oerlikon
leybold vacuum

MAG W 300 to 700
MAG.DRIVE S

Turbomolecular Pumps with Magnetic Bearing and Frequency Converter

Incorporation Declaration & Operating Instructions
17200045_002_A3

Part Nos.

410300Vxxxx
410400Vxxxx
410600Vxxxx
410700Vxxxx

and pumps modified by
Oerlikon Leybold Vacuum

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Contents

Original installation and operating instructions.

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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 Oerlikon Leybold Vacuum **MAG W 300 to W 700** have 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 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

0.2 Electrical hazards

WARNING

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 The frequency converter must only be connected to power supplies which meet the requirements for functional extra-low voltages with positive isolation in accordance with IEC 60364-4-41 (or local regulations) (PELV).

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

4 Unplug any connectors only when the mains voltage is switched off and the pump does no longer turn

5 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.

6 Unauthorized device conversion and modifications are prohibited for safety reasons.

7 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.

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

9 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.

10 Suitably support the connecting lines so that the pumps are not exposed to any major mechanical stress.

11 Do not expose pump, frequency converter and the connections to dripping water. Note the information on the IP type of protection.

12 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

13 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.

14 When applying external voltages above 42 V to the connection terminals, observe the applicable VDE safety regulations!

15 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 When pumping dusty media, use a dust filter.

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

4 Please consult us as to which types of pump are required for specific processes and applications.

5 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.
When pumping toxic gases we recommend a leak search on a regular basis.

6 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.

7 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

0.5 Danger of ignition

CAUTION

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 Dangers in connection with safety-related measures and precautions

CAUTION

1 The frequency converter is not equipped with its own emergency shut down switch. Such a facility needs to be provided from the side of the system.

0.7 Risk of damaging the pump

NOTICE

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 Also water cooled pumps need cooling air for the frequency converter.

5 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.

6 Ensure correct polarity when connecting the MAG.DRIVE. A wrong polarity may cause an internal fuse to blow. The fuse can only be changed by Oerlikon Leybold Vacuum Service.

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

8 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.

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

10 Exposure of the pump to accelerating forces mus

11 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.

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

Description

1 Description

The Oerlikon Leybold Vacuum MAG pumping system consists of:

- The **MAG** 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 **S** frequency converter is connected to the mains, the MAG.DRIVE **iS** is connected to a DC supply.

  They output 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.

  Refer to Fig. 1.11 for system configurations.

- Optional air cooler or cooling water coils.

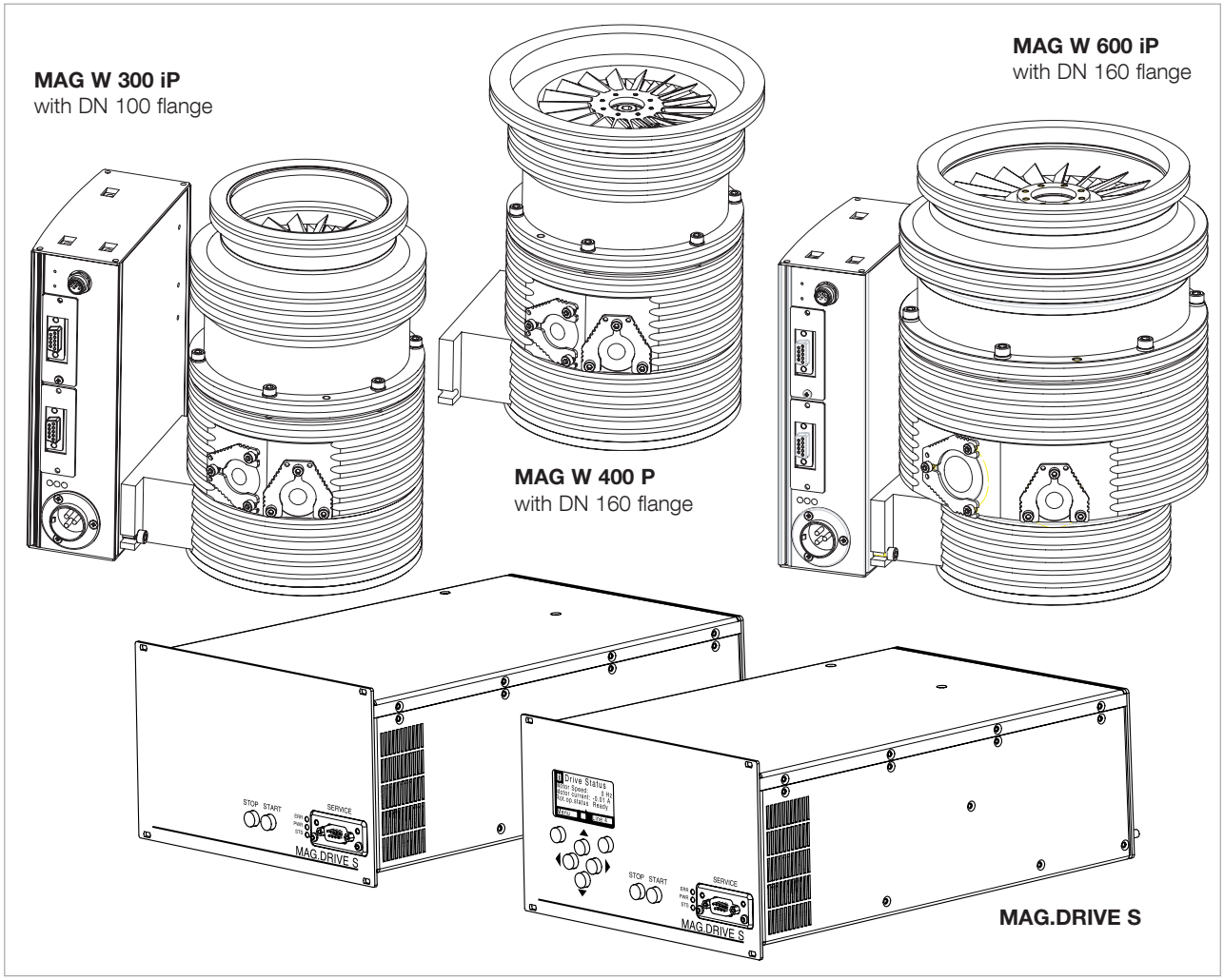


Fig. 1.1 MAG models

Description

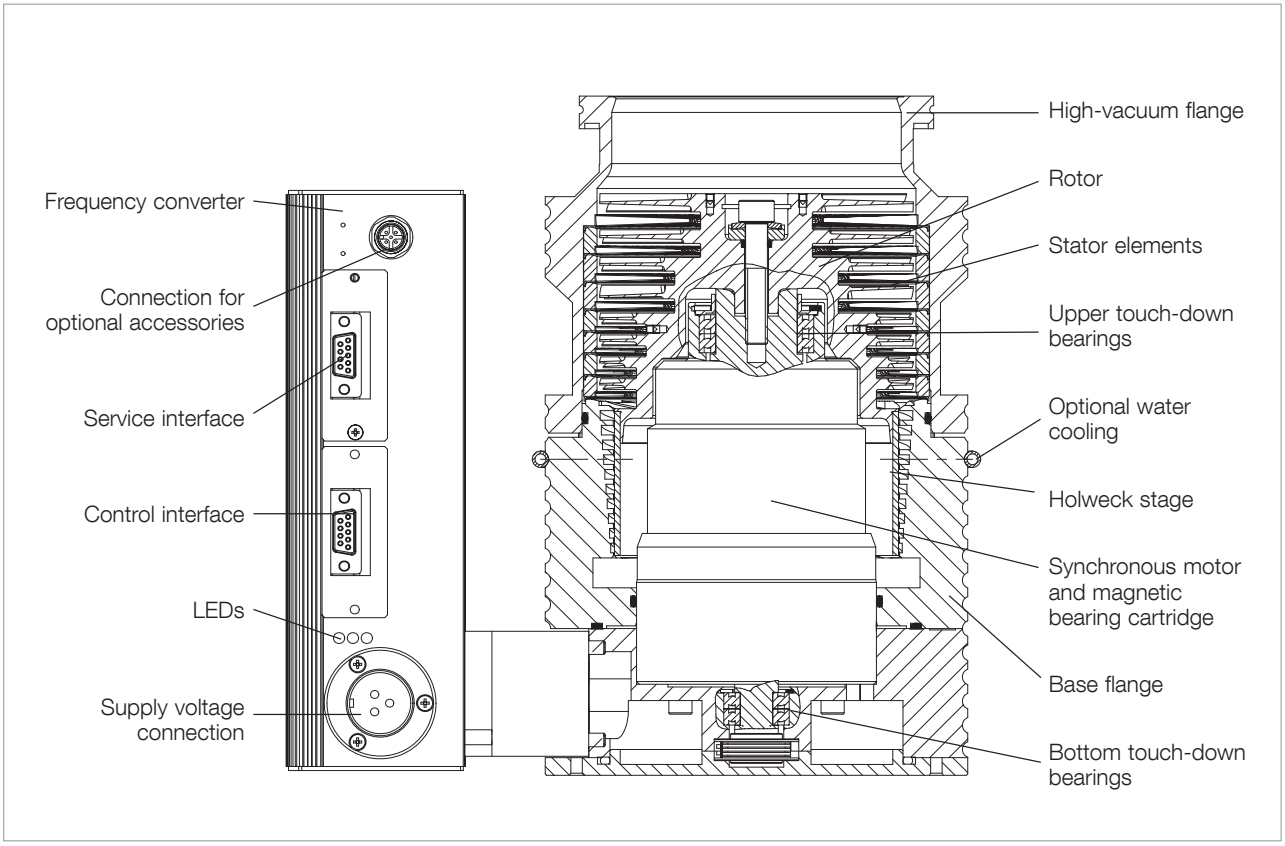


Fig. 1.2 Schematic section of the MAG W 300 with frequency converter, other models similar

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.

Rotor

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

Magnetic bearing

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

- along two orthogonal axes in each of two radial planes
- and completely in the axial direction

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

Touch down bearings are provided to stabilize the rotor mechanically if impacts occur during operation. They are only used in case of the breaking of the power supply or internal cables during operation, strong shocks, or faulty electronics.

The MAG has a purge gas device.

A controlled synchronous motor is used to power the rotor.

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

Frequency converter

The converter monitors continously 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 control interface (24 V PLC),
- an interface for the Oerlikon Leybold Vacuum Service (RS 232) and
- a connection for optional accessories, e.g. an air cooler.

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 flanges for forevacuum, venting, and purge gas are 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.

———————————————-

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

Description

1.3 Technical data

MAG W	300 P/iP	300 P/iP	400 P/iP	400 P/iP
High-vacuum flange	DN 100 ISO-K	DN 100 CF	DN 160 ISO-K	DN 160 CF
Pumping speed (PNEUROP)				
N_2	300 l · s^{-1}	300 l · s^{-1}	365 l · s^{-1}	365 l · s^{-1}
H_2	190 l · s^{-1}	190 l · s^{-1}	200 l · s^{-1}	200 l · s^{-1}
He	260 l · s^{-1}	260 l · s^{-1}	280 l · sv	280 l · s^{-1}
Speed	58,800 min^{-1}			
Compression				
N_2	$> 1.0 \cdot 10^{10}$			
H_2	$3.2 \cdot 10^3$			
He	$9.2 \cdot 10^4$			
Ultimate pressure	< 10^{-8} mbar	< 10^{-10} mbar	< 10^{-8} mbar	< 10^{-10} mbar
Max. bake-out temperature	–	80 °C	–	80 °C
temporary (see Section 4.4.1)	–	120 °C	–	120 °C
Max. forevacuum pressure for N_2	8 mbar			
Max. forevacuum pressure for N_2 for starting	6 mbar			
Recommended backing pump	TRIVAC D 2.5 B, D 8 B			
Run-up time	< 5 min			
Forevacuum flange	DN 16 KF (clamp shoe)			
Purge gas / venting flange	DN 16 KF (clamp shoe)			
Optional cooling connection	G 1/8”			
Weight, approx.	12 kg			

MAG W	600 P/iP	600 P/iP	700 P/iP	700 P/iP
High-vacuum flange	DN 160 ISO-K	DN 160 CF	DN 200 ISO-K	DN 200 CF
Pumping speed (PNEUROP)				
N_2	550 l · s^{-1}	550 l · s^{-1}	590 l · s^{-1}	590 l · s^{-1}
H_2	410 l · s^{-1}	410 l · s^{-1}	430 l · s^{-1}	430 l · s^{-1}
He	570 l · s^{-1}	570 l · s^{-1}	600 l · s^{-1}	600 l · s^{-1}
Speed	48 000 min^{-1}			
Compression				
N_2	$> 1.0 \cdot 10^{10}$			
H_2	$3.4 \cdot 10^4$			
He	$1.7 \cdot 10^6$			
Ultimate pressure	< 10^{-8} mbar	< 10^{-10} mbar	< 10^{-8} mbar	< 10^{-10} mbar
Max. bake-out temperature	–	80 °C	–	80 °C
temporary (see Section 4.4.1)	–	120 °C	–	120 °C
Max. forevacuum pressure for N_2	6 mbar			
Max. forevacuum pressure for N_2 for starting	4 mbar			
Recommended backing pump	TRIVAC			
Run-up time	< 6 min			
Forevacuum flange	DN 25 KF (clamp shoe)			
Purge gas / venting flange	DN 16 KF (clamp shoe)			
Optional cooling connection	G 1/8”			
Weight, approx.	17 kg			

