Leybold

DRYVAC

DV 450, DV 650, DV 800

Dry Compressing Vacuum Pumps

Operating Instructions 300314330_002_C7

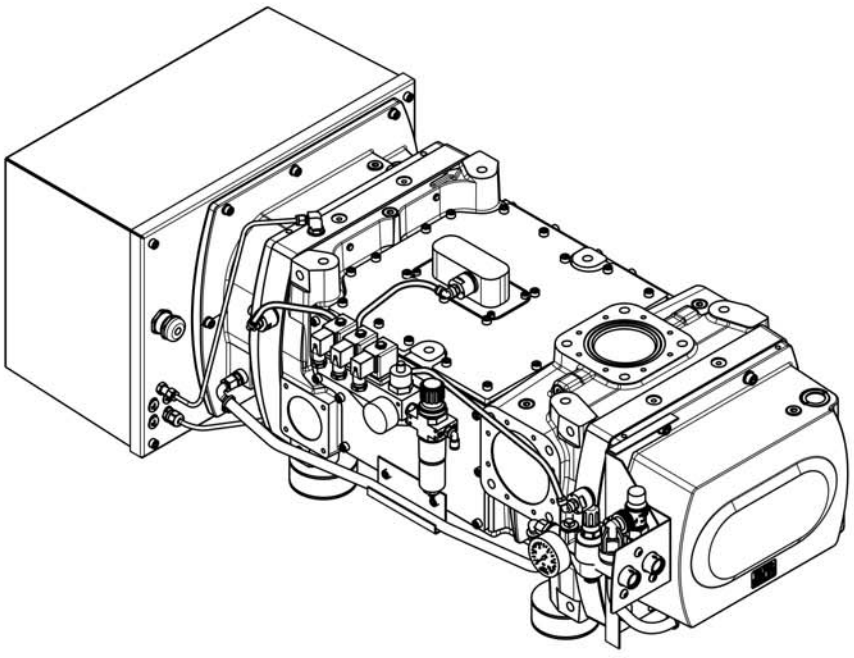
Part Numbers

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Original operating instructions.

Safety Information

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

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

WARNING



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

CAUTION



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

NOTICE



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

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

Retain the Operating Instructions for further use.

0 Important Safety Information

Explanation of Warning Symbols

	⚠ DANGER	
	**Toxic gases**	The pump must be leaktight. When the pump has been used to pump hazardous gases before, introduce appropriate safety precautions before opening it. Before opening the pump, purge it for a longer period of time with an inert gas. If necessary, wear suitable personal protection equipment like gloves, breathing protection and protection clothing, for example.
	**Danger of explosion**	
	**Fire danger**	
	**Reactive or corrosive media**	
	**Contaminated parts**	

	⚠ WARNING
	**Hazardous Voltage** Disconnect power before opening Contact causes electrical shock **High Leakage Current** Earth connection essential before connecting supply **Electrical Hazards** Danger of residual voltage for up to 5 min after disconnecting power supply. Connect and disconnect the mains plug only in deenergized condition
	**Hot Surface** Do not touch. Allow this area to cool before servicing **Burn hazard** Hot Surface inside. Do not touch, wear protective equipment.

Safety Information

	⚠ CAUTION
	**Purge gas** Check compatibility with applications **Overpressure in the discharge line** 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.
	**Pumps with wheels** must only be placed and moved on levelled horizontal surfaces!
	**Vacuum** Avoid exposing any part of the human body to the vacuum.
	**Machinery starts automatically** Connect the pump so that it not will restart automatically after a mains power failure, once the power returns.
	**Overhead load** Transport the pump only at the four crane eyes or secured with a forklift.

0.1 Mechanical Hazards

WARNING



1 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.

2 Avoid exposing any part of the human body to the vacuum.

3 Do not operate the pump with an opened intake port. There exists the risk of suffering injury.

4 The pump is intended for generating a vacuum only. If an **overpressure** can occur in the pump and the system then they must be pro-tected against such an overpressure by an overpressure safety valve, for example.

5 The maximum permissible discharge pressure for the DRYVAC is 1.2 bar abs.

Always operate the pump with a connected exhaust line. The exhaust line must be designed for the specific kind of application and shall be connected to a central exhaust gas system.

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.

No shutoff devices are required in the discharge line for pump operation. If shutoff devices are installed, open them before starting the pump.

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

6 When using purge gas, protect the purge gas supply so that in the event of a malfunction or power interruption no overpressure can occur within the pump system.

7 We recommend to design the discharge line in consideration of a possible overpressure of 10 bar. In the event of a malfunction, such a pressure can occur briefly, e.g. when the exhaust is shut suddenly.

8 For **transporting** the pump use only suitable 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 four crane eyes.

When transporting the pump with a forklift or similar, ensure that the pump has been secured on the forks or on a suitable pallet.

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

9 Select the location where the pump is installed so that all controls can be easily accessed. Place the pump only on a floor which is level. It can topple when it is tilted by more than 10° with respect to the ver-ti-cal axis.

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, screw down the adjustable feet.

10 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 discharge 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.

11 During operation, the cooling water circuit must not be shut off. A cooling water discharge which has been blocked can cause the for-mation of gas bubbles and result in excessively high pressures.

12 Lay electric feed and cooling water lines so that there is no risk of **trip-ping** over these.

13 When changing the oil remove any escaped oil as otherwise there is the risk of slipping.

14 Before doing installation work on the pump system make sure that no vacuum is present in the pump and that all media connections have been depressurised.

15 Before disassembling any cooling water lines, leave the pump to cool down, shut off the feed line.

0.2 Electrical Hazards

DANGER



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 Potentially lethal voltages are present at the mains connections. Before beginning with any maintenance or service work on the pump, disconnect the pump from all power supplies (lockout/tagout). In addition, there is the danger of residual voltage for up to 5 min after disconnection.

3 Install a device for a safe disconnection from the power supply.

4 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.

5 Note the information on the IP type of protection.

6 Always operate the pump with a properly connected protective earth conductor and make sure that the motor casing is closed

7 Observe the manufacturer's information and operating instructions for the respective frequency converter.

8 The pump must only be operated at the frequency specified for the motor. Use only the Leybold frequency converter.

9 For pumps with external frequency converter: after having connected the motor and each time after having made changes to the wiring, check the motor's direction of rotation.

A wrong direction of rotation can cause a pressure buildup on the intake side. Moreover, the pump may suffer severe damage.

10 Install a suitable motor protection for the electric motor before starting up for the first time. Note the information in these Operating Instructions and on the nameplate.

11 Before starting, check to ensure that the junction box is undamaged, run a visual inspection on the seals.

12 Install add-on parts (pressure switches, for example) without any mechanical tensions and protect these against being damaged by impacts, for example.

13 Lay the connecting lines so that these cannot be damaged. Protect the lines against humidity and contact with water. Avoid thermally stressing the lines by unfavourable laying. Comply with the required standards when designing and laying the electrical connections.

14 Provide strain relief for the connecting lines so that the plugs and the line connectors are not subjected to excessively high mechanical stresses.

15 Lay electric feed lines so that there is no risk of **tripping** over these.

16 For models with external frequency converter only:
Consider the following precautions for the output circuit wiring.
Do not connect any other load than a 3 phase motor to the frequency converters output.
Never connect a power source to the frequency converters output.
Never short or ground the output terminals.
Do not use phase correction capacitors.

17 The pump must be integrated in the system control arrangement so that it can not run-up automatically after it has been shut down due to overtemperature. This applies equally to emergency shut-down arrangements. After having determined the fault cause, the pump should be switched on manually again.

18 We recommend the use of the external display (accessory) to operating the frequency converter. Attach the external display appropriately if it used permanently.

19 Work on the frequency converter within the motor casing must always be left to suitably instructed personnel only.

0.3 Thermal Hazards

CAUTION



1 Under certain ambient conditions parts of the pump may attain temperatures over 80° C. There then exists the risk of suffering burns.
Note the danger symbols on the pump and in the case of a hot pump wear the required protection equipment.
If there is the risk of touching hot surfaces inadvertently, install corresponding protection. When working on a pump which is still warm from operation, always wear protective gloves.

2 Handle the pump only while vented and after having let it cool down.

3 Before disassembling any cooling water lines, leave the pump to cool down, shut off the feed line.

4 When uninstalling the cooling water lines, take note of splashing water. Heated water can cause burns.

5 Never remove the oil-fill or oil-drain plugs while the pump is running. There exists the risk of suffering burns. Always wear protective gloves and protective goggles also for protection against the oil.

6 Operating the pump with less than the specified amount of cooling water will result in excessively high surface temperatures. Moreover, there exists the risk of suffering burns.

7 DRYVACs without cooling water unit:
(Industrial versions) For these DRYVAC pumps do **not** connect the cooling water using self-sealing quick locks or shut off the feed and discharge lines with valves.

After switching off, the pump will continue to produce heat. If upon switching off the pump someone would then interrupt the cooling water flow (through quick locks or valves on both sides (feed and discharge)) then the water will continue to heat up further but will not be able to expand. The high pressure thus produced may cause damage to the cooling water channels and seals. Moreover, hot water or steam may escape.

0.4 Hazards Caused by Materials and Substances

DANGER



1 The vacuum line and the exhaust line must be leaktight. **Hazardous process gases** may escape or the pumped gases can react with air or atmospheric humidity. After installation of the pump and after servicing work on the vacuum system, a leak search will always be necessary.

When pumping hazardous gases we recommend a leak search on a regular basis. Leaks in the pump cannot be ruled out under all circumstances. When pumping hazardous gases, the operator must ensure that that leaks at the pump will not be a hazard.

2 Since not all application related hazards for vacuum systems can be described in detail in these Operating Instructions, Leybold has available a separate document (Safety Booklet) in which the hazards and general safety concepts for design, operation and maintenance of vacuum systems are explained.

When planning to pump hazardous substances with this pump, read the related chapters in the Safety Booklet and in these Operating Instructions first. You can download the Safety Booklet from our homepage.

3 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.

4 If required additional monitoring of the purge gas quantities is necessary from the side of the operator when a well-defined and ensured dilution is necessary from the side of the process.

The type of protection depends on the specific process and needs to be assessed by of the customer.

5 The cooling water from the return is not of drinking water quality and should not be used for this purpose.

After having operated the pump, the cooling water lines may suffer from microbiological contamination. Take appropriate safety precautions.

6 Before operating the pump with a gas ballast or a purge gas check the compatibility of the gas with the pumped media so as to avoid dangerous conditions during operation.

7 When the pump has been used to pump hazardous gases before, introduce appropriate 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 suitable personal protection equipment like gloves, breathing protection and protection clothing, for example (see Material Safety Data Sheets for the substances in use, the chemical reactions and the by-products). Firmly seal off the pump. When shipping the decontaminated pump for servicing please also indicate the type of hazard. For this see Section 5.1 Service at Leybold.

8 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.

9 When disposing of the pump, used lubricants and used oil filters observe the applicable environment regulations.

10 When pumping hazardous gases you must assume the presence of hazardous residues in the pump.

11 If the pump has been contaminated by the process or through environmental influences, it must be decontaminated professionally.

Contaminated parts can be detrimental to health and the environment. Before beginning with any repair and maintenance work inform yourself about any possible contamination. When handling contaminated parts observe the pertinent regulations and comply with the necessary protection measures.

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



12 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.

13 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.

0.5 Ignition Risk

1 The standard version of the pump is not suited for operation in explosion hazard areas. Contact us before planning to use the pump under such circumstances.

DANGER



0.6 Noise Hazard

1 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, higher values must be expected. Make sure that suitable protection measures are taken to protect your hearing.

We recommend to wear hearing protectors (earmuffs), if local noise levels exceed mandatory limits.

CAUTION



0.7 Dangers in connection with safety-related measures and precautions

1 The pump is not equipped with an emergency shutdown facility.

2 The following applies to pumps being operated with a frequency converter: after a mains power failure the pump will automatically start up again once the power returns.

3 Take note of the warning information on the casing surface. If this warning information was removed, covered or obstructed, then provide corresponding additional warning information.

CAUTION



NOTICE



0.8 Danger of Pump Damage

1 Select an installation site for the pump so that all controls are easily accessible.

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

3 Do not allow the ingestion of any objects (screws, welding beads, nuts, washers, pieces of wire, etc.) through the intake port of the pump.

If possible, use the **intake screen** which has been fitted as standard and clean it regularly.

In case the pump is operated without intake screen the operator has to make sure that no objects can enter the pump through the intake port. Objects falling into the pump can cause severe damage at the pump including leaks to atmosphere.

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.

4 In a pumping section (combination of several pumps connected in series) only a single intake screen is required. This screen needs to be fitted to the inlet for the pump closest to the process chamber. When pumping dust containing media, install a dust filter in the pro-cess gas flow upstream with respect to the pump.

5 If low concentration corrosive or reactive gases are being pumped, then operate the pump with purge gas.

Please consult us to determine which pump types are required for specific processes and applications.

6 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.

7 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.

8 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. We recommend to fit a **non return discharge valve.**

9 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.

10 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.

11 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.

12 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.

13 With the pump warm from operation do not clean it from the outside with water or suddenly supply very cold cooling water. There is the risk of a rotor crash due to shock cooling.

14 If condensable vapours have been pumped, the pump should before switching off be purged for approx. 15 min with an inert gas or air (depending on the specific application). This process should also be run before cleaning the pump chamber.

15 Improper decommissioning of the pump may damage it. For this reason, follow the instructions given in Sections 4.5 and 4.6 of these Operating Instructions.

16 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.

17 Maximum **cooling water pressure:** 7 bar. When exceeded, there is the risk of leaks.

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

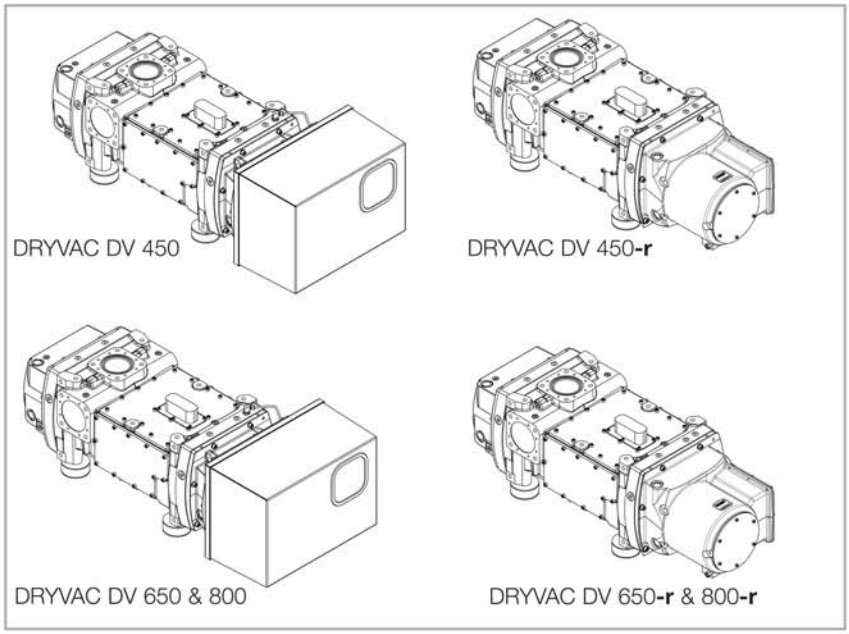


Fig. 1.1 Pump models

1 Description

1.1 Design

The DRYVAC is a dry compressing screw vacuum pump. The DRYVAC DV 450, 650 and 800 pumps are equipped with one screw pumping stage. DRYVAC DV 800 have another frequency converter compared with the other models.

We offer different pump models for different applications.

DRYVAC **Industrial versions** pumps cover all features needed for process industry applications. E.g., they are equipped with a gas ballast facility.

DRYVAC **Industrial versions** and the **DRYVAC S** have optimized pumping speeds at pressures >100 mbar. These models are specially suited for short cycle operation, e.g. load lock applications.

Models from the **DRYVAC C** range have been 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.

All DRYVAC pumps are basically equipped with the same motor. The required frequency converter has either been installed at the pump or is installed separately in a rack (**-r** models).

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.

1.2 Supplied Equipment

- Pump as described in Sections 1.1 and 1.4.1. The external frequency converter is included in the delivery.
- 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
- Intake screen with O-ring
- 3x plugs for purge gas valve (only with installed purge gas module)
- Plug for purge gas pressure switch (only with installed purge gas module)

Description

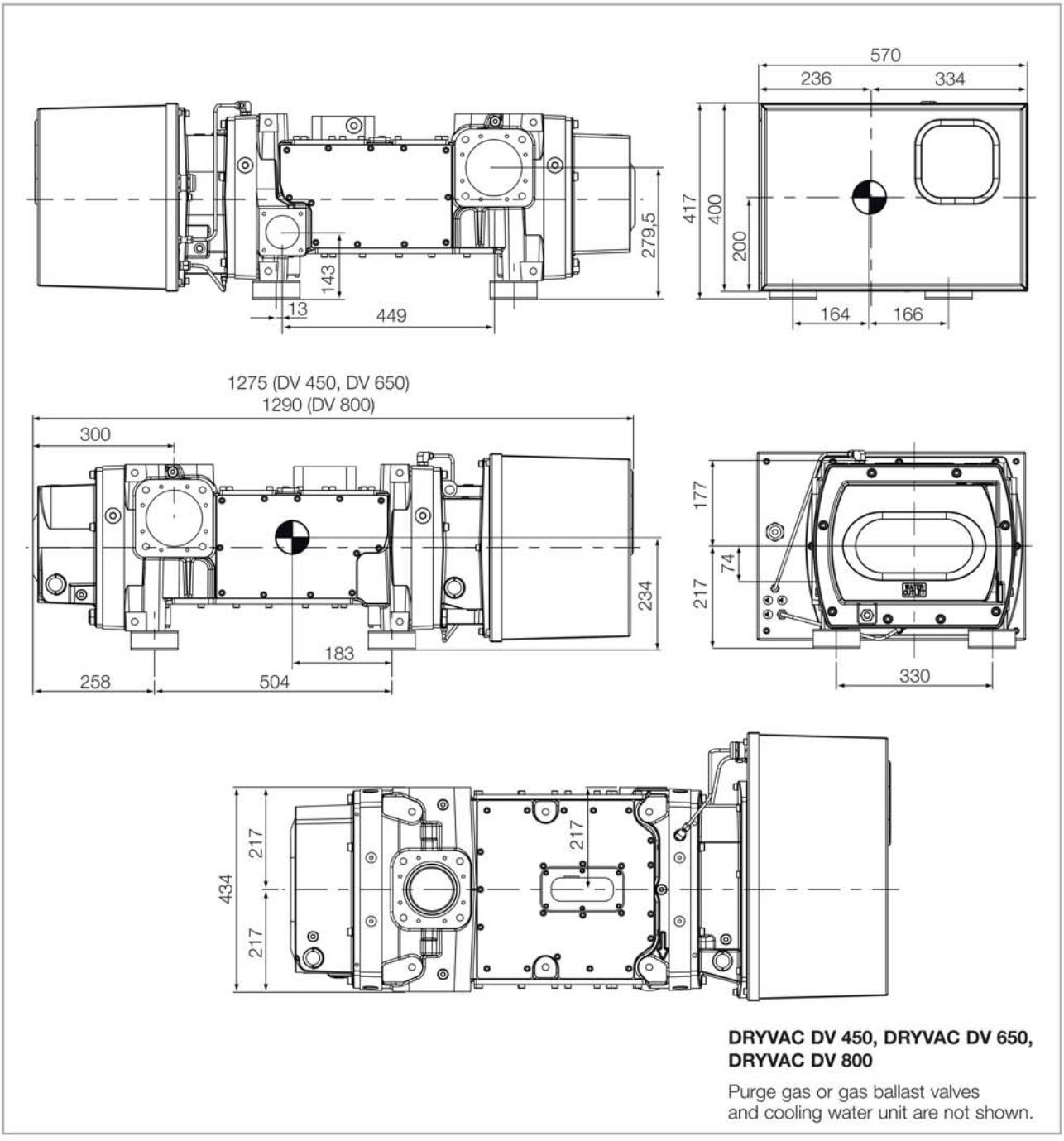
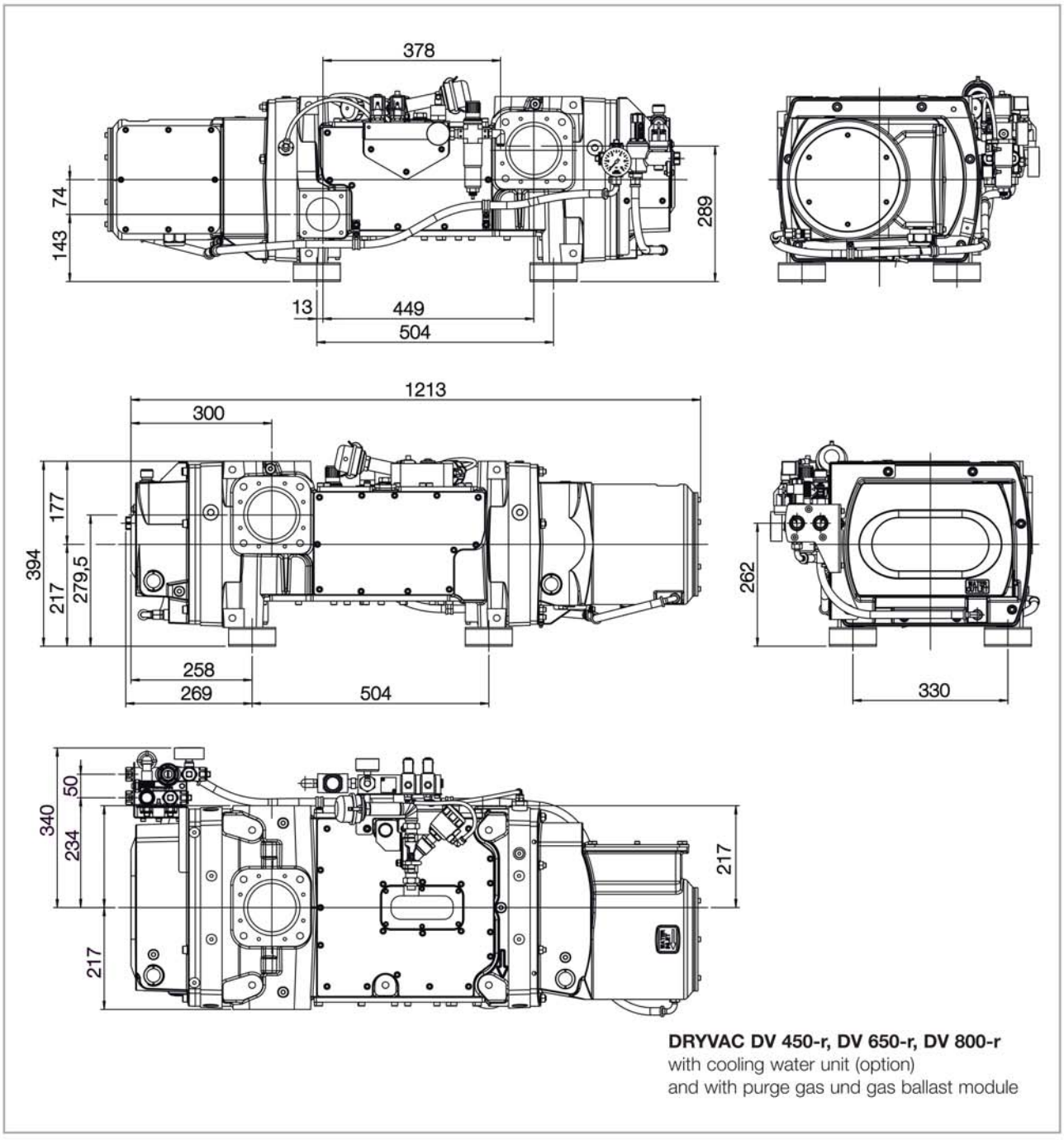


Fig. 1.2 Dimensional drawing, dimensions in mm

For CAD installation drawings in the STEP format, please contact Leybold or log in to the Leybold e-shop. You can download STEP files there.



