Vacuum Solutions | Application Support | Service

LEYBOLD

LEYBOLD VACUUM

GA 05.125/4.02

MAG 400 C, CT
MAG 410 C, CT

Turbomolecular Pumps with Magnetic Bearing

Cat. No.

894 52/53/54/55

894 62/63/64/65

Operating Instructions

Contents

Warning

Indicates procedures that must be strictly observed to prevent hazards to persons.

Caution

Indicates procedures that must be strictly observed to prevent damage to, or destruction of the MAG.

Figures

The references to diagrams, e.g. (2/10) consist of the Fig. No. and the Item No. in that order.

Leybold-Service

If a pump is returned to Leybold, indicate whether the pump is free of substances damaging to health or whether it is contaminated. If it is contaminated also indicate the nature of hazard. Leybold must return any pump without a declaration of contamination to the sender's address.

We reserve the right to alter the design or any data given in these Operating Instructions.

The illustrations are not binding.

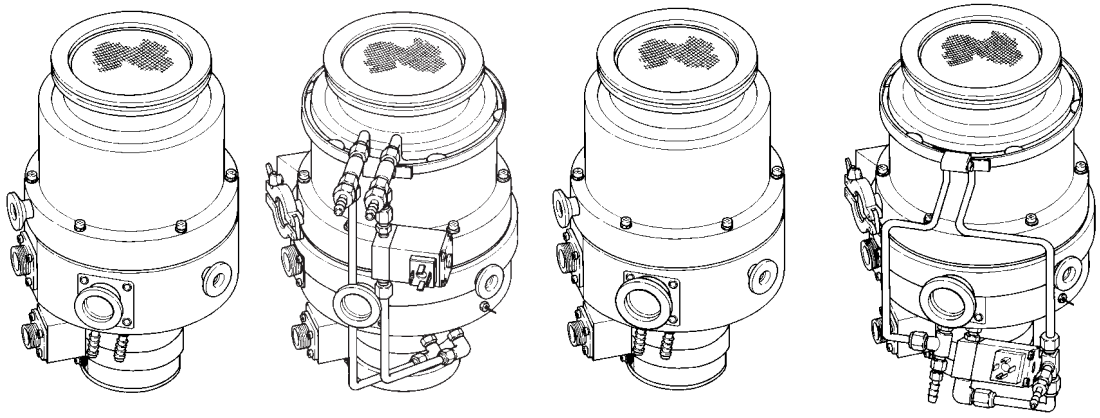


Fig. 1

MAG		**400 C**	**400 CT**	**410 C**	**410 CT**
Required frequency converter TURBOTRONIK		NT 340 MA		NT 341 MA	
Cooling / Temperature control	Temperature sensor	—	Pt 100 as accessory	—	Pt 100 as accessory
	Temperature control unit (TCU)		Accessories		Accessories
	Heating collar		fitted to		fitted to
	Water cooling	Water cooling for basic flange	Water cooling for basic flange (with magnet valve) and pump housing	Water cooling for basic flange	Water cooling for basic flange (with magnet valve) and pump housing

1 Description

The MAG 400 C, 400 CT, 410 C, and 410 CT are turbomolecular pumps utilizing magnetic bearings. They are designed to evacuate vacuum chambers down to pressure values in the high-vacuum range.

The pumps of the „MAG“ product line have the same fitting dimensions as the corresponding pumps TURBOVAC 340 MC, 340 MCT, 341 MCT.

The TURBOTRONIK frequency converter and a backing pump will be required for the operation of the MAG.

The MAG 400 C, 400 CT, 410 C, and 410 CT, referred to below simply as MAG, are the product of joint development activities by LEYBOLD and the Research Center at Jülich.

Compatibility with pumped media

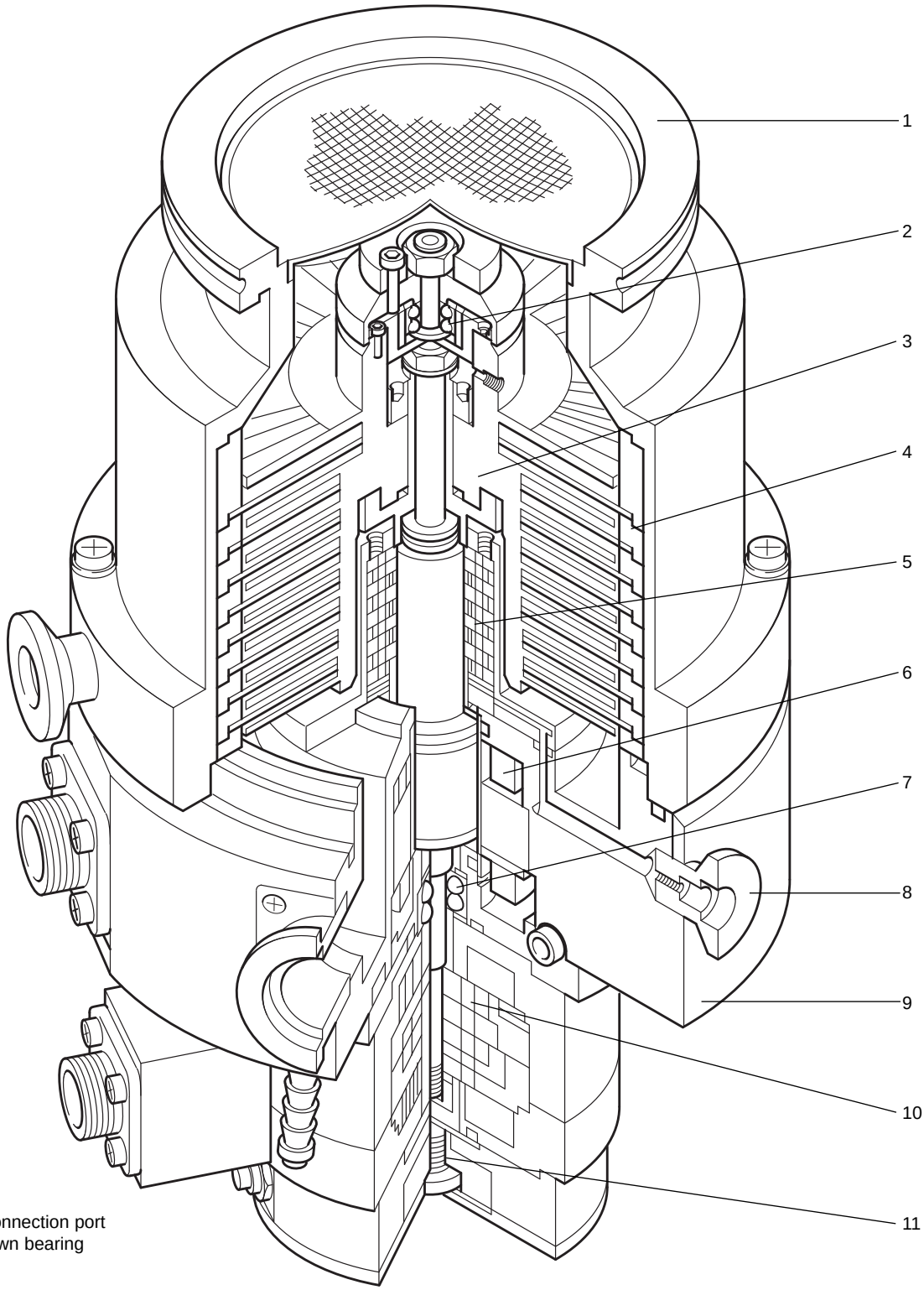
Turbomolecular pumps are **not** suitable for pumping either liquids or gases which contain dust particles.

Turbomolecular pumps without purge gas are suitable only for moving air or inert gases. They are **not** suitable for pumping corrosive or reactive gases.

The MAG are fitted with purge gas device. The gas protects only the bearing section and the MAG motor.

Some media (e.g. aluminium trichloride) can sublimate in the pump and form deposits. Thick coatings can interfere with the clearances required for operation and ultimately cause the pump to seize. Deposits can be prevented in some processes by heating the pump. The CT versions are prepared for this application.

During operation the pressure inside the MAG 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. Sparks could occur in case of damage to the pump and these could ignite explosive mixtures.



Key to Fig. 2

1 High vacuum connection port
2 Upper touch-down bearing
3 Rotor
4 Stator elements
5 Permanent-magnet bearing at center of gravity
6 DC motor
7 Bottom touch-down bearings
8 Purge gas connection
9 Basic flange
10 Stabilizer
11 Axial sensor

Fig. 2 Turbomolecular pump MAG 400 C; other types similar

Key to Fig. 3
1 Purge gas connecting flange
2 Throttle nozzle
3 Sintered metal filter
4 O-rings
5 Diaphragm filter
6 Hose nozzle
7 Venting bypass
8 Solenoid valve
9 Plug
10 Pin

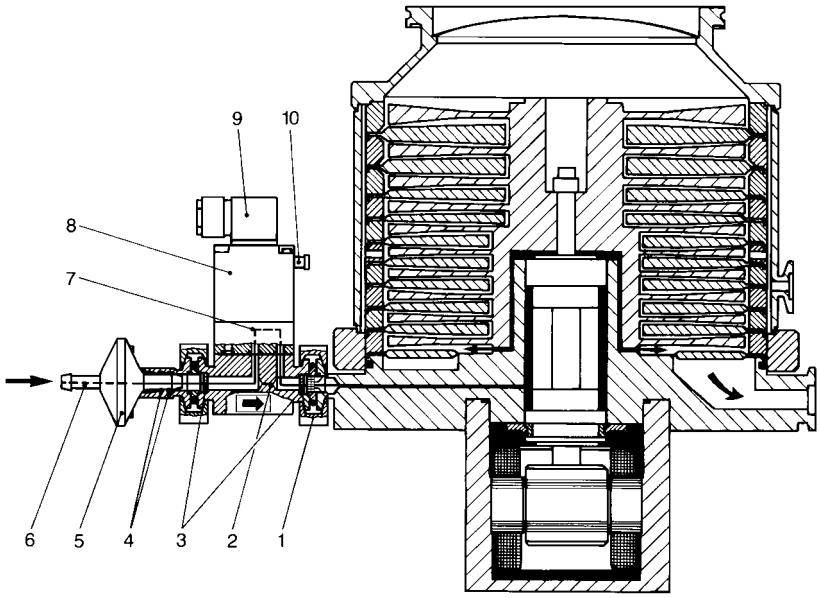


Fig. 3 Purge gas and venting valve fitted to a turbomolecular pump (schematic)

1.1 Design of the MAG

The MAG is similar in design to the turbomolecular pumps equipped with ball bearings; it comprises basically the pump housing, the multi-stage rotor with the stator package, the drive, and a magnetic bearing. The rotor is made from an aluminum alloy. The rotor and stator plates are protected with a special ceramic layer.

