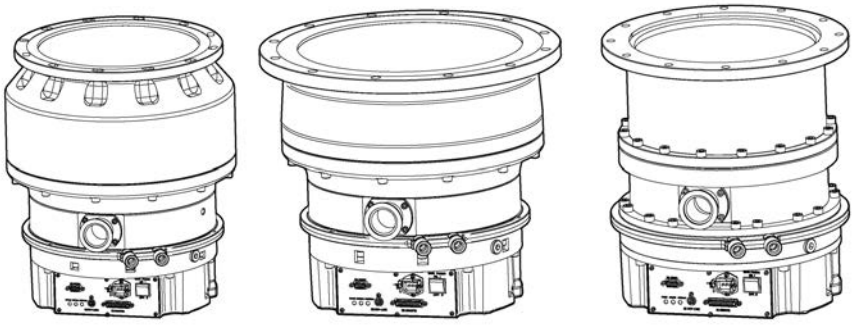
Leybold

MAG 2207 iS - MAG 3207 iS

Turbomolecular Pump with Magnetic Bearing and Frequency Converter

Instruction manual

Operating instructions 300779170_002_C2



Part No.
4122XXV7XXX
4128XXV7XXX
4132XXV7XXX

Original instructions

Copyright notice

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Associated publications

Publication title	Publication number	Link
Profibus interface	300802429	*https://4vac.io/4g9c4d*
RS232/485 interface	300976247	*https://4vac.io/p9fx4q*
Purge gas and venting valves	GA05296	*https://4vac.io/65zx1o*
Purge gas and venting valves	GA05286	*https://4vac.io/bo9axf*
Purge gas valve adapter set	300812673	*https://4vac.io/eqpqed*

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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*.

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1 Safety and compliance

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

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

1.1 Definition of Warnings and Cautions

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

WARNING:

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

CAUTION:

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

NOTICE:

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

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

1.2 Trained personnel

For the operation of this equipment “trained personnel” are:

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

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 - Dangerous voltage** Risk of injury. Identifies possible sources of hazardous electrical shock.
	**Warning - Heavy object** Risk of injury or damage to equipment. Identifies a possible hazard from a heavy object.
	**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** Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.
	**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.
	**Warning - Vacuum hazard** Risk of injury. Identifies the source of a dangerous vacuum.
	**Mandatory - Read the manual** Failure to comply with this action may result in injury or damage to equipment.

Safety and compliance

	**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.
	**Symbol - Protective earth** Identifies an electrical equipment earth (ground) terminal.

2 Important safety information

CAUTION: DANGEROUS VOLTAGE

Risk of electric shock and damage to the equipment. Make sure that the mains power supply is switched off before you connect or disconnect the mains cable.

The frequency converter must only by opened by certified service engineers. Opening by unauthorised personnel voids the warranty.

2.1 Mechanical hazards

1. Avoid exposing any part of the human body to vacuum.
2. The pump is intended for generating a vacuum only. If there is a risk of an overpressure within the system and the pump, then the pump must be protected against this by an overpressure safety valve, for example.
3. Vent the pump only up to atmospheric pressure.
4. When using the pump with a purge gas valve, protect the purge gas supply so that in the event of a malfunction no overpressure can occur within the system.
5. The pump must be firmly mounted to the vacuum chamber. If the mounting is not sturdy enough, pump blockage could cause the pump to break loose and internal pump components could be thrown in all directions.
6. Do not operate the pump (in bench testing, for example) without proper flanging to the vacuum chamber. Refer to *Attach the pump to the vacuum chamber* on page 28.
7. We recommend an overhaul after 10 years or 10000 cycles when pumping clean gases. For other applications contact us. Due to high-speed and temperature, the service life of the rotor is limited. If the rotor is changed too late it can be destroyed. Thus in the flange mounts high forces and torque conditions can occur. The mounting screws for the pump may be torn off. When using clamped flange connections at the housing or with components above the housing, sudden twisting of the entire pump can be experienced.
8. Turbomolecular pumps as described in the following operation manual contain a high portion of kinetic energy due to their high rotational speed in combination with the specific rotor mass. In case of a malfunction of the system, for example, rotor/stator contact or even a rotor crash, the rotational energy is released.
9. To avoid the risk of injury or damage to the equipment, follow the installation instructions as given in this manual.

2.2 Electrical hazards

WARNING: DANGEROUS VOLTAGE

Risk of injury. Lethal voltages are present at the mains connections. Before starting any maintenance or service work, de-energise (lockout/tagout) the product first. Obey the safety instructions given below when you work on the equipment.

1. The electrical connection must only be provided by a trained person. Please observe the national regulations in the country of use like EN 50110-1 for Europe, for example.

2. Only unplug connectors when the mains voltage is switched off and the pump is no longer turning.
3. Unauthorised device conversion and modifications are prohibited for safety reasons.
4. The outputs at the frequency converter are not free of voltage.
5. Hazardous voltages are present within the frequency converter. When coming into contact with these, death or severe injury can result. After the pump has arrived at standstill, disconnect the frequency converter from the mains power and prevent it against being switched on inadvertently (lockout/tagout) before opening it. There is no reason why the frequency converter should be opened because there are no user serviceable parts inside.
6. Lay connecting lines so that they cannot be damaged. Protect the lines against humidity and contact with water. Avoid any heat stress on the line due to unfavourable laying conditions.
7. Suitably support the connecting lines so that the pumps are not exposed to any major mechanical stress.
8. Do not expose the pump and the connections to dripping water. Note the information on the IP type of protection.
9. When storing the pump in a humid atmosphere, it can suffer corrosion. Corrosion gives rise to conductive deposits which in turn can cause short-circuits and reduce the insulation levels of electrical components.
10. Transport the pump only in its original packaging to prevent any mechanical damage which in turn may reduce air gaps and creepage distances.
11. When applying external voltages above 42 V to the connection terminals, observe the applicable VDE safety regulations.
12. Make the electrical connections only after pump and accessories (for example, air cooler) have been installed mechanically.

2.3 Thermal hazards

WARNING: HOT SURFACE

Risk of burn. During the operation of the pump certain areas can get hot (80 °C maximum). Protect hot parts against being touched.

1. Handle the pump only while vented and after having let it cool down.
2. Note the warning information on the housing surface. If these warning notices have been removed, covered or obstructed, include corresponding additional warning information.

2.4 Hazards caused by materials and substances

WARNING: HAZARDOUS MATERIALS

Risk of injury. Contaminated parts can be detrimental to health and environment. Before beginning any work, find out whether any parts are contaminated. Observe the relevant regulations and take the necessary precautions when handling contaminated parts. Obey the safety instructions given below when you work on the equipment.

1. The pump is not suitable for pumping reactive or corrosive media. The rotor may get damaged due to process gases. Thus in the flange mounts, high forces and torque conditions can occur. The mounting screws for the pump may be torn off. When using clamped flange connections at the housing or with components above the housing, sudden twisting of the entire pump can be experienced.
2. The operator of the system must ensure that no plasma is to enter the pump. Otherwise it may lead to a failure of the pump.
3. When pumping dusty media, use a dust filter.
4. If low concentration corrosive or reactive gases are being pumped, then operate the pump with purge gas.
5. Consult with us for which types of pumps are required for specific processes and applications.
6. The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity. Do a leak check after you install the pump and after every service on the vacuum system. Upon delivery, the pump has an integral leak rate of $< 1 \times 10^{-8}$ mbar·l/s. Do a leak check regularly, when pumping toxic gases.
7. If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection. Before opening the pump, purge it for a longer period with an inert gas. If necessary, use gloves, a respirator and/or protective clothing and work under an exhaust hood. Firmly seal off the pump. When shipping the contaminated pump for servicing, also state the type of hazard. For this you must use a form which we have prepared for you.

2.5 Ignition hazards

WARNING: IGNITION HAZARD

Risk of injury. Sparks could occur. In case of damage to the pump, this can ignite the explosive mixtures. Check the pump at regular intervals for damage.

During operation, the pressure inside the turbomolecular pump is so low that there is no risk of ignition (at pressures less than 100 mbar). A hazardous condition will be created if flammable mixtures enter the hot pump at pressures more than 100 mbar. During operation, the pump can reach temperatures as high as 120 °C internally, and 80 °C at parts of the outside surfaces. Also, note the safety information provided by the gas supplier.

2.6 Risk of damaging the pump

1. Do not touch the rotor. It can cause injury and damage the rotor bearing.
2. Foreign objects which enter the pump through the intake can cause serious damage to the rotor. To avoid damage install an inlet screen. Damage caused during operation without an inlet screen are excluded from warranty.
3. The contact surfaces of the pump housing, vacuum system and centring ring must be dry and free of grease to ensure sufficient stability in case the rotor seizes.

4. Only connect and disconnect the cable connections between the pump and power supply when the pump is not turning (green status LED off) and with the mains power switched off (yellow power LED off). Otherwise there is a risk of damaging the frequency converter.
5. Do not stop the pump with the mains. Switching off the mains while the pump is running will wear out the touch down bearings.
6. Exposure of the pump to accelerating forces must be avoided or prevented to such an extent that the rotor will not be affected by vibrations. In the case of critical applications you must consult our applications department first.
7. Connect the pump in an EMC compliant manner to avoid line related interference.

Note:

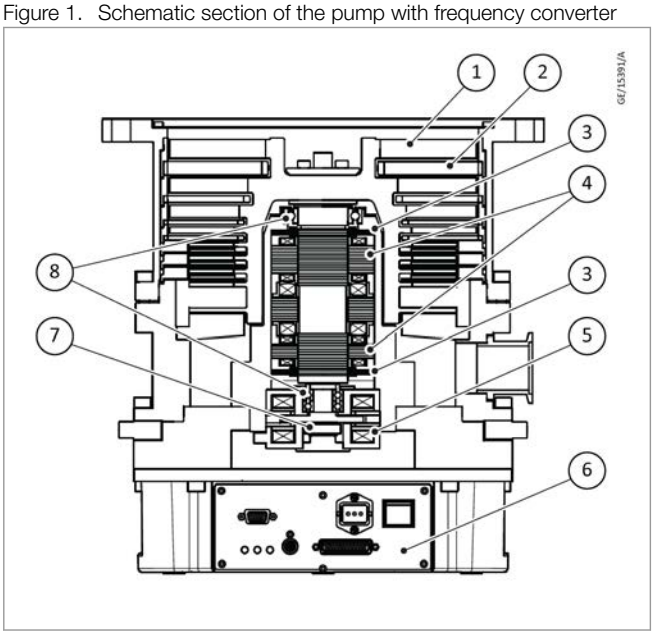
Pressures given in bar or mbar are absolute values. If exceptionally a gauge pressure is meant, a "g" is added (bar(g)).

3 Description

These pumps are turbomolecular pumps utilizing magnetic bearings.They are designed to evacuate vacuum chambers down to pressure values in the high-vacuum range.

The required frequency converter is integrated into the pump.

Figure 1. Schematic section of the pump with frequency converter



1. *Rotor blade*
2. *Stator blade*
3. *Radial sensor*
4. *Radial electromagnet*
5. *Axial electromagnet*
6. *Frequency converter*
7. *Axial sensor*
8. *Touch down bearing*

3.1 Design and function

The turbomolecular pump comprises the pump housing, the multistage rotor with the stator package, the drive, and a magnetic bearing.

Magnetic bearing

The pump has a built-in precision 5-axes controlled magnetic bearing. The rotor is suspended by trouble-free magnetic bearings.

The bearing concept allows low vibration operation and ensures operation of the pump in any mounting position. Magnetic bearings also guarantee ultra-clean vacuum because no grease is used for lubrication of bearings.

Touch-down bearings

Touch-down bearings are provided to stabilize the rotor mechanically if impacts occur during operation. They are only used in case of strong shocks or faulty electronics.

The pump is water-cooled.

Description

Frequency converter

Drive voltage for the motor and the operating voltage for the magnetic bearing are supplied by the frequency converter. It also handles the automatic monitoring of these systems.

The converter continuously monitors all important operating parameters and provides warning and alarm signals in case the operating conditions exceed the specification or the set threshold.

The frequency converter has a Profibus or RS485/232, a STP-Link and a PLC interface.

3.2 Supplied equipment

The forevacuum flange is capped with a protective cap.

The high-vacuum connection elements are not part of the standard equipment. An inlet screen has been built in.

A mains mating connector for the frequency converter side is supplied. A cable and a mains plug are not part of the standard equipment.

A communication cable for the STP-Link interface is included.

3.3 Conforming utilization

The turbomolecular pump is intended for generating a vacuum. It is suited for non-corrosive processes only.

The turbomolecular pump must be bolted to a rigid vacuum system and connected to a suitable backing pump.

The turbomolecular pump must only be operated with correspondingly specified frequency converters, the special connecting cables and mounting bolts.

Both pump and frequency converter are intended for being operated within closed rooms.

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

3.3.1 Non-conforming utilisation

WARNING: NON-CONFORMING UTILISATION OF PUMP

Risk of injury and damage to equipment. Any non-conforming utilisation of pump, frequency converter and accessories can result in severe injury or death and cause damage to components.

Non-conforming utilisations for both pump and frequency converter are:

- Pumping of gases and vapour for which the materials of the pump are unsuitable.
- Pumping of toxic gases.
- Pumping of gases including alkaline metals except Li gas, gases including Ga, Hg, In, Sn or HBr, gases including chlorine and fluorine.
- Pumping gas mixtures with an oxygen content of > 21%.
- Pumping corrosive gases and dust containing gases without reverting to purge gas operation.

