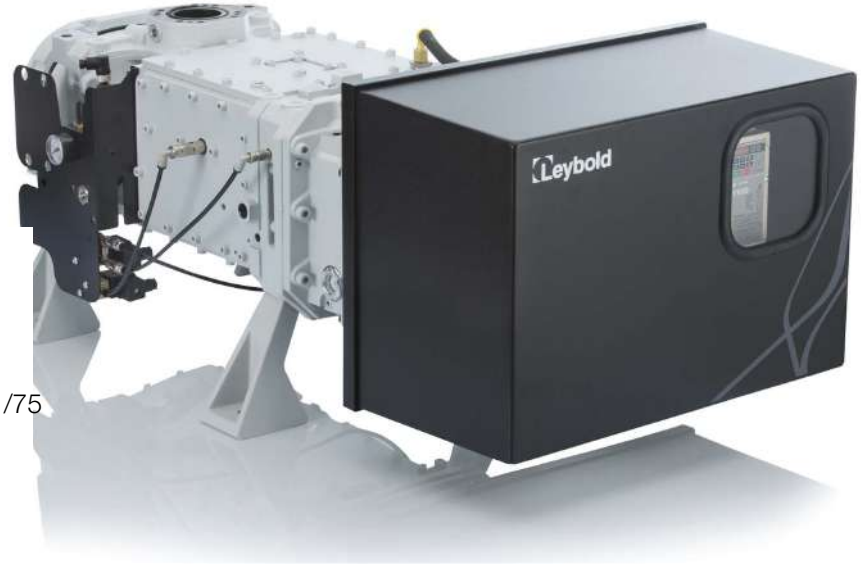
DRYVAC
DV 200, DV 300, DV 500

Dry Compressing Vacuum Pumps with synthetic oil or PFPE filling

Operating instructions 301140449_002_C2



Part Numbers

112020V15 /19 /25 /29

112030V11 /15 /19

112050V11 /15 /19 /24 /25 /75

14640200VXXDGN

14640300VXXDGN

14640500VXXDGN

Copyright notice

Published: 8/22/2024

Associated publications

Publication title	Publication number
Bus Interfaces	301076031
EMC Filter	301140450

Trademark credit

Leybold and the Leybold logo are trademarks of Leybold GmbH, Bonner Strasse 498, D-50968 Cologne.

Disclaimer

The content of this manual may change from time to time without notice. We accept no liability for any errors that may appear in this manual nor do we make any expressed or implied warranties regarding the content. As far as practical we have ensured that the products have been designed and constructed to be safe and without risks when properly installed and used in accordance with their operating instructions.

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

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

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

Contents

Contents

List of Figures

List of Tables

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 explosion prevention and protection, mechanics, electrical engineering, pollution abatement and vacuum technology.
- Have read and understood this instruction manual.
- Are trained in the work area within the current site, including explosive atmospheres if necessary.
- Know the operating processes for this vacuum pump in interaction with their system.
- Know the relevant safety devices and understand their proper function.

The competency of the person shall be relevant to the type of protection used for this pump and accessories.

When dealing with an explosive atmosphere, knowledge of the applicable guidelines and standards is mandatory.

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 - Overhead or Suspended load** Risk of injury or damage to equipment. Identifies an area where overhead or suspended items may lower or fall.
	Warning - Risk of explosion There is a risk of explosion when you do the task.
	**Warning - Toxic material** Risk of injury or damage to the environment. Identifies a source of toxic gases, liquid or material.
	**Warning - Trip hazard** Risk of injury. Identifies spilled liquids, trailing cords, pipes and other low-lying objects that may result in slipping, tripping or falling.

Safety and compliance

	**Warning - Vacuum hazard** Risk of injury. Identifies the source of a dangerous vacuum.
	**Warning - Use protective equipment** Risk of injury. Use appropriate Personal Protective Equipment (PPE) when performing the task.
	**Warning - Wear eye protection** Risk of injury. Wear appropriate protective goggles when performing the task.
	**Warning - Wear hearing protection** Risk of injury. Wear appropriate hearing protection when performing the task.
	**Warning - Fall hazard** Risk of injury. Use appropriate fall protection equipment when performing a task at height.
	**Symbol – Waste Electrical & Electronic Equipment (WEEE)** The equipment must be discarded carefully. Obey local and national regulations for disposal of this equipment. Identifies compliant product supplied with a manufacturing date (YYYY/MM).
	**Symbol - Protective earth** Identifies an electrical equipment earth (ground) terminal.

2 Important safety information

2.1 Explanation of warning symbols

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. Allow this area to cool before servicing. Hot surface inside. Do not touch, wear protective equipment.

WARNING: EXPLOSION HAZARD

Risk of injury or damage to the 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 atmospheric pressure by 200 mbar maximum. The discharge line must not be blocked or restricted.

CAUTION: PUMP WITH WHEELS

Must only be placed and moved on levelled horizontal surfaces.

CAUTION: VACUUM

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

CAUTION: AUTOMATIC START UP

Connect the pump so that it will not restart automatically after a mains power failure, once the power returns.

Important safety information

CAUTION: SUSPENDED LOAD

Transport the pump only at the four crane eyes or secured with a forklift.

2.2 Mechanical hazards

CAUTION: LOSS OF STABILITY DURING TRANSPORT

Uncontrolled movement due to incorrect attachment / lifting / carrying / rolling or movement of the vacuum pump. Only use the attachment points and conveying means described in this manual for vertical and horizontal conveying.

WARNING: EJECTION OF PARTS

Ejection of parts through bursting of vacuum system due to excessive pressure caused by the incorrect direction of rotation. Pressure build-up in the vacuum system or vacuum chambers. Check the direction of rotation of the vacuum pumps before each start-up, after each motor change and after each electrical connection change.

Ejection of parts through bursting of vacuum system as a result of excessive pressure caused by clogged or constricted exhaust. Pressure build-up in the vacuum system or exhaust pipes. Do not start up or operate the vacuum system with the outlet closed or throttled.

Ejection of parts through bursting of vacuum system due to excessive pressure, caused by faulty function at the gas inlet into the vacuum system. Pressure build-up in the vacuum system or inlet lines. Check correct connection of inlet and outlet flanges before commissioning. The inlet pressure at the suction port of the vacuum system must not exceed atmospheric pressure. If seal gas or gas ballast from pressure vessels is used, secure the supply in such a way that no overpressure can occur in the vacuum system in the event of a fault or power interruption.

Ejection of parts through bursting of vacuum system as a result of excessive pressure caused by the pump running backwards after it has been switched off under vacuum. The danger of overpressure in the inlet lines and recipients as well as the uncontrolled backward running of rotors. In the event of a fault or during service, separate the vacuum pumps from the vacuum vessel and connecting lines before the inlet using suitable valves.

WARNING: RISK OF CUTTING AND CRUSHING

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

WARNING: UNEXPECTED RESTART

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

CAUTION: RISK OF INJURY

Pulling in of body parts and objects into the vacuum through open flanges. Do not operate the vacuum pump with open flanges. When installing the vacuum pump, first mechanically connect the inlets and outlets and then make the electrical connections.

CAUTION: HIGH PRESSURE GAS

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

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

CAUTION: TRIP HAZARD

Slipping, tripping or falling as a result of oil leaking from the pump. Oil can escape from the vacuum pump during pumping or depending on the work process. Risk of falling on oil spills. Check the vacuum pump regularly for oil leaks. Take the appropriate safety measures

2.3 Electrical hazards

WARNING: ELECTRICAL SHOCK

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

Risk of electrical shock due to interruption of the protective conductor system. In the event of a fault, life-threatening voltages may be present on electrically conductive components. Before commissioning, check the resistance of the earthing cable and the suitability of the assigned overcurrent protection device.

Important safety information

WARNING: LIGHTNING STRIKE

Risk of fire and injury from lightning strike. The operator is responsible for assessing the hazard potential when used outside of buildings.

2.4 Thermal hazards

CAUTION: HOT SURFACES

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

Scalding by contact with hot equipment or lubricants. Danger of scalding when opening the hot pump with hot operating fluid or cooling-water. Only open the outlet or inlet port for operating media if the operating medium has adapted to the room temperature. Wear suitable protective equipment.

A barrier must be placed around the pump to prevent accidental contact with hot surfaces. The barrier must consist of barricade tapes or warning signs and must be reliable. Tools (such as screwdriver or allen key) are required for removal.

2.5 Hazards caused by materials and substances

WARNING: HAZARDOUS GASES

Danger due to a rapid increase in pressure due to the decomposition of pumped gases. Uncontrolled emission of process gases by reaction products within the pump. The pumping of reactive gases, vapours or gas mixtures is generally prohibited. The operator is responsible for assessing the hazard potential of the process media or mixtures.

Danger of escaping or emitting pumped hazardous gases, vapours or substances. Pumped process gases may escape from the exhaust and leaks in the vacuum system. The pumping of exothermic substances/ pyrophoric / radioactive / oxidizing gases or gas mixtures, as well as the pumping of oxygen of more than atmospheric concentration (21 %) is generally prohibited. The operator is responsible for assessing the hazard potential of the process media or mixtures.

WARNING: HAZARDOUS MATERIAL AND SUBSTANCES

Risk of Asphyxiation. Some pumps use perfluoropolyether (PFPE) as lubricant. During thermal decomposition at temperatures over 290 °C toxic and corrosive gases are released. When you use PFPE, keep the pump away from open fires. Do not smoke with PFPE on your fingers.

Do the service and maintenance work in clean and dry rooms. Wear clean gloves and use clean tools when you touch the inner sections of the pumps.

Start the pump immediately after it is removed from its packaging as cleaning agents solvents based on hydrofluorether compounds can be used.

Fluoropolymers are used as sealants (FKM) and as lubricants (PFPE) in the pumps. In case the pump suffers a severe mechanical failure, there is a possibility of hazardous substances being released due to their thermal decomposition. Refer to the Material Safety Data Sheets for details of the hazards caused by such decomposition of the material.

2.6 Explosion hazard

WARNING: INTERNAL EXPLOSION

The pump is suitable for use with internal and external flammable atmospheres as defined by the pump marking. There is a risk of internal explosions within the pump, or ignition sources externally, if the pump is operated outside of the limits of operation.

2.7 Safety precaution with O2 Version

The following versions of DRYVAC are certified to pump oxygen at concentrations above atmospheric level:

- 112020V25 DRYVAC DV 200, 380-480V, 50/60Hz LVO 410
- 112020V29 DRYVAC DV 200, 200-240V, 50/60Hz LVO 410
- 112050V24 DRYVAC DV 500, 380-460V, LVO410 no BoV
- 112050V25 DRYVAC DV 500, 380-480V, 50/60Hz LVO410

WARNING: PUMPING OXYGEN

As the pumps are not hermetically sealed pumped gas will escape in small amounts. In order to avoid hazardous oxygen concentrations outside the pump seal purge must be used on the exhaust side of the pump. Check if the pressure at purge system is enabled all the time. We also recommend to use an oxygen control sensor.

In addition, the pump must be tightly connected to an exhaust pipework which discharges the pumped gas safely. Make sure the exhaust pipe is tightly connected to the pump and the exhaust pipework.

Pumping ignitable gas mixtures and inflammable dusts are not allowed.

Ignitable gas mixtures and inflammable dusts are not allowed outside of the pump.

In the case of oxygen operation, the Viton seals in contact with the medium need to be replaced after three years by us after sales service since these are subject to ageing. Only original seals must be used since these have been qualified for oxygen operation.

The wetted parts of the DRYVAC are degreased accordingly when delivered. Make sure that no grease or oil gets into the suction chamber of the pump.

Only tested and approved sealing materials and lubricants on oxygen-carrying materials and lubricants that have been tested and found to be suitable may be used.

Lubricants containing flammable propellants or solvents in spray cans or containers are not suitable for safety Solvents in spray cans or containers. Watch out for dangerous mix-ups, especially during repair and assembly work. be especially careful. Lubricants should be avoided as far as possible.

All sealing materials of the DRYVAC and the PFPE vacuum grease are suitable for oxygen.

Important safety information

2.8 Noise hazard

CAUTION: HIGH NOISE LEVELS

The operating conditions can cause higher noise levels than specified in the technical data. Take suitable hearing protection measures.

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

3 Description

3.1 Design

The DRYVAC pumps are single-stage dry compressing screw vacuum pumps. They have optimized pumping speeds even at pressures more than 100 mbar. These models are specially suited for short cycle operation, for example, load lock applications.

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

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

The DV 200 and DV 300 have the same 2-pole motor. The DV 500 has a 4-pole motor. The pump speed corresponds to half the frequency specification in the frequency converter (250 Hz corresponds to a pump speed of 125 Hz). The DV 500 with LVO 410 has a pump speed of 115 Hz. The required frequency converter is installed at the pump.

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

The pumps are water cooled. They are lubricated with synthetic oil.

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

Plug and go box

Plug and go feature is designed to make the purge and gas ballast valves control easy to connect and operate. The plug and go variant comes with an internally connected power supply, eliminating the need for complex wiring and external power sources. The switch board can be configured on the pump for manual operation.