A suspension system without contact between moving parts was achieved by providing a permanently magnetic, passive bearing located near the center of gravity, this working in conjunction with a permanently magnetized stabilizer with coils effective in the axial direction. The coils are partially actively regulated by a non-contacting axial sensor with a downline electronic controller.

This bearing concept allows for low-vibration operations and insures operation of the MAG in any mounting position.

Two touch-down bearings are provided to stabilize the rotor mechanically if impacts occur during operation. These bearings use no lubricant. They also provide axial support of the pump rotor when the frequency converter is switched off.

A DC motor without commutator is used to power the rotor.

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

For pumps with temperature control a temperature sensor measures continuously the temperature at the basic flange. The temparature control unit switches the heating collar on or opens the magnet valve to allow cooling water to flow.

1.2 Purge gas

We recommend a purge gas and venting valve for purge gas operation, referred to below as purge gas valve. It is a throttle for supplying a dosed quantity of purge gas to turbomolecular pumps, and a venting valve for turbomolecular pumps.

It is **not** suitable for shutting off the purge gas connection of a MAG.

The purge gas flows through the filter and the throttle nozzle, into the purge gas connection (3/1) of the turbomolecular pump. The motor and bearing area of the pump is protected with purge gas.

Since the motor and bearing area is connected to the forevacuum area only by a narrow slit, a pressure higher can build up there than in the forevacuum area. This results in continuous gas flow from the motor area to the forevacuum area. The gas flow prevents aggressive, corrosive gases or dust entering the motor and bearing area.

1.3 Standard specification

The turbomolecular pumps are shipped complete, sealed in a PE bag containing a desiccant.

The maximum effective life of the desiccant is one year.

The electronic frequency converter as well as the connection lines required for operation must be **ordered separately**.

High-vacuum connection ISO-K

Splinter guard, centering ring with FPM sealing ring, outer ring.

Forevacuum connection port

Centering ring with FPM O-ring and clamping ring.

Both the purge gas port and the venting port are blanked off for shipping. High-vacuum and fore-vacuum connection are sealed with plastic caps for transport.

The standard specification includes a seal kit allowing to seal the pump tightly if it is removed from the process.

PE = Polyethylen
FPM = Fluor caoutchouc, resistant to temperatures of up to 150°C (300°F)

1.4 Technische Daten

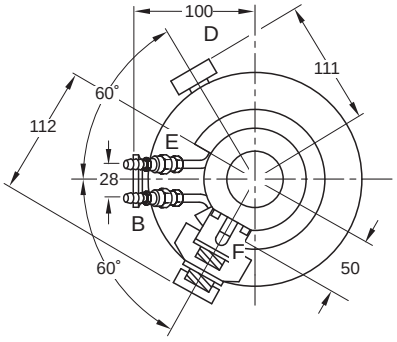
Highvacuum connection port	DN 100 ISO-K
Compression for	
N_2	$> 10^9$
He	$6.4 \cdot 10^4$
H_2	$2.5 \cdot 10^3$
Ultimate pressure according to DIN 28 400	$< 10^{-10}$ mbar
Max. forevacuum pressure at rated speed	0.8 mbar 0.6 Torr
Speed	43,860 /51,600 min^{-1}
Run-up time	3.5 min
Braking time with/wihout venting	1 / 6 min
Cooling	water
Cooling connection, hose nipple	7.5 mm
Cooling water temperature	15 to 25 °C
Cooling water throughput rate at 15°C/59 °F	20 $l \cdot h^{-1}$
Mounting position	any
Weight	approx. 16 kg
Forevacuum connection flange	
MAG 400	DN 25 KF
MAG 410	DN 40 KF
Purge gas connection flange	DN 10 KF
Venting connection flange	DN 10 KF
Recommended backing pump	TRIVAC D 25 B/BCS DRYVAC 50

Purge gas valve

Purge gas connection pressure, abs.	1,0 - 1,5 bar
Purge gas	dry nitrogen
Purge gas throughput	
at purge gas pressure 1.0 bar	see
at purge gas pressure 1.5 bar	Fig. 17
Purge gas connection, hose nipple	6 mm (1/4“)

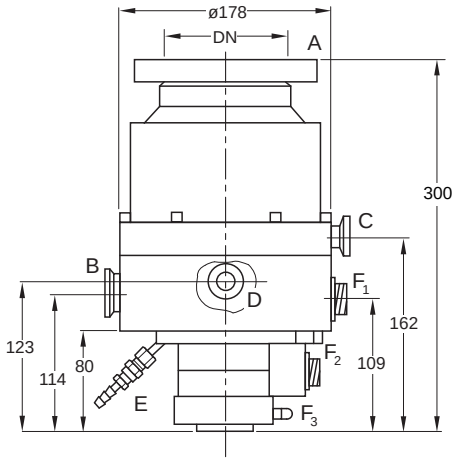
1.5 Ordering data

MAG	**400 C**	**400 CT**	**410 CT**	**410 CT**
with high vacuum flange DN 100 ISO-K	894 52 894 62	894 53 894 63	894 65	894 54 894 64
Frequency converter TURBOTRONIK	NT 340 MA 857 32 (120 V)		NT 341 MA 857 34 (208 V)	
Connection lines	Connection line motor 859 10 (3 m long) Connection line bearing 859 11 (3 m long)		Connection line motor 859 12 (20 m long) Connection line bearing 859 13 (20 m long)	
Accessories for the temperature control	—	see TURBOTRONIK Operating instructions	—	see TURBOTRONIK Operating instructions
Retrofit kit TURBOVAC 340/341 M in MAG 400/410	894 55			
Purge gas and venting valve 110 V, 50/60 Hz 230 V, 50/60 Hz 24 VDC, 5 W Diaphragm filter retrofit kit Spare diaphragm filter Spare O-ring	 855 48 855 49 174 17 200 18 517 200 18 515 239 70 103			
Power failure airing valve 230 V 24 V DC, 5 W	 174 26 174 19			
Venting valve, manual	173 24			
Adsorption trap, DN 25 KF DN 40 KF Al-Oxid; 1.3 kg	 854 15 854 10		 854 16 854 10	
Microfilter DN 100 ISO-K	887 21			
Seal kit Seal kit + Operating instructions	200 91 240 200 91 437			

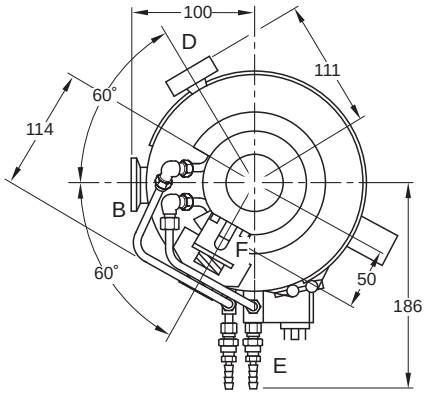


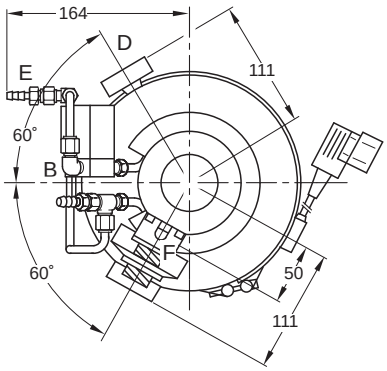
A = High vacuum flange
B = Forevacuum flange
C = Venting flange
D = Purge gas flange
E = Connection for cooling
F_1= Connection for DC motor
F_2= Connection for stabilizer
F_3= Connection for axial sensor

