

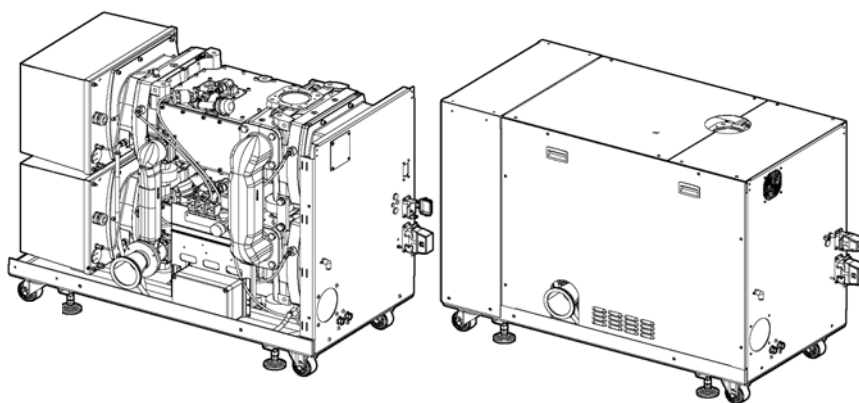


DRYVAC

DV 1200, DV 1600

Dry Compressing Vacuum Pump

Operating instructions 300987363_002_C1



Part No.

112120V17-1

112160V17-1

112160V17-2

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

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

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Safety and compliance

1 Safety and compliance

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

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

1.1 Definition of Warnings and Cautions

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

WARNING:

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

CAUTION:

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

NOTICE:

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

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

1.2 Trained personnel

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

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

Safety and compliance

1.3 Safety symbols

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

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

	Warning/Caution Risk of injury and/or damage to equipment. An appropriate safety instruction must be followed or a potential hazard exists.
	Warning - Automatic start up Risk of injury. The equipment can be started remotely and without warning.
	Warning - Corrosive substances Risk of injury or damage to equipment. Identifies the presence of corrosive gases, liquids or materials.
	Warning - Dangerous voltage Risk of injury. Identifies possible sources of hazardous electrical shock.
	Warning - Flammable material Risk of fire. Identifies possible sources of flammable gases, liquids or materials.
	Warning - Hot surfaces Risk of injury. Identifies a surface capable of inflicting burns through contact.
	Warning - Noise hazard Risk of injury. Identifies a possible source of noise above the recommended safe level.
	Warning - Risk of explosion Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.
	Warning - Toxic material Risk of injury or damage to the environment. Identifies a source of toxic gases, liquid or material.
	Warning - Overhead or Suspended load Do not stand below the suspended load.
	Warning - Wear eye protection Risk of Injury. Wear protective goggles when checking the direction of rotation.

Safety and compliance

	Warning - Wear hearing protection
	Warning - Protective earth (ground) Earth point for electrical equipment.

Important safety information

2 Important safety information



WARNING: HAZARDOUS WORKING CONDITIONS

Risk of injury. The pump must be leak tight. 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 protective clothing, for example.



WARNING: DANGEROUS VOLTAGE

Risk of electric shock. Disconnect power before opening. Contact causes electrical shock. There can be a high leakage current. Earth connection is necessary before connecting supply. Danger of residual voltage for up to 5 minutes after disconnecting power supply. Connect and disconnect the mains plug only in de-energised condition.



WARNING: HOT SURFACES

Risk of burns. Do not touch the system with bare hands after operation. Allow the pump to cool before you do any maintenance or repair work. Wear personal protective equipment.



WARNING: EXPLOSION HAZARD

Risk of injury or damage to equipment. Check compatibility with applications of the purge gas. Overpressure in the discharge line. Components can be thrown in all directions. The pressure in the discharge line must not exceed 1200 mbar. The discharge line must not be blocked or restricted.



CAUTION: PUMP DAMAGE

Risk of damage to one or both pumps. During connection and run-up, synchronise the pumps so that they run up together. Never run a single pump alone or run the system with pumps at different pumping speeds. For this refer to [Operation](#) on page 51.



CAUTION: PUMP WITH WHEELS

Risk of injury or damage to equipment. Pumps must only be placed and moved on levelled horizontal surfaces.



CAUTION: VACUUM EXPOSURE

Risk of injury. Do not expose any part of the human body to the vacuum.

Important safety information



CAUTION: AUTOMATIC START UP

Risk of injury or damage to equipment. After a mains power failure or in case of an emergency shutdown, the pump will run-up automatically again after the power has returned. The pump must be integrated within a control arrangement such that it can only be switched on manually after the mains power has returned.



CAUTION: TRANSPORTATION HAZARD

Risk of injury or damage to equipment. Always use the four crane eyes or secured forklift to transport or lift the pump. While transporting, do not stand under the lifted pump.

2.1 Mechanical hazards

1. 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 occurs in the pump and the system then they must be protected against such an overpressure by an overpressure safety valve, for example.
5. The maximum permissible discharge pressure for the pump is 1200 mbar.

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, an overpressure can occur briefly, for example, when the exhaust is shut suddenly.
8. For transporting the pump use only suitable transportation equipment.
When selecting the lifting and transport equipment 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, make sure that the pump has been secured on the forks or on a suitable pallet and all the cables at the bottom of the pump are carefully secured.
The lifting eye of the screw pump must never be used to lift any pump combinations (roots pump + backing pump).

Important safety information

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 degree with respect to the vertical axis.
10. For pumps on castors only:
Because of the installed castors, the pump must only be placed on a levelled floor capable of supporting the pump's weight, as there exists the risk of the pump rolling away. Moreover, the pump may only be moved on a levelled 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.
11. Before beginning with any maintenance and servicing work always make sure that no gas can flow backwards through the pump as the rotors might turn against the normal direction of rotation. For this reason vent the vacuum chamber to the discharge pressure level or make sure that the vacuum chamber and the lines are reliably separated from the pump through suitable valves. When connecting several pump systems, pressure differences between inlet and discharge can give rise to uncontrolled turning of the pump's shafts.
12. During operation, the cooling water circuit must not be shut off. A cooling water discharge which has been blocked can cause the formation of gas bubbles and result in excessively high pressures.
13. Lay electric feed and cooling water lines so that there is no risk of tripping over these.
14. When you change the oil remove any escaped oil as there is the risk of slipping.
15. 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.
16. Before you disassemble any cooling water lines, leave the pump to cool down, shut off the feed line.

2.2 Electrical hazards



WARNING: DANGEROUS VOLTAGES

Risk of electric shock. Potentially lethal voltages are present at the mains connections. Before you begin 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 minutes after disconnection. 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 de-energised (lockout/tagout) the equipment.

-
1. The electrical connection must only be provided by a trained person. Observe the national regulations in the country of use like EN 50110-1 for Europe, for example.
 2. Install a device for a safe disconnection from the power supply.
 3. Note the information on the IP type of protection.
 4. Always operate the pump with a properly connected protective earth conductor and make sure that the motor casing is closed.
 5. Observe the manufacturer's information and operating instructions for the respective frequency converter.

Important safety information

6. The pump must only be operated at the frequency specified for the motor. Use only our frequency converter.
7. For pumps with external frequency converter: After connecting the motor and each time after changes are made to the wiring, check the motor's direction of rotation.
A wrong direction of rotation can cause a pressure build-up on the intake side. Moreover, the pump may suffer severe damage.
8. 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.
9. Before you start, make sure that the junction box is undamaged, do a visual inspection of the seals.
10. Install add-on parts (pressure switches, for example) without any mechanical tensions and protect these against being damaged by impacts, for example.
11. 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.
12. Provide strain relief for the connecting lines so that the plugs and the line connectors are not subjected to excessively high mechanical stresses.
13. Lay electric feed lines so that there is no risk of tripping.
14. For models with external frequency converter only:
Consider the following precautions for the output circuit wiring.
Do not connect any other load than a three 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.
15. 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 over-temperature. This applies equally to emergency shut-down arrangements. After having determined the fault cause, the pump should be switched on manually again.
16. We recommend the use of the external display (accessory) to operate the frequency converter. Attach the external display appropriately if it is to be used permanently.
17. Work on the frequency converter within the motor casing must be done by trained personnel only.

2.3 Thermal hazards



WARNING: HOT SURFACE

Risk of burns. During operation the pump is hot and some surfaces can reach a temperature higher than 80 °C. 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.

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

Important safety information

2. Before you disassemble any cooling water lines, leave the pump to cool down, shut off the feed line.
3. When you uninstall the cooling water lines, take note of splashing water. Heated water can cause burns.
4. 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.
5. 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.
6. Pumps without cooling water unit:
(Industrial versions) For these 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.

2.4 Hazards caused by materials and substances

WARNING: HAZARDOUS GASES



Risk of injury or damage to the equipment. The vacuum line and the exhaust line must be leak tight. 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 make sure that leaks at the pump will not be a hazard.

WARNING: CONTAMINATION HAZARD



Risk of exposure. 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. If the pump has been contaminated by the process or through environmental influences, it must be decontaminated professionally. When shipping contaminated pumps which require approval by the authorities, note the applicable regulations regarding packaging and shipping.

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.

Important safety information

1. Since not all application related hazards for vacuum systems can be described in detail in these operating instructions, we have made 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.

2. Before commissioning the pump, make sure that the media which are to be pumped are compatible with each other so as to avoid hazardous situations.
3. 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.

4. 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.
5. 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 also indicate the type of hazard. For this see [Service](#) on page 81.
6. We are 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.
7. When disposing of the pump, used lubricants and used oil filters observe the applicable environment regulations.
8. When pumping hazardous gases you must assume the presence of hazardous residues in the pump.
9. 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 the pump is removed from its packaging, start it up as quickly as possible. Solvents based on hydrofluorether compounds may be used as cleaning agents.
10. 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.

Important safety information

2.5 Ignition risk

WARNING: INTERNAL EXPLOSION



For conforming utilisation of the vacuum pump in explosion hazard areas, note the information given in Directive 1999/92/ EG of the European Parliament and of the Council. Laid down in this directive are the obligations of the employer as to the protection of employees working in explosion hazard areas. According to this directive, the system owner/operator must compile an explosion protection document in which explosion hazard areas are divided into specific zones.

The utilisation of the pump must be reviewed with respect to the necessary category, temperature class and explosion group. A gas which at typical process pressures is non-ignitable may, because of the pressure increase within the pump, ignite. The ignition limits for the gas which is to be pumped must be assessed with respect to this.

Note:

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.

1. The motor must only be operated in connection with a frequency converter as specified in the EC type approval certificate.
2. In order to avoid sparks caused by static charges, only approved types of oil which exhibit a minimum conductance level must be used.
3. Should the oil sight glasses break, oil and atmosphere capable of igniting can escape. Immediately shut down the pump and ensure that the pumped medium can no longer flow out.
4. The equipment must only be operated provided all oil fill and oil drain ports have been properly sealed.
5. Items or particles which enter into the pump present a potential ignition source and can for this reason severely damage the pump, including leaks towards the atmosphere.
6. We recommend installing a particle filter with a 40 µm mesh for operating the pump.
7. Prevent dust deposits so that the temperature will not increase to dangerous levels at the surface.
8. The frequency converters must not be installed in an explosion hazard area. This may lead to explosions. Always install the frequency converters in the safe area.
9. During work like fitting, providing electrical connections, repairs or when opening the housing ensure that
 - no atmosphere capable of exploding is present
 - no electric power remains applied
 - inadvertent powering up is prevented.
10. Modifications to the pump and the monitoring devices and facilities are prohibited.
11. The pump consists of two individual identical pumps operating in parallel. Because if one of the two pumps shut down during operation, the other pump must also be shut down immediately.

Important safety information

2.6 Noise hazard

The noise level of the pump during ultimate pressure operation with silencer or connected discharge line corresponds to the values stated in the [Technical data](#) on page 25. 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.

2.7 Dangers in connection with safety-related measures and precautions



WARNING: AUTOMATIC RESTART

Risk of injury and damage to the equipment. For the pumps being operated with a frequency converter, after a mains power failure the pump will automatically start up again once the power returns.

1. The pump is not equipped with an emergency shutdown facility.
2. If there is power supply failure for less than 2 seconds, the frequency converter will start again, if more than that the frequency converter will not start again.
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.

2.8 Danger of pump damage

1. Safe connection and Run-up:

The two screw pumps running in parallel must always run simultaneously. If one of the two screw pump fails due to a malfunction, and the other continues to run, the failed pump may suffer from turning backwards in an uncontrolled way. For this reason the DV pumps must be connected so that it is completely shut down when one of the screw pumps fails.

The speeds for the two screw stages should differ by no more than 5 Hz at the most. During run-up, and especially when starting cold, the two screw stages will not automatically run-up synchronously. We recommend programming of the start-up process so that the screw stages will run up in increments of 5 Hz or 10 Hz and then wait for each other before moving onto the next step.

2. Select an installation site for the pump so that all controls are easily accessible.
3. 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.

Important safety information

4. 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.
5. 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 process gas flow upstream with respect to the pump.
6. If low concentration corrosive or reactive gases are being pumped, then operate the pump with purge gas.
Consult us to determine which pump types are required for specific processes and applications.
7. 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.
8. 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.
9. 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.
10. 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.
11. 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.
12. 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.
13. 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.
14. 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.

Important safety information

15. If condensable vapours have been pumped, the pump should before switching off be purged for approximately 15 minutes with an inert gas or air (depending on the specific application). This process should also be run before cleaning the pump chamber.
16. Improper decommissioning of the pump may damage it. For this reason, follow the instructions given in [Shut-off and vent](#) on page 63 and [Remove from service](#) on page 64 of these operating instructions.
17. 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.
18. Maximum cooling water pressure: 7 bar. When exceeded, there is the risk of leaks.