- Pumping condensable vapour without controlling the temperature of the pump. Upon compression within the pump these vapours can condense or form deposits.
- Pumping dust and solids without the use of suitable screens and filters.
- Operation at a high forevacuum pressure.
- Operation at high gas loads.
- Utilisation of both pump and frequency converter in explosion hazard areas.
- Non-compliance with the specified maintenance and servicing intervals.
- Operation of the pump and drive electronics in environments which demand a higher protection type than that of the pump and where the installation site is more than 2000 m above sea level.
- Operation with an inadequately mounted pump.
- Operation without having flanged the pump to the system or without having connected it to a suitable backing pump.
- Operation with additional heat sources involving thermal radiation, thermal conduction through the high vacuum or the forevacuum flange, strong magnetic fields or very hot process gases, for example.
- Use in systems in which impact stress and vibrations or periodically occurring forces affect pump, frequency converter and cables.
- Operation on the moving system or system components (locks or movable pump systems, for example).
- Operation at vibration absorbers and vacuum components (gate valves, valves) which are not capable of sustaining the specified deceleration torque at which the pump rotor seizes.
- Stepping on the pump, add-on parts, drive electronics, flanges and cables to climb onto the system. Fitting of add-on parts to the forevacuum flange which causes an inadmissible high load.
- Removing, covering or obstructing warning notices.
- Standstill or storing of the pump without suitable sealing-off and drying.
- Storing in a humid atmosphere which can cause corrosion.
- Conversions, manipulations and maintenance work by personnel not authorised by us.

4 Technical data

Table 1 Technical data

Parameter	Unit	MAG 2207 iS	MAG 2807 iS	MAG 3207 iS
High vacuum flange	DN	250 ISO-F	250 ISO-F	320 ISO-F
Pumping speed (PNEUROP)				
▪ N_2	l s^{-1}	2200	2350	3200
▪ Ar		2000	2150	3000
▪ H_2		1030	1850	1950
▪ He		1800	2500	2750
Maximum compression				
▪ Ar		≥ 10^7		
▪ H_2		2.5 x 10^2	1 x 10^3	1 x 10^3
Maximum gas throughput *#				
▪ Ar	mbar l s^{-1}	16	26	26
▪ H_2		54	33	33
Maximum forevacuum pressure	mbar	1.1	1.4	1.4
Nominal/Maximum speed	rpm	36480	31800	31800
Minimum speed	rpm	18240		
Backup rotational speed †	rpm	approximately 6000		
Ultimate pressure	mbar	1 x 10^{-8}		
Maximum bake-out temperature	°C	120		
Run-up time	min	≤ 8	≤ 10	
Forevacuum flange	DN	40 KF		
Cooling connection		Rc 1/4 (Female)		
Weight, approximate	kg	45	59	57
Noise level	dB	< 55		

** The maximum gas throughput for continuous operation in connection with N_2 or Ar is attainable with a cooling water temperature below 25 °C and a forevacuum pump system having a pumping speed of over 600 m^3/h. These values may differ for other operating conditions.*

 # Maximum gas throughput and maximum forevacuum pressure cannot be attained simultaneously.

† A backup rotational speed is the lowest rotational speed to which the magnetic bearing can be backed up at a power failure.

Table 2. Technical data for the integrated frequency converter

Parameter	Unit	Value
Input voltage	V a.c.	200 to 240 ± 10%
Input power	V A	750 maximum
Input frequency	Hz	50/60 ± 2

Parameter	Unit	Value
Leakage current	mA	2.0 maximum
Main fuse specification	A	6.3
Current Ampere Interrupting Capacity (AIC)	A	100 (250 V a.c. 50/60 Hz)
Pollution degree		2
Installation category		II
Motor driving system		3-phase d.c. brushless motor driver

Table 3. Operating environment

Parameter	Value
Ambient temperature	0 to 40 °C (32 to 104 °F)
Ambient relative humidity	30 to 95% (no dew condensing)
Environment	An area free of externally applied mechanical shock.
	A place free of a heat source (Keep clear of the heat source or attach a thermal shield plate).
	A place free of a strong magnetic field (Range: up to 15 mT (150 G) in the axial direction, and up to 3 mT (30 G) in the radial direction with respect to the rotational axis of the pump).
	A place free of a strong electric field.
	A place free of exposure to radiation.
	No discharge of high voltage (more than 500 V) (If more than 500 V is discharged, contact us).
	Others: An area free of exposure to direct sunlight, high humidity, dust, water drop, salty air, explosive or flammable gas, corrosive gas, excessive vibration and sources of electric noise.
	A place at an altitude of 2000 m or less.
Pump installation equipment conditions	Install the pump securely so that foreign materials cannot fall into the pump.
	Install the pump so that the inlet flange of the pump is not exposed to a heat source.

Technical data

Figure 2. Operation diagram for the MAG 2207 iS

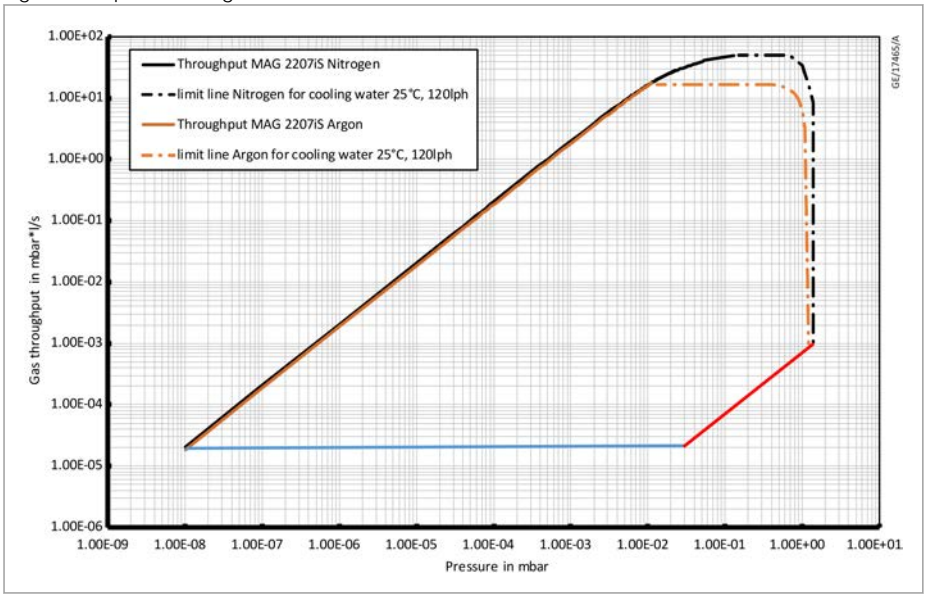


Figure 3. Operation diagram for the MAG 2807 iS

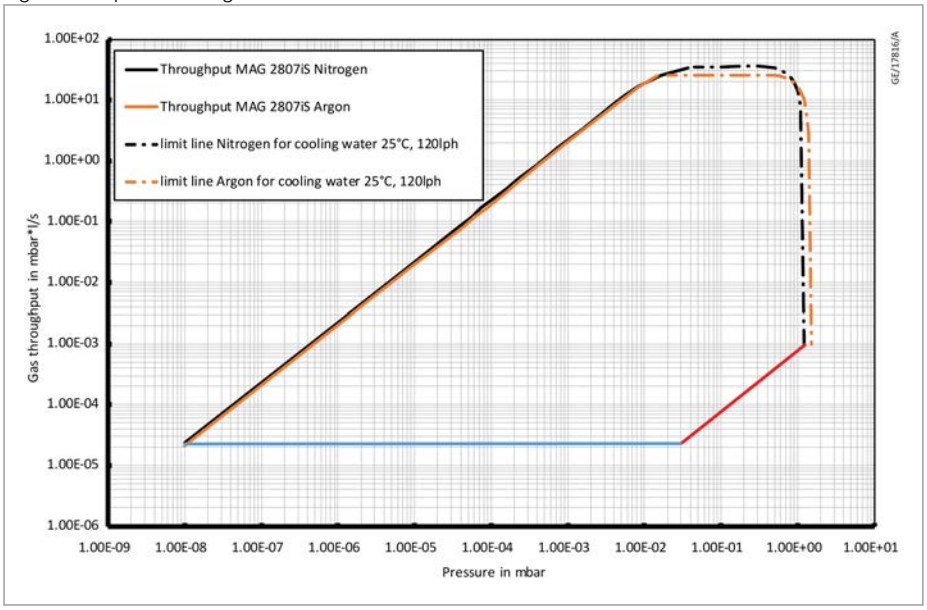


Figure 4. Operation diagram for the MAG 3207 iS

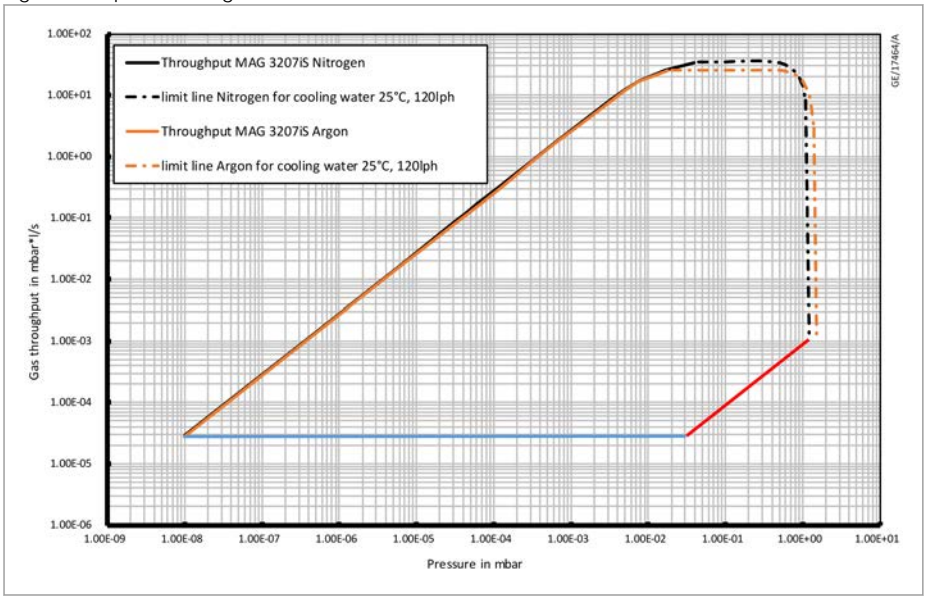
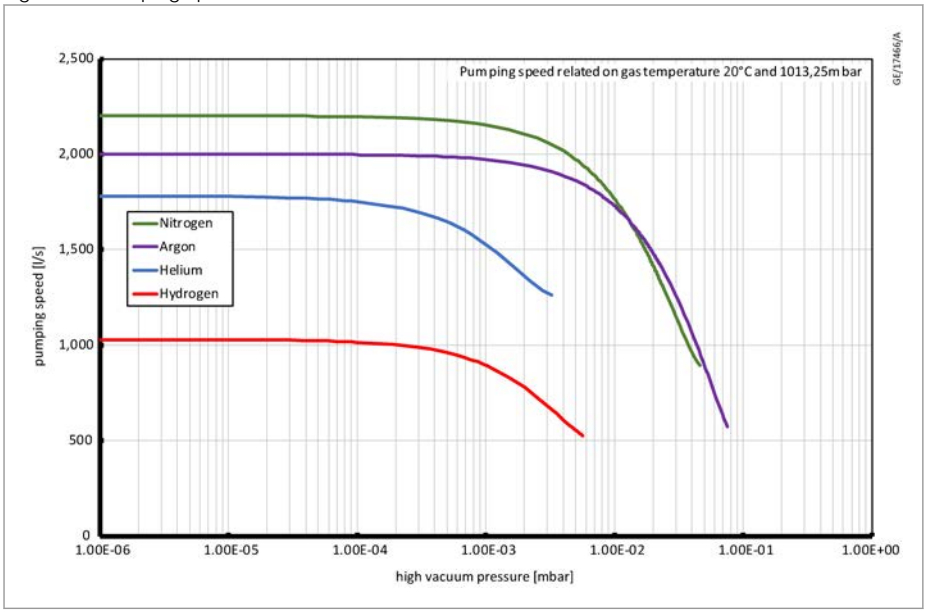


Figure 5. Pumping speed - MAG 2207 iS

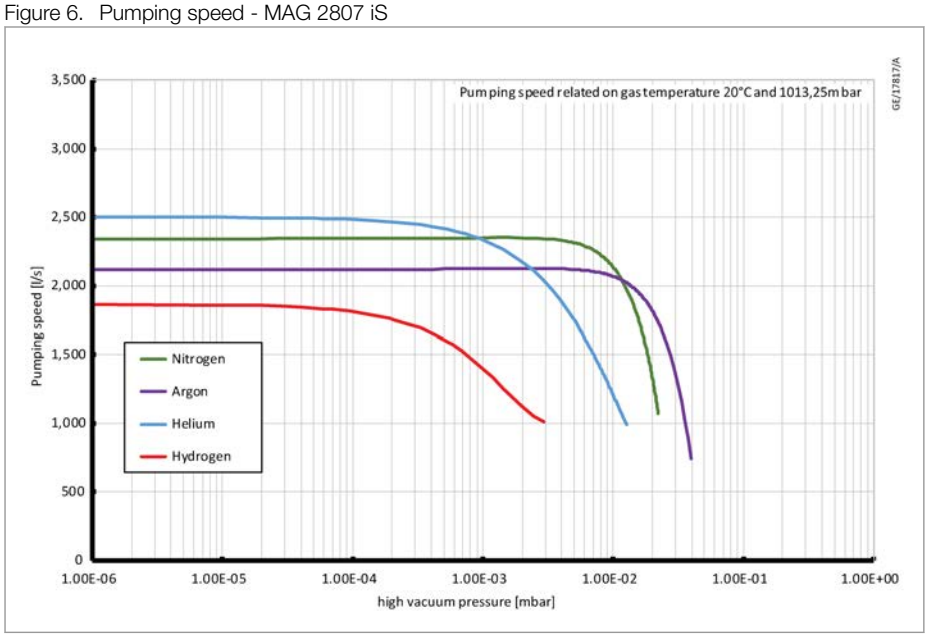


Note:

HV: DN250 ISO-F - backing pump > 8.000 l/min.