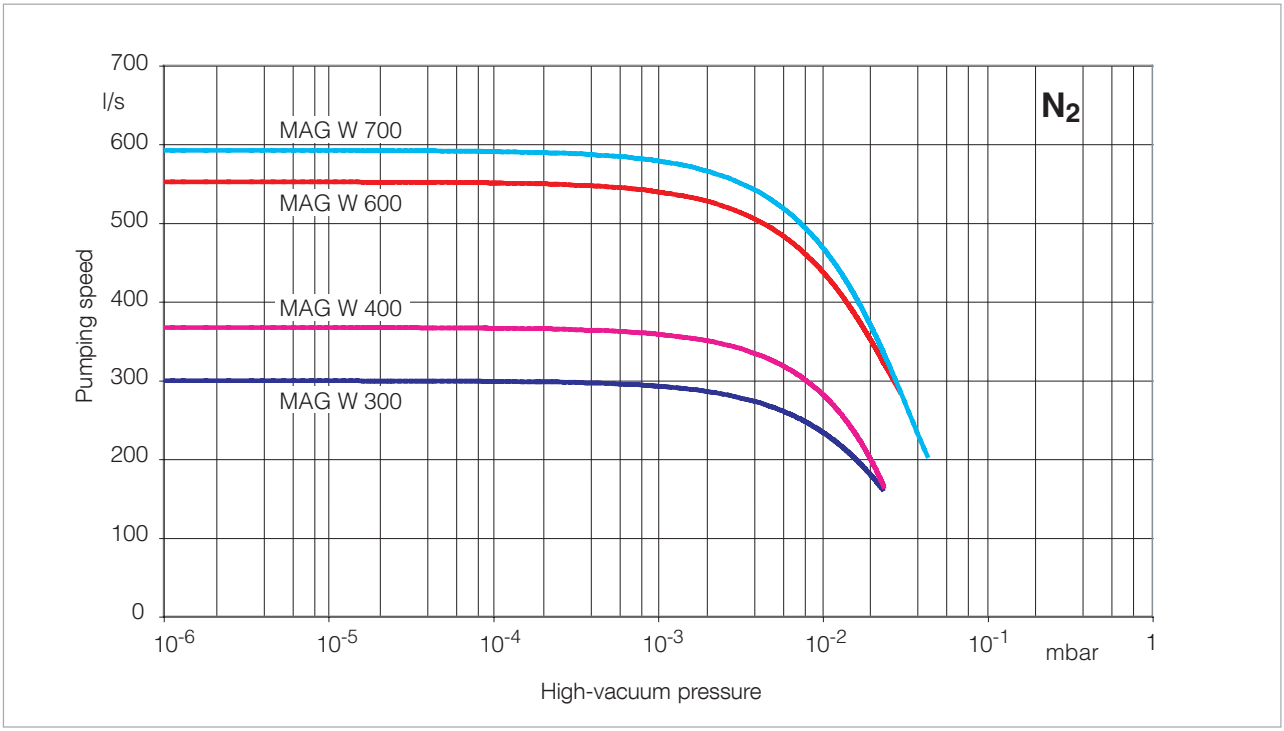


Fig. 1.3 Pumping speed curves for Nitrogen

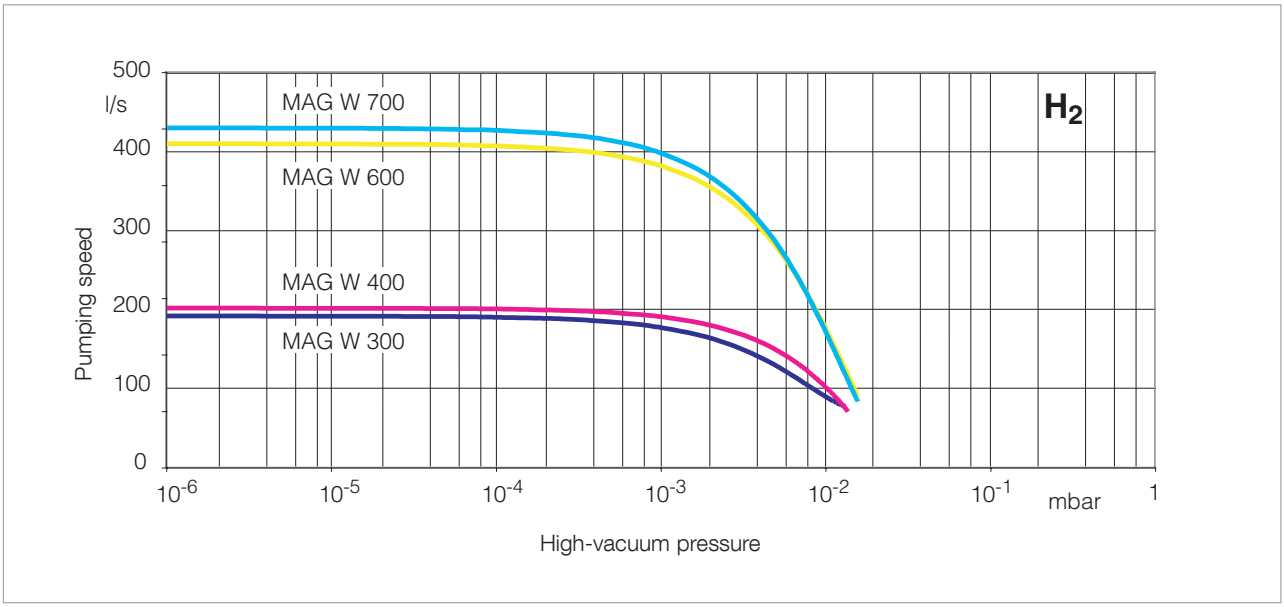


Fig. 1.4 Pumping speed curves for Hydrogen

Description

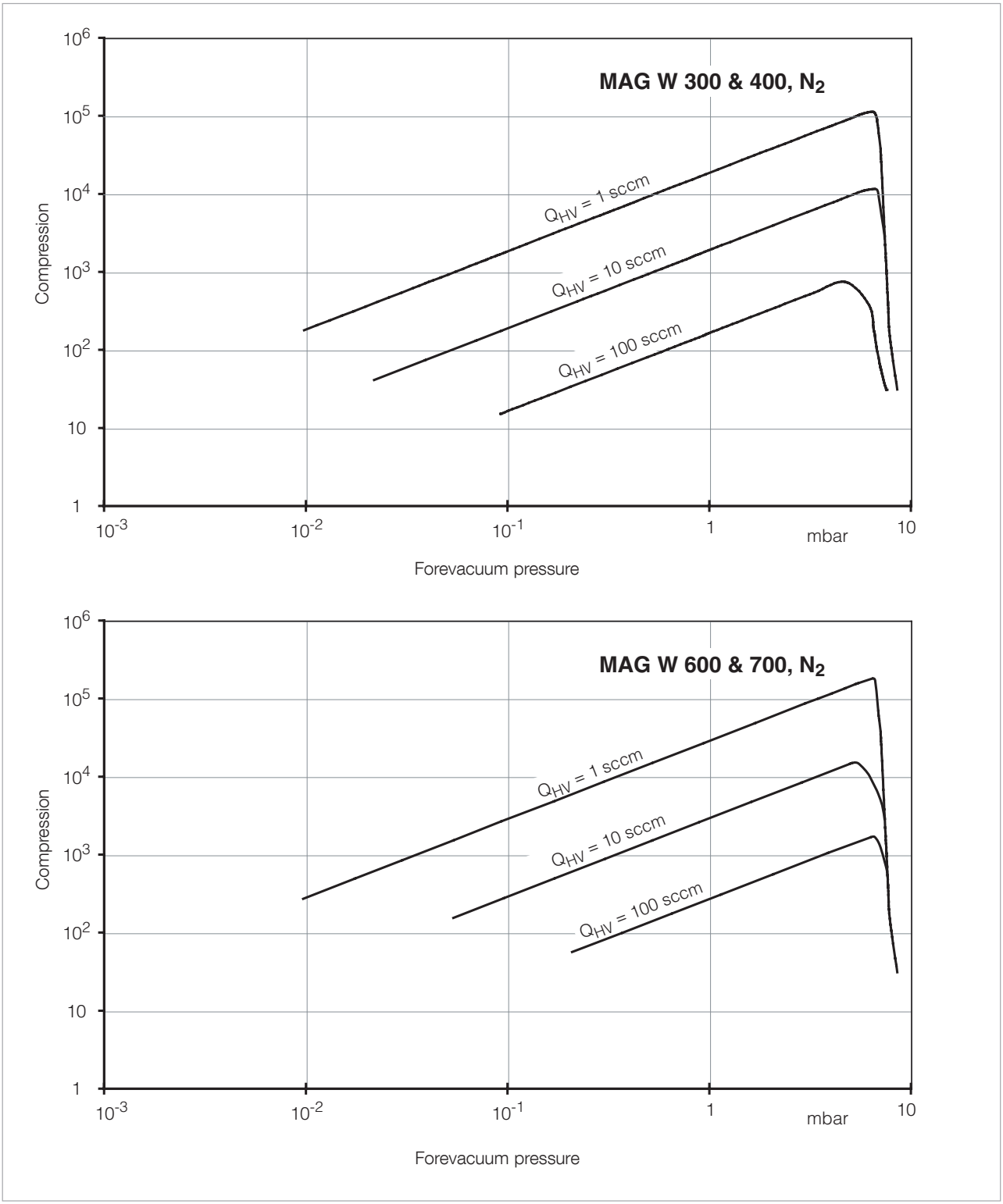


Fig. 1.5 Compression curves for Nitrogen

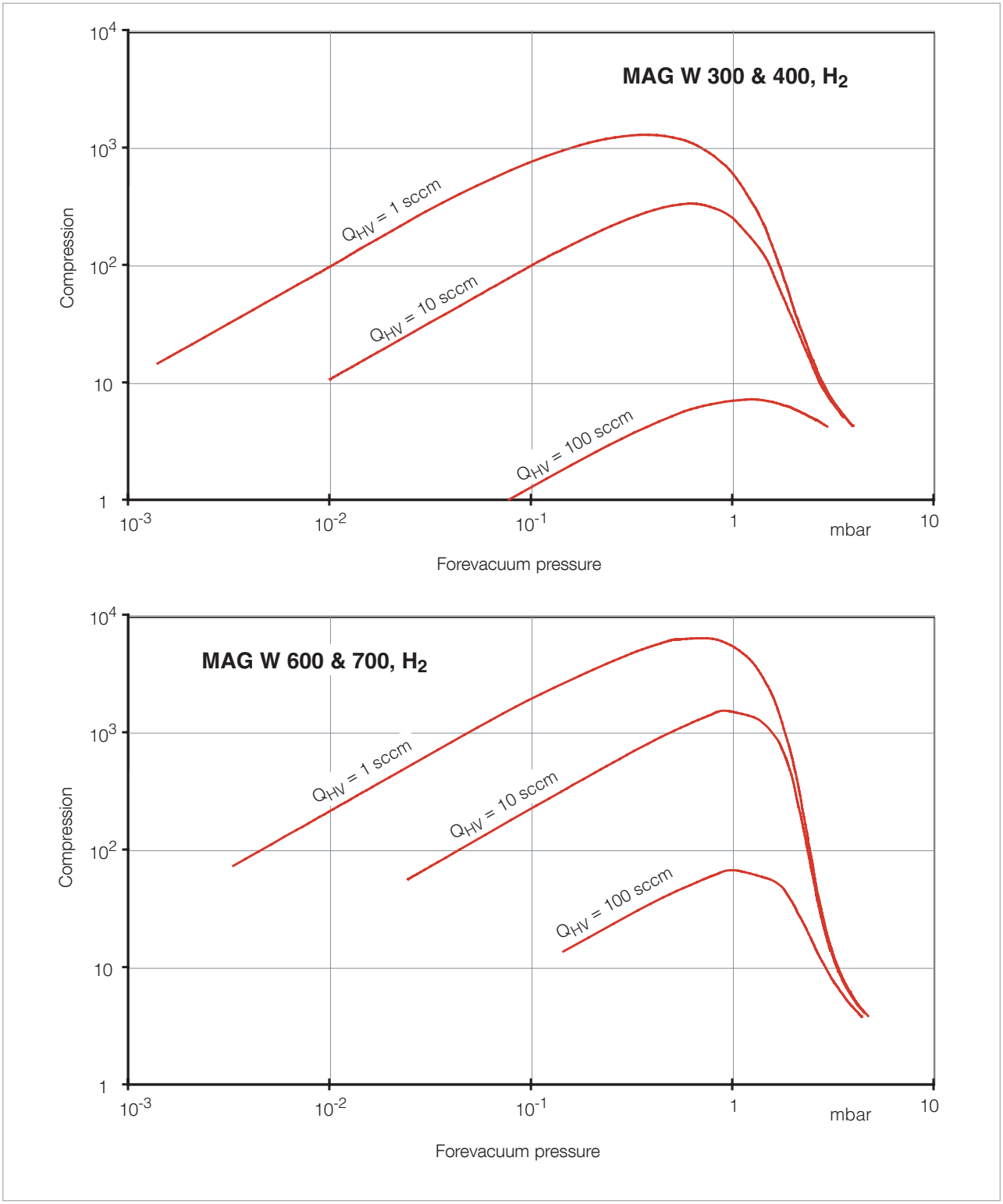
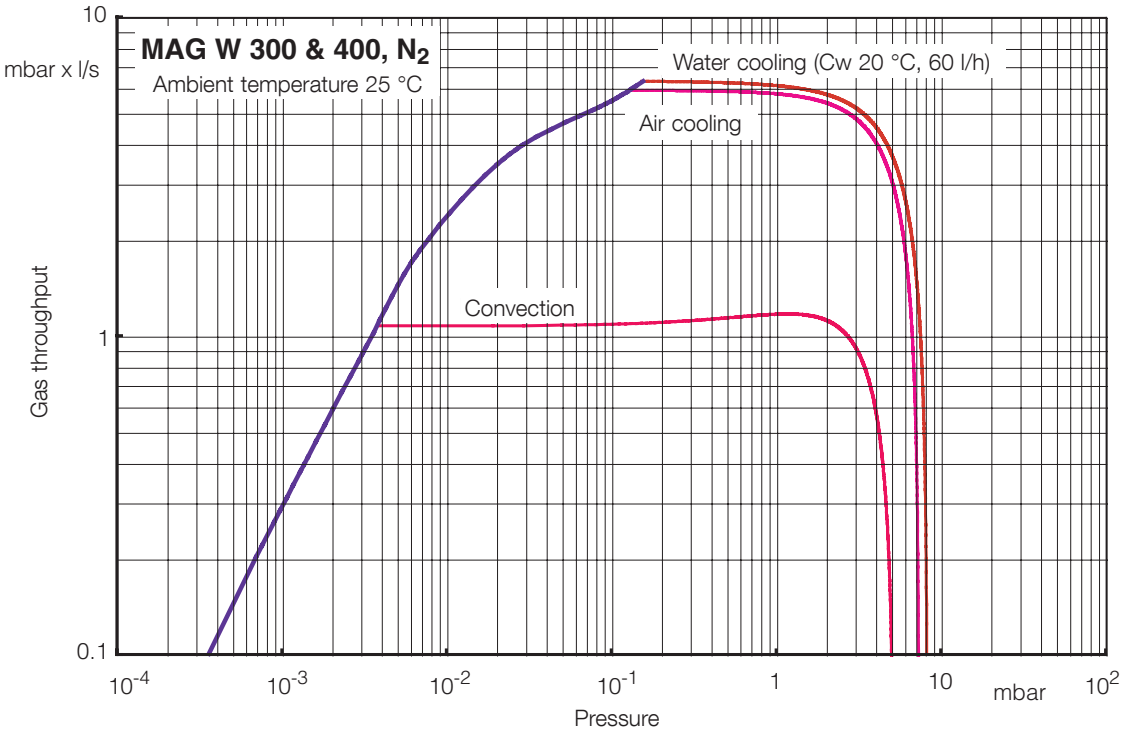


Fig. 1.6 Compression curves for Hydrogen

Description



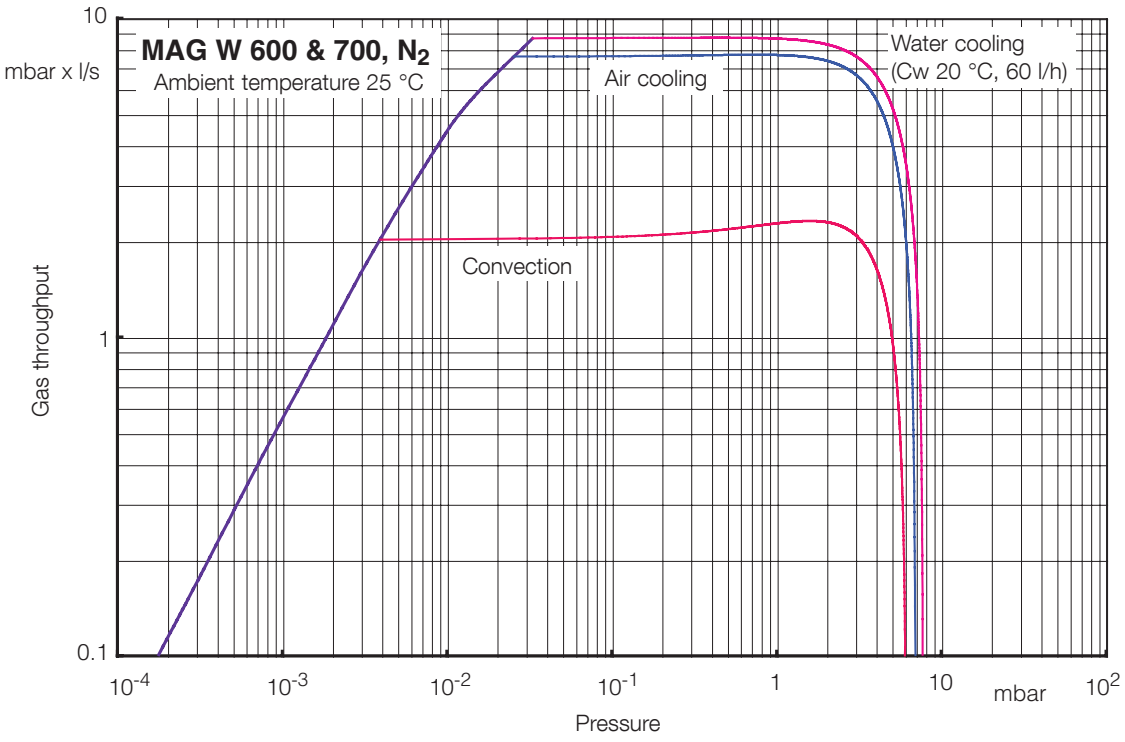


Fig. 1.7 Throughput curves for Nitrogen

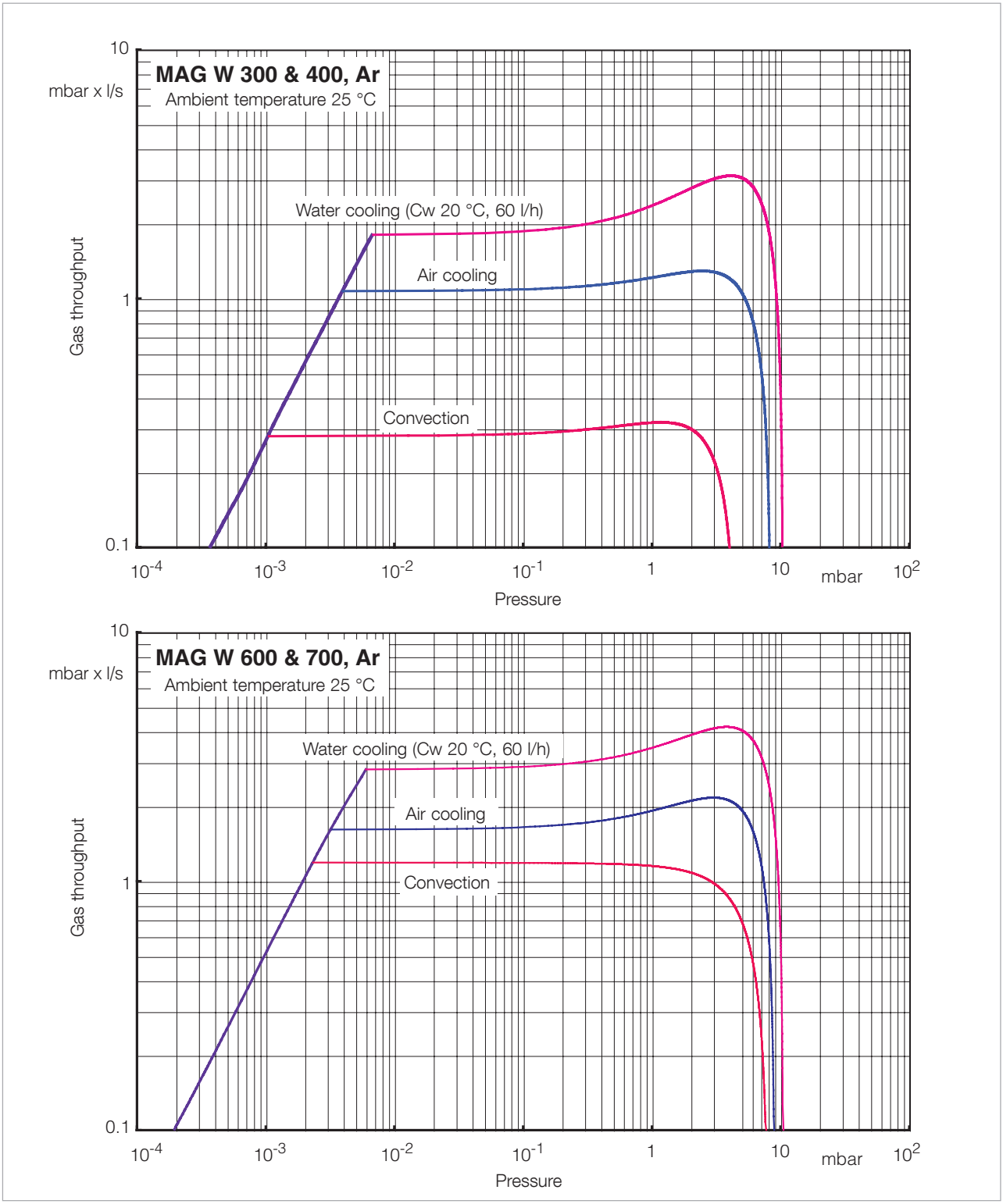
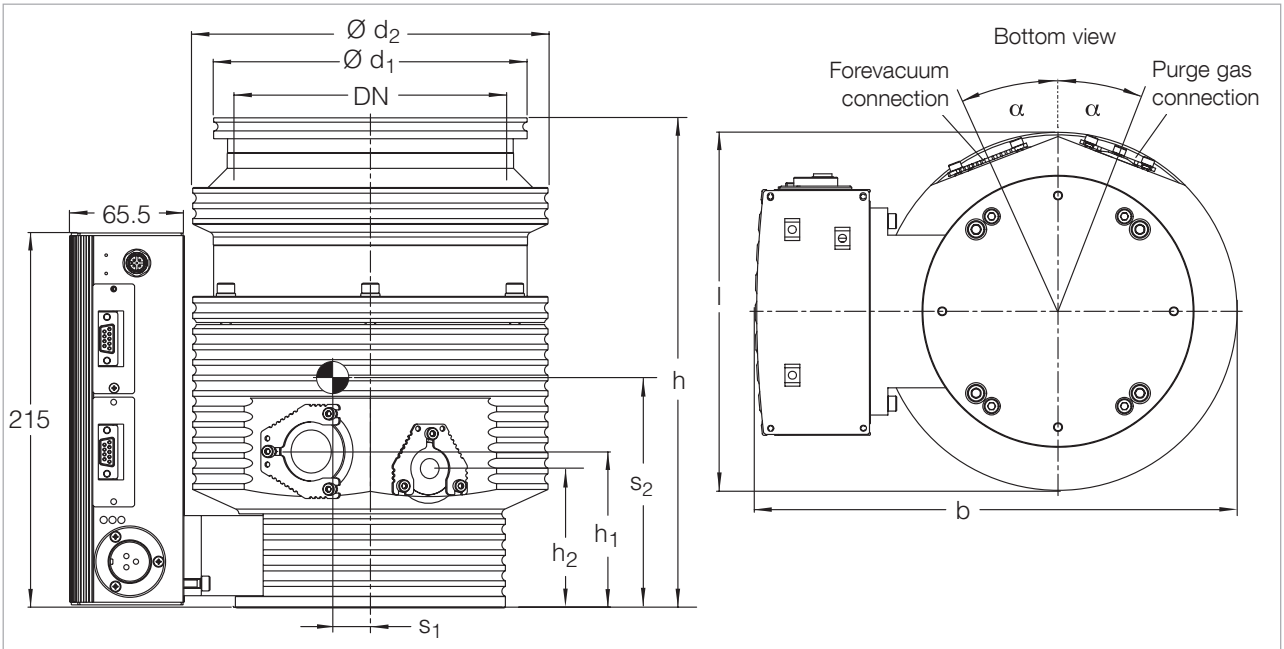