Note:

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

3 Description

3.1 Design

The DRYVAC DV 1200 and DV 1600 are dry compressing screw vacuum pumps. They are equipped with two pump stages operating in parallel.

The DRYVAC is capable of delivering an optimised pumping speed performance also at pressures more than 100 mbar. These pumps are suited for both cyclic operation, in connection with load lock chambers, for example, and also for continuous operation as a process pump.

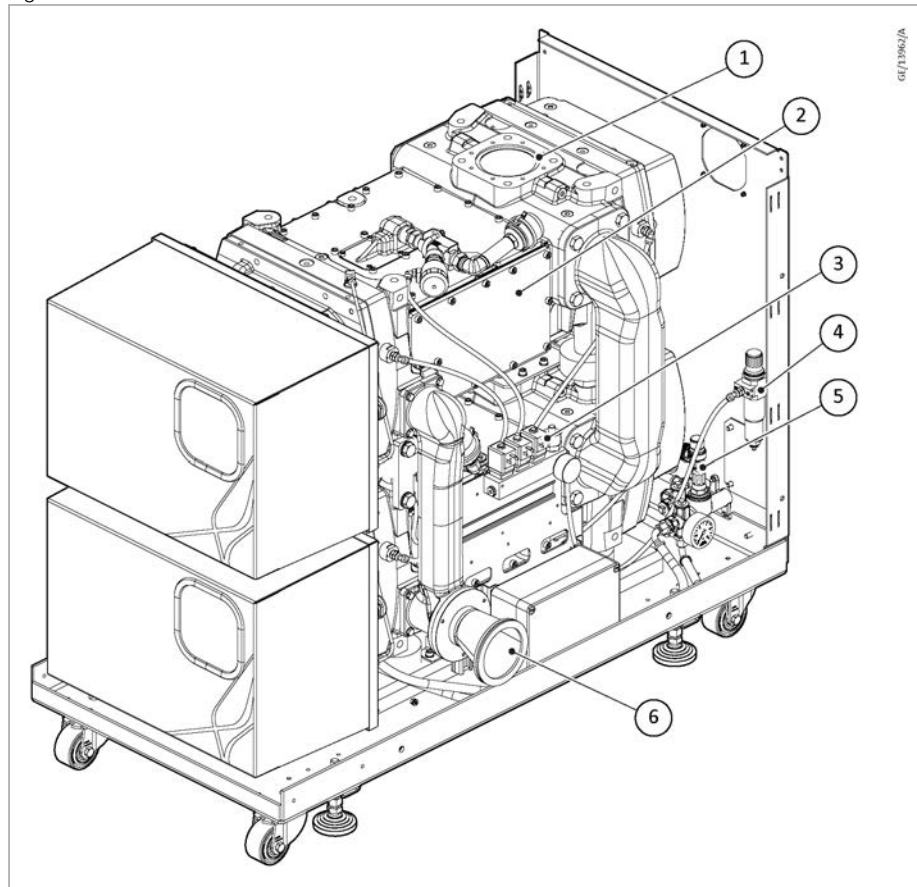
The pumps are equipped with a purge gas system which allows purging of the shaft seals (seal gas) and it is also equipped with an electro-pneumatically operated gas ballast.

The frequency converter necessary to operate the pumps, it is installed to the pumps and must be replaced by a frequency converter of the same type and parameterisation.

The pumps are approved for operation in connection with a Roots pump (RUVAC WH). The operating limits must be observed, in particular the permissible gas admission temperature. The pumps are water cooled. They are lubricated with synthetic oil.

Description

Figure 1. DRYVAC without side covers



- | | |
|--|---|
| 1. Inlet | 2. Pump stages: 2 screw pumps, pumping parallel |
| 3. Purge gas module | 4. Purge gas pressure setting and condensate vessel |
| 5. Cooling water pressure relief valve | 6. Exhaust |

3.2 Supplied equipment

- The pumps are filled with synthetic oil LEYBONOL LVO 210.
- The pumps are purged with nitrogen for protection against corrosion. The pump flanges have been blanked off with a sealing cap.
- 4x High-strength crane eyes M16
- Intake screen with O-ring

3.3 Conforming use

DRYVAC pumps with synthetic oil

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.

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 or consult us for details.

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 [Hazards caused by materials and substances](#) on page 15. When using the pumps in connection with oxidising or corrosive gases, check media compatibility first. Media compatibility and the 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 [Ordering Information](#) on page 82) for different application focuses.

DRYVAC pumps with PFPE

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

DRYVAC C

DRYVAC C pumps are process pumps also suited 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 us first.

3.3.1 Non-conforming use



WARNING: NON-CONFORMING USE

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

Non-conforming use for the pump are as follows:

- Operation with limit parameters which are not programmed by us, particularly the maximum speed.
- Pumping of gases and vapours for which the materials of the pump are not suited, consult us. For a list of materials in contact with the process gases, see [Technical data](#) on page 25.
- 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 us.
- Pumping of dusts and solids without suitable screens and filters, consult us.
- 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 absolute.

Description

- 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 us.



Note:

Accessories which have not been specified by us may only be used after approval by us.

4 Technical data

Table 1 Technical data

DRYVAC DV	DV 1600	DV 1200	Tolerance
Maximum pumping speed without gas ballast	1640 m ³ /h	1250 m ³ /h	± 5 %
Ultimate partial pressure			
Without purge gas or with purge gas for exhaust shaft seal purge	< 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 inlet shaft seal purge			
▪ (0.9 mm nozzle)	2.5 mbar		± 10 %
▪ (2.0 mm nozzle)	10.5 mbar		± 10 %
Maximum permissible inlet pressure	1050 mbar		-
Maximum permissible discharge pressure	1200 mbar		-
Integral leak rate	< 10 ⁻⁴ mbar l/s		-
Water vapour tolerance with exhaust shaft seal purge gas and gas ballast	60 mbar > 40 N l/min		-
Water vapour capacity	60 kg/h	50 kg/h	-
Gas inlet temperature	<i>Figure: Permissible gas inlet temperature as function of the inlet pressure</i>		-
Permissible ambient temperature	+5 to +40 °C		-
Storage temperature	-20 to +60°C		-
Contamination grade with/without purge gas module	2/3		-
Over-voltage category	3		-
Noise level with silencer, at ultimate pressure (according to DIN EN ISO 2151)	67 dB(A)		KpA = 3 dB
Noise level with rigid exhaust pipe, at ultimate pressure (according to DIN EN ISO 2151)	65 dB(A)		KpA = 3 dB
Relative atmospheric humidity	95%, non-condensing		-
Installation location	up to 2000 m (above sea level)*		-
Cooling	Water		-
Mains voltage ^{(1)/(2)}	380-460 V		± 10%
Frequency	50/60 Hz		± 5 %
Phases	3-phase		-
Rated motor power	39.2 kW	30 kW	± 0.8 kW
Rated current at 400 V	77 A	62 A	-
Motor efficiency class calculated and configured according to EN 60034-30	IE 3	IE 3	-
Power consumption at ultimate pressure	15 kW	13.8 kW	-

Technical data

DRYVAC DV	DV 1600	DV 1200	Tolerance
Electrical power rating	46 kVA	34 kVA	-
Mains fusing/characteristic at 400 V	100 A/C	63 A/C	-
Short-circuit interrupting capacity [†]	6 kA	10 kA	-
Connectable cable cross-section, maximum	35 mm ²	16 mm ²	-
Switching frequency of the frequency converter automatic switchover at low pump loads	8 kHz		-
Power supply for motor protection relay (SELV)	24 V a.c., 4 W		-
Speed	7200 RPM		-
Minimum permissible speed‡	1200 RPM		-
Protection class	IP 54		-
Lubricant filling	LVO 210		-
Total lubricant quantity	2.4 l		± 5 %
Intake flange	DN 100	DN 100	-
Discharge flange	DN 100 ISO-K		-
Materials			-
components in contact with gas in the pump chamber	Grey cast iron/graphite cast iron/FKM/steel/stainless steel/epoxy paint		-
Materials sealing the pump off in the pump chamber towards the outside	FKM, grey cast iron		-
Weight, approximate	1400 kg		± 30 kg
Dimensions (L x W x H)	1450 x 660 x 1050 mm	Refer Figure: Dimensional drawing	± 10 mm
Water			-
Water connection	G1/2" (female)		-
Water temperature	> 5 °C, < 35 °C		-
Minimum supply pressure	2 bar(g)** (unobstructed discharge, no backpressure)		-
Maximum supply pressure	7 bar(g)**		-
Nominal flow	20 l/min	15 l/min	-
Purge gas			-
Connection	plug-in connection D10		-
Nominal setting pressure purge gas (at nominal flow, valves open)	3.5 bar(g)**		± 5 %
Permissible setting pressure purge gas (at purge gas flow)	3.0 to 3.5 bar(g)**		± 5 %
Permissible supply pressure Purge gas	4.0 to 10.0 bar(g)**		± 5 %

Technical data

DRYVAC DV	DV 1600	DV 1200	Tolerance
Purge gas flow at nominal setting pressure Inlet shaft seal purge (d = 2.0 mm) Exhaust shaft seal purge (d = 0.9 mm)	170 slm 44 slm		± 10 %
Pilot valve gas ballast	On request		± 10 %

* 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.

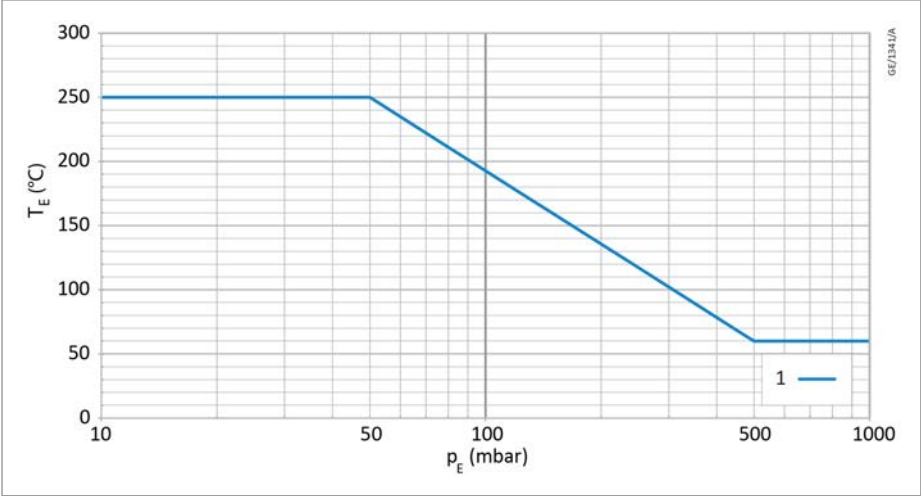
(2) Mains power grids: TN Systems, TT systems (earthing at the star point), for other types of mains power grid please consult us.

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

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

Technical data

Figure 2. Permissible gas inlet temperature as function of the inlet pressure



1. Permissible range: under the curve.

For $50 \text{ mbar} \leq p_E \leq 500 \text{ mbar}$ applies:

$$T_E = -190 \cdot \lg(p_E) + 572.8 \text{ in } ^\circ\text{C}$$

P_E	T_E
(mbar)	(°C)
<50	250
50	250
75	217
100	193
125	174
150	159
200	136
250	117
300	102
350	89
400	79
450	69
500	60
>500	60

5 Transport



WARNING: SUSPENDED LOAD

Risk of injury and damage to equipment. High-strength crane eyes only must be used. These have been included with the pump and need to be retained for later use.



Note:

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

Refer to [Figure: Lifting the DRYVAC](#).

Lift the pump at the crane eyes. Use all crane eyes. The pump can also be transported with a fork lift. Make sure that it cannot tip over.

Pumps with castors

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

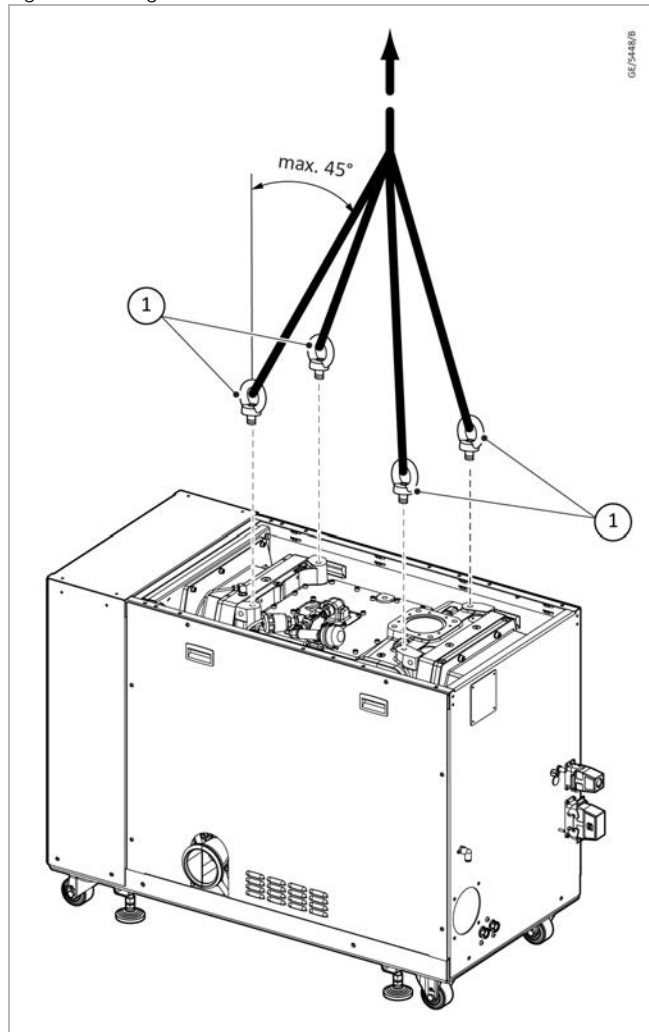
Moving the pump on slopes or ramps is not allowed.

