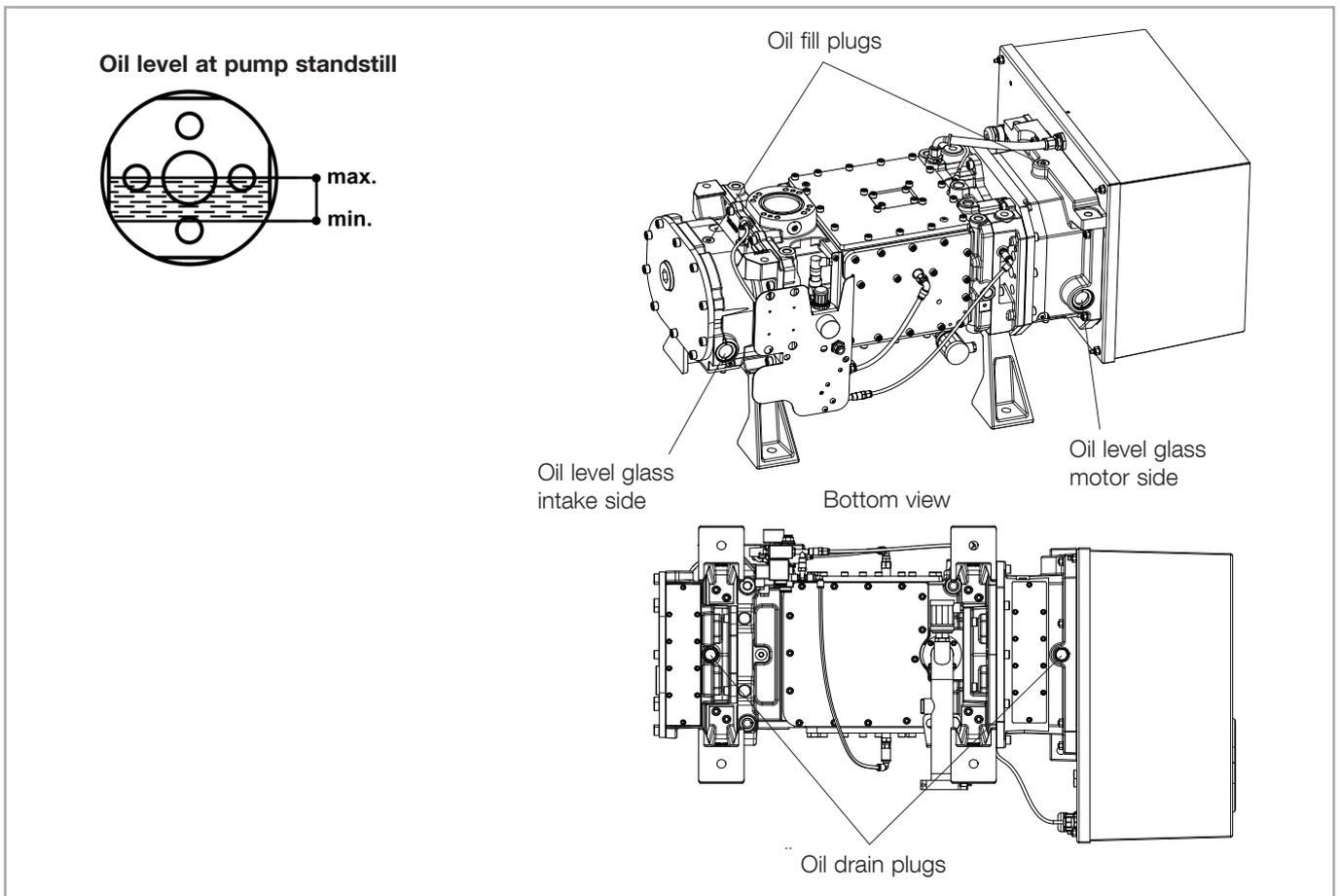


Fig. 5.1 Oil change

Observe the correct oil fill levels for the shutdown (standing still) pump.