Fig. 1.8 Throughput curves for Argon

Description



	DN	Ø d_1	Ø d_2	h	h_1	h_2	l	b	b*	α	s_1	s_2
MAG W 300	100 ISO-K	130	155	250	77.7	70	156	250	233	16°	19	103
MAG W 300	100 CF	151.5	155	264.3	77.7	70	156	250	233	16°	15	129
MAG W 400	160 ISO-K	180	155	241	77.7	70	168.5	262.5	245.5	16°	19	106
MAG W 400	160 CF	202.5	155	234.7	77.7	70	181.2	273.7	256.7	16°	14	129
MAG W 600	160 ISO-K	180	204	281.5	90	80	204	274.5	257.5	21°	13	121
MAG W 600	160 CF	202.5	204	294	90	80	204	274.5	257.5	21°	10	150
MAG W 700	200 ISO-K	240	204	280.5	90	80	240	292.5	275.5	21°	13	130
MAG W 700	200 CF	253	204	275	90	80	253	299	282	21°	9	156

b*: width with plug of the DRIVE/BEARING cable connected instead of MAG.DRIVE iS

Fig. 1.9 Dimensional drawing of the pumps, dimensions in mm

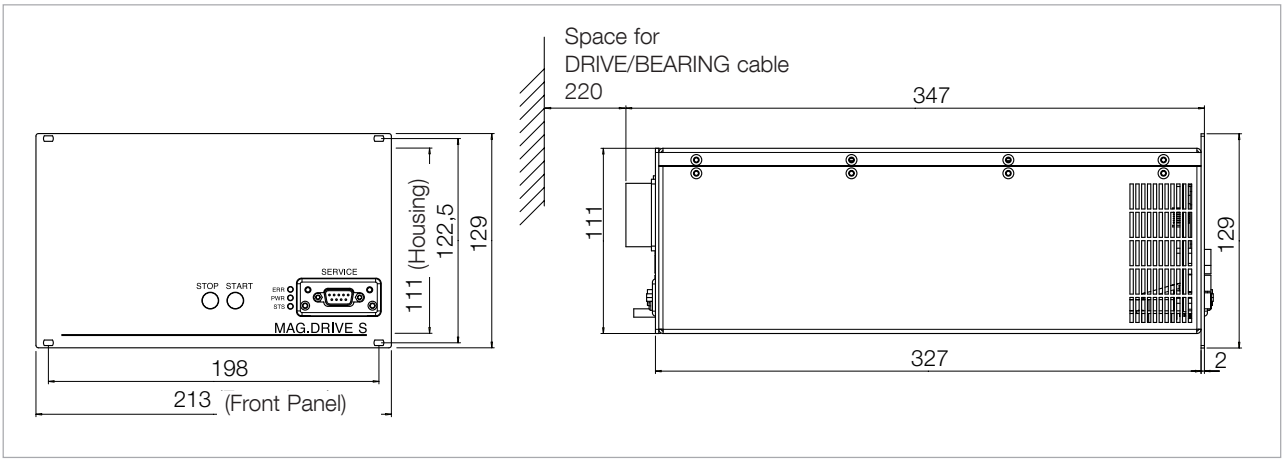


Fig. 1.10 Dimensional drawing of the MAG.DRIVE S, dimensions in mm

Technical data for the integrated frequency converter

MAG.DRIVE iS

Nominal supply voltage	48 V
Residual ripple	< 2%
Power consumption	
maximum	400 W
at ultimate pressure	100 W
Maximum DC current consumption	7.5 ... 9.3 A
DC power supply voltage range	43 … 53 V
Max. length of the DC cable	
at 3 x 1.5 mm^2	5 m
at 3 x 2.5 mm^2	20 m
Load rating, relay output (for SELV or PELV power circuits only)	32 V, 0.5 A
Ambient temperature	
during operation	10 - 40 °C
at standstill	-10 - 60 °C
Relative air humidity; non condensing	5 to 85 %
Type of protection	IP 30
Over voltage category	II
Contamination grade	2

Technical data for the separate frequency converter

MAG.DRIVE S

Voltage range	100 - 240 V ±10%
Line supply frequency	50 / 60 Hz
Load	
Stand-by	120 W
Maximum	400 W
Max. voltage motor	48 V
Maximum pump current	6 A
Fuses F1, F2, 5 x 20 mm	F (fast blow) / 10 A / High switching capacity / 250 V
System fuse	B or C characteristic
Maximum frequency	0 - 2000 Hz
Load capability, relay output (for SELV or PELV power circuits only)	32 V, 0.5 A
Temperature during operation	0-45 °C
Storage temperature	- 10 °C to + 60 °C
Relative air humidity	95% (non condensing)
Overvoltage category	II
Contamination level in accordance with EN 61010	2
Weight	6.5 kg
Degree of protection (EN 60529)	IP30

1.4 Ordering data

		Part No.
Pump with purge gas port		
MAG W 300 P	DN 100 ISO-K	410300V0005
MAG W 300 P	DN 100 CF	410300V0006
MAG W 400 P	DN 160 ISO-K	410400V0005
MAG W 400 P	DN 160 CF	410400V0006
MAG W 600 P	DN 160 ISO-K	410600V0005
MAG W 600 P	DN 160 CF	410600V0006
MAG W 700 P	DN 200 ISO-K	410700V0005
MAG W 700 P	DN 200 CF	410700V0006
MAG.DRIVE S Frequency converter		410300V0202
MAG.DRIVE S Frequency converter with display		410300V0212
DRIVE/BEARING cable (Connection between pump and MAG.DRIVE S	3 m	410300V4003
	5 m	410300V4005
	10 m	410300V4010
	20 m (only for MAG W 300/400)	410300V4020
Pump with integrated converter and purge gas port		
MAG W 300 iP	DN 100 ISO-K	410300V0505
MAG W 300 iP	DN 100 CF	410300V0506
MAG W 400 iP	DN 160 ISO-K	410400V0505
MAG W 400 iP	DN 160 CF	410400V0506
MAG W 600 iP	DN 160 ISO-K	410600V0505
MAG W 600 iP	DN 160 CF	410600V0506
MAG W 700 iP	DN 200 ISO-K	410700V0505
MAG W 700 iP	DN 200 CF	410700V0506

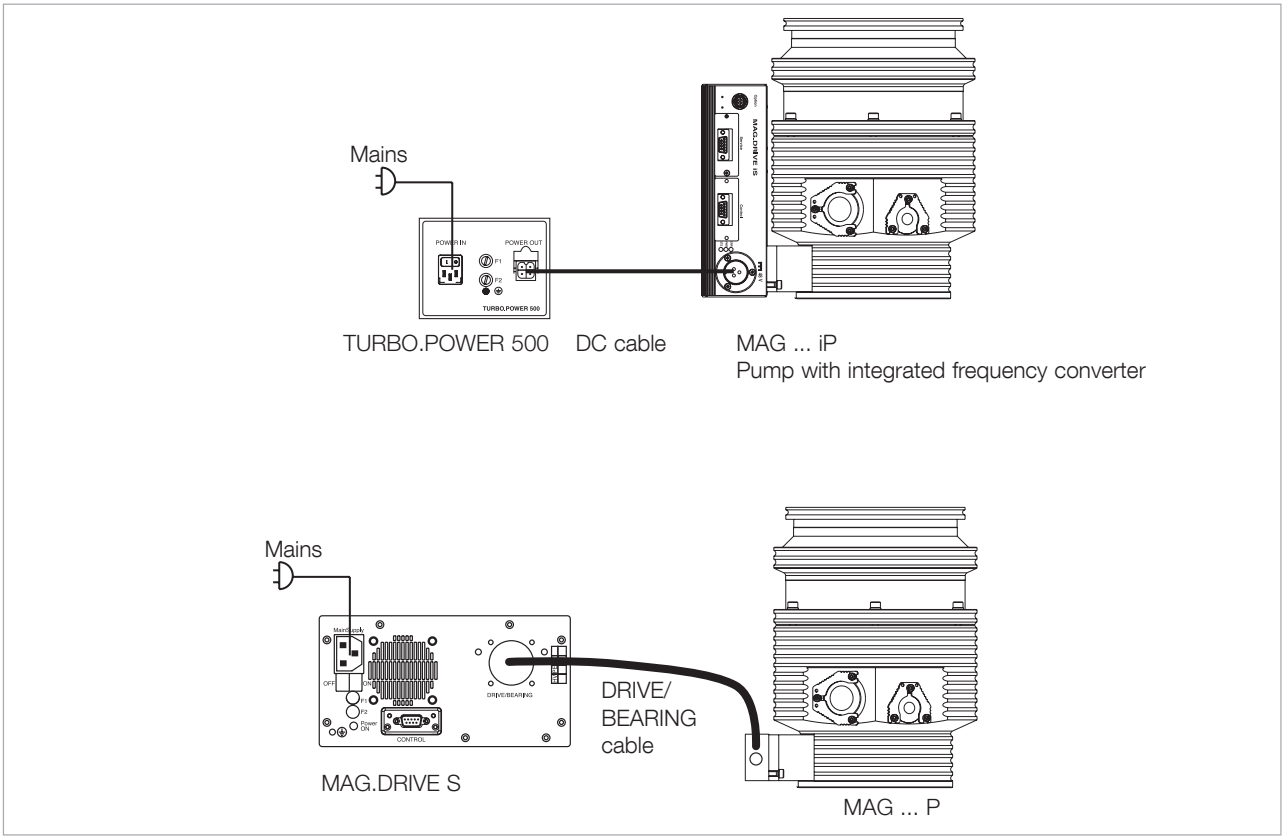
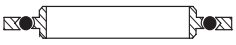


Fig. 1.11 System configurations

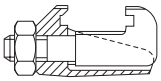
TURBO.POWER 500		410300V0221
DC cable (connection between		
TURBO.POWER 500 and MAG.DRIVE iS	1 m	410300V2001
	3 m	410300V2003
	5 m	410300V2005
	10 m	410300V2010
	20 m	410300V2020
Mains cable (for MAG.DRIVE S or TURBO.POWER 500)		
EU	3m	800102V0002
US	3m	800102V1002
UK	3m	800102V0003
Water cooling MAG W 300/400		410300V0101
Water cooling MAG W 600/700		410600V0101
Air cooling MAG W 300/400		410300V0102
Air cooling MAG W 600/700		410600V0102
Interface module		
RS 232 module		410300V0902
RS 485 module		410300V0903
Profibus module		410300V0904

Description

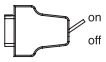
1.5 Accessories



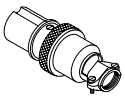
Centering ring (Al) with O-ring (FPM)			
DN 100 ISO-K			268 42
DN 160 ISO-K			268 43
DN 200 ISO-K			268 44



Clamps (Set of 4 pieces)			
Galvanized steel, clamping range 17 to 27 mm			267 01
Galvanized steel clamping range 25 to 35 mm			267 02
Stainless steel, clamping range 17 to 27 mm			887 99
Collar flange	DN 100		267 70
	Set of bolts (8x M8x40)		887 81
	DN 160		267 71
	Set of bolts (12x M10x50)		887 82
	DN 200		267 68
	Set of bolts (12x M10x50)		887 82
Copper gasket rings for CF flange (Set of 10 pieces)			
DN 100			839 45
DN 160			839 46
DN 200			839 47
Set of hex. screws with nuts, screws and washers for CF flange			
DN 100			839 04
DN 160			839 05
DN 200			839 07

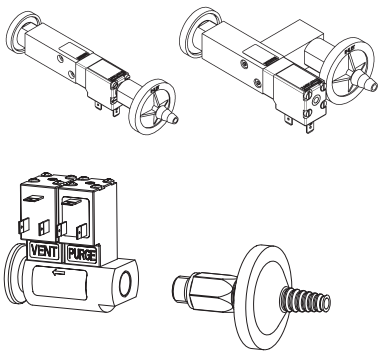


Plug for connector CONTROL with integrated ON/OFF switch for the pump (Sub-D plug, 9 way)			152 48



DC plug			800 001 694
Inlet screen	DN 100 ISO-K,	coarse	800132V0101
		fine	800132V0102
	DN 100 CF,	coarse	200 91 514
		fine	E 200 17 195
	DN 160 ISO-K		E 200 00 307
	DN 160 CF		200 17 247
	DN 200 ISO-K		on request
	DN 200 CF		on request
Microfilter, DN 100 ISO-K			887 21

Venting valve 24 VDC	800120V0011
Power failure venting valve 24 VDC	800120V0021
Spare filter	200 18 517
Purge gas and venting valve 0.4 mbar·l/s at 1 bar	
24 V DC	800152V0013
230 V AC	800152V0014
115 V AC	800152V0042
DN 10 KF – G1/4”	
Gas side connection: G1/4-in. adapter with filter	
Including O-ring and gasket	800110V0012
Centering ring adaptor DN 10/16 KF	182 56
Flange heater for CF housing	
DN 100, 230 V	854 27
DN 100, 110 V	854 28
DN 160, 230 V	854 37
DN 160, 110 V	854 38
KF Connection pieces	
DN 16/16, 80 mm, Al	184 80
DN 16/25, 40 mm, Al	183 86



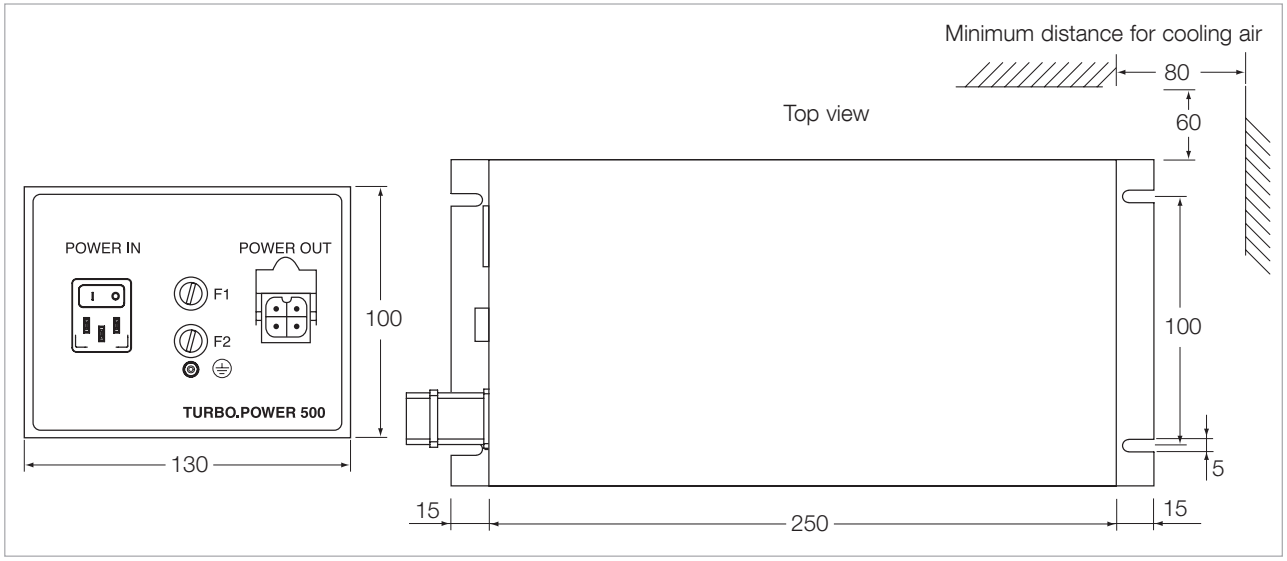


Fig. 1.12 Dimensional drawing for the power supply TURBO.POWER 500; dimensions in mm

Transport and storing

2 Transport and storing

Keep the packaging

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 Oerlikon Leybold Vacuum 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.

CAUTION

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.

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 Oerlikon Leybold Vacuum is only allowed after approval by Oerlikon Leybold Vacuum.

The integrated MAG.DRIVE iS or the separate MAG.DRIVE S frequency converter will be required for the operation of the turbomolecular pump.

The frequency converter MAG.DRIVE S is used to drive the MAG W 300 to 700 turbomolecular pumps. Other turbomolecular pumps **must not** be connected.

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.
- 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 and dust containing gases without reverting to 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 inadmissibily 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 30 or higher and where the installation site is over 1000 m the above sea level.

- 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 Oerlikon Leybold Vacuum.

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

Ambient temperature

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

Magnetic field

If the pump is used within a magnetic field, the magnetic induction at the surface of the pump housing may not exceed:
B = 5 mT if impinging radially and
B = 15 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.

Radiation

The standard pump version without frequency converter is resistant to radiation up to 10^3 Gy.

Places of installation

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.

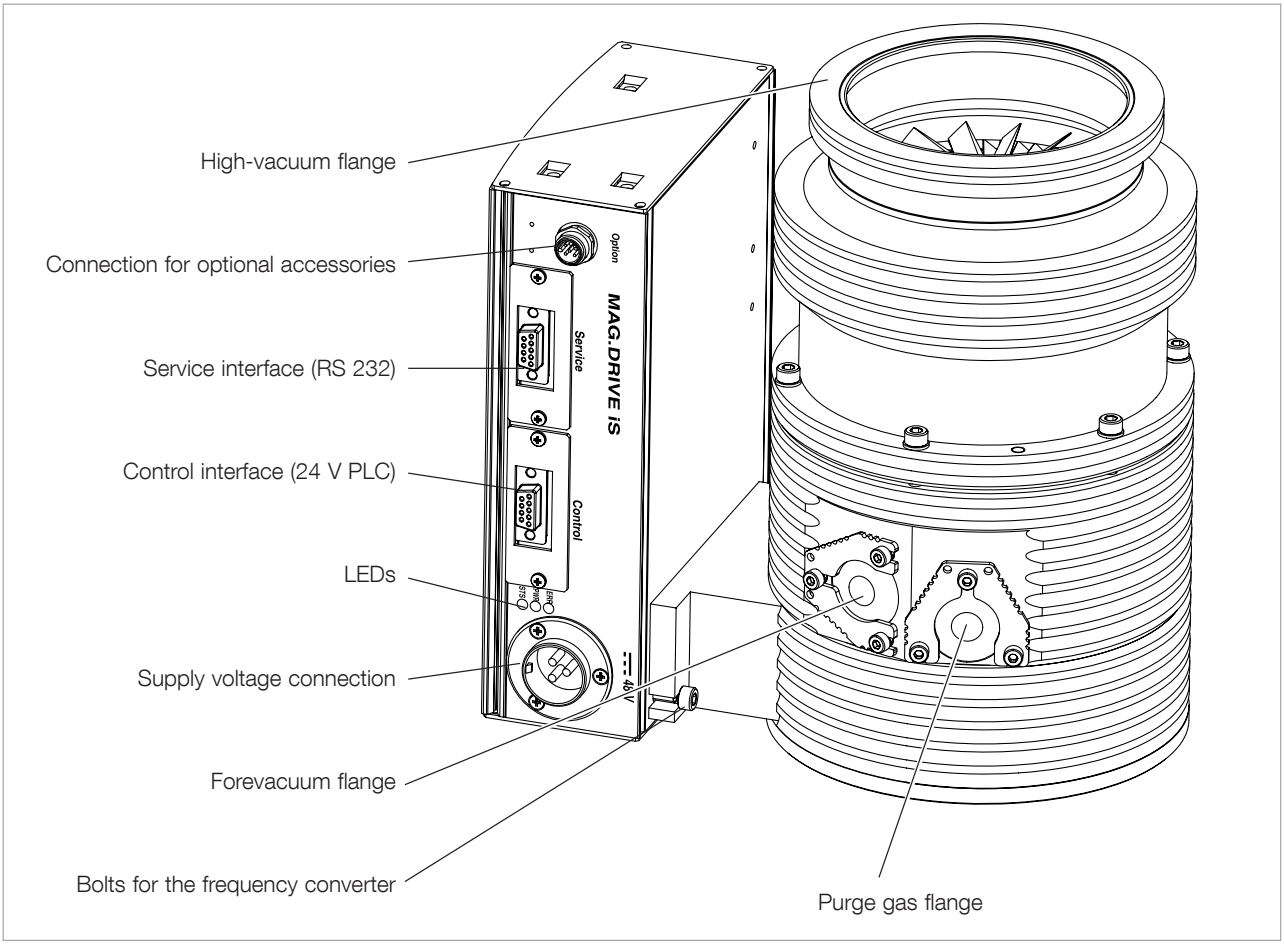


Fig. 3.1 Connection fittings

3.3 Attach the pump to the vacuum chamber

NOTICE

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

WARNING

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

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

Torque when the rotor seizes

If the pump should suddenly seize, an ensuing deceleration torque of up to 900 Nm for MAG 300/400 and up to 3500 Nm for MAG 600/700 will have to be absorbed by the system.