The pump must only be transported using a fork lift 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

Figure 3. Lifting the DRYVAC



1. Crane eyes (4 off)

6 Installation

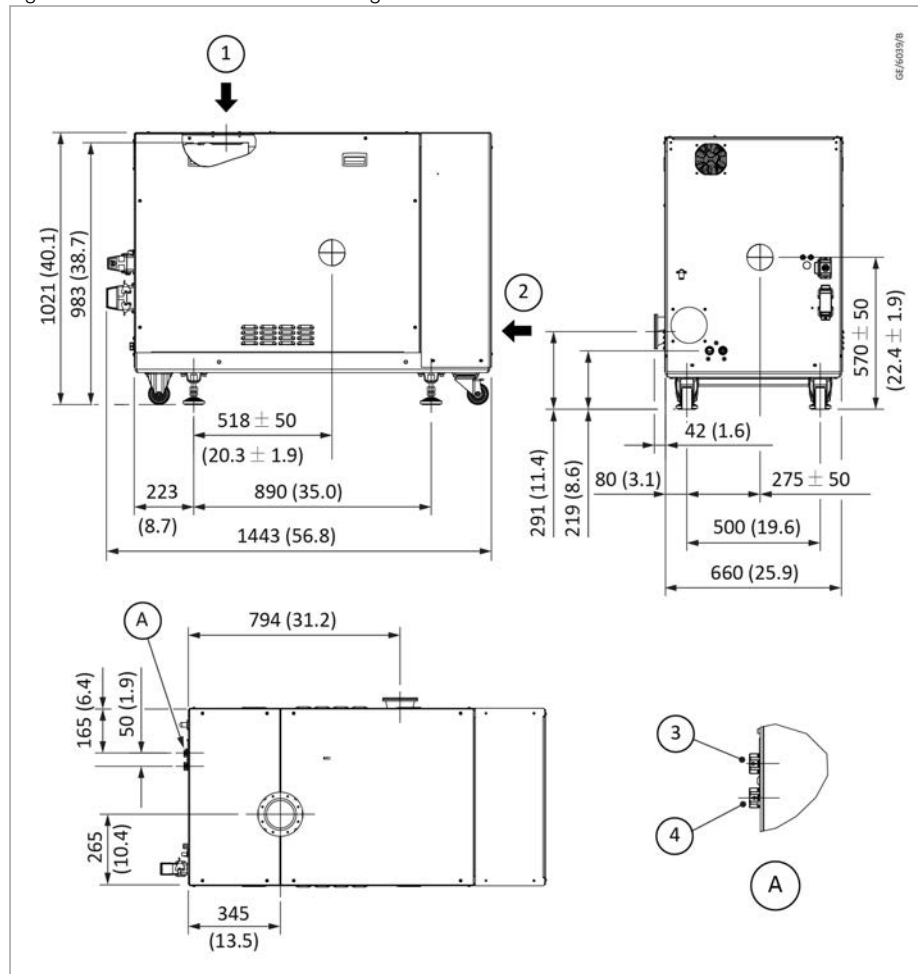
6.1 Dimension drawings



Note:

All dimensions given are in mm (inch).

Figure 4. DV 1200 Dimensional drawing



- | | |
|-----------------------------------|------------------------------------|
| 1. Inlet | 2. Outlet |
| 3. Water distribution inlet G1/2" | 4. Water distribution outlet G1/2" |

Installation

Figure 5. DV 1600 Dimensional drawing

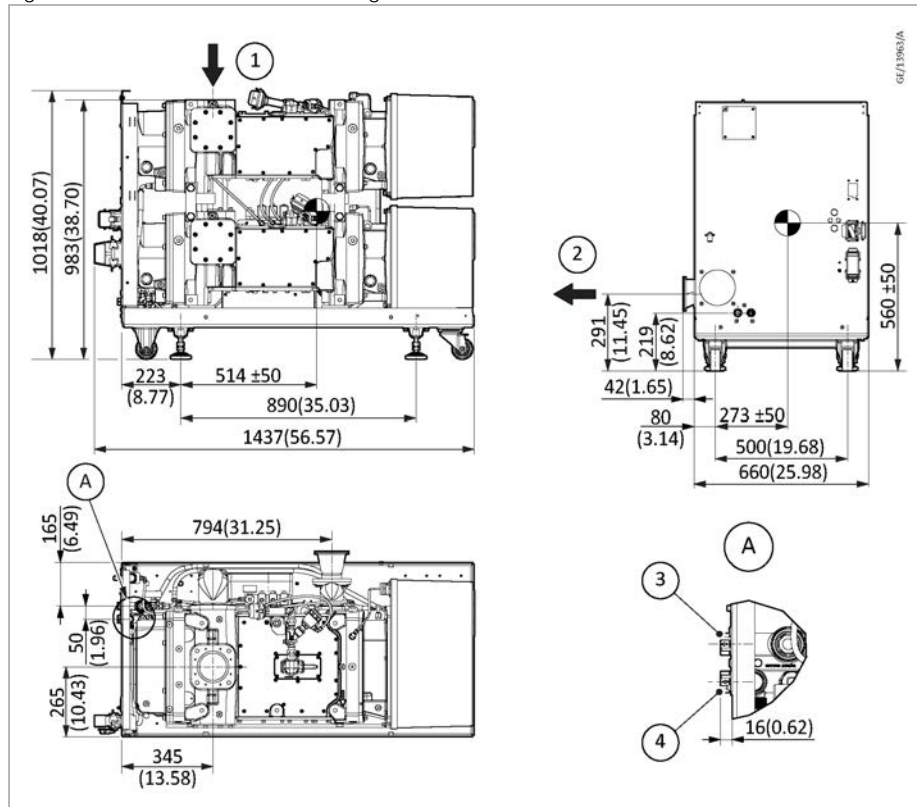
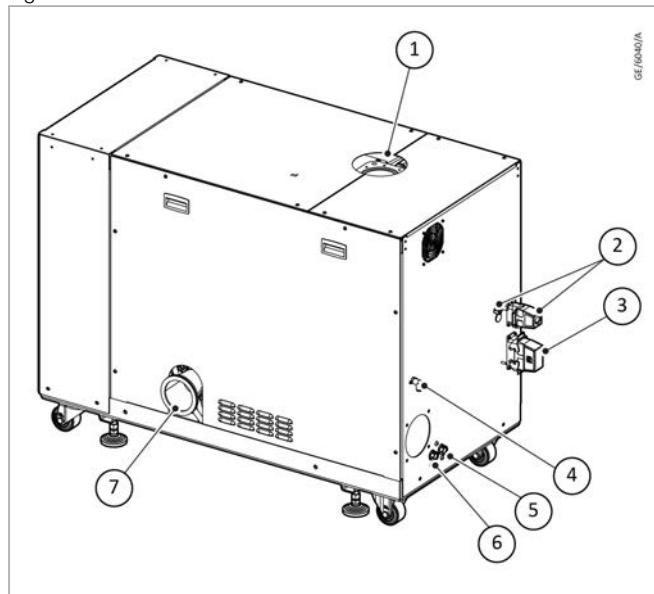


Figure 6. Connections for the DRYVAC



6.2 Placement

Place the pump system on a flat and levelled 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, first note the information given in [Mounting accessories](#) on page 50.

Oil level in the DRYVAC oil glasses

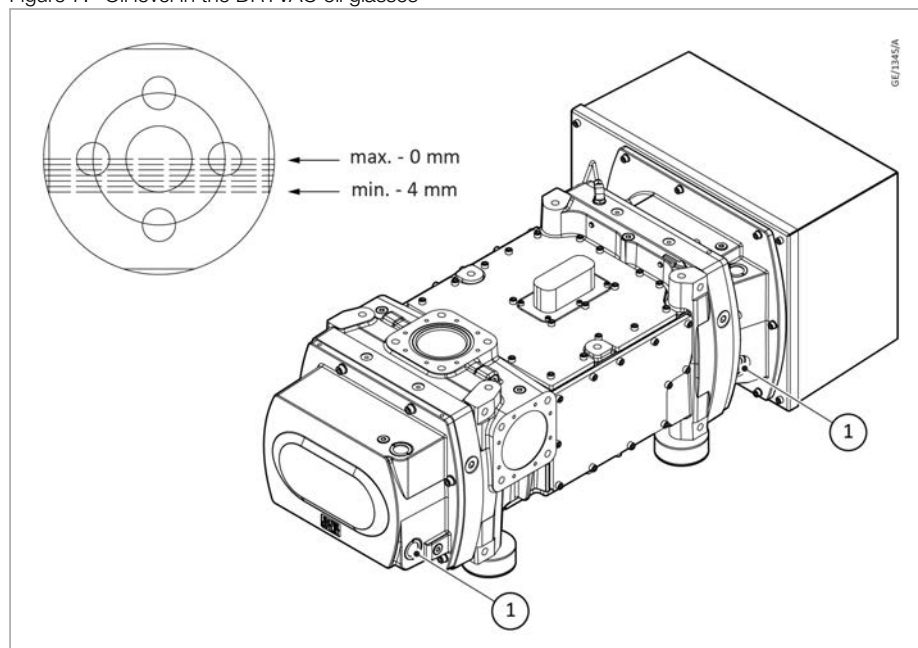
Refer to [Figure: Oil level in the DRYVAC oil glasses](#).

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, contact us.

Installation

Figure 7. Oil level in the DRYVAC oil glasses



1. Oil level glass

Table 2. Oil level during operation

Parameter	Maximum	Minimum
Gear side	-6 mm	-10 mm
Motor side	-3 mm	-7 mm



Note:

The oil level shown is applicable when the pump is at standstill.
Purge gas or gas ballast valves and cooling water unit are not shown.

6.3 Connect the intake and exhaust lines

6.3.1 Intake lines



WARNING: FAILURE OF BELLOWS

Risk of injury or damage to equipment. 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.

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

Support the intake lines.

The intake lines must be clean.

Connect the intake flange either with intake screen.



Note:

Make sure that no items like welding beads, bolts, nuts, washers, pieces of wire, for example, enter into the inlet. Observe safety information given in [Danger of pump damage](#) on page 18.

6.3.2 Exhaust lines



WARNING: LEAK TIGHTNESS

Risk of injury and damage to equipment. Check leak tightness of the exhaust lines on a regular basis. Observe safety information given in [Hazards caused by materials and substances](#) on page 15.

Observe safety information given in [Mechanical hazards](#) on page 12.

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

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

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

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

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

Keep the exhaust line free of deposits. If the exhaust flow becomes restricted, deposits could collect in the 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.



Note:

In the case of wet processes avoid the ingress of any liquid into the pump. Observe safety information given in [Danger of pump damage](#) on page 18.

6.4 Cooling water connection



CAUTION: SHOCK COOLING

Risk of crash. 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.

Observe safety information given in [Thermal hazards](#) on page 14.

Refer to [Table: Cooling water data for the pump](#).

Connect the cooling water and make sure 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.

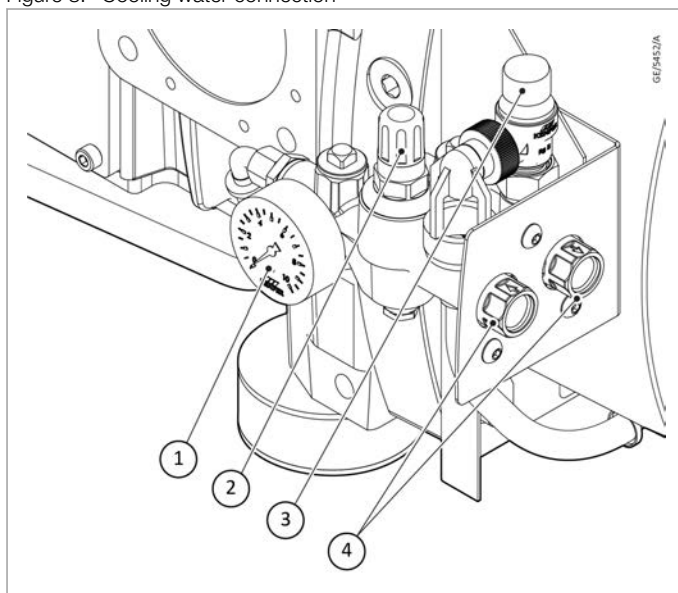
Select a nominal width which is as wide as possible so as to avoid pressure losses especially for the discharge (flow velocity below 2 m/s).

The temperature of the discharged cooling water must not exceed 55 °C as otherwise the lines will tend to calcify.

Installation

Make sure cooling water flow is adequate in accordance with the technical data.

Figure 8. Cooling water connection



- | | |
|-----------------------------------|-----------------------------|
| 1. Pressure gauge | 2. Pressure reducer |
| 3. Pressure relief valve 8 bar(g) | 4. Cooling water connectors |

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

Table 3 Cooling water data for the pump

Type	Power loss to be dissipated by the cooling water	Cooling water demand at feed temperature*			
		(Assuming a constant discharge temperature of 55 °C)			
		30 °C to 35 °C	25 °C to 30 °C	20 °C to 25 °C	< 20 °C
	kW	l/min	l/min	l/min	l/min
DV 1200	21	15.0	12.8	10.0	8.6
DV 1600	24	20	20	20	20

* It is possible to add 30% of glycol mixture to the operation of the cooling water circuit.