Install the plug and go box as follows:

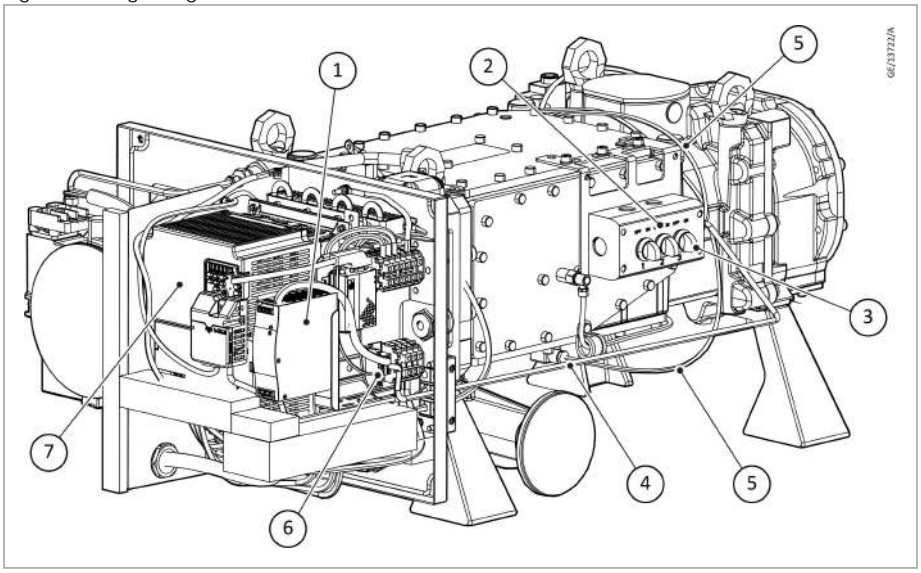
1. Use 3 bolts and washers to mount the bracket to the pump
2. Torque the bolts to 25 Nm.
3. Attach the plug and go box on the bracket with 4 screws.
4. Connect the power supply in the Electronics component (by removing the black cover).
5. Connect the gas ballast and purge valve to the plug and go box.
6. Remove the bridge between S7 and clamp to connect the purge sensor to the frequency converter.

The purpose of the plug and go connection:

- 24 V power supply for valves on board
- Purge gas sensor is monitored by the pump
- Manual switches on the pump for purge and gas ballast valves

Description

Figure 1. Plug and go box



1. *Power supply unit*
2. *Plug and go switchboard*
3. *Switches for Purge and GB control*
4. *Connection to power supply*
5. *Connection to gas system*
6. *Distribution terminal*
7. *Frequency converter*

3.2 Genius box option

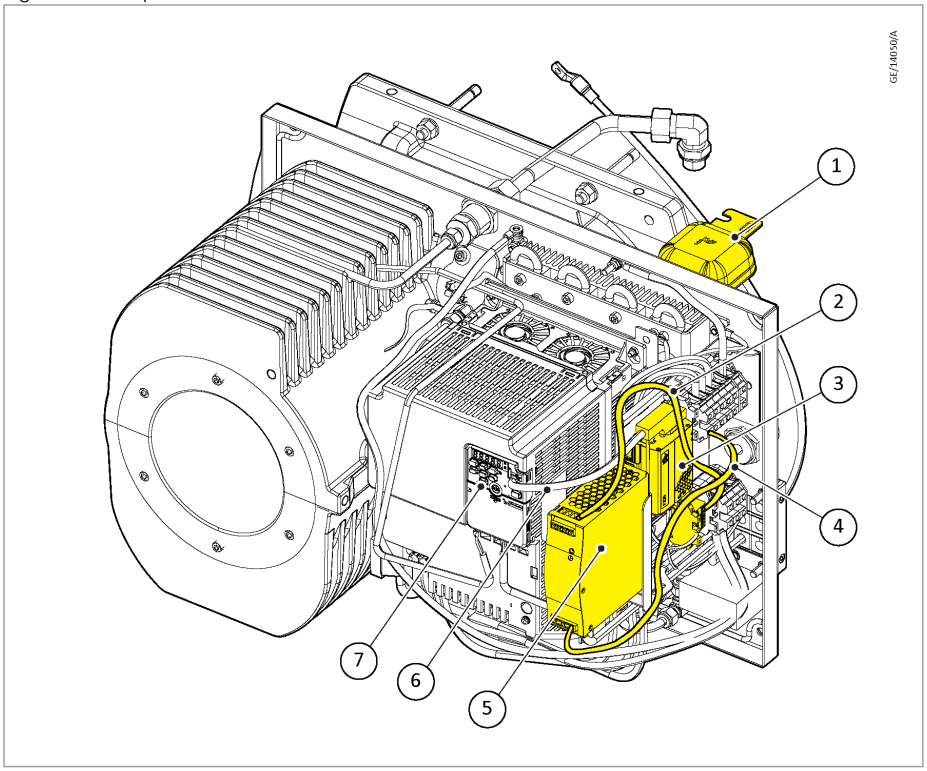
GeniusBox is a device which can be attached on vacuum pumps and helps to monitor vacuum pumps with remote access any time. With the help of genius instant insight portal you can access an overview of your vacuum pump from any location.

It makes sure vacuum pumps are in top running conditions by giving critical alerts that avoid most common vacuum pump failures. The failures such as machine breakdown, production losses and product contaminations.

It provides information and status such as,

- Machine and service status
- Availability
- Uptime
- Energy consumptions
- Alerts

Figure 2. Components of GeniusBox retrofit kit



1. *Antenna*
2. *3W3 power cable*
3. *GeniusBox*
4. *3W3 power cable*
5. *Power supply*
6. *4W9 data cable*
7. *Operator*

Note

Each pump with Genius Box Option directly installed is provided with a QR sheet to the Genius Box manual. For detailed installation instructions and safety guidelines for Genius option read Genius Box manual

These factory variants which are equipped with connectivity accessory in factory can be recognized by the Genius Instant Insights sticker on the pump:

Figure 3. GeniusBox sticker

Scan the QR code for access the GENIUS cloud portal.

It is necessary to have account and login credentials to access the cloud platform.

If you do not have an account, please create an account in the VTS cloud.

You can request account from portal.

Description

The Genius Box Retrofit Kit 175001A01 can be also ordered as an accessory equipment after initial commissioning. Please reach out to your sales representative.

3.3 Supplied equipment

- Pump as described in *Design* on page 17 and *Ordering information* on page 79.
- The pumps are filled with synthetic oil LEYBONOL LVO 210 or PFPE LEYBONOL LVO 410.
- The pumps are purged with nitrogen for protection against corrosion. The pump flanges have been blanked off with a sealing cap.
- 4x crane eyes M16
- Plug for purger and gas ballast valve
- Plug for purge gas pressure switch

3.4 Conforming use

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

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

All DRYVAC pumps are leak tight, so they are used for pumping toxic and flammable gases outside their ignition range. When using the pumps in connection with the oxidising or corrosive gases, first check the media compatibility. Media compatibility, resulting hazards of each substance used and each substance mixture need to be reassessed as per the case.

When planning to pump hazardous substances always consult us first.

3.4.1 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 24.
- 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, which do not correspond to the ATEX approval of the machines.
- Non-compliance with the described maintenance and service intervals.
- Use in systems and pump systems in which the exhaust pressure may increase over 200 mbar atmospheric pressure.
- 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.

3.5 ATEX certification

ATEX directive implications

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

Classification and marking of the pump

The pump is marked as follows:

	II 3/- G Ex h IIC T3 Gc (5 °C ≤ Ta ≤ 40 °C) (internal atmospheres only)

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

Table 1. Key to the Symbols

	ATEX logo
../..	Means that the product has two different categories
-	Means that a part of the product does not comply with the directive and has not been intended for utilisation within an explosion hazard area.
II 3/- G (Gc)	The pump may suck off gases from Zone 2, is however to be installed outside explosion hazard areas.
h	The code letter “h” is valid for all non-electrical devices.

Description

IIC	Explosion group
T3	Temperature class. Pumps belonging to temperature class T3 must only be operated with gases or vapors which exhibit an ignition temperature of over 200 °C.
Ta	Permissible ambient temperature for operation of the pump: 5 °C ≤ Ta ≤ 40 °C.

Areas of application

WARNING: EXPLOSION HAZARD

Risk of injury and damage to the equipment. The pump must not be installed and operated within explosion hazard areas.

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

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

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

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

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

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

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

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

Table 2. Process limits for DV 500 category 3 inside pump

Vacuum pump type	DV 500	DV 300
Temperature class	T3	T3
Power consumption	11 kW	7.5 kW
Rotor speed (maximum)	7500 min^{-1}	7500 min^{-1}
Internal explosive atmosphere	IIC	IIC
Inlet gas temperature at inlet pressure ≥ 150 mbar(a)	≤ 80 °C	≤ 80 °C

Vacuum pump type	DV 500	DV 300
Inlet gas temperature at inlet pressure ≤ 150 mbar(a)	≤ 110 °C	≤ 110 °C
Pump exhaust gas temperature	≤ 135 °C	≤ 165 °C
Pump case temperature	≤ 65 °C	≤ 100 °C
Pump exhaust pressure	≤ 1100 mbar(a)	≤ 1200 mbar(a)
Cooling water flow	≥ 8 l/min	≥ 10 l/min
Cooling water inlet temperature	5 °C to 30 °C	5 °C to 35 °C
Ambient temperature	5 °C to 40 °C	5 °C to 40 °C

For DV 500 category 3 inside pump:

A ramp-up time of ≥ 120 seconds needs to be set for safe use. Inverter parameter is set to ramp-up time of 120 seconds as standard.

4 Technical data

Table 3 Technical data

DRYVAC DV	200	300	500	Tolerance
Maximum pumping speed without gas ballast	210 m^3/h	280 m^3/h	460 m^3/h	± 5 %
▪ DV 500 PFPE	-	-	380 m^3/h	-
Ultimate pressure				
▪ with purge gas for shaft seal inlet & outlet	< 0.05 mbar	< 0.01 mbar	< 0.01 mbar	-
▪ with gas ballast	< 0.8 mbar	< 0.5 mbar	< 0.5 mbar	-
▪ DV 500 PFPE	-	-	< 0.05 mbar < 0.8 mbar	-
Maximum permissible inlet pressure	1050 mbar			-
Maximum permissible discharge pressure (relative to ambient)	+ 200 mbar			-
▪ DV 500 Cat. 3	-	-	+ 100 mbar	-
Integral leak rate	< 10^{-5} mbar l/s			-
Water vapour tolerance with purge and gas ballast	50 mbar > 20 N l/min			-
Water vapour capacity without condensation between 10 - 50 mbar	1.5 to 7 kg/h	2 to 10 kg/h	3 to 12 kg/h	-
Permissible ambient temperature	+5 to +50 °C			-
▪ DV 300, DV 500 Cat. 3	-	+5 to +40 °C		-
Storage temperature	-30 to +60 °C			-
Contamination grade with/without purge	2/3			-
Overvoltage category	3			-
Noise level with silencer, at ultimate pressure (according to DIN EN ISO 2151)	65 dB(A)			KpA = 3dB
Noise level with rigid exhaust pipe, at ultimate pressure (according to DIN EN ISO 2151)	65 dB(A)			KpA = 3dB
Relative atmospheric humidity	95%, non-condensing			-
Installation location	up to 2000 m (NHN) *			-

DRYVAC DV	200	300	500	Tolerance
Cooling	Water			-
Mains voltage [1)2)]	380-460 V or 200-240 V			± 10%
Frequency	50/60 Hz			± 5 %
Phases	3-phase			-
Rated power (motor shaft)	7.5 kW		11 kW	± 0.5 kW
Maximum current				
▪ at 380/ 400 /460 V	13.2/12.4/11.1 A	14.5/13.8/12.3 A	21.5/20.9/18.5 A	-
▪ at 200/ 240 V	23.0 / 20.2	28.7 / 23.2	42.2 / 37.5	-
Motor efficiency class calculated and configured according to EN 60034-30	IE3			-
Power consumption at ultimate pressure	4.1 kW	4.5 kW	4.4 kW	-
Mains fusing / characteristic				
▪ at 400 V	16 A (C type)		32 A (C type)	-
▪ at 200 V	32 A (C type)		50 A (C type)	-
Short-circuit interrupting capacity [3)]	< 10 kA_{eff}			-
Connectable conductor cross-section, maximum	10 mm^2			-
Switching frequency of the frequency converter	maximum 15kHz		maximum 12.5 kHz	-
Speed	6600 rpm	7500 rpm	7500 rpm	-
▪ DV 500 PFPE	-	-	6900 rpm	-
Minimum permissible speed [4)]	1200 rpm			-
Protection class	IP 54***			-
Protection class according to NEMA	Typ1 (UL50E)			
Lubricant filling	LVO 210 or LVO 410	LVO 210	LVO 210 or LVO 410	-
Total lubricant quantity	1.0 l			-
Intake flange	DN 63 ISO-K			-
Discharge flange	DN 40 ISO-KF		DN 63 ISO-K	-
Materials				

Technical data

DRYVAC DV	200	300	500	Tolerance
▪ 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, approx.	370 kg		415 kg	-
Water				
Water connection	G1/2"			-
Water temperature	5 °C – 35 °C			-
DV 500 Cat. 3	-	-	5 °C – 30 °C	-
Minimum supply pressure	2.5 bar(g)**			-
Maximum supply pressure	7 bar(g)**			-
Nominal flow	8 l/min			-
Purge				
Connection	plug-in connection D10			-
Nominal setting pressure Purge gas (at nominal flow, valves open)	2.2 to 3.0 bar(g)**			± 5 %
Permissible setting pressure Purge gas (at purge gas flow)	2.2 to 3.5 bar(g)**			± 5 %
Permissible supply pressure purge gas	4.0 to 10.0 bar(g)**			± 5 %

DRYVAC DV	200	300	500	Tolerance
Purge gas flow shaft seal / rotor	6 l/min			± 10 %
Maximum gas ballast flow (P_{inlet} < 10 mbar) [5)]	100 l/min		150 l/min	± 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.

