

# MAG integra

Turbomolecular Pumps with Magnetic Bearing  
and Frequency Converter

**Installation & Operating Instructions 300324726\_002\_C0**

Part Nos.

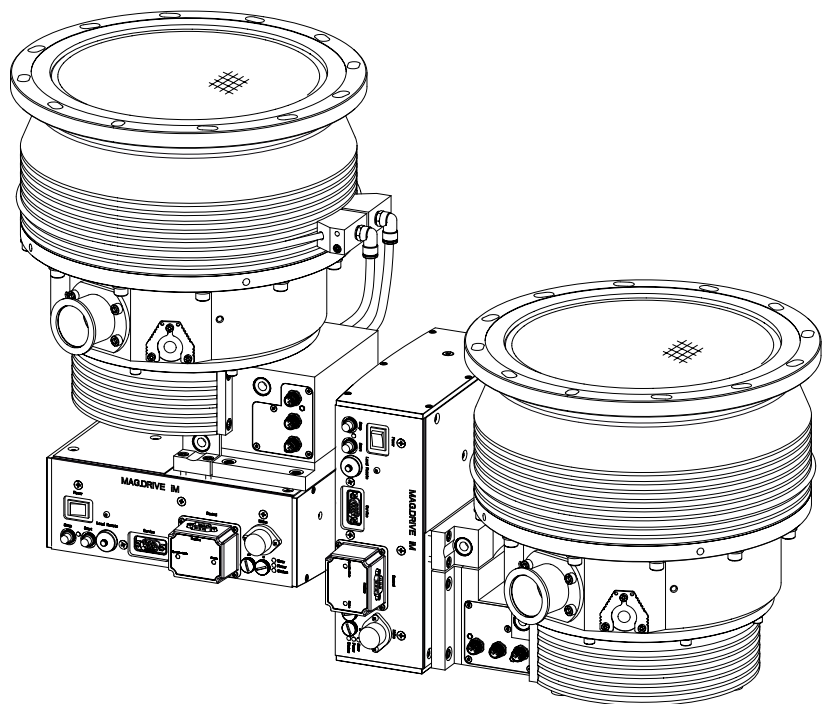
411300Vxxxx

411600Vxxxx

411700Vxxxx

412200Vxxxx

and pumps modified by  
Leybold



# Contents

	<b>Page</b>
<b>0 Important Safety Information</b>	<b>5</b>
0.1 Mechanical hazards	5
0.2 Electrical hazards	6
0.3 Thermal hazards	7
0.4 Hazards caused by materials and substances	7
0.5 Danger of ignition	8
0.6 Risk of damaging the pump	9
<b>1 Description</b>	<b>10</b>
1.1 Design and function	11
1.2 Supplied equipment	12
1.3 Technical data	13
1.4 Ordering data	20
1.5 Accessories	21
<b>2 Transport and storing</b>	<b>22</b>
<b>3 Installation</b>	<b>23</b>
3.1 Conforming utilization	23
3.1.1 Non-conforming utilization	23
3.2 Operating environment	25
3.3 Attach the pump to the vacuum chamber	25
3.4 Forevacuum connection	30
3.5 Connecting the cooling water	31
3.5.1 Water Quality	32
3.6 Connect the purge gas and venting valve	34
3.7 Electrical connection for the integrated frequency converter	35
3.8 Relays, LEDs, PLC interface	36

# Contents

	<b>Page</b>
<b>4      Operation</b>	<b>38</b>
4.1    Media compatibility / purge gas	38
4.2    Interfaces	38
4.3    Switching on	39
4.4    Operation	39
4.5    Switching off	40
4.6    Venting	41
4.7    Removing the pump from the system	42
<b>5      Maintenance</b>	<b>43</b>
5.1    Cleaning	43
5.2    Changing the touch-down bearings	44
5.3    Leybold Service	44
<b>6      Troubleshooting</b>	<b>45</b>
<b>7      Waste Disposal</b>	<b>46</b>
<b>EC Incorporation Declaration</b>	<b>47</b>
<b>EC Declaration of Conformity</b>	<b>48</b>
<b>Certificates</b>	<b>49</b>

# Safety Information

---

## NOTICE



### Obligation to Provide Information

Before installing and commissioning the pump, carefully read these Operating Instructions and follow the information so as to ensure optimum and safe working right from the start.

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

---

## DANGER



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

---

## WARNING



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

---

## CAUTION



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

---

## NOTICE



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

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

Retain the Operating Instructions for further use.

## 0 Important Safety Information

### 0.1 Mechanical hazards

- 1 Avoid exposing any part of the human body to the vacuum.
- 2 The pressure in the pump must not exceed 1.4 bar (absolute).
- 3 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 way of an overpressure safety valve, for example.
- 4 Vent the pump only up to atmospheric pressure.
- 5 When using the pump with a purge gas valve, protect the purge gas supply such that in the event of a malfunction no overpressure can occur within the system.
- 6 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; internal pump components could be thrown in all directions. Never operate the pump (in bench testing, for example) without proper flanging to the vacuum chamber. Observe the information in Section 3.3.
- 7 We recommend to change the rotor after 80,000 hours of operation or 20,000 cycles at the latest. Due to high-speed and temperature, the service life of the rotor is limited. If the rotor is changed too late, it may 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 Turbopumps 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 destruction of the equipment and to prevent injuries of the operating staff the leading European manufacturers of vacuum pumps strictly recommend to follow the installation instructions as given in this manual.

---

#### WARNING



# Safety Information

---

**WARNING**

## 0.2 Electrical hazards

- 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 Lethal voltages are present at the mains connections. Before starting with any maintenance and service work, de-energise (lockout/tagout) the product first.
- 3 Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn
- 4 At speeds approximately below 200 Hz, there will not be enough power any more for the LEDs, i.e. the pump may still turn with out any of the LEDs being on.
- 5 Unauthorized device conversion and modifications are prohibited for safety reasons.
- 6 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. Basically there is no reason why the frequency converter should be opened. There are no user serviceable parts inside.  
  
Should, even so, changes be made to the pump-frequency converter system then a trained electrician, as specified by the standard EN 50110-1, for example, must perform an electrical safety test again in accordance with the locally applicable safety regulations.
- 7 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.
- 8 Suitably support the connecting lines so that the pumps are not exposed to any major mechanical stress.
- 9 Do not expose pump, frequency converter and the connections to dripping water. Note the information on the IP type of protection.
- 10 When storing pump, frequency converter and connecting lines in a humid atmosphere, these can suffer corrosion. Corrosion gives rise to conductive deposits which in turn can cause short-circuits and reduce the insulation levels of electrical components
- 11 Transport pump, frequency converter and connecting cables only in their original packaging so as to avoid any mechanical damage which in turn may reduce air gaps and creepage distances.
- 12 When applying external voltages above 42 V to the connection terminals, observe the applicable VDE safety regulations!
- 13 Make the electrical connections only after pump and accessories (e.g. air cooler) have been installed mechanically

## 0.3 Thermal hazards

- 1 Handle the equipment only while vented and cooled down.
- 2 During operation of the pump certain areas can get so hot (80 °C max.) so that there is the risk of suffering burns. Protect hot parts against being touched.
- 3 Note the warning information on the housing surface. If these warning notices have been removed, covered or obstructed, include corresponding additional warning notices.

---

### CAUTION



## 0.4 Hazards caused by materials and substances

- 1 The pump is not suited for pumping of reactive, corrosive or toxic media. If the rotor is attacked by process gases, it can suffer destruction. 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 Please consult us as to which types of pump 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. A leak search will always be required after having installed the pump and after service work on the vacuum. Upon delivery the pump has an integral leak rate of  $< 5 \cdot 10^{-7}$  mbar·l/s.
- 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 of time 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, please also state the type of hazard. For this you must use a form which we have prepared for you.
- 8 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.

---

### DANGER



# Safety Information

---

**CAUTION****0.5 Danger of ignition**

- 1 During operation the pressure inside the turbomolecular pump is so low that there is no danger of ignition (at pressures below about 100 mbar). A hazardous condition will be created if flammable mixtures enter the hot pump at pressures above 100 mbar. During operation the pump can reach temperatures as high as 120°C internally, and at parts of the outside surfaces 80 °C. Sparks could occur in case of damage to the pump and these could ignite explosive mixtures. Also note the safety information provided by the gas supplier.



## 0.6 Risk of damaging the pump

- 1 Never touch the rotor. Touching the rotor may cause injury and damage the rotor bearing.
- 2 Foreign objects which enter the pump through the intake would cause serious damage to the rotor. That's why we recommend installing an inlet screen. Damages caused during operation without the inlet screen are excluded from warranty.
- 3 The contact surfaces of pump housing, vacuum system and centering ring must be free of grease and dry so as to ensure sufficient stability in case the rotor seizes.
- 4 Connect a purge gas or venting valve to the correct flange. Confusing the forevacuum and purge gas flange can cause shock venting of the pump.
- 5 The interface connectors have UNC 4-40 threads. Do not use connectors with M3 threads.
- 6 Disconnect and connect the cable connections only while the pump is turning no longer (green status LED off) and with the mains power switched off (yellow power LED off). Otherwise there is the risk of damaging the frequency converter.
- 7 Do not stop the MAG with the mains. Switching off the mains while the pump is running will wear out the touch down bearings.
- 8 Exposure of the pump to accelerating forces must be avoided or reduced to such an extent that the rotor unit will not be excited by vibrations. In the case of critical applications you must consult our Applications Dept. first.
- 9 Connect the pump in an EMC compliant manner so as to avoid line related interference.

---

### NOTICE



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

# Description

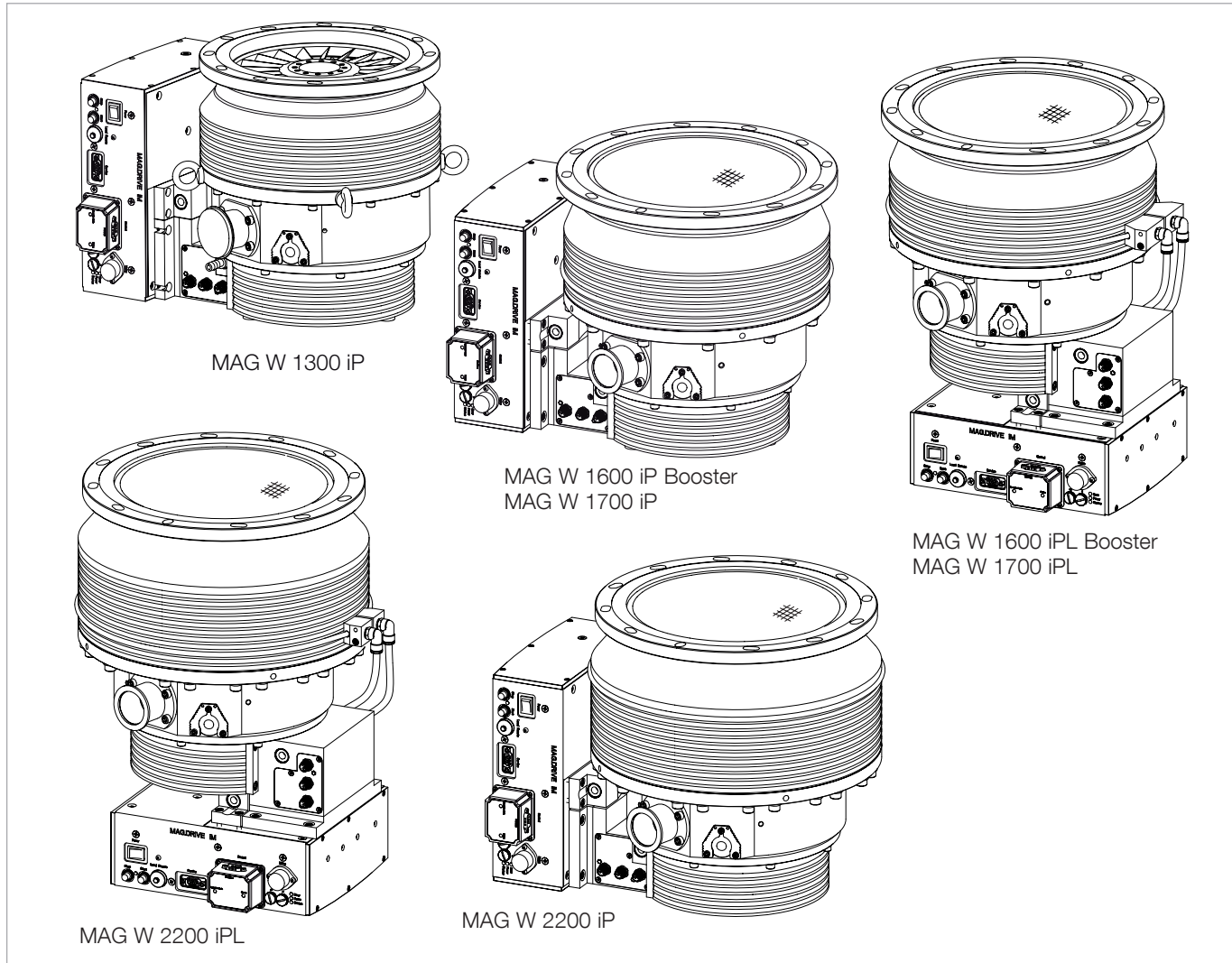


Fig. 1.1 MAG integra models

## 1 Description

The Leybold MAG integra pumping system consists of:

- The MAG integra turbo pump

The MAG 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 for the MAG ... iP models.

- The MAG.DRIVE electronic frequency converter

The MAG.DRIVE iM frequency converter is connected to the mains.

It outputs an AC voltage synchronised to the speed for the pump's motor. Moreover, the electronic frequency converter processes the measured signals and controls the magnetic levitation arrangement.