WARNING: HOT SURFACE

Risk of injury or damage to the equipment. Observe the safety information given in [Thermal hazards](#) on page 14.

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.

6.4.1 Water quality

To make sure long trouble-free operation the cooling water must not contain any oils, greases and suspended solids. Moreover, we recommend compliance with the limit values given in [Table: Water quality](#).

Table 4. Water quality

Parameter	Value
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
Sulphate	< 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



Note:

8 °dH (degrees German hardness) = 1.4 mmol/l

= 10 °e (degrees English hardness)

= 14 °f (degrees French hardness)

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

6.5 Connect the purge gas

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

- To the shaft seal on the motor side (inlet shaft seal purge)
- Into the pumping chamber (rotor purge)
- To the shaft seal on the gear side(exhaust shaft seal purge)

At the 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).

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

Gas temperature	0 to +50 °C
Filter size	40 µm
Maximum 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.

Installation

Make sure 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, polybuteneterephthalate (PBT), NBR, polyamide tube, copper, stainless steel, PTFE, Loctite.

The pressure reducer is set to 3.5 bar at nominal flow (valves open) on delivery. This is also the maximum pressure which can be set up. The inlet shaft seal purge therefore amounts to at least 80 slm per individual pump. To adjust, pull the adjustment knob to the top. Inherent to its functional principle, the pressure with closed valves is always higher than with flow. A pressure loss of up to 0.5 bar can be expected. i.e. if the pressure is set to 2.5 bar with closed valves, the pressure switch may signal a fault. In this case set the pressure moderately higher.

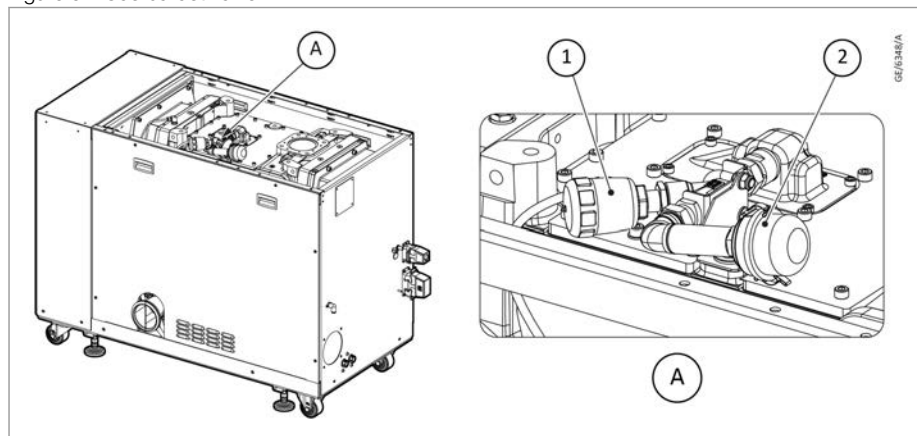
See [Electrical connection](#) on page 42 for the connection of the pressure switch and the solenoid valves.

6.6 Gas ballast valve

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.

Figure 9. Gas ballast valve



1. Gas ballast valve

2. Gas ballast filter (ambient air)

6.7 Guidelines for purge gas operation, settings and monitoring



CAUTION: AIR PURGE

Risk of injury or damage to equipment. The safety always has to be considered (be careful with air purges and read our safety booklet).



Note:

Possible purge gases are N_2 and Compressed Dry Air (CDA) only.

Exhaust shaft seal purge is running in most of all applications all the time.

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 results in: $p_{\text{end}} < 1 \times 10^{-2}$ mbar for air or N_2 .

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 to 30 minutes after stopping the pump. This cleans and dries out the exhaust.
- If you want to operate without exhaust shaft seal purge contact our 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 ($p_{\text{inlet}} < 10$ mbar):
- 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 maximum gas ballast flow results in: $p_{\text{end}} \geq 1 \times 10^{-1}$ 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 ~ 180 slm of gas flow.

Note:

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.

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.

Installation

- 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 shaft seal 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.

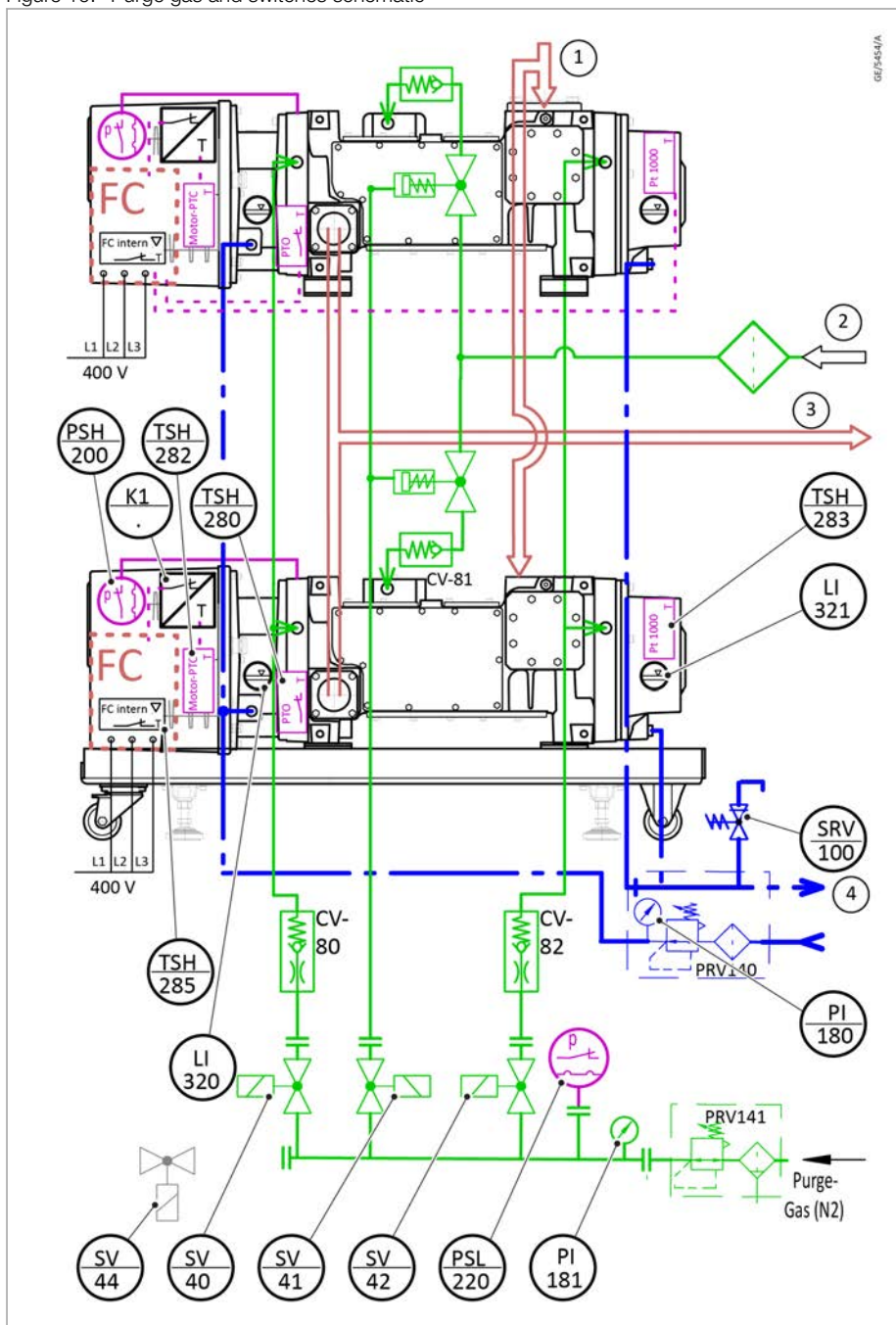
With the accessory “Permanent inlet purge kit”, the inlet side of the DRYVAC pump may be protected against being contaminated. This is effected by a permanent, comparatively small purge flow (0.5 slm). For this, the permanent inlet purge kit is so connected that it is always opened when also the exhaust shaft seal purge (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 (refer to [Figure: Purge gas and switches schematic](#)) 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.

Installation

Figure 10. Purge gas and switches schematic



Designation	Description
1	Process in
2	GB air
3	Process out
4	Cooling water
TSH	Temperature Switch High
280	PTO
282	Motor PTC
283	Pt 1000 Gear Flange
285	Temperature Switch High

Installation

Designation	Description
	Temperature limiter motor housing
K1	Motor protection relay
PSH 200	Pressure Switch High Exhaust 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 44	Solenoid Valve Exhaust shaft seal purge Rotor purge Inlet shaft seal purge Optional flushing
PI 180 181	Pressure indicator Water Nitrogen
PRV	Pressure Regulator (Filter)
SRV	Safety relief valve 8 bar(g)
CV	Check valve

* Opening of these valves will impair the ultimate pressure, refer [Technical data](#) on page 25.

6.8 Electrical connection

WARNING: ELECTRICAL HAZARD

Risk of injury or damage to equipment. Observe safety information given in [Electrical hazards](#) on page 13.



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, refer [Technical data](#) on page 25.
- If using a ground fault circuit breaker, make sure that it can detect both d.c. 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 mm² or connect a further protective ground conductor having at least the same cross-section as the connection cable. A connection point is provided, refer [Figure: Establishing the potential equalisation at the pump casing](#).
- 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.

EMC filter



WARNING: EMC FILTER SWITCH

Risk of serious injuries or death. Ground the neutral point on the power supply to comply with the EMC Directive before turning on the EMC filter or if there is high resistance grounding.

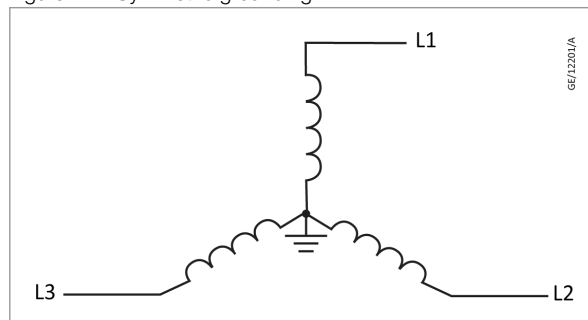


CAUTION: NON-GROUNDING NETWORK

Risk of damage to the equipment. When using a drive with a non-grounding network, high resistance grounding or asymmetric grounding network, place the screw for the EMC filter switch in the OFF position and disable the built-in EMC filter. Failure to comply could cause damage to the drive.

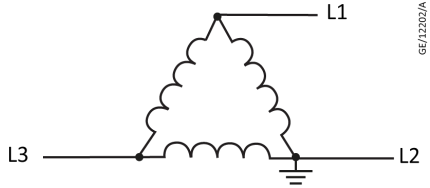
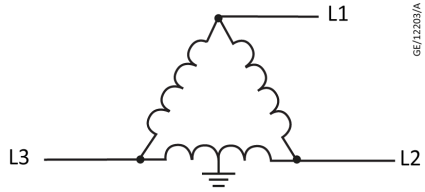
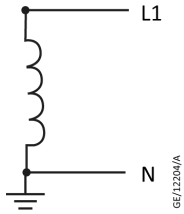
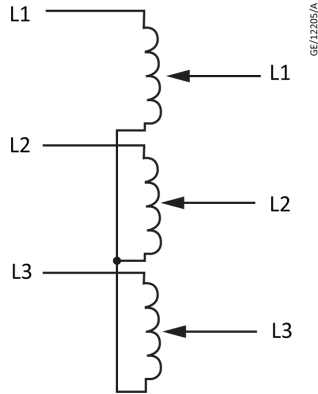
The drive has a built-in EMC filter. It is delivered with EMC Filter active for internal FC and deactivated for external FC. On the drive, move the screw position to switch ON (enable) and OFF (disable) the EMC filter. Make sure that the symmetric grounding network is applied when you install the screw in the ON position to enable the built-in EMC filter in compliance with the EMC Directive.

Figure 11. Symmetric grounding



Installation

Table 5. Asymmetric grounding

Type of grounding	Diagram
Grounded at the corner of the delta connection	 GE/12202/A
Grounded at the middle of the side	 GE/12203/A
Single-phase, grounded at the end point	 GE/12204/A
Three-phase variable transformer without solidly grounded neutral	 GE/12205/A

The screw size of the EMC switch is M4 x 20 with tightening torque 1.0 - 1.3 Nm.

The two individual screw pumps are connected within the housing. Three interfaces must be connected:

- Mains connection
- 24 V d.c voltage supply for Valves, pressure switch and genius box, refer to [Figure: Wiring of the valve, pressure switch and power supply customer interface](#).
- Refer to [Figure: Profibus connection](#).

Connector-Mains/Supply - Type for up to 60/63 A (Fuse) for DV1200:

- Maker: Harting Type: Han K4/2 Order No .09 38 006 2701, 09 14 001 3131, 09 14 016 0361, 09 11 000 6213 Female insert, 4 pole+PE, Type: Han (16B) Order No.: 19 30 016 0528 Connector housing for M40 cable fitting (or equivalent type)
- The system must only be operated off a three-phase mains power supply of 380-480 V a.c., 50/60 Hz with PE conductor.
- Pin 1 = L1 (R), Pin 2 = L2 (S), Pin 3 = L3 (T), PE terminal = PE (Earth).
- Neutral (N) must not be used.