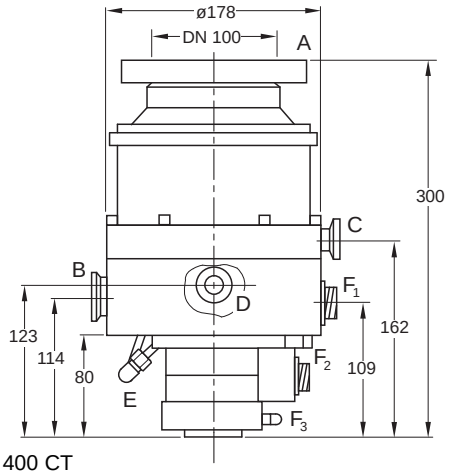
Dimensions in mm



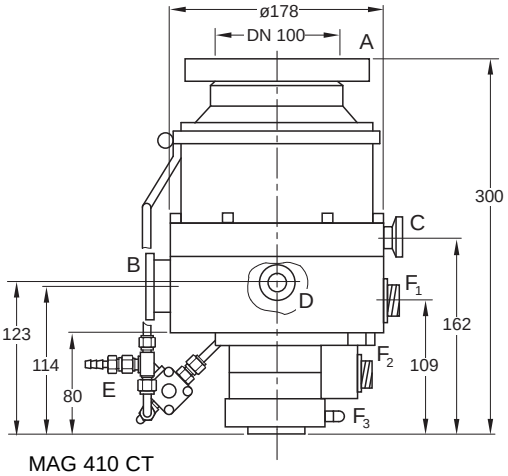
MAG 400 C; MAG 410 C similar







MAG 400 CT



MAG 410 CT

Fig. 4 Dimensional drawings of the MAG 400 and 410

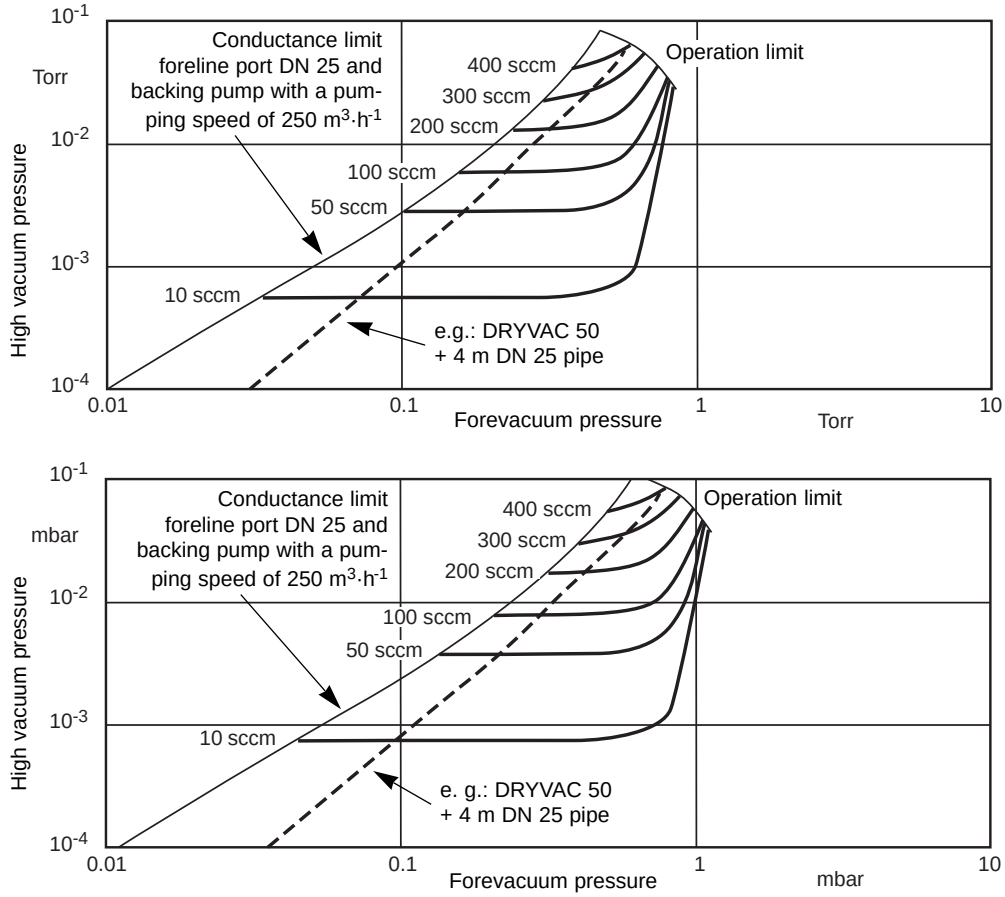


Fig. 5 Operation diagram of the MAG 400 for nitrogen

2 Installation

When moving the pumps, a lifting fork can be used at the lower surfaces on the base flange; see fig. 6. Having unpacked the pump only put it down onto its sealed high-vacuum connection flange. Every other possibility will be too unstable.

Caution

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

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

The noise level when the pump is running is below 70 dB(A). No acoustic insulation is required.

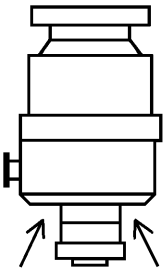


Fig. 6 Transport

Warning

Never expose any parts of the body to the vacuum.

Caution

If not equipped with adequate accessories the MAGs are **not** suitable for pumping dusty, aggressive or corrosive media. In case of aggressive or corrosive media the pumps must be operated with purge gas. When pumping media containing dust, insert a microfilter; see Section 1.5.
Observe also Section “Compatibility” at the beginning of this Operating Instructions.

2.1 Operating environment

When using the MAG inside a magnetic field, the magnetic induction at the pump housing must not exceed 5 mT, (1 mT (milliTesla) = 10 G (Gauß))

Exceeding this limit value 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.

The standard version of the MAG is resistant to radiation at levels up to 10^3 Gy. (1 Gy (Gray) = 100 rad)

The ambient temperature must not exceed 40°C (113°F).

2.2 Connecting the MAG to the vacuum chamber

Warning

The pump must be securely attached. If the pump were to become blocked, insufficient attachment could cause the pump to break away or allow internal pump parts to be discharged. Never operate the pump (in bench tests, for instance) without its being connected at the vacuum chamber.

If the pump should suddenly seize, the decleration torque of 880 Nm will have to be absorbed by the system. To accomplish this, 8 clamping bolts are required when securing an ISO-K high-vacuum flange:

Clamping bolts made of steel must be torqued down to 35 Nm, those made of stainless steel to 50 Nm.

You will find the order numbers for the (clamping) bolts in the Leybold-Catalog.

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

Remove the covers and blanking flanges only just before attaching, to ensure that the MAG is installed under the cleanest possible conditions.

Pay attention to maximum cleanliness when connecting.

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

The MAG is sensitive to low-frequency vibrations.

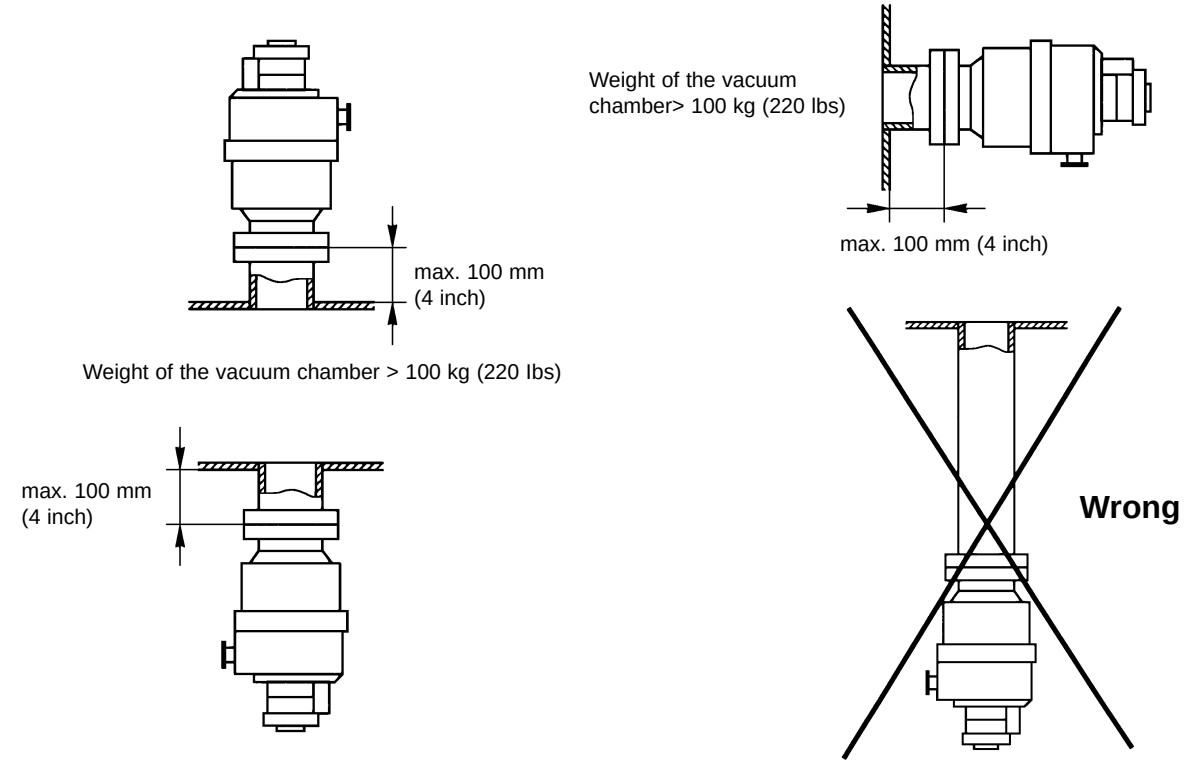


Fig. 7 Rigid flanging of the MAG to the vacuum chamber

Foreign objects entering the pump through the high vacuum flange can cause serious damage to the rotor. That's why the splinter guard supplied must always be kept installed.

Damages caused during operation without the splinter guard are excluded from warranty.

Mount the MAG as close as possible to the vacuum chamber. If the MAG 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.

In case of lighter vacuum vessels secure the pump additionally.

Use vibration absorbers when flange mounting the pump in order to decouple highly sensitive equipment and to keep external vibrations from being transmitted to the MAG. In this case the MAG is to be mounted separately from the vacuum chamber or use vibration absorbers for the attachment to the vacuum chamber; refer to Fig. 8 for details.

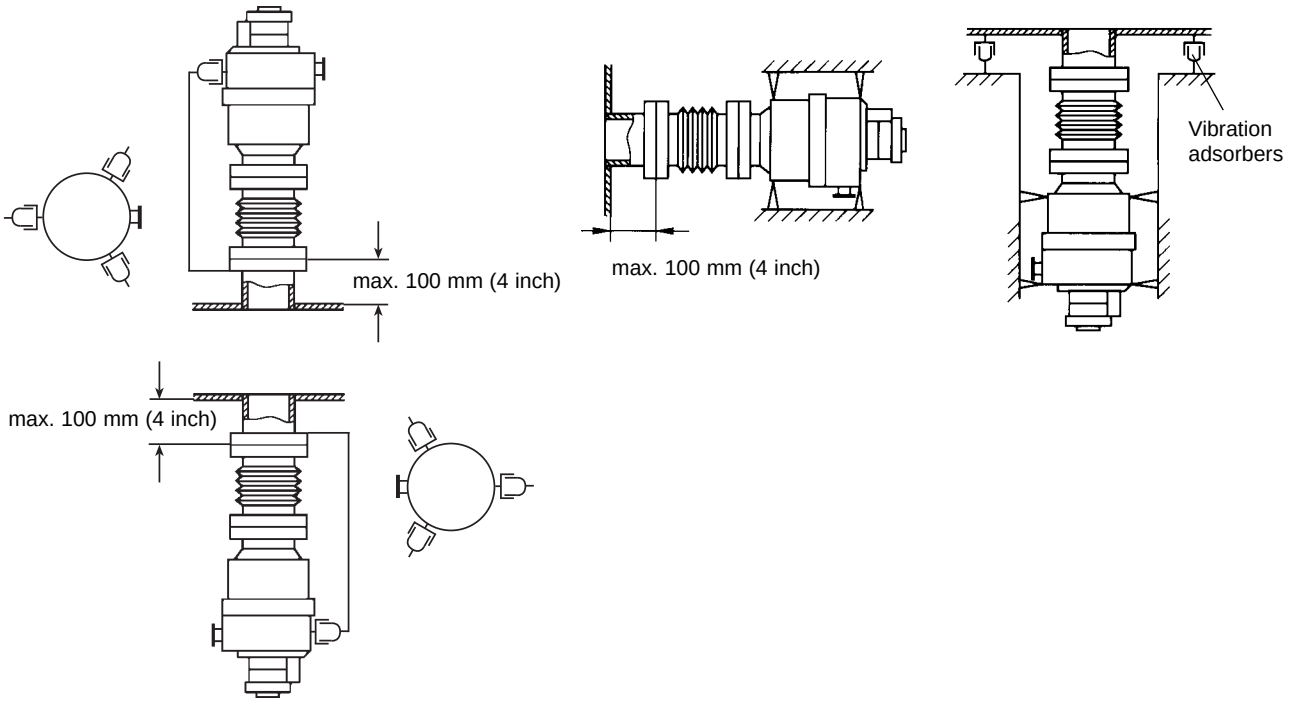


Fig. 8 Flange mounting using vibration adsorbers

Flanging on ISO-K-flanges

When connecting the high vacuum flange, fit the O-ring at the centering ring. The O-ring should be flat and even; it must not be twisted. Then add the outer ring; see Fig. 9.