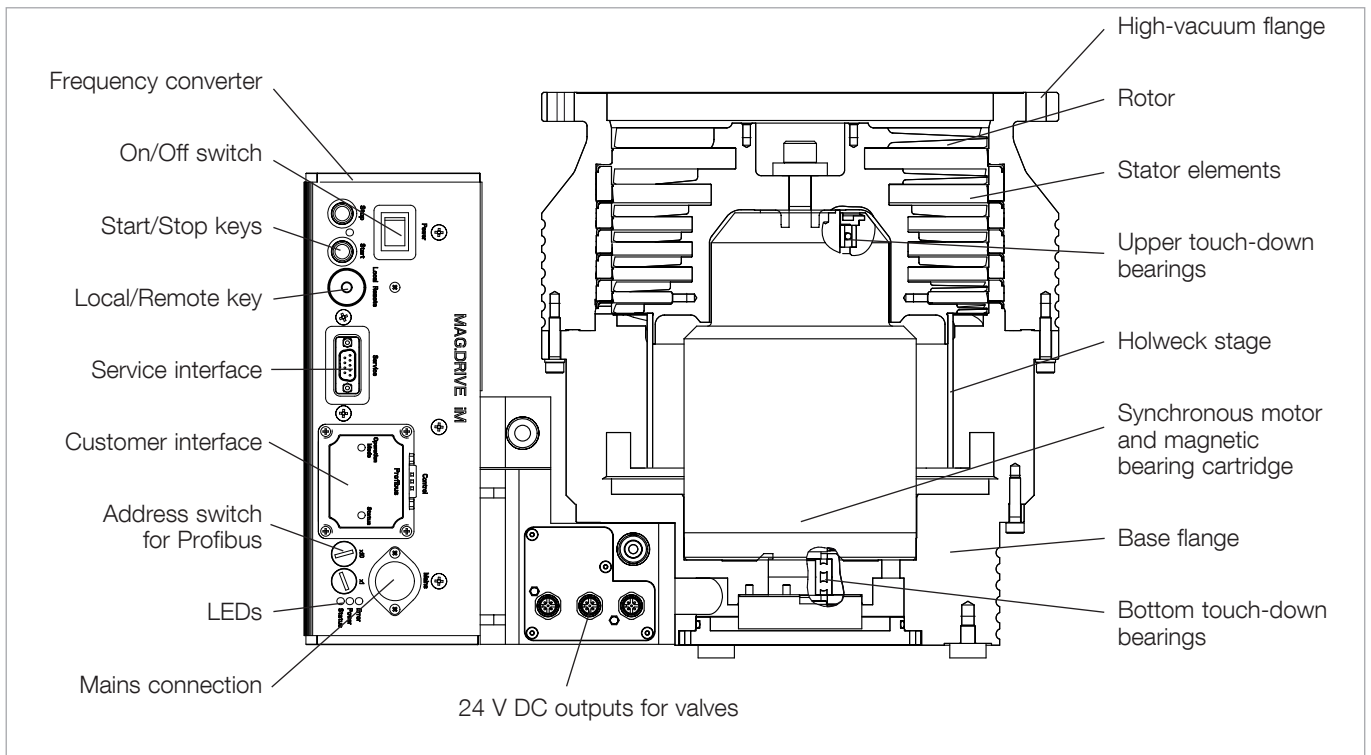


Fig. 1.2 Schematic section of the MAG integra with frequency converter, other models similar

## 1.1 Design and function

The turbomolecular pump comprises basically the pump housing, the multi-stage rotor with the stator package, the drive, and a magnetic bearing.

The rotor is made from an aluminum alloy. In addition to the turbine stage the rotor has a Holweck stage.

The MAG 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 insures 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 are provided to stabilize the rotor mechanically if impacts occur during operation. They are only used in case of strong shocks or faulty electronics.

When interrupting the power supply voltage, the turbomolecular pump will operate as a generator supplying the frequency converter with power. The rotor is decelerated down to approximately 100 Hz and will then touch down on the touchdown bearings.

The MAG has a purge gas device. It is water-cooled.

A controlled synchronous motor is used to power the rotor.

### Rotor

### Magnetic bearing

### Touch-down bearings

# Description

## **Frequency converter**

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

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

Switching the motor to the generator mode keeps the magnetic bearing unit in operation even in case of a mains power failure.

The frequency converter has the following interfaces:

- a Profibus or another optional interface, see Section 4.2
- an interface for the Leybold Service (RS 232) and
- three connections for accessories, e.g. valves.

### **1.2 Supplied equipment**

The pumps are shipped sealed in a PE bag with a desiccant to absorb moisture. The maximum useful life of the desiccant is one year.

The forevacuum flange is capped with a protective cap. The purge gas and venting flange is blank-flanged with centering ring with FPM sealing ring and a clamping yoke.

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 (IP 54) is supplied. A cable and a mains plug are not part of the standard equipment.

---

PE = Polyethylene

FPM = Fluororubber, resistant to temperatures up to 150°C (302 °F)

## 1.3 Technical data

	MAG W	1300 iP(L)	1600 iP(L) Booster	1700 iP(L)	2200 iP(L)
High-vacuum flange	DN	200 ISO-F 200 CF	250 ISO-F	250 ISO-F 250 CF	250 ISO-F 250 CF
Pumping speed (PNEUROP)	$l \cdot s^{-1}$				
N <sub>2</sub>		1100	1600	1610	2100
Ar		1050	1470	1480	1900
He		1220	1770	1710	2050
H <sub>2</sub>		1130	1570	1660	1750
Max. Compression					
N <sub>2</sub>		$> 10^8$	$> 10^7$	$> 10^8$	$> 10^8$
Ar		$> 10^8$	$> 10^7$	$> 10^8$	$> 10^8$
He	at 1 sccm	$2 \cdot 10^5$	$6 \cdot 10^4$	$2 \cdot 10^5$	$5 \cdot 10^4$
H <sub>2</sub>	at 1 sccm	$8 \cdot 10^3$	$1 \cdot 10^3$	$4 \cdot 10^3$	$5 \cdot 10^3$
Max. gas throughput <sup>1) 2)</sup>	$mbar \cdot l \cdot s^{-1}$				
N <sub>2</sub> temporary, for pump down		30	60	30	30
N <sub>2</sub> continuous operation		20	30	20	17
Ar temporary, for pump down		20	30	20	20
Ar continuous operation		15	20	15	12
Max. forevacuum pressure <sup>2)</sup> N <sub>2</sub> /Ar	mbar	4	1	4	2.5
Nominal speed		37,800 min <sup>-1</sup>	33,000 min <sup>-1</sup>	33,000 min <sup>-1</sup>	30,600 min <sup>-1</sup>
Stand-by speed to be set between and nominal speed			13,800 min <sup>-1</sup> (230 Hz)		
Ultimate pressure ISO-F / CF flange			$< 10^{-8}$ mbar / $< 10^{-10}$ mbar		
Max. bake-out temperature			80 °C		
Run-up time		< 5 min	< 7 min	< 7 min	< 10 min
Forevacuum flange			DN 40 KF		
Purge gas / venting flange			DN 16 KF (clamp shoe)		
Cooling connection			G 1/8"		
Weight, approx.		40 kg	45 kg	45 kg	50 kg
Noise level acc. to ISO 3744			< 41 db(A)		
Vibration level at high-vacuum flange at max. speed			< 0.01 $\mu$ m		

1) The maximum gas throughput for continuous operation in connection with N<sub>2</sub> 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<sup>3</sup>/h. These values may differ for other operating conditions.

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

# Description

## Technical data for the integrated frequency converter MAG.DRIVE iM

Supply voltage	200 - 240 V $\pm$ 10%
Mains frequency	50 / 60 Hz
Power consumption	
maximum	750 VA
at ultimate pressure	150 VA
Max. load capability of the relays (interface X1, optional) (for SELV or PELV power circuits only)	32 V, 0.5 A
Max. load for each valve output	24 VDC, 0.35 A
Temperature during operation	10 - 45 °C
Storage temperature	- 10 - 60 °C
Relative air humidity (non condensing)	5 to 85 %
Type of protection	IP 54
Overvoltage category	II
Contamination level acc. to IEC 61010	2