Connector-Mains/Supply - Type for up to 80 A (Fuse) for DV1600:

Han-Modular 100 A Type:

- 1x 09 14 001 2733 - Han PE module female axial 16-35 qmm
- 3x 09 14 001 3131 – Han 100 A single module female
- 3x 09 11 000 6213 – Han TC100 female contact axial 16-35 qmm
- 1x 09 14 016 0361 – Han hinged frame plus for 4 modules A-D
- 1x 19 30 016 0528 – Han 16B Hood side entry M40

The system must be operated with a three-phase mains power supply of 380-480 V a.c., 50/60 Hz with PE conductor.

- Pin 1 = L1 (R), Pin 2 = L2 (S), Pin 3 = L3 (T), PE terminal = PE (Earth).
- Neutral (N) must not be used.

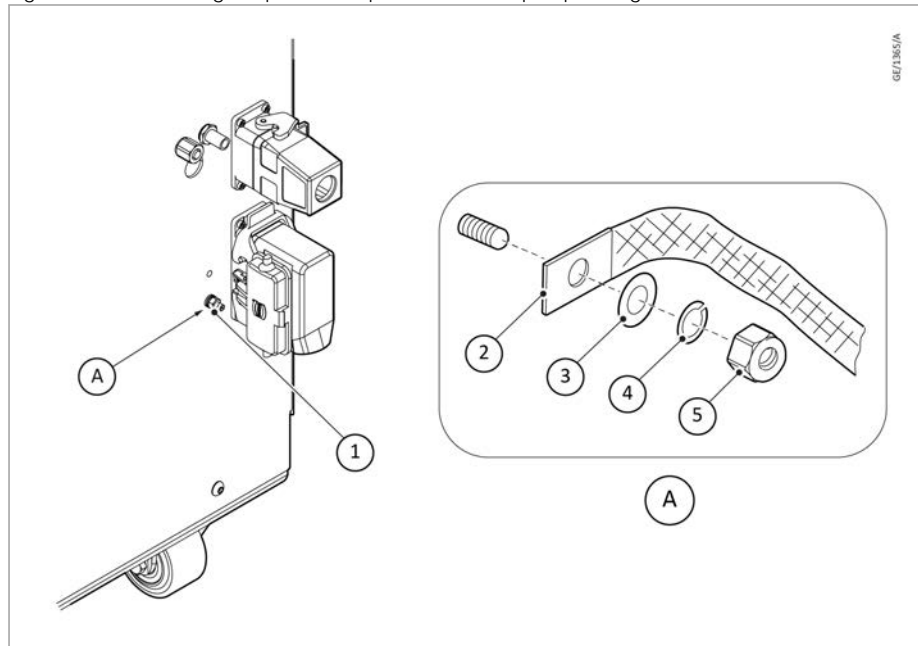
Protective potential equalisation

In addition to the protective ground connection, an additional M6 thread is available for connection of a separate ground connection (example for functional grounding).

Connect the potential equalisation conductor as shown in [Figure: Establishing the potential equalisation at the pump casing](#).

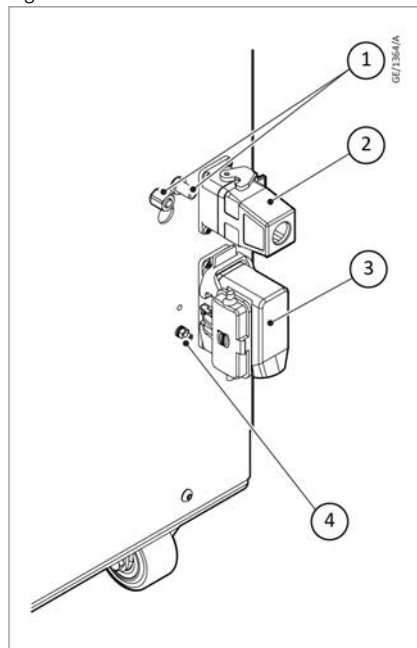
Installation

Figure 12. Establishing the potential equalisation at the pump casing



- | | |
|----------------|-------------------------------|
| 1. Ground bolt | 2. Copper strap (for example) |
| 3. Washer | 4. Elastic element |
| 5. Nut M6 | |

Figure 13. Electrical connections



- | | |
|--|--|
| 1. Field-bus interface | 2. 24 V Interface valves and pressure switch |
| 3. Mains connection | 4. Ground bolt |
| 24 V Interface (2) Harting Connection-Plug included in scope of delivery | |

Installation

Figure 14. Wiring of the valve, pressure switch and power supply customer interface

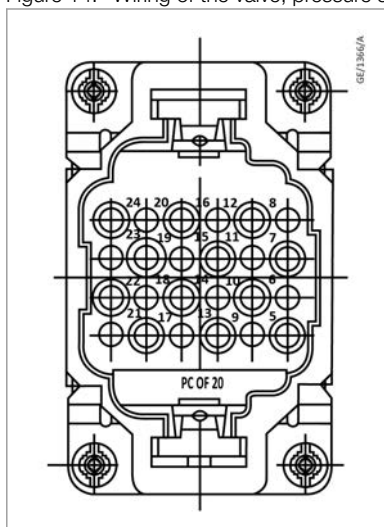


Table 6. Connector HAN 24DD-M-c

Pin	Designation	Function	Potential
1	Valve SV40	Exhaust shaft seal purge	+24 V d.c./8 W
2	Valve SV41	Gas ballast	+24 V d.c./8 W
3	Valve SV42	Inlet shaft seal purge	+24 V d.c./8 W
4	Not connected	-	-
5	Valve SV40	Exhaust shaft seal purge	0 V
6	Valve SV41	Gas ballast	0 V
7	Valve SV42	Inlet shaft seal purge	0 V
8-10	Not connected	-	-
11	K1 (Pump 1)	Thermal motor protection relay for PTC	+24 V d.c./2 W
12	K2 (Pump 2)	Thermal motor protection relay for PTC	+24 V d.c./2 W
13	Pressure switch P1.1	Power supply	+24 V d.c./4 W
	Genius Instant Insight Box	Power supply	+24 V d.c./28 W
14	Not connected	-	-
15	K1 (Pump 1)	Thermal motor protection relay for PTC	0 V
16	K2 (Pump 2)	Thermal motor protection relay for PTC	0 V
17	Pressure switch P1.1	DO = switched output	0 V
18-20	Not connected	-	-
21	Pressure switch P1.1	DO = switched output	+24 V d.c./max. 2.5 W

Installation

Pin	Designation	Function	Potential
22-24	Not connected	-	-
PE	Valve SV40	Exhaust shaft seal purge	-
PE	Valve SV41	Gas ballast	-
PE	Valve SV42	Inlet shaft seal purge	-



Note:

Pin E / PE Earth / Frame-Ground

SELV power supply (+24 V d.c., 0 V and PE) is provided externally.

Voltage tolerance $\pm 10\%$

Maximum short-circuit protection for the power supply:

- Valves 6 A

- Pressure switch and motor protection relay: 3 A

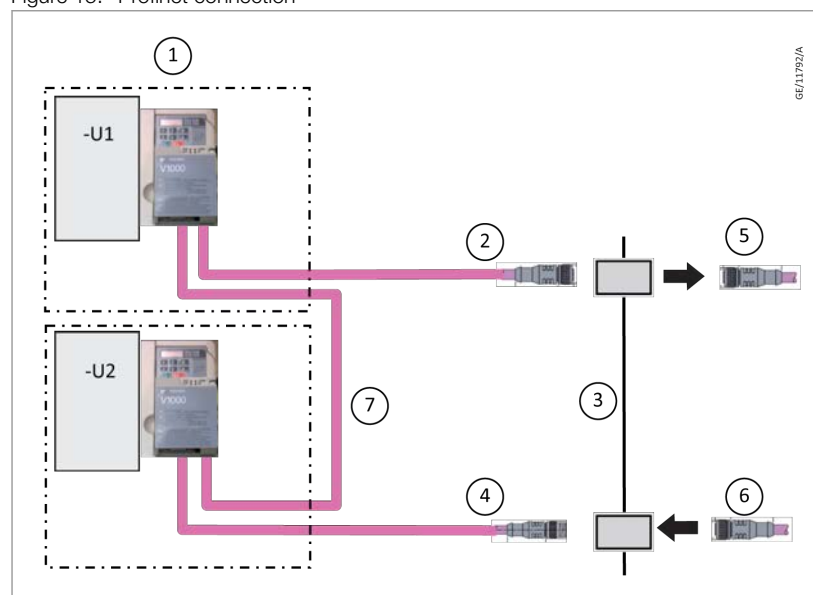


Note:

The motor protection relay and the related wiring must not be modified.

In particular, the selector switch must remain set to "Auto". After a high temperature condition has been detected, and after having left the motor to cool down, start the frequency converter again so as to acknowledge the error. Before switching on, check the operating conditions for the pump (cooling water, for example).

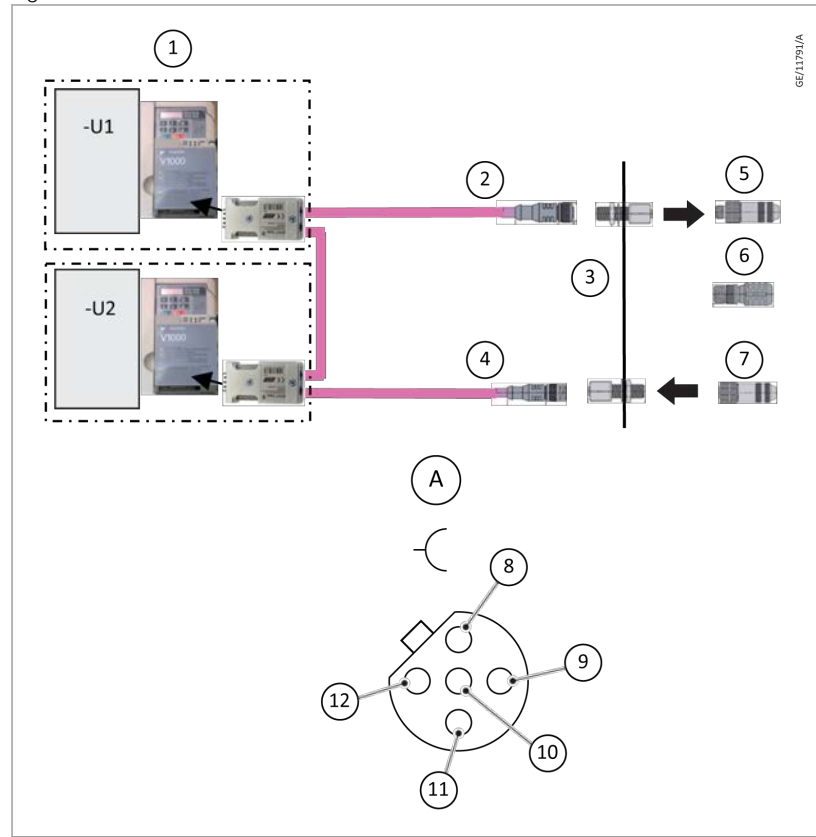
Figure 15. Profinet connection



1. DRYVAC with Profinet module
3. Profinet feedthrough
5. Male connector
7. 3 m patch cable

2. 3 m patch cable
4. 3 m patch cable
6. Male connector

Figure 16. Profibus connection



- A. Pin assignments
- B. DRYVAC with Profibus module
- C. Prepared bus cables for PROFIBUS-DP RKS451-XXm
- D. PROFIBUS feedthrough 2x FKW FSW 45/M12
- E. Prepared bus cables for PROFIBUS-DP RSS451-XXm
- F. Profibus plug customer - Male
- G. Profibus plug customer - Terminal resistor
- H. Profibus plug customer - Female
- I. GN (Bus A)
- J. 3 n.c.
- K. Shield
- L. RD (Bus B)
- M. n.c.

6.9 Leak search after installation

Observe safety information given in [Hazards caused by materials and substances](#) on page 15.

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.

Installation

6.10 Mounting accessories

6.10.1 Non-return valve



CAUTION: NON-RETURN VALVE

Risk of injury or damage to equipment. Note the safety information provided in [Mechanical hazards](#) on page 12, [Thermal hazards](#) on page 14 and [Hazards caused by materials and substances](#) on page 15.

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.

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

Installation

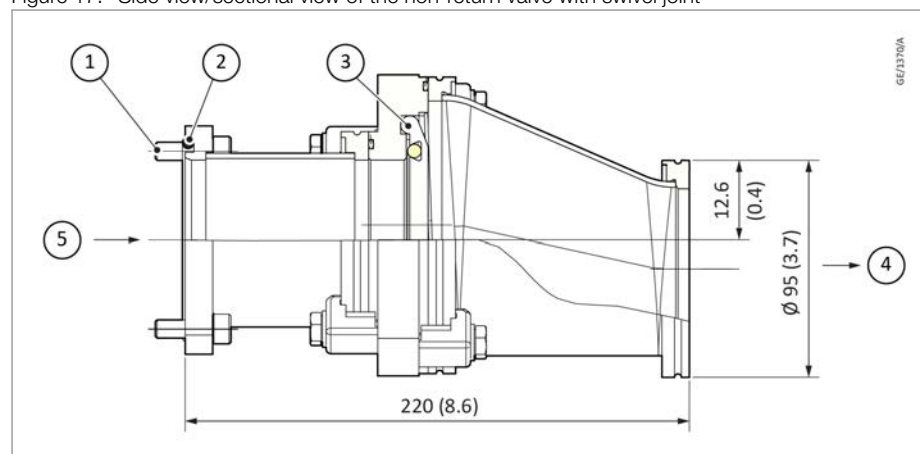
Note the installation position for the non-return valve, see [Figure: Side view/sectional view of the non-return valve with swivel joint](#). The swivel joint of the valve must be located at the top. The valves must open in the direction of the gas flow.

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.

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.