Technical data

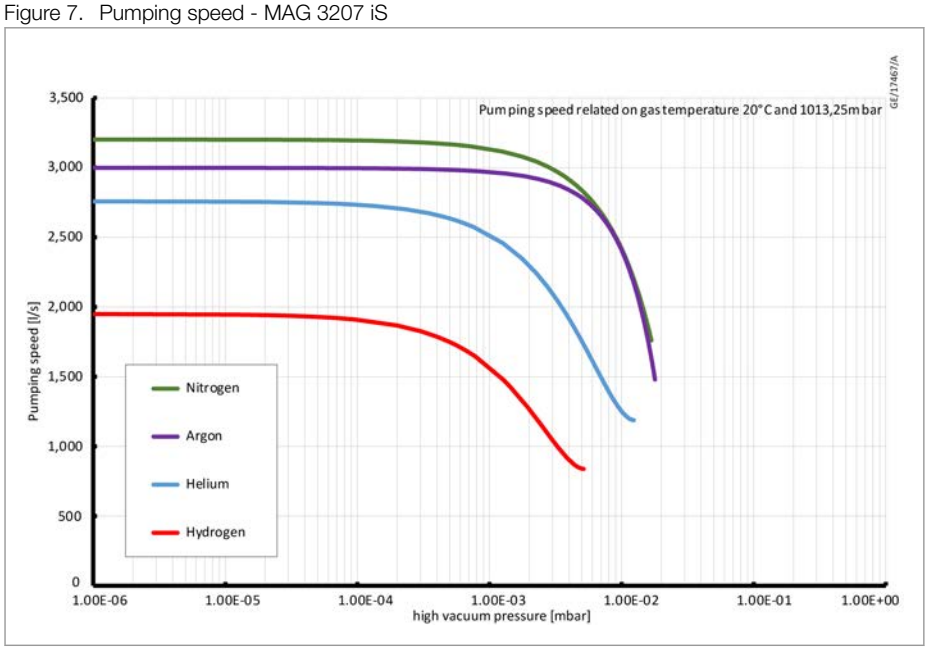
Figure 6. Pumping speed - MAG 2807 iS



Note:

HV: DN250 ISO-F - backing pump > 8.000 l/min.

Figure 7. Pumping speed - MAG 3207 iS



Note:

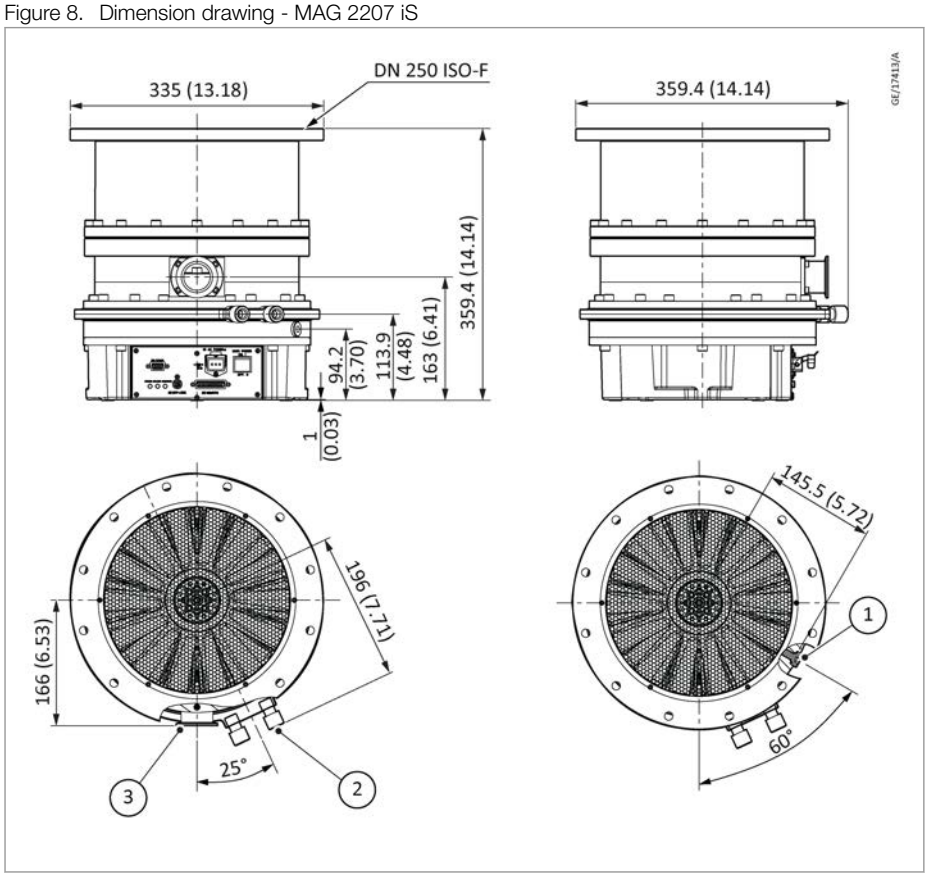
HV: DN320 ISO-F - backing pump > 8.000 l/min.

4.1 Dimension drawings

Note:

All dimensions are given in mm (inch).

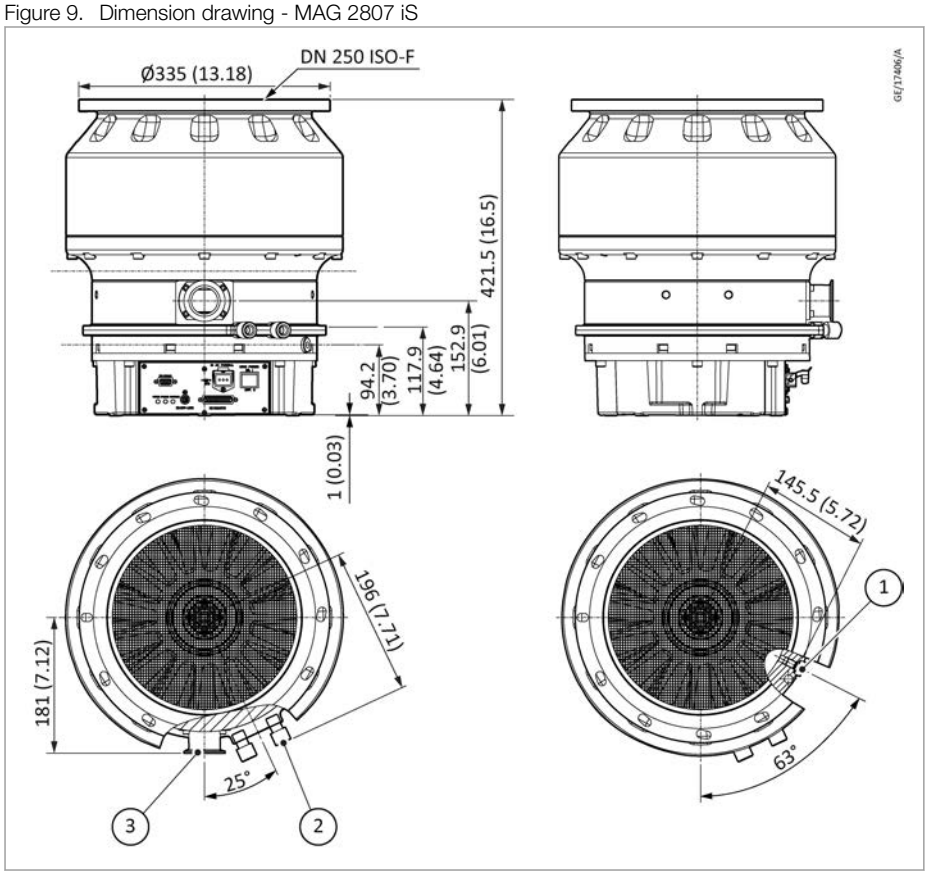
Figure 8. Dimension drawing - MAG 2207 iS



1. *Purge gas M10x1.25*
2. *Forevacuum connection DN 40 KF*
3. *Water cooling port Rc 1/4*

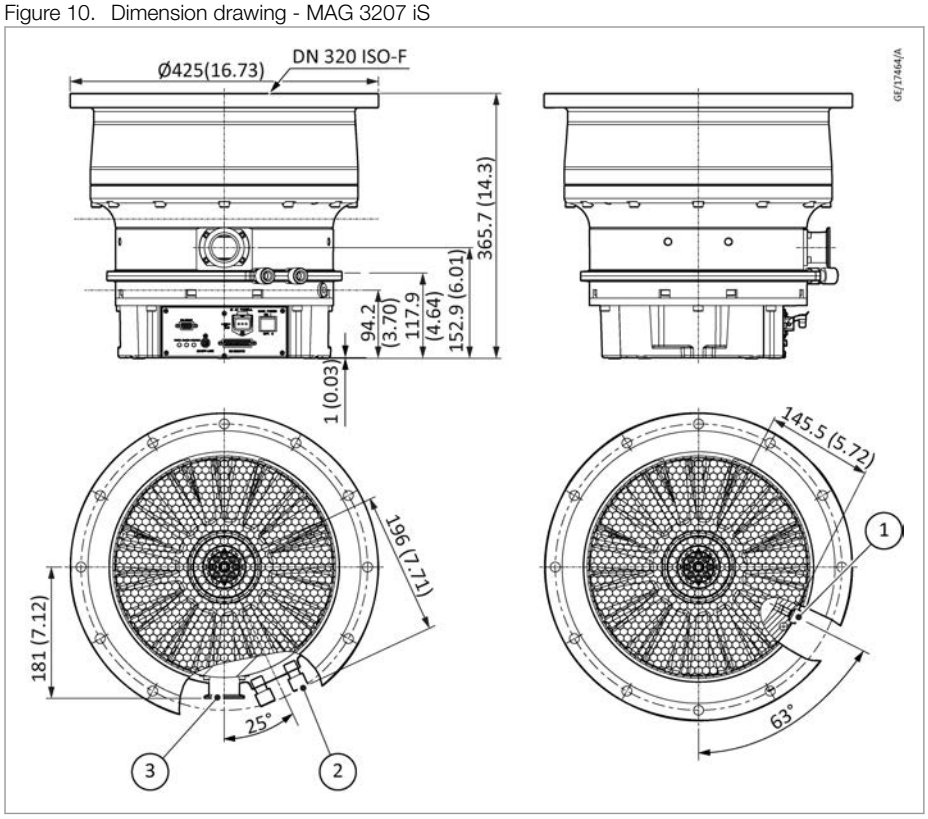
Technical data

Figure 9. Dimension drawing - MAG 2807 iS



1. *Purge gas M10x1.25*
2. *Water cooling port Rc 1/4*
3. *Forevacuum connection DN 40 KF*

Figure 10. Dimension drawing - MAG 3207 iS



1. *Purge gas M10x1.25*
2. *Water cooling port Rc 1/4*
3. *Forevacuum connection DN 40 KF*

5 Transportation

WARNING: SUSPENDED LOAD

Risk of injury. Do not stand below the pump while connecting or removing the turbomolecular pump. The pumps are heavy products. Use a crane or suitable lifting equipment to lift the pump.

The devices are delivered in safe transport packaging. Check whether the packaging has been damaged during transport. If that is the case, check the equipment immediately and notify the freight forwarder and us, if necessary.

Keep transport packaging for any further transportation and storage of the pump. Be careful not to damage the sockets and connections during transport.

Unpacking

The turbomolecular pump is shipped in a bag. You must open the bag only when the pump is ready for installation. Do not remove the covers and blanking flanges until you are ready to make the connections, to make sure that the turbomolecular pump is installed under the cleanest possible conditions.

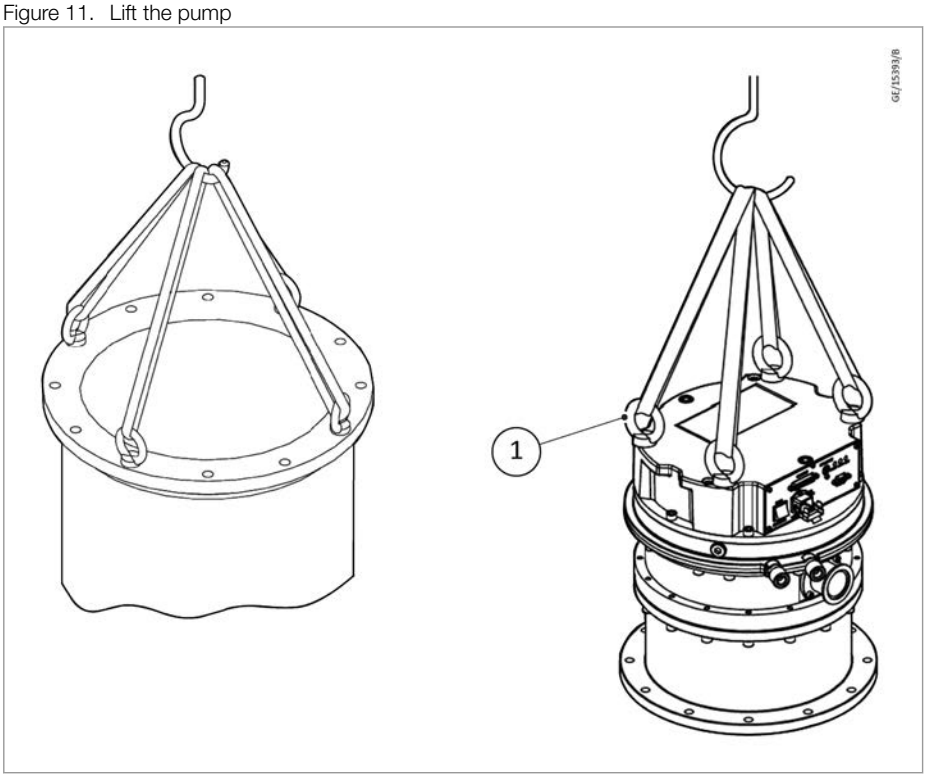
Lifting

The pump is equipped with four M8 holes for eye-bolts for lifting and moving. Remove the pump from the packaging using lifting equipment.