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.

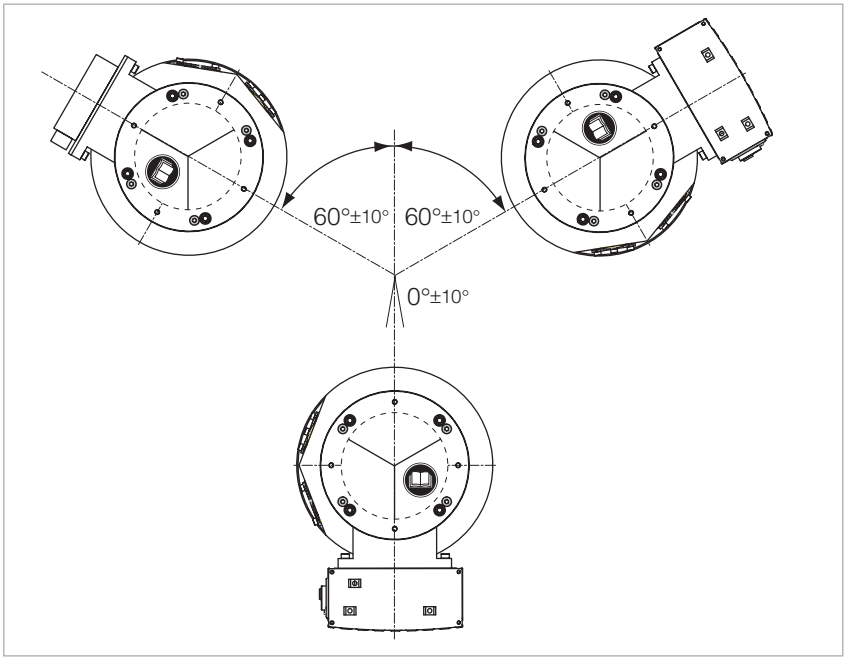


Fig. 3.2 Permissible pump orientation for the MAG W 600 and 700 when mounted horizontally to the vacuum chamber

Use exclusively flange connecting components and fittings which have been manufactured in accordance with DIN 28404, ISO 1609 (ISO-K flange connections) or ISO 3669 (CF flange connections).

For flanges which tower above the frequency converter, the frequency converter may be dismounted from the pump. To do so, the frequency converter must be deenergized and the pump must not rotate.

To dismount the frequency converter, unscrew the 2 bolts and take it off. For re-mounting tighten the bolts with 4 ± 0,4 Nm (see Fig. 3.1).

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 100 kg, it will not be necessary to secure it in any other way.

horizontal mounting of the MAG W 600 and 700

The pump can be mounted in any orientation with one exception: When the MAG W 600 or MAG W 700 is mounted **horizontally** to the vacuum chamber the frequency converter or the plug of the DRIVE/BEARING cable must only show to the bottom or at an angle of 60°(±10°) to the top (2, 6 or 10 o'clock position); see Fig. 3.2.

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.

Operation with vibration absorber

The pump is precision balanced and is generally operated without a resonance damper. To decouple extremely sensitive equipment and to prevent transfer of external vibrations to the pump a special resonance damper is available for mounting at the high-vacuum flange.

In this case mount the turbomolecular pump separately. A vibration absorber cannot reliably sustain the high deceleration torque in case of a rotor seizure.

If additional mounting is not possible, then the pump must be protected by a suitable shield during operation.

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 please contact Oerlikon Leybold Vacuum Application Support.

The standard pump fixing is sufficient for earthquake protection. If required fix the system to the bottom or to the walls. 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.

Install an 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 top 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 micropore filter must be installed between the vacuum chamber and the pump.

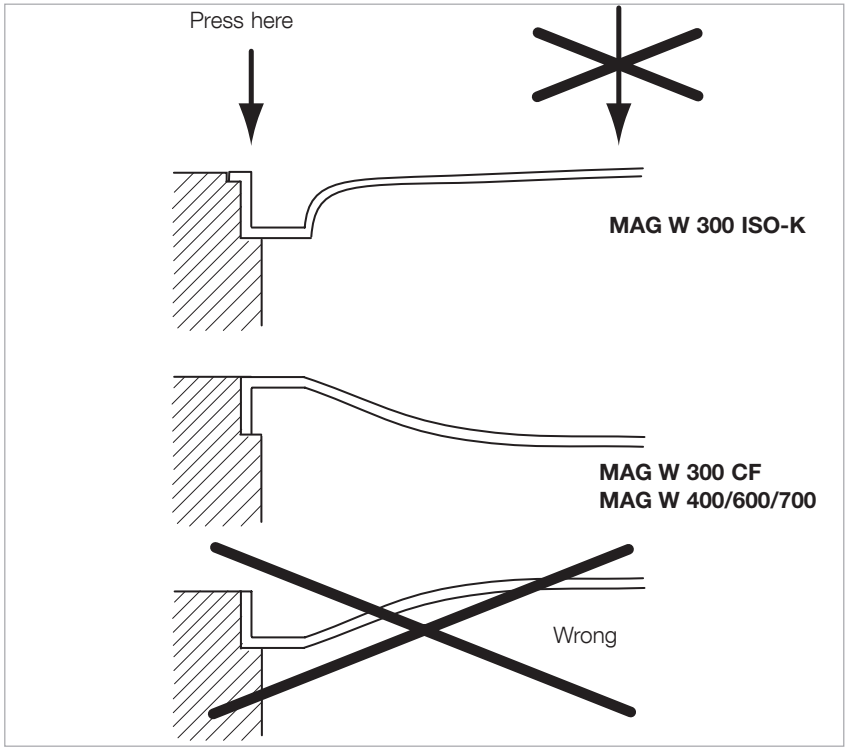


Fig. 3.3 Installing the inlet screen

Flange mounting for ISO-K flanges

When flanging on the high vacuum connecting flange, place the O-ring on the centering ring. The O-ring must remain in place smooth and untwisted. Thereafter put the outer ring in place.

Mount the turbomolecular pump according to Fig 3.4 and 3.5 and tighten the bolts crosswise step-by-step.

When using an ultra sealing ring, always use an outer support ring. The information on the number of bolts and clamps also applies to the ultra sealing rings.

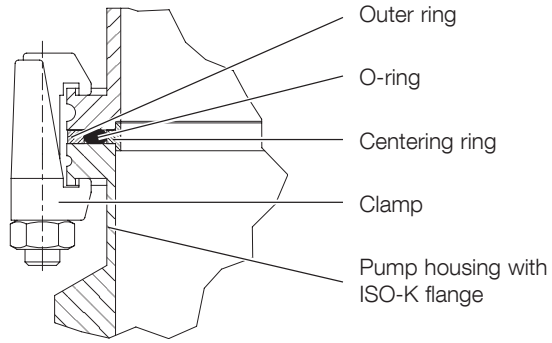
NOTICE

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.

WARNING

When using collar flanges or claws for mounting the **MAG W 600**, the pump may twist should the rotor suddenly seize.

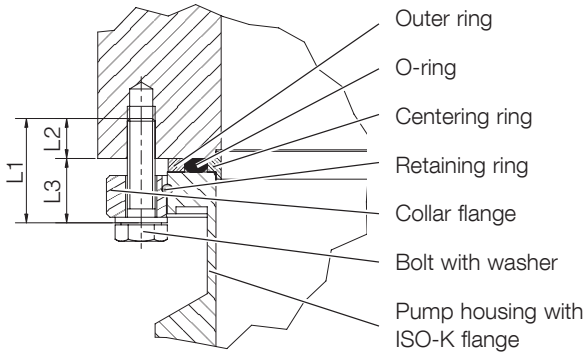
ISO-K flange at ISO-K flange



Pump/flange	MAG W 300 DN 100 ISO-K	MAG W 400 DN 160 ISO-K	MAG W 600 DN 160 ISO-K	MAG W 700 DN 200 ISO-K
Number of clamps	6x M10	6x M10	16x M10	12x M10
Minimum clamp strength, yield strength	> 450 N/mm^2			
Fastening torque	20^{+3} Nm			

The fastening torque levels apply to lubricated threads.

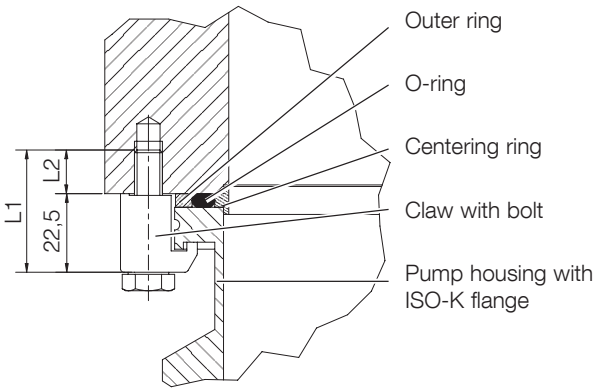
ISO-K flange at ISO-F flange with collar flange



Pump/flange	MAG W 300 DN 100 ISO-K	MAG W 400 DN 160 ISO-K	MAG W 600 DN 160 ISO-K	MAG W 700 DN 200 ISO-K
Number of clamps	8 x M8	8 x M10	8 x M10	12 x M10
Minimum bolt strength, yield strength	> 450 N/mm^2	> 600 N/mm^2	> 600 N/mm^2	> 600 N/mm^2
Minimum screw in depth L2				
for steel	12 mm	13 mm	13 mm	13 mm
for aluminium	16 mm	18 mm	18 mm	18 mm
L3	18.5 mm	23 mm	23 mm	23 mm
Recommended bolts, ISO 4014				
for steel flanges	M8x30	M10x40	M10x40	M10x40
for alum. flanges	M8x35	M10x45	M10x45	M10x45
Bolt quality stainless steel bolts	8.8 or A2(A4)-70	8.8 or A2(A4)-80	8.8 or A2(A4)-80	8.8 or A2(A4)-80
Fastening torque	20^{+3} Nm	35^{+5} Nm	35^{+5} Nm	35^{+5} Nm

Fig. 3.4 Mounting high vacuum flange ISO-K.

ISO-K flange at ISO-F flange with claws



The fastening torque levels apply to lubricated threads.

Pump/flange	MAG W 300 DN 100 ISO-K	MAG W 400 DN 160 ISO-K	MAG W 600 DN 160 ISO-K	MAG W 700 DN 200 ISO-K
Number of clamps	8 x M8	8 x M10	8 x M10	12 x M10
Minimum bolt strength, yield strength	> 450 N/mm²	> 600 N/mm²	> 600 N/mm²	> 600 N/mm²
Minimum screw in depth L2				
for steel	12 mm	13 mm	13 mm	13 mm
for aluminium	16 mm	18 mm	18 mm	18 mm
Recommended bolts, ISO 4014				
for steel flanges	M8x35	M10x35	M10x35	M10x35
for alum. flanges	M8x40	M10x40	M10x40	M10x40
Bolt quality stainless steel bolts	8.8 or A2(A4)-70	8.8 or A2(A4)-80	8.8 or A2(A4)-80	8.8 or A2(A4)-80
Fastening torque	20^{+3} Nm	35^{+5} Nm	35^{+5} Nm	35^{+5} Nm

Fig. 3.5 Mounting high vacuum flange ISO-K.

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 3.6 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.

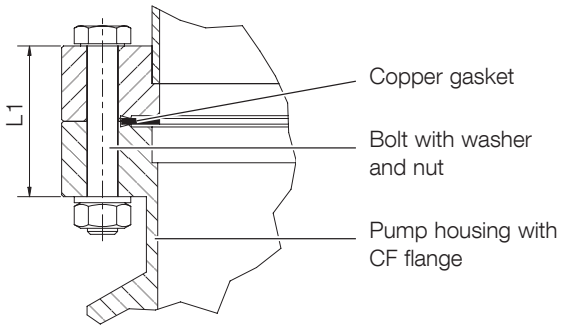
Owing to the deformation of the copper gasket, the fastening torque of all bolts must be checked once more after having completed the installation work.

CAUTION

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.

Installation

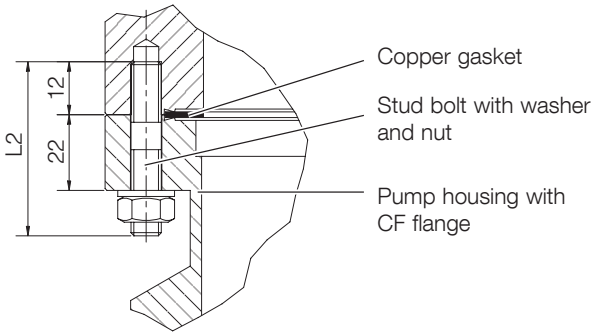
CF-flange connection with clearance hole



Pump/Flange	MAG W 300 DN 100 CF	MAG W 400 DN 160 CF	MAG W 600 DN 160 CF	MAG W 700 DN 200 CF
Number of bolts	16 x M8	20 x M8	20 x M8	24 x M8
Minimum bolt strength, yield strength	> 450 N/mm²			
Recommended bolt, ISO 4014 L1 =	M8x50 40	M8x55 44	M8x55 44	M8x60 49
Bolt quality stainless steel bolts	8.8 or A2(A4)-70			
Fastening torque	15^{+2} Nm			

The fastening torque levels apply to lubricated threads.

CF flange connection with blind hole thread



Pump/Flange	MAG W 300 DN 100 CF	MAG W 400 DN 160 CF	MAG W 600 DN 160 CF	MAG W 700 DN 200 CF
Number of bolts	16 x M8	20 x M8	20 x M8	24 x M8
Minimum bolt strength, yield strength	> 450 N/mm²			
Mindesteinschraubtiefe für Stahl	12 mm			
Recommended bolt for steel flanges DIN 835, L2 =	M8x30 46	M8x30 46	M8x30 46	M8x35 51
Bolt quality stainless steel bolts	8.8 or A2(A4)-70			
Fastening torque	15^{+2} Nm			

Fig. 3.6 Mounting high vacuum flange CF.

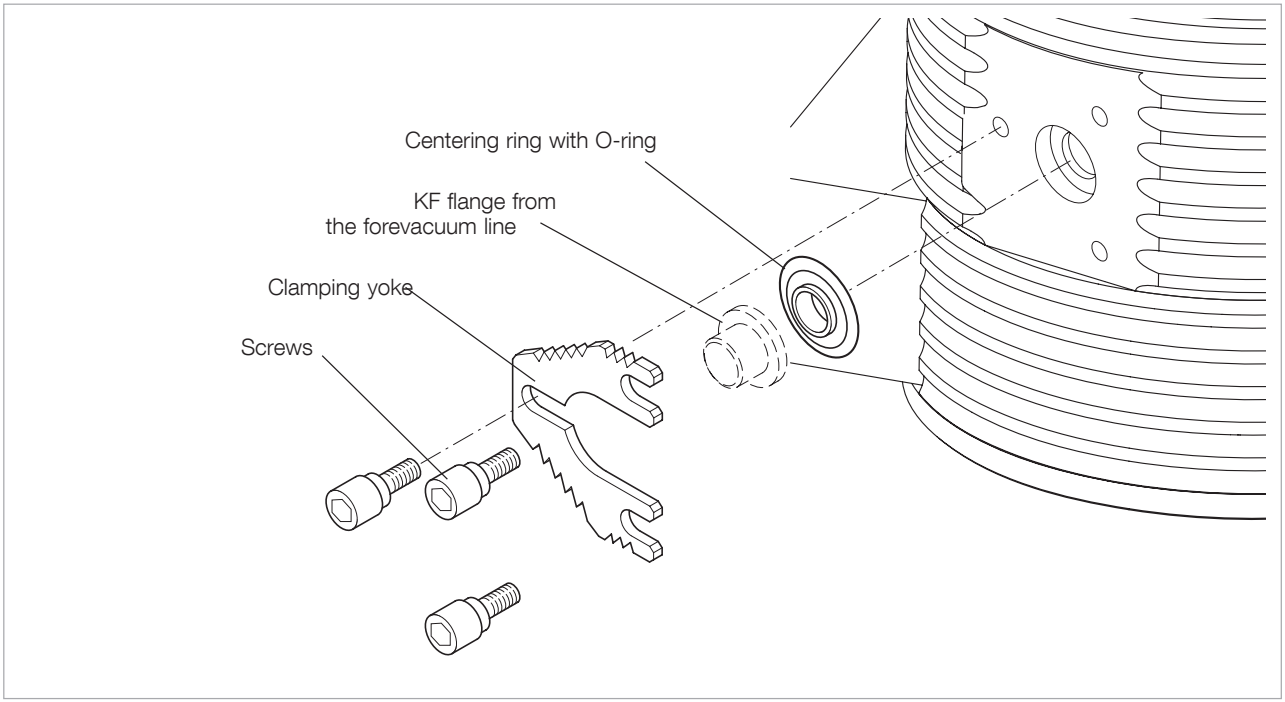


Fig. 3.7 Connecting the forevacuum line

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 for this purpose.

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 0.4.5.

Fig. 3.8 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, 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.

Installation

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

— — — — roughing line; recommended if shorter cycle times are to be achieved

— · — · — · — · drive and control line

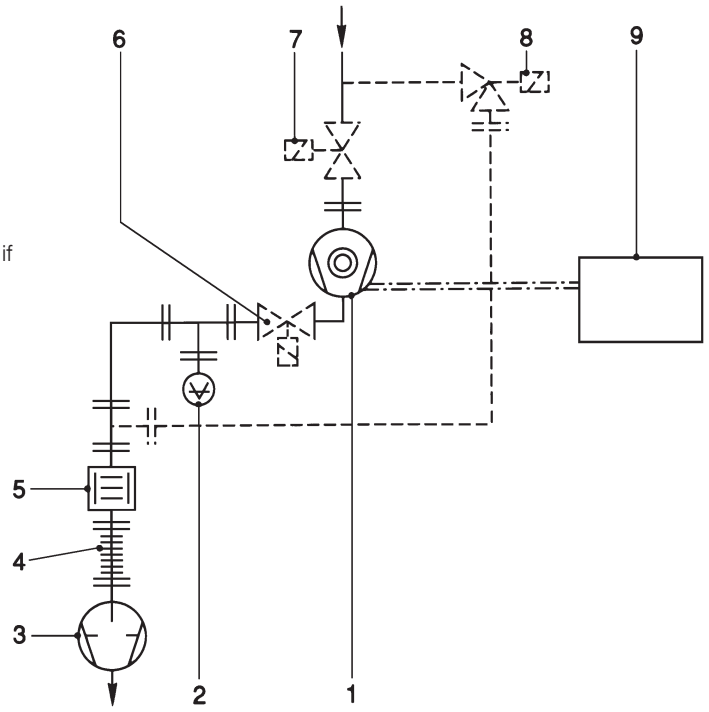


Fig. 3.8 Layout of a turbomolecular pump system

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.