Use the clamps to join securely the flange and the mating flange.

A collar flange is required when using ultra-high-vacuum sealing washers.

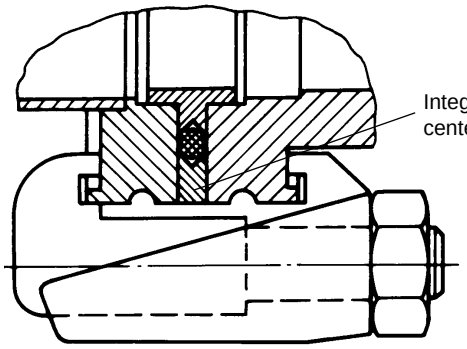
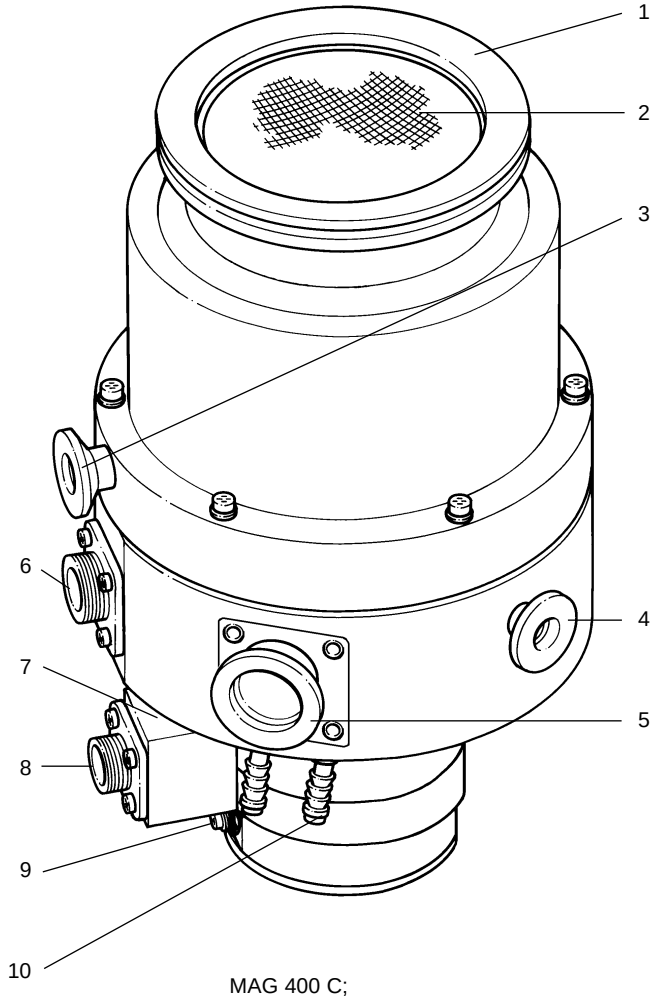


Fig. 9 Using ISO-K flanges

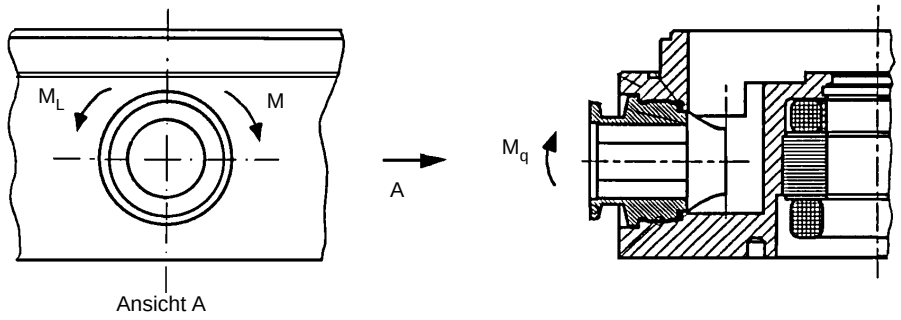


MAG 400 C;
MAG 400 CT, 410 C, and 410 CT similar

Key to Fig. 10

1 High vacuum connection flange
2 Splinter guard
3 Venting flange
4 Purge gas connection flange
5 Forevacuum connection flange
6 DC motor connection
7 Red LED, lights when the magnetic bearing is active
8 Connection for magnetic bearing
9 Connection for axial sensor
10 Cooling water connection

Fig. 10 Connection fittings



Torque with rotating-out-direction
M_L < 35 Nm (26 ft-lb)

Torque with fixed direction of rotation
M < 54 Nm (40 ft-lb)

Torque diagonally versus forevacuum connection axis
M_q < 50 Nm (37 ft-lb)

The torques M and M_L are valid only for the MAG with **screwed in** forevacuum connection flange (Cat. Nos. 894 52/53/54/55).

The MAG with the Cat. Nos. 894 62/63/64/65 have a **bolted on** forevacuum connection flange.

Fig. 11 Maximum torques for the forevacuum connection flange

2.3 Connecting the backing pump

A two-stage rotary vane pump is required as the backing pump to support operation of the MAG.

We recommend using our TRIVAC-B pumps for this purpose.

It is possible to use the dry-compression DRYVAC backing pump for operation of the MAG. Since the DRYVAC has a higher ultimate pressure than two-stage rotary pumps, the admissible throughput of the MAG will drop when operating with a DRYVAC.

Connect the backing pump connection flange of the MAG to the backing pump.

Fig. 12 shows schematically the design of a pump system incorporating a MAG turbomolecular pump and a TRIVAC backing pump with integral anti-suckback 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 backstreaming from the backing pump and into the MAG when the system is not running.

We recommend installing a sorption trap in the fore-line to insure that the forevacuum chamber in the MAG remains largely free of oil vapors during operation, too.

When operating the MAG with a dry-running forevacuum pump, ensure that the MAG cannot be vented abruptly when the forevacuum pump is switched off; see Section 3.4. The forevacuum valve must respond quickly enough to close off the line off promptly.

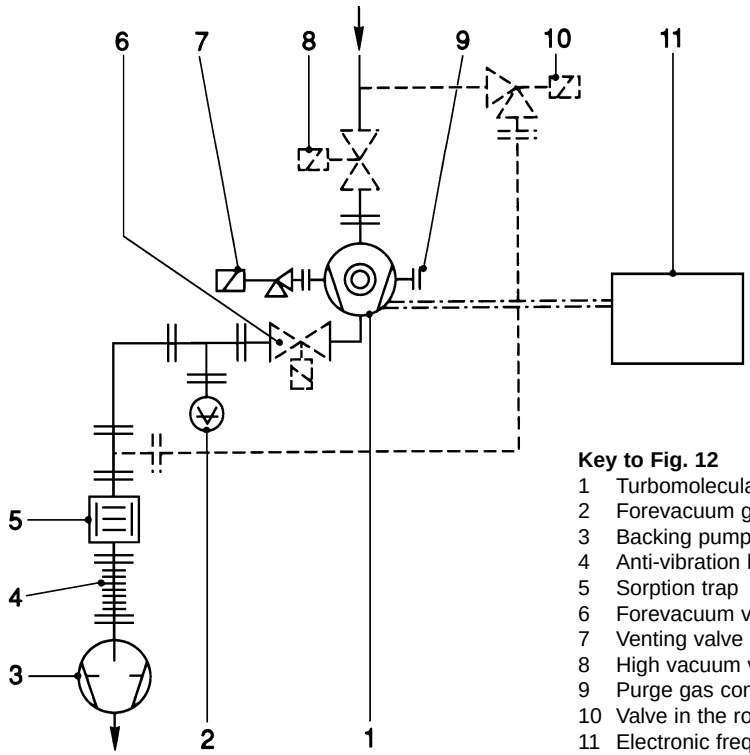
Connect the forevacuum valve so that the MAG can also not be opened suddenly to the evacuated forevacuum line.

Be sure that there is sufficient vibration decoupling between the MAG and the backing pump.

The torque on the forevacuum connection flange must not exceed the values shown in Fig. 11.

Warning

The forevacuum line must be tight.
Hazardous gases can escape at leaks or the gases being pumped can react with the air or humidity.



Key to Fig. 12

1 Turbomolecular pump
2 Forevacuum gauge point
3 Backing pump
4 Anti-vibration bellows
5 Sorption trap
6 Forevacuum valve
7 Venting valve
8 High vacuum valve
9 Purge gas connection
10 Valve in the roughing line
11 Electronic frequency converter