If the oil level is too low, the bearings and gearwheels are not lubricated adequately; if it is too high, oil may enter the pumping chamber.

The oil filling openings must be airtight. Under vacuum, the inflow of outside air can cause oily gas to enter the pump chamber via the piston rings.

Clean the oil-fill port and reinstall the plug using a gasket which is in perfect condition. Wipe off any oil residues from the casing.

Manually tighten the oil-fill plugs (tightening torque of approx. 10 - 15 Nm).

NOTICE



Troubleshooting

6 Troubleshooting

6.1 Pump Malfunctions

Malfunction	Likely cause	Remedy
Pump does not start up. EF2, EF3 or 100FT is displayed at the frequency converter (see Section 6.2)	Motor incorrectly connected. Overtemperature switch or motor stator defective. Pressure switch is defective. Lubricant is too thick. Motor rotor defective. Pump has seized: defective impellers, bearings or toothed gears.	Connect motor correctly. Leybold Service. Replace the pressure switch. Exchange the lubricant or warm up lubricant and pump. Leybold Service. Leybold Service.
Pump gets too hot. At the frequency converter (see Section 6.2) then a Pt 1000 alarm is indicated	Cooling water supply is not sufficient. Cooling water lines are clogged. Ambient temperature is too high or cooling air flow is obstructed. Pump is operating in the wrong pressure range. Gas temperature is too high. Clearance between housing and rotors are too small due to - contamination - distortion of the pump Friction resistance is too high due to contaminated bearings and/or contaminated lubricant. Lubricant level is too high. Lubricant level is too low. Wrong lubricant filled in. Bearing is defective.	Ensure sufficient cooling water supply. Decalcify cooling water lines. Install the pump at a suitable place or ensure a sufficient flow of cooling air. Check the pressure levels within the system. Check system. Clean pumping chamber. Affix and connect the pump free of tension. Clean the pump or carry out maintenance. Drain lubricant down to the correct level. Top up lubricant to the correct level. Leybold service Leybold Service.
Pump is extremely loud.	Bearing damage. Thick particle deposits. Defective silencer. High gas throughput with the discharge line open, without silencer.	Repair pump. Clean pump, respectively perform maintenance. Repair silencer. Install discharge line or silencer.
Motor power consumption is too high.	Like „Pump gets too hot“. Incorrect mains voltage for the motor.	Like malfunction „Pump gets too hot“. Connect the motor to the correct mains voltage.
Pump is too loud.	Motor stator defective. Motor rotor defective. Distances between housing and rotors is too small due to - contamination - distortion of the pump Bearing or gear damage. Rotors make contact with the housing. Rotor is running untrue. Oil slinger disc makes contact with the gear housing.	Leybold Service. Leybold Service. Clean pumping chamber. Affix and connect the pump free of tensions. Leybold Service, shutdown pump immediately. Leybold Service, shutdown pump immediately. Leybold Service, shutdown pump immediately. Leybold Service.

Malfunction	Likely cause	Remedy
Pump is losing lubricant.	Lubricant leak is apparent:	Drain lubricant, firmly screw in a new oil drain plug with the gasket, fill in correct lubricant quantity Leybold Service. Replace the O-ring of the gear cover. Leybold Service, shutdown pump immediately. See malfunction „Lubricant in the pump chamber“.
	Oil drain plug is leaky.	
	Oil level glasses leaky.	
	Gear cover is leaky.	
	Puddle under the motor, leak in the seal.	
Oil gets too dark.	No lubricant leak is apparent: See malfunction „Lubricant in the pump chamber“.	
	Oil has been used up. Pump gets too hot.	Exchange the oil. See malfunction „Pump gets too hot“; after remedy of the malfunction, exchange the oil.
Lubricant in the pump chamber.	Pump gets too hot.	
	Lubricant level is too high.	Drain the lubricant down to the correct level.
	Lubricant is ejected from the system.	Check system.
	Pump is not standing horizontally.	Place the pump correctly.
	Pump has a gas leak towards the outside.	Run a leak search and pinpoint leaks. If the leak is not at the oil-fill or oil-drain plugs, return the pump to the Leybold Service.
Pump does not attain its pumping speed.	Pump has an internal leak.	Leybold Service.
	Shaft seals are defective.	Leybold Service.
	Intake screen is clogged.	Clean intake screen.
	Motor incorrectly connected.	Connect motor correctly.
	Motor stator defective.	Leybold Service.
	Motor rotor defective.	Leybold Service.
Vacuum pump system has a gas leak.	Detect leak and seal it.	
Rotor gap is too great.	Leybold Service.	
Bearing defective.	Leybold Service.	