Figure 17. Side view/sectional view of the non-return valve with swivel joint



- | | |
|----------------------|-----------------|
| 1. M8 mounting bolts | 2. O-ring |
| 3. Swivel joint | 4. Exhaust line |
| 5. DRYVAC | |

7 Operation



CAUTION: NOISE HAZARD

Hearing loss due to high noise level. The pumps are designed for installation in connection with a higher level system controller. Only checks on a regular basis within the scope of a maintenance schedule need to be run at the installation place of the pump. Take suitable hearing protection measures.

7.1 Media compatibility

Refer [Conforming use](#) on page 22. For a list of materials in contact with the process gas, refer [Technical data](#) on page 25.

7.2 Field-bus interface

For installation and operation of the optional bus interfaces, please refer to the instructions of YASKAWA enclosed with the module.

For operating instructions regarding Field-bus interfaces, refer to the bus interface manual (Publication number - 301076031 and 301178727).

The manual information is valid except from the following:



CAUTION: PUMP DAMAGE

The two screw pumps running in parallel must always run simultaneously. If one of the two screw pump fails due to a malfunction, and the other continues to run, the failed pump may suffer from turning backwards in an uncontrolled way. For this reason the DV pumps must be connected so that it is completely shut down when one of the screw pumps fails.

The speeds for the two screw stages should differ by no more than 5 Hz at the most. During run-up, and especially when starting cold, the two screw stages will not automatically run-up synchronously. We recommend programming of the start-up process so that the screw stages will run up in increments of 5 Hz or 10 Hz and then wait for each other before moving onto the next step.

MEMOBUS/Modbus Message

MEMOBUS/Modbus Message is not active.

Table 7 Basic Data Register Map Detail

Output		Input	
Byte	Description	Byte	Description
0	Operation Command High Byte	0	Drive Status High Byte
1	Operation Command Low Byte	1	Drive Status Low Byte
2	Frequency setpoint High Byte*1	2	Motor Speed High Byte*1
3	Frequency setpoint Low Byte*1	3	Motor Speed Low Byte*1

Operation

Output		Input	
Byte	Description	Byte	Description
4	Reserved	4	Output Current High Byte*2
5	Reserved	5	Output Current Low Byte*2

* 1. The unit is 0.01 Hz

* 2. The unit is 0.01 A for drives set up to 11 kW in Heavy Duty or Normal Duty and 0.1 A for drives set up for 15 kW and above.

Table 8 Extended Data 1 Register Map

Output		Input	
Byte	Description	Byte	Description
0	Operation Command High Byte	0	Drive Status High Byte
1	Operation Command Low Byte	1	Drive Status Low Byte
2	Frequency setpoint High Byte*3	2	Motor Speed High Byte*3
3	Frequency setpoint Low Byte*3	3	Motor Speed Low Byte *3
4	Reserved	4	Torque Reference Monitor High Byte *4
5	Reserved	5	Torque Reference Monitor Low Byte *4
6, 7	Reserved	6, 7	Reserved
8	Reserved	8	Frequency setpoint High Byte
9	Reserved	9	Frequency setpoint Low Byte
10	Analog Output Channel 1 High Byte *1	10	Output Frequency High Byte
11	Analog Output Channel 1 Low Byte *1	11	Output Frequency Low Byte
12	Reserved	12	Output Current High Byte *5
13	Reserved	13	Output Current Low Byte *5
14	Digital Output High Byte *2	14	Reserved
15	Digital Output Low Byte *2	15	Reserved

* 1. To select drive analog output channel for communications, set H4-01 (Multi-Function Analog Output Terminal AM) to 31 (Not used).

* 2. Drive digital output ON/OFF during communications, set H2-01 (Terminal MA, MB and MC Function Selection (relay)), H2-02 (Terminal P1 Function Selection (open collector)), and H2-03 (Terminal P2 Function Selection (open-collector)) to F.

* 3. The unit is 0.01 Hz

* 4. Cannot be used when setting A1-02 (Control Method Selection) to 0 (V/f Control without PG).

* 5. The unit is 0.01 A for drives set up to 11 kW in Heavy Duty or Normal Duty and 0.1 A for drives set up for 15 kW and above.

Table 9 Extended Data 2 Register Map

Output		Input	
Byte	Description	Byte	Description
0	Operation Command High Byte	0	Drive Status High Byte
1	Operation Command Low Byte	1	Drive Status Low Byte

Operation

Output		Input	
Byte	Description	Byte	Description
2	Frequency setpoint High Byte*1	2	Motor Speed High Byte*1
3	Frequency setpoint Low Byte*1	3	Motor Speed Low Byte*1
4 to 11	Reserved	4 to 11	Reserved

*1. The unit is 0.01 Hz

Table 10 Operation command

Byte	Command bits	Description
Byte 1	0	Start/Stop (1 = Start, 0 = Stop)
Byte 1	1 to 7	Reserved
Byte 0	8	Reserved
Byte 0	9	Reset
Byte 0	A to F	Reserved

Basically set reserved bits to 0

Table 11 Drive Status

Byte	Command Bits	Description
Byte 1	0	Pump rotating
Byte 1	1	Pump stands still
Byte 1	2, 3	Reserved
Byte 1	4	Normal operation (frequency setpoint reached)
Byte 1	5	Drive ready (ready to start, no fault)
Byte 1	6	Alarm
Byte 1	7	Fault
Byte 0	8 to F	Reserved

Example for control data in the “Basic data” format:

Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
0000 0000	0000 0000	1101 1000	0010 1110	0000 0001	0000 0000
Reserved	Reserved	Frequency set-point low byte	Frequency set-point high byte	Start	Reset

In addition to the start bit, a speed in the range of 10 to 120 Hz must be set. (2E D8hex = 119.92 Hz).

Operation

Example for status data in the “Basic data” format:

Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
0111 0110	0000 0111	1101 1000	0010 1110	0011 0001	0000 0000
Actual motor current low byte (07 76hex = 19.10 A)	Actual motor current high byte	Actual frequency low byte	Actual frequency high byte	0 Fault	Reserved
				0 Alarm	
				1 Pump ready	
				1 Normal operation	
				0 Reserved	
				0 Reserved	
				0 Pump stands still	
				1 Pump rotating.	

Example for reading out the pump temperature via the Profibus

Applies to control data in the “Extended Data 1” format only:

Byte 32	Byte 20	Byte 19	Byte 18	Byte 17	Byte 16
1000 0000	0000 0000	0000 0010	0110 0010	0000 0110	0000 0011
Bit for data updating	Reserved	Number of 2 bytes	662 hex parameter	Number	Read parameter

Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
0000 0000	1101 1000	0010 1110	0000 0000	0000 0000
Reserved	Frequency setpoint low byte	Frequency setpoint high byte	Start	Reset

Explanation: through a parameter channel it is possible to query in the control word the parameter X662 hex which represents the pump temperature and read out in the bytes 20/21 the status data. By activating, respectively deactivating the seventh bit in the last byte of the control data, the temperature value in the status data is updated.

Example for status data in the “Extended Data 1” format:

Byte 21	Byte 20	Byte 19	Byte 18	Byte 17	Byte 16
0001 1010	0000 0000	0000 0010	0110 0010	0000 0110	0000 0011
Temperature low byte 1A = 26 °C	Temperature high byte	Number of 2 bytes	662 hex parameter	Number	Read parameter

Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
0000 0000	1101 1000	0010 1110	0000 0000	0000 0000
Actual motor current high byte	Actual frequency low byte	Actual frequency high byte	0 Error	Reserved
			0 Warning,	
			1 Pump ready	
			1 Normal operation	
			0 Reserved	

MEMOBUS/Modbus Message Area

MEMOBUS/Modbus Message Area is not active.

Handshaking Register

Handshaking Register is not active.

7.3 Start-up



WARNING: EXPLOSION HAZARD

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



WARNING: HOT SURFACE

Risk of hot surface. Observe the safety information given in [Thermal hazards](#) on page 14.

The operator must only commission the vacuum pump after having ensured that the operation monitoring devices are properly installed and connected, and after having ensured also that the stated switching conditions have been implemented in the controller and properly tested.

Operation of the pump is only permissible provided compliance with the gas inlet temperature is ensured corresponding to the [Technical data](#) on page 25.

Do the checks before every start-up as follows:

- If the pump system is leak tight.
- Close all protective covers.
- Open the exhaust lines.
- Open the purge gas supply if connected.
- Open the cooling water return and supply.
- Switch on the main switches.
- Check messages on the frequency converter display.

Start the pump. It is ready for operation after 5 minutes.

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

7.4 Pump control connections

Depending on the connection, the pumps are operated through the Field-bus. For the information about remote control connections refer to the [Electrical connection](#) on page 42, and for the information of Field-bus refer to [Field-bus interface](#) on page 51.

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

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

Operation



Note:

The two screw pumps running in parallel must always run simultaneously. If one of the two screw pump fails due to a malfunction, and the other continues to run, the failed pump may suffer from turning backwards in an uncontrolled way. For this reason the DRYVAC must be connected so that it is completely shut down when one of the screw pumps fails.

Refer to [Field-bus interface](#) on page 51 for the recommendations related to running up of the pump. Some parameters are only taken over after a restart.

7.4.1 LED operator and keys

The display shows the output frequency in the delivery state (U1-02). The Pt-1000 temperature can be read out in U7-03.

Figure 18. LED operator

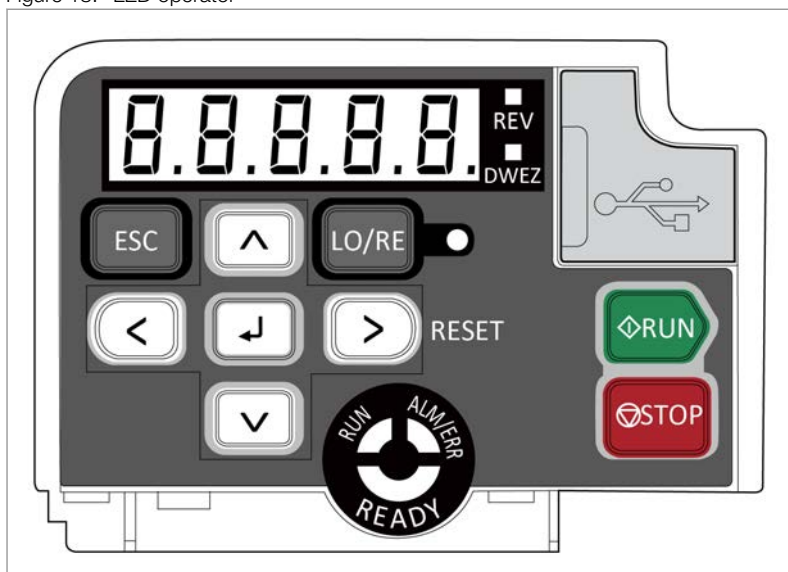


Table 12 Keys and functions

Display	Name	Function
	Data display area	Displays parameters, errors and other data
	RUN Key	Starts the drive in the LOCAL* mode, if control is set to LOCAL.
	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 selection key	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE) *. The LED is on when the drive is in the LOCAL mode (operation from keypad).
	ALM LED	Flashing: The drive is in the alarm state. On: The drive is in a fault state and the output is stopped

Operation

Display	Name	Function
	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 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 Key	Returns to the previous menu. Push and hold to go back to the frequency reference screen (the initial screen).
	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 mode is REMOTE.

Operation

7.4.2 Power on



CAUTION: OPERATION SAFETY

Risk of damage to the equipment. The pre-set limiting parameters, in particular the maximum speed, must not be changed. Observe the safety information given in [Electrical hazards](#) on page 13.

Before you turn the power supply on make sure that:

- All wires are connected properly.
- No screws, loose wire ends or tools are left in the frequency converter.

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

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	Setting
Standard output frequency reference	d1-01	120 Hz



Note:

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

7.4.3 Frequency converter outputs

The frequency converter outputs have been assigned as follows:

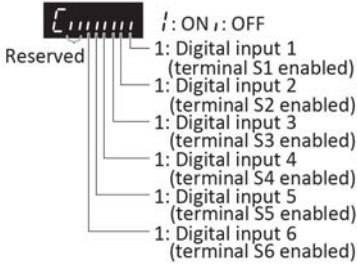
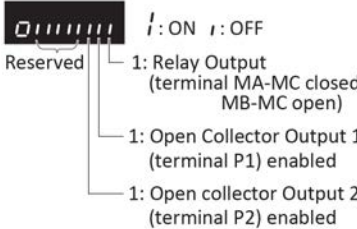
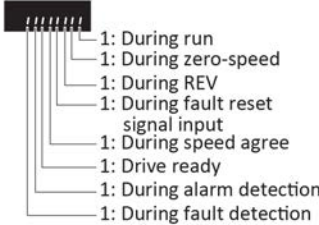
P1-PC	Digital output Multifunction opto-coupler 48 V d.c. maximum 50 mA maximum	Contact closed during Warning (general message)
P2-PC	Digital output Multifunction opto-coupler 48 V d.c. maximum 50 mA maximum	Contact closed during Error (general message)
MA-MC	Relay output maximum AC 250 V 1A maximum DV 30 V 1A minimum 5 V 10 mA	Contact closed when pump is on target speed

Monitor parameter

The [Table: Monitor parameter](#) shows the most important monitoring parameters about the frequency converter status and faults (monitoring mode).