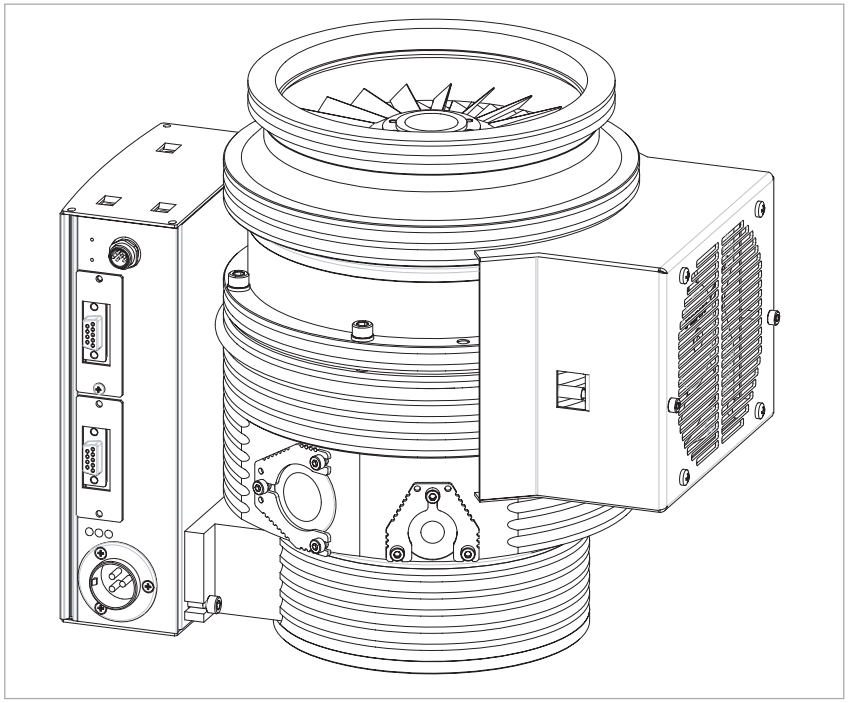


Fig. 3.9 MAG W 600 with air cooler; MAG W 300 and 400 similar

3.5 Connecting the cooling

Cooling of the MAG depends on the required pumping power and the ambient temperature. When the pump is insufficiently cooled it will shut down.

Required Cooling

Convection cooling possible	Ultimate pressure operation
Air or water cooling required	High gas throughput, cyclic operation or high ambient temperatures up to 35 °C for pumps with an ISO-K flange.
Water cooling necessary	High gas throughput, cyclic operation or high ambient temperatures for pumps with a CF flange
	Pumping of argon

Air or water cooling can be mounted to the pump; see Section 1.4 Ordering Data.

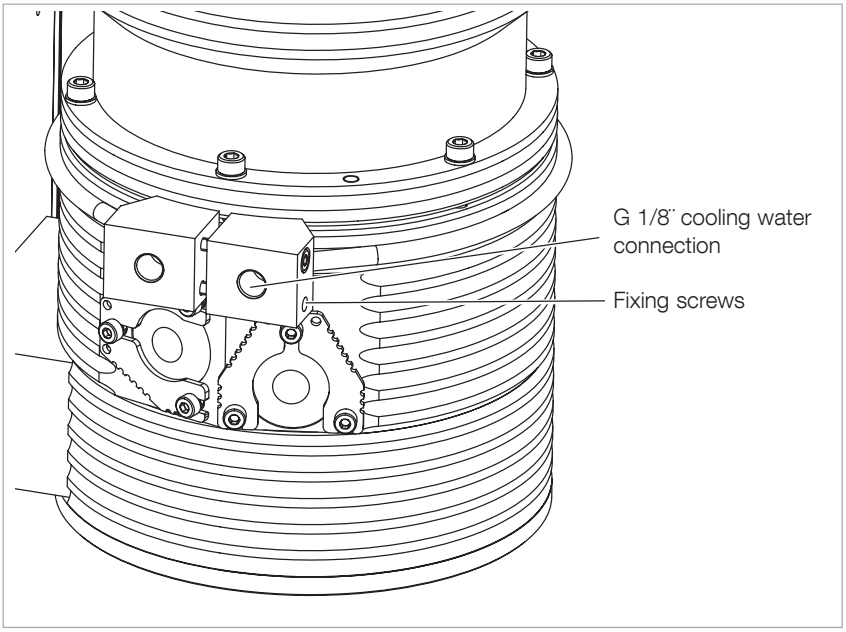


Fig. 3.10 MAG W 300 with optional water cooling, other models similar

Cooling water specifications

Inlet temperature	15 - 25 °C (59 - 77 °F)
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
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)

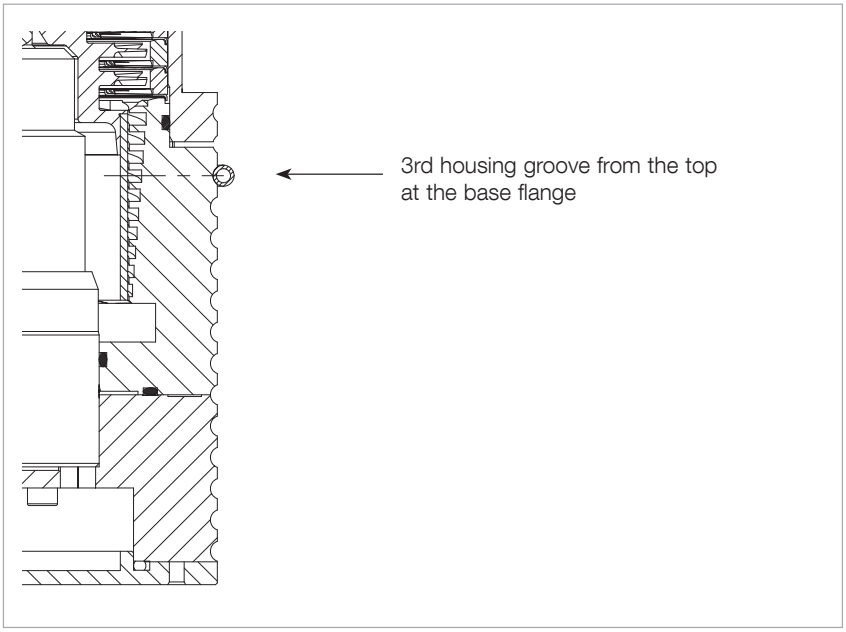


Fig. 3.11 Mounting position of the water cooling

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

When using DS water/deionised water (softened or fully desalinated water) check whether cooling system, water and materials used are suitable. For this please consult us.

Mounting the water cooling (optional)

Unscrew 2 screws, bend the cooling coil cautiously a little bit open and mount it to the pump. Mounting position: 3rd housing groove from the top at the base flange.

Do not mount the cooling coil into the first or second groove, the thermal contact is worse there.

Fix the 2 screws. See Fig. 3.11 for the position of the cooling coil. The cooling coil can be turned radially into any desired direction before fixing the screws.

Connecting the cooling water

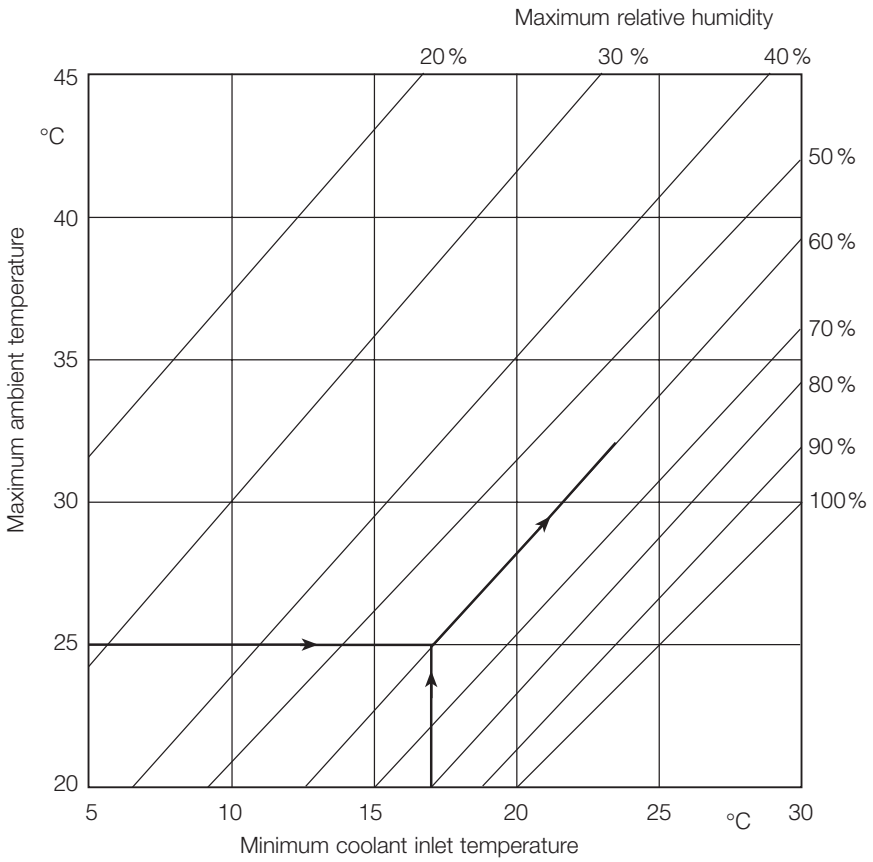
Screw on the cooling water lines.

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

When switching the cooling water supply on and off by means of an electrically actuated valve, connect the valve so that it will be switched on and off together with the pump.

Avoid condensate formation

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.



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

Example:

Max. ambient temperature	25 °C
Min. coolant inlet temperature	17 °C
⇒ Max. relative humidity	60%

Fig. 3.12 Dewpoint diagram

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.

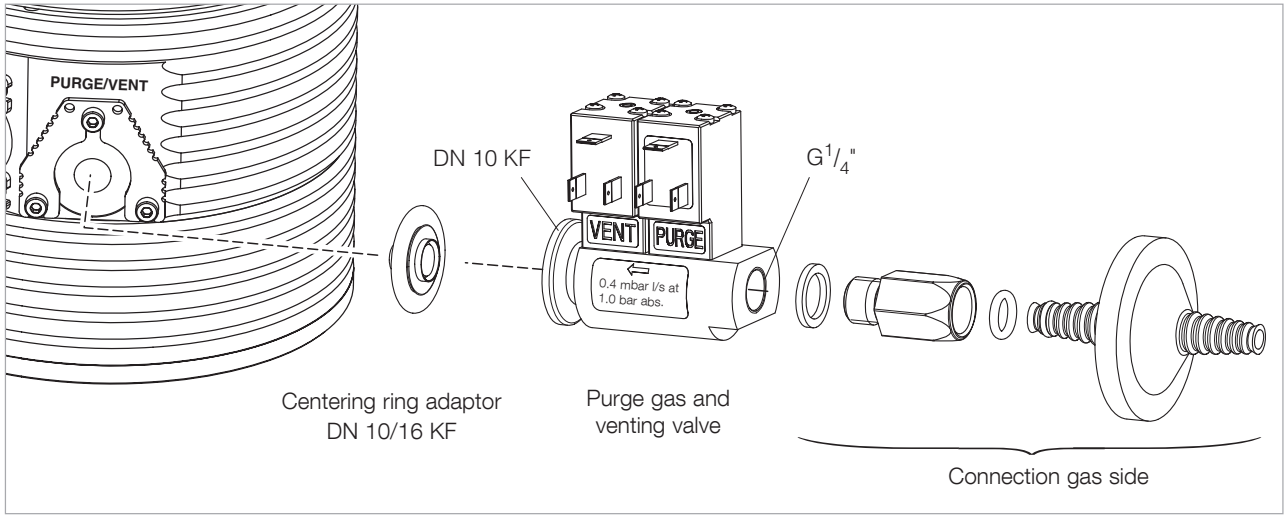


Fig. 3.13 Connect purge gas and venting valve

3.6 Connect purge gas or a 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 10/16 KF centering ring adapter.

The power failure venting valve or venting valve vents the pump and the fore-vacuum 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 0.4 mbar·l/s (24 sccm) with Nitrogen.

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

WARNING

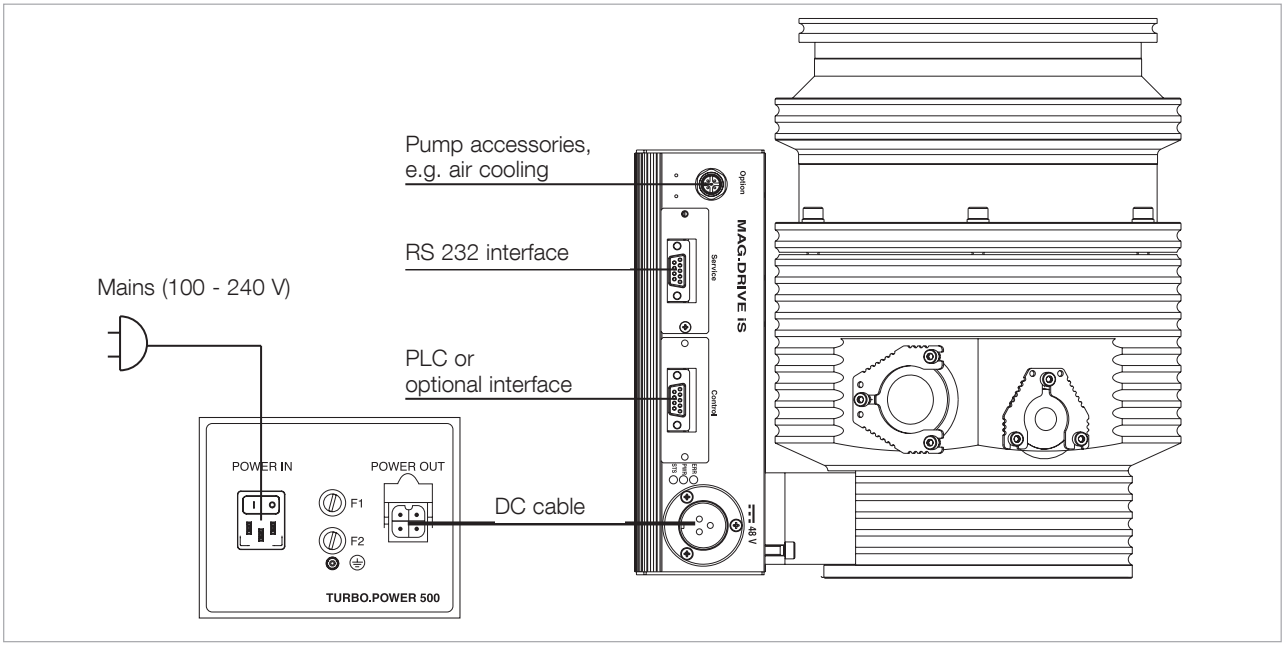


Fig. 3.14 Connection schematic TURBO.POWER 500 power supply

3.7 Electrical connection for the integrated frequency converter

DANGER

Observe Safety Informations 0.2.

NOTICE

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.

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

The pump may be operated only with suitable connector cables.

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

Do not expose the pump, the frequency converter or the connections to dripping water.

We recommend to connect the frequency converter to the TURBO.POWER 500 power supply.

If you use another power supply, it must have a current limiter or fuse which limits the maximum current to 10 Amps or another suitable current limitation element.

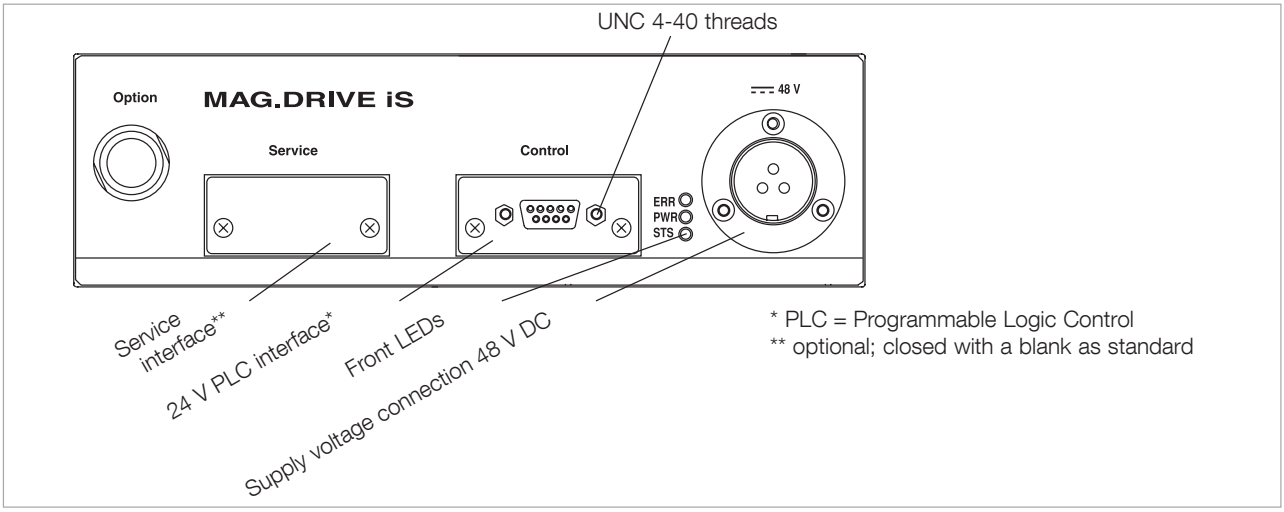


Fig. 3.15 View of the integrated frequency converter

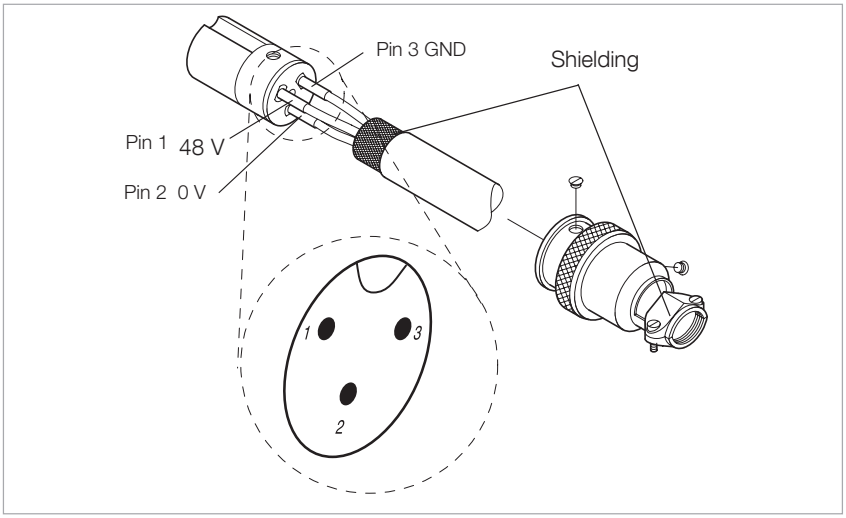


Fig. 3.16 Reqired pin assignment of the 3 pole connector model Hirose HS21P-3; view from the soldered side

Ensure correct polarity; see Fig. 3.16.

Pin 1 + 48 VDC
Pin 2 0 V
Pin 3 GND

Connect the power supply to the mains.

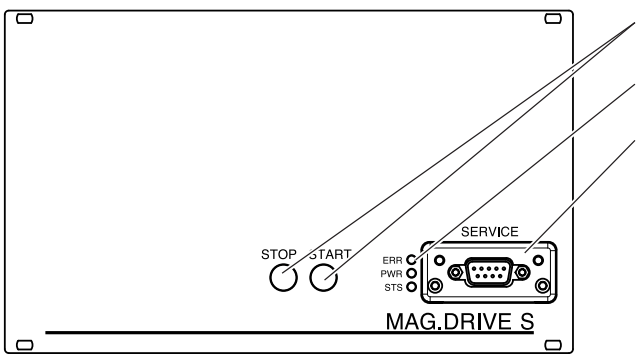
3.8 Separating the frequency converter from the pump

Optionally the frequency converter can be separated from the pump. For this you need a connection cable between frequency converter and pump; please consult with Oerlikon Leybold Vacuum.

The heat dissipation of the MAG.DRIVE iS must not be obstructed. Insure a sufficient ventilation - the ambient temperature during operation must not exceed 40 °C (104 °F).