DRYVAC DV 450-r, DV 650-r, DV 800-r
with cooling water unit (option)
and with purge gas und gas ballast module

Fig. 1.3 Dimensional drawing, dimensions in mm

Description

1.3 Technical Data

DRYVAC DV	450	450-r	650	650-r	Tolerance
Maximum pumping speed without gas ballast	450 m^3/h	450 m^3/h	650 m^3/h	650 m^3/h	± 5 %
Ultimate partial pressure without purge gas or with purge gas for shaft seal outlet		< 5 x 10^{-3} mbar			
with rotor purge		1 x 10^{-2} mbar			± 10 %
with gas ballast		0.1 mbar			± 10 %
with purge gas for shaft seal inlet (0.9 mm nozzle)		2.5 mbar			± 10 %
(2.0 mm nozzle)		10.5 mbar			± 10 %
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 gas and gas ballast	60 mbar > 20 Nl/min	60 mbar > 20 Nl/min	60 mbar > 20 Nl/min	60 mbar > 20 Nl/min	
Water vapour capacity	15 kg/h	15 kg/h	25 kg/h	25 kg/h	
Permissible ambient temperature		+5 to +50 °C			
Storage temperature		-20 to + 60°C			
Contamination grade with/without purge gas module		2/3			
Overvoltage category		3			
Noise level with silencer, at ultimate pressure (acc. to DIN EN ISO 2151)		67 dB(A)			KpA = 3dB
Noise level with rigid exhaust pipe, at ultimate pressure (acc. to DIN EN ISO 2151)		65 dB(A)			KpA = 3dB
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			
Motor rated power	11 kW	11 kW	15 kW	15 kW	± 0.8 kW
Motor rated current at 400 V	24 A	24 A	31 A	31 A	
at 200 V	47 A	47 A	60 A	60 A	
Motor efficiency class calculated and configured acc. to EN 60034-30		IE2			
Because of the frequency converter, in EU corresponds to		IE3			
Power consumption at ultimate pressure	4.7 kW	4.7 kW	6.6 kW	6.6 kW	
Electrical power rating	13 kVA	13 kVA	17 kVA	17 kVA	
Mains fusing/characteristic at 400 V	32 A/C	32 A/C	32 A/C	32 A/C	
at 200 V	50 A/C	50 A/C	63 A/C	63 A/C	
Short-circuit interrupting capacity[3)]		< 30 kA_{eff}			
Connectable cable cross-section, max.	10 mm^2	10 mm^2	10 mm^2	10 mm^2	
Switching frequency of the frequency conv. automatic switchover at low pump loads		8 kHz 15 kHz			

DRYVAC DV	450	450-r	650	650-r	Tolerance
Speed	7,200 RPM				
Min. permissible speed[4)]	1,200 RPM				
Protection class	IP 54	IP 55	IP 54	IP 55	
Lubricant filling	LVO 410 LVO 210	– LVO 210	LVO 410 LVO 210	LVO 410 LVO 210	
Total lubricant quantity	1.2 l	1.2 l	1.2 l	1.2 l	± 5 %
Intake flange	DN 100 ISO-K / PN6 (1x on top, 2x on the sides)				
Discharge flange	DN 63 ISO-K				
Materials components in contact with gas in the pump chamber Materials sealing the pump off in the pump chamber towards the outside	Grey cast iron/graphite cast iron/FKM/ steel/stainless steel/epoxy paint FKM, grey cast iron				
Weight, approx.	620 kg	580 kg	590 kg	550 kg	± 20 kg
Dimensions (L x W x H)	1280 x 570 x 420 mm	1200 x 450 x 400 mm	1280 x 570 x 420 mm	1200 x 450 x 400 mm	± 10 mm

Water					
Water connection with cooling water unit without cooling water unit	G1/2″ (female) G1/4″				
Water temperature Pumps with synthetic oil Pumps with PFPE	5 °C – 35 °C 5 °C – 25 °C				
Minimum supply pressure	2 bar(g)** (unobstructed discharge, no backpressure)				
Maximum supply pressure	7 bar(g)**				
Nominal flow LVO 210 LVO 410 (PFPE)	6 l/min 7 l/min	6 l/min 7 l/min	7.5 l/min 10 l/min	7.5 l/min 10 l/min	

Purge gas					
Connection	plug-in connection D10				
Nominal setting pressure Purge gas (at nominal flow, valves open)	2.8 bar(g)**				± 5 %
Permissible setting pressure Purge gas (at purge gas flow)	2.5 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	22 to 107 slm see Section 3.5				± 10 %
Max. **Gas ballast flow** (P_{Inlet} < 10 mbar) [5)]	180 slm	180 slm	220 slm	220 slm	± 10 %

Description

DRYVAC DV	800	800-r	Tolerance
Maximum pumping speed without gas ballast	800 m^3/h		± 5 %
Ultimate partial pressure without purge gas or with purge gas for shaft seal outlet with rotor purge with gas ballast with purge gas for shaft seal inlet (0.9 mm nozzle) (2.0 mm nozzle)	 < 5 x 10^{-3} mbar 1 x 10^{-2} mbar 0.1 mbar 2.5 mbar 10.5 mbar		 ± 10 % ± 10 % ± 10 % ± 10 %
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 gas and gas ballast	60 mbar > 20 Nl/min		
Water vapour capacity	30 kg/h		
Permissible ambient temperature	+5 to +45 °C		
Storage temperature	-20 to + 60 °C		
Contamination grade with/without purge gas module	2		
Overvoltage category	3		
Noise level with silencer, at ultimate pressure (acc. to DIN EN ISO 2151)	70 dB(A)		KpA = 3dB
Noise level with rigid exhaust pipe, at ultimate pressure (acc. to DIN EN ISO 2151)	70 dB(A)		KpA = 3dB
Relative atmospheric humidity	95%, non-condensing		
Installation location	up to 2000 m (NHN)		
Cooling	Water		
Mains voltage[1)2)]	380-460 V		± 10 %
Frequency	50/60 Hz		± 5 %
Phases	3-ph		
Motor rated power	19.6 kW		± 0.8 kW
Motor rated current	38 A		
Motor efficiency class calculated and configured acc. to EN 60034-30	IE3		
Power consumption at ultimate pressure	7.5 kW		
Electrical power rating	23 kVA		
Mains fusing/characteristic	50 A/C		
Short-circuit interrupting capacity[3)]	< 30 kA_{eff}		
Connectable cable cross-section, max.	10 mm^2		
Switching frequency of the frequency conv.	8 kHz		

DRYVAC DV	800	800-r	Tolerance
Speed	7,200 RPM		
Min. permissible speed[4)]	1,200 RPM		
Protection class	IP 54	IP 55	
Lubricant filling	LVO 210		
Total lubricant quantity	1.2 l		± 5 %
Intake flange	DN 100 ISO-K / PN6 (1x on top, 2x on the sides)		
Discharge flange	DN 63 ISO-K		
Materials components in contact with gas in the pump chamber Materials sealing the pump off in the pump chamber towards the outside	Grey cast iron/graphite cast iron/FKM/ steel/stainless steel/epoxy paint FKM, grey cast iron		
Weight, approx.	590 kg	550 kg	± 20 kg
Dimensions (L x W x H)	1290 x 570 x 420 mm	1200 x 450 x 400 mm	± 10 mm

Water		
Water connection with cooling water unit without cooling water unit	 G1/2″ (female) G1/4″	
Water temperature Pumps with synthetic oil	 5 °C – 35 °C [6)]	
Minimum supply pressure	2 bar(g)** (unobstructed discharge, no backpressure)	
Maximum supply pressure	7 bar(g)**	
Nominal flow	10 l/min	

Purge gas		
Connection	plug-in connection D10	
Nominal setting pressure Purge gas (at nominal flow, valves open)	2.8 bar(g)**	± 5 %
Permissible setting pressure Purge gas (at purge gas flow)	2.5 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	22 to 107 slm see Section 3.5	± 10 %
Max. **Gas ballast flow** (P_{Inlet} < 10 mbar) [5)]	on request	± 10 %

Description

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!

6) At 460 V and higher, we recommend a maximum cooling water temperature of 25°C.

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

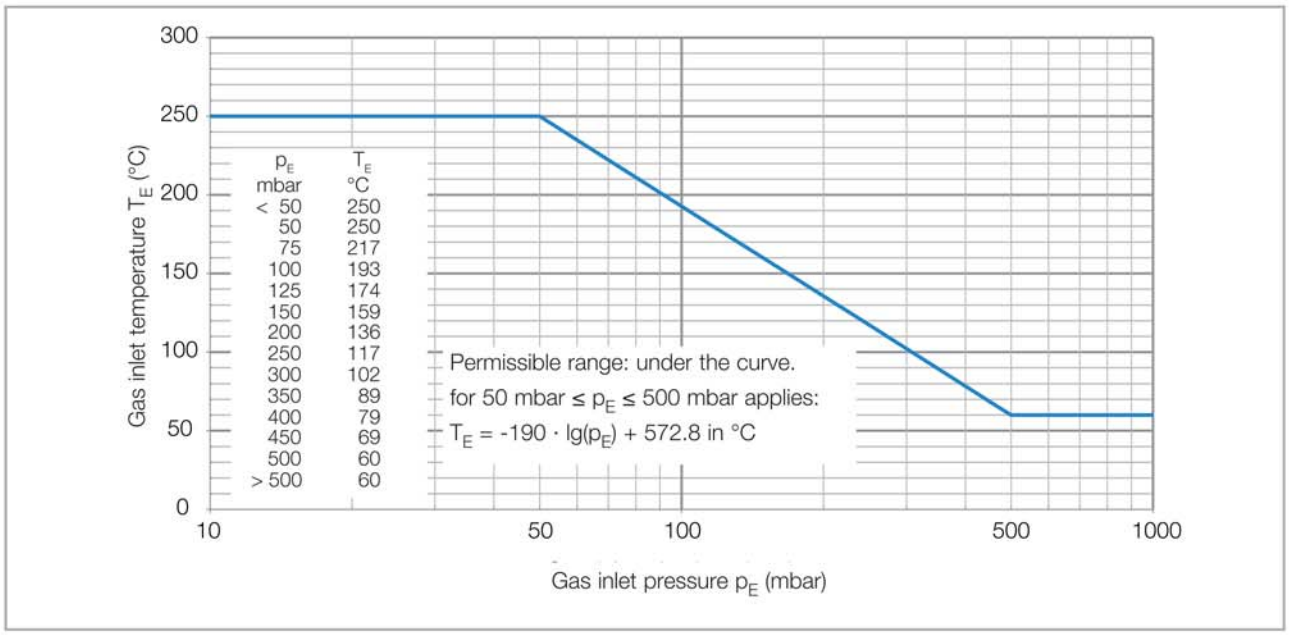


Fig. 1.4 Permissible gas inlet temperature as function of the inlet pressure

1.4 Ordering Information

1.4.1 Pumps

For all industrial applications as well as processes where quick pumping or short cycle times (e.g. load lock chambers) are required, the DRYVAC industrial is the best solution

The DRYVAC DV industrial versions (with the synthetic oil LVO 210) ensure a high suction capacity even above a pressure of 100 mbar. They were developed for short cycle operation and evacuating large vacuum chambers. These DRYVAC versions are also equipped with all the features for industrial applications.

Applications with a high oxygen content, corrosive gases, or PECVD processes require pumps with the LVO 410 (PFPE) lubricant. In these cases, the DRYVAC S or C (harsh applications) is the correct version.

DRYVAC	Frequency converter	Purge gas module	Gas ballast module (ambient air)	Cooling water unit	Cover and feet	Lubricant LEYBONOL	Part No.
DRYVAC Industrial (synthetic oil)							
DV 450-r, 400 V	extern (Rack)	triple	none	none	Rubber feet	LVO 210	112045V07-1
DV 450, 400 V	on board	double	24 V valve	none	Rubber feet	LVO 210	112045V15-1
DV 450, 200 V	on board	double	24 V valve	none	Rubber feet	LVO 210	112045V19-1
DV 650-r, 400 V	extern (Rack)	double	24 V valve	none	Rubber feet	LVO 210	112065V05-1
DV 650-r, 400 V	extern (Rack)	triple	none	none	Rubber feet	LVO 210	112065V07-1
DV 650 FP-r, 400 V IP 55	extern (Rack) (IP 66)	double	none	none	Rubber feet, epoxy-lacquer, washable	LVO 210	112065FP08-1
DV 650-r, 200 V	extern (Rack)	double	24 V valve	none	Rubber feet	LVO 210	112065V19-1
DV 650, 400 V	on board	triple	none	installed	Housing, castors, adjustable feet	LVO 210	112065V14-1
DV 650, 400 V with Energy Saver	on board	triple	none	installed	Housing, castors, adjustable feet	LVO 210	112065V14-2
DV 650 C, 400 V	on board	triple	none	installed	Housing, castors, adjustable feet	LVO 210	112065V14-3
DV 650, 400 V	on board	double	24 V valve	none	Rubber feet	LVO 210	112065V15-1
DV 650, 400 V with Energy Saver	on board	double	24 V valve	none	Rubber feet	LVO 210	112065V16-1
DV 650, 400 V	on board	triple	none	none	Rubber feet	LVO 210	112065V17-1
DV 650, 400 V with Energy Saver	on board	triple	none	none	Rubber feet	LVO 210	112065V18-1
DV 650 FP, 400 V	on board	triple	none	none	Rubber feet, epoxy-lacquer, washable	LVO 210	112065FP18-1

Description

DRYVAC	Frequency converter	Purge gas module	Gas ballast module (ambient air)	Cooling water unit	Cover and feet	Lubricant LEYBONOL	Part No.
DV 450 S, 400 V	on board	single	none	installed	Rubber feet	LVO 210	112045V09-1
DV 650 S, 400 V	on board	single	none	installed	Rubber feet	LVO 210	112065V09-1
DV 800-r, 400 V*	extern (Rack)	double	24 V valve	none	Rubber feet	LVO 210	112080V05-1
DV 800-r, 400 V*	extern (Rack)	triple	none	none	Rubber feet	LVO 210	112080V07-1
DV 800, 400 V*	on board	triple	none	installed	Housing, castors, adjustable feet	LVO 210	112080V14-1
DV 800, 400 V*	on board	double	24 V valve	none	Rubber feet	LVO 210	112080V15-1
DV 800, 400 V*	on board	triple	none	none	Rubber feet	LVO 210	112080V17-1
* 2 mm purge at GS for venting							
DRYVAC PFPE							
DV 450 S, 400 V	on board	single	none	installed	Rubber feet	LVO 410	112045V20-1
DV 450 S, 200 V	on board	single	none	installed	Rubber feet	LVO 410	112045V29-1
DV 650 S, 400 V	on board	single	none	installed	Rubber feet	LVO 410	112065V20-1
DV 650 S-r, 400 V	extern (Rack)	double	none	none	Rubber feet	LVO 410	112065V23-1
DV 650 FP 400 V	on board	triple	none	none	Rubber feet, epoxy-lacquer, washable	LVO 410	112065FP28-1
DV 450 C, 400 V	on board	triple	none	installed	Rubber feet	LVO 410	112045V30-1
DV 650 C, 400 V	on board	triple	none	installed	Rubber feet	LVO 410	112065V30-1
DV 650 C, 400 V LIB	on board	triple	none	installed	Rubber feet, also outside free of non-ferrous metal	LVO 410	112065V32-1
DV 650 C-r, 200 V	extern (Rack)	triple	none	installed	Rubber feet	LVO 410	112065V35-1
DV 650 C-r, 400 V with relay option board	extern (Rack)	triple	none	installed	Rubber feet	LVO 410	112065V36-1
DV 650 C-r, 200 V LIB	extern (Rack)	triple	none	none	Rubber feet, also outside free of non-ferrous metal	LVO 410	112065V37-1

1.4.2 Accessories

	Part No. DV/DV-r 450/650	Part No. DV/DV-r 800
Synthetic oil, ester oil, LEYBONOL LVO 210, 5 litres	L21005	
PFPE LEYBONOL LVO 410, 1 litre	L41001	–
Profibus module for DRYVAC	155212V	112005A78
ProfiNet module for DRYVAC	112005A35	112005A75
EtherCAT module for DRYVAC	112005A36	112005A76
Relay module (digital output) for DRYVAC	112005A01	112005A70
Ethernet module (dual port) for DRYVAC	112005A02	112005A72
LEYASSIST Windows software (control, configuration and analysis software for the DRYVAC and other Leybold products) (RS232 adapter for FC DRYVAC RUVAC WH 155224V and adapter USB - RS232 800110V0103 are required for connecting a PC to the DRYVAC and the use of the LEYASSIST software)	230439V01	
RS232 adapter for FC DRYVAC RUVAC WH	155224V	–
Adapter USB – RS232	800110V0103	–
G3" Inlet adapter DRYVAC (female) G4" Inlet adapter DRYVAC (female)	112005A18 112005A19	
Outlet flange DRYVAC DN 63 ISO K x 80 mm	112005A62	
Adapter DRYVAC for RUVAC WH 700 RUVAC WS(U) 1001 RUVAC WS(U) 2001 RUVAC WH(U) 2500 RUVAC WH(U) 4400/7000	 112005A03 112005A04 112005A05 112005A07 112005A10	
Cooling water unit DRYVAC 450/650/800 S DRYVAC 450/650/800 S-r	 112005A12 112005A13	
Fluid air cooling system FLKS-4S (heat exchanger) Kit glycol tubes for cooling system 112005A45	112005A45 112005A47	
Non-return valve DRYVAC with swivel joint, DN 63 ISO-K	112005A15	
Non-return valve for DRYVAC	112005A14	–
Gas ballast kit DRYVAC, 24 V electro-pneumatic	112005A17	
Silencer DN 63 ISO-K for DRYVAC	119002	
Serviceable silencer DN 63 ISO-K for DRYVAC	119003V	
External display	155213V	
Set of nozzles for DRYVAC purge gas (not for new purge gas modules)	112005A30	
Permanent inlet purge kit (not for new purge gas modules)	112005A32	
Castors for DV450/650 KIT (Set 4x)	504408V901	

Description

	Part No. DV/DV-r 450/650	Part No. DV/DV-r 800
Frequency Converter IP66 for DV 650-r	112005A65	–
Net filter 200V 11 kW corner grounded (Jp)	112 005A25	–
Net filter 200V 15 kW corner grounded (Jp)	112 005A26	–
DRYVAC Energy Saver (only for DV/DV-r with LVO 210)	112005A60	–
Upgrade DRYVAC with Energy Saver, contains the DRYVAC Energy Saver and installation by Leybold Service	AS1406F	–
GSD file, manual for the Profibus interface and Ethernet IP driver see: www.leybold.com -> Downloads -> Download Software		

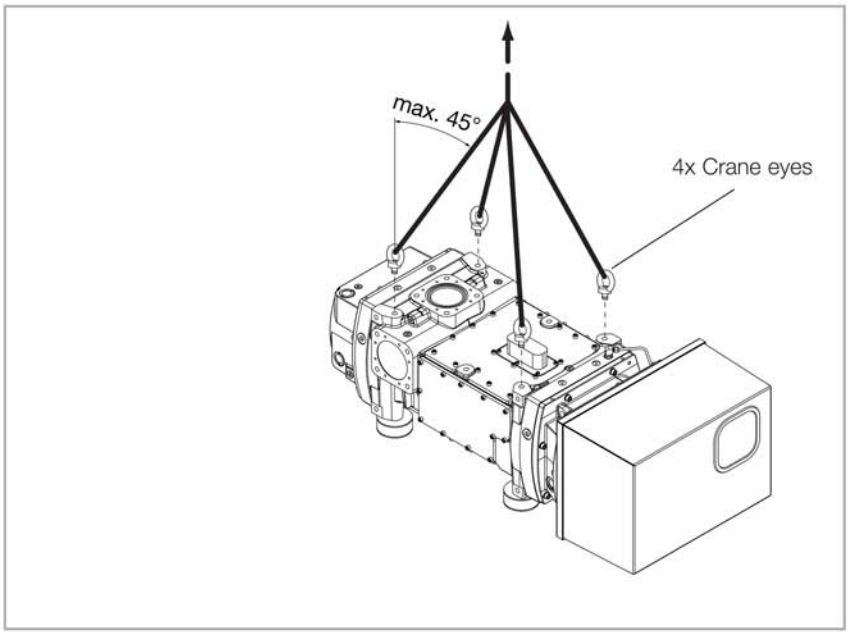


Fig. 2.1 Lifting the DRYVAC

2 Transport and Storage

Observe safety notes 0.1.8 and 0.1.9.