# Description

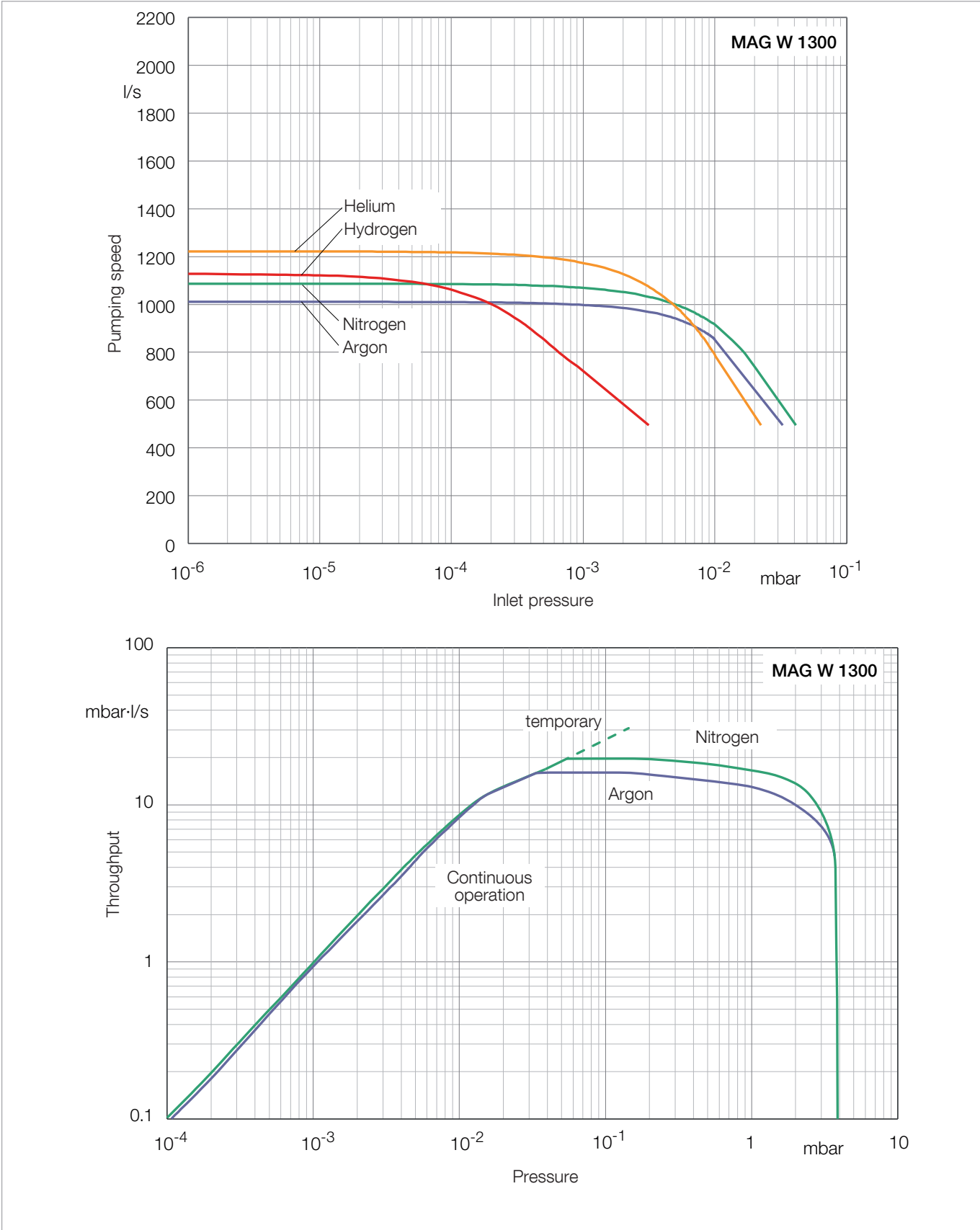


Fig. 1.3 Pumping speed curves and operation diagrams for the MAG W 1300

# Description

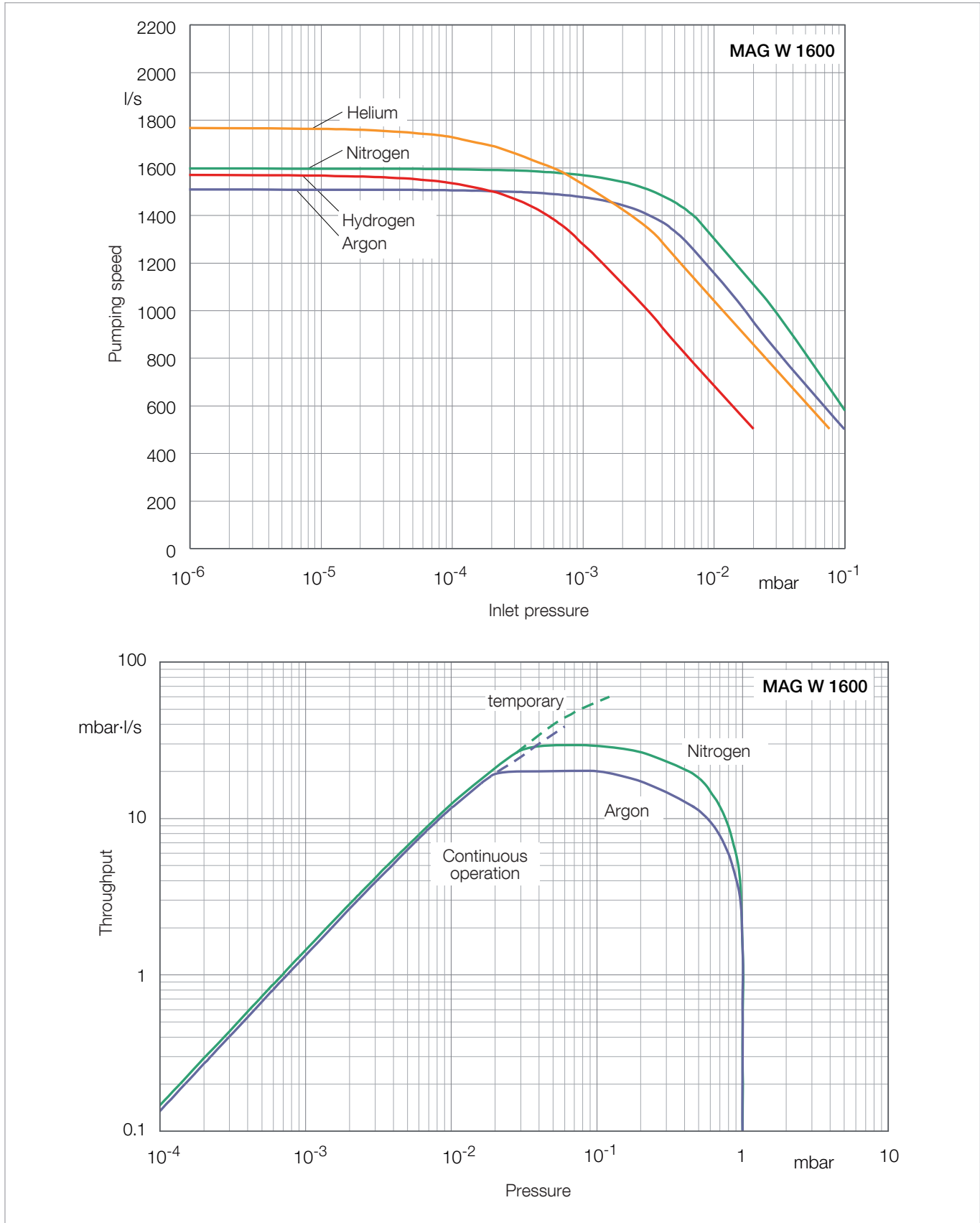


Fig. 1.4 Pumping speed curves and operation diagrams for the MAG W 1600



# Description

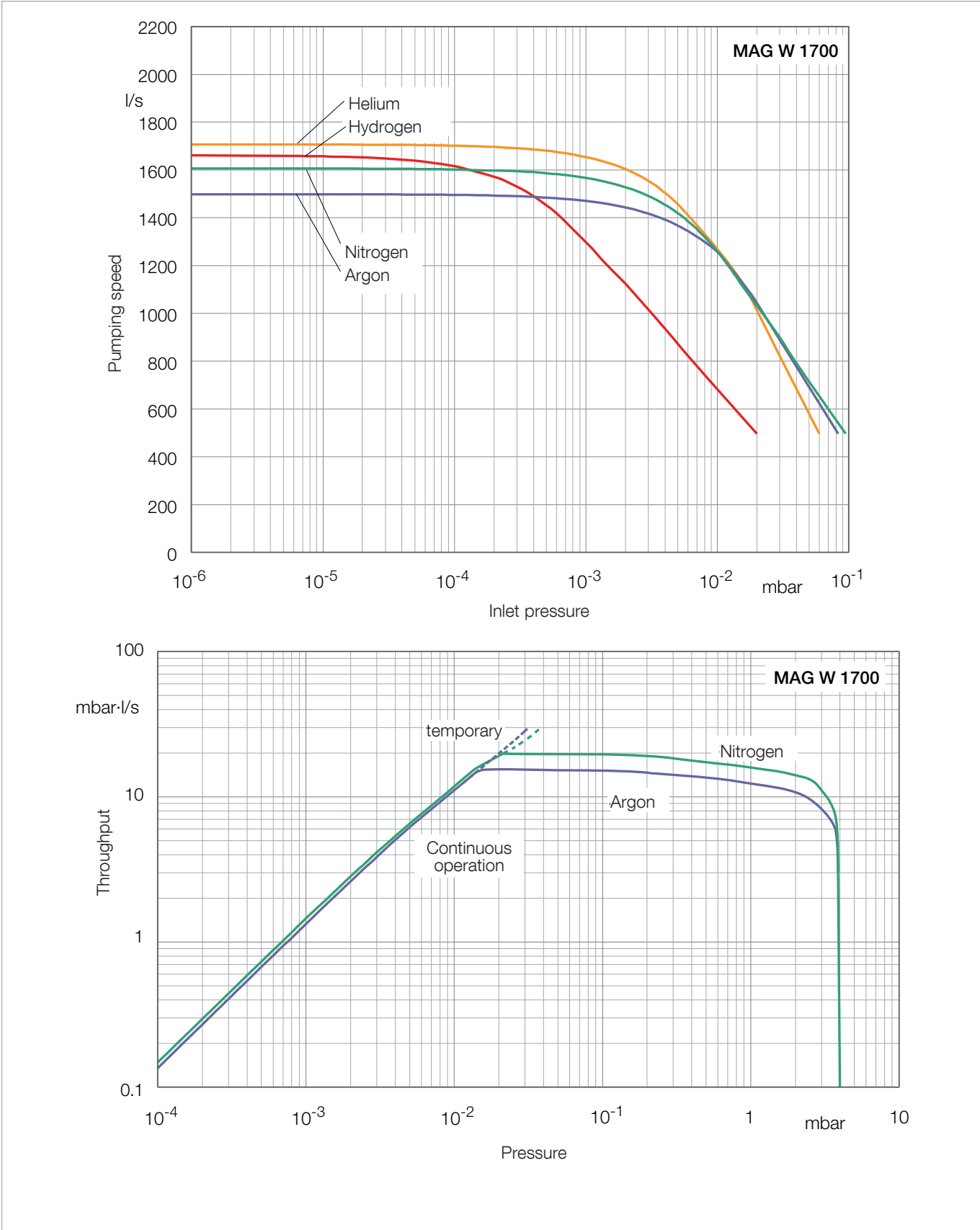


Fig. 1.5 Pumping speed curves and operation diagrams for the MAG W 1700

# Description

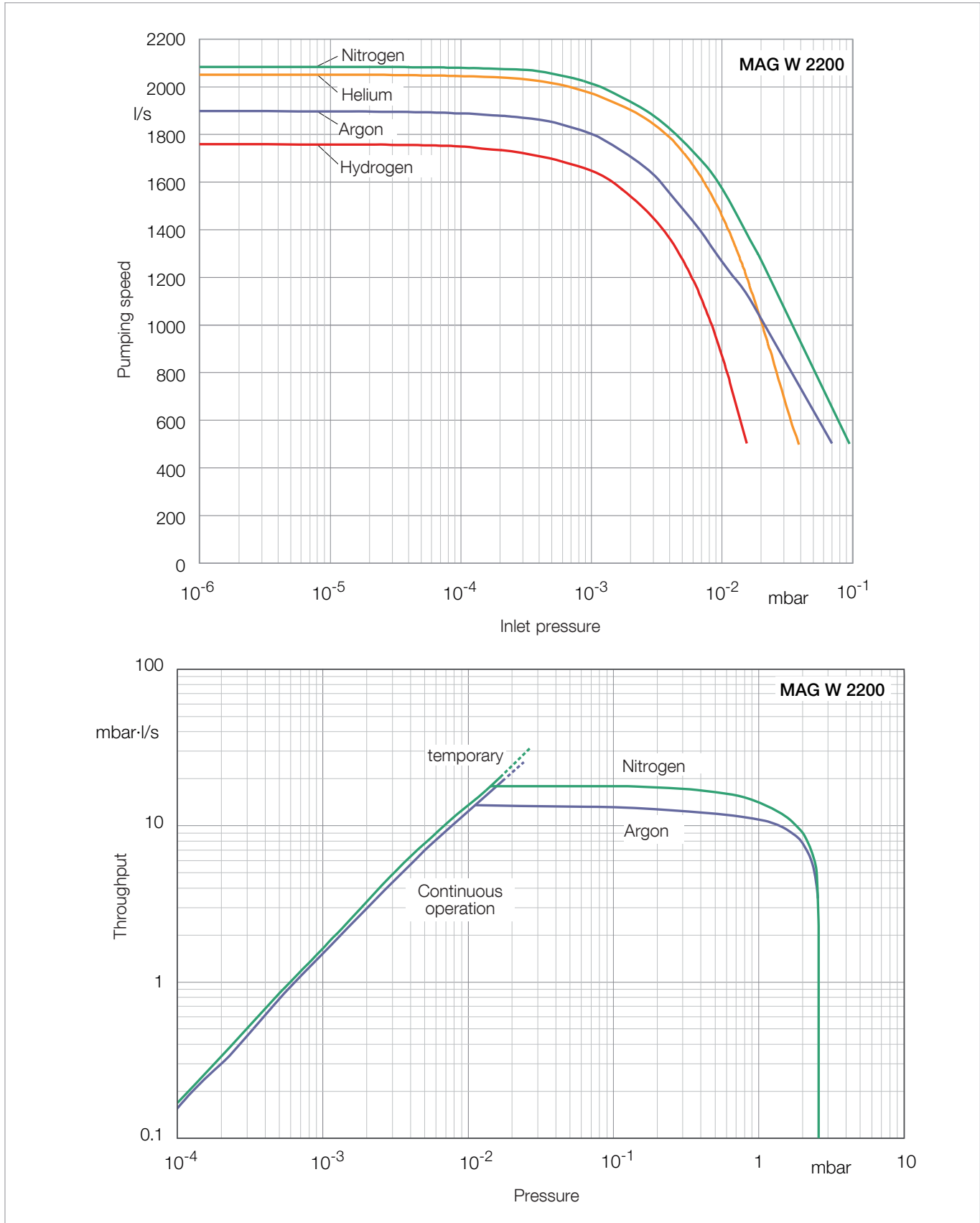


Fig. 1.6 Pumping speed curves and operation diagrams for the MAG W 2200

# Description

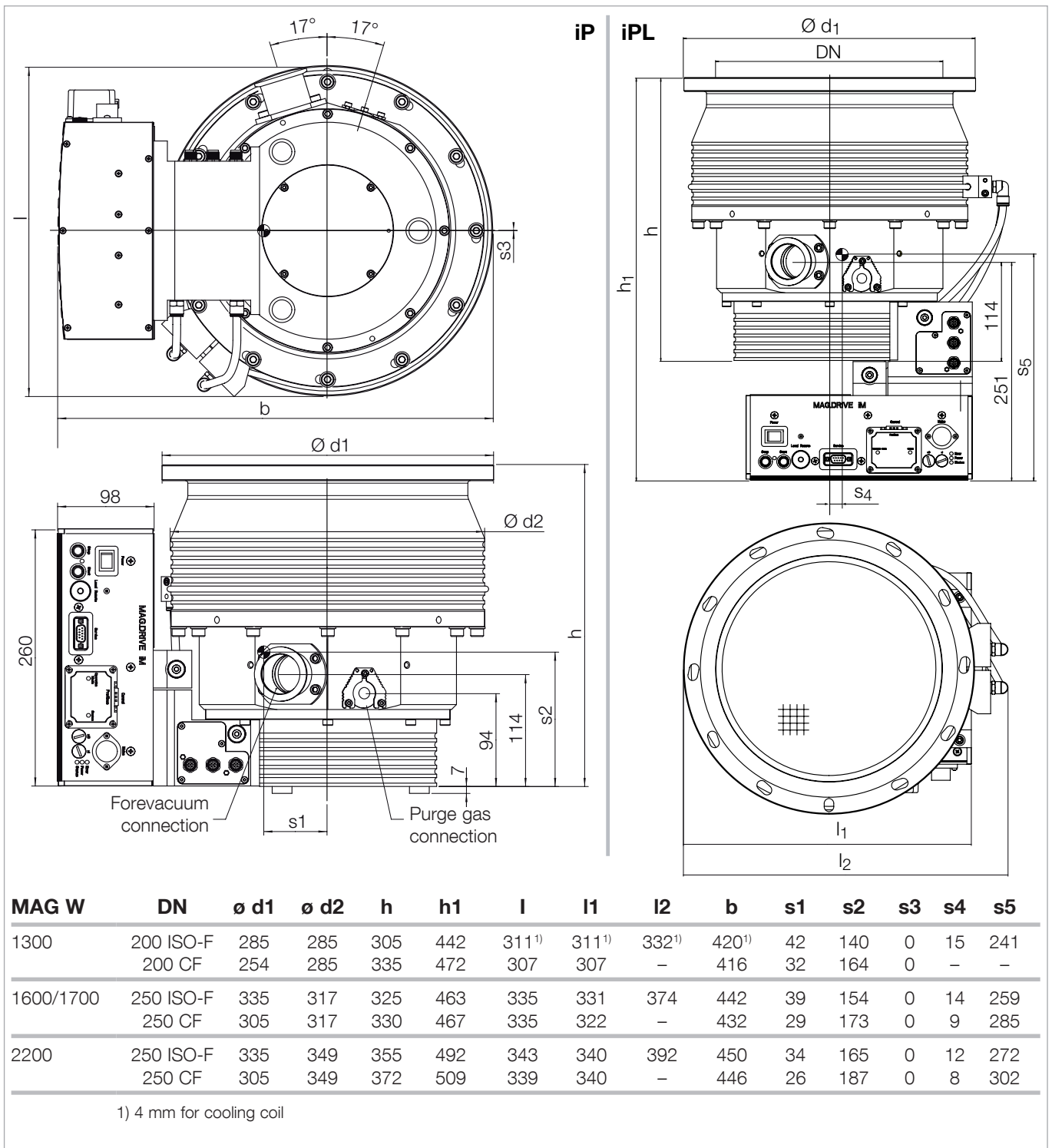


Fig. 1.7 Dimensional drawing of the pumps, dimensions in mm

# Description

## 1.4 Ordering data

		Part No.	
<b>Pump with integrated converter and purge gas port, Type of protection IP 54*</b>			
<b>with</b>		<b>Profibus</b>	<b>24 V PLC Interface</b>
MAG W 1300 iP	DN 200 ISO-F	411300V0504	411300V0514
MAG W 1300 iP	DN 200 CF	411300V0506	411300V0516
MAG W 1300 iPL	DN 200 ISO-F	411300V0704	411300V0714
MAG W 1300 iPL	DN 200 CF	411300V0706	411300V0716
MAG W 1600 iP Booster	DN 250 ISO-F	411600V0504	411600V0514
MAG W 1600 iPL Booster	DN 250 ISO-F	411600V0704	411600V0714
MAG W 1700 iP	DN 250 ISO-F	411700V0504	411700V0514
MAG W 1700 iP	DN 250 CF	411700V0506	411700V0516
MAG W 1700 iPL	DN 250 ISO-F	411700V0704	411700V0714
MAG W 1700 iPL	DN 250 CF	411700V0706	411700V0716
MAG W 2200 iP	DN 250 ISO-F	412200V0504	412200V0514
MAG W 2200 iP	DN 250 CF	412200V0506	412200V0516
MAG W 2200 iPL	DN 250 ISO-F	412200V0704	412200V0714
MAG W 2200 iPL	DN 250 CF	412200V0706	412200V0716

other interfaces on request

\* The IP 54 type of protection is only ensured with an IP 54 protection cap on the customer interface. Pump versions without IP 54 protection cap can only be classified as IP 20. Please consult with us for an optional IP 54 protection cap.

## 1.5 Accessories

### Required accessories

Set of bolts, nuts and washers for ISO-F flange (12 each)	400153V0012
Bolts M 10 x 50	
Bolts M 10 x 35	400153V0010
Bolt quality 12.9 acc. to EN ISO 898-1 with coating; 0,2 % yield strength > 1080 N/mm <sup>2</sup>	

Centering ring with O-ring	DN 200	DN 250
Al/FPM	268 44	268 45
Stainless steel/FPM	887 02	887 08

Set of bolts, nuts and washers for CF flange (8 each)	400153V0016
Bolts M 8 x 40	
Bolt quality 10.9 acc. to EN ISO 898-1 with coating; 0,2 % yield strength > 900 N/mm <sup>2</sup> (for DN 200 3 sets required, for DN 250 4 sets)	

Copper gasket rings for CF flange	
DN 200 (Set of 10 pieces)	839 47
DN 250 (Set of 5 pieces)	839 48

Set of hex. screws with nuts, screws and washers for CF flange	
DN 200	839 07
DN 250 (2 sets required)	839 07

### Optional accessories

Mains cable for MAG.DRIVE iM, 2.5 m	
EU	411310V03
US	411320V03

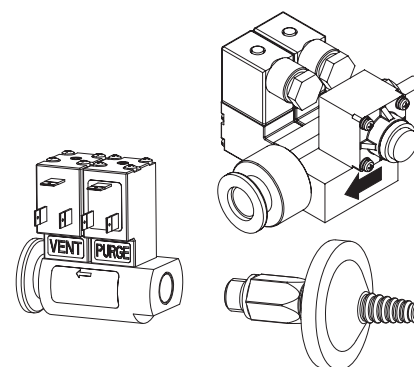
Inlet screen	
DN 200 ISO-F and DN 200 CF	E 200 04 558
DN 250 ISO-F and DN 250 CF	E 200 04 557

Seal Kit DN 250 Metal	200 07 901
-----------------------	------------

Seal Kit Metal for other flanges	on request
----------------------------------	------------

Purge gas and venting valve 24 V DC	
0.6 mbar-l/s at 1.5 to 6 bar	121 33
0.6 mbar-l/s at 1 to 1.5 bar	800152V0010
Cable set (2 pieces) for connection to the pump	411300V01

Cooling water valve kit	411300V02
-------------------------	-----------



# Transport and storing

## Keep the packaging

### 2 Transport and storing

Remove the equipment from the transportation box and keep the packaging. Make sure that the product has not been damaged during transportation. If this unit is damaged contact your carrier and inform Leybold if necessary.

To prevent damages to the pump, use the packaging provided for storage and transport.

#### NOTICE



Be careful not to damage the sockets and connections during transportation.

#### WARNING



Do not stand below the pump while connecting or removing the turbomolecular pump.

The turbomolecular pump is shipped in a sealed PE bag with desiccant. Do not open the sealed package until immediately before installing.

Do not remove the covers and blanking flanges until you are ready to make the connections, to ensure that the turbomolecular pump is installed under the cleanest possible conditions.

Turbomolecular pumps which were not operated for a period of over 12 months should be returned to us. For more information on this please contact your local sales partner.

Do not store pump and accessories in a moist atmosphere so as to prevent these items from suffering corrosion.