CAUTION

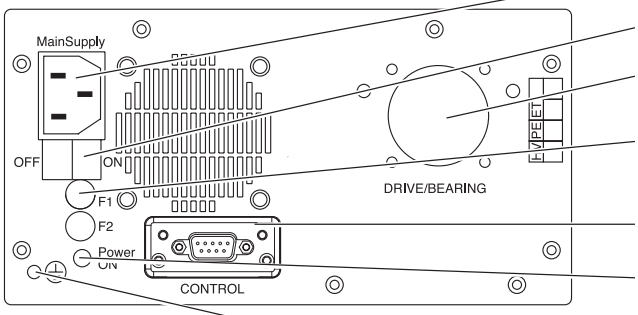
During operation the frequency converter may attain temperatures up to 75 °C. We recommend that the unit be installed so that it can not be touched inadvertently.



START and STOP buttons

Front LEDs

Service interface (RS 232) (UNC 4-40 threads)



Mains supply connection

Main switch

Connection for DRIVE/BEARING cable

Fuses (F10AH250V) (Fast-blow, 10 A nominal current, high switching capacity, 250 V nominal voltage)

24 V PLC interface* (UNC 4-40 threads)

Power ON LED
lights green when mains connection is ok
lights red when mains problems are present or the internal power supply is defective

* PLC = Programmable Logic Control

Ground bolt

Fig. 3.17 Front and rear view of the separate frequency converter

3.9 Electrical connection for the separate frequency converter

Observe Safety Informations 0.2

DANGER

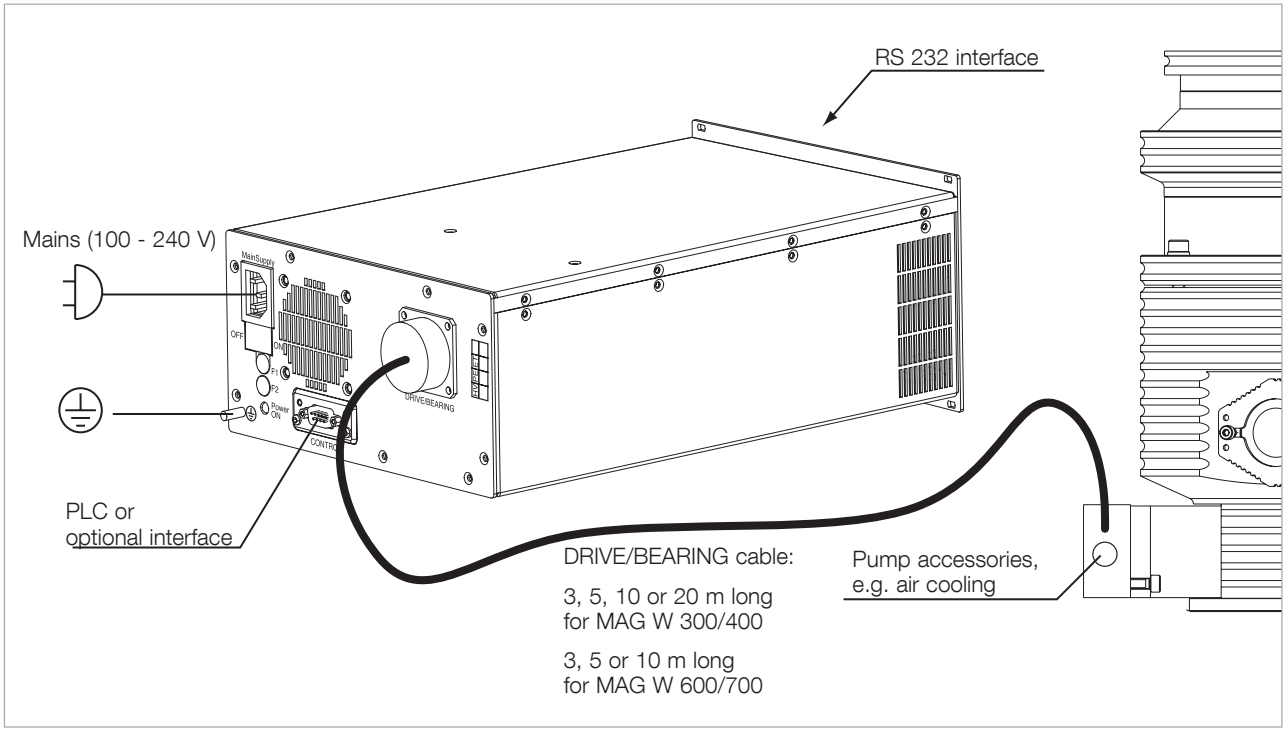


Fig. 3.18 Connection schematic MAG.DRIVE S

NOTICE

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

The pump may be operated only with suitable connector cables.

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

Do not expose the pump, the frequency converter or the connections to dripping water.

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 pump or the frequency converter.

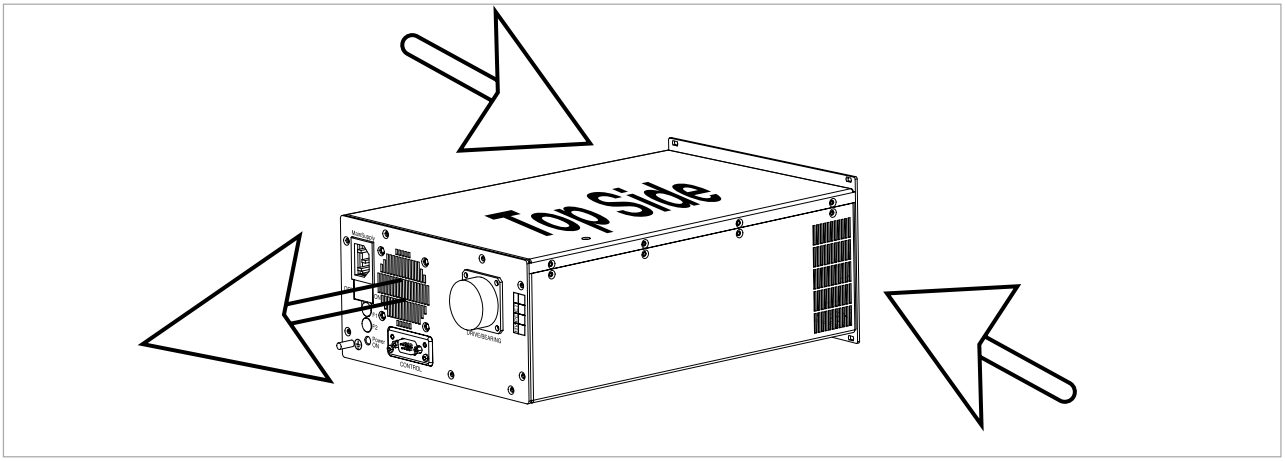


Fig. 3.19 Air flow pattern for MAG.DRIVE S

Place the MAG.DRIVE S on a flat, smooth surface.

For installation in a rack use the mounting frame 19“, 3 HU.
For this unscrew the bolts from the rubber feet and detach the feet.

Do not operate the MAG.DRIVE S upside down or turned. Leave at least 5 cm space in front of one of the cooling air inlets, see Fig. 3.18.

The heat dissipation of the MAG.DRIVE S must not be obstructed. Insure a sufficient ventilation - the ambient temperature during operation must not exceed 45 °C (113 °F).

If the MAG.DRIVE S is built into a rack the mains plug is not within easy reach. Therefore install a separation between the MAG.DRIVE S and the mains when you build it into a rack.

Insert and fasten the DRIVE/BEARING cable. On the converter side the fastener must click.

Connect the frequency converter using the ground bolt to the protective ground system.

WARNING

Connect the frequency converter to the mains..

3.10 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

Front LEDs

Red LED ERR

off:	No error, no warning
flashes:	Warning is present, pump can be operated, possibly with some restrictions
on:	Fault is present, pump stopped or can not be operated

Yellow LED PWR

off:	No supply voltage
flashes:	Supply voltage too low or too high, 9 Hz <n <100Hz (venting possible)
on:	Supply voltage is present

Green LED STS

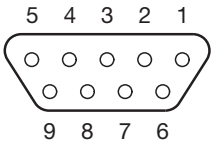
off:	Pump at standstill (< 9 Hz)
flashes slowly 1/s:	Start command is present
(flashes fast 3/s:	Running down, brake operation: option)
flashes shortly (0.3 s):	Start delay active
on:	Normal operation

Yellow LED PWR and green LED STS

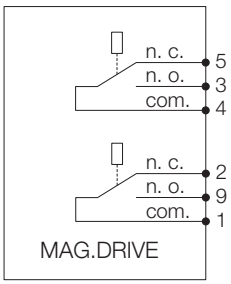
(flash fast alternately	Running down, brake operation at n < 100 Hz i.e. venting is possible: option)

PLC interface

Pin assignment of the connector



Relay functions



Relay - Normal operation (standard setting)

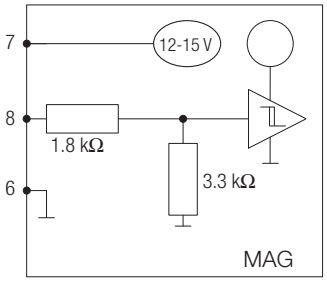
- While deceleration, acceleration, Stop: 4 connected to 5 (as shown; passive)
- During normal operation ($f > 0{,}9 \cdot f_{nom.}$): 4 connected to 3 (active)

Relay - Error

- No error: 1 connected to 2 (as shown; passive)
- Error is present: 1 connected to 9 (active)

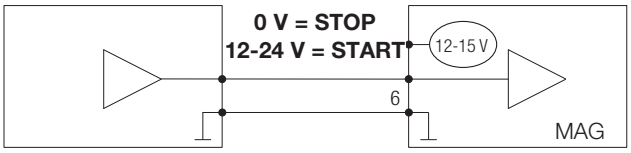
Only for SELV or PELV power circuits up to 32 V, maximum current 0.5 A

Pin assignment for the Start/Stop input



Switching threshold for the Start/Stop control input:
Low level: < 8 V
High level: > 10.5 V

Start/Stop operation
Example 1: Operation via a PLC



Example 2: Operation via contacts

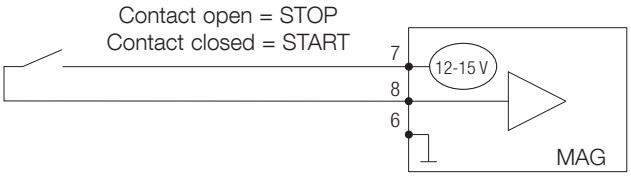


Fig.3.20 Pin assignment of the CONTROL connector

4 Operation

4.1 Media compatibility / purge gas

The MAG are suitable for pumping air and clean gases.

If reactive gases in low concentrations must be pumped operate the pump with purge gas.

The MAG ... P/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.

Fig. 4.1 Interface modules

4.2 Interfaces

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

- RS 232
- RS 485
- Profibus
- DeviceNet (in preparation)
- Ethernet (in preparation)

The interface modules replace or supplement the standard PLC interface of the MAG.DRIVE.

The Operating Instructions for the individual interface are supplied with the the interface module.

Installation

Generally the modules work in both slots. The supplied PLC interface works only in the CONTROL slot.

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

Normally it makes sense to install the interface in the CONTROL slot.

For Profibus, RS 485 and DeviceNet, an RS 232 module is possibly needed to set up the address for the Fieldbus module. You may use the RS 232 module in the service slot.

NOTICE

Before making any connections switch the pump off and wait until it turns no longer. Then deenergise the frequency converter.

Before inserting the module, ensure that the affixing screws have been fully loosened.

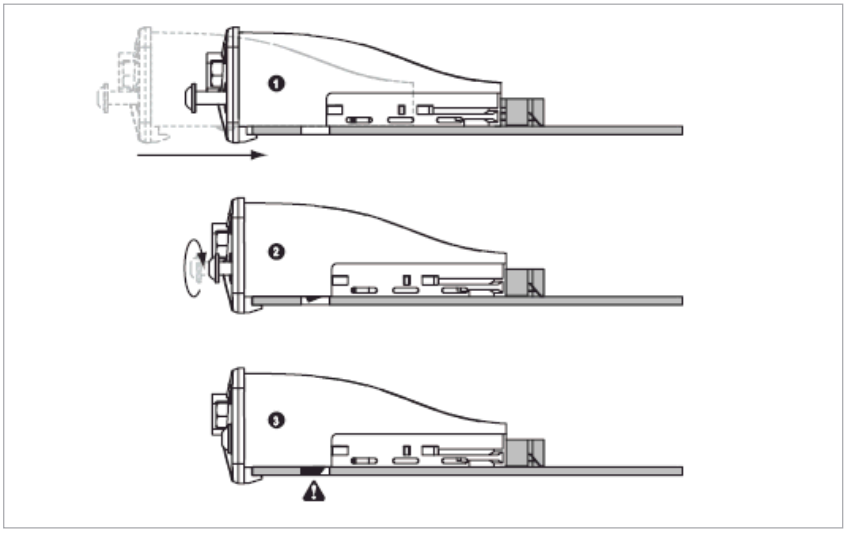


Fig. 4.2 Installation of an interface module

Fig. 4.3 Inserting the module

1 When inserting the module into the slot, press it with its plain side onto the frequency converter board.

2 Tighten the affixing screws until they make contact with the panel.

3 The affixing screws lock the module in place in the slot.

4.2.1 Specific parameter data for the pumps

Type of pump **P23**	Pump-designation	Nominal and setpoint frequency Hz **P18 / P24**	Minimum setpoint frequency Hz **P19**	Minimum frequency level Hz **P20**	Max. motor current A **P17**	Max. bearing temp. °C **P131**	Max. motor temp. °C **P133**	temp. warning threshold °C **P126**	temp. warning threshold °C **P16**
230	MAG W 300/400	980	230	200	4,5	90	115	85	110
230	MAG W 600/700	800	230	200	6,0	90	115	85	110

4.3 Switching on

Switch on the backing pump.

Only for integrated frequency converter:
Switch on the 48 V DC power supply.

Only for MAG.DRIVE S:
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 (only for MAG.DRIVE S)
- via a remote control at the pins 7 and 8 of the socket CONTROL
- with the aid of the plug with integrated ON/OFF switch: see Section 1.5 Accessories.

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.

NOTICE

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

Protecting the touch-down bearings

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 disconnect the MAG and the frequency converter while they are operating.
- 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 accidently re-connect it.

4.4.1 Bakeout

For MAGs with CF flange

If pressures in the range of 10^{-8} mbar or below are to be developed, the vacuum chamber and the components installed therein will have to be baked out. In addition, the MAG can be baked out using the flange heater provided for this purpose. The pump must have a forced cooling in this case.

At the high vacuum flange the pump may be heated to a maximum temperature of 120° C for two days maximum.

Protect the rotor against intensive, direct heat radiation. When baking out at the forevacuum side – at a sorption trap, for example – ensure that the components attached direct are not heated to more than 80 °C (176 °F).

The forevacuum pump must be in operation so as to eliminate the vapors liberated at the sorption trap.

4.5 Switching off

Switch off the pump

- by pressing the STOP button (only for MAG.DRIVE S)
- via a remote control at the pins 7 and 8 of the socket CONTROL
- with the aid of the plug with integrated ON/OFF switch: see Section 1.5 Accessories).

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 rotor may be stopped faster by venting the pump. The pump must only be handled with the rotor not rotating.

Generator operation

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 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.

Switch off the forevacuum pump.

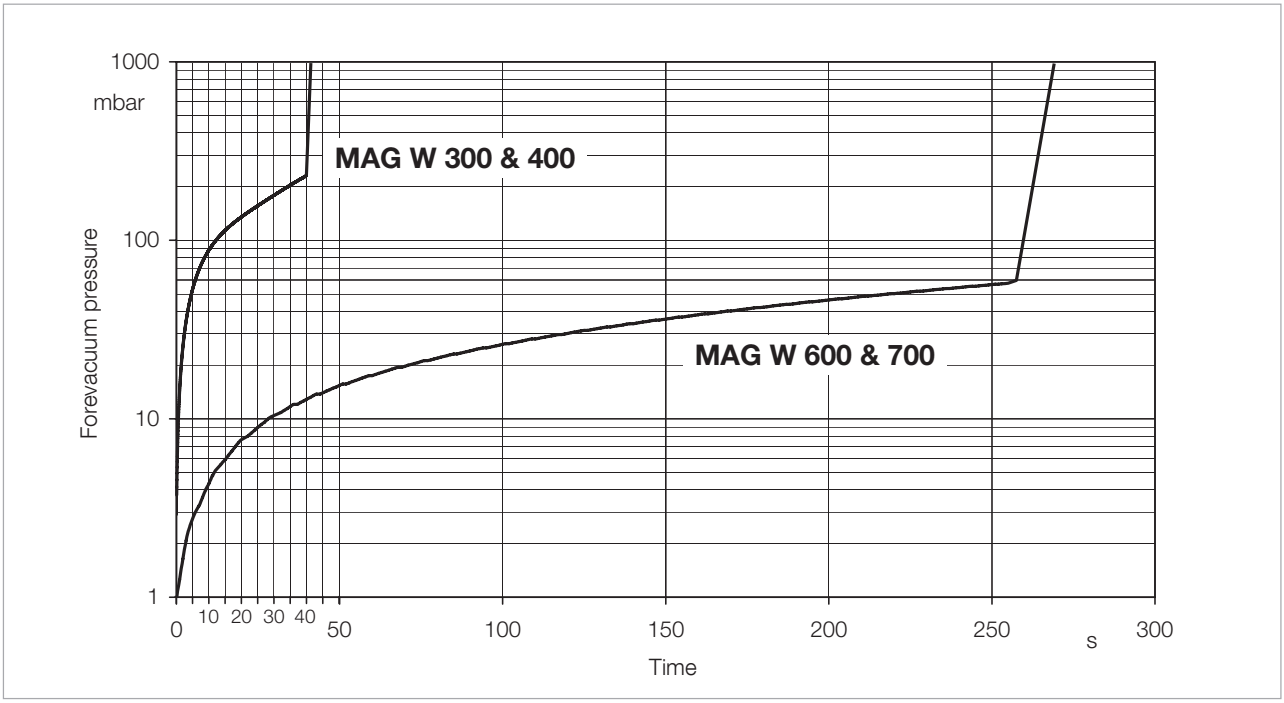


Fig. 4.4 Pressure rise curve for safe venting

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. 4.4.

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.

Venting Methods

There are three different methods of venting the turbomolecular pump.

Purge gas and venting valve

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.

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 so as 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.

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. 4.4.

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 0.4.6.

DANGER

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
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 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 Oerlikon Leybold Vacuum.

Display

Fig. 4.5 MAG.DRIVE S with Display

4.8 Display

Optionally the MAG.DRIVE S is equipped with a display and 6 additional buttons for control. The current function of the two black function buttons is described in the display line above them. The four scroll buttons are used for scrolling through the menu.

The display can be set to four different languages: English, German, Chinese and Japanese. For English and German it has 6 lines, for Chinese and Japanese 4.