6.2 Fault and Alarms Displayed at the Frequency Converter

Faults and alarms indicate problems in the frequency converter or in the pump.

An alarm (warning) is indicated by a code on the data display and the flashing ALM LED. The frequency converter output is not necessarily switched off.

A fault is indicated by a code on the data display and the ALM LED is on. The frequency converter output is always switched off immediately and the motor coast to stop.

To remove an alarm or reset a fault, trace the cause, remove it and reset the frequency converter by pushing the Reset key on the operator or cycling the power supply.

This lists up the most important alarms and faults only.

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
<i>bb</i>	Base Block	■		The software base block function is assigned to one of the digital inputs and the input is off. The frequency converter does not accept Run commands.	Check the digital inputs function selection. Provide link between X103-2 and X103-1.
<i>CF</i>	Control Fault			The torque limit was reached during deceleration for longer than 3 sec. when in Open Loop Vector control <ul style="list-style-type: none"> • The load inertia is too big. • The torque limit is too low. • The motor parameters are wrong. 	Check the load. Set the torque limit to the most appropriate setting (L7-01 through L7-04). Check the motor parameters.
<i>CPFD2 to CFF24</i>	Control Circuit Fault		■	There is a problem in the frequency converter's control circuit.	Cycle the frequency converter power supply. Initialize the frequency converter. Replace the frequency converter if the fault occurs again.
<i>CPF25</i>	Control Circuit Fault		■	There is no terminal board connected to the control board.	Check if the terminal board is installed properly. Uninstall and Reapply the terminal board. Change the frequency converter.
<i>CR5F</i>	Cannot Reset	■		Fault reset was input when a Run command was active.	Turn off the Run command and reset the frequency converter.
<i>EF</i>	Option External Fault	■	■	An external fault was tripped by the upper controller via an option card.	Remove the fault cause, reset the fault and restart the frequency converter. Check the upper controller program.
<i>EF</i>	External Fault	■		A forward and reverse command were input simultaneously for longer than 500 ms. This alarm stops a running motor.	Check the sequence and make sure that the forward and reverse input are not set at the same time.
<i>EF1 to EFB</i>	External Faults	■	■	An external fault was triggered by an external device via one of the digital inputs S1 to S3. EF2: Pressure sensor exceeds fault threshold. EF3: Temperature limiter exceeds fault threshold. The digital inputs are set up incorrectly.	Find out why the device tripped the EF. Remove the cause and reset the fault. Check exhaust line. Check motor load, reduce if required, improve cooling. Check the functions assigned to the digital inputs.
<i>GF</i>	Ground Fault		■	Ground leakage current has exceeded 50% of the frequency converters rated output current. Cable or motor insulation is broken. Excessive stray capacitance at frequency converter output.	Check the output wiring and the motor for short circuits or broken insulation. Replace any broken parts. Reduce the carrier frequency.