Crane eyes must not be interchanged with pumps! Only use the crane eyes specifically supplied with the respective pump.

The pumps are supplied filled with 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.

WARNING



NOTICE



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.

Pumps with castors

Due to the castors which have been fitted, the DRYVAC must only be installed on a level surface capable of carrying the weight of the pump as otherwise there exists the danger of the pump rolling away. The pump must also only be moved on level surfaces.

Moving the pump on slopes or ramps is not allowed!

The pump must only be transported using a fork lifter or a crane.

At the installation site, use all four adjustable feet for aligning thereby securing the unit from rolling away and thus taking away the load from the castors.

Transport and Storage

Storage

Store the pumps only horizontally standing on their feet.

The pumps are filled with nitrogen for protection against corrosion and are sealed off. 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

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

Temperature (only for storage without cooling water!)	–10 °C to +60 °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 longer than 2 years on stock?

If an inverter was on stock for a time longer than two years, it should not be connected directly to the power line. If doing so the capacitors might be permanently damaged.

Instead the DC bus of the inverter should be connected to a DC power source including an cur-rent limiting resistor and the voltage should be raised slowly. This kind of process is called forming capacitors.

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.

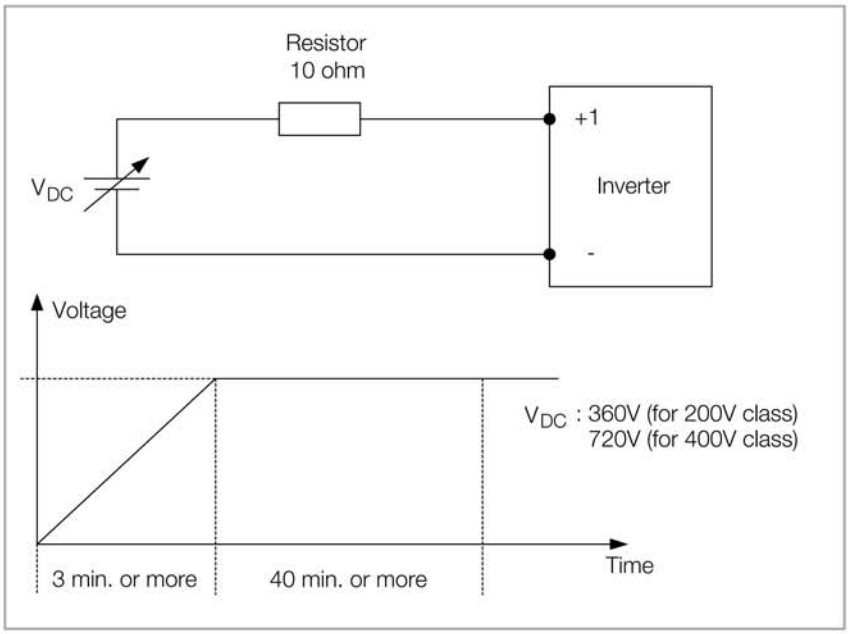


Fig. 2.2 Capacitor forming

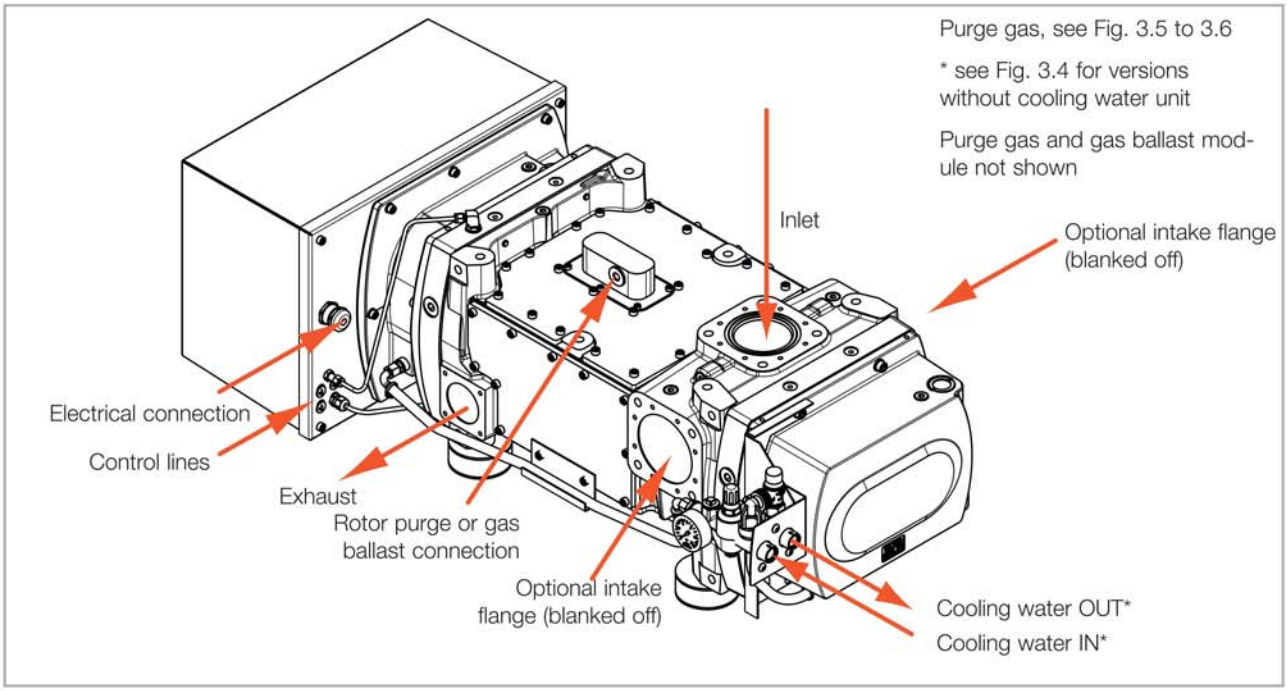


Fig. 3.1 Connections for the DRYVAC DV 450/650/800

3 Installation

3.1 Placement

Place the pump system on a flat and level surface.

The pump is designed for operation in buildings.

We recommend to leave the crane eyes screwed in.

Pumps with castors and feet: For proper securing against rolling away, use all four adjustable feet for aligning thus taking away the load from the castors.

Remove 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.

Fitting accessories

When planning to fit the accessory parts Roots pump adapter or non-return valve, please note the information given in Section 3.8 first.

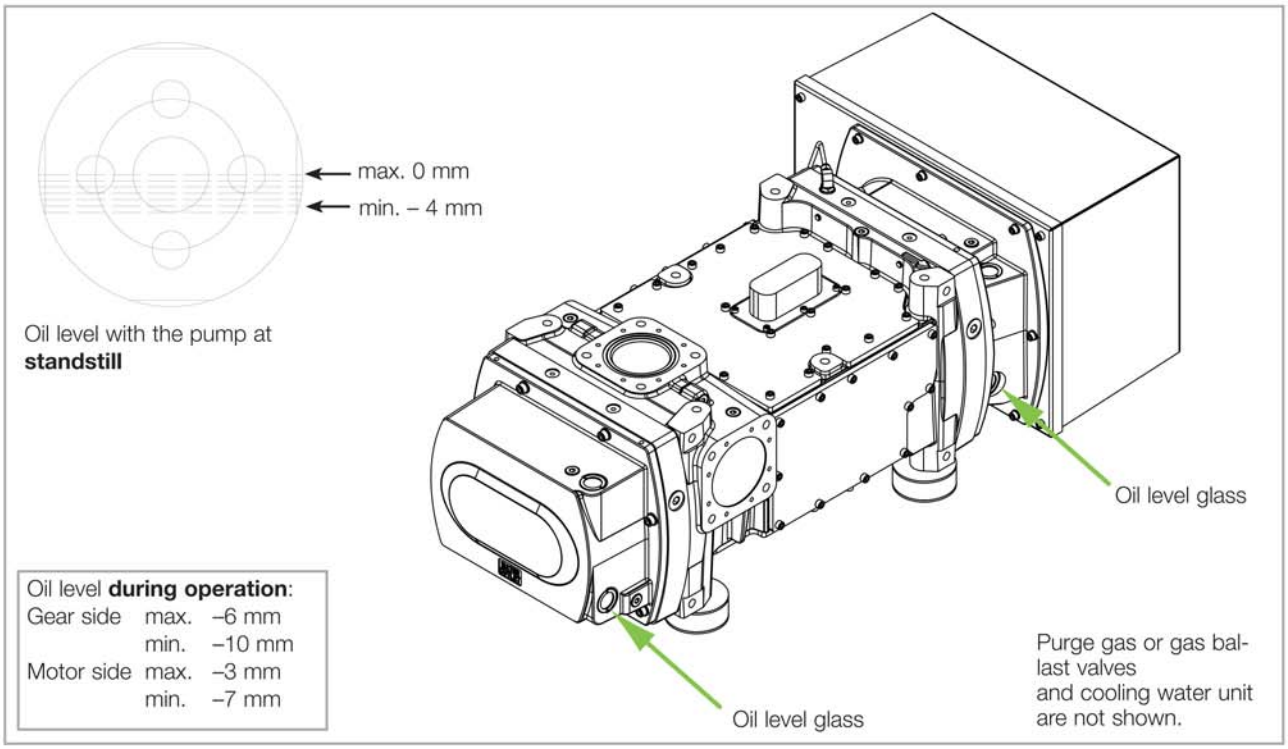


Fig. 3.2 Oil level in the DRYVAC oil glasses

The pumps are supplied filled with synthetic oil or PFPE. Nothing will have to be refilled. Check the oil levels through all oil level glasses (2 per pumping stage).

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

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 and for thin film coating (solar, glass coatings, display coatings, for example).

Basically, all DRYVAC pumps are leaktight and may for this reason be utilised for pumping toxic and potentially flammable gases outside their ignition range. For such applications, note the safety information given in Section 0.4. When using the pumps in connection with oxidising or corrosive gases, check media compatibility first. Media compatibility and the therefrom resulting hazards of each substance used and also of each substance mixture need to be reassessed on a case-by-case basis.

There are different product variants (see Section 1.4.1) for different application focuses.

DRYVAC pumps with synthetic oil (hydrocarbons) have a limited application scope. When assessing media compatibility here, in particular the hazards resulting from the reaction of the process gases with the hydrocarbons must be assessed. For this read the information given in the Safety Booklet and/or consult us for details.

DRYVAC pumps with synthetic oil are load lock, transfer and process pumps for medium rough processes. Their deployment in combination with much oxidising media is not recommended.

DRYVAC C and S pumps with PFPE offer a higher level of media compatibility.

DRYVAC C pumps are process pumps suited also for operation with much oxidising and corrosive media. With these pumps, you may pump both toxic and potentially flammable gases outside their ignition range and a large number of corrosive and much oxidising substances and substance mixtures.

When planning to pump hazardous substances always consult Leybold first.

3.2.1 Non-conforming Use

Non-conforming use for the pump are among others:

- 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 Section 1.3 Technical Data.
- Pumping of substances and mixtures (gases, liquids and solids) which are rated as being explosive.
- 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.

- Pumping of dusts and solids without suitable screens and filters, consult Leybold.
- Pumping of liquids
- Pumping of ignitable gas mixtures
- Pumping of process gases which form hard or sticky deposits which may cause the pump to seize.
- The use of pump and frequency converter in the explosion hazard areas
- Non-compliance with the described maintenance and service intervals.
- 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
- Use in systems where pump, frequency converter and cables are subjected to impact stresses.
- Operation on movable systems or system components (locks or mobile pump systems).
- Use of pump, fitted ad-on components, drive electronics, flanges and cables to climb onto the system.
- Removing, covering or obstructing warning notices.
- Operation outside of buildings.
- Standstill or storing of pump and drive electronics without suitable sealing and drying. When stored in a humid atmosphere corrosion can occur.
- Conversions, manipulations and maintenance work by persons not authorised by Leybold.
- Accessories which have not been specified by Leybold may only be used after approval by Leybold.

The non-conforming use of pump and accessories may result in severe injury or damage to the components.

WARNING



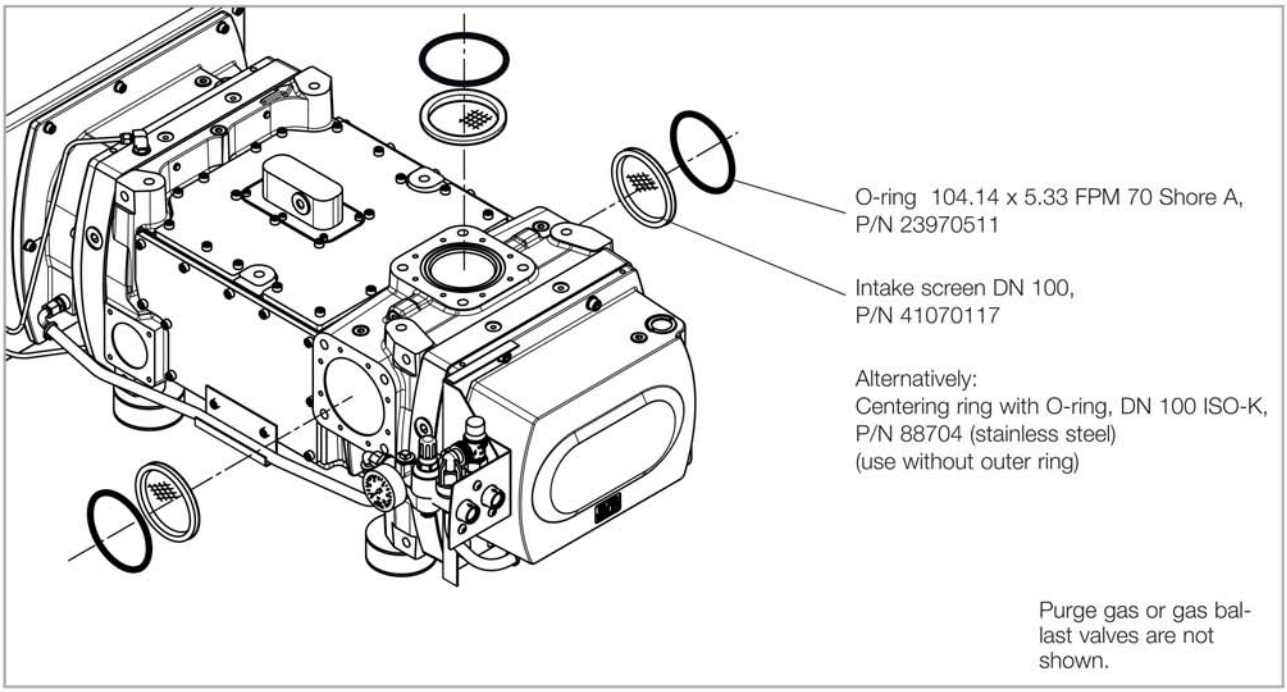


Fig. 3.3 Intake flange connections

3.3 Connecting the Intake and Exhaust Lines

3.3.1 Intake Lines

Connect the intake line to the pump. We recommend using bellows on the top of the pump for vibration absorption.

Support the intake lines.

DANGER



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

The intake lines must be clean.

NOTICE



Ensure that no items like **welding beads**, bolts, nuts, washers, pieces of wire, for example, enter into the inlet.
Observe Safety Information 0.8.3.

Connect the intake flange: Either with intake screen and O-ring or with a centering ring without outer ring.

Upon delivery, the optional intake flanges at the side are only provided with an O-ring seal. This will be **inadequate** for the purpose of connecting an intake line.

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.

Abatement

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 tension in the line.

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

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

DANGER

Observe Safety Information 0.1.6 to 0.1.7.



Keep the exhaust line free of deposits. If the exhaust flow becomes restricted, deposits could collect in the DRYVACs. 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. Observe Safety Information 0.8.9 and 0.8.10.



DANGER

Check leak tightness of the exhaust lines on a regular basis! Observe Safety Information 0.4.



3.4 Connecting Cooling Water

CAUTION



Observe Safety Information 0.3.3 to 0.3.6.

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.

NOTICE



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.

Cooling water data for the pump

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

Type	Power loss to be dissipated by the cooling water	Cooling water discharge temperature	Cooling water demand at feed temperature			
			30 °C...35 °C	25 °C...30 °C	20 °C...25 °C	5 °C ... 20 °C
	kW	°C	l/min	l/min	l/min	l/min
DV 450 (LVO 210)	7	50	6.0	4.8	4.0	3.5
DV 450 (LVO 410)	7	45	–	–	6.0	6.0
DV 650 (LVO 210)	10.5	50	7.5	6.0	5.0	4.3
DV 650 (LVO 410)	10.5	45	–	–	8.0	7.0
DV 800 (LVO 210)	12	45	10.0	8.0	7.0	6.0

DRYVACs with cooling water unit

The DRYVAC pumps are equipped with a built-in pressure reducer. We recommend not to change the setting.

The DRYVAC pumps are equipped with a pressure relief valve. It prevents the water from boiling in the cooling circuit when the cooling water supply and drain are closed. The valve opens at 8 bar(g) and releases small amounts of water or vapour into the base pan.

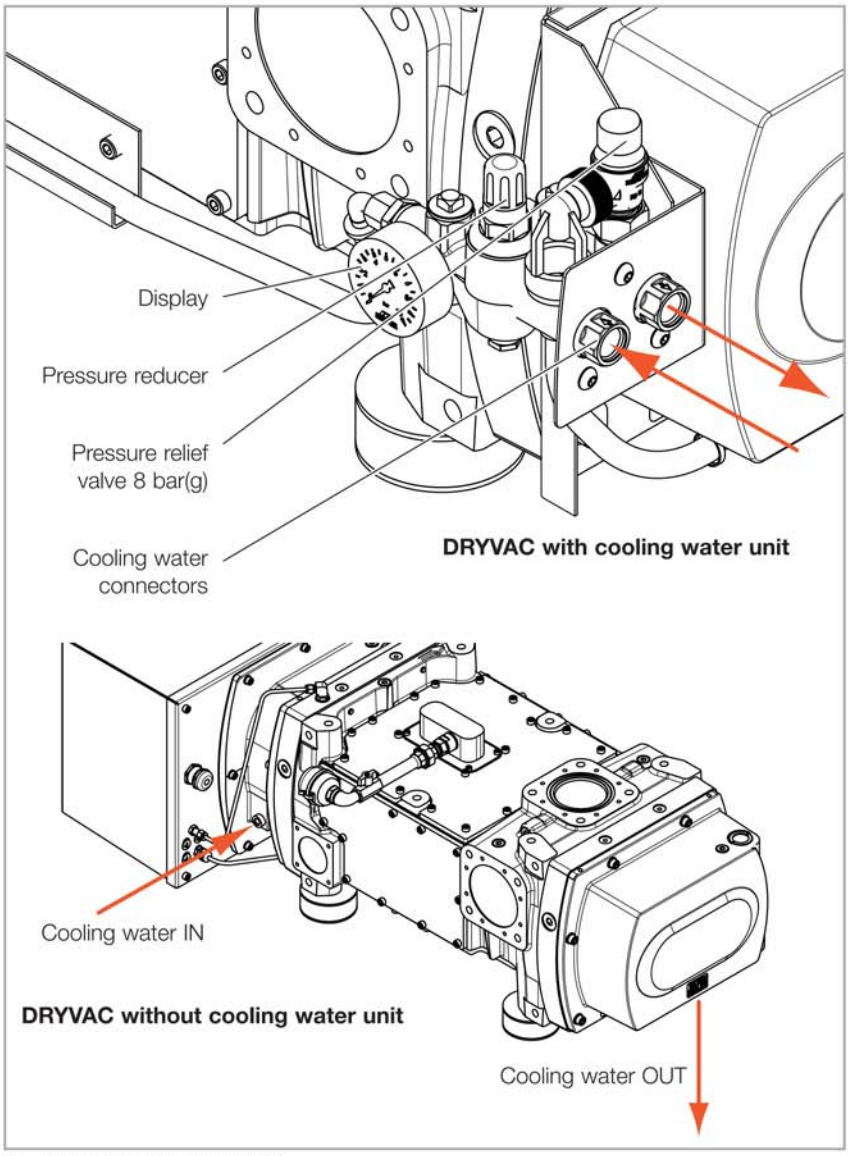


Fig. 3.4 Cooling water connection

DRYVACs without cooling water unit

(Industrial versions) For these DRYVAC pumps do **not** connect the cooling water using self-sealing quick locks or shut off the feed and discharge lines with valves.

Notice Safety Information 0.3.7.

CAUTION



All DRYVAC versions

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 (with nitrogen, for example).

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

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.	