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

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

Fig. 12 Layout of a turbomolecular pump system

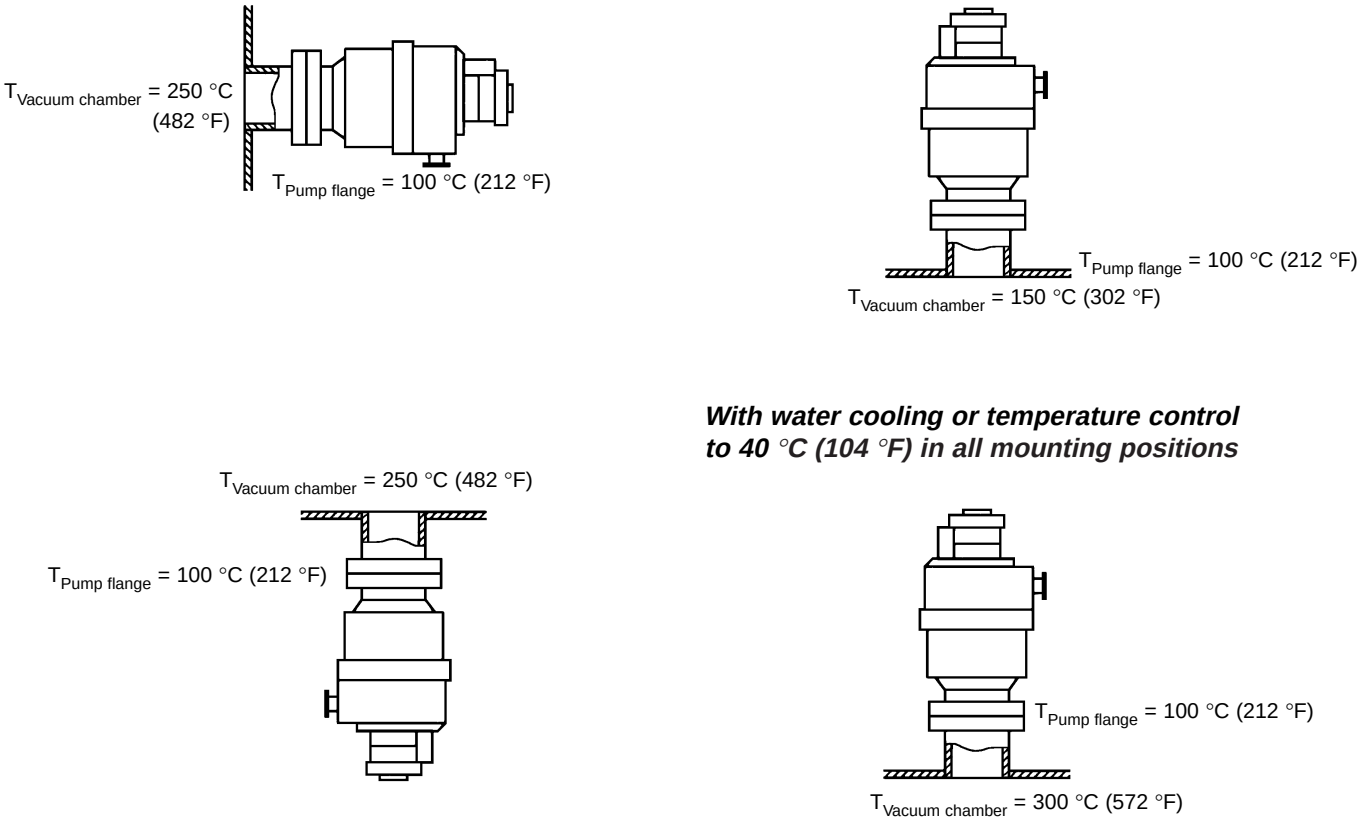


Fig. 13 Permissible continuous temperature in the vacuum chamber

2.4 Connecting the cooling

In normal operation the MAG will not require any cooling.

Water cooling will be needed, however,

- for processes where the pump temperature must be regulated,

- for processes where an intake pressure of $p > 10^{-3}$ mbar is maintained over an extended period of time,

- when continuous temperatures in the vacuum chamber exceed 150°C (302°F) and the pump is mounted on top of the vacuum chamber,

- when continuous temperatures in the vacuum chamber exceed 250°C (482°F) regardless of where the pump is mounted.

- when heating of the basic pump flange is necessary or wanted.

Cooling water specifications

Inlet temperature	15 - 25 °C (59 - 77 °F)
Inlet pressure	max. 6 bar
Cooling water requirement	See Fig. 14
Appearance	Colorless, clear, free of oils and greases
Sediments	< 250 mg/l
Particle size	< 150 µm
pH value	7 to 8.5
Overall hardness (total alkaline earths)	max. 20 ° German hardness scale (= 3.57 mmol/l)

Further information on request.

Temperatures which are slightly lower (between 10°C and 15°C; 50°F and 59°F) are permissible but there will be danger of condensation on or in the pump.

Slightly higher temperatures (between 25°C and 30°C; 77°F and 86°F) are also acceptable and present no hazard to the pump. Considerably higher temperatures may cause a drop in performance, since the TURBO-

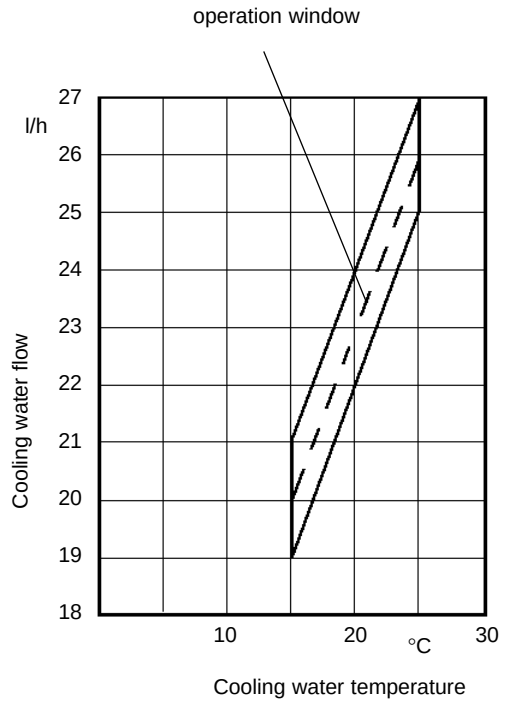
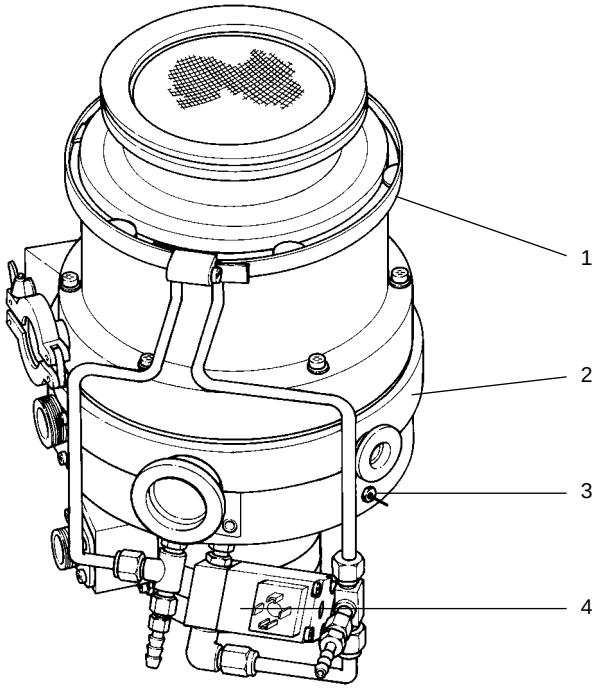


Fig. 14 Recommended cooling water flow



Key to Fig. 15
1 Cooling coil for pump housing
2 Heating collar
3 Temperature sensor Pt 100
4 Magnet valve for water cooling

Fig. 15 MAG 410 CT; 400 CT similar

TRONIK will slow down pumping speed if temperatures are too high.

Connect the cooling water feed and drain lines at the hose nipples. Do not mix up water inlet and water outlet. Use hose clamps to keep the hoses from slipping off.

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

If immediate pump shut-down in case of cooling water supply failure is required, then a flow monitor will have to be inserted in the drain line.

Temperature control for MAG 400/410 CT

For connection and operation of the temperature control see also Operating Instructions for the TURBOTRONIK.

Plug in the connection line heating collar - TURBOTRONIK to the heating collar and at the socket HEATER of the TURBOTRONIK.

Plug in the connection line cooling water magnet valve - TURBOTRONIK at the cooling water magnet valve and at the socket COOLER of the TURBOTRONIK.

Screw in the Pt 100 temperature sensor. Maximum torque = 2.5 Nm = 1.8 ft-lb. Insert the plug of the Pt 100 connection line at the socket Pt 100 of the TURBOTRONIK.

Warning

The basic flange heater can become so hot during operation (> 80°C, 176 °F) that it represents a burn hazard:
Provide protection against contact with the hot components.

2.5 Connecting the purge gas or power failure airing valve

Connect either a power failure airing valve to venting flange (10/3) or a purge gas valve to the purge gas flange (10/4).

Which of the two valves is used will depend on the nature of the process.

When pumping **clean, non-corrosive gases** you should install the power failure airing valve. This valve keeps the MAG from continuing to run for a long time after it has been switched off; it also keeps oil vapor from diffusing back from the fore-line.

Connect a purge gas valve when pumping **reactive media**.

Use dry nitrogen as purge gas.

We will provide technical support when making the decision as to which media can be pumped with or without purge gas.

When using purge gas, the larger volume of gas at the forevacuum port may require the use of a backing pump providing higher pumping speed.

A turbomolecular pump operated with purge gas **must** be vented through the purge gas connection when switched off; hazardous gases may otherwise enter the motor and bearing area.

The purge gas flow must be between 24 and 36 sccm with an ideal flow shortly over 24 sccm.

Caution

Excessively high purging gas pressure and flow rate will affect pump performance. If the pumping speed of the forevacuum pump is too low, the forevacuum pressure at the turbomolecular pump will be too high. This can cause abnormal wear to the bearings.

During cycle operation the purge gas supply should be permanently open. After switching off the pump the purge gas will have to be flown for at least another hour.

Shut off the purging gas when the MAG is running with the forevacuum valve closed.

Connection of the purge gas valve

Flange the purge gas valve directly onto the purge gas connecting flange (10/4), (16/1) of the pump.

A centering ring and a nozzle with filter is integrated in the purge gas connection flange of the pump. **Do not** remove this centering ring.

The arrow on the valve must point in the direction of flow of the purge gas, i.e. towards the pump.

The pin (16/10) must be in the withdrawn position, and with the valve fitted must also point towards the pump. If the pin is pushed in, the bypass of the purge gas valve cannot be opened. In this case, the valve operates as a simple purge gas valve, without the venting facility.

Connect the purge gas hose to the hose nozzle (16/6) and secure using a hose clip.

Set the purge gas pressure at the inlet of the purge gas valve to 1.0 - 1.5 bar absolute pressure (0.0 psig to 7.5 psig).

When taking purge gas from a pressure tank or a central supply system, use only combined pressure reducing and regulating valves with flow meters which can supply both the low purge gas flow and the considerably larger ventilation gas volumes.

Electrical connection must only be performed by a qualified electrician in accordance with the guidelines of VDE.

Release the M3 retaining screw and withdraw the plug (16/9).

Connect the 3-core mains lead.

Replace the plug and secure.

The venting bypass (16/7) is open when de-energized.

The purge gas channel (16/2) is permanently open.

Connect the purge gas valve to the TURBOTRONIK.