CAUTION: FALLING PARTS

Risk of injury from falling parts. Mistakes made during transport can cause the pump to fall down. Transport the pump only in its transport packaging or by using suitable eye-bolts.

Figure 11. Lift the pump



1. Screw holes for securing the base

6 Installation

6.1 Attach the pump to the vacuum chamber

WARNING: ROTOR DAMAGE

Risk of injury and damage to equipment. Do not touch the rotor. It can cause injury and damage the rotor bearing.

WARNING: EXPLOSIVE MATERIALS

Risk of injury. The high vacuum flange must be firmly mounted to the vacuum chamber. Observe safety information given in *Mechanical hazards* **on page 11.**

The shipping flange and bolts may be used only for shipping purposes. They are not suitable for mounting the pumps in systems.

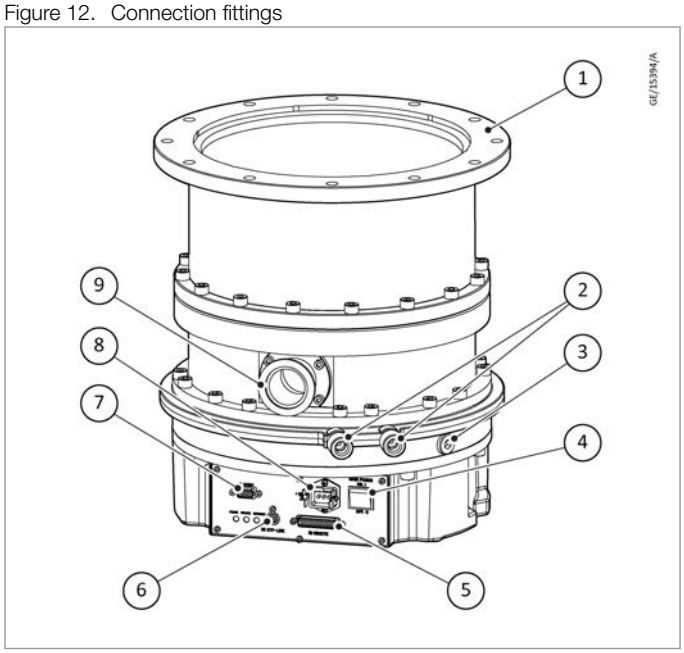
Remove the transport seal from the intake flange and remove the desiccant. Pay attention to maximum cleanliness when connecting.

Torques when the rotor seizes

In the case of a sudden rotor vane rupture or rotor-stator contact which may occur in practice (caused, for example, by solid objects from the process chamber entering the pump through the high vacuum flange), a crash momentum amounting to 5 kNm maximum needs to be absorbed by the system.

When not complying with the installation and operating conditions or the maintenance intervals described in the Operating Instructions, the rotor may suffer complete destruction by material fatigue, for example. In this case which is highly unlikely to occur in practice, a deceleration or burst momentum of 41 kNm needs be absorbed by the system, should the pump suddenly seize.

Figure 12. Connection fittings



1. *High-vacuum flange*
2. *Cooling water connections*
3. *Purge gas port (blanked off)*
4. *Main switch*
5. *Remote connection*
6. *Service To Pump (STP) link*
7. *Profibus interface*
8. *Mains connection*
9. *Forevacuum flange*

In most applications the pump is flanged to the high-vacuum flange at the apparatus.

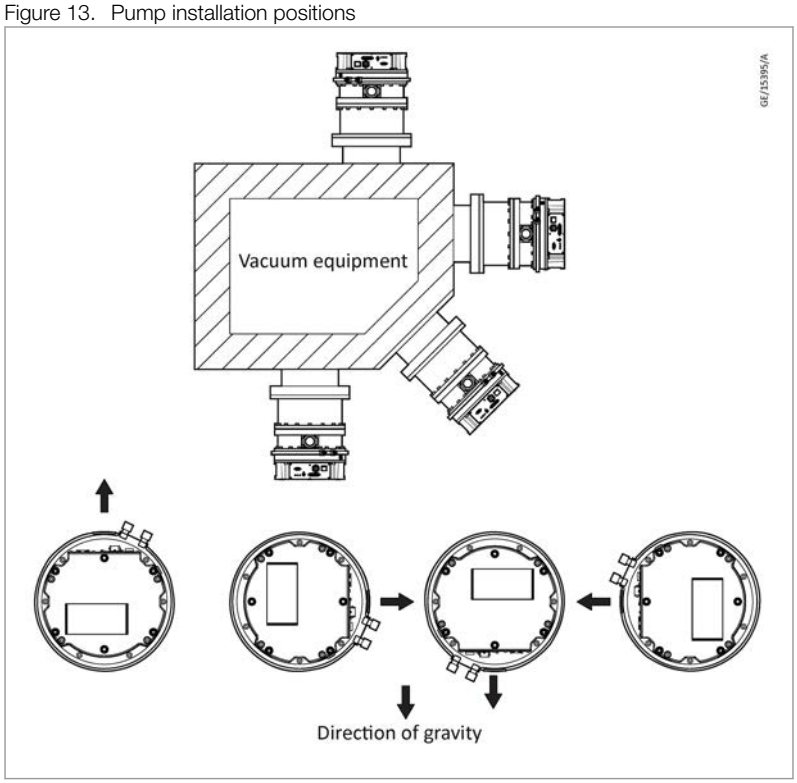
Use exclusively flange connecting components and fittings in accordance with DIN 28404, ISO 1609 (ISO-F and ISO-K flange connections), or ISO 3669 (CF flange connections) and DIN 28403 and ISO 2861 (KF small flange quick connections).

Mount the turbomolecular pump as close as possible to the vacuum chamber. If the turbomolecular pump is permanently flanged to a vacuum chamber with a weight exceeding 500 kg, it will not be necessary to secure it in any other way.

Leave enough space for maintenance and inspection and for connecting cables (approx. 150 mm).

Installation

Figure 13. Pump installation positions



The pump can be installed vertically, horizontally, upside-down or slanted. When installing the pump in a horizontal or slanted position, we recommend that you install it so that the direction of the outlet port is on a vertical or horizontal plane in the direction of the gravity. This makes it possible to reduce the load on the magnetic bearing and the heat generated by the pump.

The turbomolecular pump runs low in vibration and noise. No vibrations or resonances from outside equipment may be allowed to be transferred to the turbomolecular pump.

The turbomolecular pump is sensitive to low-frequency vibrations.

The flange material to which the pump is bolted must have at operating temperature a minimum strength specification of 150 N/mm ^{2}.

Vibration influence

If several turbomolecular pumps are installed to the vacuum chamber of the same system, there is the risk of interference (vibration interference between the pumps). If such a risk exists, contact us for application support.

Earthquake protection

The standard pump fixing is sufficient for earthquake protection. If required fix the system to the bottom or to the walls. Depending on the chamber's weight and fixing use the boreholes in the pump's bottom in addition.

In case of an earthquake (strong vibrations) the pump switches off automatically.

Isolation valve

We recommend installing an isolation valve between the pump and the chamber. The valve should be closed during wet cleans of the chamber and in case of pump failures which will lead to a pump shut down. The valve should normally be closed with power off.

An inlet screen is attached to the inlet port flange to prevent foreign materials from falling into the pump. Always leave the inlet screen attached during operation.

If dust could pass from the vacuum chamber into the pump, then a micro-pore filter must be installed between the vacuum chamber and the pump.

Flange mounting for ISO-F flanges

WARNING: HOT SURFACE

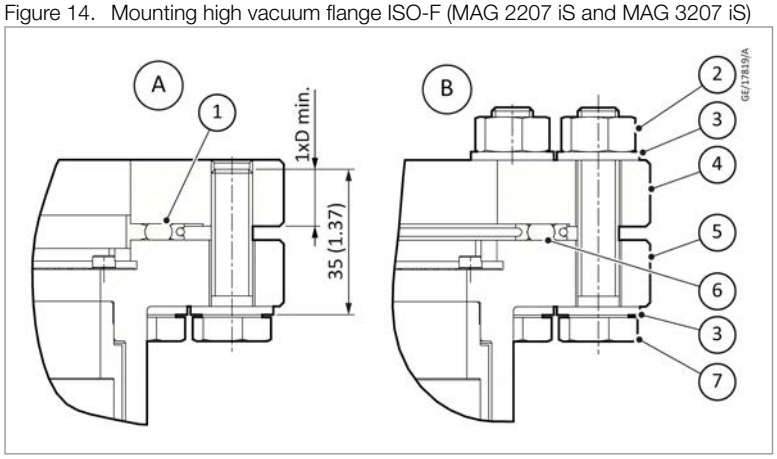
Risk of injury. During the operation, the pump can get so hot that there is the risk of suffering burns (up to approximately 120 °C). Protect the hot parts against being touched.

Mount the turbomolecular pump and tighten the bolts step-by-step.

The contact surfaces of the pump housing, vacuum system and centring ring must be dry and free of grease to make sure adequate strength in case the rotor should seize.

Installation

Figure 14. Mounting high vacuum flange ISO-F (MAG 2207 iS and MAG 3207 iS)



A. Mounting high vacuum ISO-F flange connection with blind hole thread the flange connection shown is designed for a steel counter flange*
B. Mounting high vacuum ISO-F flange connection with clearance hole

1. *ISO-K vacuum seal center ring (Alternative 2)*
2. *Nut ISO 4032 - Mx** - 12*
3. *Washer ISO 7089 - X** - 300 HV*
4. *Customer ISO-F flange (Counter flange)*
5. *Turbomolecular pump flange*
6. *ISO-F vacuum seal washer (Alternative 1)*
7. *Bolt ISO 4017 - Mxx** - 12.9*

Note:

** Refer to below tables.*

*** X (Example 10), Mx (Example: M10), Mxx (Example: M10x50)*

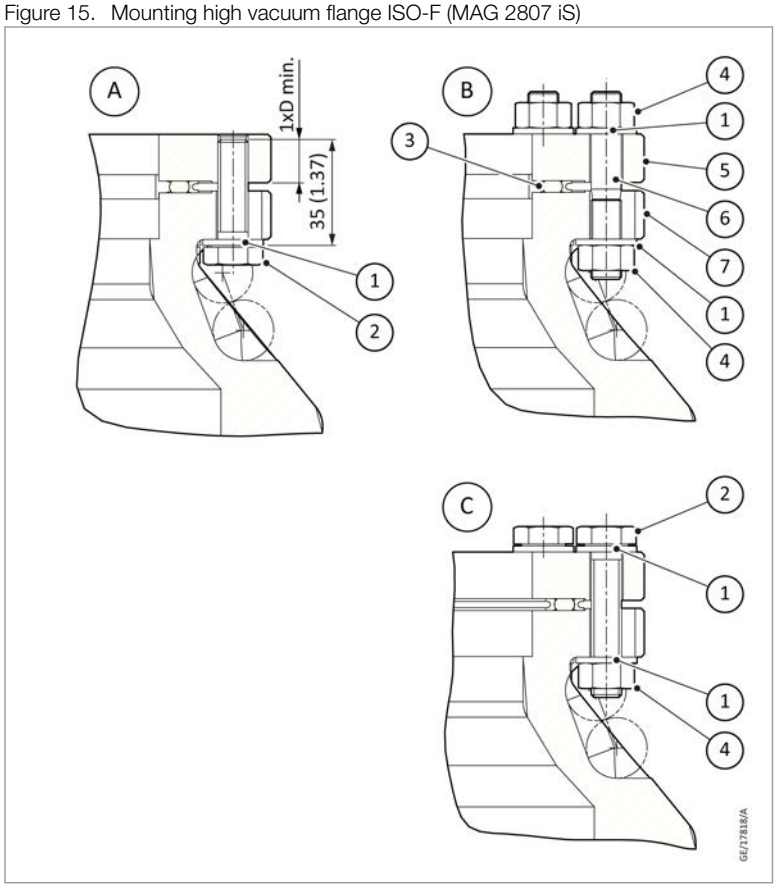
Turbomolecular	**MAG 2207 iS**	
Flange	**A**	**B**
Number of bolts	12 x M10x35	12 x M10x50
Minimum bolt strength, yield strength	> 1080 N/mm ^{2}	
Bolt quality according to EN ISO 898-1	12.9	
Fastening torque #	35 $^{+5}$ Nm	

 # The fastening torque levels apply to lubricated threads.

Turbomolecular	**MAG 3207 iS**	
Flange	**A**	**B**
Number of bolts	12 x M12x45	12 x M12x60
Minimum bolt strength, yield strength	> 1080 N/mm ^{2}	
Bolt quality according to EN ISO 898-1	12.9	
Fastening torque #	45 $^{+5}$ Nm	

 # The fastening torque levels apply to lubricated threads.

Figure 15. Mounting high vacuum flange ISO-F (MAG 2807 iS)



A. Mounting high vacuum ISO-F flange connection with blind hole thread the flange connection shown is designed for a steel counter flange*

B. Mounting high vacuum ISO-F flange connection with clearance hole, using stud bolts and each two nuts and washers. Fixing the nut using adhesive as an assembly aid

C. Mounting high vacuum ISO-F flange connection with through hole, mounting the screws from the side of the customer flange. This requires appropriate installation space on the customer side

1. *Washer ISO 7089 - X** - 300 HV*
2. *Bolt ISO 4017 - Mxx** - 12.9*
3. *ISO-K vacuum seal center ring*
4. *Nut ISO 4032 - Mx** - 12*
5. *Customer ISO-F flange (Counter flange)*
6. *Stud bolt DIN 939 - Mxx** - 12.9*
7. *Turbomolecular pump flange*

Note:

** Refer to below table.*

*** X (Example 10), Mx (Example: M10), Mxx (Example: M10x50)*

Turbomolecular	**MAG 2807 iS**		
Flange	**A**	**B**	**C**
Number of bolts	12 x M10x35	12 x M10x50 (Stud bolts)	12 x M10x50
Minimum bolt strength, yield strength	> 1080 N/mm ^{2}		
Bolt quality according to EN ISO 898-1	12.9		
Fastening torque #	35 $^{+5}$ Nm		

 # The fastening torque levels apply to lubricated threads.

6.1.1 Forevacuum connection

WARNING: TOXIC MATERIAL

Risk of injury. The forevacuum line must be tight. Hazardous gases can escape at leaks or the gases being pumped can react with air or humidity. Observe safety information given in *Hazards caused by materials and substances* on page 12.