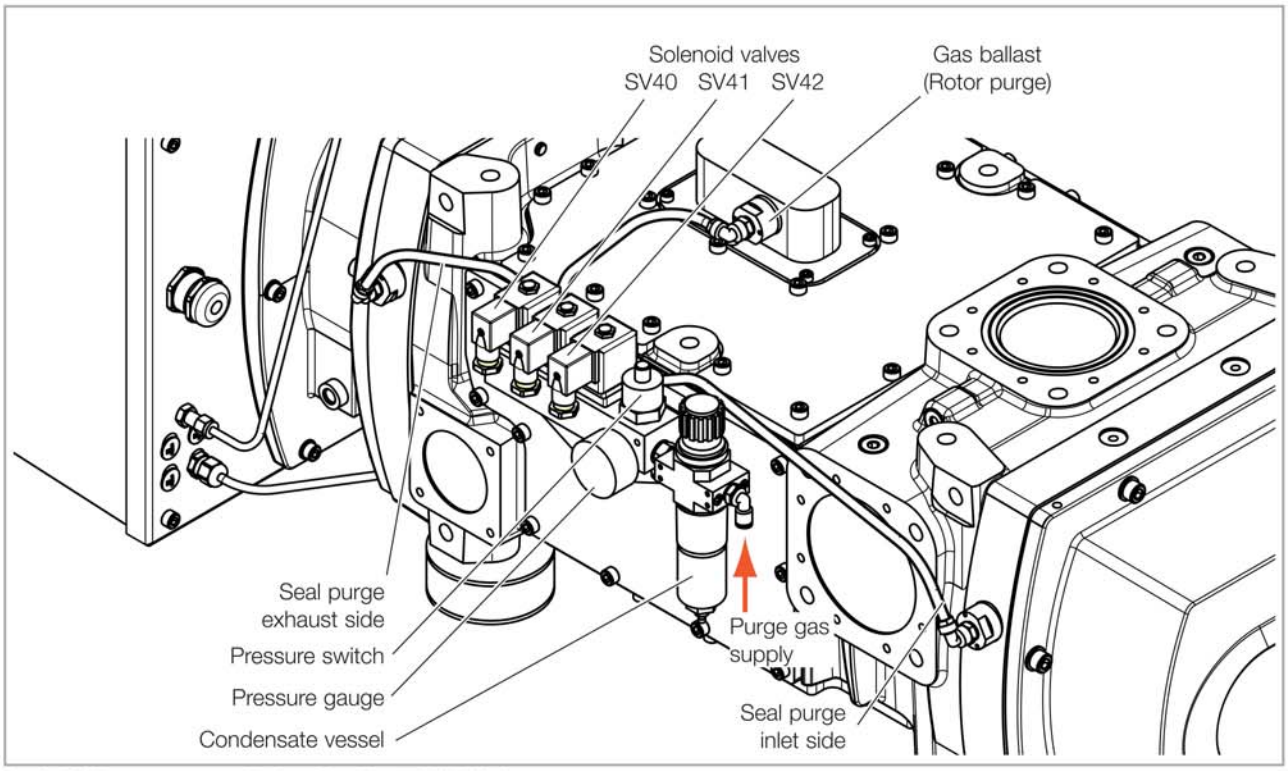


Fig. 3.5 Triple purge gas module (e.g. Part No. 112065V30-1)

3.5 Connecting Purge Gas

There are three versions of the purge gas module:

- At the triple purge gas module the gear chamber seals right and left of the pumping chamber are protected with purge gas. The third gas inlet inserts the purge gas directly into the pumping chamber (rotor purge).
- At the double purge gas module the gear chamber seals right and left of the pumping chamber are protected with purge gas.
- At the single purge gas module only the gas inlet for the protection of the motor gear is connected. The second purge gas connection and the rotor purge are blank flanged.

The manifold block with valves, gauge and condensate separator is identical for the versions.

From 2020, new purge gas modules will be used in some DRYVAC models. The function is the same for new and old modules, they just look different.

Connect nitrogen or air as purge gas. If in doubt, please contact Leybold.

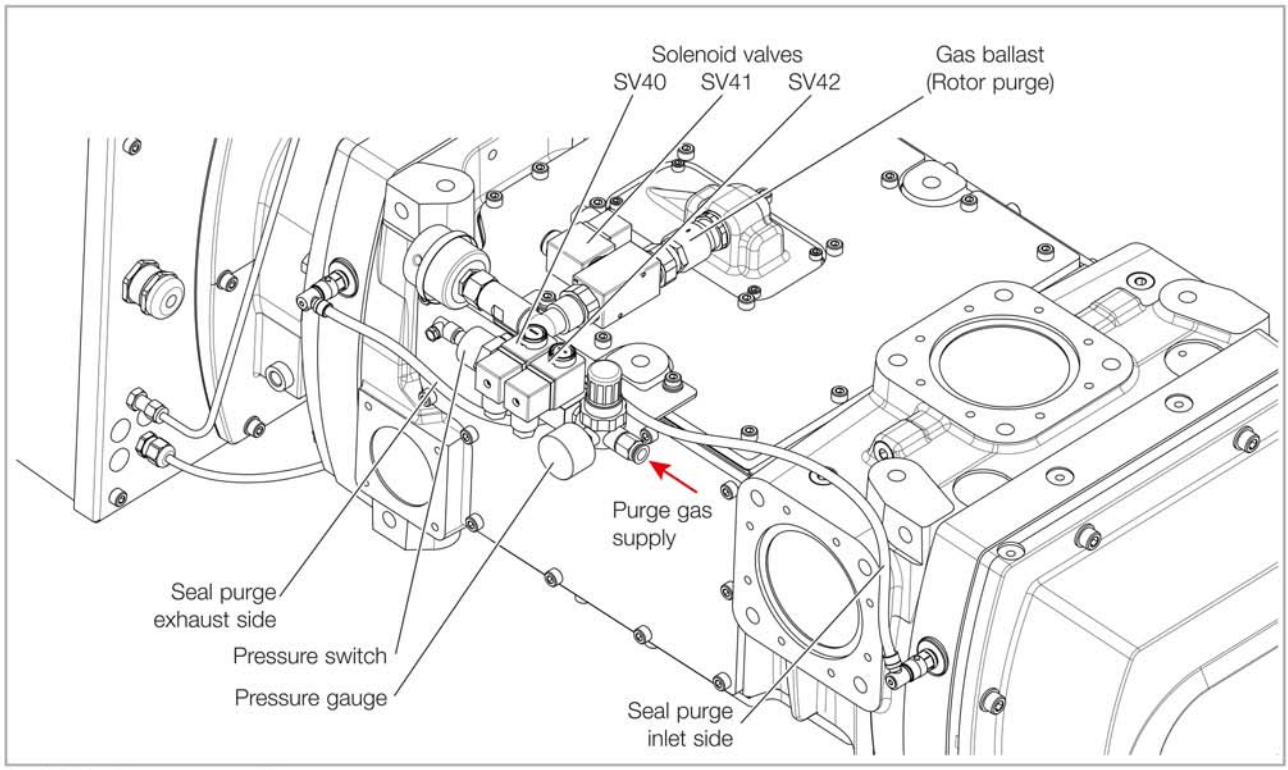


Fig. 3.6 Double purge gas module



Nozzle / Check valve

The nozzles can be changed according to the application. As standard, the S and C versions of the DRYVAC are equipped with 0.9 mm nozzles for the shaft seals and a 1.0 mm nozzle for the rotor purge.

The process industry versions (operating agent: LVO 210) of the DRYVAC are equipped as standard with a 0.9 mm nozzle for the shaft seal on the discharge side, and a 2.0 mm nozzle for the shaft seal on the inlet side (for ensuring a sufficient purge during venting). Here the rotor purge is ambient air gas ballast.

	Nozzle diameter						
Gauge setting	**0.2 mm**	**0.9 mm**	**1.0 mm**	**1.2 mm**	**1.5 mm**	**1.7 mm**	**2.0 mm**
bar	slm	slm	slm	slm	slm	slm	slm
2.8	1	22	28	38	60	74	92
3	1	23	30	41	63	78	97
3.5	2	26	33	46	70	86	107

Range red -1 to 2.0 bar	Pressure and flow too low
Range green 2.5 to 3.5 bar	recommended range
Range red 4.5 to 9.0 bar	Caution! Pressure too high. Regulator valve cannot open against the pressure

Fig. 3.7 Details for the purge gas module

Gas temperature	0 to +50°C.
Filter size	40 µm
Max. condensate capacity	22 cm^3
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

The pump must be vented, but only **up to atmospheric pressure**.

Ensure that the purge gas flow is not obstructed.

The purge gas supply should not be shut off while the pump system is operating, above all especially not during shutdown and venting operations.

Wetted materials:, Brass, aluminium, zinc, polycarbonate, polybutenetere-phthalate (PBT), NBR, polyamide tube, copper, stainless steel, PTFE, Loctite.

The pressure reducer is set to 2.8 bar at nominal flow (valves open) on delivery.

See Section 3.6.1 for the connection of the pressure switch and the solenoid valves.

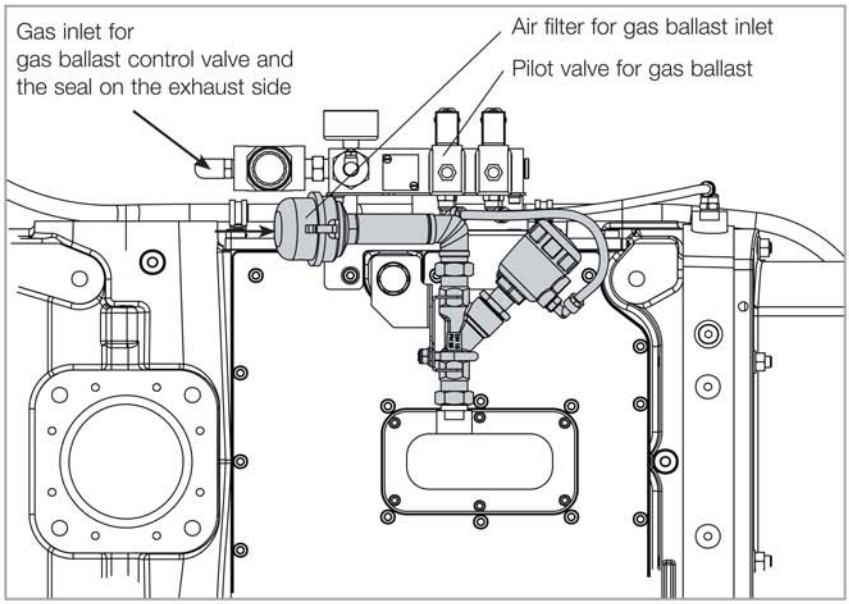


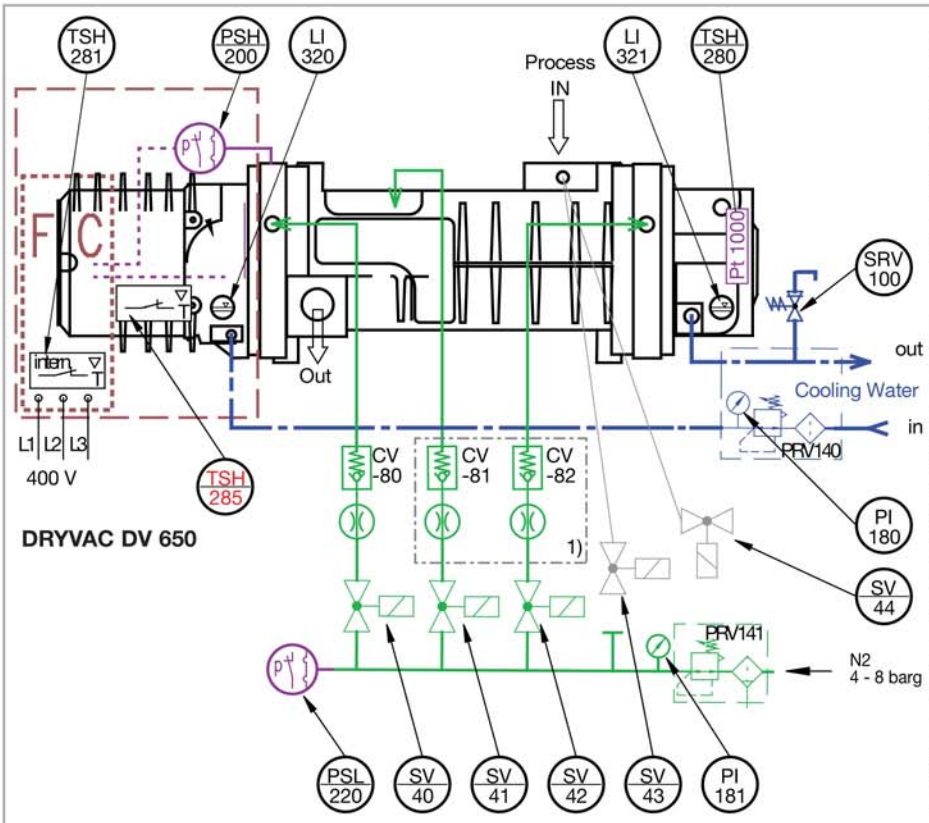
Fig. 3.8 Electropneumatic gas ballast valve (option)

3.5.1 Gas Ballast Valve

(only for some versions, see Section 1.4.1, or option)

The gas ballast valve is of the electropneumatically operated type. Here the gas (compressed air or nitrogen) from the valve block is used to actuate the electropneumatic gas ballast valve. The valve needs a pressure of **3.0 bar**.

The actual ballast gas will generally be ambient air.



No	Description
TSH 281	Temperature Switch High Frequency Conv. Intern
TSH 280	Temperature Switch High Pt 1000 Gear Flange
TSH 285	Temperature Switch High Temperature limiter Frequency conv. housing (Motor terminal box (-r))
PSH 200	Pressure Switch High Exh. Pressure 0.25 bar(g)
LI 320 321	Level Indicator Oil Motor Bearing Oil Gear Side
PSL 220	Pressure Switch Low Purge 2.4 bar(g)
SV 40 41 42 43 44	Solenoid Valve Exhaust seal purge Rotor purge2) Inlet seal purge2) Optional purge Optional flushing
PI 180 181	Pressure indicator Water Nitrogen
PRV	Pressure Regulator (Filter)
SRV 100	Safety relief valve 8 bar(g)
CV	Check valve

1) At pumps with single purge gas module check valves CV-81 and CV-82 and the corresponding throttles are missing, the lines are blanked off
2) Opening of these valves will impair the ultimate pressure; see Technical Data.

Fig. 3.9 Purge gas and switches schematic

3.5.2 Guidelines for Purge Gas Operation, Settings and Monitoring

Possible purge gases are N2 and CDA only.
The safety always has to be considered (please be careful with air purges and read the safety booklet of Leybold).
Exhaust shaft seal purge is running in most of all applications all the time.

NOTICE



Rotor purge

- In most cases not used all the time, often active in specific process steps.
- Used for light gas performance, dilution to avoid condensation, dilution to reduce chemical reaction and dilution to dilute below flammability limits.
- Applying up to 33 slm purge gas (1.0 mm nozzle) to the rotor purge position on DV450 and on DV650 results in: $p_{end} < 1x10^{-2}$ mbar for air or N2.

Exhaust shaft seal purge

The exhaust shaft seal purge is the most important purge position of the pump to protect the pump from process materials and to keep it dry and clean. The exhaust shaft seal purge protects the motor area (piston ring shaft seal, bearings, motor) against particles / dust and condensable gases like water or others. This purge is always recommended and there are only a few applications possible where one can stop exhaust shaft seal purge flow.

Gas types: Air (consider safety concerning flammable gases), Nitrogen.

- Exhaust shaft seal purge is running in 99% of all applications at all time.
- Open exhaust shaft seal purge when starting the pump and stop it after the pump has stopped.
- In many cases it might be better to keep the exhaust shaft seal purge on for 15 – 30 min after stopping the pump – this cleans and dries out the exhaust.
- If you want to operate without exhaust shaft seal purge please contact Leybold technical support.
- The exhaust purge gas does not reduce the pump performance in any way.

Gas ballast

- Used for dilution by ambient air to avoid condensation, for drying out the pump, dilution to reduce chemical reaction or to transport small amounts of dust to the exhaust.
- The maximum gas ballast flow ($p_{inlet} < 10$ mbar)

DV 800	on request
DV 650	220 slm
DV 450	180 slm

- The gas ballast flow is not constant under all conditions!
- The gas ballast flow of the DV pumps is strongly depending on the inlet pressure!
- Applying max gas ballast flow results in: $p_{end} \geq 1x10^{-1}$ mbar for air.

Inlet shaft seal purge

- The process industry pumps (all pumps which have LVO210 as lubricant) are equipped with a 2.0 mm nozzle – this provides ~ 90 slm of gas flow.

  If there is a risk, that in the application condensable gases or solids can be transported into the gearbox area, it is a must to use inlet side venting purge to protect the DRYVAC pump.

NOTICE



a) Contamination during pump down or fast pressure rise

- For fast pressure rises the 2.0 mm nozzle has to be used on the inlet side.
- Activate flow (solenoid valve) 2 seconds before pressure rise.
- Stop flow when the inlet pressure drops below 100 mbar.
- If you have only the 0.9 mm nozzle installed (2.0 mm recommended) activate flow 2 seconds before pump down and stop the flow when the pressure drops below 20 mbar.

b) Contamination during chamber vent

- To avoid contamination during chamber venting, the inlet purge should be activated at all time during the chamber venting.

c) Contamination during continuous operation

- Use the 2.0 mm nozzle in combination with the solenoid valve (customer controlled) to protect against fast pressure rises.
- Use the smaller nozzle to allow a continuous flow of gas at all time (constant flow).
- If a constant flow is not possible you can try to control the small flow (0.9 mm nozzle) as well, i.e. with pressure rises and ventilation.

With the **accessory "Permanent Inlet Purge Kit"**, the inlet side of the DRYVAC pump may be protected against being contaminated. This is effected by a permanent, comparatively small purge flow (0.5 SLM). For this, the Permanent Inlet Purge Kit is so connected that it is always opened when also the purge gas on the exhaust side (motor side) of the pump is open; i.e. generally always when the DRYVAC being switched on.

Pressure switch: To monitor purge gas availability

The shut-off threshold of the pressure switch PSL220 is 2.4 bar(g). This switch (cf. fig. 3.5) is located in between pressure regulator and the solenoid valves. This switch is always installed, but the signal is not controlled by the pump itself (frequency converter). An LED indicates the status on the device itself. A to be connected PLC or junction box is needed to monitor this signal.

3.6 Electrical Connection

DANGER



Observe Safety Information 0.2.

Take note of the information provided in the Operating Instructions 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.

Wiring the Main Circuit Input

Consider the following precautions for the main circuit input.

- Use fuses recommended in Main Circuit only, see technical data.
- If using a ground fault circuit breaker, make sure that it can detect both DC and high frequency current.

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 mm^2. 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. 3.15.
- 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 (EMC)

By maintaining the operational conditions specified this product complies with the EMC emission limits for industrial production environments.

NOTICE



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

The control terminal board is equipped with screwless terminals. Always use wires within the specification listed below. For safe wiring it is recommended to use solid wires or flexible wires with ferrules. The stripping length respectively ferrule length should be 8 mm.

Wire Type	Wire size (mm^2)
Solid	0.2 to 1.5
Flexible	0.2 to 1.0
Flexible with ferrule	0.25 to 0.5

Control Circuit Wiring Precautions

Consider the following precautions for wiring the control circuits.

- 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 grounded on both cable ends.
- If flexible wires with ferrules are connected they might fit tightly into the terminals. To disconnect them, grasp the wire end with a pair of pliers, release the terminal using a straight-edge screw driver, turn the wire for about 45°, and pull it gently out of the terminal.

3.6.1 Electrical Connection DRYVAC DV 450/650 and 450/650-r

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 motor.
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)	Ground Terminal	For 200 V class: Ground with 100 Ω or less For 400 V class: Ground with 10 Ω or less

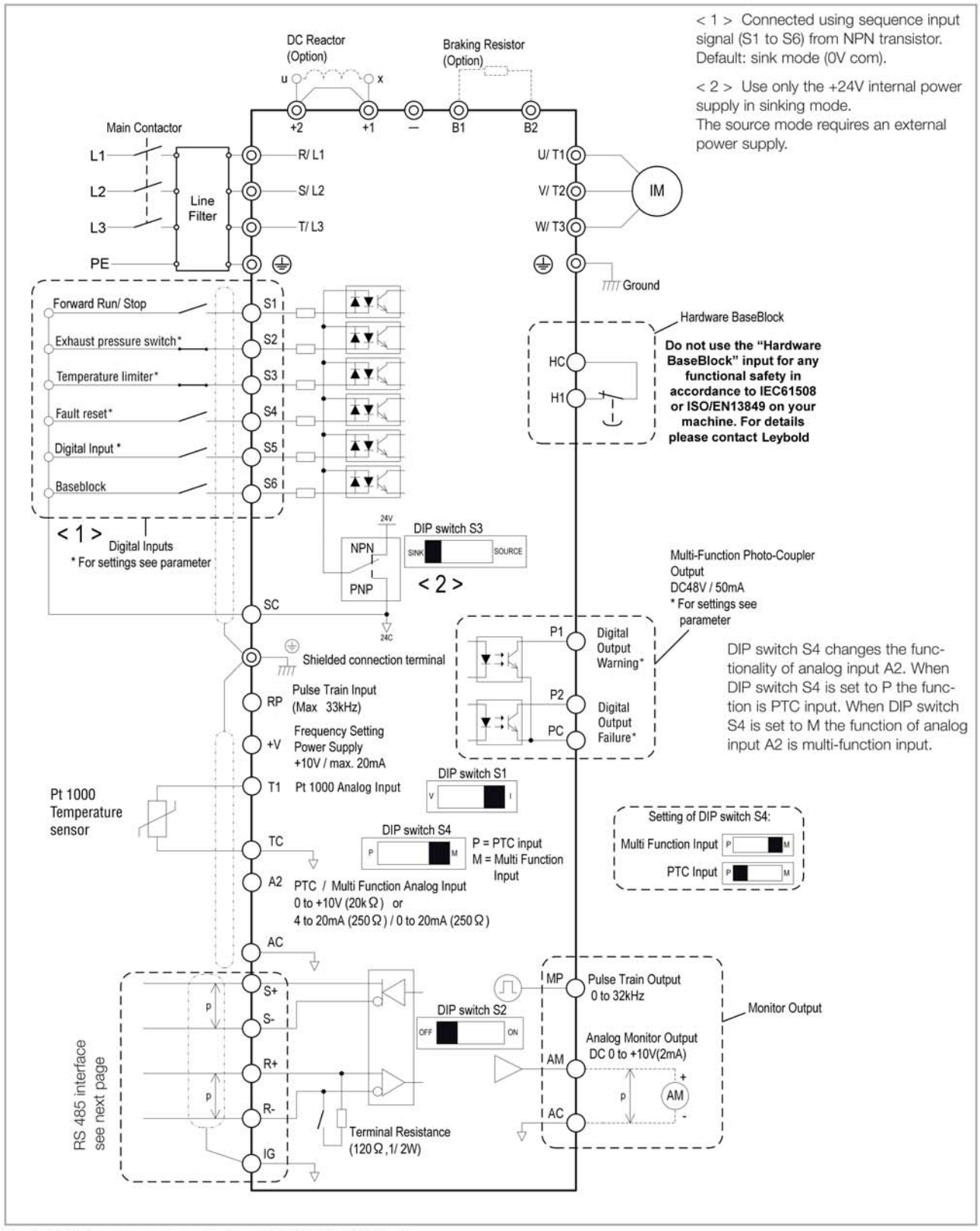


Fig. 3.10 Main and control circuit wiring DRYVAC DV 450/650 (-r)