Key to Fig. 16
1 Purge gas connecting flange
2 Throttle nozzle
3 Sintered metal filter
4 O-rings
5 Diaphragm filter
6 Hose nozzle
7 Venting bypass
8 Solenoid valve
9 Plug
10 Pin

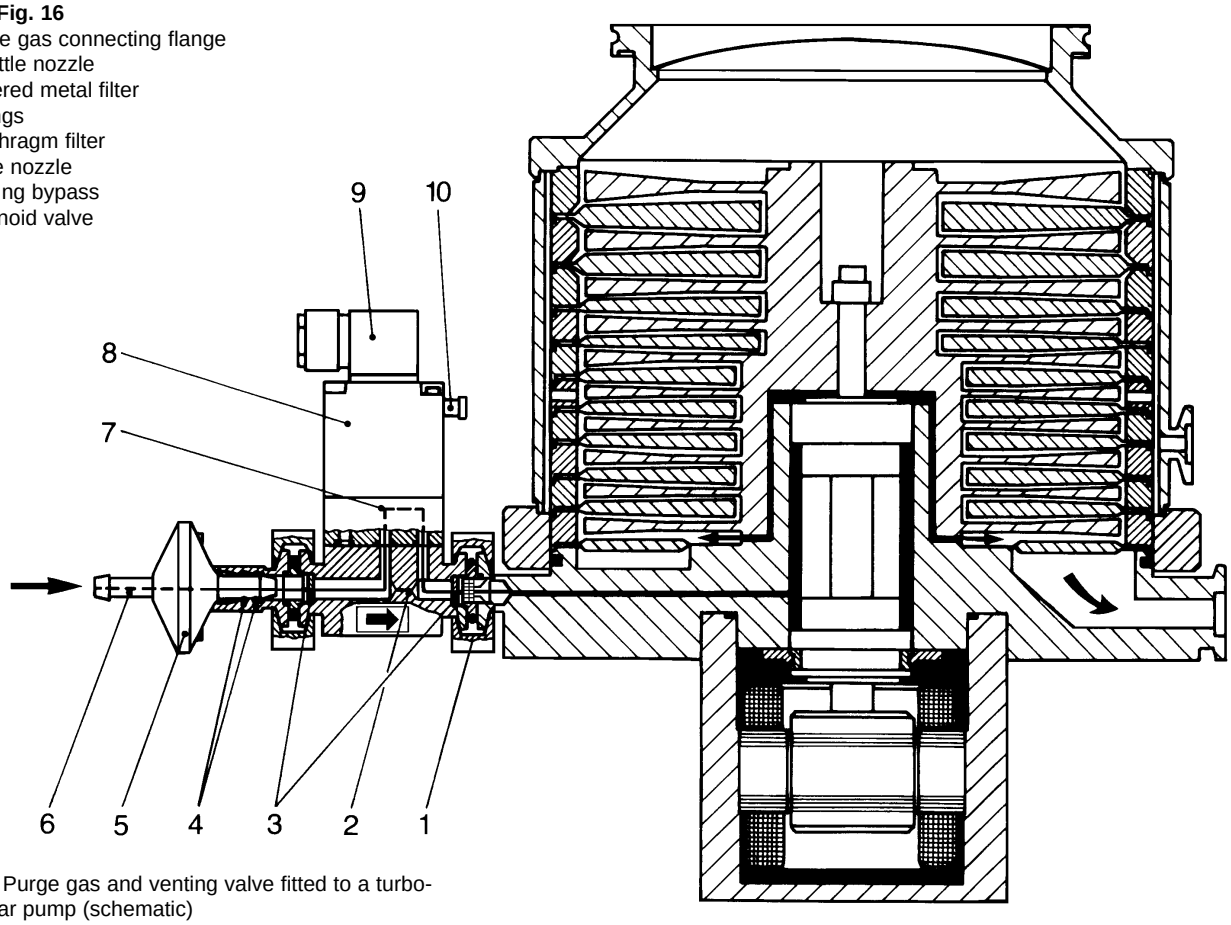


Fig. 16 Purge gas and venting valve fitted to a turbo-molecular pump (schematic)

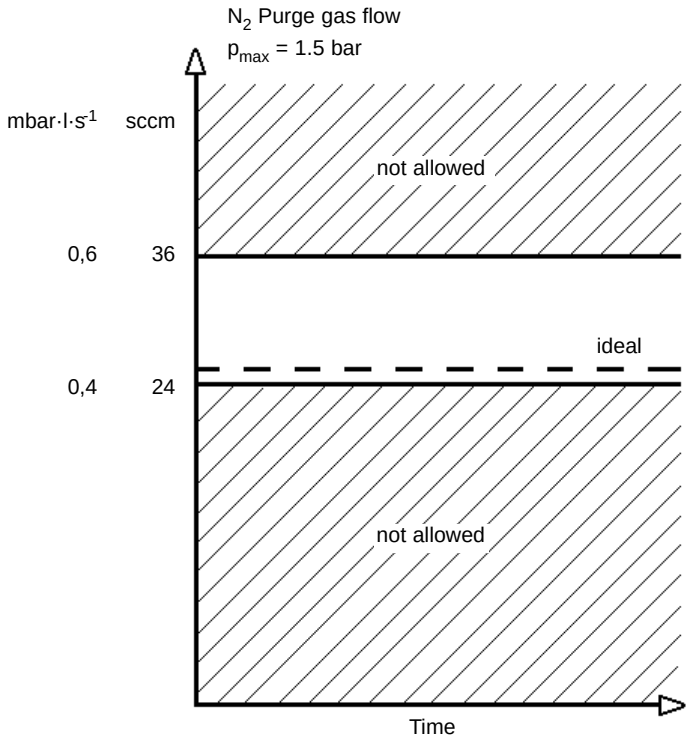


Fig. 17 Recommended purge gas flow

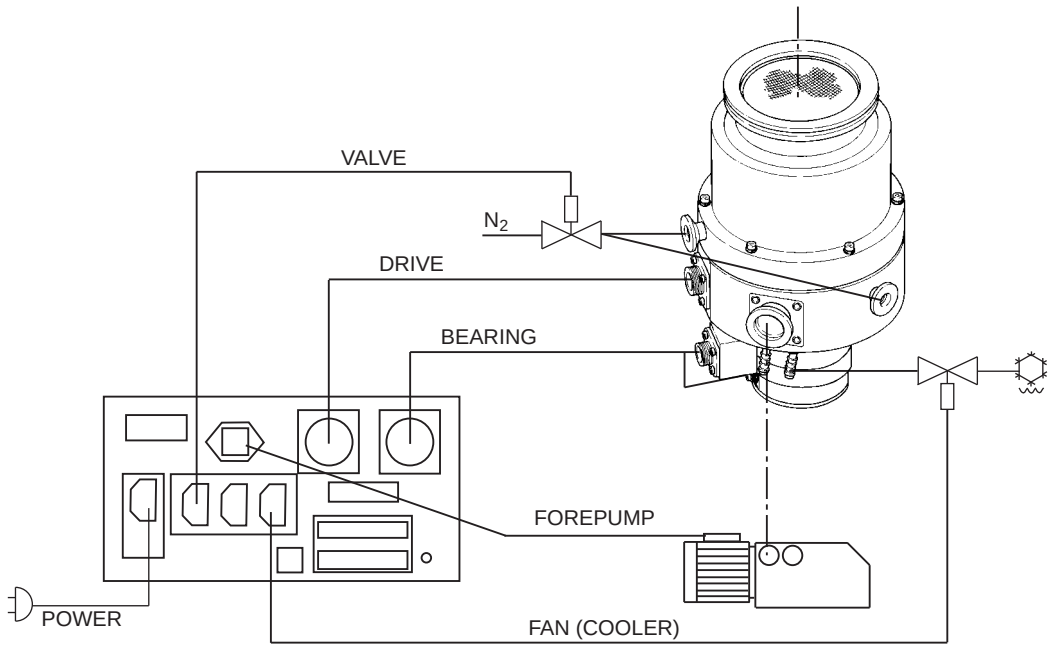


Fig. 18 Block wiring diagram for connection of the MAG 400 C to the TURBOTRONIK

2.6 Connecting the TURBOTRONIK

Refer to the TURBOTRONIK Operating Instructions for details regarding its mounting, connection and operation.

Warning

The pump may be operated only with the matching frequency converter and a suitable connector cable.
Peak voltages of up to 130 V may be present at the connector line between the frequency converter and the pump; mains voltage is present at the valves and their feed leads.
Route all cables so as to protect them from damage.

The protection rating for the connectors is IP 20.