The MAG is supplied with three crane eyes which have been screwed into the casing. They can also be screwed into the bottom of the pump. For this unscrew the feet first.

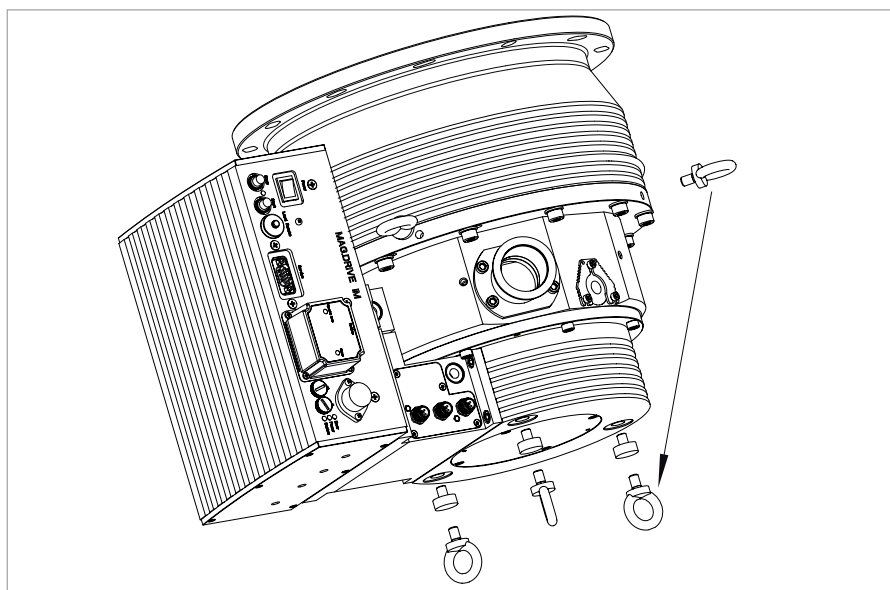


Fig. 2.1 Crane eyes

## 3 Installation

### 3.1 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.

The use of any accessories which have not been specified by Leybold is only allowed after approval by Leybold.

The supplied integrated MAG.DRIVE iM frequency converter will be required for the operation of the turbomolecular pump.

#### 3.1.1 Non-conforming utilization

Non-conforming utilizations for both pump and frequency converter are among others:

- Pumping of gases and vapours for which the materials of the pump are unsuitable.
- Pumping of toxic gases
- Operation in connection with processes in which GaAs (gallium arsenide) is being pumped.
- Pumping of gas mixtures with an oxygen content of > 21%.
- Pumping of corrosive gases
- Pumping of dust containing gases without purge gas operation.
- Pumping of condensable vapours without suitably controlling the temperature of the pump. Upon compression within the pump, these vapours may condense or form deposits.
- Pumping of dusts and solids without the use of suitable screens and filters.
- Operation at an inadmissibly high forevacuum pressure.
- Operation at inadmissibly high gas loads.
- Utilization of both pump and frequency converter in explosion hazard areas.
- Non-compliance of the specified maintenance and servicing intervals for both pump and frequency converter.
- Operation of the pump and drive electronics in environments which demand protection type IP 54 or higher and where the installation site is over 1000 m the above sea level.

# Installation

- Utilization in systems and pump systems in which the pressure may exceed 1.4 bar abs.
- 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 via 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 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 should the pump rotor seize.
- Stepping on pump, add-on parts, drive electronics, flanges and cables to climb onto the system.
- Fitting of add-on parts to the forevacuum flange which cause an inadmissible high load.
- Removing, covering or obstructing warning notices.
- Standstill or storing of pump and drive electronics without suitable sealing-off and drying. Storing in a humid atmosphere can cause corrosion.
- Conversions, manipulations and maintenance work by personnel not authorised by Leybold.

---

**WARNING**

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



## 3.2 Operating environment

The maximum permissible ambient temperature is 45 °C (113 °F). Do not expose the pump or the frequency converter with type of protection IP 30 to dripping or spraying water.

If the pump is used within a magnetic field, the magnetic induction at the surface of the pump housing may not exceed:

$B = 5 \text{ mT}$  if impinging radially and

$B = 15 \text{ mT}$  if impinging axially.

Exceeding this limit can cause excessive rotor heating due to the eddy currents generated in this situation. It is therefore necessary to provide suitable shielding in such cases.

Places of installation up to 1000 m above sea level (3300 ft) are possible without restrictions. At altitudes over 1000 m heat dissipation by the ambient air is impaired. Please consult us.

The frequency converter must not be operated in explosive gas atmospheres.

## 3.3 Attach the pump to the vacuum chamber

Never touch the rotor. Touching the rotor may cause injury and damage the rotor bearing.

The high-vacuum flange must be solidly mounted to the vacuum chamber. Observe Safety Information 0.1.6.

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.

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 35 kNm maximum needs to be absorbed by the system, should the pump suddenly seize.

We have successfully tested the pumps in agreement with ISO 27892 both against crashes and also bursts.

### Ambient temperature

### Magnetic field

### Places of installation

---

#### NOTICE



---

#### WARNING



---

### Torques when the rotor seizes

# Installation

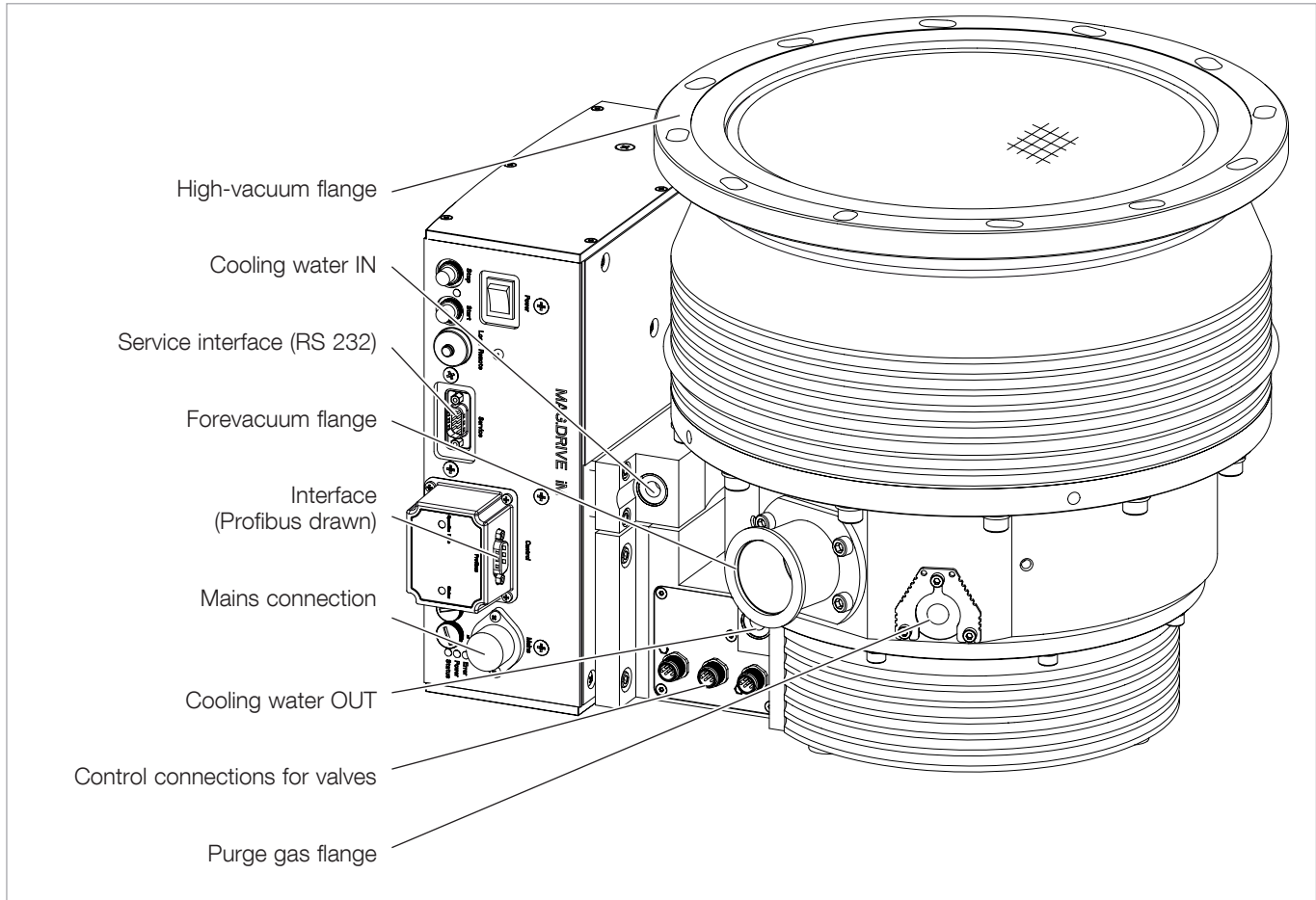


Fig. 3.1 Connection fittings

In most applications the pump is flanged to the high-vacuum flange at the apparatus. The pump can be mounted and operated in any desired attitude.

Use exclusively flange connecting components and fittings which have been manufactured in accordance with DIN 28404 (ISO-K flange connections) or ISO 3669 (CF flange connections).

Basically the frequency converter can be detached from the pump. However, this must only be done by an expert trained by Leybold. For this consult with us.

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.

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<sup>2</sup>.

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 please contact Leybold Application Support.

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.

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.

## Vibration influence

## Earthquake protection

## Isolation valve

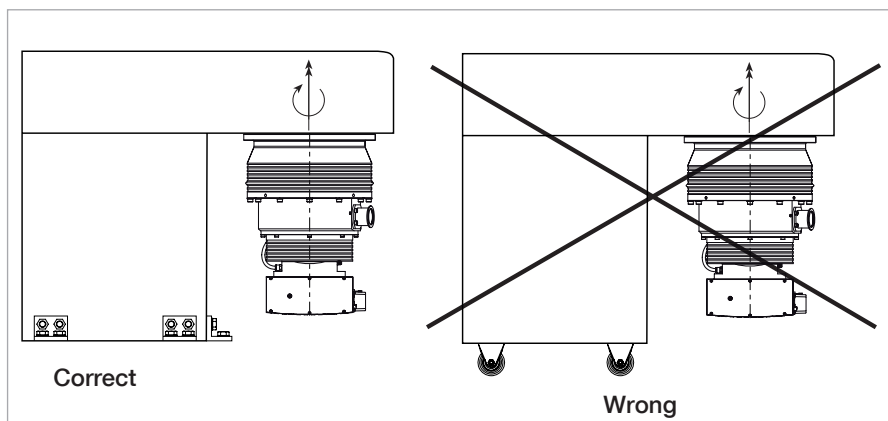


Fig. 3.2 Fixing to the system

# Installation

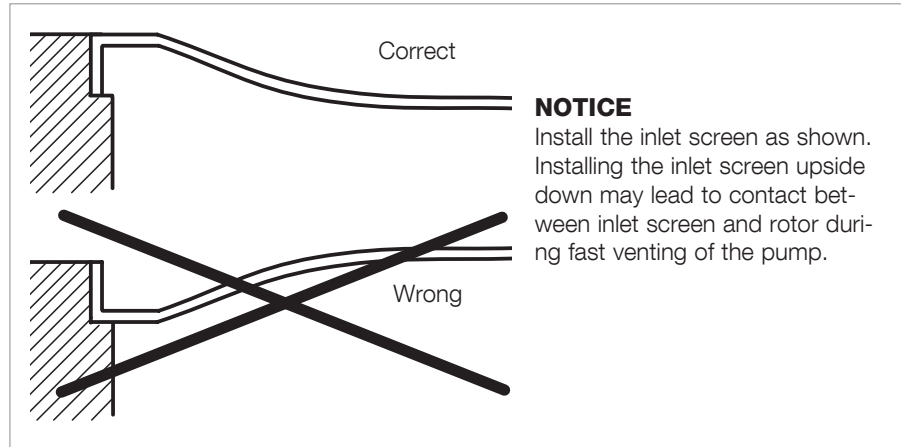


Fig. 3.3 Installing the inlet screen

---

## NOTICE



Foreign objects which enter the pump through the intake would cause serious damage to the rotor. That's why we recommend installing an inlet screen. Damages caused during operation without the inlet screen are excluded from warranty.

Insert the inlet screen so that the surface curvature is at the bottom and apply some pressure lightly at the rim so that the inlet screen engages, see Fig. 3.3.

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

Mount the turbomolecular pump according to Fig 3.4 and tighten the bolts crosswise step-by-step.

---

## NOTICE



The contact surfaces of pump housing, vacuum system and centering ring must be free of grease and dry so as to ensure adequate strength in case the rotor should seize.

### Flange mounting for CF flanges

Before fitting, check to ensure that the sealing edge is undamaged. Do not touch the copper gasket and the sealing edge with your bare hands.

---

## NOTICE



The contact surfaces of pump housing, vacuum system and centering ring must be free of grease and dry so as to ensure adequate strength in case the rotor should seize.

Mount the turbomolecular pump according to Fig 3.5 and tighten the bolts crosswise step-by-step.

When the pump shall be baked out, the threads of the bolts should have been lubricated with a high temperature lubricant.