3) The pump is not suited for electric circuits capable of delivering a current in excess of 10 kA (rms) at maximum mains voltage.

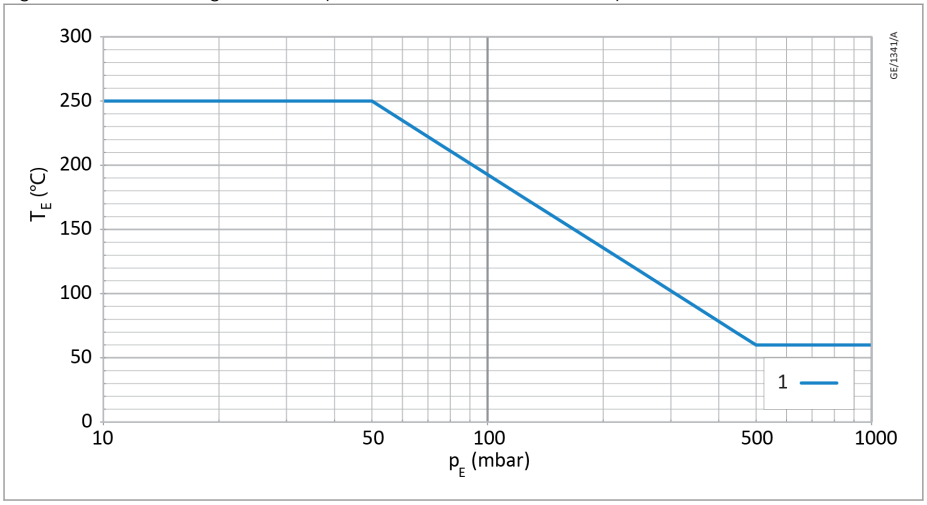
4) The minimum permissible speed is relevant for the oil lubrication of bearings and gears. Running the pump at less than the minimum speed for more than 1 hour can cause damage to the pump due to a lack of lubrication.

5) The gas ballast flow may vary due to different conditions. The gas ballast flow through the DV pump is much dependent on the inlet pressure.

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

**** equivalent*

Figure 4. Permissible gas inlet temperature as function of the inlet pressure



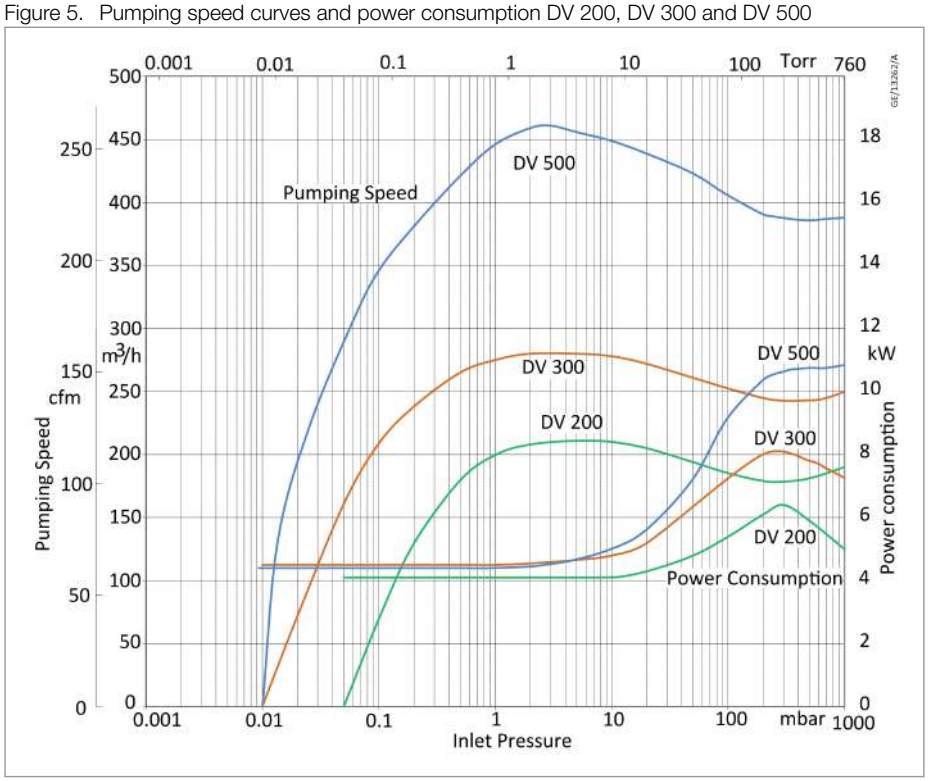
1. *Permissible range: under the curve.*

For 50 mbar ≤ P_E ≤ 500 mbar applies:

Te= -190 x lg(P_E) + 572.8 in °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

Figure 5. Pumping speed curves and power consumption DV 200, DV 300 and DV 500



5 Transportation

CAUTION: LOSS OF STABILITY DURING TRANSPORT

Uncontrolled movement due to faulty attaching/lifting/carrying/rolling or moving the vacuum pump. For vertical and horizontal transport, use only the attachment points and transport means described in this manual.

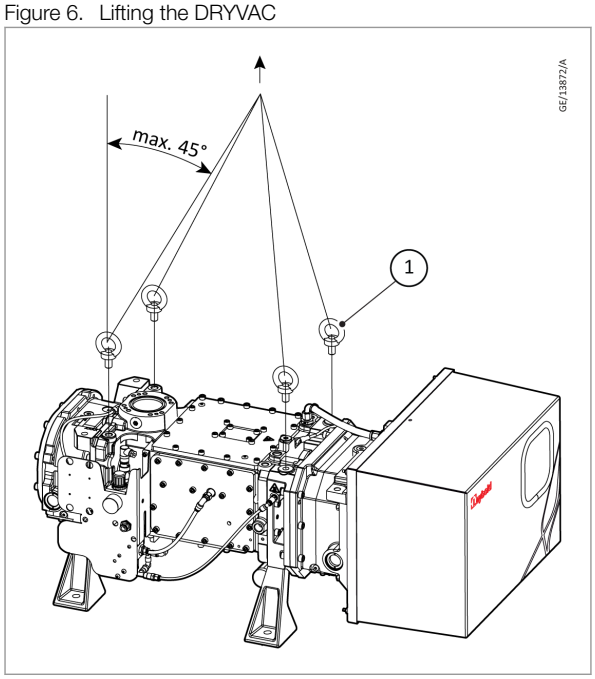
Note:

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.

Figure 6. Lifting the DRYVAC



1. *Crane eyes (4 off)*

6 Installation

WARNING: RISK OF CUTTING AND CRUSHING

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

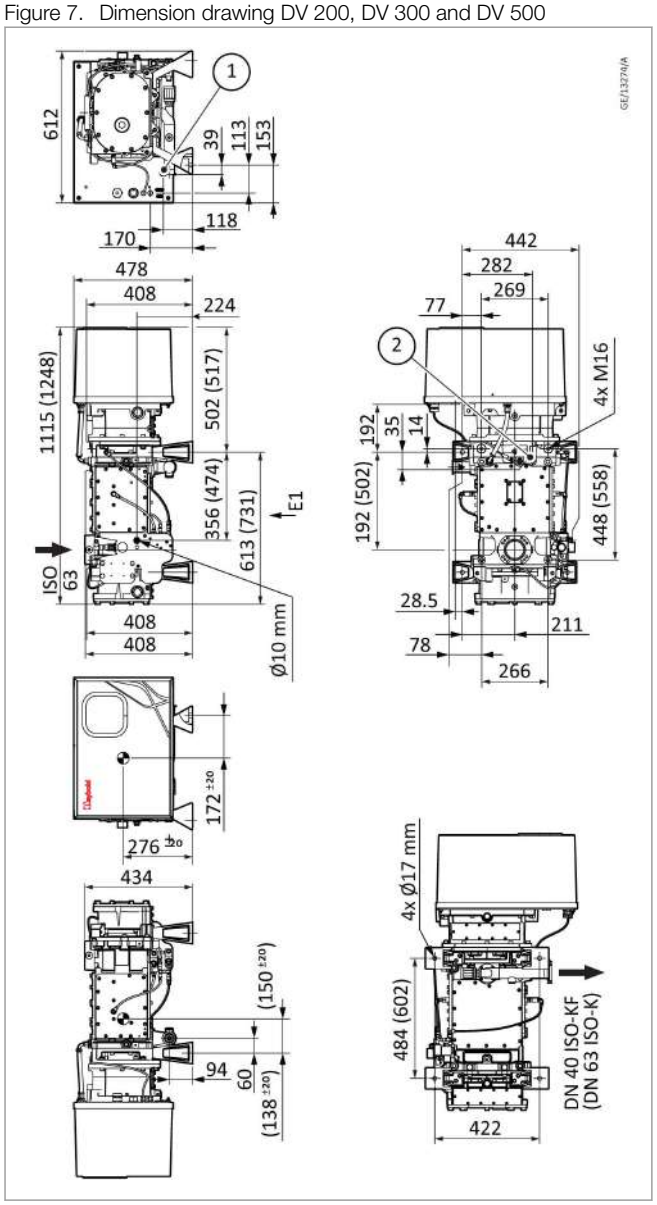
WARNING: EJECTION OF PARTS

Ejection of parts through bursting of vacuum system due to excessive pressure, caused by faulty function at the gas inlet into the vacuum system. Pressure build-up in the vacuum system or inlet lines. Check correct connection of inlet and outlet flanges before commissioning. The inlet pressure at the suction port of the vacuum system must not exceed atmospheric pressure. If seal gas or gas-ballast from pressure vessels is used, secure the supply in such a way that no overpressure can occur in the vacuum system in the event of a fault or power interruption.

Installation

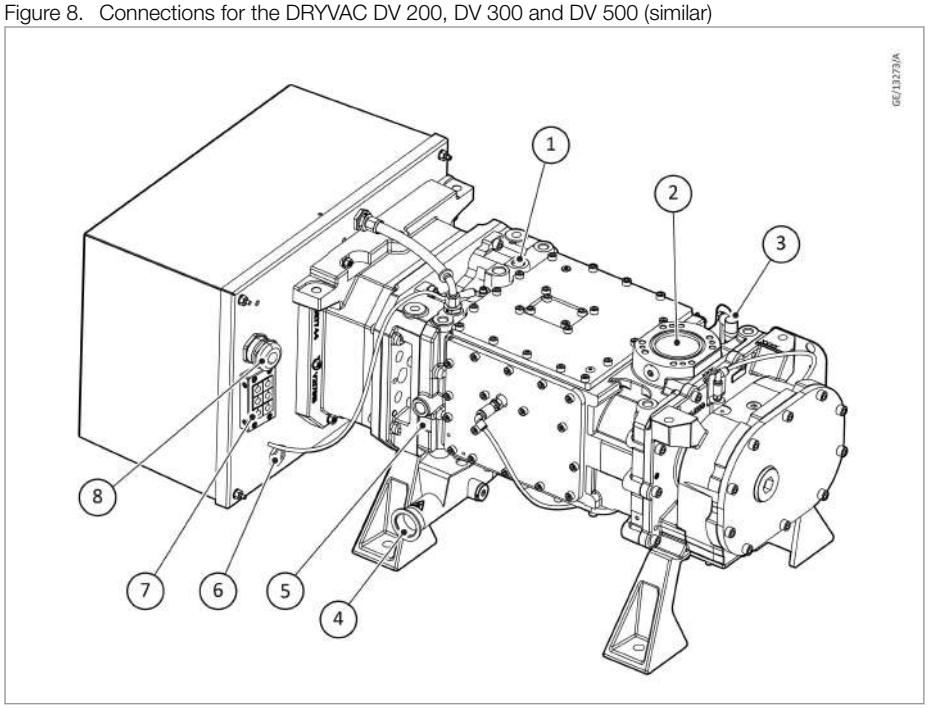
6.1 Dimension drawing

Figure 7. Dimension drawing DV 200, DV 300 and DV 500



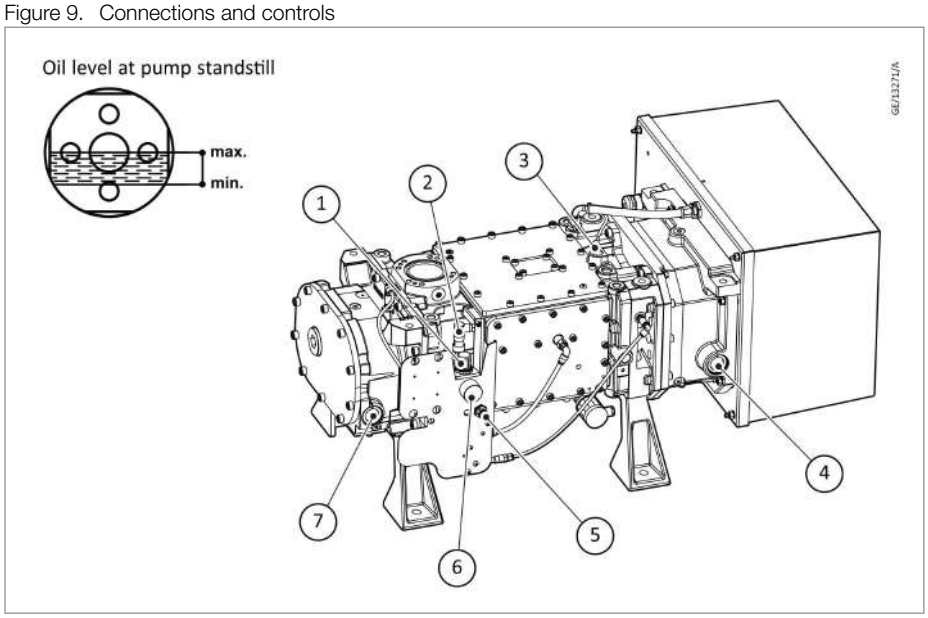
All dimensions are in mm (inch).