The high vacuum pressure level which can be achieved is a function of the volume of gas flow Q to be pumped and the forevacuum pressure.

Forevacuum pump

We recommend using our two stage TRIVAC-B pumps or dry compressing pumps as backing pumps.

Connect the clean forevacuum line. The connecting flanges must be clean and undamaged. The cross section of this line must be so wide that safe operation of the pump can be ensured.

Figure: Layout a turbomolecular pump system on page 35 shows schematically the design of a pump system incorporating a turbomolecular pump turbomolecular pump and a TRIVAC backing pump with integral anti-suckback valve.

Safety valve

When using a backing pump not having an integrated anti-suckback valve, a separate safety valve should be used. The safety valve keeps oil from back-streaming from the backing pump and into the turbomolecular pump when the system is not running.

Adsorption trap

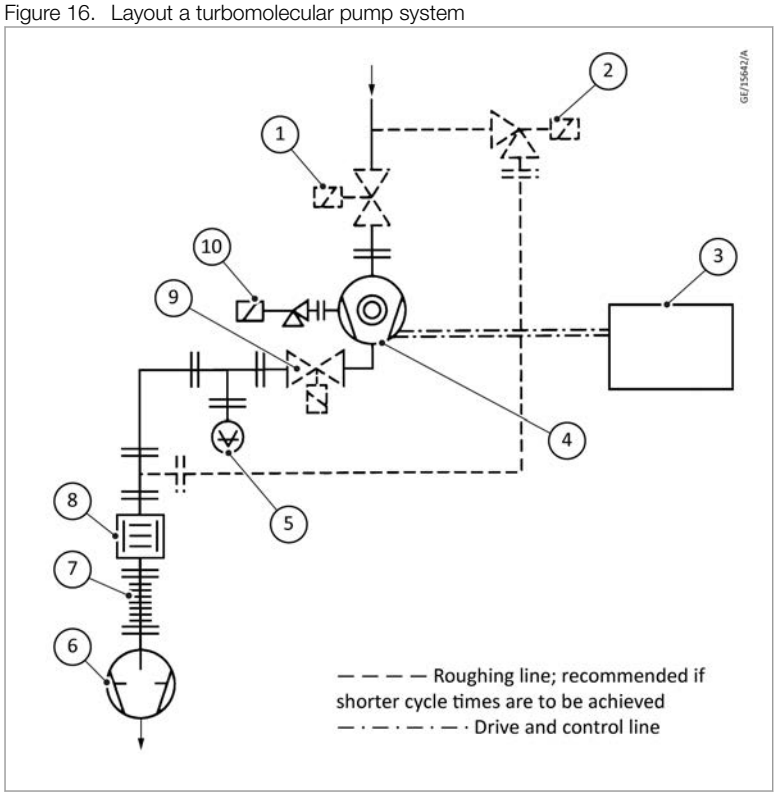
To ensure that the forevacuum space at the turbomolecular pump is kept largely free of oil vapors during operation. We also recommend installing an adsorption trap in the forevacuum line. Alternatively purge the forevacuum line with inert gas. In this case the pressure in the forevacuum line must be over 10^{-2} mbar.

Provide a roughing line to achieve the shortest cycle times.

Ensure that the pump is sufficiently isolated against vibrations generated by the forevacuum pump.

No forces from the piping system may be allowed to affect the turbomolecular pump. Support the piping correspondingly or decouple through flexible joints.

Figure 16. Layout a turbomolecular pump system



1. *Isolation valve*
2. *Valve in the roughing line*
3. *Frequency converter*
4. *Turbomolecular pump*
5. *Forevacuum gauge point*
6. *Backing pump*
7. *Anti-vibration bellows*
8. *Sorption trap*
9. *Forevacuum valve*
10. *Purge gas and venting valve*

6.2 Connecting the cooling water

Screw on the cooling water lines. The direction of cooling water is not specified.

Avoid condensate formation

Adjust the cooling water temperature so that the formation of condensate is avoided.

Turn off the cooling water supply before venting the turbomolecular pump and when it is not running to avoid condensate formation in the pump.

If immediate pump shut-down in case of cooling water supply failure is required, then a flow monitor will have to be inserted in the drain line. If you do not close the cooling water it may take longer to achieve ultimate pressure after start up of the system.

When decommissioning the pump, drain out the cooling water and blow out the cooling water lines to prevent frost damage.

Table 4. Cooling water specifications

Parameter	Value
Inlet temperature	15 - 35 °C
Inlet pressure	3 bar
Cooling water requirement	3 l/min

6.3 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:

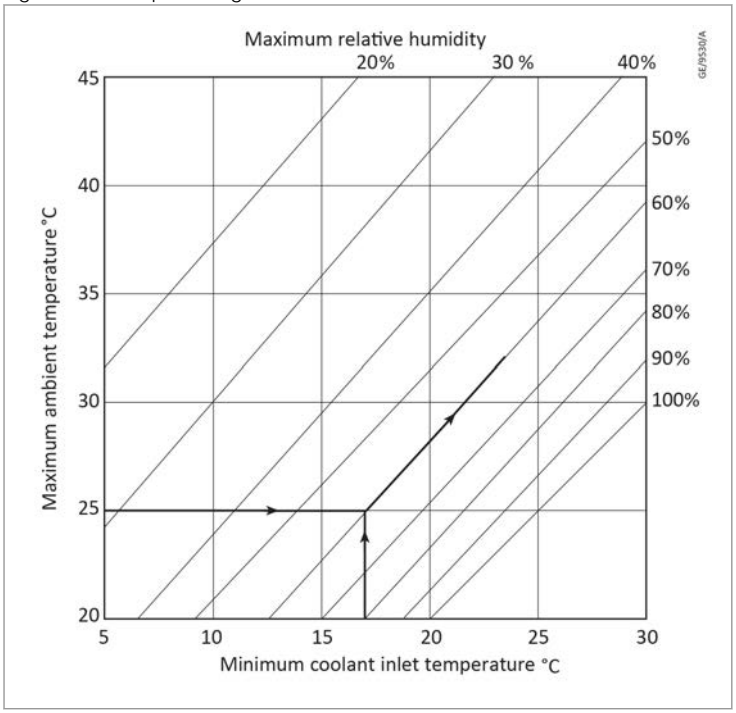
8 °dH (degrees German hardness) = 1.4 mmol/l

= 10 °e (degrees English hardness)

= 14 °f (degrees French hardness)

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

Figure 17. Dewpoint diagram



Minimum coolant inlet temperature at which condensation does not yet occur, as a function of maximum room temperature and maximum relative humidity.

Example:

Maximum ambient temperature 25 °C

Minimum coolant inlet temperature 17 °C

⇒ Maximum relative humidity 60%

6.4 Electrical connection

WARNING: HAZARDOUS VOLTAGES

Risk of electric shock. Make sure that the system and the electrical supply cable are correctly protected against earth (ground) faults and that the earth (ground) and X1 AC POWER is correctly connected. The interface connectors have M2.6 threads. In addition, always lock it with the fixed metal fittings attached to the connector.

WARNING: TRIPPING HAZARD

Risk of tripping. Lay cables in such a way as to avoid tripping or falling. Mark protruding parts accordingly.

Connect the power cable securely to prevent any poor or cross connections. Do not apply voltages exceeding 1 kV to the input line.

Ensure that the supply voltage is as indicated on the power supply information label.

The pump may be operated only with suitable connector cables.

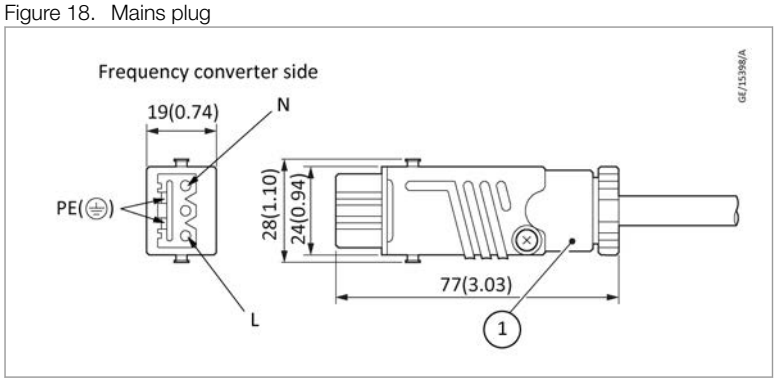
Installation

Route all cables in such a way that they cannot be damaged and that tripping or falling is avoided.

Clearly mark protruding components.

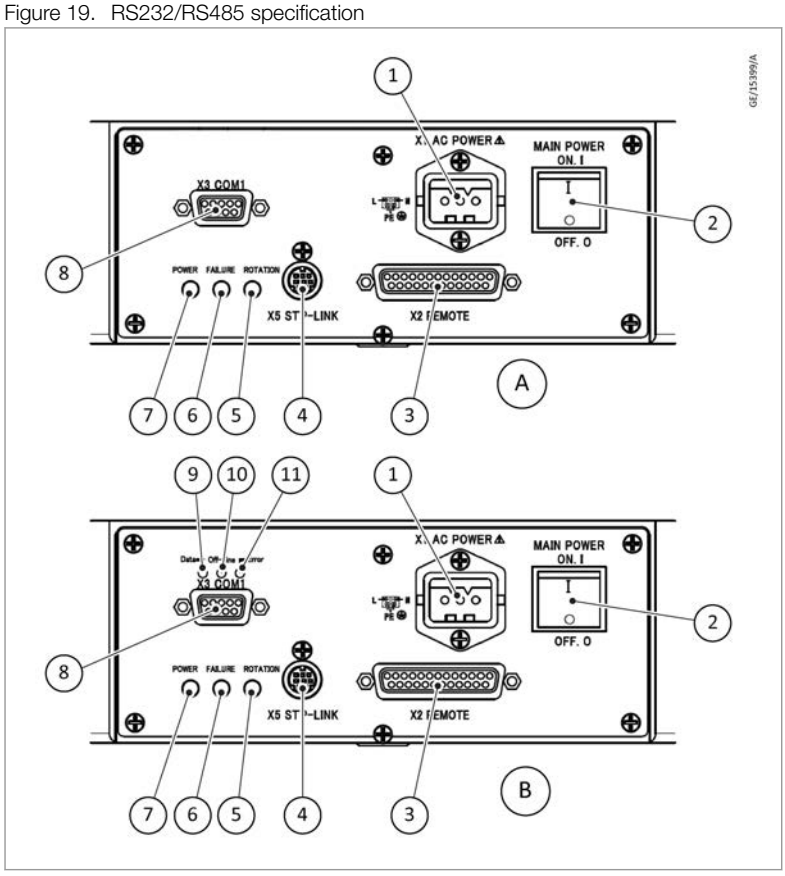
Connect the power cable to the “X1 AC POWER” on the frequency converter front panel.

Figure 18. Mains plug



1. *3 pin (socket)*

Figure 19. RS232/RS485 specification



A. *Standard specification* B. *Profibus specification*

Item	Description	Function
1	AC POWER connector (X1)	AC input (240 Va.c. maximum) Input voltage range is between 200 to 240V AC (50/60Hz)
2	MAIN POWER switch	Main power circuit breaker

Item	Description	Function
		NEVER stop the power supply to the pump while the pump is in rotation.
3	REMOTE connector (X2), D-SUB 25 pin, socket contacts	For remote input/output signal in the parallel mode setting. See *Figure 21* on page 40.
4	STP-LINK connector (X5)	For communication configuration
5	ROTATION LED	(Green/Orange LED) The rotational speed is indicated by the flashing pattern of the LED (acceleration state: green, deceleration state: orange).
6	FAILURE LED	(Red/Orange LED) A failure of the pump is indicated by the flashing pattern of the red LED. The flashing pattern indicates the failure type. Refer to *Safety functions* on page 46.
		A warning of the pump is indicated by flashing of the orange LED. The flashing pattern indicates the warning type. Refer to *WARNING function* on page 48.
7	POWER LED	(Green LED) Illuminates when 200 to 240 Va.c. is input to the connector X1 (Power ON state).
8	COM1 connector (X3)	Depending of interface refer to the instruction manual of the RS485/232 or Profibus interface.
9	Data LED	(Green LED) Slave (pump) is in data exchange as defined by the Profibus standard.
10	Off-Line LED	(Orange LED) Slave (pump) is not in data exchange as defined by the Profibus standard.
11	Error LED	(Red LED) ON at the same time as Offline LED = Configuration or parameterization error.
		Flashing at 1 Hz = Invalid address selected.