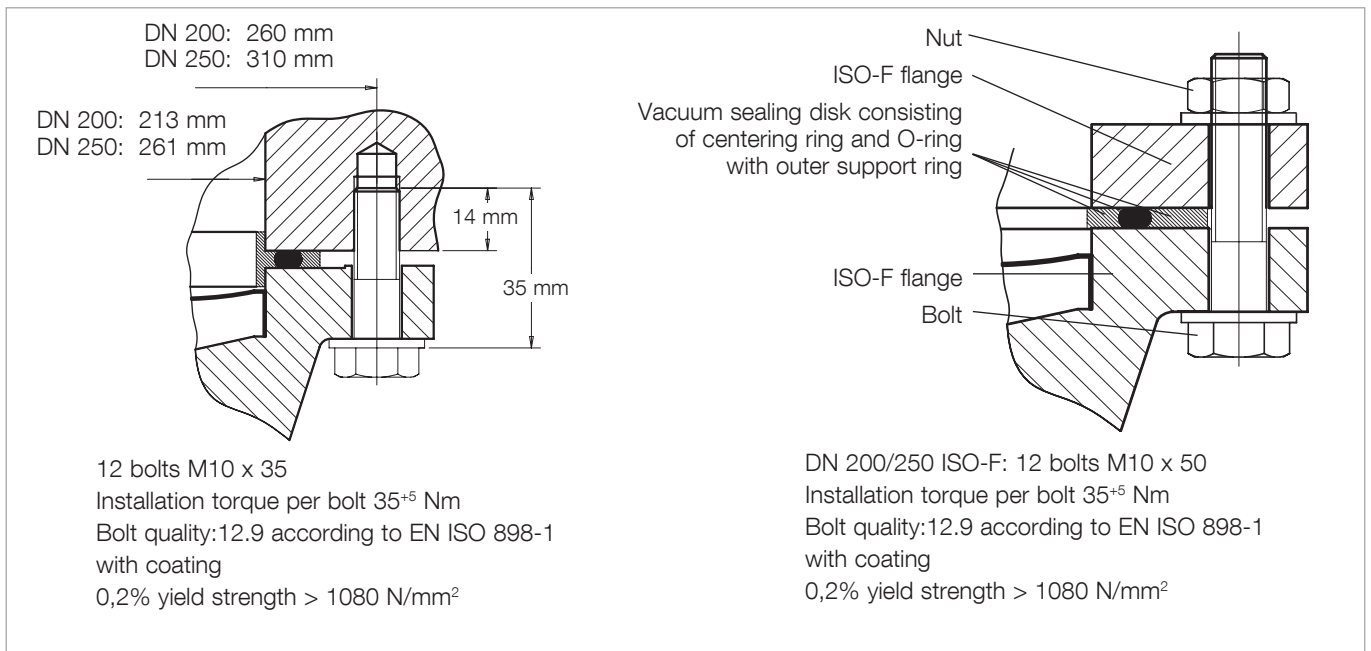


Fig. 3.4 Mounting high vacuum flange ISO-F

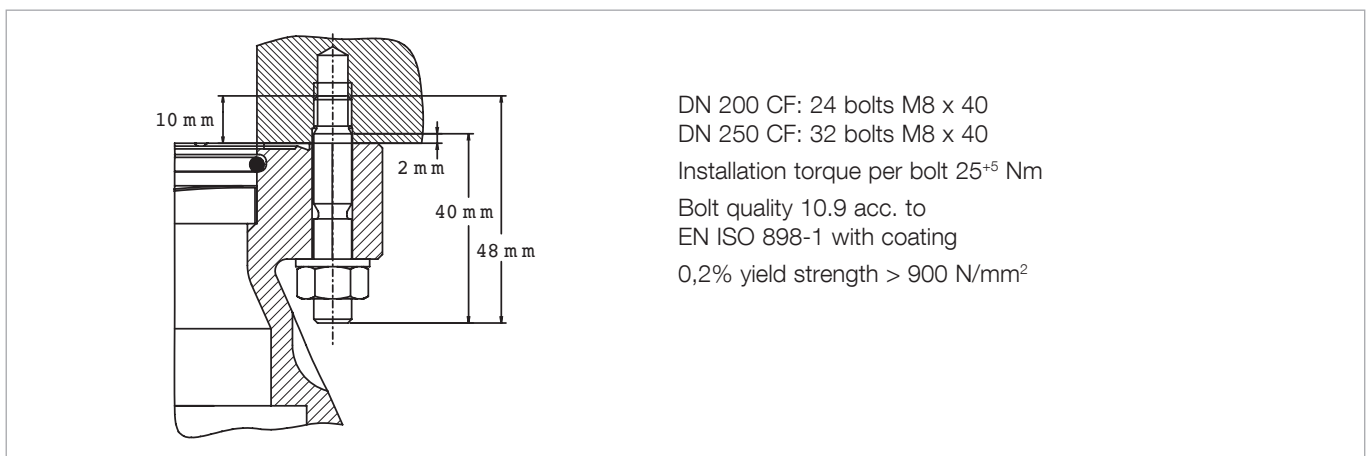


Fig. 3.5 Mounting high vacuum flange CF

Owing to the deformation of the copper gasket, the fastening torque of all bolts must be checked once more after having completed the installation work.

During 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.

**CAUTION**



# Installation

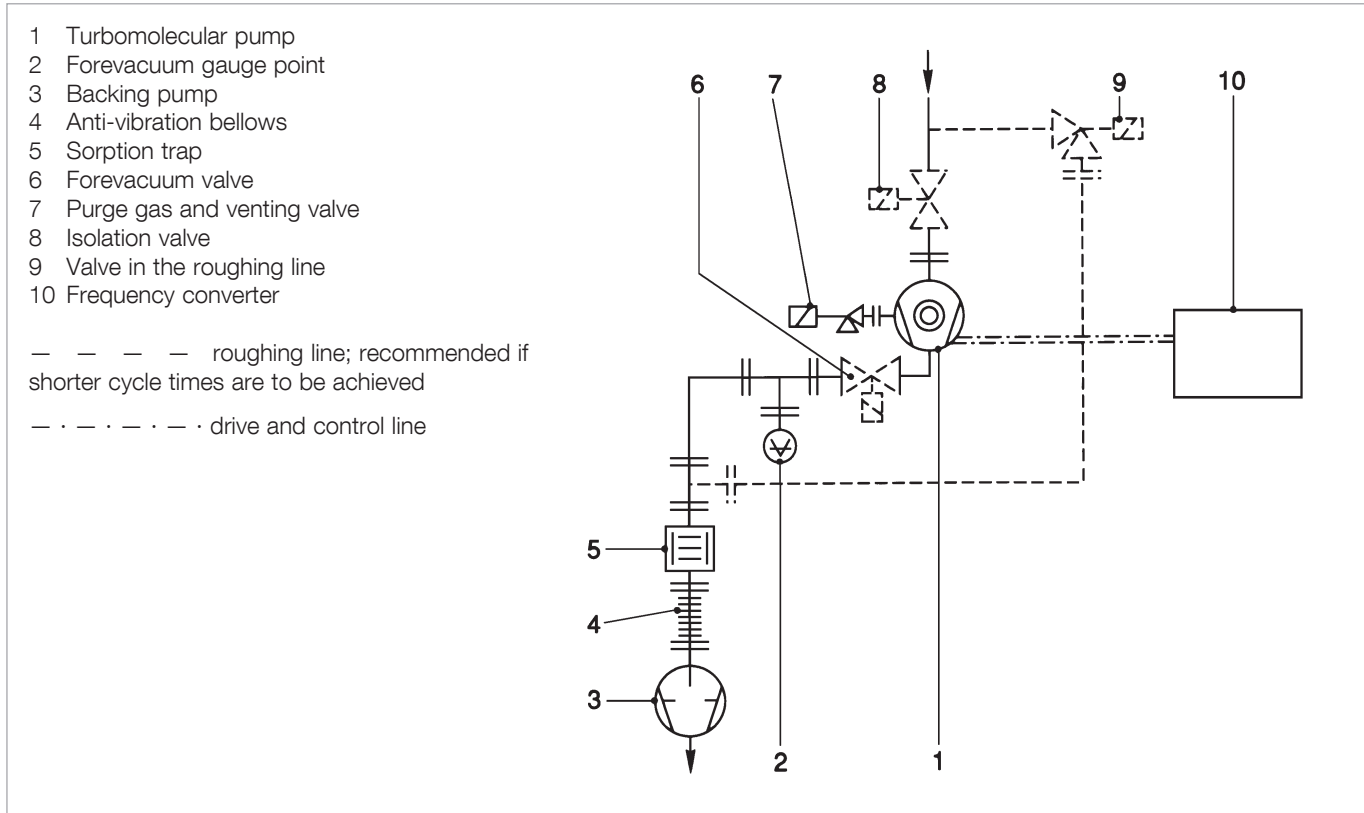


Fig. 3.6 Layout of a turbomolecular pump system

### 3.4 Forevacuum connection

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.

#### DANGER



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 0.4.6.

Fig. 3.6 shows schematically the design of a pump system incorporating a 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.

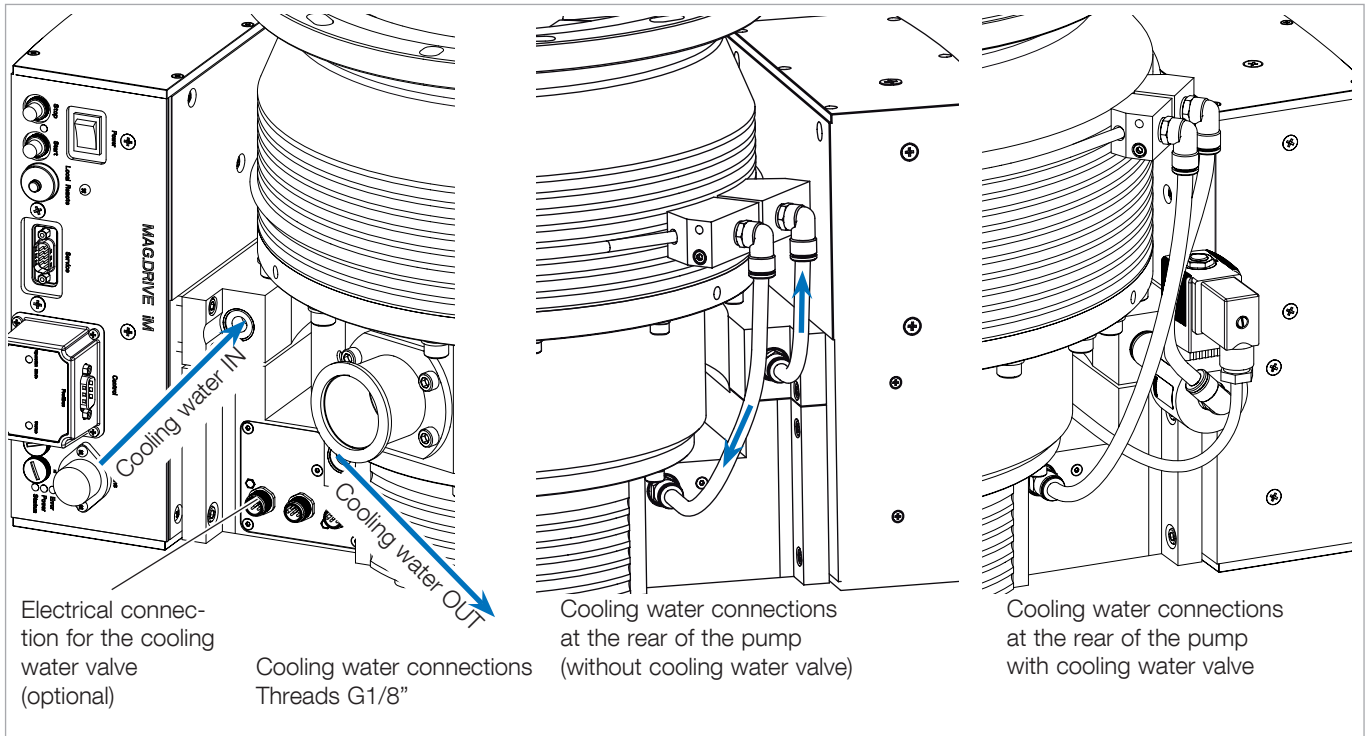


Fig. 3.7 Cooling water connection

To ensure that the forevacuum space at the turbomolecular pump is kept largely free of oil vapors during operation, as well, we 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.

### 3.5 Connecting the cooling water

Screw on the cooling water lines, fastening torque 8 to 10 Nm.

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 in order to avoid condensate formation in the pump.

The optional cooling water valve shuts off the cooling water flow when the pump is not turning ( $n < 15$  Hz) thereby preventing the formation of condensate within the pump. Install the valve as depicted in fig. 3.7 and electrically connect it to the frequency converter, see fig. 3.11.

### Adsorption trap

### Avoid condensate formation

# Installation

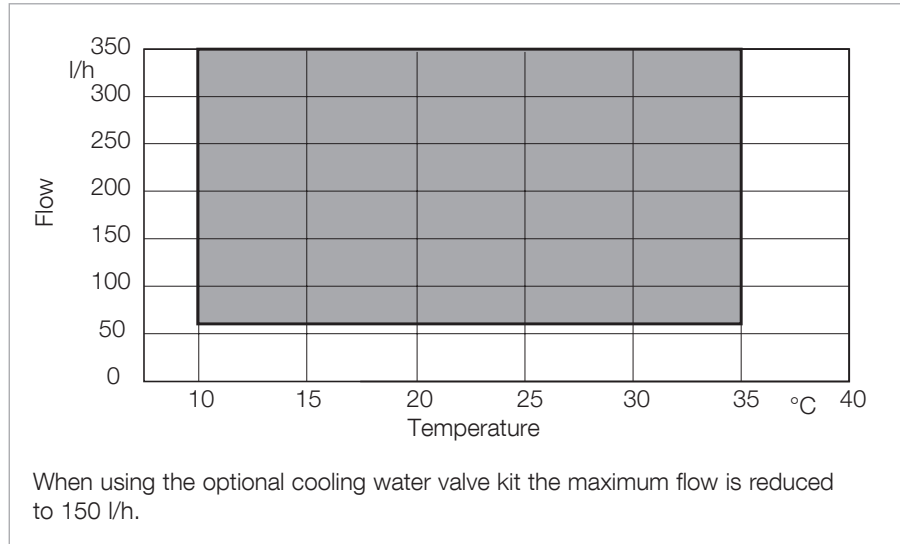


Fig. 3.8 Recommended cooling water flow

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 so as to avoid frost damage.

Do not open or modify the cooling water connections at the rear of the pump.

## Cooling water specifications

Inlet temperature	10 - 35 °C
Inlet pressure	max. 6 bar
Cooling water requirement	> 60 l/h

### 3.5.1 Water Quality

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

Appearance	Clear, free of oils and greases
Suspended matter	< 250 mg/l
Particle size	< 150 µm
Electrical conductivity	< 700 µS/cm
pH value	7.0 to 9,0
Total hardness (total alkaline earths)	< 8 °dH
Aggressive carbon dioxide	None, not detectable
Chloride	< 100 mg/l
Sulfate	< 150 mg/l
Nitrate	≤ 50 mg/l
Iron	< 0.2 mg/l



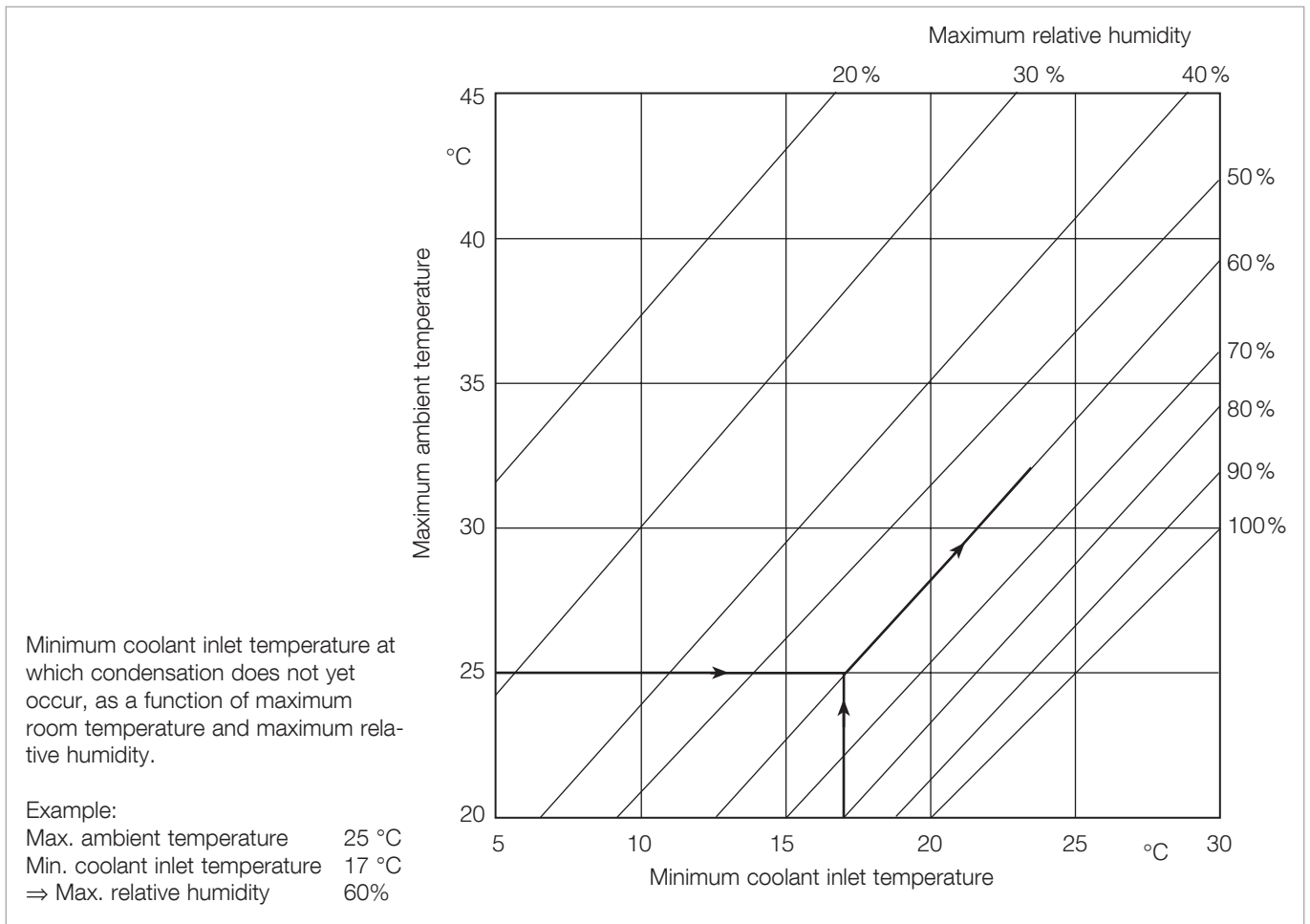


Fig. 3.9 Dewpoint diagram

Manganese	< 0.1 mg/l
Ammonium	< 1.0 mg/l
Free chlorine	< 0.2 mg/l

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

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

DS water (softened or fully desalinated water) can be used for cooling the pump, if the pH value corresponds to the range indicated above.