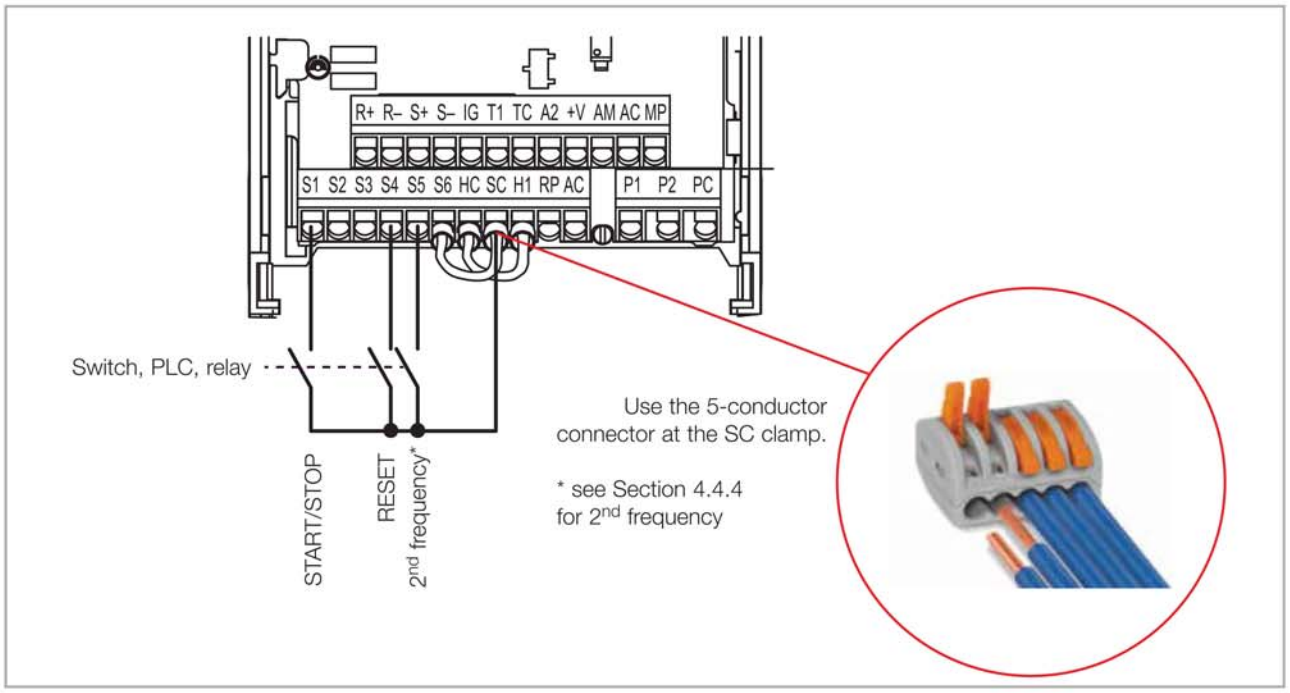


Fig. 3.11 Control I/Os

Control with I/Os

The DRYVAC can be controlled via digital inputs and outputs. To do so, change the parameter b1-02 from 0 (RUN and STOP buttons) to 1 (digital inputs), see Section 4.2 Interface Description.

SC = earth

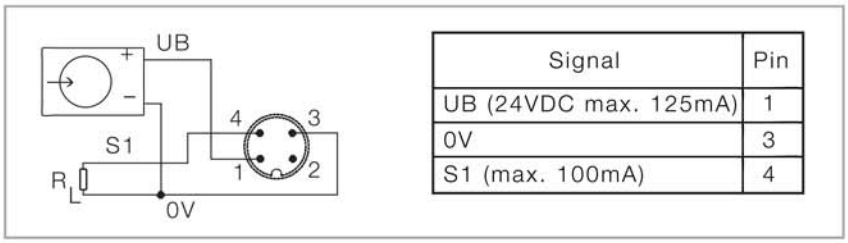
Bridge SC and S1 to start the DRYVAC. The run-up time to nominal speed (120 Hz) amounts to 200 seconds. Open SC and S1 to stop the DRYVAC.

Connect SC with S4 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.

The SC (earth) terminal in the frequency converter is already occupied by a ferrule. If you wish to control the pump per I/Os, use the supplied 5-conductor connector to ground the I/Os and the pump sensors on the I/O board of the frequency converter, see Fig. 3.18.

You will find the 5-conductor connector in the PE bag of the operating instructions.



Signal	Pin
UB (24VDC max. 125mA)	1
0V	3
S1 (max. 100mA)	4

Fig. 3.12 Circuit diagram for the purge gas pressure switch

Connecting the Purge Gas Module Electrically

Connect the

- purge gas pressure switch and
- solenoid valves

to your system control.

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

MEMOBUS/Modbus

The frequency converter is equipped with a serial RS 485 interface with MEMOBUS/Modbus (RTU) protocol. Further details are available on request.

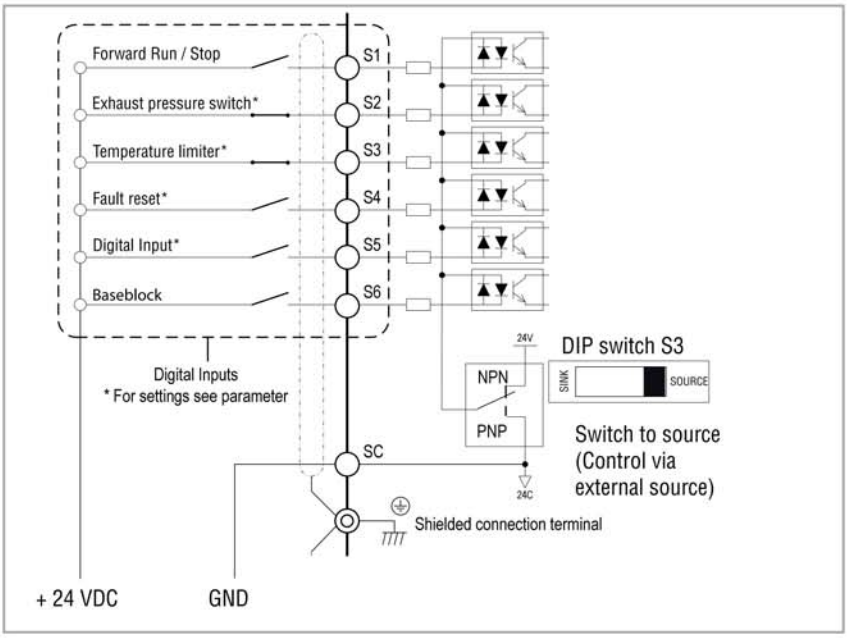


Fig. 3.13 Option: Wiring with external power supply

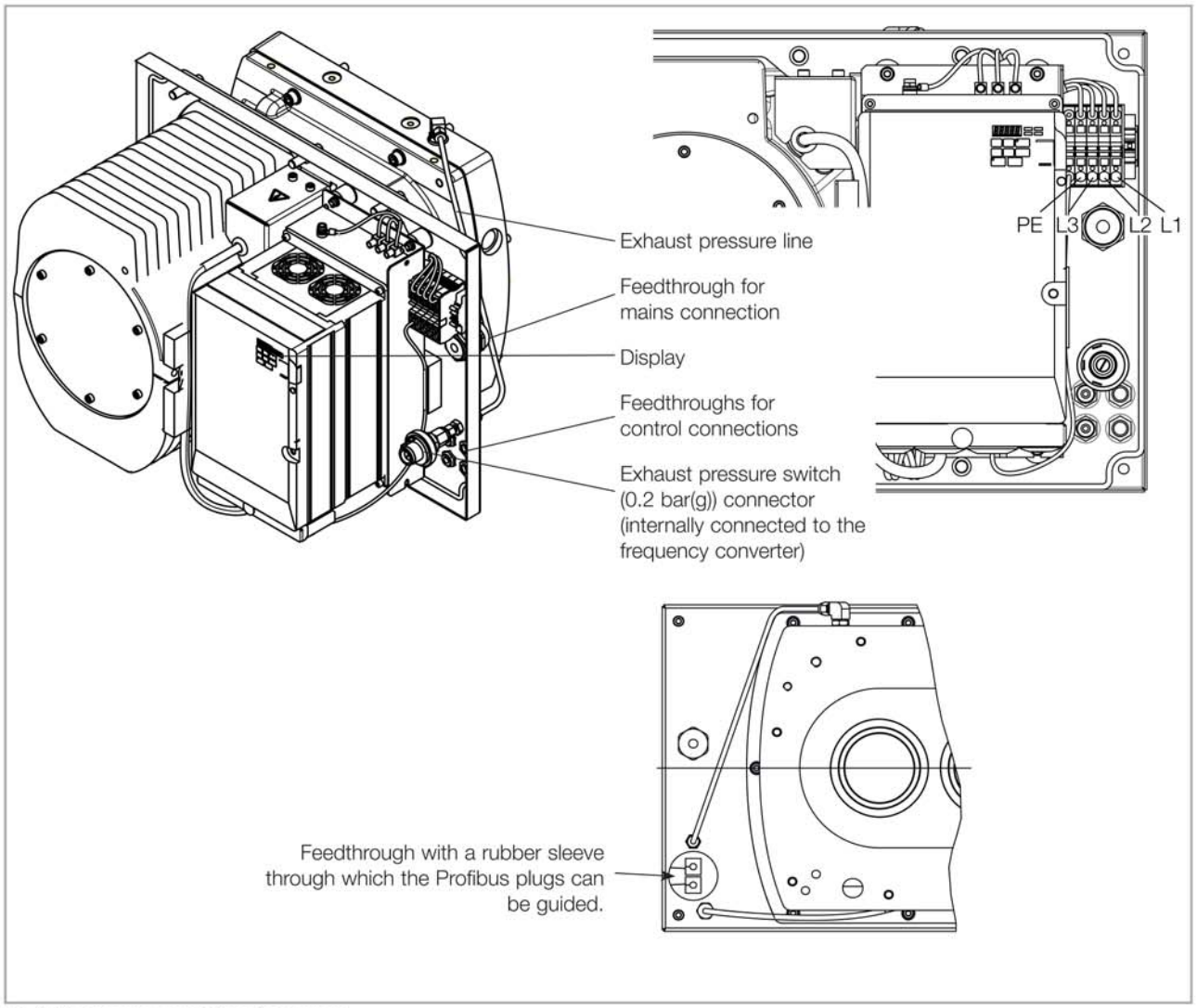


Fig. 3.14 Frequency converter without covers

3.6.2 Electrical Connection DRYVAC DV 450/650

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. 3.14. Use the M32 cable fitting for that purpose. The terminals are designed for 10 mm^2 max. cable diameter.

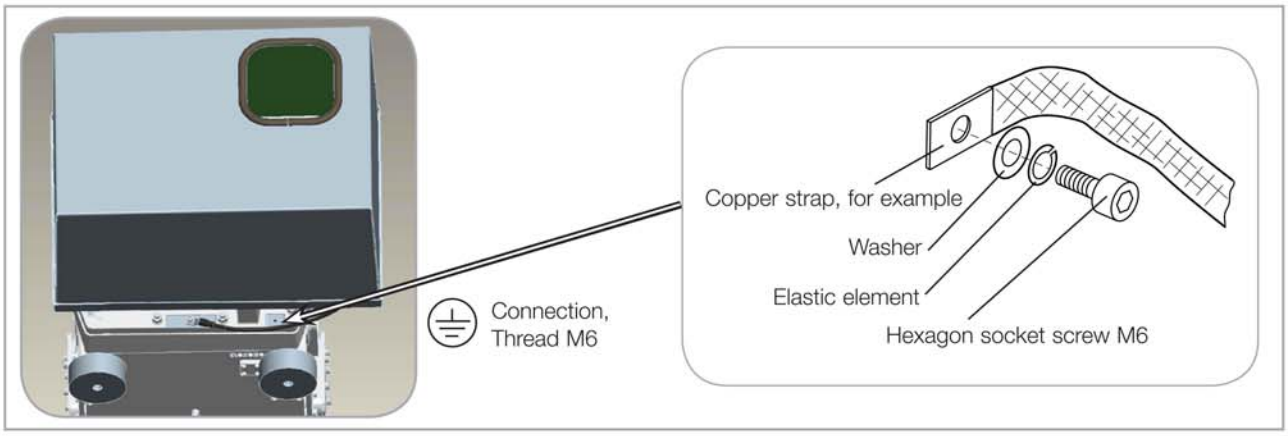


Fig. 3.15 Establishing the potential equalisation at the pump casing

Establishing Potential Equalisation

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

Connect the potential equalisation conductor as depicted in Fig. 3.15.

Start/stop connection

Bridge SC and S1 to start the DRYVAC. The run-up time to nominal speed (120 Hz) amounts to 200 seconds. Open SC and S1 to stop the DRYVAC.

For the connection of the control cables install a cable fitting M16x1.5 in a bore hole at the terminal box. Use EMC cable fittings if required.

Sensors

The exhaust pressure switch (setpoint 1.25 bar = 0.25 bar(g)) is connected to S2 and SC.

The pump's temperature sensor is connected to T1 and TC.

The temperature limiter is connected to S3 and SC.

Remount the cover on the frequency converter.

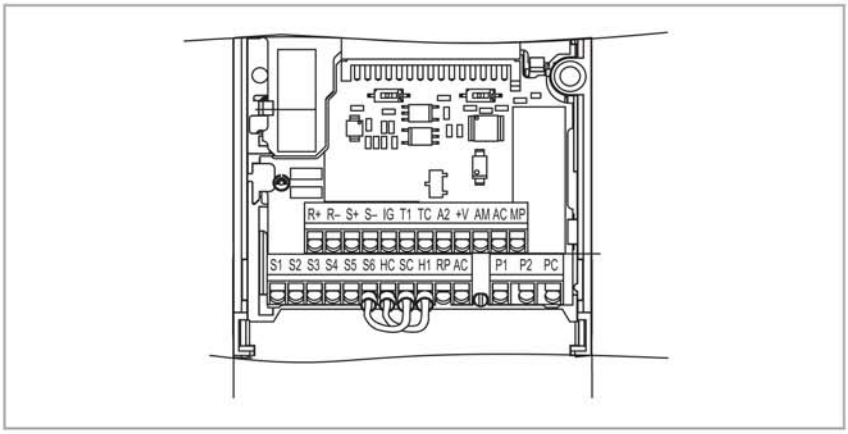


Fig. 3.16 Control circuit terminals

3.6.3 Electrical Connection DRYVAC DV 450/650-r

The external frequency converters comply with EMC guidelines when the cable between pump and frequency converter does not exceed a length of 25 meters maximum. Longer cables are possible but at the risk of possibility exceeding EMC limits.

The max. current load at the frequency converter output is 31 A.

Connect the main and control circuits as shown in Fig. 3.18.

CAUTION



Observe safety information 0.2.16.

Check the Direction of Rotation

Check the direction of rotation after connection. To do so, open the intake.

CAUTION



Wear protective goggles when checking the direction of rotation!

Switch on the pump and switch it off immediately. The rotors shall move upwards in the middle and shall move down at the sides.

Start/stop connection

Bridge SC and S1 to start the DRYVAC. The run-up time to nominal speed (120 Hz) amounts to 200 seconds. Open SC and S1 to stop the DRYVAC.

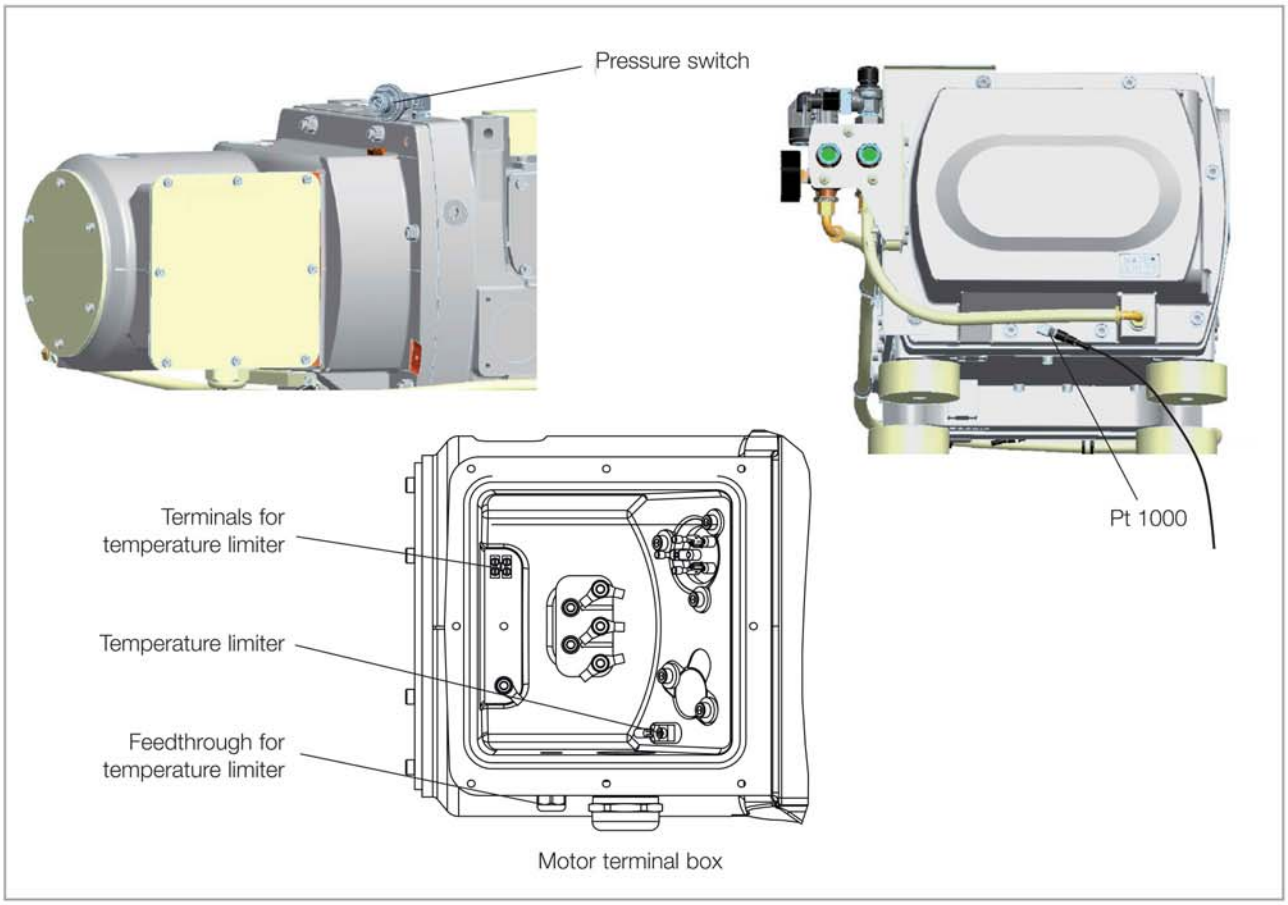


Fig. 3.17 DRYVAC DV 450/650/800-r sensors

Sensors

Connect the exhaust pressure switch (setpoint 1.25 bar = 0.25 bar(g)) to S2 and SC. A mating connector is delivered for the exhaust pressure switch.

The Pt 1000 cable (30 m) is delivered seperately, so that it does not get damaged during transport. Unscrew the bolt with washer in the pump, place the Pt 1000 cable lug on the pump and screw in the bolt with washer with a torque of $10^{\pm 1}$ Nm.

Connect the pump's temperature sensor (Pt 1000) to T1 and TC. Lay the cable so that it does not touch any hot surfaces.

Connect the temperature limiter to S3 and SC.

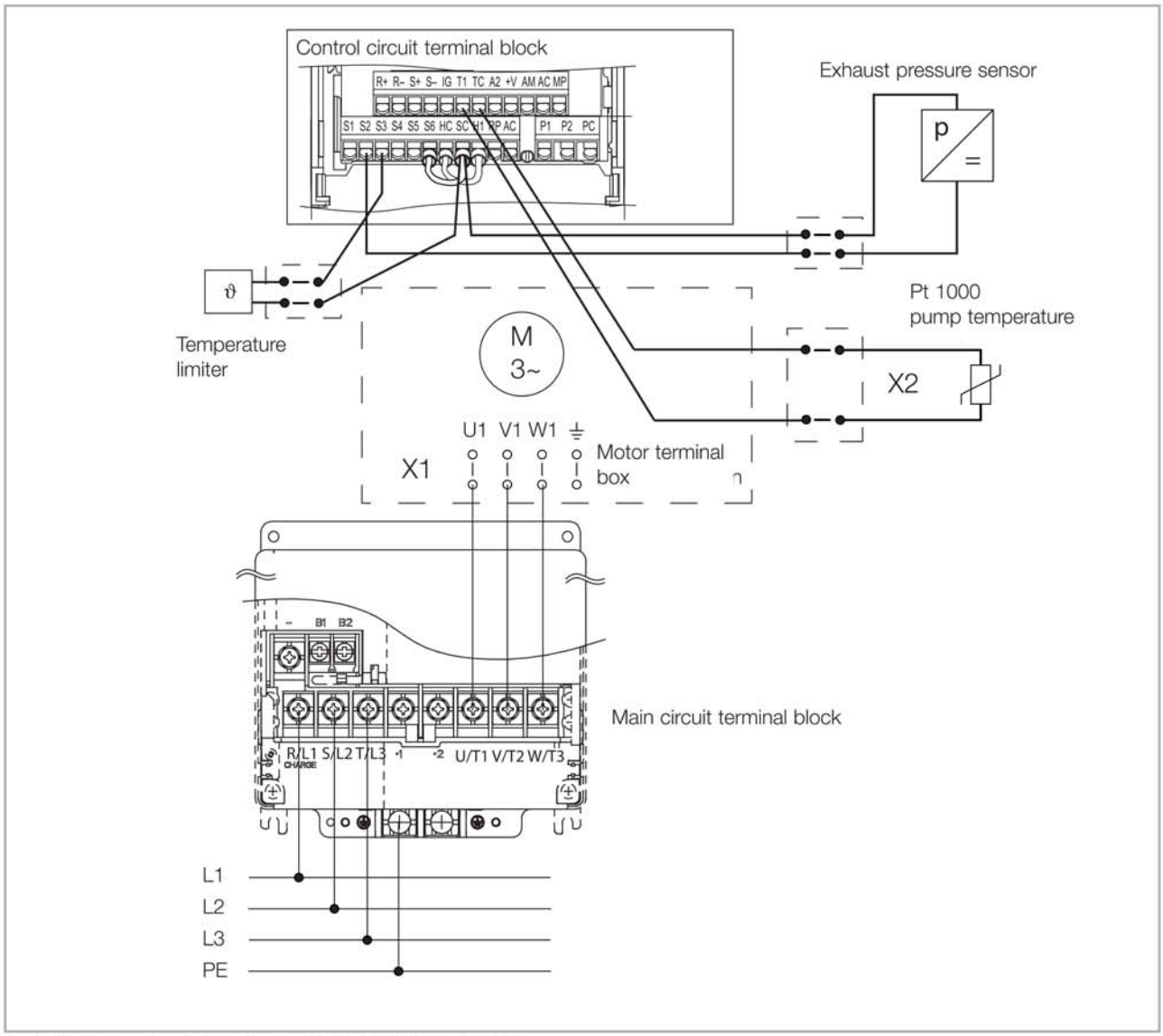


Fig. 3.18 Main and control circuit wiring for the DRYVAC DV 450/650-r

3.6.4 Electrical Connection DRYVAC DV 800

Connect the terminals as shown in Fig. 3.20.