Figure 20. View of the integrated frequency converter

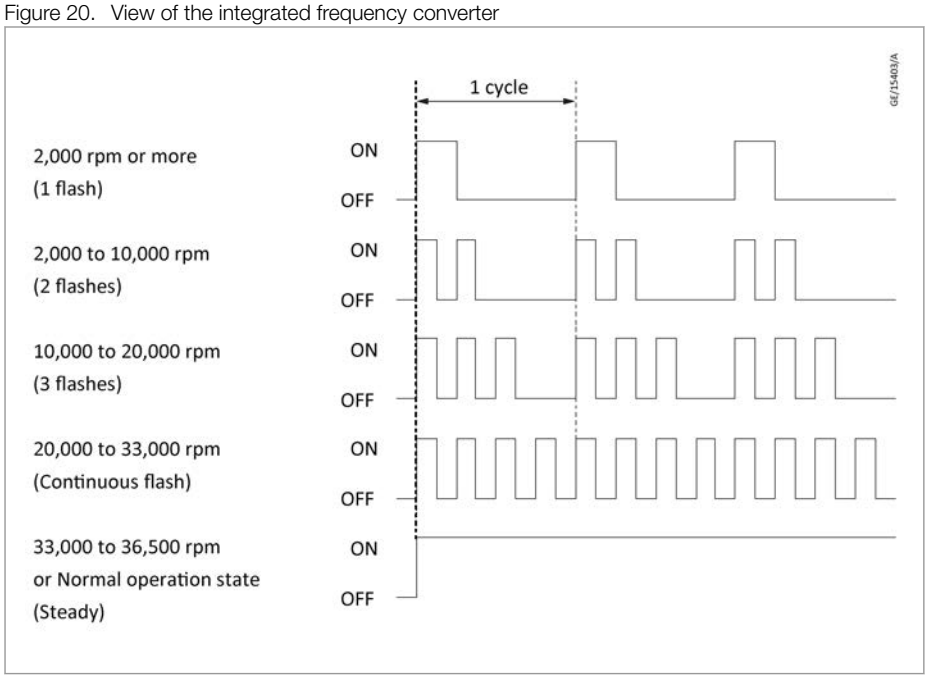
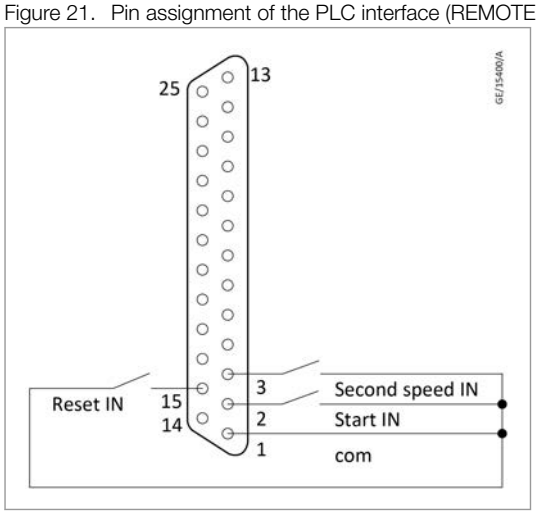


Figure 21. Pin assignment of the PLC interface (REMOTE connector)



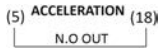
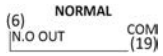
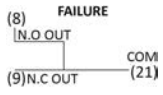
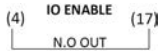
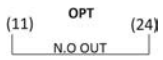
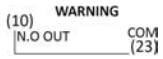
Note:

Pin 1 (0 V) is isolated from the frame ground.

The input current of the remote input signal is approx. 2.5 mA. Make sure the minimum applicable load of the relay contact when remote operation with the relay.

Input signals:

- RESET operation: (Short the circuit between (1)-(15) for 0.3 seconds or more.
- Short the circuit between (1)-(2) to start the pump.
- When the pins (1)-(2) are opened, the pump will stop.

Pins for remote output	Description
	These pins are closed when the pump is in acceleration.
	When the pump is in rated operation, the pins between (6)-(19) are closed.
	These pins are closed when the pump brakes.
	When an abnormality/error is detected, the pins between (8)-(21) are closed, and the pins between (9)-(21) are opened.
	These pins are closed when the pump is in a WARNING state.
	When the input operation port is set to the parallel port (I/O REMOTE), the pins are closed.
	In state of the second speed option is ENABLE, and second speed is selected, the pins are closed.

Remote output relays	Resistance Load (COS φ = 1)
Maximum voltage	30 V d.c.
Maximum rated current	0.1 A
Maximum OFF-state current	1 µA

Second speed option

When the second speed option is enabled, second speed can be set independently of the normal speed setting. The selection of the second speed and normal speed are operated from I/0 remote input or serial communication port.

The second speed setting is changed from serial communication port, or STP-Link.

Speed selection	Pump status
Difference between Normal Speed and Second Speed Setting is more than approximately 10%	When the rotational speed becomes low, the pump enters BRAKE mode, and then decelerates. When the rotational speed becomes high, the pump enters ACCEL mode, and then accelerates. The pump will enter the normal mode when the rotational speed attains within +10% of speed setting. Refer to *Figure: Different speed mode* on page 42.
Difference between Normal Speed and Second Speed Setting is approximately 10% or less	The rotational speed changes in the normal mode. Refer to *Figure: Normal speed mode* on page 42.

Figure 22. Different speed mode

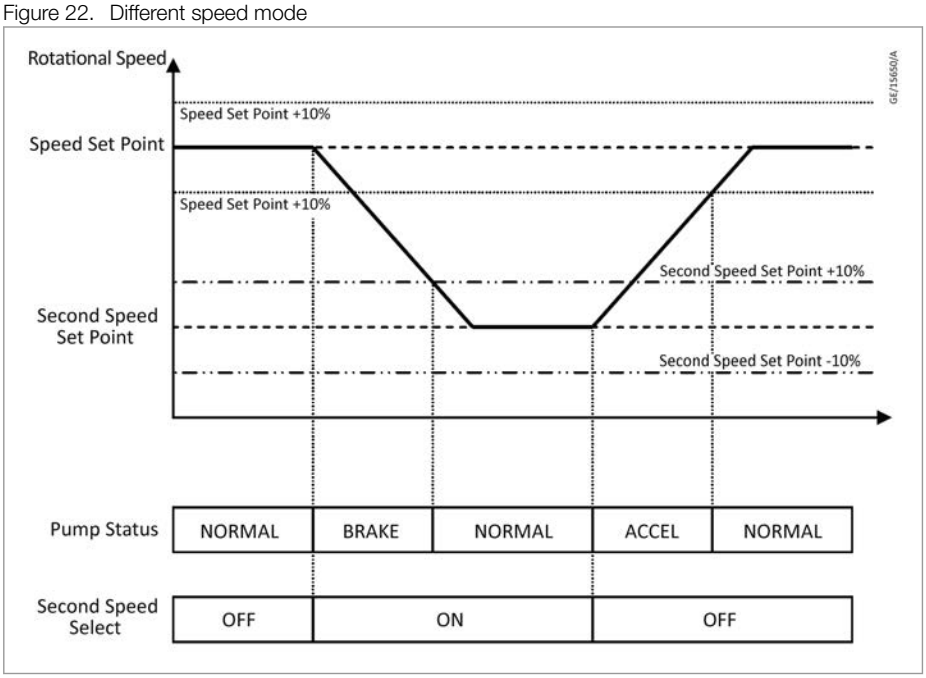
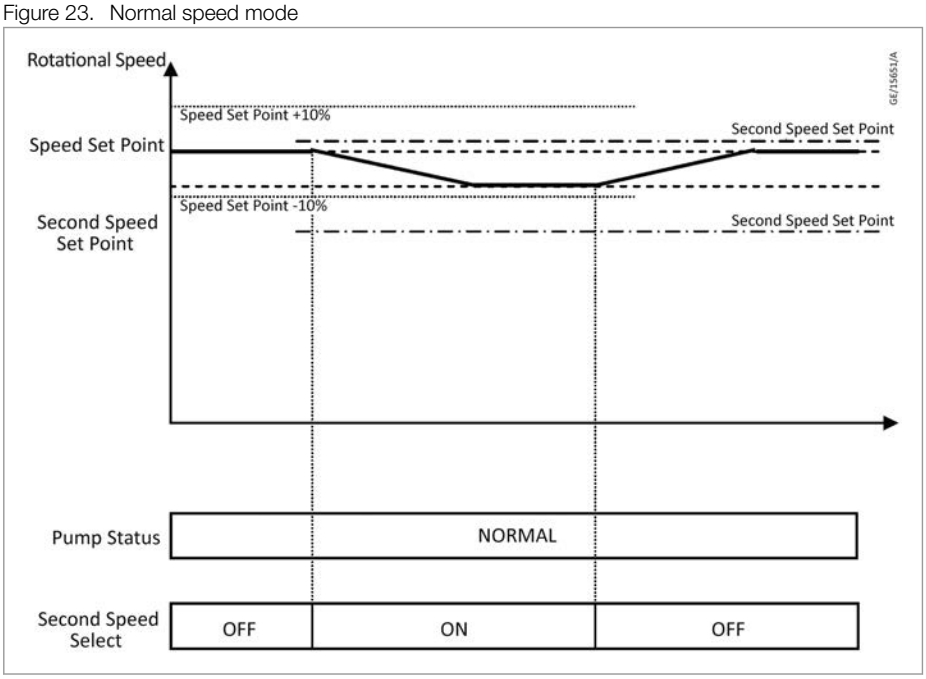


Figure 23. Normal speed mode



7 Operation

CAUTION: DANGEROUS VOLTAGE

Risk of electric shock and damage to equipment. The turbomolecular pump must only be operated if installed in compliance with the information provided in the operating instructions and an existing disconnecting device.

The disconnecting device must be easily accessible. The mains connector can be used as the disconnecting device.

7.1 Media compatibility

These turbomolecular pumps are suitable for pumping air and clean gases.

Refer to *Non-conforming utilisation* on page 16 for gases which are not allowed.

7.2 Interfaces

The pump can be operated with the PLC interface (REMOTE connector) (this is the default setting, the RS485/232) or with the Profibus interface.

7.3 Start-up

CAUTION: DANGEROUS VOLTAGE

Risk of electric shock and damage to equipment. Make sure that the mains power supply is switched off before you connect or disconnect the mains cable.

The mains power supply must have a suitable earth connection.

To start the Turbomolecular pump do the steps that follow:

1. Plug in the mains cable.
2. Secure the mains cable so that it cannot be pulled out inadvertently.

To test the connection, switch the turbomolecular pump on and off.

The turbomolecular pump will start only when the mains cable is plugged in and a start command is provided.

7.4 Switch on

Switch on the backing pump.

Switch on the main switch.

Switch on the turbomolecular pump.

The backing pump and the pump can be switched on simultaneously. In such a situation the turbomolecular pump serves from the very outset as an effective baffle.

If the turbomolecular pump is to be switched on after a certain delay period, pre-evacuation can take place through the turbomolecular pump even though it is not running.

Avoid frequent start/stop operations as this may cause the pump to overheat. The pump can be re-accelerated even while it is stopping.

Starting the pump after a safety function operates

A safety function operates when an abnormality/error occurs in the pump or peripheral equipment. To restart the pump, remove the cause of the abnormality/error after the ROTATION LED extinguishes, and perform a Reset (Short the circuit between (1)-(15) for 0.3 seconds or more). The FAILURE LED extinguishes and the safety function is released. Then restart the pump.

7.5 Protect the touch-down bearings

The magnetic bearings in the pump are immune to wear. In addition to the magnetic bearings, the pump is equipped with touch-down bearings which protect the rotor against mechanical contact with the stator if the pump is subjected to external shock loading, or when the pump is switched off. These touch-down bearings have a limited service life. Please observe the following in order to obtain maximum service life:

- Avoid shock and vibrations (e.g. from other pumps) when the pump is running. Shocks are particularly harmful. If the pump appears to be running in the mechanical bearings continuously it is switched off.
- Avoid frequent switching on and off.
- Do not suddenly expose the pump to an already evacuated vacuum chamber. The pressure surge may cause the rotor to make contact with the touch-down bearings. This will cause increased wear.
- Do not stop the pump with the mains. Use a stop command. Switching off the mains while the pump is running will wear out the touch down bearings. If the mains supply has been disconnected accidentally re-connect it.

7.6 Shut down

CAUTION: AUTOMATIC START UP

Risk of damage to equipment. After a mains power failure the pump can run up automatically. This is intended to keep the vacuum during short mains failures. The operator must ensure safety by applying suitable measures.

CAUTION: ELECTRICITY HAZARD

Risk of injury. Unplug any connectors only when the mains voltage is switched off and the pump no longer turns.

Switch off the pump.

Note:
Do not stop the pump with the mains. Switching off the mains while the pump is running will wear out the touch down bearings.

Switch off the forevacuum pump.

Vent

When using oil-sealed forevacuum pumps, vent the turbomolecular pump before it comes to a stop. Refer to *Venting* on page 45.

When using TRIVAC pumps the built-in anti-suckback valve will close automatically, shutting off the forevacuum line. In forevacuum pumps without a vacuum retention valve, close the valve in the forevacuum line.

When the system is not operating, make sure that ambient air or cleaning media cannot enter the pump.

If a failure occurs the turbomolecular pump will be shut down automatically. The red LED at the frequency converter lights up.

7.7 Venting

Vent the turbomolecular pump each time it is shut down, to prevent any return diffusion of oil vapors out of the forevacuum line into the high-vacuum side.

Venting Methods

There are two different methods of venting the turbomolecular pump.

High vacuum side

Cautious venting of the pump is possible from the high vacuum side, since here the bearing forces will be lowest. When doing so, no free jet of gas must be allowed to form on the rotor to avoid exposing the rotor to additional forces.

Foreline connection

When venting the pump through its foreline connection, neither oil nor particles may be entrained in the gas flow from the forevacuum side into the pump.

7.8 Remove the pump from the system

WARNING: HAZARDOUS GASES

Risk of injury. If the pump has previously handled hazardous gases, implement the proper precautionary measures before opening the intake or exhaust connection.

Observe safety information given in *Hazards caused by materials and substances* on page 12.