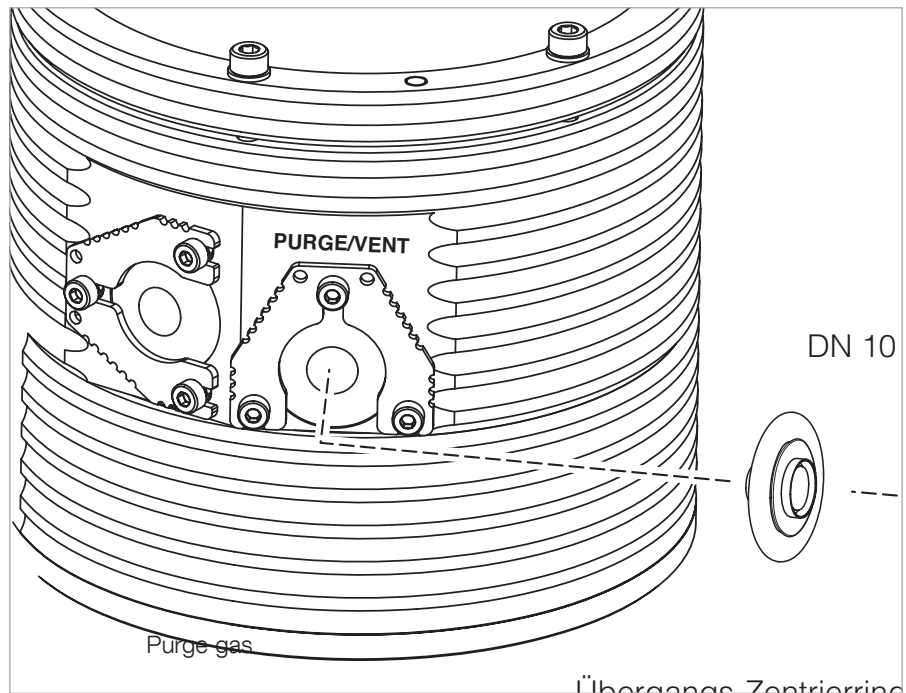


Fig. 3.10 Connect purge gas and venting valve

### 3.6 Connect the purge gas and venting valve

The pumps are equipped with a purge gas facility. A purge gas and venting valve or a power failure venting valve or a venting valve may be connected directly using a DN 16 KF centering ring.

The power failure venting valve or venting valve vents the pump and the forevacuum line when the pump is switched off and thus keeps oil vapor from diffusing back from the forevacuum line.

A choke nozzle in the vent port ensures that the pump is not vented too fast.

When having to decide which gases need or not need to be pumped with purge gas we are available to provide assistance.

Refer to Section 4.1 for suited gases.

When operating the pump with purge gas, the pump needs to be vented via the purge gas valve after having shut down the pump, see Section 4.6.

Consider the additional purge gas flow when selecting a suitable backing pump.

We recommend a purge gas flow of 0.6 mbar·l/s (36 sccm) with Nitrogen.

#### WARNING



The pressure in the pump must not exceed 1400 mbar (0.4 bar overpressure). Observe Safety Informations 0.1.2 to 0.1.5.

Connect the purge gas and the venting valve recommended by us according to its instructions. The valve cables can be connected directly at the pump. When doing so, do not confuse "Purge" and "Vent"!

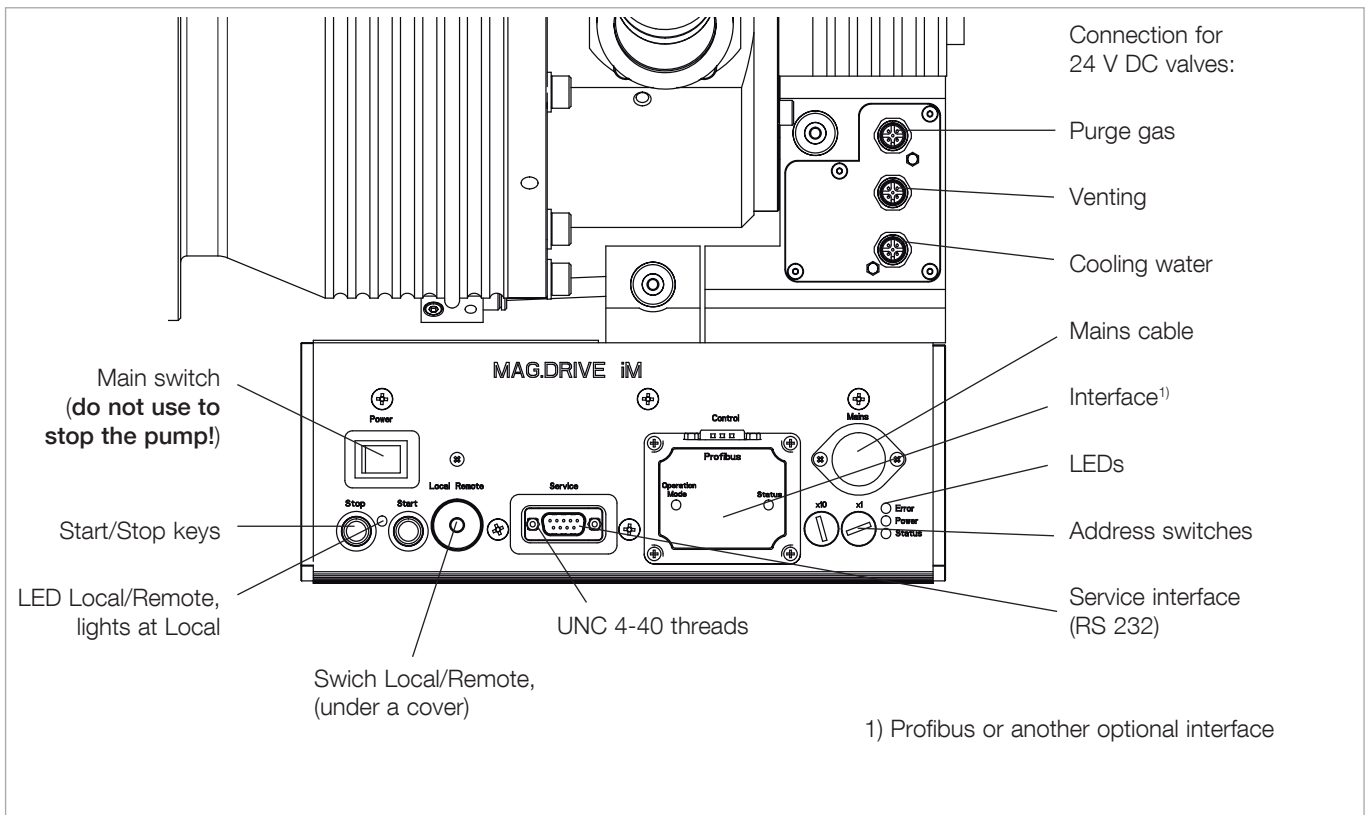


Fig. 3.11 View of the integrated frequency converter

### 3.7 Electrical connection for the integrated frequency converter

Observe Safety Informations 0.2.

#### DANGER



Disconnect and connect the cable connections only while the pump is turning no longer (green status LED off) and with the mains power switched off (yellow power LED off). Otherwise there is the risk of damaging the frequency converter.

#### NOTICE



The interface connectors have UNC 4-40 threads. Do not use connectors with M3 threads.

The pump may be operated only with suitable connector cables.

Route all cables so, as to protect them from damage.

Plug in the mains cable. Refer to Fig. 3.12 for the mains plug connection.

In order to comply with the standard SEMI S2, install an additional mains power circuit breaker at the sides of the system. The short-circuit switch-off capacity of this mains power circuit breaker needs to be rated at 10,000 A minimum.

# Installation

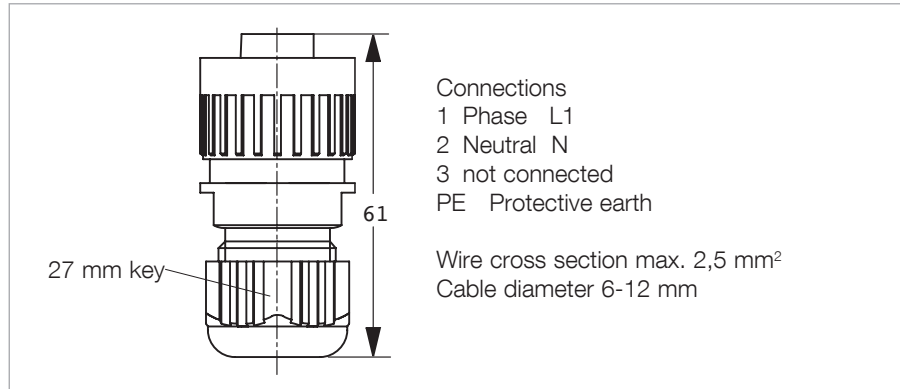


Fig. 3.12 Mains plug

## CAUTION



During operation the frequency converter may attain temperatures up to 75 °C. We recommend that the unit be installed so that it can not be touched inadvertently.

## 3.8 Relays, LEDs, PLC interface

### Relay status

Input data / status				Output data					Operating mode
Start/stop signal	Pump rotating	Normal frequency ≥ 90% of setpoint frequency	Error is present	Motor drive	Relay NORMAL OPERATION	Relay ERROR	LED STATUS	LED ERROR	Other modes are not possible; they indicate a failure affecting the TURBO.DRIVE.
Stop	no	no	no	off	passive	passive	off	off	Pump not operating
Stop	yes	no	no	off	passive	passive	flashes	off	Pump is decelerating
Stop	yes	yes	no	off	passive	passive	flashes	off	Just after stop; pump was in the normal operating mode before that
Start	no	no	no	on	passive	passive	off	off	Just after start
Start	yes	no	no	on	passive	passive	flashes	off	Pump is accelerating
Start	yes	yes	no	on	active	passive	green	off	Pump is in the normal operating mode
Stop	no	no	yes	off	passive	active	off	red	Error is present; pump is at standstill
Stop	yes	no	yes	off	passive	active	flashes	red	Error is present; pump is decelerating
Stop	yes	yes	yes	off	passive	active	flashes	red	Error has just occurred
Start	no	no	yes	off	passive	active	off	red	Error is present; pump is at standstill
Start	yes	no	yes	off	passive	active	flashes	red	Error is present; pump is decelerating
Start	yes	yes	yes	off	passive	active	flashes	red	Error has just occurred

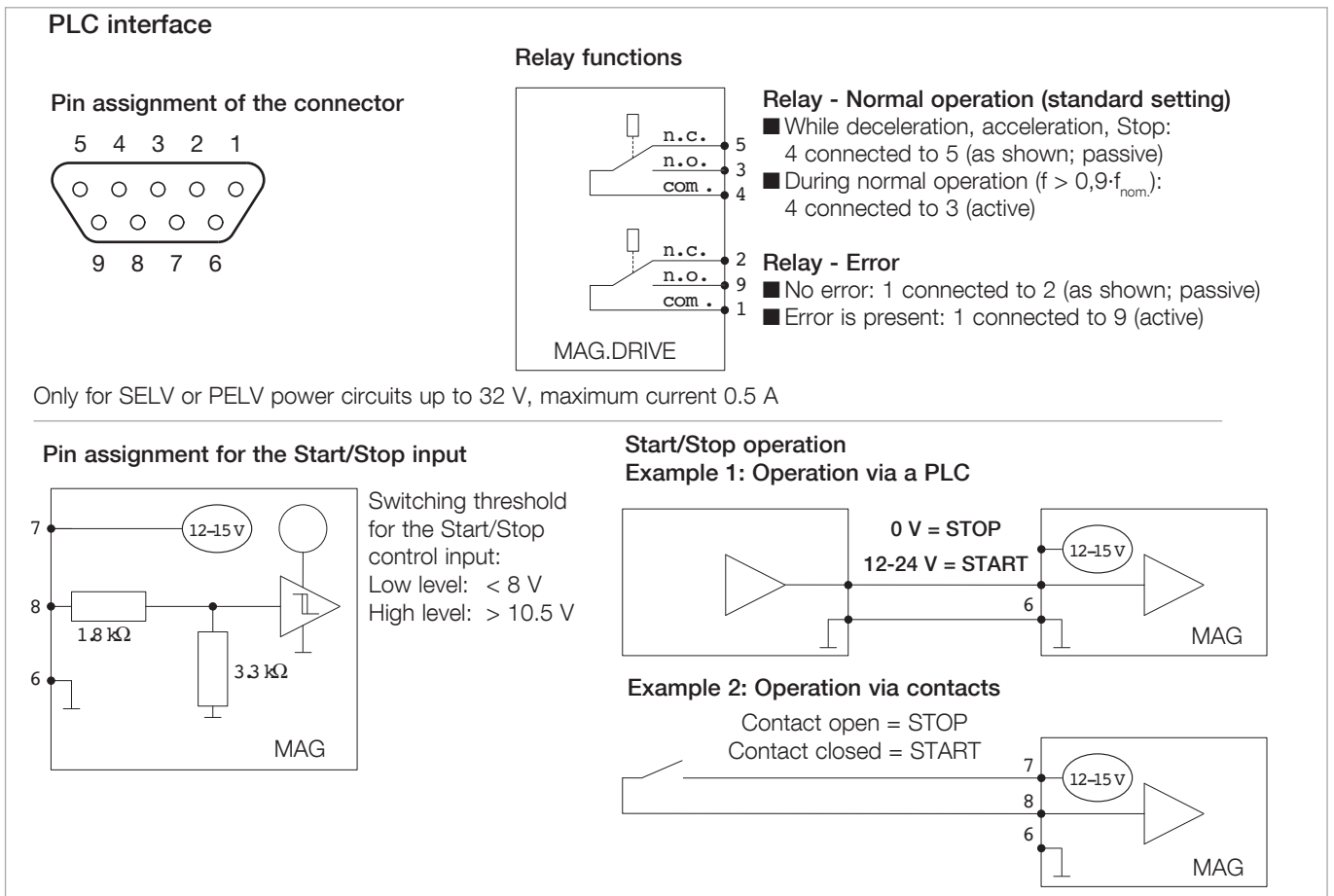





Fig.3.13 Pin assignment of the PLC interface (optional for CONTROL connector)

## Front LEDs

<b>ERR</b> 	<b>Red LED ERR</b>	
<b>PWR</b> 	off:	No error, no warning
<b>STS</b> 	flashes:	Warning is present, pump can be operated, possibly with some restrictions
	on:	Fault is present, pump stopped or can not be operated
<hr/>		
	<b>Yellow LED PWR</b>	
	off:	No supply voltage
	flashes:	Supply voltage too low or too high, 9 Hz < n < 100Hz (venting possible)
	on:	Supply voltage is present
<hr/>		
	<b>Green LED STS</b>	
	off:	Pump at standstill (< 9 Hz)
	flashes slowly 1/s:	Start command is present
	(flashes fast 3/s:	Running down, brake operation: option)
	flashes shortly (0.3 s):	Start delay active
	on:	Normal operation
<hr/>		
	<b>Yellow LED PWR and green LED STS</b>	
	(flash fast alternately	Running down, brake operation at n < 100 Hz i.e. venting is possible: option)

## 4 Operation

### 4.1 Media compatibility / purge gas

The MAG turbomolecular pumps are suitable for pumping air and clean gases.