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

Mains connection

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. 3.14. Use the M32 cable fitting for that purpose. The terminals are designed for 10 mm^2 max. cable diameter.

Establishing Potential Equalisation

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

Connect the potential equalisation conductor as depicted in Fig. 3.15.

Start/stop connection

Bridge SN and S1 to start the DRYVAC. The run-up time to nominal speed (120 Hz) amounts to 200 seconds. Open SN and S1 to stop the DRYVAC.

The SN (earth) terminal in the frequency converter is already occupied by a ferrule. If you wish to control the pump per I/Os, use the supplied 5-conductor connector to ground the I/Os and the pump sensors on the I/O board of the frequency converter.

You will find the 5-conductor connector in the PE bag of the operating instructions.

For the connection of the control cables install a cable fitting M16x1.5 in a bore hole at the terminal box. Use EMC cable fittings if required.

Sensors

The exhaust pressure switch (setpoint 1.25 bar = 0.25 bar(g)) is connected to S2 and SN.

The pump's temperature sensor is connected to A1 and AC.

The temperature limiter is connected to S3 and SN.

Remount the cover on the frequency converter.

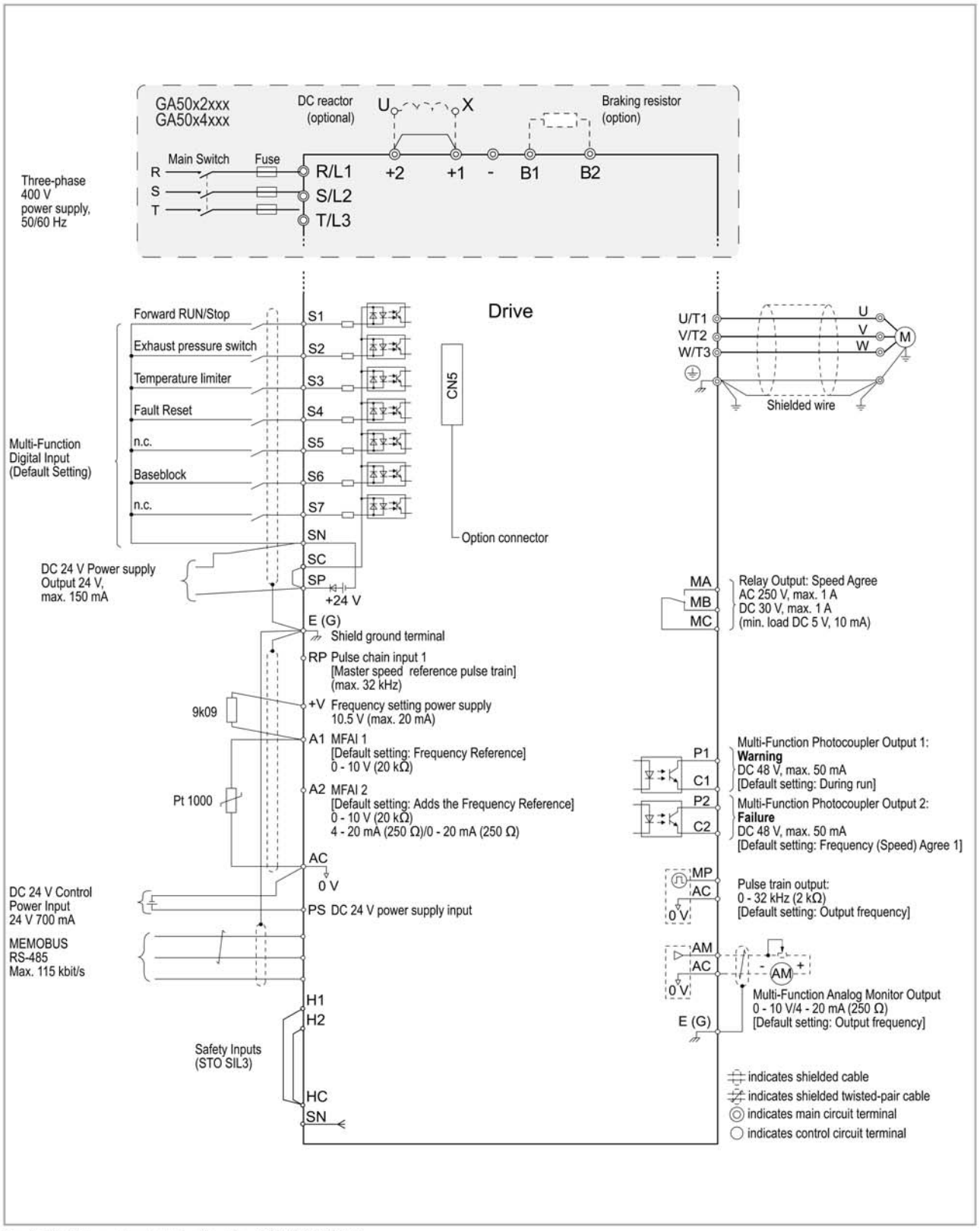


Fig. 3.19 Main and control circuit wiring DRYVAC DV 800

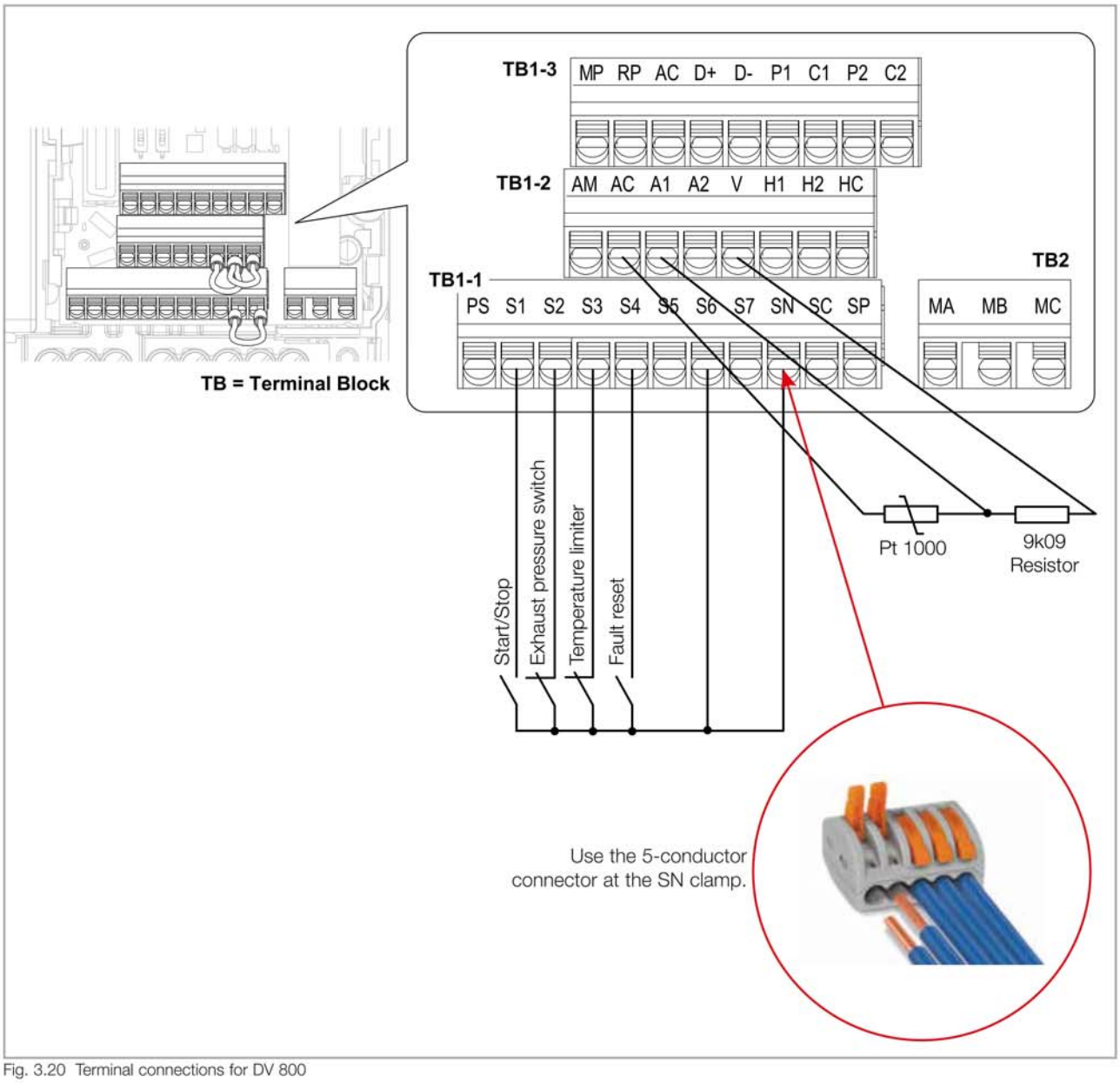


Fig. 3.20 Terminal connections for DV 800

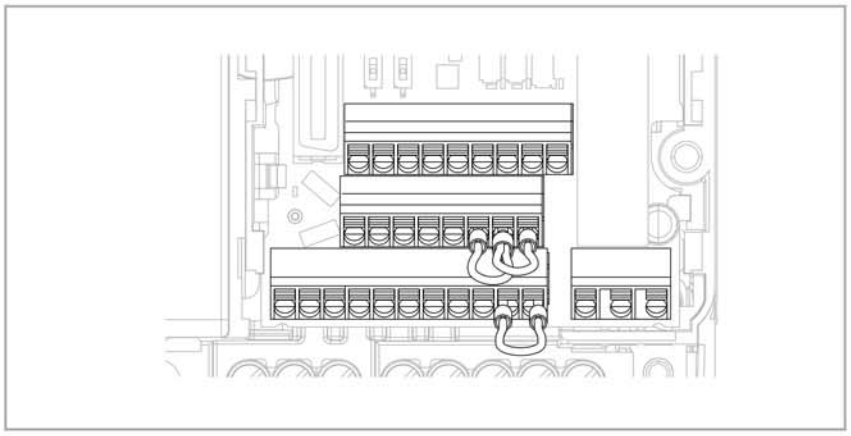


Fig. 3.21 Control circuit terminals

3.6.5 Electrical Connection DRYVAC DV 800-r

The external frequency converters comply with EMC guidelines when the cable between pump and frequency converter does not exceed a length of 20 meters maximum. Longer cables are possible but at the risk of possibility exceeding EMC limits.

The max. current load at the frequency converter output is 38 A.

Connect the main and control circuits as shown in Fig. 3.22.

CAUTION



Observe safety information 0.2.16.

Check the Direction of Rotation

Check the direction of rotation after connection. To do so, open the intake.

CAUTION



Wear protective goggles when checking the direction of rotation!

Switch on the pump and switch it off immediately. The rotors shall move upwards in the middle and shall move down at the sides.

Start/stop connection

Bridge SN and S1 to start the DRYVAC. The run-up time to nominal speed (120 Hz) amounts to 200 seconds. Open SN and S1 to stop the DRYVAC.

Sensors

See Figs. 3.17 and 3.22.

Connect the exhaust pressure switch (setpoint 1.25 bar = 0.25 bar(g)) to S2 and SN. A mating connector is delivered for the exhaust pressure switch.

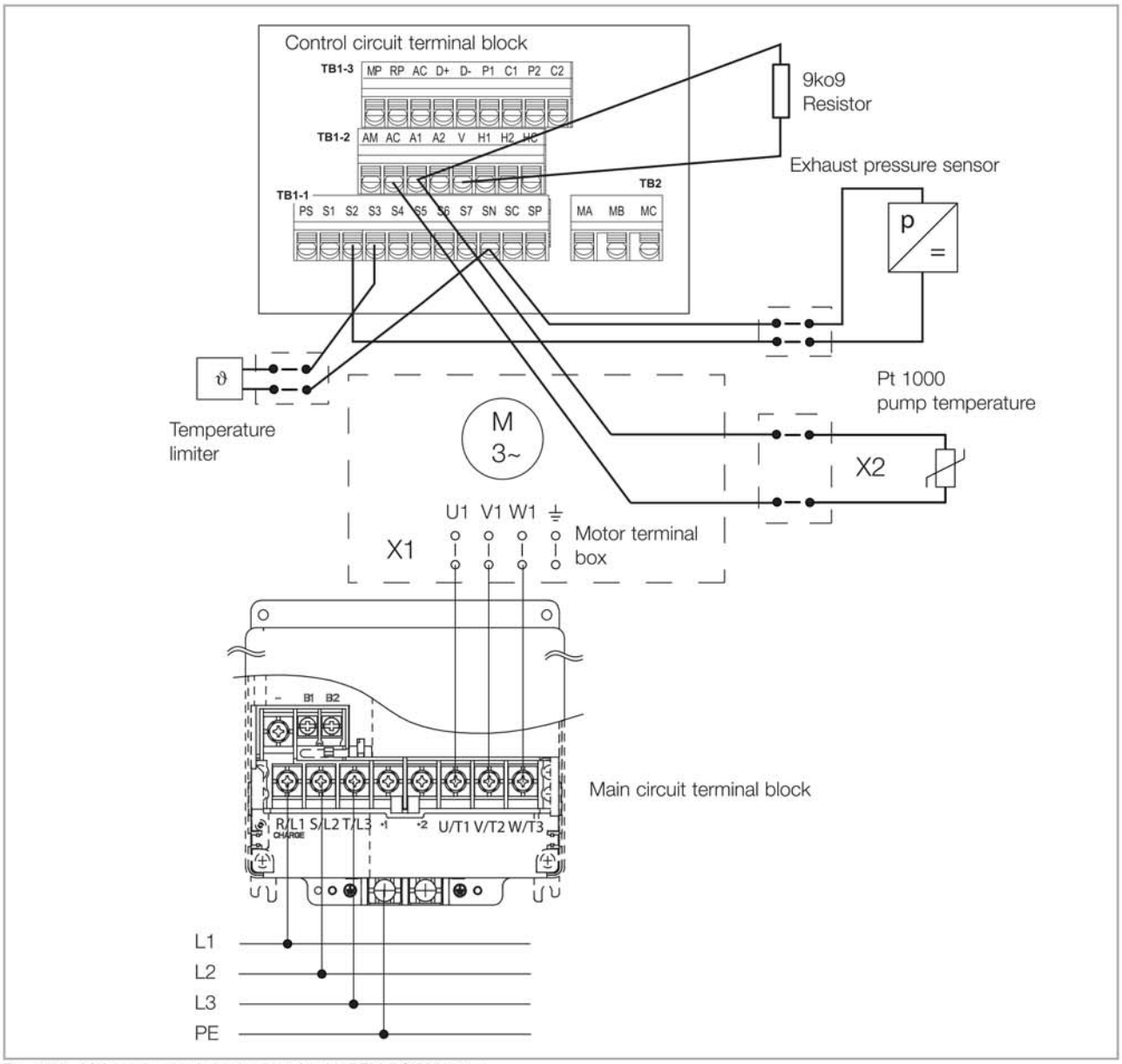


Fig. 3.22 Main and control circuit wiring for the DRYVAC DV 800-r

The Pt 1000 cable (30 m) is delivered seperately, so that it does not get damaged during transport. Unscrew the bolt with washer in the pump, place the Pt 1000 cable lug on the pump and screw in the bolt with washer with a torque of $10^{\pm 1}$ Nm.

Connect the pump's temperature sensor (Pt 1000) to A1 and AC. Lay the cable so that it does not touch any hot surfaces.

Connect the temperature limiter to S3 and SN.

Connect the external resistor 9k09 to A1 and V.

3.7 Leak Search after Installation

DANGER



Observe Safety Information 0.4.

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.

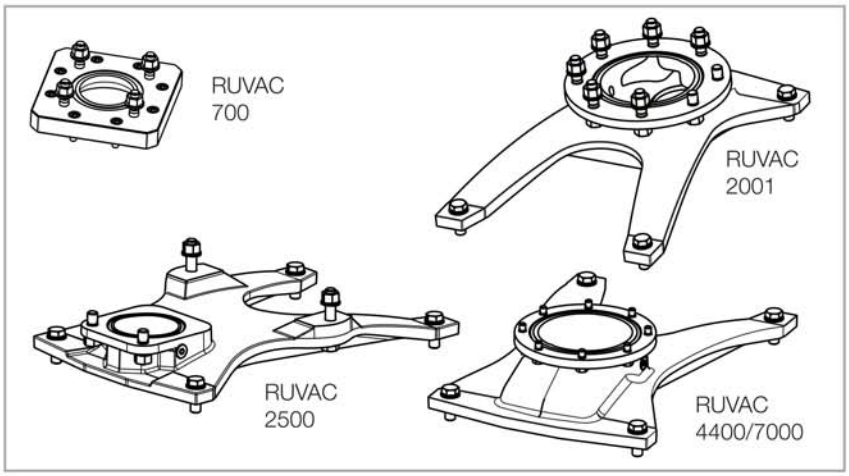


Fig. 3.23 Roots pump adapters

3.8 Mounting Accessories

3.8.1 Roots Pump Adapter

The adapters serve as a connecting component when fitting a Roots vacuum pump onto the DRYVAC.

The adapter mounting is described in the corresponding Operating Instructions.

After fitting, we recommend running of a leak search.

CAUTION



The eye-bolts at the RUVAC must **not** be used to lift the pump combination.

When transporting, the DRVAC and the RUVAC need to be separated for safety reasons and reassembled at the new destination.

Exception: The WH 2500 can be lifted at its 4 eye-bolts together with the DRYVAC if no other accessories are fitted.

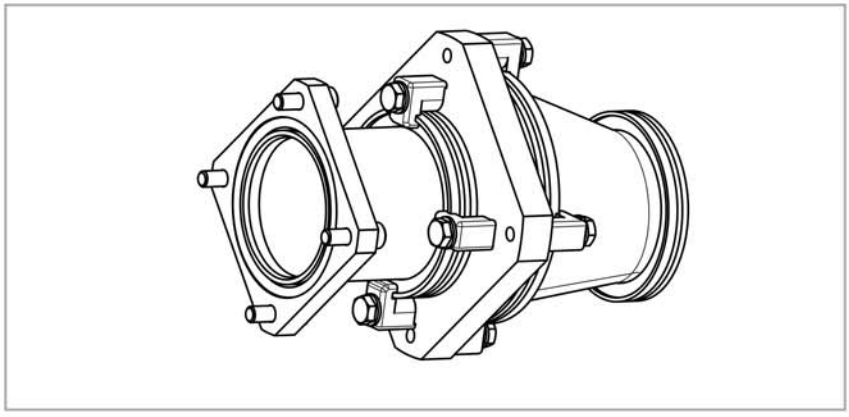


Fig. 3.24 Non-return valve 112005A15 with swivel joint

3.8.2 Non-return Valve

The non-return valve is a fitting for shutting off which is fitted to the exhaust flange of the DRYVAC. It prevents gas from flowing back into the pump.

With the pump running, the non-return valve opens more or less wide depending on the gas flow. When the pump is switched off, the non-return valve closes automatically.

Installation

CAUTION



Note the safety information provided in Sections 0.1, 0.3 and 0.4.

Only for non-return valve 112005A15 with swivel joint

Supplied equipment: Non-return valve complete with O-ring and four M8 mounting bolts.

Note the installation position for the non-return valve, see Fig. 3.25. The swivel joint of the valve must be located at the top. The valves must open in the direction of the gas flow.

Make sure that the O-ring sits in its groove. Bolt the non-return valve to the exhaust of the DRYVAC using the four M8 mounting bolts, tightening torque 25 +/- 2.5 Nm.