Shut down the pump and vent as described in *Shut down* on page 44 and *Venting* on page 45.

Disconnect the pump only when it has completely stopped. The green LED must have gone out.

Then switch the mains power off and wait until the yellow power LED is off.

Then disconnect any cable connections.

Drain cooling water

Drain out the cooling water and blow out the cooling water lines to prevent frost damage.

Hazardous gases/Deposits

The pumps may be contaminated with process gases. These gases may be toxic and hazardous to health. In addition, deposits with similarly dangerous properties may have formed. Many of these gases and deposits form acids when they come into contact with humid air. This will result in serious corrosion damage to the pump.

Desiccant

To avoid health hazards and corrosion when the pumps are detached from the system, fasten a container of desiccant under the transport cover of the high vacuum connection and then close the pump immediately at all flange connections. Store the pump, with a desiccant, in an airtight PE bag.

Corrosion due to faulty packing will nullify the guarantee.

Pack the pump to prevent damage during shipping and storage. Pay particular attention to protection for the flanges and the electrical plug.

Observe the instructions in *Service* on page 62 if you forward the pump to us.

7.9 Safety functions

The pump is provided with safety functions for various abnormalities/errors. When two or more warnings are detected simultaneously, a high-priority warning is indicated. Also, the warning signal is output from the X2 REMOTE connector. If an abnormality/error is found when using the pump, check it and take measures in accordance with the following procedures. If you cannot trace it or if the pump does not function normally after the troubleshooting, contact Service office.

7.9.1 Power failure

When the power voltage drops below 160 V due to a power failure or another fault, the normal operation of the magnetic bearing is maintained at the high rotational speed using the regenerative energy of the rotating rotor (backup operation during a power failure).

The lowest rotational speed to which the magnetic bearing can operate at a power failure is called a backup rotational speed.

1. When the rotational speed is approx. 6000 rpm or more at a power failure:

   The pump detects any power failure of 2 seconds or more and decelerates. At this time, the POWER LED extinguishes and the FAILURE LED (red) illuminates. Also, a failure signal is output from FAILURE OUT pins (8)-(21) and (9)-(21) of the X2 REMOTE connector.

   When the rotational speed goes down to approx. 6000 rpm, the rotor lands on the touch down bearing and stops. All LCDs extinguish.

   The pump does not detect a power failure of less than 2 seconds and the pump will continue to rotate. Moreover, the pump does not detect a power failure during deceleration.
2. When the rotational speed is less than approx. 6000 rpm at a power failure:

   The pump does not detect the power failure. The rotor lands on the touch down bearing and stops.

Table 6. Power failure

Rotational speed	Duration of power failure	LEDs		REMOTE output signal (REMOTE X2)	
		POWER LED	FAILURE LED	ALARM	
				N.O.	N.C.
6000 rpm or more	Approx. 2 seconds or longer	Extinguish	Illuminate	Close	Open
	Shorter than approx. 2 seconds		Continue as before		
Less than 6000 rpm		Extinguish	Extinguish	Open	Close

7.9.2 Operation after a power recovery

1. The pump continues decelerating, and power failure detection is reset automatically.

   At this time, the POWER" LED illuminates and the FAILURE LED extinguishes.

   Also a failure signal is reset between FAILURE OUT pins (8)-(21) and (9)-(21) of the X2 REMOTE connector.
2. When the START signal is input after a power recovery, the pump accelerates even while it is in BRAKE state.

   However, the control unit may detect excessive vibration when power is recovered after the rotor lands on the touch down bearing. In this case, the pump once stops and cannot re-accelerate until the RESET operation completed.

   It is recommended that you establish a procedure so that the power can be supplied to the pump immediately after a power recovery.

7.9.3 Abnormal state of magnetic bearing (Disturbance)

Note:
When an abnormality/error occurs in the magnetic bearing, check the pump. If FAILURE cannot be released after reset operation, contact us.

When the magnetic bearing does not function normally due to a breakage of the connection cable, disconnection of connectors or any abnormality/error of the control circuit, the rotor lands on the touch down bearing and stops. The FAILURE LED (red) flashes and a failure signal is output from the X2 REMOTE connector.

7.9.4 Excessive vibration (Disturbance)

When serious vibration or mechanical shock causes the rotor to come in contact with the touch down bearing (due to external vibration/impact, intrusion of atmosphere, foreign matter into the pump, or rotor imbalance), and the state lasts for a certain period of time, the pump decelerates and stops.

The FAILURE LED (red) flashes and a failure signal is output from the X2 REMOTE connector.

When the rotor contacts the touch down bearing, contact noise and rotational noise of the touch down bearing are generated from the pump.

7.9.5 Motor driver overload (DRV Overload)

When the pump does not attain the rated speed within approx. 30 minutes after starting or when the ACCELERATION state remains unchanged during operation for approx. 30 minutes, the pump decelerates and stops.

The FAILURE LED (red) flashes, and a failure signal is output from the X2 REMOTE connector.

7.9.6 Overheating inside the pump (MOTOR Overheat)

When the temperature of the motor inside the pump is overheated due to an overload, the pump decelerates and stops.

The FAILURE LED (red) flashes, and a failure signal is output from the X2 REMOTE connector.

7.9.7 Overheating inside the control unit (CNT Overheat)

When the temperature inside the control unit rises due to abnormal cooling water flow rate or water temperature, external heat source, or other event, the pump decelerates and stops.

The FAILURE LED (red) flashes, and a failure signal is output from the X2 REMOTE connector.

7.9.8 Overspeed

When the rotational speed of the pump exceeds a certain overspeed due to a failure in the motor driver, the pump changes into free-running and stops.

The FAILURE LED (red) illuminates, and a failure signal is output from the X2 REMOTE connector.

7.10 WARNING function

The pump is provided with a WARNING function when an overhaul is needed following a self-test. The type of warning is indicated by the flashing pattern of the FAILURE LED (orange).

When two or more warnings are detected simultaneously, a high-priority warning is indicated and the warning signal is output from the X2 REMOTE connector.

The serial communication can confirm the error message and change the settings.

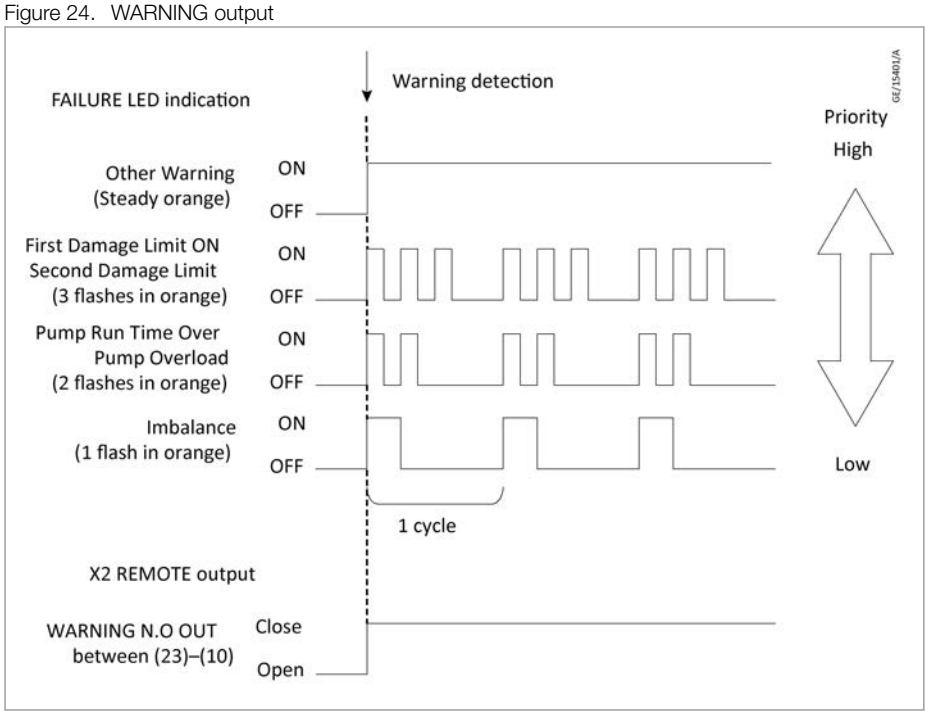
The WARNING detection cannot be reset by the RESET operation.

See *WARNING function setting* on page 51 for releasing the WARNING detection.

The pump can operate even when the WARNING is detected.

Overhaul the pump when a WARNING detection is indicated.

Figure 24. WARNING output



7.10.1 First damage limit

Impact of the pump rotor onto the touch-down bearing, such as by an unexpected in-rush of air from outside or in the event of power failure, can damage the touch-down bearings. The pump monitors these impacts and assigns damage points to the event of “Disturbance” or “Power Failure”. When the accumulated damage point attains a set limit, the “First Damage Limit” is detected.

“First Damage Limit” warning can be released by setting the warning function to disable after it is detected. The accumulated damage points can be confirmed and the setting can be changed via serial communication or STP-Link.

7.10.2 Second damage limit

“Second Damage Limit” is detected when continuing to operate the pump after “First Damage Limit” is detected and the accumulation of the damage point reaches the setting value by further “Disturbance” and “Power Failure”.

“Second Damage Limit” warning detects “START NOT ALLOWED” failure at the same time.

Overhaul the pump because the pump cannot perform the rotational operation when “Second Damage Limit” is displayed.

When operating the pump is needed after “Second Damage Limit” is displayed, disable the “Second Damage Limit”. The rotating operation can be performed even though the “WARNING” is detected.

The setting can be changed via serial communication or STP-Link.

7.10.3 Pump run time over

When the run-time counter reaches the setting value, the “Pump Run Time Over” is detected. When deposit accumulates inside the pump, this function can be used to consider the time of the overhaul.

The setting value is user-definable.

Confirmation of the total running hours of the pump and change of the setting value can be performed via serial communication or STP-Link.

7.10.4 Pump overload

"Pump Overload" is displayed when the state that the motor current exceeds the setting value continues during the fixed time, or the state that the pump rotational speed drops below the setting value continues during the fixed time. However, the motor current and the rotational speed are monitored only in the NORMAL state.

When deposit accumulates in the pump, the load in NORMAL state may gradually grow with the operating time. Considering the time of the overhaul, this "WARNING" function can be used.

The current setting value and rotational speed setting value are user-definable. The "Pump Overload" warning can be released by setting the warning function to disable after it is detected.

The setting can be changed via serial communication or STP-Link.

7.10.5 Imbalance

The pump continuously monitors its rotor balance. An "Imbalance" is detected when imbalance of the synchronized rotor with the rotational speed exceeds the setting value.

When deposit accumulates in the pump, with the increase of the pump operation hours, the rotor balance is lost and the imbalance increases gradually.

An increase in the amount of deposit may lead to a malfunction of the pump. Perform the overhaul before the scheduled time.

The setting value of the imbalance is fixed and the user cannot change it.

Set the "WARNING" function of the Enable/Disable to disable to release the "Imbalance X_H", "Imbalance X_B" or "Imbalance Z". The setting can be changed via serial communication or STP-Link.

7.10.6 Other Warnings

Occurrence condition	Pump operation	Counter measures
Air-cooling fan failure in control unit	Continuing operation	Contact Service office.
(FAN Warning)	When operating continuously, the pump may overheat and detect overheat abnormality.	
Unexpected restart of control unit during the pump rotation (C/U Restart)	Each interface signal re-outputs the current status after initialization. At warning detection, if the pump is in normal operation or acceleration, the pump accelerates again and operates continuously.	Influence of external noise. Check the setting of the pump, and take measures to reduce the influence of external noise.

7.10.7 WARNING function setting

The WARNING functions can be set to Enable or Disable. Set to “ENABLE” when using the WARNING function. Set to “DISABLE” to release each WARNING function after the WARNING is detected.

A setting value of the “Pump Run Time Over” and “Pump Overload” are adjustable. The WARNING detection can be released by setting the value larger than pump running hours after “Pump Run Time Over” is detected.

Also, the WARNING detection can be released by powering off the pump after “Pump Overload” is detected.

See the following tables for the default setting. The setting can be changed via serial communication or STP-Link.

Table 7. Default setting of WARNING function

WARNING function	Default setting	User setting	User setting change (threshold)
Second Damage Limit	Enable	Disable	Disable
First Damage Limit	Enable	Enable	Disable
Pump Run Time Over	Disable	Enable	Enable
Pump Overload	Disable	Enable	Enable
Imbalance	Enable	Enable	Disable
Other Warning	Enable	Disable	Disable

Table 8. Factory setting and variable range

WARNING function	Factory setting (threshold)		Variable range	User setting change (threshold)
Pump Run Time Over	0 hour		100.0 %	It can be set in units of 100 hour. 0 is not counted.
Pump Over-load	Motor current	100.0%	0 to 100.0%	The ratio (%) to the rated current value. A smaller value has a high possibility to trigger a “WARNING”.
	Rotational speed	0.0%	0 to 100.0%	The rate (%) to the rated speed value. A larger value has a high possibility to trigger a “WARNING”.

8 Maintenance

Observe the *Important safety information* on page 11.

For recommended overhaul intervals, contact us. Refer to *Remove the pump from the system* on page 45.

The rotating unit must only be serviced by a certified service centre.

8.1 Cleaning

If required clean the turbomolecular pump of dust with a dry cloth. Inspection and cleaning of electronics is recommended every 5 years.

Depending on the installation particulars and the ambient conditions, the converter may collect grime (dust, moisture) on the inside. Such contamination can lead to malfunctions, overheating or short circuits and will have to be avoided to the maximum extent possible. Our service department can clean the converter.

8.2 Inspecting the deposit

Note:
Leaving the pump without removing the deposit may cause the pump to be corroded beyond repair.

Deposit may have accumulated inside the pump depending upon the type of the vacuum equipment installed in the pump. An increase in the amount of deposit may lead to a malfunction of the pump.