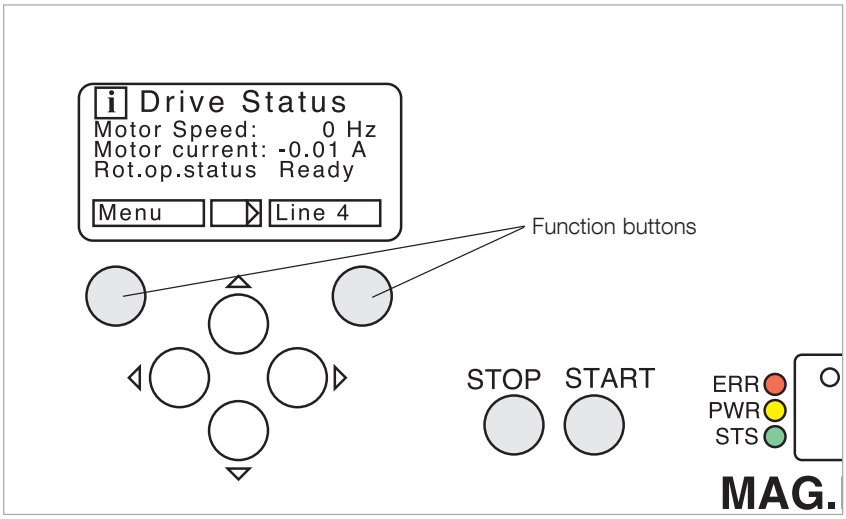


Fig. 4.6 MAG.DRIVE S with English display

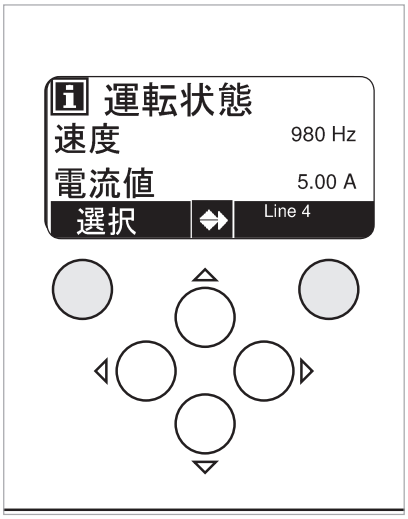


Fig. 4.7 MAG.DRIVE S with Japanese display

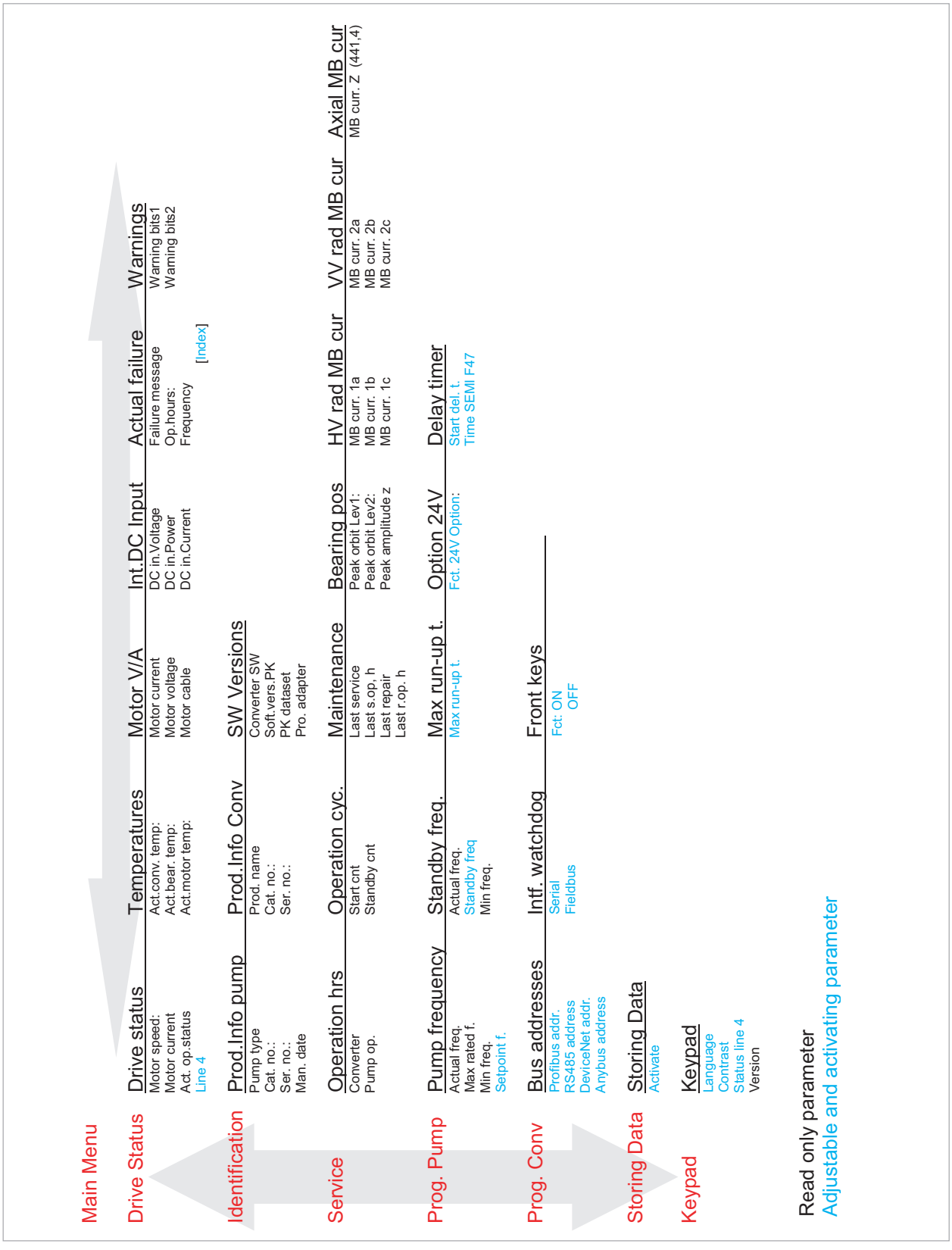


Fig. 4.8 English version of the menu structure

Display

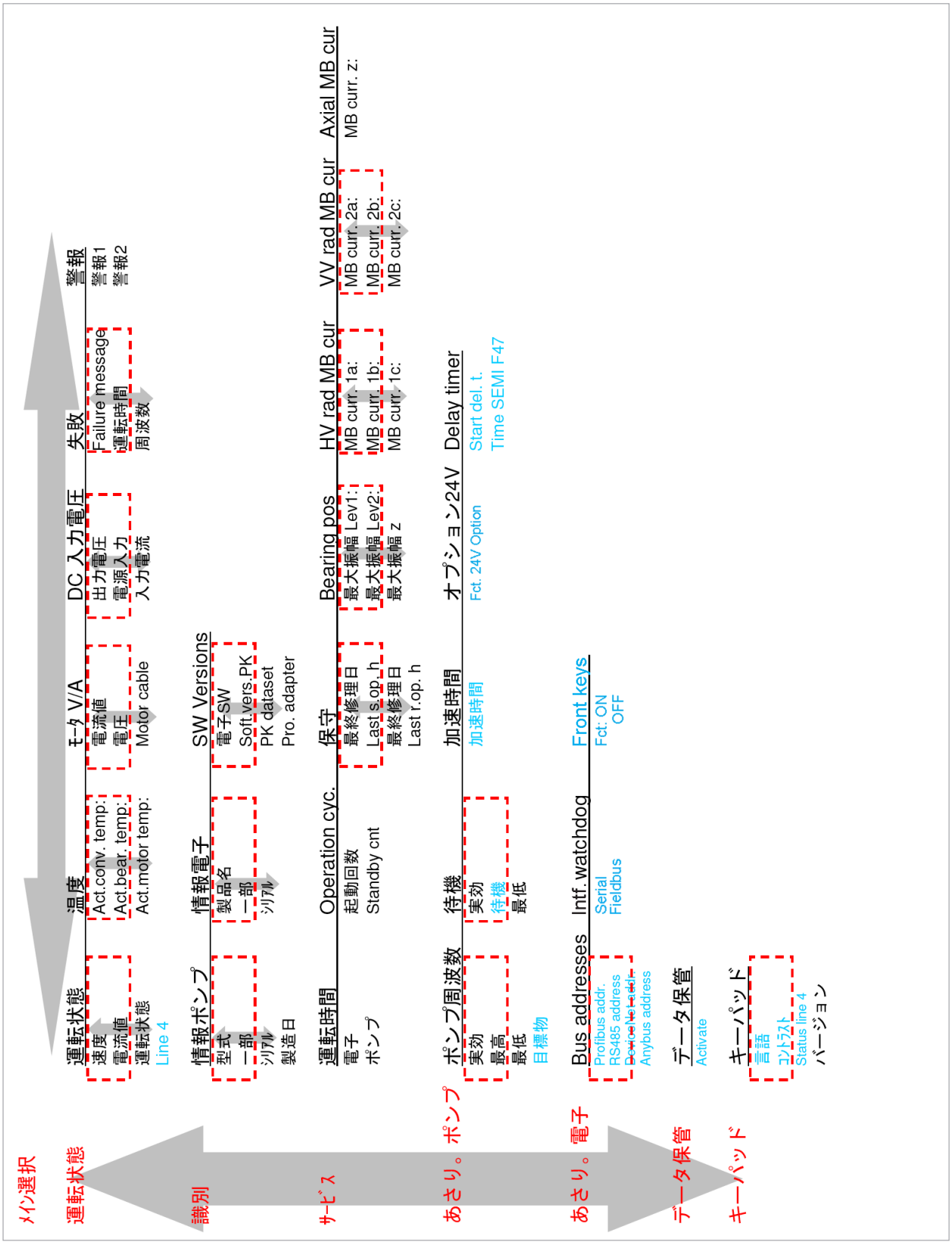


Fig. 4.9 Japanese version of the menu structure

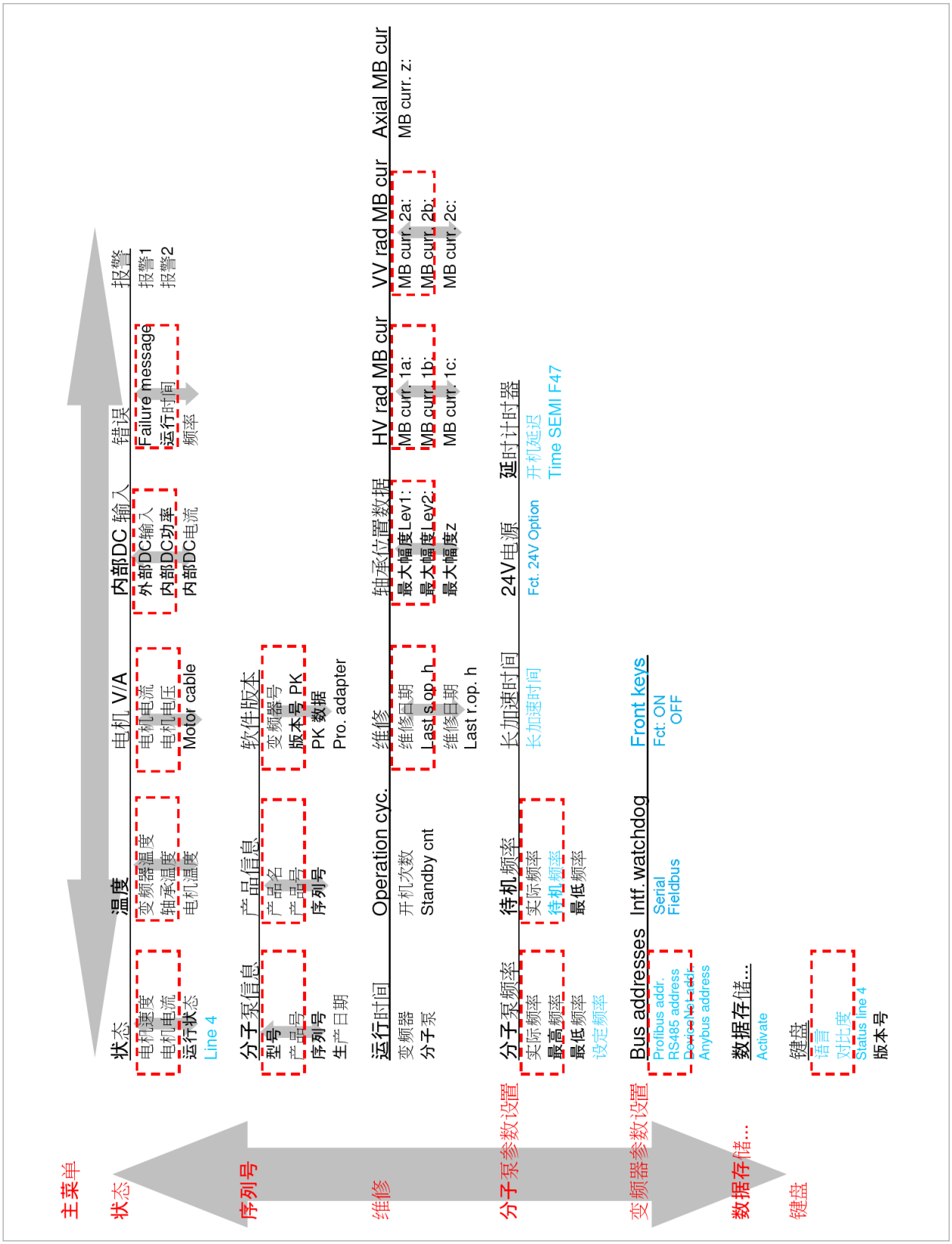


Fig. 4.10 Chinese version of the menu structure

Display

When you have chosen the Asian languages the displayed characters will be shown in a bigger size, so that only four lines can be arranged on one screen.

The missing data lines can be made visible by scrolling up or down. That is also the reason why partly English text has been used instead of Asian.

In the status screen, the header, 3 display lines and the possible functions of the function keys are set by the program. The **4th display line** can be chosen.

„ – „ = blank line, no data shown at line 4 of status window

Pump frequency	= Actual pump frequency [Hz]
Sys. time on	= Actual power ON system time [minutes]
Converter op.	= Actual converter operation time [h]
Converter SW	= Actual converter software version
Int. Overload	= Overload time [sec]
Int. High load	= High load condition time [sec]
Motor Current	= Actual motor current [A]
DC in.Voltage	= Internal DC intermediate circuit voltage [V]
Act. motor temp:	= Actual motor temperature [°C]
Inp. Voltage	= Internal DC intermediate circuit voltage [V] (and additional diode voltage
Analog values	= Not used
Input/Output	= Not used
Act. conv. temp:	= Actual internal converter temperature [°C]
Temp heatsink	= Actual internal converter temp. at heat sink [°C]
Act. bear. temp:	= Actual bearing temperature [°C]
Ist-Posit.[0]	= Magnet bearing position [µm]
Ist-Posit.[1]	= Magnet bearing position [µm]
Ist-Posit.[2]	= Magnet bearing position [µm]
Ist-Posit.[3]	= Magnet bearing position [µm]
Ist-Posit.[4]	= Magnet bearing position [µm]
Ist-Ströme[0]	= Magnet bearing current [A]
Ist-Ströme[1]	= Magnet bearing current [A]
Ist-Ströme[2]	= Magnet bearing current [A]
Ist-Ströme[3]	= Magnet bearing current [A]
Ist-Ströme[4]	= Magnet bearing current [A]
Start cnt	= Number of start/stop cycles
Pump op.	= Actual pump operation time [h]
Standby cnt	= Number of standby/normal cycles
Pump type	= Pump type

To return to the default settings (English language) of the display you need to press at the same time the ▲ and the ▼ keys while switching power mains ON.

This is only practicable during standstill of the pump.

Switching on

After Power ON of the converter the display shows during initialising:

```
Oerlikon
Leybold Vacuum
Initialisation:
Please wait!
```

When initialising has finished, the display switches to the pump status screen:

```
i Drive Status
Motor speed:     0 Hz
Motor current    0.00 A
Act.op.status    Ready

Menu ◀  ▶  Line 4
```

Main menu

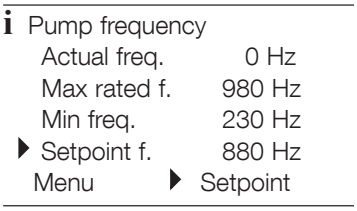
By pressing the left button “Menu” it switches to the main menu: By use of the Up/Down keys you can choose the main menu item, see also menu structure table

```
i Main menu
▶ Drive status
  Identification
  Service
  Prog. pump
    ▲▼  Enter
```

```
i Main menu
  Prog. pump
  Prog. conv.
  Storing data
▶ Keypad
    ▲▼  Enter
```

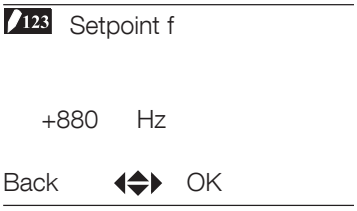
Pump speed adjustment

From main menu “Prog. pump”, “Pump frequency” is accessed. Here you can review the actual pump frequency, the max. setpoint, the min. setpoint and the setpoint which was set up.



To change this value press the right button “Setpoint”.

This invokes the edit mode for the frequency setpoint adjustment.



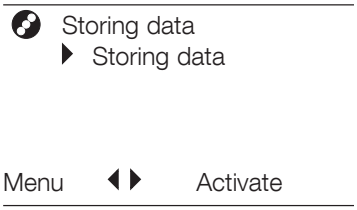
By using the left/right button you will change the edit position.
By using the up/down button you can adjust the value of the position.

If you have adjusted the new value it will be activated by pressing OK button. In case of invalid setting it will be corrected to the nearest valid value.

The new setpoint is then applied to the pump but **not** finally saved to the pump’s EEPROM.

Finally storing the new setpoint in the pump’s EEPROM can be done by choosing the “storing data” item from the main menu.

The storing option will also automatically be opened when changing to the “Drive Status” menu after changing some settings.

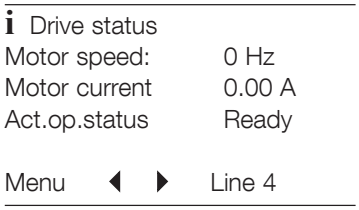


Pressing the “Activate” button will store all data to the pump EEPROM.

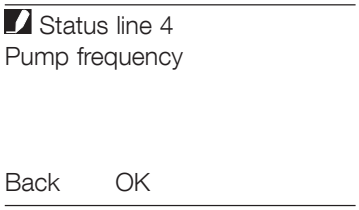
Important: Do not interrupt this procedure (power OFF) as long as the LED lights are flashing.

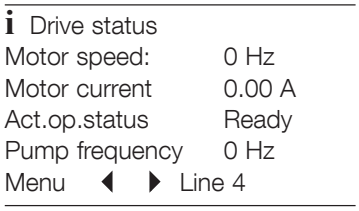
Line 4 setting

Within the “Drive status” window it is possible to define the 4th line of data information by the customer.



By pressing the “Line 4” button you will see a list of usable data structures (e.g. temperatures, operation time, magnet bearing information …). One of the listed items can be chosen (press OK key when the correct data item is shown) to be displayed in the 4th line of the “Drive status” screen.





This function is limited, when using an Asian language setting because bigger character size only allows two lines of data at a time to be displayed.

Other settings

- Failure history

  In the “Actual failure” screen it is possible through the up/down keys to switch to earlier error messages. Index [0] is the latest error message, [40] is the oldest (first failure). This function is not supported for the Asian language setting!

- Standby frequency

  Changing the setting of the standby speed is done in the same way as for the nominal speed setting. The standby setpoint needs to be adjusted between min. speed and max. nominal speed. Standby speed must be activated through a serial or Fieldbus interface.

- Max run up time

  Changing the setting of max. run up time is done in the same way as for nominal speed setting. This parameter is used to setup the max. allowed run up time (in sec.) for the pump until the converter reacts with a failure message if 95% of nominal speed was not reached within that time.

- Fct. 24V option

  The 24V output at the pump side (5-way M12 connector) can be used for supplying a fan as well as to control a valve. Therefore the output voltage can be switched ON/OFF.