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
$P\bar{F}$	Output Phase Loss		■	<p>Output cable is disconnected or the motor winding is damaged.</p> <p>Loose wires at the frequency converter output.</p> <p>Motor is too small (less than 5% of frequency converter current).</p>	<p>Check the motor wiring.</p> <p>Make sure all terminal screws in the frequency converter and motor are properly tightened.</p> <p>Check the motor and frequency converter capacity.</p>
$\sigma\bar{L}$	Overcurrent		■	<p>Short circuit or ground fault on the frequency converter output side</p> <p>The load is too heavy.</p> <p>The accel./decel. times are too short.</p> <p>Wrong motor data or V/f pattern settings.</p> <p>A magnetic contactor was switched at the output.</p>	<p>Check the output wiring and the motor for short circuits or broken insulation. Replace the broken parts.</p> <p>Check the machine for damages (gears, etc.) and repair any broken parts.</p> <p>Check the frequency converter parameter settings.</p> <p>Check the output contactor sequence.</p>
σH or $\sigma H I$	Heatsink Overheat	■	■	<p>Surrounding temperature is too high.</p> <p>The cooling fan has stopped.</p> <p>The heatsink is dirty.</p> <p>The airflow to the heatsink is restricted.</p>	<p>Check the surrounding temperature and install cooling devices if necessary.</p> <p>Check the frequency converter cooling fan.</p> <p>Clean the heatsink.</p> <p>Check the airflow around the heatsink.</p>
$\sigma L I$	Motor Overload		■	<p>The motor load is too heavy.</p> <p>The motor is operated at low speed with heavy load.</p> <p>Cycle times of accel./ decel. are too short.</p> <p>Incorrect motor rated current has been set.</p>	<p>Reduce the motor load.</p> <p>Use a motor with external cooling and set the correct motor in parameter L1-01</p> <p>Check the sequence.</p> <p>Check the rated current setting.</p>
$\sigma L \bar{L}$	Drive Overload		■	<p>The load is too heavy.</p> <p>Too much torque at low speed.</p>	<p>Check the load.</p> <p>The overload capability is reduced at low speeds. Reduce the load or increase the frequency converter size.</p>

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
<i>OU</i>	DC Overvoltage	■	■	DC bus voltage rose too high. The deceleration time is too short. Stall prevention is disabled1. Unstable motor control. Too high input voltage.	Increase the deceleration time. Enable stall prevention by parameter L3-04. Check motor parameter settings and adjust torque and slip compensation, AFR and hunting prevention as needed. Make sure that the power supply voltage meets the frequency converters specifications.
<i>LF</i>	Input Phase Loss		■	Input voltage drop or phase imbalance. One of the input phase is lost. Loose wires at the frequency converter input.	Check the power supply. Make sure that all cables are properly fixed to the correct terminals.
<i>UU1</i>	DC Under-voltage	■	■	The voltage in the DC bus fell for longer than 2 secs below the undervoltage detection level (L2-05). The power supply failed or one input phase has been lost. The power supply is too weak.	Check the power supply. Make sure, that the power supply is strong enough.
<i>UU2</i>	Controller Under-voltage		■	The frequency converters controller power supply voltage is too low.	Cycle power to the frequency converter. Check if the fault reoccurs. Replace the frequency converter if the fault continues to occur.
<i>UU3</i>	DC Charge Circuit Fault		■	The charge circuit for the DC bus is broken.	Cycle power to the frequency converter. Check if the fault reoccurs. Replace the frequency converter if the fault reoccurs.

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
100A1 / A2	Pt 1000 Alarm 1	■		Occurs when Pt 1000 temperature is > 90 °C.	Check and improve cooling.
PrECE	Pre CE alarm	■		Alarm is active for the time P5-01 before H5-09 elapsed during Memobus Communication error.	
EAL02	External Alarm during delay of MFDI set in S2	■		External alarm during delay of MFDI settings for S2 (H1-02). Delay time set in P1-05 Pressure sensor exceeds alarm/(warning)	
EAL03	External Alarm during delay of MFDI set in S3	■		External alarm during delay of MFDI settings for S3 (H1-03). Delay time set in P1-06	
L_SPd	Low Speed Detected		■	The output frequency is below the frequency set in P3-01 for the time set in P3-02.	