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

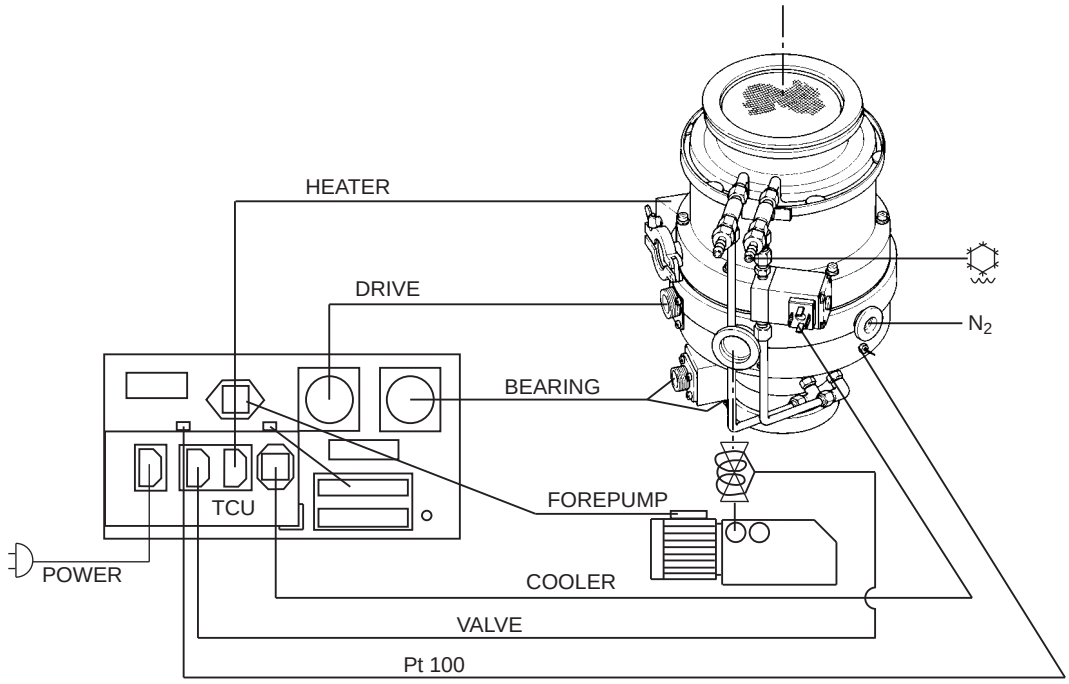


Fig. 19 Block wiring diagram for connection of the MAG 400 CT to the TURBOTRONIK

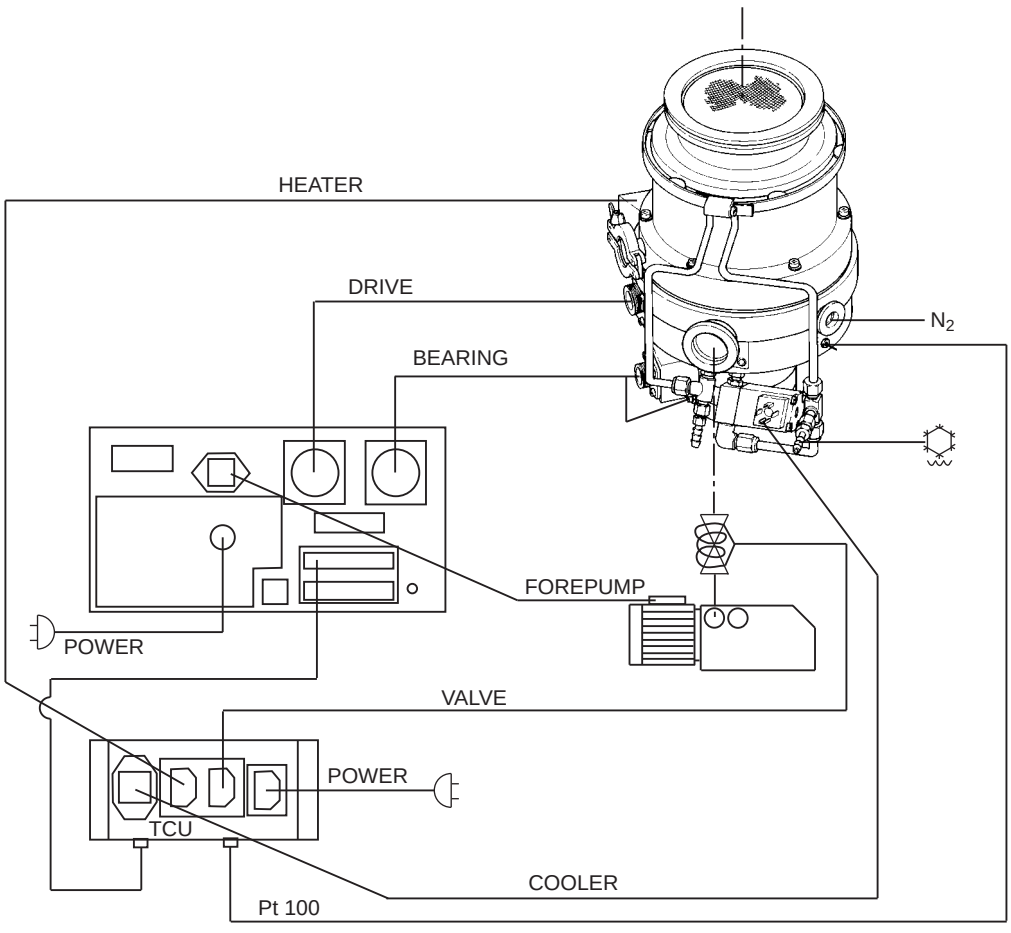


Fig. 20 Block wiring diagram for connection of the MAG 410 CT to the TURBOTRONIK

3 Operation

3.1 Switching on

First of all, open the purge gas supply, then press the START button at the TURBOTRONIK; see the TURBOTRONIK Operating Instructions.

Open the cooling water supply.

In case of corresponding connection the temperature control and the backing pump will be activated when switching on the TURBOTRONIK.

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

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

Do not open the MAG 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. Observe the evacuation time curve; see Fig. 21.

The pump may make noise during the run-up and run-down phases. This happens when, in the lower speed range, the touch-down bearings are touched intermittently. This has neither an influence on the pump nor on the process.

3.2 Operation

The magnetic bearing in the MAG are immune to wear. In addition to the magnetic bearings, the MAG is equipped with touch-down bearings which protect the rotor against mechanical contact with the stator if the pump is subjected to external shock loading and when the pump is switched off. These touch-down bearings use no lubricant and thus have a limited service life. Please observe the following in order to obtain maximum service life.

- Avoid shock and vibrations when the pump is running. Shocks perpendicular to the rotation axis are particularly harmful. If the pump should appear to be running in the mechanical bearings continuously while operating at rated speed (and thus making noise), switch off and vent the MAG; see Section 3.4.

- Avoid a frequent switching on and off.

- Do not disconnect the MAG and TURBOTRONIK while they are operating; see Section 3.5. A red LED (10/7) lights up when the magnetic bearing is active. The connection lines to the TURBOTRONIK can only be disconnected when the red LED is extinguished.

Warning

Monitor the purge gas flow continuously. Insufficient purge gas flow can result in:
- Process gases entering the motor and bearing area of the MAG
- Process gases escaping from the purge gas valve
- Humidity entering the pump.

The purge gas valve is not a shut-off valve.

MAG with heating collar:

Warning

The heating collar will be hot during operation. Burn hazard!

Operating failures will be indicated by the TURBOTRONIK; refer to the Section Troubleshooting Guide in the Operating Instructions of the TURBOTRONIK.

3.3 Switching off

See the TURBOTRONIK Operating Instructions.

Vent the MAG before it comes to a full standstill; see Section 3.4.

The TURBOTRONIK controls the venting automatically provided a purge gas valve or a power failure airing valve is connected to the TURBOTRONIK.

Caution

Only switch off the MAG at the TURBOTRONIK. Switching off through the mains switch is not permissible since it results in an increasing wear of the touch-down bearings.

Press the STOP key at the TURBOTRONIK and wait until the pump has come to a standstill.

Close off the cooling water supply immediately after switching off the MAG in order to avoid condensate formation in the pump.

The backing pump may be switched off once the MAG has stopped.

When using TRIVAC-B pumps, the anti-suckback valve will close automatically, closing off the fore-line. On backing pumps without vacuum lock close the valve in the forevacuum line.

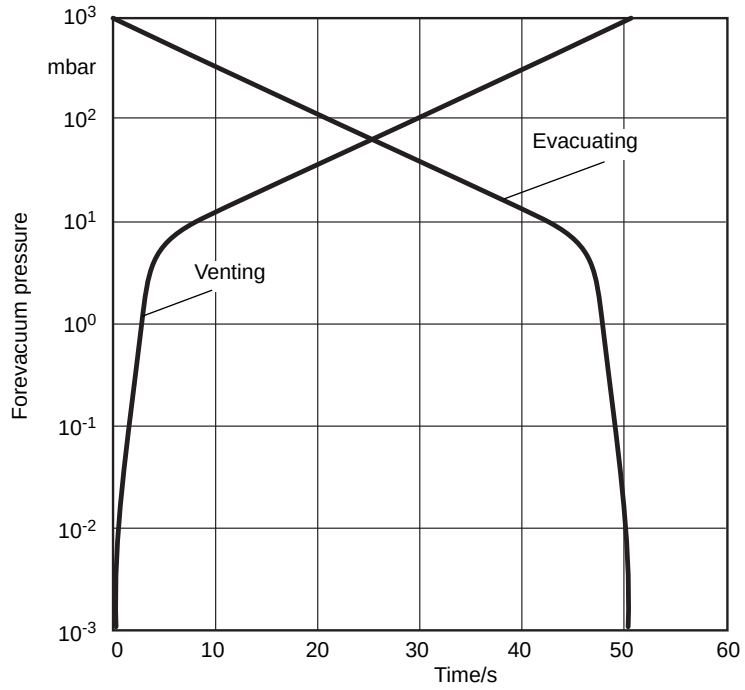


Fig. 21 Minimum pump out time and safe venting for the MAG 400/410

If the MAG has been used for pumping of corrosive gases it should be purged with dry nitrogen for one hour before switching off. During down times of the system take care that neither ambient air nor cleaning agents enter the MAG.

3.4 Venting

Vent the MAG 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.

The TURBOTRONIK controls the venting automatically provided a purge gas valve or a power failure airing valve is connected to the TURBOTRONIK.

Use dry nitrogen, for instance, for venting purposes.

There are three methods for venting the MAG:

1. In processes requiring purge gas, the pump will have to be vented through the purge gas valve when it is shut off.

First switch off the MAG and then the backing pump; afterwards open the venting bypass.

Leave the venting bypass open as long as hazardous gases from the vacuum chamber or the rotor or stator of the MAG can enter the motor and bearings' chamber.

If the vacuum chamber is vented with protective gas the bypass must either be opened simultaneously or before.

If the MAG is vented only via the purge gas valve the prescribed pressure rise curve for the MAG will be maintained.

Caution

The pressure in the motor and bearing chamber of the MAG must always be higher than that in the forevacuum chamber.

2. For pumps which are operated without purge gas we recommend venting the pump through the venting connection flange. A throttle integrated into the pump eliminates any potential damage to the pump during venting.

3. The pump can be vented from the high-vacuum side.

Caution

Do not suddenly expose the pump to venting. In all cases the values shown in the pressure rise curve in Fig. 21 must be observed.

The pump can be vented while running at full speed.

Do not vent the MAG via the forevacuum connection as oil vapors could enter the MAG.

3.5 Power failure - Cable break

If there is a power failure or if the mains plug is accidentally disconnected, the TURBOTRONIK automatically switches over to generator operation to drive the MAG. In this way the active magnetic bearing control circuits will be kept in operation as the pump runs down, until the rotor seats on the touch-down bearings once it has reached a low speed.

If the connections between the MAG and the TURBOTRONIK are interrupted, the automatic generator mode and the emergency supply of the magnetic bearing control will be disabled. In this case the rotor will seat directly on the touch-down bearings and runs down making audible running noises. It cannot be excluded that the touch-down bearings would be irreparably damaged in such a situation.

The connection cables between MAG and TURBOTRONIK are protected against accidental interruption. If, nevertheless, the connection cable is interrupted through mechanical destruction, brake the MAG until it comes to a standstill via venting.

Once the rotor has set down from the nominal speed on the touch-down bearings, wait about 1 hour before restarting the pump, allowing it sufficient time to cool down.

Caution

The touch-down bearings use no lubricant and thus have a limited service life.

After several rotor run-downs from nominal speed into the touch-down bearings get in contact with the Leybold after sales service in order to have the bearings checked.

4 Maintenance

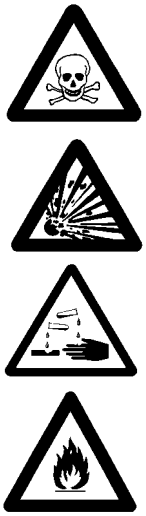
The MAG are maintenance-free. Wear only occurs at the touch-down bearings when hard shocks have to be supported.

Regenerate or replace the agent in the sorption trap at regular intervals; for details on the sorption trap please refer to the corresponding Operating Instructions.