Figure 8. Connections for the DRYVAC DV 200, DV 300 and DV 500 (similar)



1. *Water OUT*
2. *Intake*
3. *Purge gas*
4. *Exhaust*
5. *Grounding IN*
6. *Water IN*
7. *Cable entry frame*
8. *Mains power supply*

Figure 9. Connections and controls



1. *Control valve purge gas*
2. *Pressure switch purge gas*
3. *Pt 1000 for temperature monitoring*
4. *Oil level glass motor side*
5. *Purge gas IN*
6. *Pressure gauge purge gas*
7. *Oil level glass intake side*

6.2 Placement

Place the pump system on a flat and level surface.

Installation

The pump is designed for operation in building.

We recommend leaving the crane eyes screwed in.

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

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

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

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

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

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.

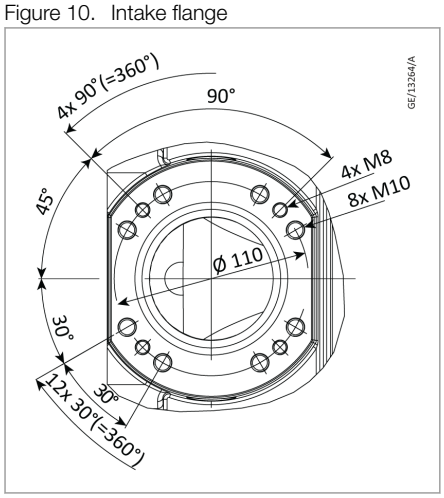
The intake lines must be clean.

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

Note:

Make sure that no items like welding beads, bolts, nuts, washers, pieces of wire, enter into the inlet.

Figure 10. Intake flange



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.

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 wall thickness.

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

Keep the exhaust line free of deposits. If the exhaust flow becomes restricted, deposits could collect in the 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. Check leak tightness of the exhaust lines on a regular basis.

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.

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.

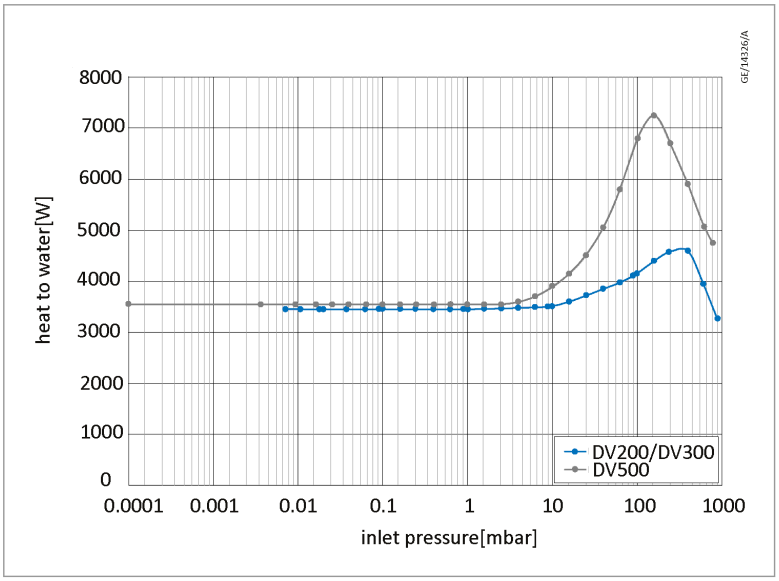
Make sure cooling water flow is adequate in accordance with the technical data.

Cooling water data for the pump

Materials in the cooling circuit of the pump	Grey cast iron, stainless steel, polyester/silicone, FKM, galvanised components, cathodic dip coating and epoxy paint
Feed temperature	5 - 35 °C
Feed pressure	2.5 - 7 bar(g)

Table 4 Cooling water data for the pump

Type	Power loss to be dissipated by the cooling water (at ultimate pressure)	Cooling-water demand at feed temperature (assuming a constant discharge temperature of 50 °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 200/300/500	<4	10	8.0	6.0	4.0
DV 500 Cat.3i	<4	-	8.0	8.0	8.0



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

If work on the water cooling system becomes necessary and in the case of a longer standstill or transportation, completely drain out all cooling water and completely dry the lines (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 5. 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)
If there is the danger of frost, you may use a water glycol mixture of up to 30 %.
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 exhaust side
- Into the pumping chamber (rotor purge)
- To the shaft seal on the inlet side

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

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

Use nitrogen or compressed air as purge gas.

Parameter	Value
Medium temperature	0 to +50 °C.
Filter size	40 µm
Maximum condensate volume	22 cm^3
Operating medium	filtered, dry air or nitrogen of quality class 5, oil free, quality class 3 according to ISO 8573-1, filtration rating 40 µm.
Purge intake side	0.01 - 2 l/min depends on the intake pressure, few purge at low intake pressure, higher purge at high intake pressure.

Purge pressure side	6 l/min
Rotor purge	0.01 to 6 l/min
Gas ballast (ambient air)	DV 200/300: 100 l/min DV 500: 150 l/min
Pressure setting purge gas	2.2 - 3 bar

Note:

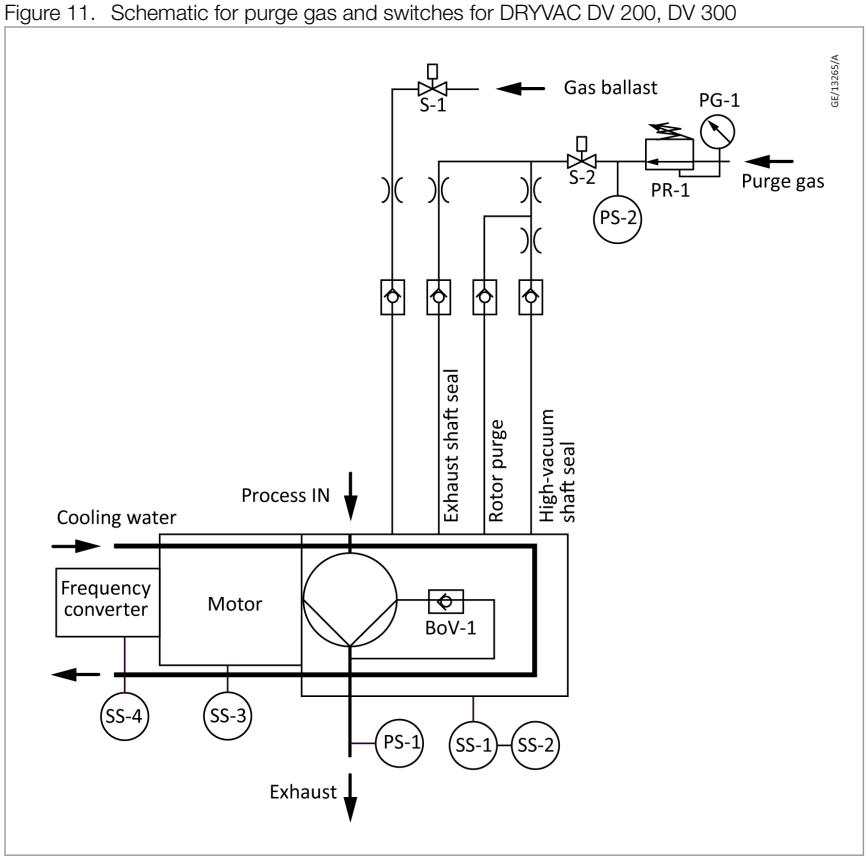
Operation without sufficient purge gas leads to premature wear of the shaft seals.

Polarity does not have to be observed when connecting the solenoid valves (24 V DC).

At the DRYVAC DV 500:

- inlet purge can be increased to 6 l/min by the valve S-3 (see *Figure: Schematic for purge gas and switches for DRYVAC DV 500*). This can additionally protect the seal in special processes due to a higher purge flow. The ultimate pressure will increase to around 1 mbar.
- gas ballast supply can be manually shut off or reduced by the valve MV-2 (see *Figure: Schematic for purge gas and switches for DRYVAC DV 500*).

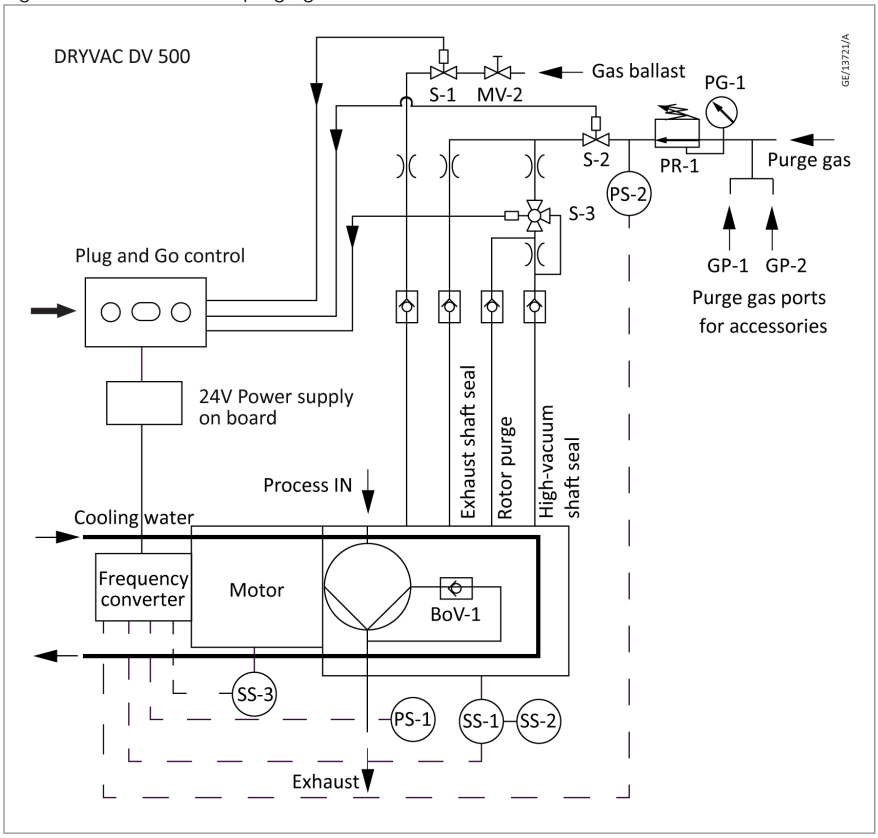
Figure 11. Schematic for purge gas and switches for DRYVAC DV 200, DV 300



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

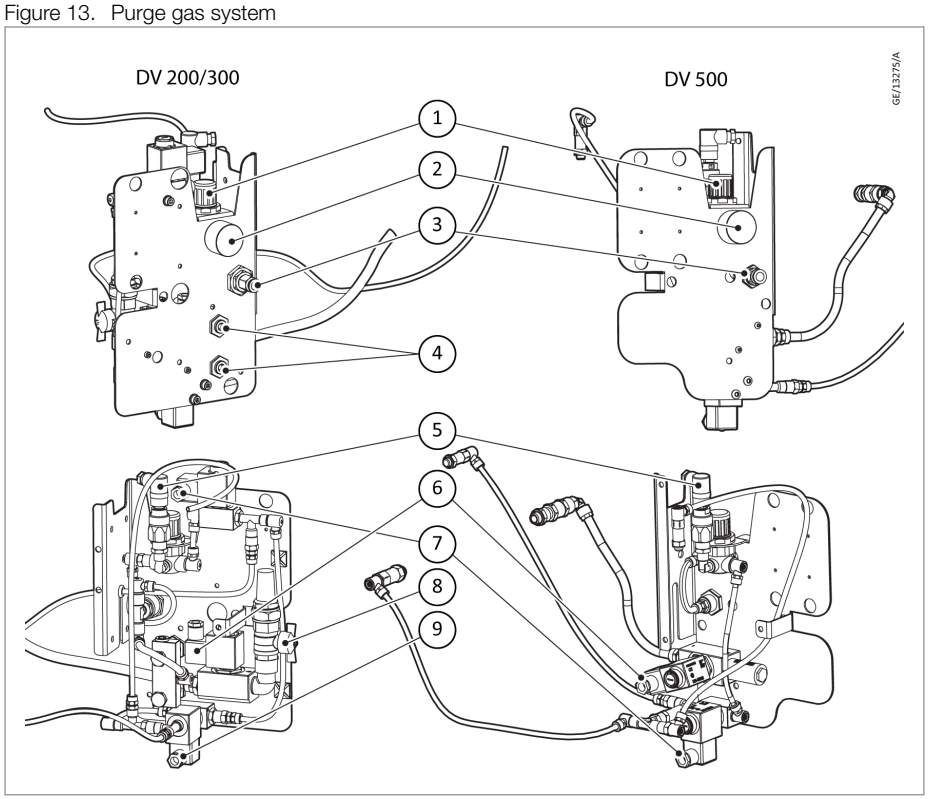
Installation

Figure 12. Schematic for purge gas and switches for DRYVAC DV 500



MV-2	Manual valve for ambient air gas ballast
S-1	Solenoid valve ambient air gas ballast
S-2	Solenoid valve purge gas
S-3	Solenoid valve for high-vacuum shaft seal
PG-1	Pressure gauge purge gas
PR-1	Pressure regulator purge gas
PS-1	Pressure switch exhaust
PS-2	Pressure switch purge gas
BoV-1	Blow off valve
SS-1	Temperature sensor (Pt 1000) pump warning
SS-2	Temperature sensor (Pt 1000) pump trip
SS-3	Thermal switch motor
)(	Flow restrictor
◇	Non-return valve