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
C-LiM	C-Lim Alarm	■		Drive was running at or above the Final Current Limit for the time P5-04 – P5-03	
oPEn	Pt 1000 open		■	Open circuit is detected. Note "Wait" fault.	Check Pt 1000 and connection cable, replace if required.
SHorT	Pt 1000 short circuit		■	Short circuit is detected.	Check Pt 1000 and connection cable, replace if required.
100FT	Pt 1000 fault		■	Temperature measured with the Pt 1000 reaches > 100 °C. Note "Wait" fault.	Check and improve cooling.
CMPFT	Compensation Fault		■	Contact Leybold	
C-LiM	C-Lim Fault		■	Drive was running at or above the Final Current Limit for the time set by parameter P5-04.	
_AiT	Wait		■	<p>Condition for Pt 1000 Fault is reached. If the "Pt 1000 Open" threshold is reached within 10 seconds, then "Wait" changes to "Pt 1000 open", else it changes to "Pt 1000 fault".</p> <p>The fault is different to standard faults. There is no error code available and also no entry in the fault history. This ensures that only the faults "Pt 1000 open" and "Pt 1000 fault" can be seen or traced.</p> <p>As soon "Wait" is occurring the frequency converter stops with RUN to coast.</p>	

Operator Programming Errors

An Operator Programming Error (OPE) occurs when an inapplicable parameter is set or an individual parameter setting is inappropriate. When an OPE error is displayed, press the ENTER button to display U1-18 (OPE fault constant). This monitor will display the parameter that is causing the OPE error.

Error message	Possible cause	Corrective Action
oPE01	Drive capacity and value set to o2-04 do not match.	Correct the value set to o2-04.
oPE02	Parameters were set outside the allowable setting range.	Set parameters to the proper values.
oPE03	A contradictory setting is assigned to multi-function contact inputs H1-01 through to H1-06. The same function is assigned to two inputs. (this excludes "External fault" and "Not used") Input functions which require the setting of other input functions were set alone. Input functions that are not allowed to be used simultaneously have been set.	Fix any incorrect settings.
oPE05	The run command source (b1-02) or frequency reference source (b1-01) is set to 3 but no option board is installed. The frequency reference source is set to pulse input but H6-01 is not 0.	Install the required option board. Correct the values set to b1-01 and b1-02.
oPE07	Settings to multi-function analog inputs H3-02 and H3-10 and PID functions conflict. H3-02 and H3-10 are set to the same value. (this excludes settings "0" and "F") PID functions have been assigned to both analog inputs and the pulse input at the same time.	Fix any incorrect settings.
oPE08	A function has been set that cannot be used in the control mode selected.(might appear after control mode change)	Fix any incorrect settings.
oPE10	The V/f pattern setting is incorrect.	Check the V/f pattern settings.
oPE12	Occurs if b1-01 (Frequency Reference) = 3 or b1-02 (Sequence Reference) =3 and Leybold Parameters Lower Level is set and option card is connected. Occurs if following condition is not given: P2-02 < P2-04 < P2-06 < P2-08 < P2-10 < P2-12 < P2-14 < P2-16 < P2-18 < P2-20 < P2-22. Occurs if following condition is not given: P4-01 < P4-02 < P4-03 Occurs if MFDI setting in H1-02 is not an external fault setting and P1-05 is unequal to 0. (H1-02 < 20h) OR (H1-02 > 2Fh) AND (P1-05 NOT 0) Occurs if MFDI setting in H1-03 is not an external fault setting and P1-06 is unequal to 0. (H1-03 < 20h) OR (H1-03 > 2Fh) AND (P1-06 NOT 0)	

Wearing Parts / Disposal

7 Wearing Parts

Gasket for plug screw G 3/8 (oil fill plug)

ES23955165

8 Waste Disposal

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

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

When sending us any equipment, observe the regulations given in Section "5.1 Leybold service".

Disposal of Waste Oil

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

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

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

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

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

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

Symbols on the vacuum device



Do not dispose of the vacuum device as residual waste but in accordance with the applicable local regulations.



China RoHS: Products marked with this symbol contain residual quantities of substances that are subject to quantitative regulation in accordance with Chinese Directive GB/T 26552. These parts can safely be used for the environmental protection use period (20 years) as indicated and should enter into the recycling system after their environmental protection use period.

EU Declaration of Conformity



Pioneering products. Passionately applied.

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