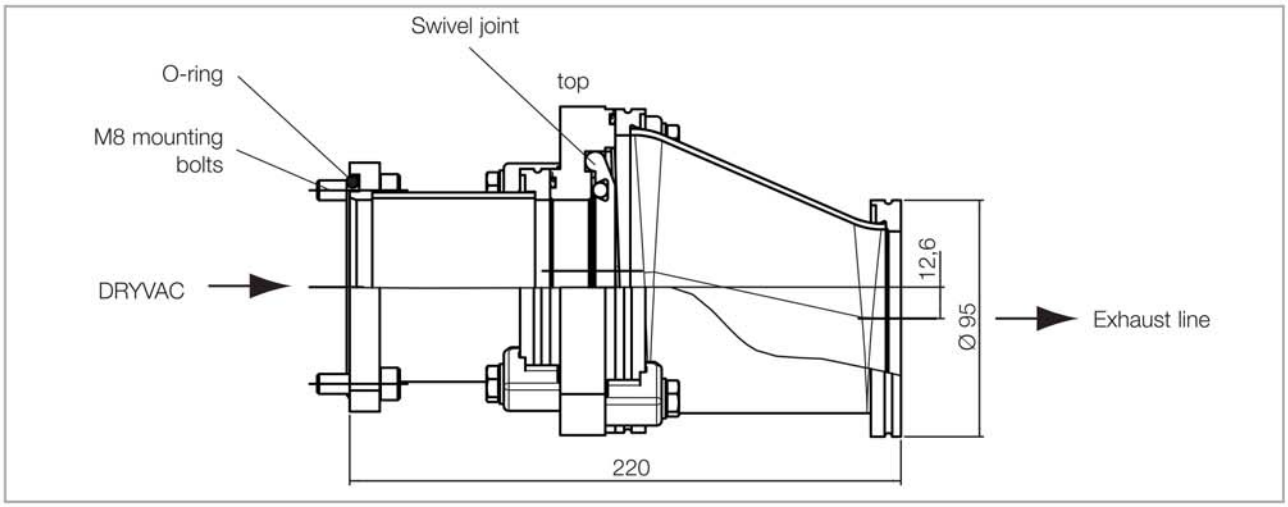


Fig. 3.25 Side view/sectional view of the non-return valve with swivel joint

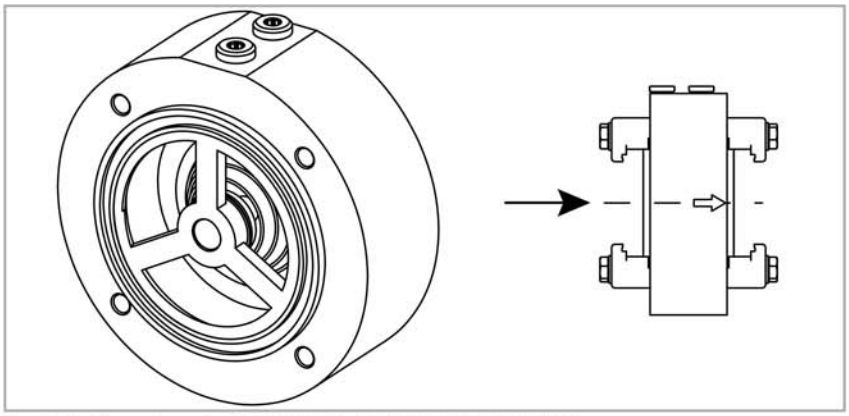


Fig. 3.26 Non-return valve 112005A14 for DRYVAC DV 450/650/800

Only for non-return valve 112005A14 for DRYVAC DV 450/650/800
Supplied equipment: Non-return valve complete with mounting equipment, e.g. O-rings and claws.

Note the installation position for the non-return valve, see Fig. 3.26. The valve must open in the direction of the gas flow. Observe the arrow on the check valve. The lock screws should be positioned at the top so that no condensate can collect in the holes.

Operation
Proper operation of the non-return valve is only ensured in connection with clean processes. Operation of the valve needs to be checked regularly depending on the type of application.

4 Operation



Observe Safety Information 0.6.

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 Profibus Interface

For installation and operation of the optional bus interfaces, please refer to the instructions of YASKAWA enclosed with the module, and to Operating Instructions 300802431 regarding bus interfaces for DRYVAC DV and RUVAC WH. For the DRYVAC DV 800 please contact Leybold.

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.

In processes, where the process gases or by-products react with air, purge the pump with nitrogen at every start-up before opening it to the process. This reduces the risk of reactions (like explosions) when the process gases come into contact with remaining oxygen in the pump.

DANGER



Start the pump. The DV 450/650 is ready for operation after 5 minutes, the DV 800 after 10 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.

Hot surfaces, risk of suffering burns.
Notice safety information 0.3.

CAUTION



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.

Please also note the recommendations relating to running up of the pumps provided at the beginning of Section 4.2.

Some parameters are only taken over after a restart.



Fig. 4.1 LED operator at DRYVAC DV 450/650

4.4.1 LED Operator and Keys

DRYVAC DV 450/650

The LED operator 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 = 120.00 Hz
50 (FOUT LED off)	U7-03 = 50 °C

Keys and Functions DV 450/650

Display	Name	Function
F50.00	Data Display Area	Displays the frequency reference, parameter number, etc.
ESC	ESC Key	Returns to the previous menu.
RESET	RESET Key	Moves the cursor to the right. Resets a fault.
RUN	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	STOP Key	Stops the drive.
ENTER	ENTER Key	Selects modes, parameters and is used to store settings.
LO RE	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	ALM LED	Flashing: The drive is in the alarm state. On: The drive is in a fault state and the output is stopped
REV	REV LED	On: The motor rotation direction is reverse. Off: The motor rotation direction is forward
DRV	DRV LED	On: The drive is ready to operate the motor. Off: The drive is in the Verify, Setup, Parameter Setting or Auto tuning mode
FOUT	FOUT LED	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

DRYVAC DV 800

The display shows the output frequency in the delivery state (U1-02). The Pt-1000 temperature can be read out in U8-08 or 07-03.

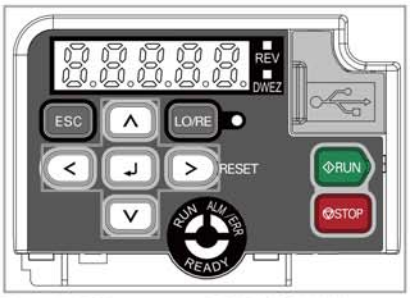


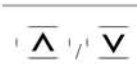
Fig. 4.2 LED operator at DRYVAC DV 800

Keys and Functions DV 800

Display	Name	Function
8.8.8.8.8.	Data Display Area	Displays parameters, errors and other data
RUN	RUN Key	Starts the drive in the LOCAL* mode, if control is set to LOCAL.
STOP	STOP Key	Stops the drive. Uses a stop-priority circuit. This will also apply when a Run command (REMOTE Mode) is active at an external Run command source. To disable STOP priority, set o2-02 = 0 [STOP Key Function Selection = Disabled].
LO/RE	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/ERR	ALM LED	Flashing: The drive is in the alarm state. On: The drive is in a fault state and the output is stopped
READY	DRV LED	On: The drive is ready to operate the motor. Off: The drive is in the Verify, Setup, Parameter Setting or Auto tuning mode
RUN	RUN LED	Illuminated: The drive is in normal operation. OFF: The drive is stopped. Flashing: • The drive is decelerating to stop. • The drive received a Run command, but the frequency reference is 0 Hz. Flashing quickly: • When the drive is in LOCAL Mode, the drive received a Run command from the MFDI terminals and is switched to REMOTE Mode. • The drive received a Run command from the MFDI terminals when the drive is not in Drive Mode. • The drive received a Fast Stop command. • The safety function shut off the drive output. • The user pushed STOP on the keypad while the drive is operating in REMOTE Mode. • The drive is energized with an active Run command and b1-17 = 0 [Run Command at Power Up = Disregard Existing RUN Command].
ESC	ESC Key	Returns to the previous menu. Push and hold to go back to the frequency reference screen (the initial screen).

Operation

Keys and Functions DV 800

Display	Name	Function
	Left Arrow Key	Moves the cursor to the left.
	Up/ Down Arrow Key	Scrolls up/down to select parameter numbers, setting values, etc.
	Right Arrow Key (RESET)	Moves the cursor to the right. Resets a fault.
	ENTER Key	Selects modes, parameters and is used to store settings.
	REV LED	On: The motor rotation direction is reverse. Off: The motor rotation direction is forward
	DWEZ LED	On: The drive is In DriveWorksEZ operation.
		* The pump is not intended for LOCAL mode. Default is REMOTE

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 S6 to SC (base block) for enable, see Section 3.6.
- Connect S1 to SC for start.

The frequency converter is programmed for this pump. The parameter access is limited. The default output frequency can be changed in the programming mode between 0 Hz and 120 Hz.

Description	Parameter in Programming mode	Leybold setting
Standard output frequency reference	d1-01	120 Hz for DV 450/650/800

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

CAUTION



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

NOTICE



4.4.2 Frequency Converter Outputs

The frequency converter outputs have been assigned as follows:

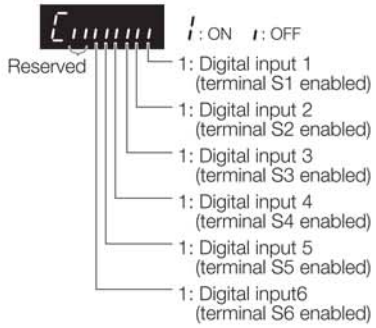
P1-PC	Digital output Multifunction opto-coupler 48 V DC max. 50 mA max.	Contact closed during **Warning** (general message)
P2-PC	Digital output Multifunction opto-coupler 48 V DC max. 50 mA max.	Contact closed during **Error** (general message)
AM-AC	Analog output 0 to +10 V DC (2 mA)	Analog monitor output 10 V when the pump is running

Operation

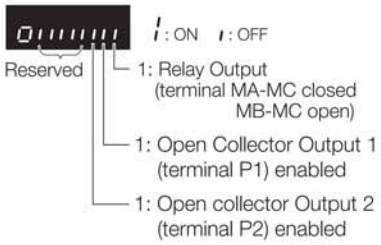
Monitor Parameter Table

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

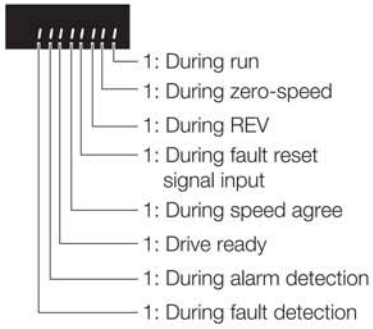
Monitor	Description
U1-01	Frequency Reference (Hz)
U1-02	Output Frequency (Hz)
U1-03	Output Current (A)
U1-05	Motor Speed (Hz)
U1-06	Output Voltage Reference (Vac)
U1-07	DC Bus Voltage (Vdc)
U1-08	Output Power (kW)
U1-09	Torque Reference (% of motor rated torque)
U1-10	Input Terminal Status



U1-11	Output Terminal Status



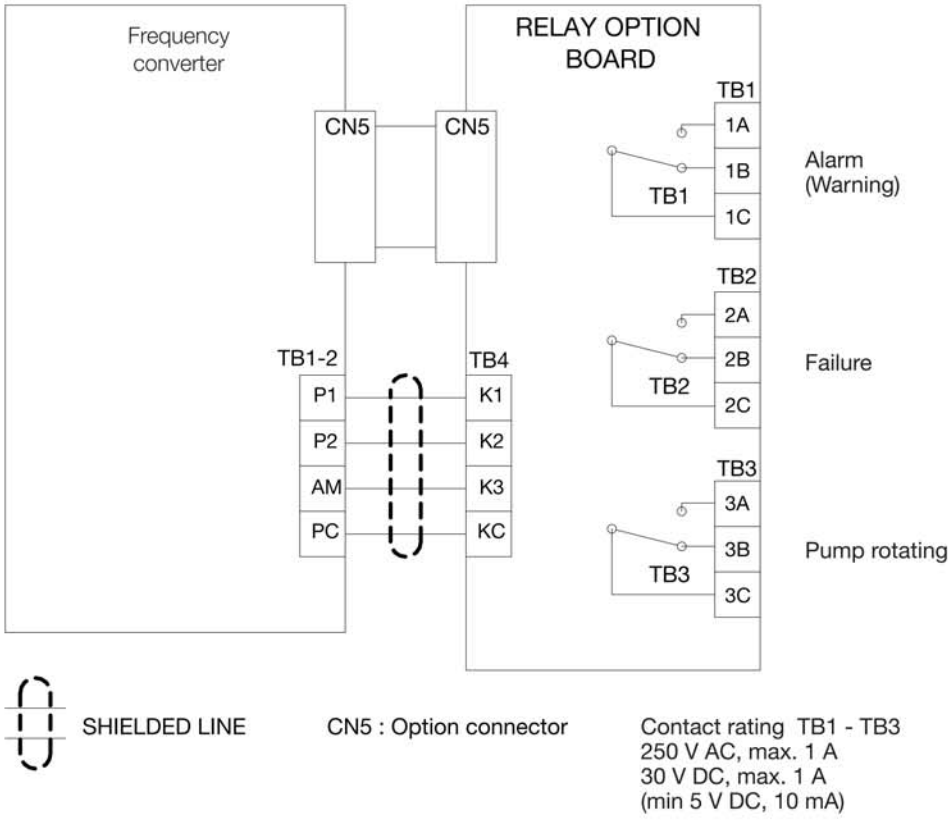
U1-12	Drive Status



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.

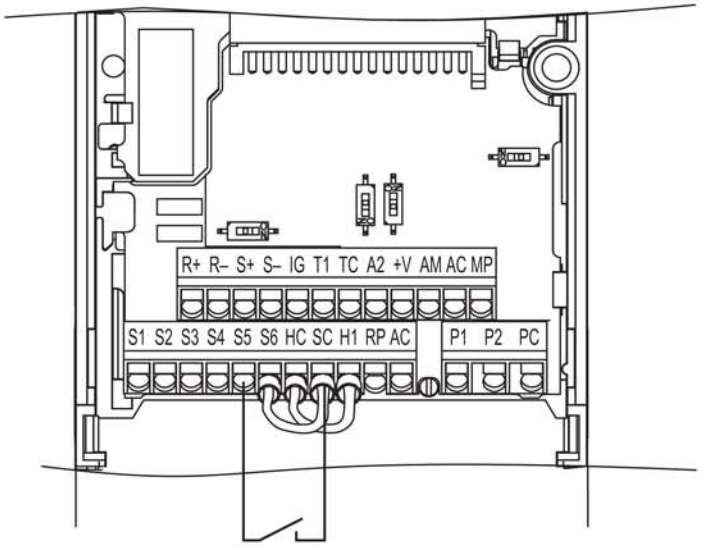
4.4.3 Relay Option Board



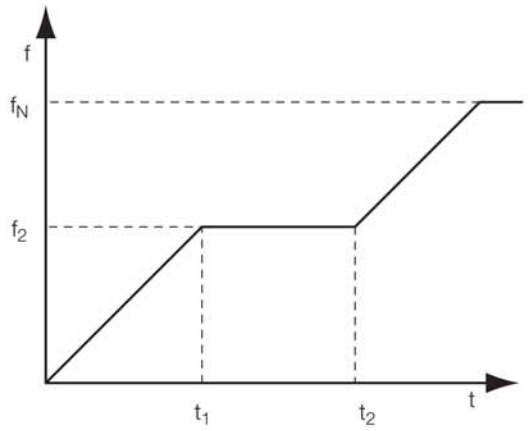
Terminal Block

Symbol	PIN No.	Function
TB1	1A	K1 Output, Normally Open (NO) contact
	1B	K1 Output, Normally Closed (NC) contact
	1C	K1 Output, Common
TB2	2A	K2 Output, Normally Open (NO) contact
	2B	K2 Output, Normally Closed (NC) contact
	2C	K2 Output, Common
TB3	3A	K3 Output, Normally Open (NO) contact
	3B	K3 Output, Normally Closed (NC) contact
	3C	K3 Output, Common
TB4	K1	K1 control signal
	K2	K2 control signal
	K3	K3 control signal
	KC	Common for K1,K2 and K3

Fig. 4.3 Relay option board: Connections



Switch (normally open)



Pump run-up with two set up frequencies (schematic)

Fig. 4.4 Setting up the second set point frequency

4.4.4 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.

DANGER



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

We urgently recommend to consult us first.

NOTICE



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

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 120 Hz). Closing of the switch between the digital input S5 and SC will enable the second frequency.

The input signal at S5 can be controlled through a timer relay or through the PLC.

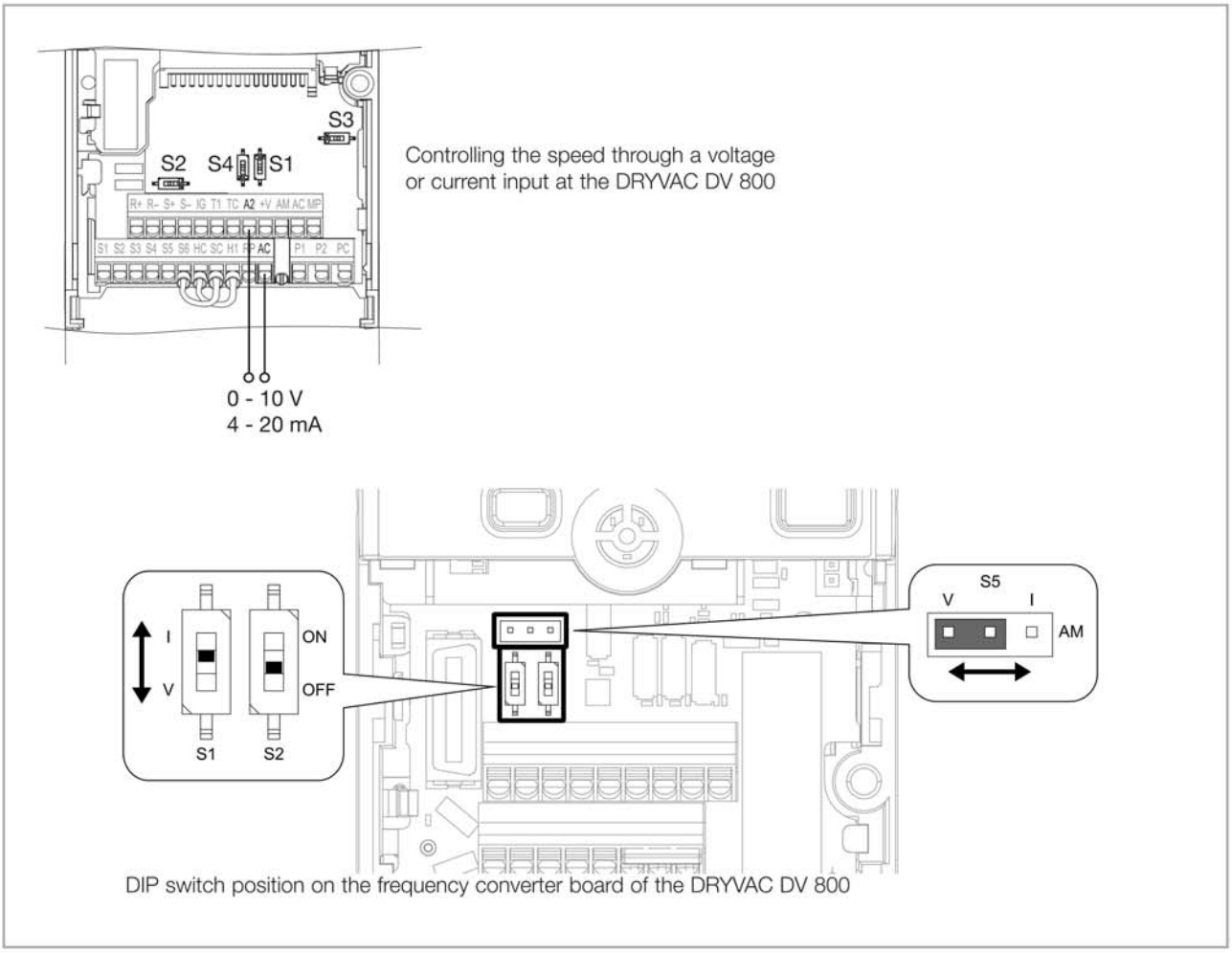


Fig. 4.5 Controlling the pump speed

Controlling the Speed through a Voltage Input

Only for DV 450/650: DIP switch S4 must remain at its default position: top, multifunction input.

For all pumps

Set parameter b1-01 to 1 (0 default). Through this, the analogue input terminal A2 becomes the main frequency reference.

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

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 A2 and AC. 0 to 10 V, 0 V corresponds to 0 Hz, 10 V corresponds to 120 Hz, linear increase.

Controlling the Speed through a Current Input
Only for DV 450/650: DIP switch S4 must be at its default position: top, multifunction input

For all pumps
Set parameter b1-01 to 1 (0 default). Through this, the analogue input terminal A2 becomes the main frequency reference.

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

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 A2 and AC. 4 to 20 mA, 4 mA corresponds to 0 Hz, 20 mA corresponds to 120 Hz, linear increase.