Figure 13. Purge gas system



1. *Purge gas pressure regulator*
2. *Purge gas pressure display*
3. *Purge gas IN*
4. *Prepared for accessories*
5. *Purge gas pressure switch*
6. *Gas ballast control valve (solenoid valve on/off)*
7. *Purge gas control valve (solenoid valve on/off)*
8. *Gas ballast flow vane*
9. *High vacuum purge gas control valve (low 0.01 slm / high 6 slm)*

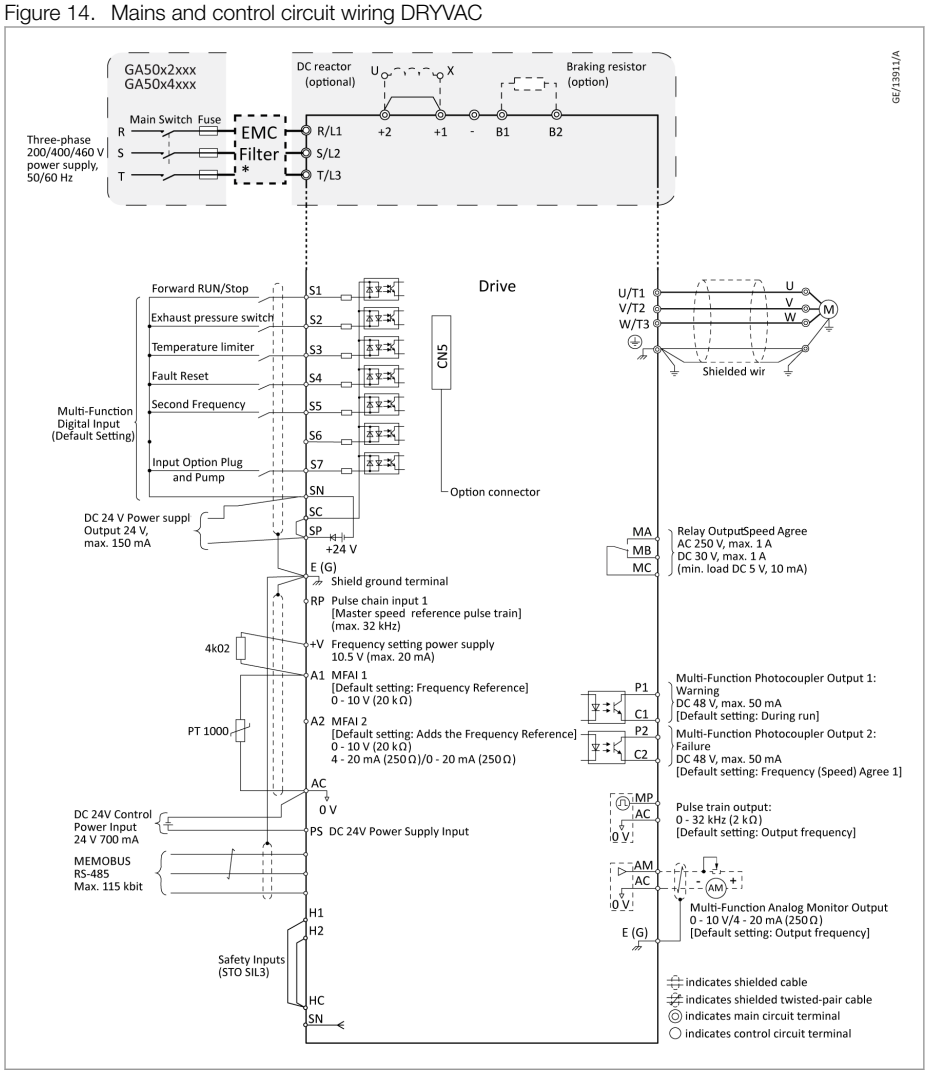
Switch position	Flow
On (open)	6 slm
Off (closed)	0.01 slm

Note:

The pump must be operated with purge. For this purpose, the purge gas control valve must be open.

Installation

Figure 14. Mains and control circuit wiring DRYVAC



**External EMC filter for 200 V.*

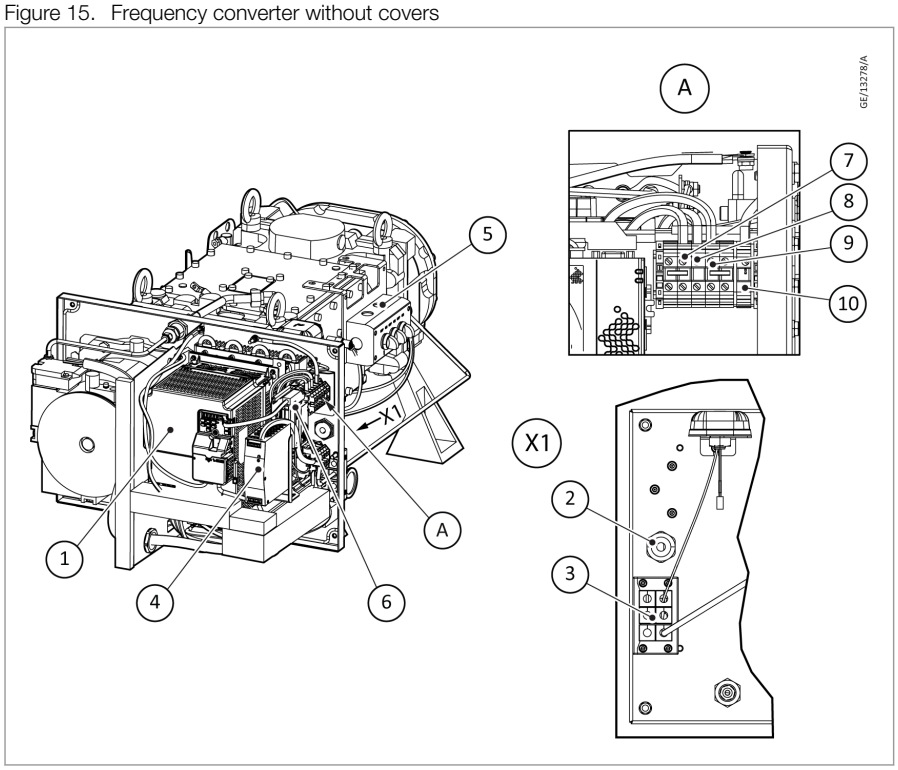
Note:

< 1 > Connected using sequence input signal (S1 to S7) from NPN transistor. Default: sink mode (0V com).

< 2 > Use only the +24 V internal power supply in sinking mode. The source mode requires an external power supply.

–

Figure 15. Frequency converter without covers



1. *Frequency converter*
2. *Feedthrough for mains connection*
3. *Cable entry frame*
4. *Power supply kit*
5. *Plug and go switchboard*
6. *Genius (IoT) kit*
7. *L1*
8. *L2*
9. *L3*
10. *PE*

6.6 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.

Installation

WARNING: ELECTRIC SHOCK

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

Electrical shock due to interruption of the protective conductor system. In the event of a fault, life-threatening voltages may be present on electrically conductive components. Before commissioning, check the resistance of the earthing cable and the suitability of the assigned overcurrent protection device.

WARNING: LIGHTNING STRIKE

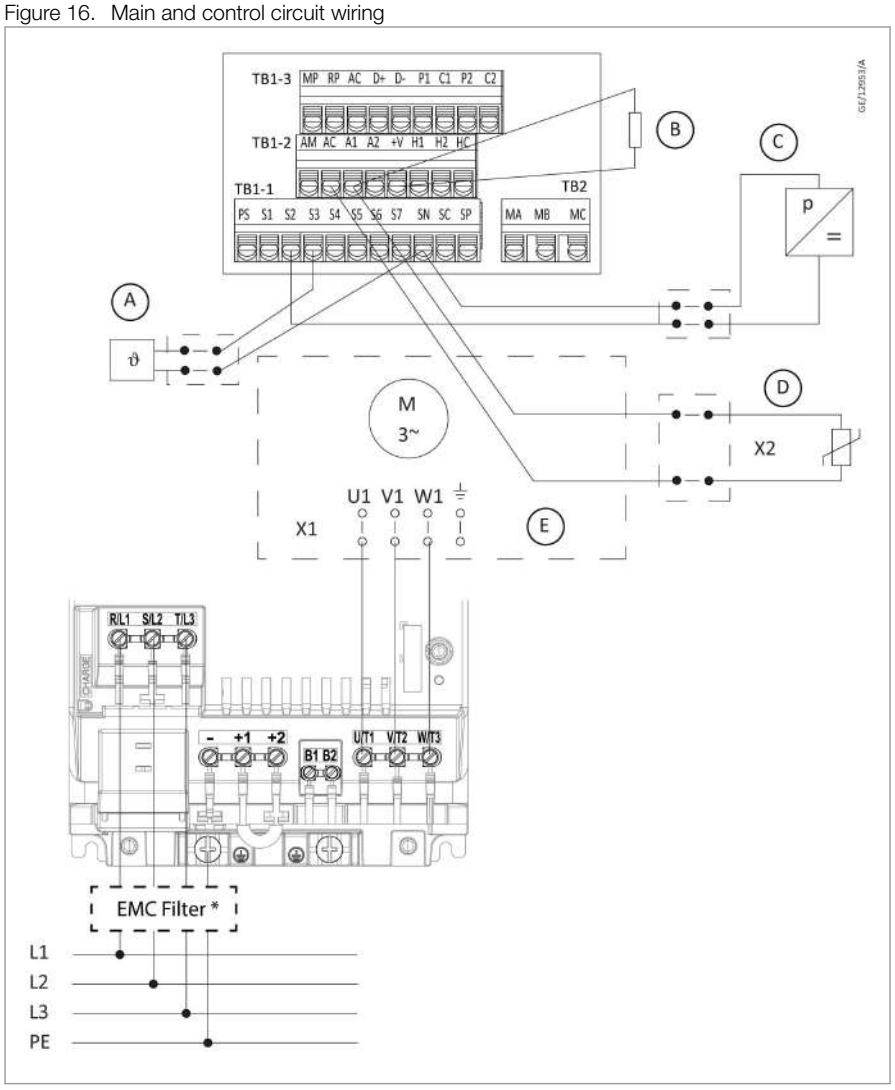
Risk of fire and injury from lightning strike. The operator is responsible for assessing the hazard potential when used outside of buildings.

Wiring the main circuit Input

Consider the following precautions for the main circuit input.

- Use fuses recommended in main circuit only, refer to *Technical data* on page 24. Do not use a motor protection switch.
- If using a ground fault circuit breaker, make sure that it can detect both d.c. and high frequency current.
- The pump has no circuit breaker. Therefore install a circuit breaker in the system. Arrange the circuit breaker in such a way that it is easy for the operator to reach and mark it in such a way that it can be identified as a disconnecting device for the DRYVAC.

Figure 16. Main and control circuit wiring



External EMC filter for 200 V.

Note:
TB = Terminal Block

Ground connection

Take the following precautions when grounding the frequency converter.

- Always connect the frequency converter to ground in accordance with the international and local regulations for equipment exhibiting an increased leakage current.
- Keep the ground wires as short as possible. The frequency converter produces leakage currents (typically less than 10 mA). In the case of unbalanced mains power supplies, the leakage current may exceed 10 mA. In this case the protective ground conductor must exhibit a cross-section of at least 10 mm^2 or connect a further protective ground conductor having at least the same cross-section as the connection cable. The connection screw must be secured against self-loosening by the customer. A connection point is provided, refer to *Figure: Connections for the DRYVAC DV 200, DV 300 and DV 500 (similar)*.

- 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.

Electromagnetic Compatibility (EMC)

By maintaining the operational conditions specified this product complies with the EMC emission limits for industrial production environments. For 200 V, refer to the EMC filter manual (Publication number - 301140450).

Note:

The frequency converter may, when deployed in residential areas, cause high-frequency interference. In such a case the operator of the unit will have to introduce additional measures for the purpose of suppressing high-frequency interferences.

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.

For 200 V, the internal filter does not comply with the requirements of EN61000-6-4. Connect the external filter in compliance with the EMC directive. When you connect the external filter make sure to deactivate the internal filter.