The MAG ... iP have a purge gas device.

We would be glad to consult with you as regards the media which can safely be handled with this unit.

Install a micropore filter when pumping media which contains dust.

#### Suited gases

Suited for venting or purging are all gases,

- which will not cause corrosion or pitting in aluminium and steel and
- which in connection with process deposits in the pump will not cause corrosion or sticking.

For venting and as the purge gas we recommend inert gases like nitrogen or argon. The temperature of these gases should be between 5 °C and 80 °C, max. relative humidity should not exceed 10 ppm.

The gas must be clean.

In individual cases and after consultation also dry, filtered, oil-free air or filtered ambient air may be used (filter mesh < 1µm).

Change the filters after some time, at least annually.

### 4.2 Interfaces

The MAG.DRIVE can optionally be equipped with the following interfaces:

- RS 232
- RS 485
- Profibus
- PLC (9-pin Sub-D)
- Ethernet/IP (1-port)
- EtherCat (in preparation)

#### Type of protection

If the interface modules are not covered, they will comply with type of protection IP 30, with cover to IP 54. The remainder of the pump and the frequency converter will in the case of properly connected cables always comply with IP 54.

If you try to control via two installed interfaces, the interface in the CONTROL slot will have the higher priority.

The address for the Fieldbus module can be set via the RS 232 service interface or at the address switches.

The set default address is 126dec = 7Ehex.

## 4.3 Switching on

Switch on the backing pump.

Switch on the main switch. The Power ON LED will light green.

During an initialisation phase of approximately 45 seconds all LEDs at the frequency converter will light up alternatingly, thereafter the yellow LED will come on.

Switch on the turbomolecular pump

- by pressing the START button (in the LOCAL mode)
- via the interface, e.g. Profibus

The turbomolecular pump runs up. The green LED flashes. When the pump reaches normal operation the green LED lights up permanently.

The backing pump and the MAG 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.

Do not open the turbomolecular pump suddenly to a previously evacuated vacuum chamber or to a large-volume forevacuum line which has already been evacuated. The pressure surge can press against the rotor into the limiting bearing, causing accelerated wear at that bearing.

## 4.4 Operation

The magnetic bearing in the MAG are immune to wear. In addition to the magnetic bearings, the MAG 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 a frequent switching on and off.
- Do not suddenly expose the MAG 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 Mag 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.

---

### NOTICE



---

### Protecting the touch-down bearings

## 4.5 Switching off

Switch off the pump

- by pressing the STOP button (in the LOCAL mode)
- via the interface, e.g. Profibus

---

### NOTICE



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

After switching off, the green status LED will flash until the rotor of the turbomolecular pump is at standstill. This may take several minutes. The deceleration time of the pump corresponds approximately to the run-up time of the pump. The rotor may be stopped faster by venting the pump. The pump must only be handled with the rotor not rotating.

With the DC power supply off, the turbomolecular pump will act as a generator supplying the frequency converter with energy as indicated by the yellow power LED.

---

### CAUTION



At speeds approximately below 100 Hz there will not be enough power any more for the LEDs, i.e. the pump may still turn with out any of the LEDs being on.

Switch off the forevacuum pump.

### Venting

When using oil-sealed forevacuum pumps, vent the turbomolecular pump before it comes to a stop; refer to Section 4.6.

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, ensure that neither ambient air nor cleaning media can enter the pump.

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

---

### CAUTION



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

Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn (the green LED is off).

---

### Emergency shut down

In the case of an emergency shut down, the pump is switched off as described above. The rotor of the turbomolecular pump may be stopped faster by controlled venting the pump, see Fig. 4.1.



## 4.6 Venting

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

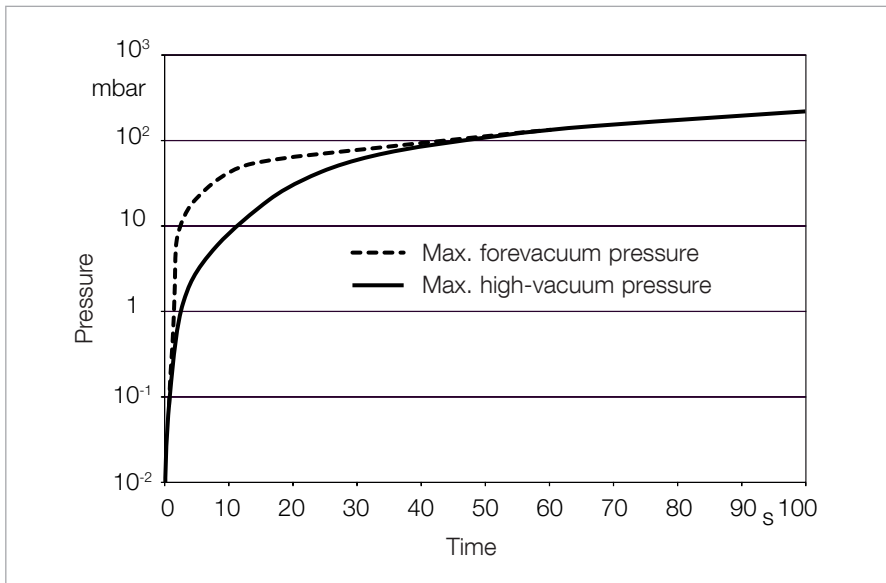


Fig. 4.1 Pressure rise curve for safe venting

### Venting Methods

There are three different methods of venting the turbomolecular pump.

In the case processes requiring a purge gas, the pump must be vented via the purge gas and venting valve when shutting the pump down.

When additionally venting the vacuum chamber, the venting function of the purge gas and venting valve must be opened before opening the chamber valve. This will ensure the presence of a higher pressure in the area of the bearings compared to the remaining vacuum area. This will prevent particles, dust or aggressive gases from being forced through the bearings into the not yet vented motor chamber of the pump.

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 so as to avoid exposing the rotor to additional forces.

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.

### Purge gas and venting valve

### High vacuum side

### Foreline connection

# Operation

## Speed of the Pressure Rise

**Speed** All turbomolecular pumps may be vented at full speed. However, the pressure must not increase faster than specified through the pressure rise curve, see Fig. 4.1.

**Pressure rise curve**

**Particles** The pump must be vented significantly slower when there is the risk of particles entering into the pump from the process. During venting, the flow must be of the laminar type in both the vacuum chamber and the turbomolecular pump.

The speed of the pressure rise during venting of the running pump will greatly influence the load on the rotor/stator pack and the bearings. The slower the pump is vented, the longer the service life of the bearings will be.

The pump must not be vented to pressures above atmospheric pressure.

## 4.7 Removing the pump from the system

Shut down the pump and vent as described in Sections 4.5 and 4.6.

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

Observe Safety Informations 0.4.7.



Disconnect the pump only when it has come to a full stop. The green LED at the frequency converter must have gone out.

Then switch the mains power off and wait until the yellow power LED is off. Then only disconnect any cable connections.

**Drain cooling water** Drain out the cooling water and blow out the cooling water lines so as to avoid frost damage.

**Hazardous gases** 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.

### Deposits

### Desiccant

To avoid health hazards and corrosion damage 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 damage due to faulty packing will nullify the guarantee.

Pack the pump so that it cannot be damaged during shipping and storage. Pay particular attention to protection for the flanges and the electrical plug.

Observe the instructions in Section 5.3 if you forward the pump to Leybold.

## 5 Maintenance

We recommend an exchange of the rotor unit after 80,000 operating hours or 20,000 cycles at the latest.

Such maintenance work can only be done by the Leybold Service. If required contact the Leybold service center nearest to your location. You can find the address on our internet page [www.leybold.com](http://www.leybold.com).

At high pump loads - for example during cyclic operation, at high gas throughputs or at high ambient temperatures - the aforementioned maintenance work should be carried forward. Please consult Leybold for recommendations.

Observe Safety information 0.1.7.

Depending on the degree of contamination of the purge gas used the filter will clog and will have to be exchanged (our experience indicates that this will become necessary after 1 to 6 months).

When an adsorption trap is used, regenerate or renew the adsorption agent regularly; refer to the operating instructions provided with the trap.

### 5.1 Cleaning

If required clean the turbomolecular pump of dust with a dry cloth.

### Rotor exchange

---

#### WARNING



---

### Purge gas filter

### Adsorption trap

# Maintenance

## 5.2 Changing the touch-down bearings

Wear occurs at the touch-down bearings when hard shocks have to be supported.

The frequency converter outputs a warning and then an error message if the touch-down bearings have had contact too often or for a too long time (default 1000 contacts or 1 hour). In this case maintenance is required.

Only the Leybold service can change the touch-down bearings.

## 5.3 Leybold Service

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

### Contamination

#### Form

A copy of the form has been reproduced at the end of these Operating Instructions: "Declaration of Contamination for Compressors, Vacuum Pumps and Components". Another suitable form is available from [www.leybold.com](http://www.leybold.com) → Documents → Download Documents.

Attach the form to each pump.

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

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

## 6 Troubleshooting

When the connector cable is attached, the outputs at the frequency converter are not free of voltage.

### CAUTION



Before you start searching for the source of the problem, you should carry out a few simple checks:

Are the electric connections in good working order?

Is the forevacuum pressure sufficient?

After having removed the cause for the error reset the error message at the frequency converter by applying a STOP signal via the socket CONTROL or by switching the mains power off.

Malfunction	Possible cause	Corrective action	Responsible
Red ERROR LED is on	Forevacuum or high-vacuum pressure too high.	Check the forevacuum pump and use a different forevacuum pump if necessary.	Operator/ maintenance staff
	Gas volume too great.	Seal leak; install a higher-capacity vacuum pump if necessary.	Maintenance staff
	Bearing defective.	Repair the pump.	Leybold service
	Ambient temperature too high.	Install additional water cooling or reduce throughput.	Maintenance staff
	Frequency converter faulty	Replace frequency converter.	Maintenance staff/ Leybold service
	EMC influence	Switch the power supply voltage off and then on again	Operator
Yellow power LED is not on.	No power supply	Check cables and power supply.	Operator/ maintenance staff
	Frequency converter defective.	Replace frequency converter.	Maintenance staff/ Leybold service
Red LED flashes.	Warning message. Possible causes as in "Red ERROR LED is on"	The pump can continue to run, as long as operation limits are only exceeded for a short time.	Operator
Yellow LED flashes.	Warning message: Supply voltage too low or too high.	The pump can continue to run. Check the reason for wrong voltage and eliminate the fault.	Operator/ maintenance staff

# Troubleshooting / Disposal

Malfunction	Possible cause	Corrective action	Responsible
Turbomolecular pump does not start, ERROR LED does not light.	CONTROL connector connected wrongly.	Connect as shown in Fig. 3.13.	Operator/ Maintenance staff
	CONTROL and SERVICE connectors mixed up.	Connect correctly.	Maintenance staff
Turbomolecular pump produces loud running noises and vibrations.	Rotor out of balance.	Balance the rotor.	Leybold service
	Bearing defective.	Replace the bearing.	Leybold service
	Exciting of vibrations by the process	Modify the system.	Maintenance staff
Turbomolecular pump does not reach ultimate pressure.	Measurement instrument defective.	Inspect the measurement sensor.	Operator/ Maintenance staff
	Measurement sensors soiled.	Clean or replace the sensors.	Maintenance staff
	Leaks at the equipment, lines or the pump.	Check for leaks.	Maintenance staff
	Pump soiled.	Clean the pump.	Leybold service
	Backing pump provides insufficient pumping speed or ultimate pressure which is too high.	Check the ultimate pressure of the backing pump and install a higher capacity vacuum pump if necessary.	Operator/ maintenance staff
	Frequency parameters programmed wrongly.	Check parameters.	Leybold service

## Contamination

### 7 Waste Disposal

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



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

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

When sending us any equipment, observe the regulations given in Section "5.3 Leybold service".

# EC Declaration of Incorporation

(Translation of original Declaration of Incorporation)

**The manufacturer:** Leybold GmbH  
Bonner Strasse 498  
D-50968 Köln  
Germany

herewith declares that the following product:

**Product designation:** magnetic levitated turbo-molecular pump with integrated controller

Type designation:	Part number:
MAG W 1300iP(L)	411300Vxxxx
MAG W 1600iP(L)	411600Vxxxx
MAG W 1700iP(L)	411700Vxxxx
MAG W 2200iP(L)	412200Vxxxx

x=0 until 9

complies with the following fundamental requirements of the **Machinery Directive (2006/42/EC)**:  
Annex I, Paragraph 1.1.2, 1.1.3, 1.1.5, 1.2.1, 1.2.3, 1.2.4.1, 1.2.4.2, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7,  
1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.13, 1.6.1 and 1.7.1

The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with  
Appendix 1 No. 1.5.1 of Machinery Directive 2006/42/EC.

The following harmonised standards have been applied:

EN 1012-2:1996+A1:2009 Compressors and vacuum pumps - Safety requirements  
Part 2: Vacuum pumps

EN 61010-1:2010 Safety requirements for electrical equipment for measurement,  
control, and laboratory use — Part 1: General requirements

The incomplete machine may only be put into operation after it has been determined that the machine into  
which the incomplete machine shall be installed complies with the regulations laid down in the EC  
Machinery Directive (2006/42/EG).

The manufacturer commits himself to make the special documentation on the incomplete machine  
electronically available to national authorities upon request.

The special engineering documentation belonging to the machine was compiled in accordance with  
Annex VII Part B.