Table 13. Monitor parameter

Monitor	Description
U1-01	Frequency reference (Hz)
U1-02	Output frequency (Hz)
U1-03	Output current (A)

Monitor	Description
U1-05	Motor speed (Hz)
U1-06	Output voltage reference (V a.c.)
U1-07	DC bus voltage (V d.c.)
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 
U1-13	Terminal A1 input level
U1-14	Terminal A2 input level
U1-16	Soft starter output (frequency after acceleration/deceleration 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

Operation

Monitor	Description
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 faults CPF00, 01, 02, 03, UV1, and UV2 are not recorded in the error log.

Relay option board

Figure 19. Relay option board - Connections

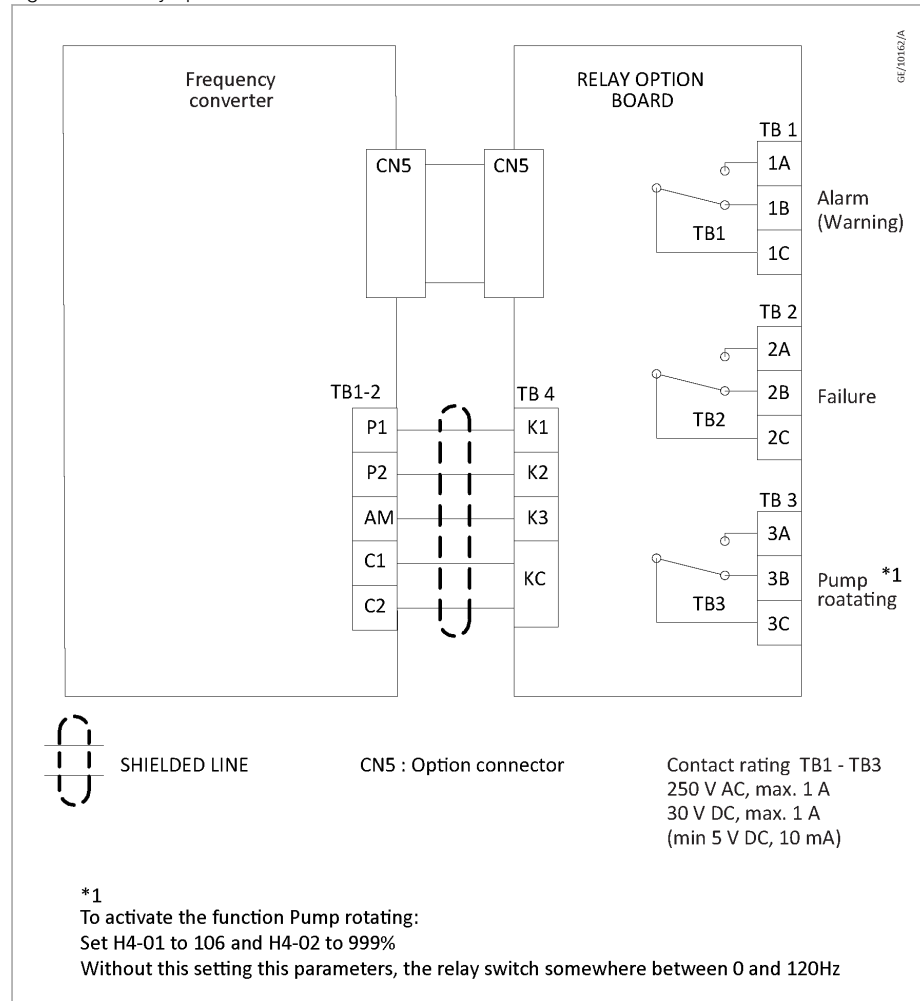


Table 14. Terminal block

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

Operation

7.4.4 Option: Change the speed of the pump



WARNING: ELECTRICAL CONNECTIONS

Risk of injury. Connections 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 recommend to consult us first.

The frequency converter permits to:

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



Note:

Do not operate the pump for more than one hour at frequencies less than 20 Hz.

Table 15 Warning and shut-off thresholds

Parameter	Designation	Warning threshold	Shut-off threshold	Processing by	Fault display
Exhaust pressure (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	EF7
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	PTF
Frequency converter temperature	TSH 281	105 °C	110 °C	frequency converter	oH oHi

7.4.5 Gas ballast operation



WARNING: EXPLOSION HAZARD

Risk of explosion and damage to the equipment. Explosive mixture can form within the gas chamber during the decompression process. Select the type of gas and such that even under the most unfavourable circumstances no explosive mixture can occur which are not covered by the ATEX approval specified on the nameplate.

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

7.4.6 Pumping of 100% Argon

- Constant working pressure between 1 and 80 mbar is possible.

- Working pressure > 80 mbar is permissible for maximum 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 with N₂ purge.
- Argon is not permitted as purge gas.

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

7.5 Shut-off and vent



WARNING: PUMP SAFETY

Risk of injury or damage to the equipment. Low purge gas flow during shut-off may damage the pump. Vent the pump only up to atmospheric pressure. If hazardous gases has been pumped previously, then follow safety information given in [Hazards caused by materials and substances](#) on page 15 and in the safety booklet.

When operation is finished, switch the pump off and 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 make sure that it is free of process gases.
- Then switch off the pump.

DRYVAC without cooling water unit:

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

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.

7.5.1 Process pump recovery after pump failure



WARNING: HAZARDOUS GASES

Risk of injury or damage to the equipment. If hazardous gases have been pumped previously then observe the safety information given in [Hazards caused by materials and substances](#) on page 15 and in the safety booklet.

If the pump stops during a process step there is a risk that the pump could contain hazardous materials, the following procedure should be followed in order to minimise the risk to people and property.

- When the process pump stops, interlock the process valve to close.
- 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.
- The lubricant must not be drained in any condition.
- Shut off the purge.

Operation

- 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.

7.5.2 Remove from service

Shut off and vent the pump system as described in [Shut-off and vent](#) on page 63.

Clean the pump system of any substances which may lead to corrosion. (for example, by extended purge).

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

Remove the cooling water from the pump system.

Remove the cooling water hoses from the pump and drain the cooling water. Blow out the cooling water coils with compressed air or nitrogen (maximum 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.

8 Maintenance

8.1 Maintenance intervals

Refer the [Table: Maintenance interval](#) for the recommended maintenance intervals for the pumps. We recommend a service contract with us.

We recommend to inspect the pump system and all components every 6 months under the process conditions. The inspection of the components shall detect the corrosion at an early stage and possible deposits of process dust. Depending on the findings, change in maintenance and replacement intervals can become necessary for specific components.

Table 16. Maintenance interval

Service work	Interval
Check the oil level	1 year
Oil change for synthetic oil	1 year
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, maximum 4 years
Check the leakage on the entire pump system	After all maintenance and assembly work and upon request
Bearing exchange	40,000h for synthetic oil or 25,000h for PFPE fluid. Depending on application impacts, running conditions, cooling and maintenance these intervals might vary.

8.2 Change the oil



CAUTION: MAINTENANCE SAFETY

Risk of damage to the equipment. Refer [Electrical hazards](#) on page 13, [Thermal hazards](#) on page 14, [Hazards caused by materials and substances](#) on page 15 for safety information. 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.



WARNING: HOT SURFACE

Risk of injury or damage to the equipment. Before you remove the oil-drain or oil-fill plug always switch off the pump first and vent to atmospheric pressure. If 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.

Maintenance

Change the oil more frequently when pumping corrosive vapours or large amounts of dust or when cycling frequently from atmospheric to working pressure.

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

Clean the sealing surface and firmly re-install the oil-drain plugs using a gasket which is in good condition. Wipe off 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 the oil supplied by the manufacturer. Refer [Accessories](#) on page 82.

Please contact us if you intend to operate the pump with other oils or special lubricants.

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

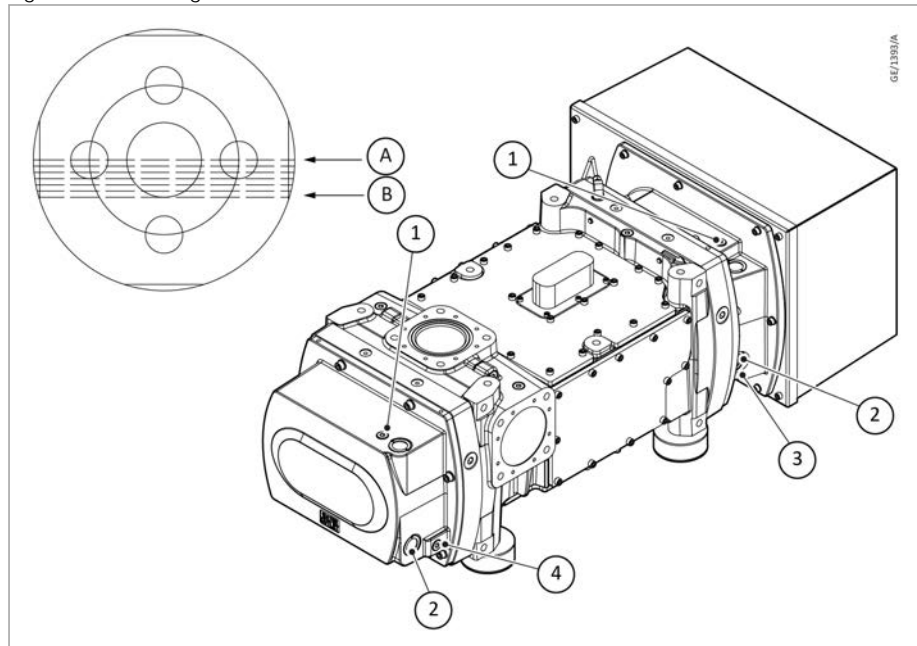
 Note:

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 re-install 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).

Figure 20. Oil change



A. Maximum - 0 mm

B. Minimum - 4 mm

C. Oil fill plug

D. Oil level glass

E. Oil drain plug

F. Oil drain plug

Note:

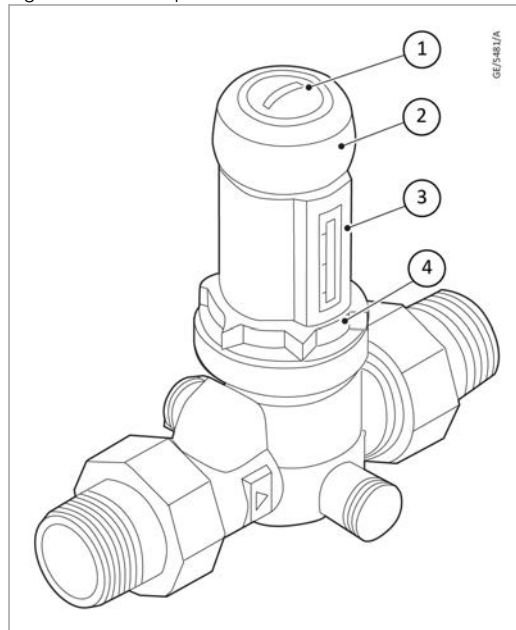
The oil level shown is applicable when the pump is at standstill.

Purge gas or gas ballast valves and cooling water unit are not shown.

- Screw the cartridge back in, tightening torque 20 Nm.
- Open the water supply and discharge again, check leak tightness and pressure setting.

Maintenance

Figure 21. Water pressure reducer



1. Interlock (optional)
 3. Rotatable outlet pressure indicator*
- *(Optional, depending on type)

2. Adjustment knob
4. Flats for removing the cartridge (for maintenance only)

8.3 Clean the filter insert in the cooling water pressure reducer

- Shut off the cooling water supply and discharge.
- Unscrew the cartridge.
- For this, a 27 mm hexagon pipe wrench is required. The adjustment knob can be pulled off should the inside of the wrench be too narrow.
- Clean the filter insert with plain cold water.

8.4 Check and clean the gas ballast filter

The air filter is used for 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.

Clean the filter housing, replace the paper air filter insert, for P/N see [Wearing parts](#) on page 82.

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

8.5 Replace the filter cartridge in the purge gas pressure reducer



CAUTION: SAFETY INFORMATION

Observe the safety information given in [Important safety information](#) on page 11.

Maintenance

The filter cartridge in the purge gas module pressure reducer must be replaced annually, refer to [Figure: DRYVAC without side covers](#).

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

Fault finding

9 Fault finding

Table 17 Fault finding

Symptoms
<i>Pump does not start. EF3 or 100FT is displayed at the frequency converter</i> on page 70
<i>Pump gets too hot, at the frequency converter a PTFT alarm is indicated</i> on page 70
<i>Pump is extremely loud</i> on page 71
<i>Motor power consumption is too high</i> on page 71
<i>Pump is too loud</i> on page 72
<i>Pump is losing lubricant (Lubricant leak is apparent)</i> on page 72
<i>Pump is losing lubricant (Lubricant leak is not apparent)</i> on page 72
<i>Oil gets too dark</i> on page 73
<i>Lubricant in the pump chamber</i> on page 73
<i>Pump does not attain its pumping speed</i> on page 73

Fault	Pump does not start. EF3 or 100FT is displayed at the frequency converter
Cause	Motor is incorrectly connected.
Remedy	Connect motor correctly.
Cause	Over temperature switch or motor stator is defective.
Remedy	Contact us.
Cause	Pressure switch is defective.
Remedy	Replace the pressure switch.
Cause	Lubricant is too thick.
Remedy	Exchange the lubricant or warm up lubricant and the pump.
Cause	Motor rotor is defective.
Remedy	Contact us.
Cause	Pump has seized: defective impellers, bearings or toothed gears
Remedy	Contact us.

Fault	Pump gets too hot, at the frequency converter a PTFT alarm is indicated
Cause	Cooling water supply is not sufficient.
Remedy	Make sure sufficient cooling water is supplied.
Cause	Cooling water lines are clogged.
Remedy	Decalcify cooling water lines.
Cause	Filter insert in the pressure reducer is clogged.
Remedy	Clean the filter insert.