Therefore, perform regular maintenance (once every three to six months as a target).

Inspect the inside of the outlet port for adhesion of deposit while watching the outlet port. If deposit has accumulated to some extent, an overhaul (cleaning) is required. Contact Service office.

The costs of troubleshooting problems resulting from deposit will be at your own charge, even during the warranty period.

If a problem resulting from deposit occurs inside the pump, hermetically seal the inlet port, outlet port, purge port, leak port flanges, ventilation port of the control unit, and immediately return them to Service office.

Contact with the atmosphere may cause a reaction of the deposit. DO NOT open the pump to the atmosphere.

9 Fault finding

9.1 Fault finding immediately after failure occurs

The pump is provided with safety functions for various abnormalities/errors.

A safety function operates when an abnormality/error occurs. The FAILURE LED illuminates or flashes and the failure signal is output from the X2 REMOTE connector. If an abnormality/error is found when using the pump, check it and take measures in accordance with the following procedures. If you cannot trace the cause of the error or if the pump does not function normally after troubleshooting, contact us.

After power failure

It is recommended to establish a procedure so that the power can be supplied to the pump immediately after a power recovery.

After other abnormality/error

WARNING: HAZARDOUS VOLTAGES

Risk of electric shock. Lethal voltages are present at the mains connections. Before starting any maintenance and service work, de-energise (lockout/tagout) the product first.

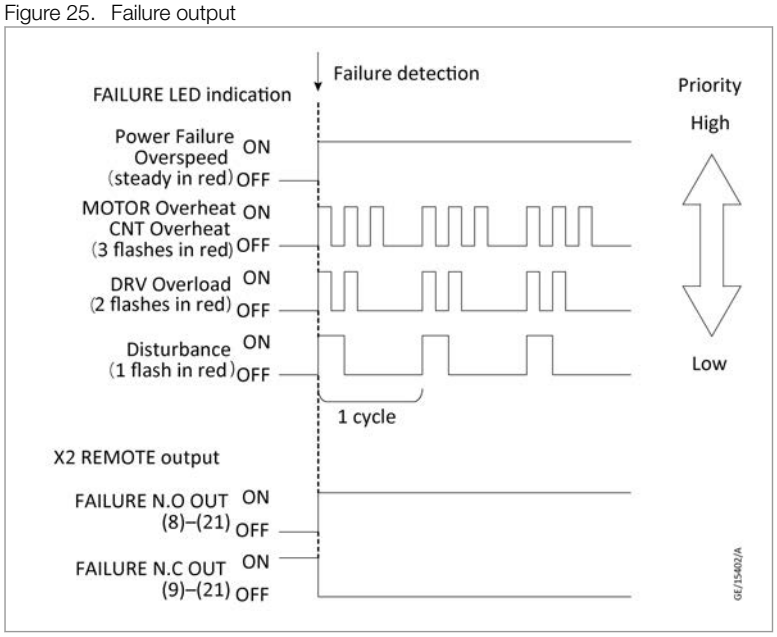
Unplug any connectors only when the mains voltage is switched off and the pump is no longer turning.

If the RESET operation does not extinguish the FAILURE LED, confirm that the pump has stopped, turn OFF the primary power (Switch the switch OFF), then turn ON the primary power (Switch the switch ON) again.

1. After confirming the ROTATION LED has extinguished and the pump has stopped, remove the probable cause of the abnormality.

   When the FAILURE LED illuminates or flashes, follow the recommended actions given in the following table.
2. Perform the RESET operation to extinguish the FAILURE LED.
3. Perform the START operation. Check if the pump operates correctly.

Figure 25. Failure output



9.2 Indication of FAILURE LED (red)

The flashing pattern of the FAILURE LED (red) differs depending on the type of abnormality/error. When two or more failures are detected simultaneously, a high-priority failure is indicated. Also, the failure signal is output from the X2 REMOTE connector. If an abnormality/error is found, take measures in accordance with the following tables. DO NOT perform operations not mentioned in the following tables.

FAILURE LED & Error message & Pump operation	Occurrence condition	Possible cause	Corrective action
1 flash in red Disturbance X_H Disturbance Y_H Disturbance X_B Disturbance Y_B Disturbance Z The pump decelerates and stops.	Excessive imbalance	Excessive vibration applied externally to the pump: External vibration/impact. Atmospheric air flows into the pump. Foreign materials fall into the pump. Sudden pressure change at start of roughing vacuum Abnormal magnetic bearing: Control circuit error. Disconnection of the internal wiring.	Remove external vibration so as not to transmit it to the pump. Check the vacuum piping. Install the pump in a way that no foreign materials fall into the pump. Perform roughing vacuum through bypass root. Contact Service office.
2 flashes in red DRV Overload The pump decelerates and stops.	Acceleration state continues for approx. 30 minutes	High pressure at the inlet port. High pressure at the outlet port. Leakage of the piping system. Failure of the backing pump.	Use the maximum working pressure or less. Use the allowable backing pressure or less. Check the vacuum piping system for leakage. Check the backing-pump for its capacity and START state. (use a backing-pump with the recommended capacity or more)
3 flashes in red CNT Overheat 1, 2 The pump decelerates and stops.	Overheating inside the control unit	High ambient temperature. Insufficient cooling of the control unit.	Set the ambient temperature to 40 °C or less. Set the cooling water flow rate at 3 l/min and cooling water temperature between 15 to 35 °C
3 flashes in red MOTOR Overheat The pump decelerates and stops.	Overheating inside the pump	Overheating during baking. Insufficient cooling. Leakage of the vacuum piping system. Repetitive start/stop operations.	Set the temperature of the baking heater to 120 °C or less. Always cool the pump. Check the piping system for leakage. Repetitious start/stop operations may cause the pump to overheat.
Steady red Aberrant Accel Free run 1)	Rotational speed increases in brake or levitation state	Atmospheric air flows the pump.	Check the vacuum piping system for leakage. Check the exhaust sequence. Turn OFF the switch to stop the pump, and then turn ON the switch again to recover.

Fault finding

FAILURE LED & Error message & Pump operation	Occurrence condition	Possible cause	Corrective action
Steady red Aberrant Brake Free run 1)	The rotation does not stop after 30 min. into brake state	Failure of the control unit.	Contact Service office.
Steady red Accel Malfunction The pump decelerates and stops.	Accelerate up to 2000 rpm or less.	Malfunction by external noise. Failure of the control unit.	Perform rotational operation after resetting. Contact Service office.
Steady red AMB Com. Failure The pump decelerates and stops.	Communication failure in the control unit	Failure of the control unit.	Contact Service office.
Steady red DRV Com. Failure The pump decelerates and stops.	Communication failure with motor driver	Failure of the control unit.	Contact Service office.
Steady red DRV Failure The pump decelerates and stops.	Abnormal motor driver operation.	Failure of the control unit.	Contact Service office.
Steady red DRV Overcurrent Free run 1)	Motor driver over current	Short-circuit or ground fault in the motor winding. Failure of the control unit.	Contact Service office.
Steady red DRV Overvoltage Free run 1)	Motor driver over voltage	Failure of the control unit.	Contact Service office.
Steady red Inordinate Current Touch down 2)	Excessive magnetic bearing electric current continues for 30 sec.	Failure of the pump. Failure of the control unit.	Contact Service office.
Steady red	Abnormal motor temperature detection	Disconnection of the motor temperature sensor.	Contact Service office.

FAILURE LED & Error message & Pump operation	Occurrence condition	Possible cause	Corrective action
M_Temp Lost The pump decelerates and stops.			
Steady red Overspeed 1, 2, 3, 4 Free run 1)	Rotaional speed exceeds rated speed	Failure of the control unit.	Contact Service office.
Steady red Power Failure The pump decelerates and stops.	Insufficient power supply	Power failure. Incorrect connection of the power cable. Failure of the power cable. Failure of the power supply voltage.	Check whether or not a power failure has occurred. Connect the power cable correctly. Replace the power cable. Set the rated voltage ± 10 %.
	Overheat inside the control unit.	Insufficient cooling of the control unit. Failure of the control unit.	Check the volume of water and water temperature with water cooling unit. In order to recover, turn off the power (switch OFF), and then switch ON after sufficient cooling of the control unit. (isolate input power supply 3 minutes or more) Contact Service office.
Steady red Power Supply Fail Free run 1)	Abnormal power circuit.	Failure of the control unit.	Contact Service office.
Steady red Serial Com. Fail The pump decelerates and stops.	Communication failure of the input operation port during acceleration and normal operation	Insufficient user application setting. Disconnection or break of the communication cable. Failure of the control unit.	Send a communication command periodically at intervals of less than setting value. Check the communication cable. Contact Service office.
Steady red Speed Pulse Lost Free run 1)	Abnormal rotational speed detection	Failure of the control unit.	Contact Service office.
Steady red START NOT ALLOWED The pump decelerates and stops.	Damage point exceed setting value	Frequency of "Disturbance" or "Power Failure" error.	Overhaul is needed. Contact Service office.

Fault finding

1) The driver output stops and the rotor continues rotating by inertia. It may take several hours to stop. To stop the pump quickly, close the vacuum valve at the outlet port flange and start the venting procedure by following the venting instructions.

2) The magnetic bearing output stops and the rotor is descended on the touch down bearing.

9.3 Indication of FAILURE LED (green)

If an abnormality/error is detected by self test during the power ON operation, the FAILURE LED flashes green. This indicates of pump or control unit failure. Contact Service Office.

9.4 No Indication of the FAILURE LED

Symptom	Possible cause	Corrective action
The POWER LED does not illuminate.	Incorrect connection of power cable	Connect the power cable correctly.
	Abnormal power voltage	Set the input voltage to the rated voltage ±10 %.
	Power failure	Check whether or not a power failure has occurred.
	Insufficient cooling	Make sure that the pump is cooled.
The ROTATION LED does not flash after performing the start operation.	Failure of the "Input Operation Port" setting.	Set the input operation port correctly.
Insufficient ultimate pressure.	Failure of the backing pump.	Check the capacity and starting state (use a backing pump having more capacity that we specified).
	Leakage of the piping system.	Check the piping system for leakage.
	Residual molecules.	If the main composition is H2 or H2O, perform baking; if it is other gases, clean the inside of the vacuum equipment (If gases remain inside the pump, contact Service office when it is needed to be cleaned).
Abnormal noise is generated while the pump is rotating	External vibration or impact	Remove external vibration so as not to transmit it to the pump.

10 Storage

To store the devices, place them in a sealable PE bag containing a drying agent and use the supplied transport packaging. Do not store the pump and accessories in a moist atmosphere to prevent it from corrosion. Take note of details in *Remove the pump from the system* on page 45.

11 Disposal

WARNING: CONTAMINATED PARTS

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

Waste disposal

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

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

When sending us any equipment, observe the regulations given in *Service* on page 62.

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

Table 9. Accessories

Accessory	Part number
Al/FPM	26845
Stainless steel/FPM	88708
Purge adapter set	412207V01
Set of bolts, nuts and washers for ISO-F flange	
Set M10x35, 12.9	400153V0010
Set M10x50, 12.9	400153V0012
Set M10x50 (Stud bolts), 12.9	400153V0019
Set M12x45, 12.9	400153V0020
Set M12x60, 12.9	400153V0021

13.1 Ordering data

Description	Part number
Pump with integrated converter with Profibus and 24 V PLC Interface MAG 2207 iS, DN 250 ISO-F	412200V7704
Pump with integrated converter with RS485/232 and 24 V PLC Interface MAG 2207 iS, DN 250 ISO-F	412200V7724
Pump with integrated converter with Profibus and 24 V PLC Interface MAG 2807 iS, DN 250 ISO-F	412800V7704
Pump with integrated converter with RS485/232 and 24 V PLC Interface MAG 2807 iS, DN 250 ISO-F	412800V7724
Pump with integrated converter with Profibus and 24 V PLC Interface MAG 3207 iS, DN 320 ISO-F	413200V7704
Pump with integrated converter with RS485/232 and 24 V PLC Interface MAG 3207 iS, DN 320 ISO-F	413200V7724

300818757 - A

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:

- *Magnetically levitated turbo molecular pump - with integrated frequency converter*
- *MAG2207iS, MAG2807iS, MAG3207iS*
- *412200Vxxxxy, 412800Vxxxxy, 413200Vxxxxy* *x= 0-9; y= blank or A-Z*

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 relevant requirements of harmonised standards:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61010-1:2010 +A1:2019	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements
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: *2024-08-29*

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

Ian Keech – VP Engineering, Scientific Vacuum Division Burgess Hill

Rene Rose Stueber – General Manager Product Company Cologne

Declaration of Conformity

Leybold GmbH
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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.

- *Magnetically levitated turbo molecular pump - with integrated frequency converter*
- *MAG2207iS, MAG2807iS, MAG3207iS*
- *412200Vxxxxy, 412800Vxxxxy, 413200Vxxxxy* *x= 0-9; y= blank or A-Z*

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 61010-1:2010 +A1:2019	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements
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: *2024-08-29*

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

Signed for and on behalf of Leybold GmbH

Ian Keech – VP Engineering, Scientific Vacuum Division Burgess Hill

Rene Rose Stueber – General Manager Product Company Cologne

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION (EU/UK)

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
- 6(c) Copper alloy containing up to 4% **lead** by weight

REACH (EU, UK)

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

Article 33.1 Declaration (EU, UK)

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

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

WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (EU,UK)

This product must be disposed of in accordance with the requirements of the WEEE Directive.

ADDITIONAL APPLICABLE REQUIREMENTS

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

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 72301459
	The product is certified by TÜV Rheinland of North America which is a “Nationally Recognized Testing Laboratory” (NRTL) for USA and Canada.
TSCA PBTs	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.

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
铜管管件 Brass pipe fitting	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.

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Leybold

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