Documentation officer:	Herbert Etges T: +49(0)221 347 0 F: +49(0)221 347 1250 documentation@leybold.com
------------------------	---

Cologne, October 11, 2016

Cologne, October 11, 2016



ppa. Martin Tollner  
Head of Product Lines



ppa. Dr. Monika Mattern-Klosson  
Head of Quality & Business Process Management



# EU Declaration of Conformity

(Translation of original Declaration of Conformity)

**The manufacturer:** Leybold GmbH  
Bonner Strasse 498  
D-50968 Köln  
Germany

herewith declares that the products specified and listed below which we have placed on the market, comply with the applicable EU Directives. This declaration becomes invalid if modifications are made to the product without agreement of Leybold GmbH.

**Product designation:** magnetic levitated turbo-molecular pump with integrated controller

Type designation:	Part number:
MAG W 1300iP(L)	411300Vxxxx
MAG W 1600iP(L)	411600Vxxxx
MAG W 1700iP(L)	411700Vxxxx
MAG W 2200iP(L)	412200Vxxxx

x=0 until 9

**The products complies to the following Directives:**

Electromagnetic Compatibility (2014/30/EU)

**The following harmonized standards have been applied:**

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

Documentation officer:	Herbert Etges T: +49(0)221 347 0 F: +49(0)221 347 1250 documentation@leybold.com
------------------------	---

Cologne, October 11, 2016

Cologne, October 11, 2016



ppa. Martin Tollner  
Head of Product Lines



ppa. Dr. Monika Mattern-Klosson  
Head of Quality & Business Process Management

Document No.: 300353440\_002\_A1



The MAG integra have been tested by the TÜV Rheinland of North America according to the requirements of

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

The components are in compliance to the tested standards.

Test Report No. 31480039.001  
Certificate No. CU 72140054 01

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



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

## Declaration of Contamination of Compressors, Vacuum Pumps and Components

The repair and / or servicing of compressors, vacuum pumps and components will be carried out only if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer can refuse to accept any equipment without a declaration.

**A separate declaration has to be completed for each single component.**

This declaration may be completed and signed only by authorized and qualified staff.

Customer/Dep./Institute : _____ Address : _____ _____ Person to contact: _____ Phone : _____ Fax: _____ End user: _____	Reason for return: <input checked="" type="checkbox"/> applicable please mark <b>Repair:</b> <input type="checkbox"/> chargeable <input type="checkbox"/> warranty <b>Exchange:</b> <input type="checkbox"/> chargeable <input type="checkbox"/> warranty <input type="checkbox"/> Exchange already arranged / received <b>Return only:</b> <input type="checkbox"/> rent <input type="checkbox"/> loan <input type="checkbox"/> for credit <b>Calibration:</b> <input type="checkbox"/> DKD <input type="checkbox"/> Factory-calibr. <input type="checkbox"/> Quality test certificate DIN 55350-18-4.2.1																																																																
<b>A. Description of the Leybold product:</b> _____ <b>Failure description:</b> _____ Material description : _____ Catalog number: _____ <b>Additional parts:</b> _____ Serial number: _____ <b>Application-Tool:</b> _____ Type of oil (ForeVacuum-Pumps) : _____ <b>Application- Process:</b> _____																																																																	
<b>B. Condition of the equipment</b> <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:60%;"></th> <th style="width:10%; text-align: center;">No<sup>1)</sup></th> <th style="width:10%; text-align: center;">Yes</th> <th style="width:10%; text-align: center;">No</th> <th style="width:10%;"></th> <th style="width:10%;"></th> <th style="width:10%;"></th> <th style="width:10%;"></th> </tr> </thead> <tbody> <tr> <td>1. Has the equipment been used</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;">→</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2. Drained (Product/service fluid)</td> <td style="text-align: center;">↓</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3. All openings sealed airtight</td> <td style="text-align: center;">↓</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4. Purged</td> <td style="text-align: center;">↓</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="8">If yes, which cleaning agent _____</td> </tr> <tr> <td colspan="8">and which method of cleaning _____</td> </tr> <tr> <td colspan="8">1) If answered with "No", go to D. ←</td> </tr> </tbody> </table>			No <sup>1)</sup>	Yes	No					1. Has the equipment been used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→				2. Drained (Product/service fluid)	↓	<input type="checkbox"/>	<input type="checkbox"/>					3. All openings sealed airtight	↓	<input type="checkbox"/>	<input type="checkbox"/>					4. Purged	↓	<input type="checkbox"/>	<input type="checkbox"/>					If yes, which cleaning agent _____								and which method of cleaning _____								1) If answered with "No", go to D. ←							
	No <sup>1)</sup>	Yes	No																																																														
1. Has the equipment been used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	→																																																													
2. Drained (Product/service fluid)	↓	<input type="checkbox"/>	<input type="checkbox"/>																																																														
3. All openings sealed airtight	↓	<input type="checkbox"/>	<input type="checkbox"/>																																																														
4. Purged	↓	<input type="checkbox"/>	<input type="checkbox"/>																																																														
If yes, which cleaning agent _____																																																																	
and which method of cleaning _____																																																																	
1) If answered with "No", go to D. ←																																																																	
<b>C. Description of processed substances (Please fill in absolutely)</b> <b>1. What substances have come into contact with the equipment ?</b> Trade name and / or chemical term of service fluids and substances processed, properties of the substances According to safety data sheet (e.g. toxic, inflammable, corrosive, radioactive)																																																																	
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:5%;">X</th> <th style="width:30%;">Tradename:</th> <th style="width:65%;">Chemical name:</th> </tr> </thead> <tbody> <tr><td> </td><td>a)</td><td> </td></tr> <tr><td> </td><td>b)</td><td> </td></tr> <tr><td> </td><td>c)</td><td> </td></tr> <tr><td> </td><td>d)</td><td> </td></tr> </tbody> </table>		X	Tradename:	Chemical name:		a)			b)			c)			d)																																																		
X	Tradename:	Chemical name:																																																															
	a)																																																																
	b)																																																																
	c)																																																																
	d)																																																																
<table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:60%;"></th> <th style="width:10%; text-align: center;">No</th> <th style="width:10%; text-align: center;">Yes</th> <th style="width:10%;"></th> <th style="width:10%;"></th> </tr> </thead> <tbody> <tr> <td>2. Are these substances harmful ?</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;">←</td> <td></td> </tr> <tr> <td>3. Dangerous decomposition products when heated ?</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;">←</td> <td></td> </tr> <tr> <td colspan="5">If yes, which ? _____</td> </tr> </tbody> </table>			No	Yes			2. Are these substances harmful ?	<input type="checkbox"/>	<input type="checkbox"/>	←		3. Dangerous decomposition products when heated ?	<input type="checkbox"/>	<input type="checkbox"/>	←		If yes, which ? _____																																																
	No	Yes																																																															
2. Are these substances harmful ?	<input type="checkbox"/>	<input type="checkbox"/>	←																																																														
3. Dangerous decomposition products when heated ?	<input type="checkbox"/>	<input type="checkbox"/>	←																																																														
If yes, which ? _____																																																																	
<b>2) Components contaminated by microbiological, explosive or radioactive products/substances will not be accepted without written evidence of decontamination.</b>																																																																	

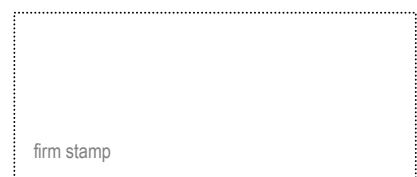
### D. Legally binding declaration

I / we hereby declare that the information supplied on this form is accurate and sufficient to judge any contamination level.

Name of authorized person (block letters) : \_\_\_\_\_

\_\_\_\_\_ Date

\_\_\_\_\_ signature of authorized person





# Sales and Service

## Germany

### Leybold GmbH

Sales, Service, Support Center (3SC)  
Bonner Strasse 498  
D-50968 Cologne  
T: +49-(0)221-347 1234  
F: +49-(0)221-347 31234  
sales@leybold.com  
www.leybold.com

### Leybold GmbH

#### Sales Area North

Branch Office Berlin  
Industriestrasse 10b  
D-12099 Berlin  
T: +49-(0)30-435 609 0  
F: +49-(0)30-435 609 10  
sales.bn@leybold.com

### Leybold GmbH

#### Sales Office South

Branch Office Munich  
Karl-Hammerschmidt-Strasse 34  
D-85609 Aschheim-Dornach  
T: +49-(0)89-357 33 9-10  
F: +49-(0)89-357 33 9-33  
sales.mn@leybold.com  
service.mn@leybold.com

### Leybold Dresden GmbH

#### Service Competence Center

Zur Wetterwarte 50, Haus 304  
D-01109 Dresden  
Service:  
T: +49-(0)351-88 55 00  
F: +49-(0)351-88 55 041  
info.dr@leybold.com

## Europe

### Belgium

### Leybold Nederland B.V.

#### Belgisch bijkantoor

Leuvensesteenweg 542-9A  
B-1930 Zaventem  
Sales:  
T: +32-2-711 00 83  
F: +32-2-720 83 38  
sales.zv@leybold.com  
Service:  
T: +32-2-711 00 82  
F: +32-2-720 83 38  
service.zv@leybold.com

### France

### Leybold France S.A.S.

Parc du Technopolis, Bâtiment Beta  
3, Avenue du Canada  
F-91940 Les Ulis cedex  
Sales and Service:  
T: +33-1-69 82 48 00  
F: +33-1-69 07 57 38  
info.ctb@leybold.com  
sales.ctb@leybold.com

### Leybold France S.A.S.

Valence Factory  
640, Rue A. Bergès  
B.P. 107  
F-26501 Bourg-lès-Valence Cedex  
T: +33-4-75 82 33 00  
F: +33-4-75 82 92 69  
marketing.vc@leybold.com

## Great Britain

### Leybold UK LTD.

Unit 9  
Silverglade Business Park  
Leatherhead Road  
Cheshington  
Surrey (London)  
KT9 2QL  
Sales:  
T: +44-13-7273 7300  
F: +44-13-7273 7301  
sales.ln@leybold.com  
Service:  
T: +44-13-7273 7320  
F: +44-13-7273 7303  
service.ln@leybold.com

## Italy

### Leybold Italia S.r.l.

Via Trasimeno 8  
I-20128 Mailand  
Sales:  
T: +39-02-27 22 31  
F: +39-02-27 20 96 41  
sales.mi@leybold.com  
Service:  
T: +39-02-27 22 31  
F: +39-02-27 22 32 17  
service.mi@leybold.com

## Netherlands

### Leybold Nederland B.V.

Floridadreef 102  
NL-3565 AM Utrecht  
Sales and Service:  
T: +31-(30) 242 63 30  
F: +31-(30) 242 63 31  
sales.ut@leybold.com  
service.ut@leybold.com

## Switzerland

### Leybold Schweiz AG, Pfäffikon

Churerstrasse 120  
CH-8808 Pfäffikon  
Warehouse and shipping address:  
Riedthofstrasse 214  
CH-8105 Regensdorf  
Sales:  
T: +41-44-308 40 50  
F: +41-44-302 43 73  
sales.zh@leybold.com  
Service:  
T: +41-44-308 40 62  
F: +41-44-308 40 60  
service.zh@leybold.com

## Spain

### Leybold Spain, S.A.

C/. Huelva, 7  
E-08940 Cornellà de Llobregat  
(Barcelona)  
Sales:  
T: +34-93-666 43 11  
F: +34-93-666 43 70  
sales.ba@leybold.com  
Service:  
T: +34-93-666 46 11  
F: +34-93-685 43 70  
service.ba@leybold.com

## America

## USA

### Leybold USA Inc.

5700 Mellon Road  
USA-Export, PA 15632  
T: +1-724-327-5700  
F: +1-724-325-3577  
info.ex@leybold.com  
Sales:  
T: +1-724-327-5700  
F: +1-724-333-1217  
Service:  
T: +1-724-327-5700  
F: +1-724-325-3577

## Brazil

### Leybold do Brasil

Rod. Vice-Prefeito Hermenegildo Tonolli,  
nº. 4413 - 6B  
Distrito Industrial  
Jundiaí - SP  
CEP 13.213-086  
Sales and Service:  
T: +55 11 3395 3180  
F: +55 11 99467 5934  
sales.ju@leybold.com  
service.ju@leybold.com

## Asia

## P. R. China

### Leybold (Tianjin)

#### International Trade Co. Ltd.

Beichen Economic  
Development Area (BEDA),  
No. 8 Western Shuangchen Road  
Tianjin 300400  
China  
Sales and Service:  
T: +86-22-2697 0808  
F: +86-22-2697 4061  
F: +86-22-2697 2017  
sales.tj@leybold.com  
service.tj@leybold.com

## India

### Leybold India Pvt Ltd.

No. 82(P), 4th Phase  
K.I.A.D.B. Plot  
Bommasandra Industrial Area  
Bangalore - 560 099  
Indien  
Sales and Service:  
T: +91-80-2783 9925  
F: +91-80-2783 9926  
sales.bgl@leybold.com  
service.bgl@leybold.com

## Japan

### Leybold Japan Co., Ltd.

Headquarters  
Shin-Yokohama A.K.Bldg., 4th floor  
3-23-3, Shin-Yokohama  
Kohoku-ku, Yokohama-shi  
Kanawaga 222-0033  
Japan  
Sales:  
T: +81-45-471-3330  
F: +81-45-471-3323  
sales.yh@leybold.com

### Leybold Japan Co., Ltd.

Tsukuba Technical Service Center  
1959, Kami-yokoba  
Tsukuba-shi, Ibaraki-shi 305-0854  
Japan  
Service:  
T: +81-29 839 5480  
F: +81-29 839 5485  
service.ik@leybold.com

## Malaysia

### Leybold Malaysia

#### Leybold Singapore Pte Ltd.

No. 1 Jalan Hi-Tech 2/6  
Kulim Hi-Tech Park  
Kulim, Kedah Darul  
Aman 09000  
Malaysia  
Sales and Service:  
T: +604 4020 222  
F: +604 4020 221  
sales.ku@leybold.com  
service.ku@leybold.com

## South Korea

### Leybold Korea Ltd.

3F. Jellzone 2 Tower  
Jeongja-dong 159-4  
Bundang-gu Sungnam-si  
Gyeonggi-do  
Bundang 463-384, Korea  
Sales:  
T: +82-31 785 1367  
F: +82-31 785 1359  
sales.bd@leybold.com  
Service:  
623-7, Upsung-Dong  
Cheonan-Si  
Chungcheongnam-Do  
Korea 330-290  
T: +82-41 589 3035  
F: +82-41 588 0166  
service.cn@leybold.com

## Singapore

### Leybold Singapore Pte Ltd.

8 Commonwealth Lane #01-01  
Singapore 149555  
Singapore  
Sales and Service:  
T: +65-6303 7030  
F: +65-6773 0039  
sales.sg@leybold.com  
service.sg@leybold.com

## Taiwan

### Leybold Taiwan Ltd.

No 416-1, Sec. 3  
Chunghsin Rd., Chungtung  
Hsinchu County 310  
Taiwan, R.O.C.  
Sales and Service:  
T: +886-3-500 1688  
F: +886-3-583 3999  
sales.hc@leybold.com  
service.hc@leybold.com

## Headquarter

### Leybold GmbH

Bonner Strasse 498  
D-50968 Cologne  
T: +49-(0)221-347-0  
F: +49-(0)221-347-1250  
info@leybold.com



www.leybold.com