Figure 17. Symmetric grounding

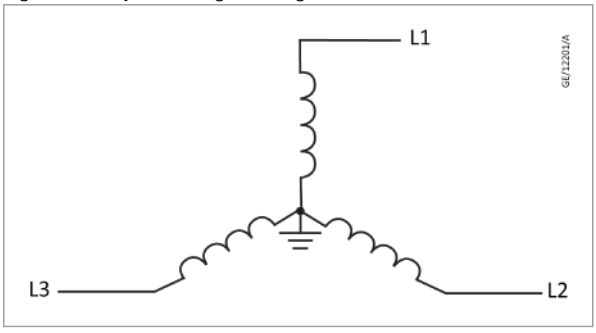
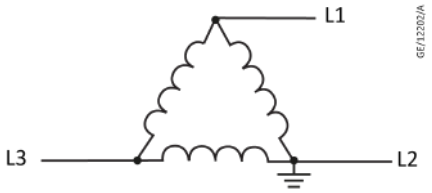
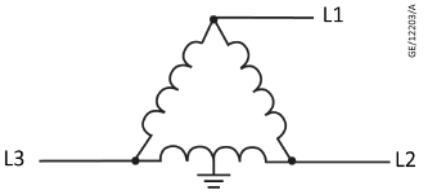
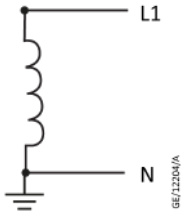
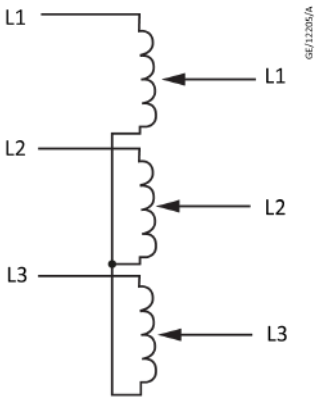


Table 6. Asymmetric grounding

Type of grounding	Diagram
Grounded at the corner of the delta connection	
Grounded at the middle of the side	
Single-phase, grounded at the end point	
Three-phase variable transformer without solidly grounded neutral	

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

Control circuit wiring precautions

Consider the following precautions for wiring the control circuits:

- Separate control circuit wiring from main circuit wiring and other high-power lines.
- For external control power supply use a UL Listed Class 2 power supply.
- Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults.

- Ground the cable shields with the maximum contact area of the shield and ground.
- Cable shields should be grounded on both cable ends.

Table 7 Main circuit terminals

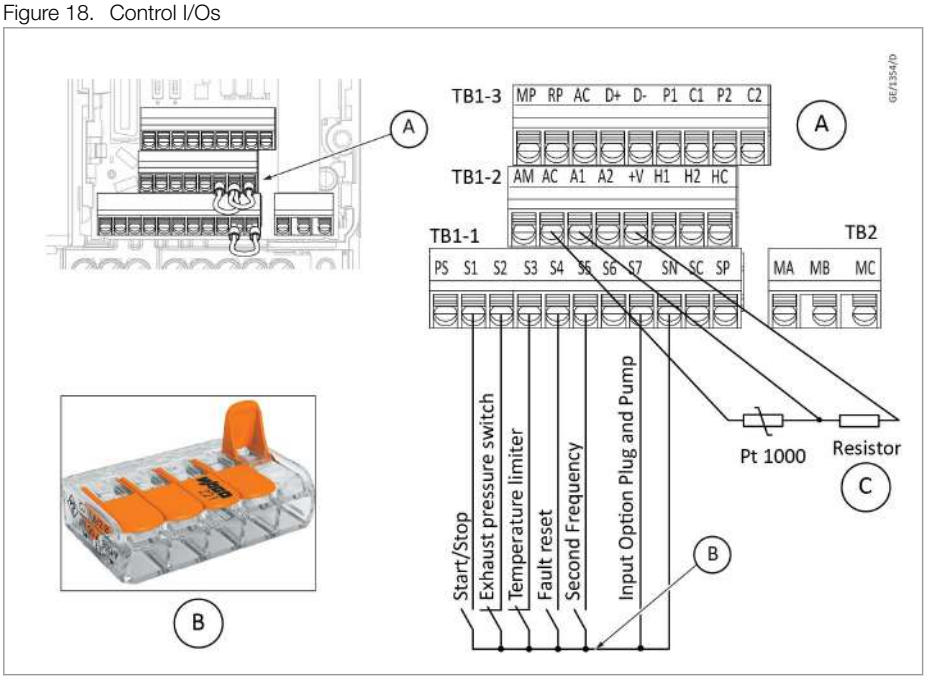
Terminal	Type	Function
R/L1, S/L2, T/L3	Main circuit power supply input	Connects line power to the frequency converter via line filter.
U/T1, V/T2, W/T3	Drive output	Connects to the motor.
B1, B2	Braking resistor	For connecting an optional braking resistor
+1 –	d.c. power supply input	For connecting a d.c. power supply.
⏚ (2 terminals)	Ground terminal	For 200 V class: Ground with 100 Ω or less For 400 V class: Ground with 10 Ω or less

Control with I/Os

Refer to *Figure: Control I/Os*.

The DRYVAC can be controlled via digital inputs and outputs. To do so, change the parameter b1-02 from 0 (RUN and STOP buttons) to 1 (digital inputs), see *Field-bus interface* on page 52.

Figure 18. Control I/Os



Note:

TB = Terminal Block

Use the 5-conductor connector at the SN clamp.

Refer to Option: Change the speed of the pump on page 58 for 2nd frequency.

Start/stop connection

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

Connect SN with S4 to reset an error message. Reset will not function as long as the error message is active. In addition, the start signal must be set to “0” before the reset.

To set a 2 nd frequency refer to *Option: Change the speed of the pump* on page 58.

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

The 5-conductor connector is connected to SN and sensors.

Sensors

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

The pump’s temperature sensor is connected to A1, AC and +V.

The temperature limiter is connected to S3 and SN.

For Plug and go

To start the pump when powered ON:

- Bridge wire SN to S1 through 5-conductor connector, so start signal is always ON.
- Change parameter B1-17=1 to accept existing Run Command.

Connect the purge gas module electrically

Refer to *Figure: Purge gas pressure switch connection*.

Connect the purge gas pressure switch and solenoid valves to your system control.

Table 8. Purge gas pressure switch

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

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

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

Polarity does not have to be observed when connecting the solenoid valves.

Table 9. Data for the solenoid coils

Parameter	Value
Voltage	24 V d.c.
Power consumption	8 W
Type of protection (DIN 40050)	IP 65
Cable screw connection	Pg 9

Connect the mains cable

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

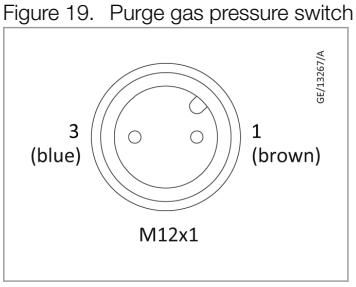
Connect the mains cable as shown in *Figure: Frequency converter without covers*. Use the M32 cable fitting for that purpose. The terminals are designed for 10 mm^2 max. cable diameter.

Remount the cover on the frequency converter.

Establishing potential equalisation

An M 6 thread is provided at the motor housing for connecting the external potential equalisation cable, see *Figure: Connections for the DRYVAC DV 200, DV 300 and DV 500*. The connection screw must be secured against self-loosening by the customer.

Figure 19. Purge gas pressure switch connection



6.7 Leak search after installation

On delivery, the pump is leak tight to 10^{-4} mbar·l/s (integral, leak-checked).

Leak-check all relevant connections after having installed the pump.

7 Operation

WARNING: EMISSION OF HAZARDOUS GAS

Danger as a result of rapid increase in pressure due to decomposition of pumped gases. Uncontrolled emission of process gases by reaction products within the pump. The pumping of exothermic substances, reactive gases, vapours or gas mixtures is generally prohibited. The operator is responsible for the assessment of the hazard potential of the process media or mixtures.

WARNING: HAZARDOUS SUBSTANCES

Dangers through escaping or emitting transported hazardous gases, vapours or substances. Process gases may escape from the exhaust and leaks in the vacuum system. The pumping of exothermic substances, pyrophoric, radioactive, oxidising gases or gas mixtures, as well as the pumping of oxygen of more than the atmospheric concentration (21 %) is generally prohibited. The operator is responsible for the assessment of the hazard potential of the process media or mixtures.

WARNING: EJECTION OF PARTS

Ejection of parts by bursting of the vacuum system due to excessive pressure caused by clogged or constricted exhaust. Pressure build-up in the vacuum system or exhaust pipes. Do not operate the vacuum system with the outlet closed or throttled.

Ejection of parts by bursting of the vacuum system due to excessive pressure caused by the pump running backwards after it has been switched off under vacuum. The danger of overpressure in the inlet lines and recipients as well as the uncontrolled backward running of rotors. In the event of a fault or during service, separate the vacuum pumps from the vacuum container and connecting lines before the inlet using suitable valves.

CAUTION: EXTREME SUCTION

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

CAUTION: TRIP HAZARD

Hazard of slipping, tripping or falling due to oil leakage from the pump. During transport or depending on the work process, the oil may escape from the vacuum pump. Risk of falling on oil spills. Check vacuum pump regularly for oil leaks. Take appropriate safety measures.

CAUTION: HOT SURFACES

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

Operation

CAUTION: HIGH NOISE LEVELS

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

7.1 Media compatibility

See *Conforming use* on page 20. For a list of materials in contact with the process gas, see *Technical data* on page 24.

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

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).

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.

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. The pump 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 *Electrical connection* on page 43, and for the information of Field-bus refer to *Field-bus interface* on page 52.

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.

7.4.1 LED operator and keys

After switching on, the display shows the output frequency in the delivery state (U1-02). The Pt1000 temperature can be read out in U07-03

7.4.2 LED operator keys

For DV 200, DV 300 and DV 500

The display shows the output frequency in the delivery state (U1-02). The Pt1000 temperature can be read out in U07-03.

Figure 20. LED operator

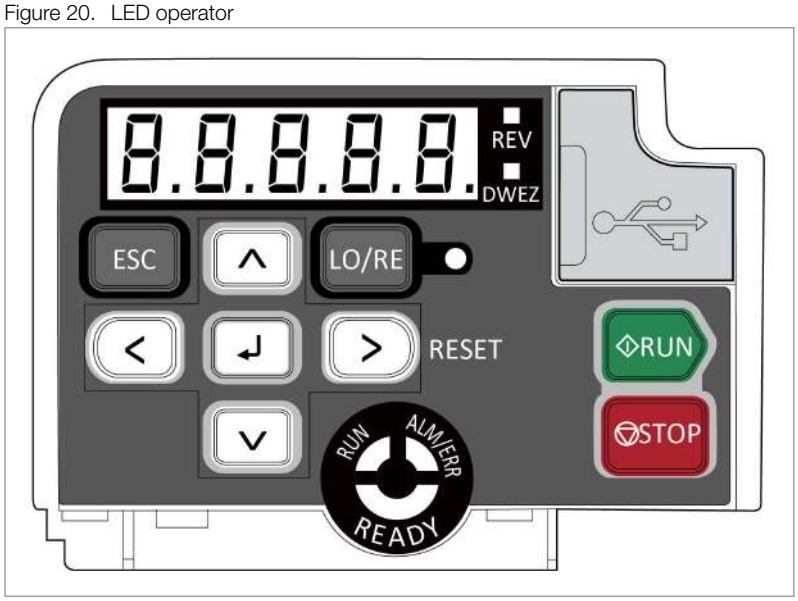


Table 10 Keys and functions

Display	Name	Function
8.8.8.8.8.	Data display area	Displays the parameter, errors and other data
RUN	RUN key	Starts the drive in the LOCAL* mode, if control is set to LOCAL.
STOP	STOP key	Stops drive. Uses a stop-priority circuit. This will also apply when a Run command (REMOTE Mode) is active at an external Run command source. To disable STOP priority, set o2-02 = 0 [STOP Key Function Selection = Disabled].
LO/RE	LO/RE selection key	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE) *. The LED is on when the drive is in the LOCAL mode (operation from keypad).
ALM/ERR	ALM LED light	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 light	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 light	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 energised 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*

7.4.3 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.

Refer to *Electrical connection* on page 43, connect S1 to SN, to start.

The frequency converter is programmed for this pump. The parameter access is limited. The default output frequency can be changed in the programming mode between 0 Hz and 110 Hz (DV 200) or 125 Hz (DV 300) or 250 (230) Hz (DV 500).

Description	Parameter in programming mode	Setting
Standard output frequency reference	d1-01	110 Hz for DV 200 125 Hz for DV 300 125 Hz for DV 500 230 Hz for DV 500 (LVO 410)

The DV 500 has a 4-pole motor. The pump frequency corresponds to half of the field frequency specification in the frequency converter.