Fct.	Option	
0	OFF	Output disabled (no voltage)
1	Failure	24 V is enabled when a failure is present
2	No failure	24 V is disabled when a failure is present
3	Warning	24 V is enabled when a warning is present
4	No warning	24 V is disabled when a warning is present
5	Normal	24 V is enabled when normal operation has been attained
6	Not normal	24 V is disabled when normal operation has been attained
7	Rotation	24 V is enabled when the pump is turning
8	No rotation	24 V is disabled when the pump is turning
9	Ref.speed	24 V is enabled when the nominal speed has been reached
10	Warn.low V	24 V is enabled when a low voltage is measured
11	Warn.high V	24 V is enabled when an Overvoltage is measured
12	Warn.mot temp	24 V is enabled when the warning temperature of the pump motor has been reached
13	Warn.cooler temp	24 V is enabled when the warning temperature of the heat sink of the frequency converter has been reached
14	Warn.conv.temp	24 V is enabled when the warning temperature of the frequency converter has been reached
15	Warn.MAGtemp	24 V is enabled when the warning temperature of the magnetic suspension has been reached
16	Warn.rotation.speed	24 V is enabled when the speed gets too high
17	Warn.overload	24 V is enabled when an overload warning is present
18	Interf.contr .	24 V is enabled when control through the interface is active
19	ON	24 V is constantly active when the mains power has been switched on
20	Data valid	24 V is enabled when logging data is true
21	Vent valve	24 V for driving a venting valve
199	Brake	48 V voltage enables the deceleration effect when the brake resistor has been connected

- Start delay timer

  The setting of the start delay timer is done in the same way as for the nominal speed setting. This setting is used specify a delay time between 0 s and 3600 s before a given Start command (press START button) accelerates the pump.

- SEMI F47

  The setting of the SEMI delay timer is done in the same way as for the nominal speed setting. This setting is used specify a delay time to create an error message in case of mains power OFF.

  It is adjustable between 0 and 9999 sec.

- Bus Addresses

  For any installed network or Fieldbus system it is possible to adjust the node address within a specific range.

- Intf. Watchdog

  The Interface watchdog can be activated to stop the pump with failure message in case no communication takes place within the adjusted time frame 0 = OFF to 3000sec.

- Front switches on/off

  The front switches START and STOP may be enabled or disabled so as to prevent any inadvertent operation of these switches during operation via the interface.

4.8.1 Error messages

The error text is always in English language even if Asian language has been chosen.

See also the troubleshooting list in Section 6.

Error No.	English error text	Possible cause	Corrective action
	__E0000_General error:		
	__E6c09_Data transm. to PK	Cable or connector damaged	
	__Ea314_Touchdown gen.mode		
	__Ea414_Touchdown		
2	Overtemperature motor	Pump load too high, cooling system breakdown, temp. sensor damaged, cable or connection damaged	Check forevacuum pressure, check leakage, check process conditions, check fan, check water cooling.
3	Supply voltage fail	Mains voltage breakdown	Check supply input voltage.
4	Overtemp. converter	Wrong mounting position of converter, internal fan of converter damaged	Check max. ambient temperature, optimize cabinet cooling.
5	Overspeed warning		Contact OLV service, check pump type and speed setting, change converter.
6	Overload error	Pump load too high, cooling system breakdown, temp. sensor damaged	Check forevacuum pressure, check leakage, check process conditions, remove foreign material from pump rotor, check converter, check pump, contact OLV service.
7	Time limit fmin-> Norm	Pump load too high, leakage failure	Check forevacuum pressure, check leakage, check process conditions, remove foreign material from pump rotor, check converter, check pump, contact OLV service.
8	Pump fail	Pump identification failure, cable or connection damaged	Check cable connection between pump and converter, contact OLV service, change converter, change pump.
9	Overtemp. MB	Pump load too high	Check forevacuum pressure, check leakage, check process conditions, check fan, check water cooling.
12	Orbit monitoring XY1	Mechanical or pressure burst too high	Check external vibration level, contact OLV service, change pump.
13	Orbit monitoring XY2		
14	Orbit monitoring axi.		
16	Overload long time f	Pump load too high	Check forevacuum pressure, check leakage, check process conditions
17	Motor current fail	Cable or connector damaged	Check cable and connector, change converter, contact OLV service.
18	Connection failure	Cable or connector damaged	Check cable and connector, change converter, contact OLV service.
19	Time limit. Start->fmin	Pump load too high, leakage failure	Check forevacuum pressure, check leakage, check process conditions, remove foreign material from pump rotor, check converter, check pump, contact OLV service.

Error No.	English error text	Possible cause	Corrective action
26	Connect. temp. MB	Cable or connector damaged	Check cable, check converter, check pump, contact OLV service.
28	Connect. temp. Motor	Cable or connector damaged	Check cable, check converter, check pump, contact OLV service.
31	High load long time f	Pump load too high, leakage failure	Check forevacuum pressure, check leakage, check process conditions
39	General MB fail	Magnet bearing defekt, selftest error	Remove foreign material, change converter, change pump if necessary.
63	Parameter failure	Converter failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary.
65	Intern. com fail	Converter failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary.
66	Current MB too high	Horizontal mounting position of MAG 600/700 incorrect, magnet bearing overload	Check converter and cable, check mounting position of pump, check external vibration level, send pump to OLV service.
67	Overcur. through Para.	Wrong parameter setting	
67	Overcur. power stage	Cable or connector damaged	
71	First init. fail	Converter failure, pump failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary.
73	Number starts >>	Very high number of pump starts	Pump service needed
74	Operation h. pump >>	Very high number of rotor operation hours	Pump service needed
75 76	Init. pump data Checksum PK-adj.	Communication to pump or PK failed The saving process was interrupted by removing the supply voltage.	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary. Renewed saving through “save data” in the display menu or saving through the RS 232 interface (see also Operating Instructions 17200308).
77 78	Numb. MB touchdowns. Bear. touch down time	Horizontal mounting position of MAG 600/700 incorrect, magnet bearing overload	Check converter and cable, check mounting position of pump, check external vibration level, send pump to OLV service.
79	Periphery assembly	Converter failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary.
80	Equipm. module slot	Wrong Anybus module configuration, X1 –Module in Service Slot, two active Fieldbus modules installed.	Check installation of Fieldbus module
81	Watchdog USS-Bus	Cable connection to communication module lost, master communication was interrupted, interface defective.	Check cable connection, check master functionality, change converter, contact OLV service.

Display

Error No.	English error text	Possible cause	Corrective action
82	Watchdog Fieldbus	Cable connection to communication module lost, master communication was interrupted, interface defective.	Check cable connection, check master functionality, change converter, contact service.
90	Speed adj. not OK	Wrong parameter setting	Correct parameter setting
91	Wrong cable length	Cable defective or wrong cable length connected. Failure during initialisation.	Power OFF / ON converter, change cable, change converter.
92	MAG S cable length	Cable defective or wrong cable length connected. Failure during initialisation.	Power OFF / ON converter, change cable, change converter.
201	Electronics failure	Hardware failure in converter	
203	Fail during selftest	Hardware failure in converter	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary.
204	Scope functionality	Hardware failure in converter	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary.
206	Data failure in PK	Converter failure, pump failure, cable failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter or pump if necessary.
209	Invalid par. adj.	Converter failure, pump failure, cable failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter or pump if necessary.
227	Invalid pump	Converter failure, pump failure, cable failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter or pump if necessary, update software if separated converter is used.
299	General pump fail	Converter failure, pump failure, cable failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter or pump if necessary.
941	Incompatibl. compiler	Failure during software update	Repeat software update if necessary, contact OLV service
942	Channel 4	Horizontal mounting position of MAG 600/700 incorrect, magnet bearing overload	Check mounting position of MAG 600/700, check external vibration level, change pump if necessary
943	Channel 3		
944	Channel 2		
945	Channel 1		
946	Channel 0		
947	Intern. setp.value lim.	Converter failure, pump failure, cable failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
948	Ixt-shut down < 5Hz	Rotor blocked, converter failure, pump failure, cable failure	Switch OFF pump, wait until pump rotor has stopped, check pump rotor blocked, power OFF / ON converter, change converter or pump if necessary
949	Checksum converter-E.	Converter failure, pump failure, cable failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary

Error No.	English error text	Possible cause	Corrective action
950	Checksum AutoSave-P.	Converter failure, pump failure, cable failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
951	String write failure		
952	EEPROM read failure		
953	EEPROM write failure		
954	EEPROM access failure		
955	Watchdog LustBus	Converter failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
956	No opcode		
957	Invalid opcode		
958	Read out parameter		
959	Writing of para.		
960	Profil adapter fail		
961	Guarding sync/pdo obj.		
962	Ensure com. objec.		
963	Invalid CAN address		
964	Heartbeat error		
965	Target pos. storage		
966	Init. com. parameter	Converter hardware failure, external interference	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
967	Pdo. object not OK	Converter failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
968	Initialization fail	Converter hardware failure, external interference	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
969	Node error	Converter failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
970	Guarding - Failure		
971	Transmit not send		
972	BUSOFF identified		
973	Failure CAN-BUS		
974	CAN open Initi. fail		
975	CAN open node err.		
976	CAN open guarding		
977	CAN open transmit prot.		

Display

Error No.	English error text	Possible cause	Corrective action
978	Failure external unit	Converter hardware failure, external interference, cable failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
979	Floating point calc.	Converter failure	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
980	Storage module para. <		
981	UZK-Calibration	Converter hardware failure, external interference	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
982	Init. mains power fail		
983	Init. speed controller		
984	Init. speed calcul.		
985	Init. current control		
986	Controller init.		
987	Status machine reg.		
988	Init. motor safety module		
989	Fail number format		
990	Intern. para. access		
991	Init. of parameters		
992	User stack overflow		
993	Par. controller ini.		
994	Insp. assistance p.		
995	Exception failure		
996	Param. access layer		
997	Activ. assist. para.		
998	Runtime error		

4.8.2 Warning messages

Example:

0010H Mains failure too low, generator mode active.

0184H At the same time warning for: Run time error; bearing temp. too high; motor coil overheat.

Bits 1	Warning message	Corrective action
0001H	Converter power stage temp. too high	Check internal fan of converter, check max. ambient temperature, optimize cabinet cooling.
0002H	Controller overheat	Check internal fan of converter, check max. ambient temperature, optimize cabinet cooling.
0004H	Motor coil overheat	Check forevacuum pressure, check leakage, check process conditions, check fan, check water cooling.
0008H	Mains failure too high	Check supply input voltage.
0010H	Mains failure too low	Check supply input voltage.
0020H	Overspeed	Contact OLV Service, check pump type and speed setting, change converter.
0040H	System overload	Check forevacuum pressure, check leakage, check process conditions, remove foreign material from pump rotor, check converter, check pump, contact OLV Service.
0080H	Bearing overheat	Check forevacuum pressure, check leakage, check process conditions, check fan, check water cooling.
0100H	Run time error	Switch OFF pump, wait until pump rotor has stopped, power OFF / ON converter, change converter if necessary
0200H	High load	Check forevacuum pressure, check leakage, check process conditions
0400H	Scheduled maintenance due	Contact Oerlikon Leybold Vacuum Service
0800H	Scheduled maintenance due	Contact Oerlikon Leybold Vacuum Service
1000H	Magnet bearing system deactivated	
2000H	Bus watchdog	Check cable connection, check master functionality, change converter, contact service.
4000H	Bearing system overloaded (5)	Check mounting position of MAG 600/700, check external vibration level, change pump if necessary
8000H	Bearing system overloaded (6)	Check mounting position of MAG 600/700, check external vibration level, change pump if necessary.

Display

Bits2	Warning message	Corrective action
0001H	Bearing system overloaded (0)	Check mounting position of MAG 600/700, check external vibration level, change pump if necessary
0002H	Bearing system overloaded (1)	
0004H	Bearing system overloaded (2)	
0008H	Bearing system overloaded (3)	
0010H	Bearing system overloaded (4)	
0020H	Unbalance in X-axis	
0040H	Unbalance in Y-axis	
0080H	Unbalance in Z-axis	
0100H	Bearing clearance X1	
0200H	Bearing clearance X2	
0400H	Bearing clearance X3	
0800H	Bearing clearance X4	
1000H	Bearing clearance X5	
2000H	Aux. bearing contact numbers	Check converter and cable, check mounting position of pump, check external vibration level, send pump to service.
4000H	Aux. bearing contact time	
8000H	Bearing contact generator	

5 Maintenance

Rotor exchange

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

Such maintenance work can only be done by the Oerlikon Leybold Vacuum Service. If required contact the Oerlikon Leybold Vacuum service center nearest to your location. You can find the address on our internet page www.oerlikon.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 Oerlikon Leybold Vacuum for recommendations.

WARNING

Observe Safety information 0.1.7.

Purge gas filter

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).

Adsorption trap

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.

Cleaning the frequency converter internally

The converter essentially requires no servicing since it contains no components which could be adjusted.

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. The Oerlikon Leybold Vacuum Service Department can clean the converter. We recommend adhering to a cleaning interval of about five years.

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 Oerlikon Leybold Vacuum service can change the touch-down bearings.

5.3 Oerlikon Leybold Vacuum Service

Contamination

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.

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.oerlikon.com/leyboldvacuum → 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

Are the connections in good working order?

- Mains connection,
- 48 V DC cable to the frequency converter,
- Connector cable between the frequency converter and the pump (optional)

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.

If your frequency converter has a display see also the error messages list in Section 4.8.1.

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
	Power supply overloaded	Reduce the number of consumers or use a stronger power supply or switch on the consumers one after the other.	Operator/ maintenance staff
	Bearing defective.	Repair the pump.	OLV service
	Ambient temperature too high.	Install additional water cooling or reduce throughput.	Maintenance staff
	Frequency converter faulty	Replace frequency converter.	Maintenance staff/ OLV 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
	DC power miswired.	Ensure correct polarity of the DC cable.	Maintenance staff
	Frequency converter defective.	Replace frequency converter.	Maintenance staff/ OLV service

Troubleshooting

Malfunction	Possible cause	Corrective action	Responsible
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
Turbomolecular pump does not start, ERROR LED does not light.	CONTROL connector connected wrongly.	Connect as shown in Fig. 3.20.	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.	OLV service
	Bearing defective.	Replace the bearing.	OLV 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.	OLV 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.	OLV service

7 Waste Disposal

Contamination

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

WARNING

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

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

When sending us any equipment, observe the regulations given in Section “5.3 Oerlikon Leybold Vacuum service”.

Certificates

oerlikon leybold vacuum

NRTL & SEMI

The system **MAG W 300 to 700 iP**

- Turbomolecular pump
- Frequency converter

has been tested by the TÜV Rheinland of North America to the following requirements:

- UL 61010-1: 2012
- CAN/CSA-C22.2 No. 61010-1-12
- **SEMI S2**-0706

The components are in compliance to the tested standards.

Certificate No. CU 72140055 01 (for the pump)

Certificate No. CU 72140588 01 (for the frequency converter)

SEMI Report No. 21132341_001

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

TÜVRheinland
C US

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.

oerlikon
leybold vacuum

EC Incorporation Declaration

The manufacturer: Oerlikon Leybold Vacuum GmbH
Bonner Straße 498
D-50968 Cologne
Germany
Tel.: +49(0)221 347-0
info.vacuum@oerlikon.com

herewith declares that the following product:

Product designation: **Turbo-Molecular pump**

Typenbezeichnung	**Katalognummer** x=0 bis 9
TURBOVAC MAG W300 / 400	410300V0xxx, 410400V0xxx
TURBOVAC MAG W600 / 700	410600V0xxx, 410700V0xxx

complies with the following fundamental requirements of the **EC Machinery Directive (2006/42/EG)**: 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

With respect to potential electrical hazards as stated in appendix I No. 1.5.1 of the machine guide lines 2006/42/EG all safety protection goals are met according to the low voltage guide lines 2006/95/EG.

The following harmonised standard has been applied:

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

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

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Cologne, dated 2014-03-14

ppa. H. Udelhoven

Harald Udelhoven
Head of Quality Management

300303471 002 A1

oerlikon
leybold vacuum

CE

EC Declaration of Conformity

The manufacturer: Oerlikon Leybold Vacuum GmbH
Bonner Straße 498
D-50968 Cologne
Germany
Tel.: +49(0)221 347-0
info.vacuum@oerlikon.com

herewith declares that the products specified and listed below which we have placed on the market, comply with the applicable EC Council Directives.

This declaration becomes invalid if modifications are made to the product without agreement of Oerlikon Leybold Vacuum GmbH.

Compliance with the EMC Directives requires that the components are installed within a system or machine in a manner adapted to EMC requirements.

Product designation: **Turbo-Molecular Pump**

Typenbezeichnung	**Katalognummer** x=0 bis 9
TURBOVAC MAG W300 / 400	410300V0xxx, 410400V0xxx
TURBOVAC MAG W600 / 700	410600V0xxx, 410700V0xxx

The product complies with the following European Council Directives:

- EC-Directive relating to electromagnetic compatibility (2004/108/EG),

The following harmonised standards have been applied:

EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use -: EMC requirements - Part1: General requirements	
	emission	EN 61326-1 2006 Class A
	immunity	EN 61326-1 2006 (industrial environment)

Cologne, dated 2014-03-11

ppa. M. Mattern-Klosson

Dr. Monika Mattern-Klosson
Head of Research & Development

Cologne, dated 2014-03-14

ppa. U. Udelhoven

Harald Udelhoven
Head of Quality Management

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Compliance with the EMC Directives requires that the components are installed within a system or machine in a manner adapted to EMC requirements.

Product designation: **Frequency Converter**

Typenbezeichnung	**Katalognummer** x=0 bis 9
MAG.DRIVE S	410300V02xx

The product complies with the following European Council Directives:

- EC Directive relating to Low Voltage Directive (2006/95/EG),
- EC-Directive relating to electromagnetic compatibility (2004/108/EG),

The following harmonised standards have been applied:

EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use -: EMC requirements - Part1: General requirements EMC emission EN 61326-1 2006 Class B EMC immunity EN 61326-1 2006 (industrial environment)

Cologne, dated 2014-03-11

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oerlikon
leybold vacuum

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: ☒ applicable please mark

Repair: ☐ chargeable ☐ warranty

Exchange: ☐ chargeable ☐ warranty

☐ Exchange already arranged / received

Return only: ☐ rent ☐ loan ☐ for credit

Calibration: ☐ DKD ☐ Factory-calibr.

☐ Quality test certificate DIN 55350-18-4.2.1

A. Description of the product:

Material description :

Catalog number:

Serial number:

Type of oil (ForeVacuum-Pumps) :

Failure description:

Additional parts:

Application-Tool:

Application- Process:

B. Condition of the equipment	No[1]	Yes	No
1. Has the equipment been used	☐	☐	
2. Drained (Product/service fluid)		☐	☐
3. All openings sealed airtight		☐	
4. Purged		☐	☐

If yes, which cleaning agent

and which method of cleaning

[1] If answered with "No", go to D.

Contamination :	No[1]	Yes
toxic	☐	☐
corrosive	☐	☐
flammable	☐	☐
explosive [2]	☐	☐
radioactive [2]	☐	☐
microbiological [2]	☐	☐
other harmful substances	☐	☐

C. Description of processed substances (Please fill in absolutely)

1. **What substances have come into contact with the equipment ?**
   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)

X	Tradename:	Chemical name:
a)		
b)		
c)		
d)		

	No	Yes
2. **Are these substances harmful ?**	☐	☐
3. **Dangerous decomposition products when heated ?**	☐	☐

If yes, which ?

[2] **Components contaminated by microbiological, explosive or radioactive products/substances will not be accepted without written evidence of decontamination.**

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

firm stamp

17200001_002_A1

Index

Sales and Service

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