Fault finding

Cause	Ambient temperature is too high or cooling air flow is obstructed.
Remedy	Install the pump at a suitable place or make sure that there is sufficient flow of cooling air.
Cause	Pump is operating in the wrong pressure range.
Remedy	Check the pressure levels within the system.
Cause	Gas temperature is too high.
Remedy	Check the system.
Cause	Clearance between housing and rotors are too small due to contamination or distortion of the pump.
Remedy	Clean pumping chamber. Affix and connect the pump free of tension.
Cause	Friction resistance is too high due to contaminated bearings and/or contaminated lubricant.
Remedy	Clean pump, respectively perform maintenance.
Cause	Lubricant level is too high.
Remedy	Drain lubricant down to the correct level.
Cause	Lubricant level is too low.
Remedy	Top up lubricant to the correct level.
Cause	Wrong lubricant is filled in.
Remedy	Contact us.
Cause	Bearing is defective.
Remedy	Contact us.

Fault	Pump is extremely loud
Cause	Bearing is damaged.
Remedy	Repair the pump.
Cause	Thick particle is deposited.
Remedy	Clean the pump, respectively perform maintenance.
Cause	Silencer is defective.
Remedy	Repair the silencer.
Cause	High gas throughput with the discharge line is open, without silencer.
Remedy	Install discharge line or silencer.

Fault	Motor power consumption is too high
Cause	Pump gets too hot
Remedy	Refer remedy in Pump gets too hot, at the frequency converter a PTFT alarm is indicated on page 70.

Fault finding

Cause	Incorrect mains voltage for the motor
Remedy	Connect the motor to the correct mains voltage.

Fault Pump is too loud

Cause	Motor stator is defective.
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Remedy	Contact us.
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Cause	Motor rotor is defective.
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Remedy	Contact us.
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Cause	Distances between housing and rotors is too small due to contamination or distortion of the pump.
--------------	--

Remedy	Clean pumping chamber. Affix and connect the pump free of tensions.
--------	---

Cause	Bearing or gear is damaged.
--------------	------------------------------------

Remedy	Shutdown pump immediately. Contact us.
--------	--

Cause	Pistons make contact with the housing.
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Remedy	Shutdown pump immediately. Contact us.
--------	--

Cause	Rotor is running untrue.
--------------	---------------------------------

Remedy	Shutdown pump immediately. Contact us.
--------	--

Cause	Oil slinger disc makes contact with the gear housing or the oil pipe.
--------------	--

Remedy	Contact us.
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Cause	Oil pump is blocked or defective.
--------------	--

Remedy	Shutdown pump immediately. Contact us.
--------	--

Fault Pump is losing lubricant (Lubricant leak is apparent)

Cause	Oil drain plug leaks
--------------	-----------------------------

Remedy	Drain lubricant, firmly screw in a new oil drain plug with the gasket, fill in correct lubricant quantity.
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Cause	Oil level glass leaks
--------------	------------------------------

Remedy	Contact us.
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Cause	Gear cover leaks
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Remedy	Replace the O-ring of the gear cover.
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Cause	Puddle under the motor, leak in the seal
--------------	---

Remedy	Shutdown pump immediately. Contact us.
--------	--

Fault Pump is losing lubricant (Lubricant leak is not apparent)

Cause	Lubricant in the pump chamber.
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Remedy	For remedy, refer Lubricant in the pump chamber on page 73.
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Fault finding

Fault	Oil gets too dark
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Cause Oil has been used up.

Remedy Exchange the oil.

Cause Pump gets too hot.

Remedy Refer [Pump gets too hot, at the frequency converter a PTFT alarm is indicated](#) on page 70. After the corrective action is taken for the malfunction, exchange the oil.

Fault	Lubricant in the pump chamber
-------	-------------------------------

Cause Lubricant level is too high.

Remedy Drain the lubricant down to the correct level.

Cause Lubricant is ejected from the system.

Remedy Check the system.

Cause Pump is not standing horizontally.

Remedy Place the pump correctly.

Cause Pump has a gas leak towards outside.

Remedy 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 manufacturer. Contact us.

Cause Pump has an internal leak.

Remedy Contact us.

Cause Piston rings are defective.

Remedy Contact us.

Fault	Pump does not attain its pumping speed
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Cause Intake screen is clogged.

Remedy Clean intake screen.

Cause Motor is incorrectly connected.

Remedy Connect the motor correctly.

Cause Motor stator is defective.

Remedy Contact us.

Cause Motor rotor is defective.

Remedy Contact us.

Cause Vacuum pump system has a gas leak.

Remedy Detect leak and seal it.

Cause Impeller play is more than normal.

Remedy Contact us.

Fault finding

Cause	Bearing is defective.
Remedy	Contact us.

9.1 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.

The [Table: Fault and alarms displayed at the frequency converter](#) lists the most important alarms and faults only. Refer to Frequency converter manual (Publication number Y26/301007788 or YASKAWA GA500 maintenance and troubleshooting manual TOEPYAIGA5001A) for additional error codes which are missing in this manual. The error code information can be found on the frequency converter nameplate.

Table 18 Fault and alarms displayed at the frequency converter

Error message	Brief description	AL	FLT	Possible cause	Corrective action
CF	Control Fault			The torque limit was reached during deceleration for longer than 3 second 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 control circuit of the frequency converter.	Cycle the frequency converter power supply. Initialise the frequency converter. Replace the frequency converter if the fault occurs again.
CrSr	Cannot Reset	■		Fault reset was input when a Run command was active.	Turn off the Run command and reset the frequency converter.
EFO	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 programme.
EF	FWD/REV Run Command Input Error	■		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.

Fault finding

Error message	Brief description	AL	FLT	Possible cause	Corrective action
EF 1 to EF7	External Faults	■	■	An external fault was triggered by an external device via one of the digital inputs S1 to S7. EF2: Pressure sensor exceeds fault threshold. EF3: Temperature limiter exceeds fault threshold. The digital inputs are set up incorrectly. EF7: If purge sensor is connected, the pressure is not enough. If purge sensor is not connected then bridge between wago clamp and S7 is missing.	Find out why the device tripped the EF. Remove the cause and reset the fault. Check the functions assigned to the digital inputs. EF2: Check exhaust line. EF3: Check motor load, reduce if required, improve cooling.
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 the broken parts. Reduce the carrier frequency.
LF	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 acceleration/deceleration 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 oH 1	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.
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.

Fault finding

Error message	Brief description	AL	FLT	Possible cause	Corrective action
OU	DC Overvoltage	■	■	DC bus voltage is too high. The deceleration time is too short. Stall prevention is disabled ¹ . 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.
PF	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 Under-voltage	■	■	The voltage in the DC bus fell for longer than 2 second 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 power supply voltage of the controller (of frequency converter) 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.
PTA1 / A2	Pt 1000 Alarm A1/2	■		Is true, when Pt 1000 measures temperatures of >50 °C (LVO 210) or >45 °C (LVO 410).	Check and improve cooling.
PTCA1 / A2	PTC and Pt 1000 Alarm A1/2	■		Is true, when PTC and 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). Pressure sensor exceeds alarm/ (warning)	

Fault finding

Error message	Brief description	AL	FLT	Possible cause	Corrective action
EAL03	External Alarm during delay of MFDI set in S3	■		External alarm during delay of MFDI settings for S3 (H1-03).	
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	
PTFT			■	Open circuit is detected. Note "Wait" fault.	Check Pt 1000 and connection cable, replace if required.
				Short circuit is detected.	Check Pt 1000 and connection cable, replace if required.
				Is true, when Pt 1000 measures temperatures of >60 °C (LVO 210) or >50 °C (LVO 410). Note "Wait" fault.	Check and improve cooling.
CMPFT	Compensation Fault		■	Contact us.	
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.	

9.2 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.

Fault finding

Table 19 Operator programming errors

Error message	Possible cause	Corrective action
oPE01	Drive capacity and value set to 02-04 do not match.	Contact Service
oPE02	Parameters were set outside the allowable setting range.	Set the 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 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 < P4-04 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)	

10 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.

Note:

If there is the danger of frost, the cooling water must be drained, refer [Remove from service](#) on page 64.

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 the pump (The intake flange can stay sealed during this brief operation, the exhaust flange must be opened).

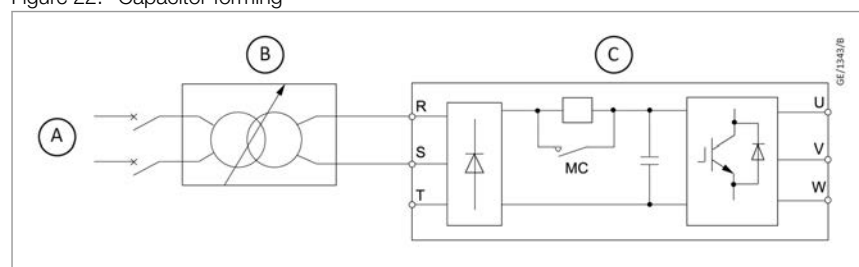
Capacitor forming – What has to be observed when an inverter was longer than 2 years on stock?

Refer to [Figure: Capacitor forming](#).

To prevent the deterioration of the capacitors, we recommend that you apply power to the drive a minimum of one time each year for at least 30 minutes.

If you store the drive for longer than two years and do not apply power, we recommend that you use a variable power source and gradually increase the power from 0 V to the rated drive voltage over a period of 2 to 3 minutes. Apply power for at least 1 hour with no load to reform the main circuit electrolytic capacitor. When you operate the drive after you apply the power, wire the drive correctly and check for drive faults, overcurrents, motor vibration, motor speed differences and other defects during operation.

Figure 22. Capacitor forming



11 Disposal



WARNING: CONTAMINATION HAZARD

Risk of contamination. Contaminated parts can be detrimental to health and environment. Before beginning with any work, first find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

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

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

When you send us the equipment, observe the regulations given in [Return the equipment or components for service](#) on page 81.

11.1 Disposal of waste oil

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

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

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

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

12 Service

12.1 Return the equipment or components for service

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

If you are returning equipment note the following:

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

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



NOTICE:

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

Accessories

13 Accessories

13.1 Ordering Information

Accessory	Part number
DRYVAC DV 1200	112120V17-1
DRYVAC DV 1600	112160V17-1

Table 20. Accessories

Accessory	Part number
Synthetic oil, ester oil, LEYBONOL LVO 210, 5 litres	L21005
ProfiNet module for DRYVAC	112005A75
EtherCAT module for DRYVAC	112005A76
Ethernet module (dual port) for DRYVAC	112005A72
Non-return valve DRYVAC, DN 63 ISO-K	112005A15
Gas ballast kit DRYVAC, 24 V electro-pneumatic	112005A17
Silencer DN 100 ISO-K for DRYVAC 1200/1600	119001
Serviceable silencer DN 100 ISO-K for DRYVAC 1200/1600	119003V
External display	112005A80
Set of nozzles for DRYVAC purge gas	112005A30
Permanent inlet purge kit	112005A32
Floor mount for DRYVAC DV 1200, DV 1600	503637V001
Harting plug for DV 1200, DV 1600	112005A20

For GSD file, manual for the Profibus interface see
www.leybold.com/en/media/downloads/download-software/.

13.2 Wearing parts

Table 21. Wearing parts

Accessory	Part number
Plug screw M16x1.5 (oil fill plug)	ES20127105
Gasket for plug screw	ES23955165
Filter cartridge for purge gas pressure reducer	E110000850
Air filter for gas ballast valve	E110000980
Pressure reducing cartridge for cooling water unit	E6519936

EU Declaration of Conformity

**Leybold GmbH**

Bonner Strasse 498
D-50968 Köln
Germany

Documentation Officer

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

The product specified and listed below

- Screw vacuum pump DRYVAC
- DV1200, DV1600
- 112120VXX-Z, 112160VXX-Z
XXX=01-10; 15-999, Z=1-9

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

2006/42/EC	Machinery directive <i>Note: The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Annex 1 No. 1.5.1 of this directive.</i>
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 60204-1:2018	Safety of machinery. Electrical equipment of machines. General requirements
EN 61000-6-2:2005	Electromagnetic Compatibility (EMC) - Part 6-2: Generic Industrial Immunity Standard
EN 61000-6-4:2007/A1:2011	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: **2023-11-21**

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 – Vice President Engineering
Industrial Vacuum Division, Cologne



Rene Rose Stueber – General Manager
Product Company Cologne

Declaration of Conformity

Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

Documentation Officer
Innovation Drive
Burgess Hill
West Sussex
RH15 9TW
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This declaration of conformity is issued under the sole responsibility of the manufacturer.

- Screw vacuum pump DRYVAC
- DV1200, DV1600
- 112120VXX-Z, 112160VXX-Z
XXX=01-10; 15-999, 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 60204-1:2018	Safety of machinery. Electrical equipment of machines. General requirements
EN 61000-6-2:2005	Electromagnetic Compatibility (EMC) - Part 6-2: Generic Industrial Immunity Standard
EN 61000-6-4:2007/A1:2011	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: **2023-11-21**

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 – Vice President Engineering
Industrial Vacuum Division, Cologne



Rene Rose Stueber – General Manager
Product Company Cologne

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU, UK): Class A 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 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)
Product is certified to	Safety requirements for electrical equipment for measurement, control and
UL61010-1 3 rd Edition	laboratory use – Part 1: General requirements
cTUVus Certificate No.	CU 72190339

The product is certified by TÜV Rheinland of North America which is a “Nationally Recognized Testing Laboratory” (NRTL) for USA and Canada.

材料成分声明
China Material Content Declaration

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



Pioneering products. Passionately applied.

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