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

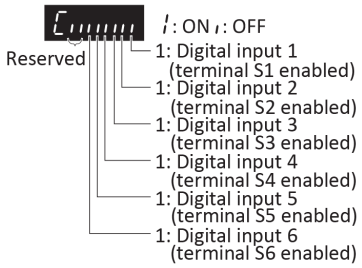
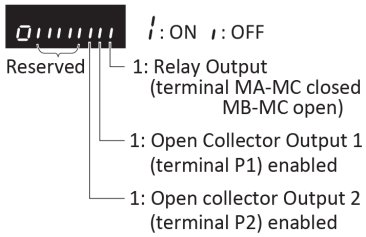
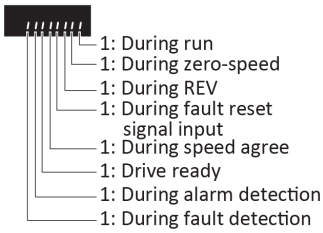
7.4.4 Monitor parameter

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

Table 11. Monitor parameter

Monitor	Description
U1-01	Frequency reference (Hz)
U1-02	Output frequency (Hz)
U1-03	Output current (A)
U1-05	Motor speed (Hz)
U1-06	Output voltage reference (V a.c.)
U1-07	DC bus voltage (V d.c.)
U1-08	Output power (kW)
U1-09	Torque reference (% of motor rated torque)

Operation

Monitor	Description
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
Fault trace	
U2-01	Current fault
U2-02	Previous fault
U2-03	Frequency reference at previous fault
U2-04	Output frequency at previous fault
U2-05	Output current at previous fault
U2-06	Motor speed at previous fault
U2-07	Output voltage at previous fault
U2-08	DC bus voltage at previous fault
U2-09	Output power at previous fault
U2-10	Torque reference at previous fault
U2-11	Input terminal status at previous fault

Monitor	Description
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.*

7.4.5 Relay option board

Figure 21. Relay option board - Connections

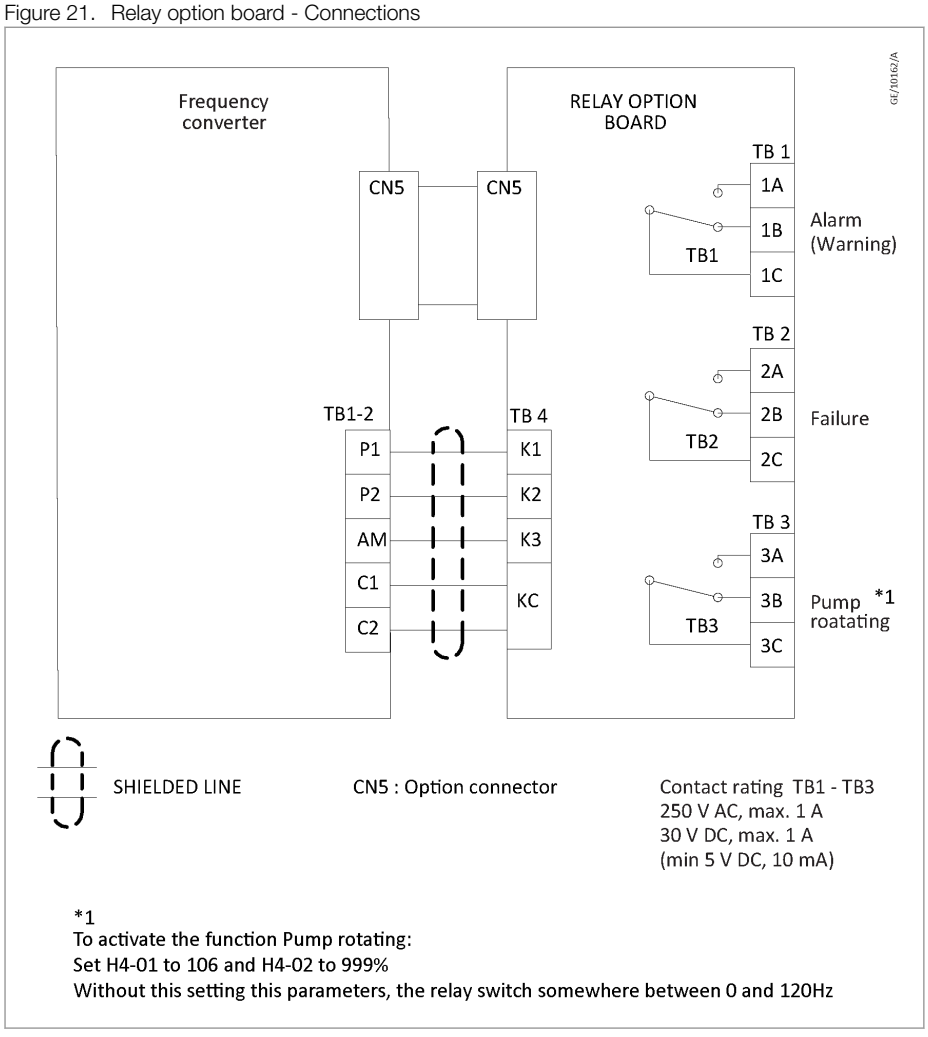


Table 12. Terminal block

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

7.4.6 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 (DV 200 and DV 300) or 40 Hz (DV 500).

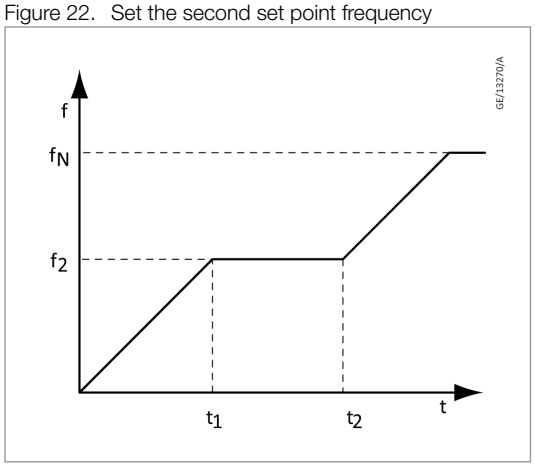
The DV 500 has a 4-pole motor. The pump frequency corresponds to half the field frequency specification in the frequency converter, i.e. for all pumps the minimum speed is 1200 rpm.

Set the second setpoint frequency

Enter the desired second frequency through the parameter d1-03 (default 0 Hz, allowed input range 0 Hz to 120 Hz). Closing of the switch between the digital input S5 and SN will enable the second frequency.

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

Figure 22. Set the second set point frequency



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

Control the speed through a voltage input

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

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

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

Connect the control voltage to terminals A2 and AC. 0 to 10 V, 0 V corresponds to 0 Hz, 10 V corresponds to 120 Hz, linear increase.

Control the speed through a current input

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

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

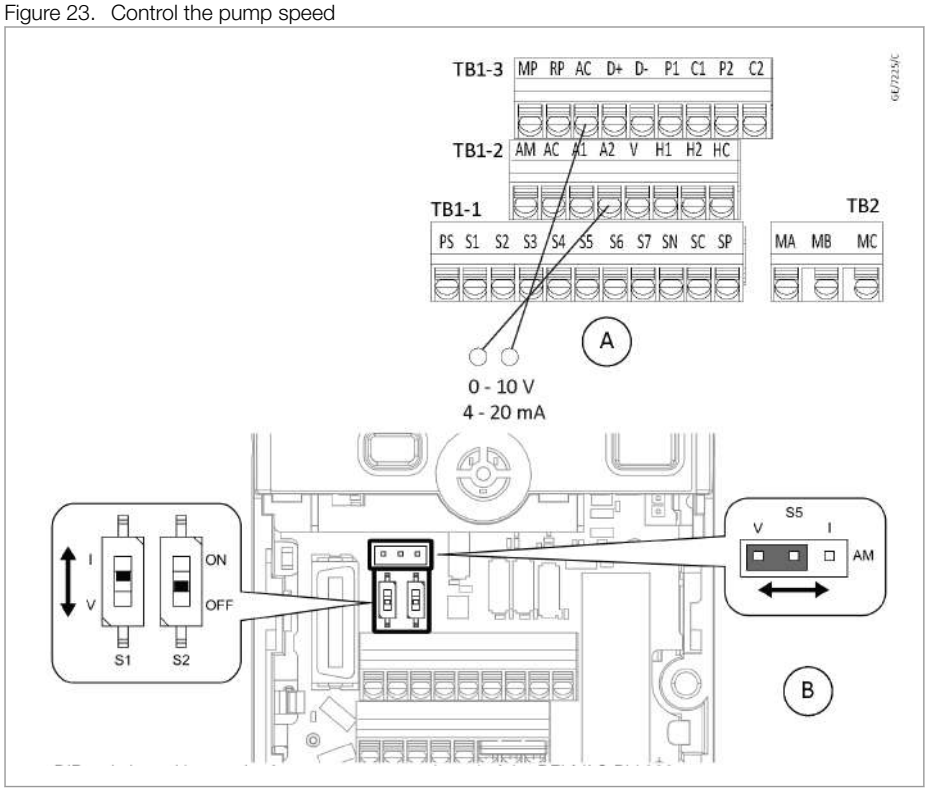
DIP switch S2 must be in off position.

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

Connect the control current to terminals A2 and AC. 4 to 20 mA, 4 mA corresponds to 0 Hz, 20 mA corresponds to 120 Hz, linear increase.

Operation

Figure 23. Control the pump speed



A. Controlling the speed through a voltage or current input

B. DIP switch position on the frequency converter board of the pump

Table 13 Warning and shut-off thresholds

Parameter	Designation	Warning threshold	Shut-off threshold	Processing by	Fault display
Exhaust pressure (Pressure difference to ambient pressure)	PS-1	-	250 ± 50 mbar	frequency converter	EF2
Purge gas supply pressure	PS-2	-	2.2 bar(g)	customer PLC	-
Temperature pump Motor side (temperature sensor Pt 1000)	SS-1 SS-2	90/91 °C	100 °C	frequency converter	PTFT
Temperature pump motor side (temperature sensor Pt 1000) DV 500 Cat.3	SS-1 SS-2	60 °C	65 °C	frequency converter	PTFT

Parameter	Designation	Warning threshold	Shut-off threshold	Processing by	Fault display
Temperature motor	SS-3	-	70 °C	frequency converter	EF3
Frequency converter temperature	SS-4	105 °C	110 °C	frequency converter	oH oHi

Note

For the DV 500 Cat. 3 the exhaust pressure is limited to +100 mbar.

7.4.7 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 purge gas quantity such that even under the most unfavourable circumstances no explosive mixture can occur that 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.

7.4.8 Pumping of 100 % Argon

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

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.

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.

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

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

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 14 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.

- Make sure that the process valve is closed if the process pump stops suddenly.
- 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.
- 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 61.

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

WARNING: UNEXPECTED RESTART

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

CAUTION: HOT EQUIPMENT

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

CAUTION: HIGH PRESSURE GAS

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

8.1 Maintenance intervals

Refer to the *Table: Maintenance intervals* 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 14. Maintenance interval

Service work	Interval
Check the oil level	1 week
Check the water hoses	6 months
Check the purge gas hoses	6 months
Oil change for synthetic oil	1 year
Oil change for PFPE	Not required
Replace the blow off valve	1 year
Complete overhaul in the service centre	4 years or 32000 operating hours
Check the leakage on the entire pump system	After all maintenance and assembly work and upon request

8.2 Change the oil

CAUTION: MAINTENANCE SAFETY

Risk of damage to the equipment. Refer to *Electrical hazards* on page 13, *Thermal hazards* on page 14, *Hazards caused by materials and substances* on page 14 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. When you do the maintenance of the pump, check the wiring and make sure that all the screws tight.

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.

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

Change the synthetic oil more frequently if you pump corrosive vapours or large amount of dust.

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 to *Accessories* on page 79.

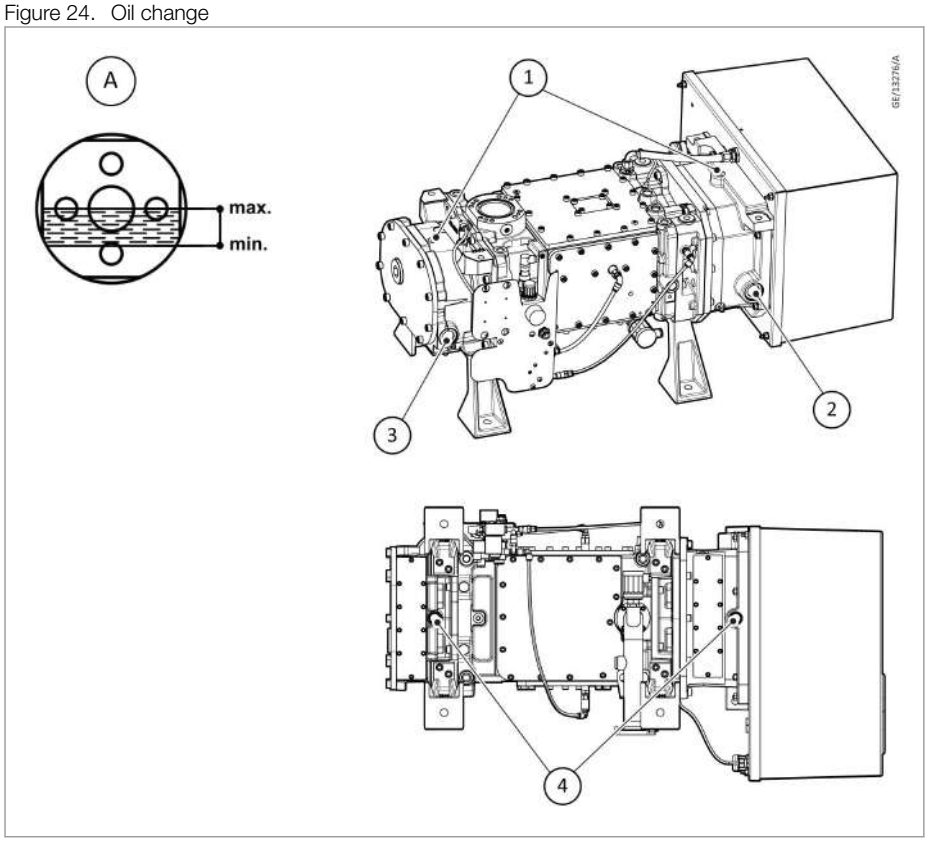
Observe the correct oil fill levels for the shutdown (standing still) pump.