4.4.5 Warning and Shut-off Thresholds

	Designation	Warning threshold	Shut-off threshold	Processing by	Fault display
Exhaust presure (Pressure difference to ambient pressure)	PSH 200		250 +/- 50 mbar	frequency converter	EF2
Purge gas supply pressure (optional)	PSL 220		2.4 bar(g)	customer PLC	-
Temperature pump Motor side (temperature limiter)	TSH 285	—	75 °C	frequency converter	EF3
Temperature pump Gear side (Pt 1000)	TSH 280	50 °C (LVO 210) 45 °C (LVO 410)	60 °C (LVO 210) 50 °C (LVO 410)	frequency converter	100 FT (DV 450/650) dWFL (DV 800)
Frequency converter temperature	TSH 281	105 °C	110 °C	frequency converter	oH oHi

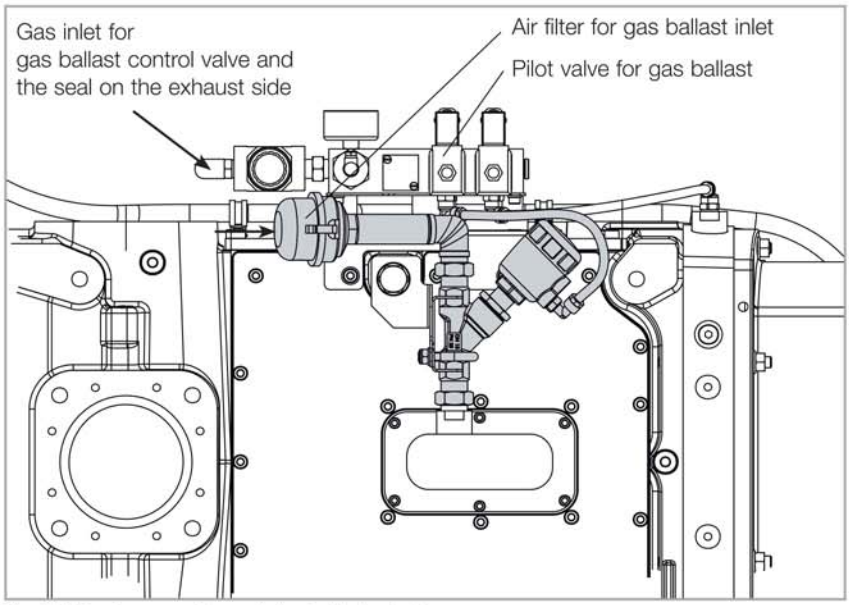


Fig. 4.6 Electropneumatic gas ballast valve (option)

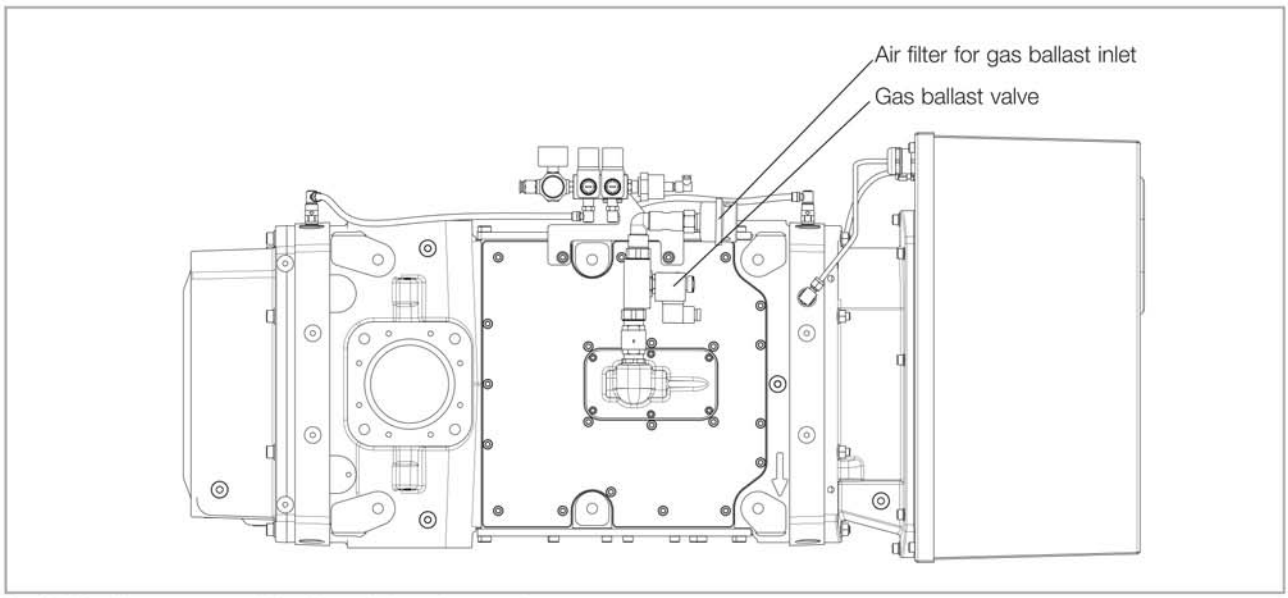


Fig. 3.7 Double purge gas module with gas ballast valve, top view

4.4.6 Gas Ballast Operation

The gas ballast is used to avoid condensation within the pump. To be effective, this requires the pump to attain its operating temperature.

CAUTION



Type of gas and purge gas quantity must be selected so that even under the most unfavourable circumstances no explosive mixture can occur within the gas chamber during decompression process.

4.4.7 Pumping of 100% Argon

- Constant working pressure between 1 and 80 mbar is possible.
- Working pressure > 80 mbar is permissible for max. 5 minutes (30 minutes recovery afterwards) or at a reduced speed of 70 Hz without time limit.
- Working pressure < 1 mbar and for longer than 5 minutes is only possible at 70 Hz operation or with N2 purge.
- Argon is not permitted as purge gas.

Provide 20 slm N2 or dry air as purge gas at the exhaust.

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.
- Run the pump for 15 minutes with purge gas to ensure that it is free of process gases.
- Then switch off the pump.

DANGER



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

The pump must be vented, but only **up to atmospheric pressure**.

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

DRYVAC without cooling water unit: 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 pumpdown times until attaining the desired ultimate pressure.

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

Process 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 be followed in order to minimise the risk to people and property.

DANGER



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 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.
- Shut off the purge.
- Disconnect the pump exhaust and inlet and fit a metal ISO / NW blanking plate.
- 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).

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

Drain cooling water

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 only.

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

5 Maintenance

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.

Contamination

This form is available from
www.leybold.com -> Downloads -> Download Documents.

Form

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.

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 year
Oil change for synthetic oil	1 year
Oil change for PFPE	not required
Clean the filter insert in the cooling water pressure reducer	Depending on the pollution degree of the cooling water
Check and clean the gas ballast filter	Depending on the specific ambient conditions
Replace the filter cartridge in the purge gas pressure reducer	1 year
Check the water hoses	1 year
Check the purge gas hoses	1 year
Complete overhaul in the service centre	Depending on the specific operating conditions
Leak search on the entire pump system	after all maintenance and assembly work and upon request

5.3 Exchanging the Oil

CAUTION



Notice safety information 0.3 to 0.5.

The oil-fill port must be sealed air-tight. In the presence of a vacuum, the entry of air may cause oil-containing gas to enter the pumping chamber via the impeller seals.

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.

Change the synthetic oil more frequently when pumping corrosive vapours or large amounts of dust.

WARNING



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.

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

NOTICE



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.

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 approximately 10 -15 Nm).

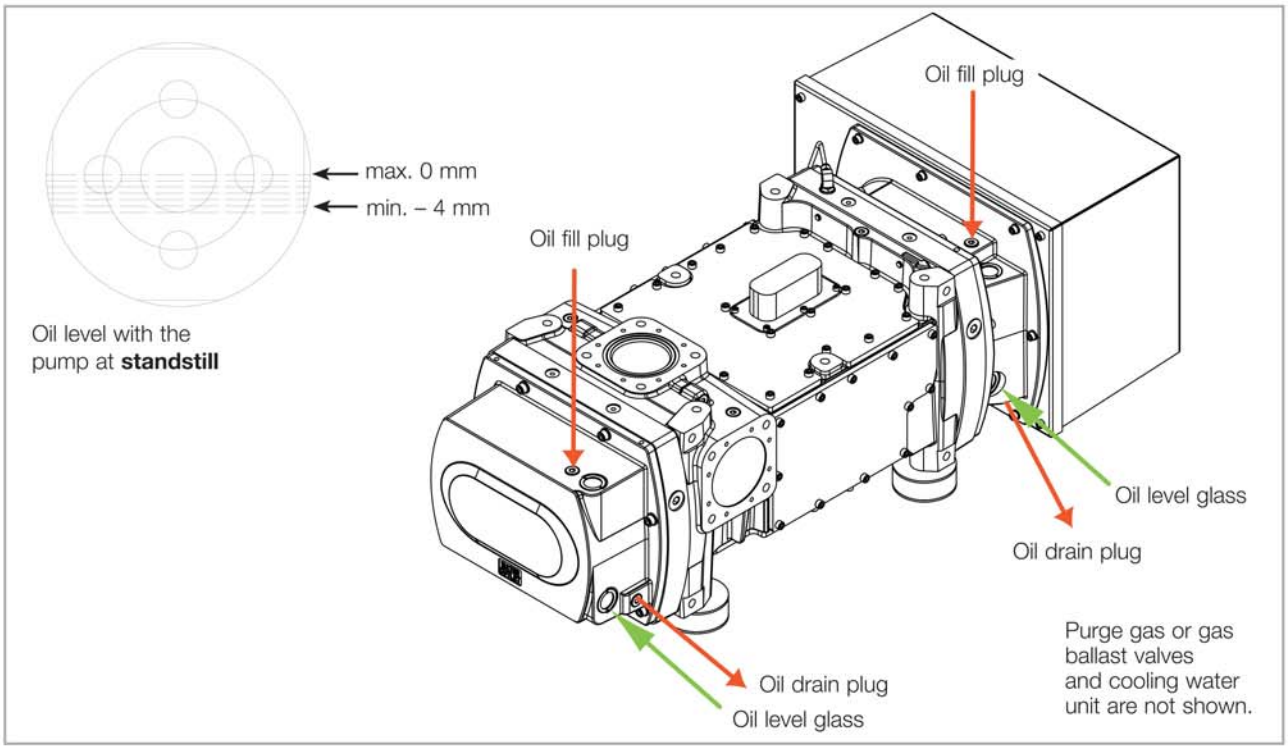


Fig. 5.1 Oil change

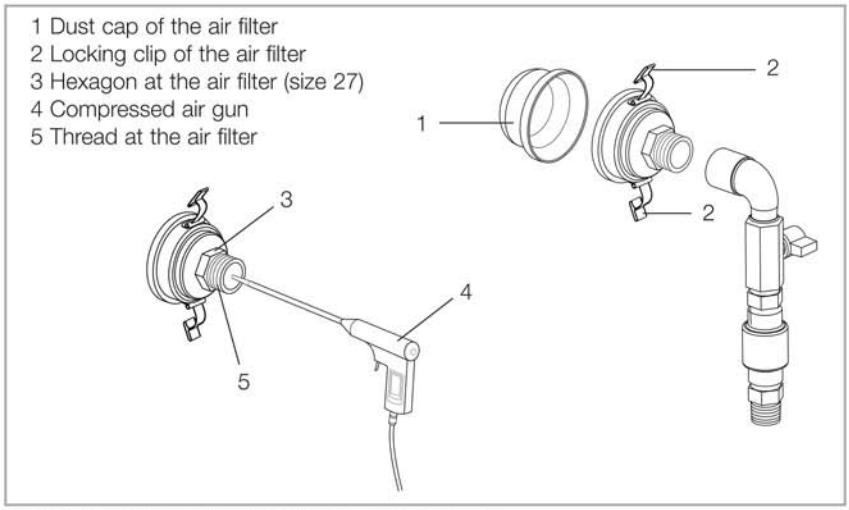


Fig. 5.3 Maintenance on the air filter at the gas ballast valve

5.4 Checking and Cleaning the Gas Ballast Filter

The air filter serves the purpose of filtering dust particles out of the air so that only clean air can enter the pump chamber.

The air filter should be subjected to maintenance within regular intervals.

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.

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

CAUTION



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.

5.5 Replacing the Filter Cartridge in the Purge Gas Pressure Reducer

Notice safety information in Section 0.

CAUTION



The filter cartridge in the purge gas module pressure reducer must be replaced annually, see Fig. 3.5.

For replacing, unscrew the metal protection basket with cup from the pressure reducer. Unscrew the mounting component and detach the used filter cartridge. Fit the parts using a new filter cartridge again.

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.	Connect motor correctly.
	Overtemperature switch or motor stator defective.	Leybold Service.
	Pressure switch is defective.	Replace the pressure switch.
	Lubricant is too thick.	Exchange the lubricant or warm up lubricant and pump.
	Motor rotor defective.	Leybold Service.
	Pump has seized: defective impellers, bearings or toothed gears.	Leybold Service.
Pump gets too hot. PT1000 or dwFL is displayed at the frequency converter (see Section 6.2)	Cooling water supply is not sufficient.	Ensure sufficient cooling water supply.
	Cooling water lines are clogged.	Decalcify cooling water lines.
	Filter insert in the pressure reducer is clogged.	Clean filter insert.
	Ambient temperature is too high or cooling air flow is obstructed.	Install the pump at a suitable place or ensure a sufficient flow of cooling air.
	Pump is operating in the wrong pressure range.	Check the pressure levels within the system.
	Gas temperature is too high.	Check system.
	Clearance between housing and rotors are too small due to - contamination - distortion of the pump	Clean pumping chamber. Affix and connect the pump free of tension.
	Friction resistance is too high due to contaminated bearings and/or contaminated lubricant.	Clean pump, respectively perform maintenance.
	Lubricant level is too high.	Drain lubricant down to the correct level.
	Lubricant level is too low.	Top up lubricant to the correct level.
	Wrong lubricant filled in.	Leybold service
	Bearing is defective.	Leybold Service.
Pump is extremely loud.	Bearing damage.	Repair pump.
	Thick particle deposits.	Clean pump, respectively perform maintenance.
	Defective silencer.	Repair silencer.
	High gas throughput with the discharge line open, without silencer.	Install discharge line or silencer.
Motor power consumption is too high.	Like „Pump gets too hot“.	Like malfunction „Pump gets too hot“.
	Incorrect mains voltage for the motor.	Connect the motor to the correct mains voltage.
Pump is too loud.	Motor stator defective.	Leybold Service.
	Motor rotor defective.	Leybold Service.
	Distances between housing and rotors is too small due to - contamination - distortion of the pump	Clean pumping chamber. Affix and connect the pump free of tensions.
	Bearing or gear damage.	Leybold Service, shutdown pump immediately.
	Pistons make contact with the housing.	Leybold Service, shutdown pump immediately.
	Rotor is running untrue.	Leybold Service, shutdown pump immediately.
	Oil slinger disc makes contact with the gear housing or the oil pipe.	Leybold Service.
	Oil pump is blocked or defective.	Leybold Service, shutdown pump immediately.

Malfunction	Likely cause	Remedy
Pump is losing lubricant.	Lubricant leak is apparent:	
	Oil drain plug is leaky.	Drain lubricant, firmly screw in a new oil drain plug with the gasket, fill in correct lubricant quantity
	Oil level glasses leaky.	Leybold Service.
	Gear cover is leaky.	Replace the O-ring of the gear cover.
	Puddle under the motor, leak in the seal.	Leybold Service, shutdown pump immediately.
	No lubricant leak is apparent: See malfunction „Lubricant in the pump chamber“.	See malfunction „Lubricant in the pump chamber“.
Oil gets too dark.	Oil has been used up.	LVO 210: Exchange the oil. LVO 410: Leybold Service.
	Pump gets too hot.	See malfunction „Pump gets too hot“; after remedy of the malfunction, exchange the oil.
Lubricant in the pump chamber.	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 has an internal leak.	Leybold Service.
	Piston rings are defective.	Leybold Service.
Pump does not attain its pumping speed.	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.
	Impeller play 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
bb	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 SC and S6.
CF	Control Fault			The torque limit was reached during deceleration for longer than 3 sec. when in Open Loop Vector control • 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.
CPF02 to CPF24	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.
CPF25	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.
Cr5r	Cannot Reset	■		Fault reset was input when a Run command was active.	Turn off the Run command and reset the frequency converter.
EF0	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.
EF	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.
EF1 to EF6	External Faults	■	■	An external fault was triggered by an external device via one of the digital inputs S1 to S6. 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.
GF	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.

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
PF	Output Phase Loss		■	Output cable is disconnected or the motor winding is damaged. Loose wires at the frequency converter output. Motor is too small (less than 5% of frequency converter current).	Check the motor wiring. Make sure all terminal screws in the frequency converter and motor are properly tightened. Check the motor and frequency converter capacity.
oC	Overcurrent		■	Short circuit or ground fault on the frequency converter output side The load is too heavy. The accel./decel. times are too short. Wrong motor data or V/f pattern settings. A magnetic contactor was switched at the output.	Check the output wiring and the motor for short circuits or broken insulation. Replace the broken parts. Check the machine for damages (gears, etc.) and repair any broken parts. Check the frequency converter parameter settings. Check the output contactor sequence.
oH or oH1	Heatsink Overheat	■	■	Surrounding temperature is too high. The cooling fan has stopped. The heatsink is dirty. The airflow to the heatsink is restricted.	Check the surrounding temperature and install cooling devices if necessary. Check the frequency converter cooling fan. Clean the heatsink. Check the airflow around the heatsink.
oL1	Motor Overload		■	The motor load is too heavy. The motor is operated at low speed with heavy load. Cycle times of accel./ decel. are too short. Incorrect motor rated current has been set.	Reduce the motor load. Use a motor with external cooling and set the correct motor in parameter L1-01 Check the sequence. Check the rated current setting.
oL2	Drive Overload		■	The load is too heavy. Too much torque at low speed.	Check the load. The overload capability is reduced at low speeds. Reduce the load or increase the frequency converter size.

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
ou	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.
LF	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.
Uu1	DC Undervoltage	■	■	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.
Uu2	Controller Undervoltage		■	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.
Uu3	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.

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
100A1 / A2 (DV 450/650) dWAL (DV 800)	Pt 1000 Alarm 1	■		Is true, when Pt 1000 measures temperatures of >50 °C (LVO 210) or >45 °C (LVO 410).	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.	
C-LiM	C-Lim Alarm	■		Drive was running at or above the Final Current Limit for the time P5-04 – P5-03	

Troubleshooting

Error message	Brief Description	AL	FLT	Possible cause	Corrective Action
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		■	Is true, when Pt 1000 measures temperatures of >60 °C (LVO 210) or >50 °C (LVO 410). Note “Wait” fault.	Check and improve cooling.
DV800: PT 1000 / dWFL	Pt 1000 fault		■	Pt 1000 not connected, series resistor missing, Pt 1000 defective, series resistor defective.	Check Pt 1000 and connecting cable. Check series resistor. Should be 9090 Ohm.
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		■	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”. 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. As soon “Wait” is occurring the frequency converter stops with RUN to coast.	

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

Plug screw M16x1,5 (oil fill plug)	E20127105
Gasket for plug screw	E23955165
Filter cartridge for purge gas pressure reducer	E110000850
Air filter for gas ballast valve	E110000980
Pressure reducing cartridge for cooling water unit	E6519936

8 Waste Disposal

Contamination

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

WARNING



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.

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.

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 vacuum pump DRYVAC**
Type designation:	DV450, DV650, DVR5000, DV1200
Part numbers:	112045VXX-Z, 112065VXX-Z, 112065FPXX-Z; 112500VXXX-Z, 112120VXX-Z XXX=01-10; 15-999, Z=1-9

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 61010-1:2010	Safety requirements for electrical equipment for measurement, control, and laboratory use — Part 1: General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use — EMC requirements — Part 1: General requirements Emissions: Group 1, Class A Immunity: Industrial electromagnetic environment

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Cologne, September 25, 2017

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Cologne, September 25, 2017

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P20010449A

EU Declaration of Conformity

CE

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The product specified and listed below

- *Screw vacuum pump DRYVAC*
- *DV800*
- *112080VXX-Z*
  XX=01-10; 14-99, Z=1-9

Is in conformity with the relevant requirements of European CE legislation:

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

Based on the relevant requirements of harmonised standards:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 60204-1:2006 +A1:2009	Safety of machinery. Electrical equipment of machines. General requirements
EN 61000-6-2:2005	Electromagnetic Compatibility (EMC) - Part 6-2: Generic Industrial Immunity Standard
EN 61000-6-4:2007	Electromagnetic Compatibility (EMC) - Part 6-4: Generic Industrial Emission Standard

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2021-04-29*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Andries De Bock
VP Engineering
Industrial Vacuum Division

Axel Guddas
General Manager
Product Company Cologne

This product has been manufactured under a quality management system certified to ISO 9001:2015

Declaration of Conformity

Leybold GmbH
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This declaration of conformity is issued under the sole responsibility of the manufacturer.

- *Screw vacuum pump DRYVAC*
- *DV800*
- *112080VXX-Z*
  XX=01-10; 14-99, Z=1-9

The object of the declaration described above is in conformity with relevant statutory requirements:

Supply of Machinery (Safety) Regulations 2008
The objectives of the Electrical Equipment (Safety) Regulations 2016 are governed by Annex 1 1.5.1 of this regulation.

Electromagnetic Compatibility Regulations 2016
Class A Emissions, Industrial Immunity

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Relevant designated standards or technical specifications are as follows:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 60204-1:2006 +A1:2009	Safety of machinery. Electrical equipment of machines. General requirements
EN 61000-6-2:2005	Electromagnetic Compatibility (EMC) - Part 6-2: Generic Industrial Immunity Standard
EN 61000-6-4:2007	Electromagnetic Compatibility (EMC) - Part 6-4: Generic Industrial Emission Standard

This declaration, based on the requirements of the listed Statutory Instruments and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: 2021-04-29

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Signed for and on behalf of Leybold GmbH

Andries De Bock
VP Engineering
Industrial Vacuum Division

Axel Guddas
General Manager
Product Company Cologne

This product has been manufactured under a quality management system certified to ISO 9001:2015

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU, UK): Class A/B Industrial equipment

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

RoHS (EU, UK): Material Exemption Information

This product is compliant with the following Exemptions
Annex III:

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

REACH (EU, UK)

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

Article 33.1 Declaration (EU, UK)

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

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

Additional Applicable Requirements

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

2012/19/EU	Directive on waste electrical and electronic equipment (WEEE)

材料成分声明
China Material Content Declaration

	有害物质 Hazardous Substances					
部件名称 Part name 	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr VI)	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
铸铝及铝合金制品 Aluminium alloys	X	0	0	0	0	0
钢合金制品 Steel alloys	X	0	0	0	0	0
铜管管件 Brass pipe fitting	X	0	0	0	0	0

O: 表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求。
O: Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572.

X: 表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 标准规定的限量要求。
X: Indicates that the hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T26572.

This product has been manufactured under a quality management system certified to ISO 9001:2015

Certificates

The DRYVAC DV 450 and DV 650 pumps have been certified by the TÜV Rheinland of North America according to the requirements of

- UL 61010-1: 2012
- CAN/CSA-C22.2 No.61010-1-12

The components are in compliance to the tested standards.

- TUVus Certificate No. CU 72190339 01/02

The TÜV Rheinland of North America is a “Nationally Recognized Testing Laboratory” (**NRTL**) for the USA and Canada.

This product has been certified to the requirements of CAN/CSA-C22.2 No. 61010-1-12, or a later version of the same standard incorporating the same level of testing requirements.

Leybold

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