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 24. Oil change



A. Oil level at pump standstill

1. Oil fill plugs
2. Oil level glass motor side
3. Oil level glass intake side
4. Oil drain plugs

9 Fault finding

Table 15 Fault finding

Symptoms
Pump does not start. EF2, EF3 or 100FT is displayed at the frequency converter on page 66
Pump gets too hot. At the frequency converter a Pt 1000 alarm is indicated on page 66
Pump is extremely loud on page 67
Motor power consumption is too high on page 67
Pump is too loud on page 68
Pump is losing lubricant (Lubricant leak is apparent) on page 68
Pump is losing lubricant (Lubricant leak is not apparent) on page 68
Oil gets too dark on page 69
Lubricant in the pump chamber on page 69
Pump does not attain its pumping speed on page 69

Fault	Pump does not start. EF2, 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 Pt 1000 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.

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 Pt 1000 alarm is indicated* on page 66.

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.**
Remedy	Contact us.
Cause	**Motor rotor is defective.**
Remedy	Contact us.
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.**
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.
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.
Cause	**Oil level glass leaks**
Remedy	Contact us.
Cause	**Gear cover leaks**
Remedy	Replace the O-ring of the gear cover.
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.**
Remedy	For remedy, refer *Lubricant in the pump chamber* on page 69.

Fault	Oil gets too dark
Cause	**Oil has been used up.**
Remedy	LVO 210: Exchange the oil. LVO 410: Contact us.
Cause	**Pump gets too hot.**
Remedy	Refer *Pump gets too hot. At the frequency converter a Pt 1000 alarm is indicated* on page 66. 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
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.

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 up 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 16 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.
CPF25	Control Circuit Fault		■	There is no terminal board connected to the control board.	Check if the terminal board is installed properly. Uninstall and re-apply the terminal board. Change the frequency converter.
CrST	Cannot Reset	■		Fault reset was input when a Run command was active.	Turn off the Run command and reset the frequency converter.

Error message	Brief description	AL	FLT	Possible cause	Corrective action
EF0	Option External Fault	■	■	An external fault was tripped by the upper controller via an option card.	Remove the fault cause, reset the fault and restart the frequency converter. Check the upper controller programme.
EF	External Fault	■		A forward and reverse command were input simultaneously for longer than 500 ms.	Check the sequence and make sure that the forward and reverse input are not set at the same time.
EF1 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.

Fault finding

Error message	Brief description	AL	FLT	Possible cause	Corrective action
oH or oH1	Heatsink Overheat	■	■	Surrounding temperature is too high. The cooling fan has stopped. The heatsink is dirty. The airflow to the heatsink is restricted.	Check the surrounding temperature and install cooling devices if necessary. Check the frequency converter cooling fan. Clean the heatsink. Check the airflow around the heatsink.
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.
ou	DC Overvoltage	■	■	DC bus voltage is too high. The deceleration time is too short. Stall prevention is disabled1. Unstable motor control. Too high input voltage.	Increase the deceleration time. Enable stall prevention by parameter L3-04. Check motor parameter settings and adjust torque and slip compensation, AFR and hunting prevention as needed. Make sure that the power supply voltage meets the frequency converters specifications.
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.
Uv1	DC Undervoltage	■	■	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.
Uv2	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.
Uv3	DC Charge Circuit Fault		■	The charge circuit for the DC bus is broken.	Cycle power to the frequency converter. Check if the fault reoccurs. Replace the frequency converter if the fault reoccurs.

Error message	Brief description	AL	FLT	Possible cause	Corrective action
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)	
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.	

Error message	Brief description	AL	FLT	Possible cause	Corrective action
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.

Table 17 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.

Error message	Possible cause	Corrective action
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 to *Remove from service on page 62.*

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

Temperature (only for storage without cooling water)	-30 °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).

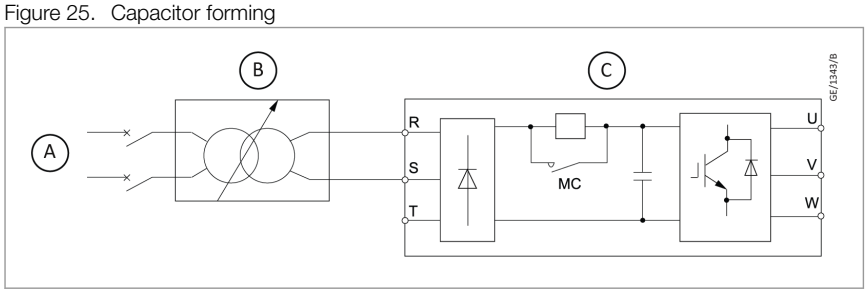
Capacitor forming – What has to be observed when an inverter was longer than 2 years on stock?

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 25. Capacitor forming



11 Disposal

11.1 Waste 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 78.

11.2 Disposal of waste oil

Owners of waste oil are responsible for the proper disposal of this waste.

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

Waste oil from vacuum pumps (Manufacturer's oils are based on mineral oils) which are contaminated due to the influence of oxygen in the air, high temperatures or mechanical wear must be disposed of through a local waste oil disposal system.

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

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

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

Symbols on the vacuum device

	Do not dispose of the vacuum device as residual waste. Dispose of it in accordance with the applicable local regulations.
	China RoHS: Products marked with this symbol contain residual quantities of substances that are subject to quantitative regulation in accordance with Chinese Directive GB/T 26552. These parts can safely be used for the environmental protection use period (20 years) as indicated and should enter into the recycling system after their environmental protection use period.

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.

13 Accessories

Accessory	Part number	
	DV 200/300	DV 500
Synthetic ester oil, LEYBONOL LVO 210, 5 litres	L21005	
PFPE LEYBONOL LVO 410, 1 litre	L41001	
Profibus module for DRYVAC DV / DV-r	112005A78	
ProfiNet module for DRYVAC DV / DV-r	112005A75	
EtherCAT module for DRYVAC DV / DV-r	112005A76	
Relay module (digital output) for DV / DV-r	112005A70	
Ethernet module (dual port) for DRYVAC DV / DV-r	112005A72	
Adapter for:		
▪ RUVAC WHx501/WH700	112004A03	112003A03
▪ RUVAC Wx(U)1001	112004A04	112003A04
▪ RUVAC Wx(U) 2001	112004A05	112003A05
▪ RUVAC WH(U) 2500	112004A07	112003A07
▪ RUVAC WH(U) 4400/7000	-	112003A10
Non-return valve DRYVAC, DN 40 KF	115005A01 (must only be installed vertically)	
Elbow 90° DN 40 KF, stainless steel	88464	
Spring loaded disc check valve 63 ISO-K	112004A14	112003A14
Silencer, DN 40 KF	115005A21	-
Silencer, required rubber feet	-	119002 112003A35
Silencer DN 63 stainless steel, serviceable	-	112003A36
BoV plug accessory	112004A10	
BoV Kit Valve ball PEEK 450CA30	112004A11	
Flush-Kit / SV	112004A33	
Inlet Purge Kit / SV	112004A34	
Purge bracket - Plug and go	E6547518	
Plug and go kit	G6547692	
24 V Power supply (optional)	G6547008	
Genius kit	175001A01	

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

13.1 Ordering information

DRYVAC industrial (synthetic oil)	ATEX	Part number
DV 200, 400 V	-	112020V15
DV 200, 200 V	-	112020V19
DV 300, 400 V	Cat. 3i	112030V11

DV 300, 400 V	-	112030V15
DV 300, 200 V	-	112030V19
DV 500, 400 V	-	112050V15
DV 500, 200 V	-	112050V19
DV 500, 400 V	Cat. 3i	112050V11
DV 500, 400 V Plug and Go	-	112050V75

DRYVAC PFPE	ATEX	Part number
DV 200, 400 V	-	112020V25
DV 200, 200 V	-	112020V19
DV 500, 400 V	-	112030V11
DV 500, 400 V (no BoV)	-	112050V24

13.2 Wearing parts

Table 18. Wearing parts

Accessory	Part number
Gasket for plug screw G 3/8 (oil fill plug)	ES23955165

P20050086A

EU Declaration of Conformity

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

Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

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

The product specified and listed below

- Product: Screw vacuum pump - with motor
- Models: DRYVAC DV e f — e = 200, 300, 500 (pumping speed), f = 200V, 400V (motor variant)
- Pump family codes: 1120yyVzz — yy = 20, 30, 50 (pumping speed), zz = 00-99 (pump variants)

Is in conformity with the relevant Union harmonisation legislation:

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

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

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 60204-1:2018	Safety of machinery. Electrical equipment of machines. General requirements
EN 61000-6-2:2005	Electromagnetic Compatibility (EMC) - Part 6-2: Generic Industrial Immunity Standard
EN 61000-6-4:2007 +A1:2011	Electromagnetic Compatibility (EMC) - Part 6-4: Generic Industrial Emission Standard
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

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: *2022-02-25*

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

Axel Guddas – General Manager
Product Company Cologne

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

P20050086A

Declaration of Conformity

Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

Documentation Officer
Innovation Drive
Burgess Hill
West Sussex
RH15 9TW
documentation@leybold.com

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

- Product: Screw vacuum pump - with motor
- Models: DRYVAC DV e f — e = 200, 300, 500 (pumping speed), f = 200V, 400V (motor variant)
- Pump family codes: 1120yyVzz — yy = 20, 30, 50 (pumping speed), zz = 00-99 (pump variants)

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
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

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: *2022-02-25*

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

Axel Guddas – General Manager
Product Company Cologne

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU, UK): 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

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.

TSCA PBTs (US)

Regulation of Persistent, Bioaccumulative, and Toxic Chemicals Under TSCA Section 6(h)
The product does not knowingly or intentionally contain substances in contravention with the above requirements.

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 CSA-C22.2 No.61010-1-12	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
Product is certified to UL61010-1 3rd Edition	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
cTUVus Certificate No.	CU 72200696

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

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

P20050084A

EU Declaration of Conformity

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

Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

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

The product specified and listed below

- Product: Screw vacuum pump - with motor
- Models: DRYVAC DV 300, DV 500
- Pump family codes: 112030V11, 112050V11

ATEX Marking:

II 3/- G Ex h IIC T3 Gc/-
5°C ≤ Ta ≤ 40°C
(Internal atmospheres only)

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

2006/42/EC	Machinery directive *Note: The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Annex 1 No. 1.5.1 of this directive.*
2014/34/EU	ATEX directive on use in potentially explosive atmospheres
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

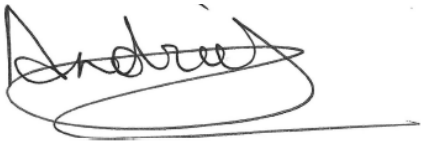
Based on the relevant requirements of harmonised standards:

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 ISO 80079-36:2016	Explosive atmospheres – Part 36: Non-electrical equipment for explosive atmospheres. Basic method and requirements
EN ISO 80079-37:2016	Explosive atmospheres - Part 37: Non-electrical equipment for explosive atmospheres -- Non-electrical type of protection constructional safety ''c'', control of ignition sources ''b'', liquid immersion ''k''
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
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

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: *2022-02-25*

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

Axel Guddas – General Manager
Product Company Cologne

P20050084A

Declaration of Conformity

Leybold GmbH
Bonner Strasse 498
D-50968 Köln
Germany

Documentation Officer
Innovation Drive
Burgess Hill
West Sussex
RH15 9TW
documentation@leybold.com

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

- Product: Screw vacuum pump - with motor
- Models: DRYVAC DV 300, DV 500
- Pump family codes: 112030V11, 112050V11

ATEX Marking:

II 3/- G Ex h IIC T3 Gc/-
5°C ≤ Ta ≤ 40°C
(Internal atmospheres only)

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.

Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016

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 ISO 80079-36:2016	Explosive atmospheres – Part 36: Non-electrical equipment for explosive atmospheres. Basic method and requirements
EN ISO 80079-37:2016	Explosive atmospheres - Part 37: Non-electrical equipment for explosive atmospheres -- Non-electrical type of protection constructional safety ''c'', control of ignition sources ''b'', liquid immersion ''k''
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
EN IEC 63000:2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

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: *2022-02-25*

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

Axel Guddas – General Manager
Product Company Cologne

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU, UK): 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

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.

TSCA PBTs (US)

Regulation of Persistent, Bioaccumulative, and Toxic Chemicals Under TSCA Section 6(h)
The product does not knowingly or intentionally contain substances in contravention with the above requirements.

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 CSA-C22.2 No.61010-1-12	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
Product is certified to UL61010-1 3rd Edition	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
cTUVus Certificate No.	CU 72200696

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

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

This page has been intentionally left blank.

Leybold

Pioneering products. Passionately applied.

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