4.1 Changing the diaphragm filter of the purge gas and venting valve

The diaphragm filter becomes clogged with time, depending on the degree purity of the purge gas, and must be changed. The purge gas flow must not fall below 90% of the desired value.

Warning



If the purge gas supply has been interrupted during operation of the pump, the diaphragm filter may be contaminated with hazardous substances.
The appropriate safety measures must be carried out before any work is performed.

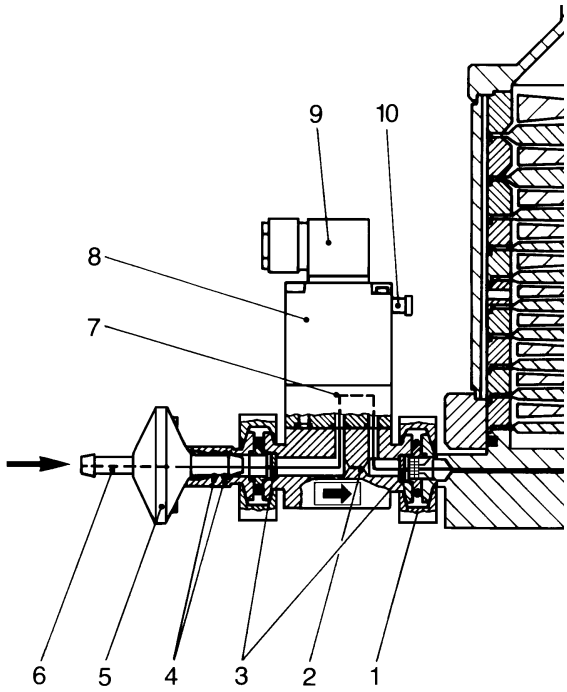
To change the diaphragm filter, first switch off the pump. Having vented the pump sufficiently, shut off the purge gas supply.

Remove the purge gas hose from the hose nozzle (22/6).

Withdraw the diaphragm filter (22/5).

We recommend renewing the O-rings (22/4).

Push the new diaphragm filter in as far as to the stop.



Key to Fig. 22
1 Purge gas connecting flange
2 Throttle nozzle
3 Sintered metal filter
4 O-rings
5 Diaphragm filter
6 Hose nozzle
7 Venting bypass
8 Solenoid valve
9 Plug
10 Pin

Fig. 22 Changing the diaphragm filter

The arrows on the diaphragm filter must point towards the purge gas valve.

Caution

If the used diaphragm filter has been contaminated by process gases, it must be disposed of as industrial waste.

Reconnect the purge gas hose to the hose nozzle.

If you send a purge gas valve to Leybold for repair, indicate any harmful substances which may be in or at the valve.

To do so, use a preprinted form which we'll send to you on request. You find a copy at the end of the Operating Instructions.

4.2 Removing the pump from the system

Press the STOP button at the TURBOTRONIK and wait until the pump has come to a standstill.

Afterwards turn the mains switch to the „0“ position.

The cables between the MAG and the TURBOTRONIK may be disconnected only after the red LED at the rear of the TURBOTRONIK has gone out.

Pumps which are used in semiconductor processes, for example, are 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.

To avoid health hazards and corrosion damage when the pumps are detached from the system, use the seal kit.

Failure to seal a contaminated MAG voids the warranty.

The seal kit contains the following
- dry cartridge,
- plastic caps for high-vacuum, forevacuum, venting and purge gas connection flanges,
- rubber or screw caps for the cooling water connections,
- plastic adhesive film,
- polyethylene bag with cable ties.

Warning

If the pump has previously pumped hazardous gases take the appropriate safety measures before opening the intake or exhaust port.

Use gloves, a breathing mask or protective clothing to avoid skin contact with toxic or highly corrosive substances. Work under a fume hood.

Proceed as follows to seal the MAG immediately after removing it from your process.

Purge the pump with purge gas for one hour with the backing pump running. This helps to remove a large quantity of the process gases from the pump.

Remove the pump from the process.

Note
If the venting port was sealed with a blank flange, it isn’t necessary to clean, tape and install its cap.

Clean the high-vacuum, backing, venting and purge gas connection flange as necessary for good adhesion of tape.

Place the dry cartridge onto the inlet screen. Don’t use loose crystals. The holes of the dry cardridge must point **towards the inlet screen**.

Firmly seal all ports with plastic adhesive film.

Cover each connection ports with its plastic cap.

Seal the cooling water connections.

Place the pump in the plastic bag and secure it with the cable tie.

Attach the fully completed form „Turbopump Field Failure Report“.

Pack the pump so that it cannot be damaged during shipping and so that no contaminants can escape from the packaging.

4.3 Service at Leybold’s

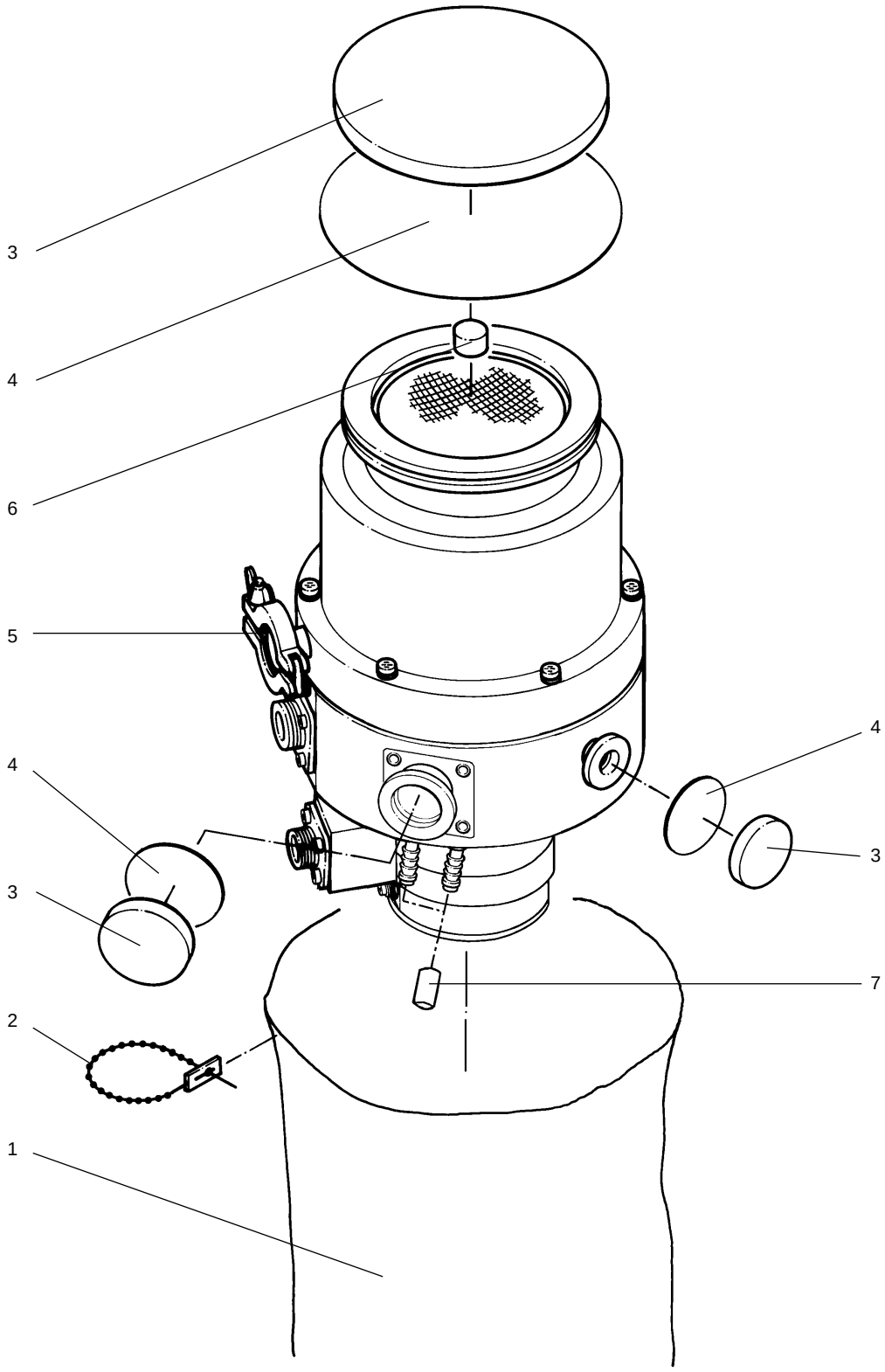
If you send a pump to Leybold indicate whether the pump is free of substances damaging to health or whether it is contaminated. If it is contaminated also indicate the nature of hazard. To do so, you must use a preprinted form which we shall send to you upon request.

A copy of this form is printed at the end of the Operating Instructions: „Declaration of Contamination of Vacuum Equipment and Components“.

Either fasten this form at the pump or simply enclose it to the pump. Don’t pack the form with the pump into the PE bag.

This declaration of contamination is necessary to comply with legal requirements and to protect our staff.

Leybold must return any pump without a declaration of contamination to the sender’s address.



Key to Fig. 23

1 Polyethylene bag
2 Cable tie
3 Plastic caps
4 Plastic adhesive film
5 Venting connection flange (blanked off)
6 Dry cartridge
7 Rubber or screw cap

Fig. 23 Sealing the MAG tightly

LEYBOLD

VDMA

Declaration of Contamination of Vacuum Equipment and Components

The repair and/or service of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer could refuse to accept any equipment without a declaration.
This declaration can only be completed and signed by authorized and qualified staff.

1. Description of Vacuum Equipment and Components

- Equipment type/model: _____
- Code No.: _____
- Serial No.: _____
- Invoice No.: _____
- Delivery date: _____

2. Reason for Return

_____
_____
_____
_____
_____
_____

3. Condition of the Vacuum Equipment and Components

- Has the equipment been used?
  yes ❒ no ❒
- What type of pump oil/liquid was used? _____
- Is the equipment free from potentially harmful substances?
  yes ❒ (go to Section 5)
  no ❒ (go to Section 4)

4. Process related Contamination of Vacuum Equipment and Components:

- toxic	yes ❒	no ❒
- corrosive	yes ❒	no ❒
- explosive*)	yes ❒	no ❒
- biological hazard*)	yes ❒	no ❒
- radioactive*)	yes ❒	no ❒
- other harmful substances	yes ❒	no ❒

*) Vacuum equipment and components which have been contaminated by biological explosive or radioactive substances, will not accepted without written evidence of decontamination!

Please list all substances, gases and by-products which may have come into contact with the equipment:

Trade name Product name Manufacturer	Chemical name (or Symbol)	Dangerous material class	Measures if spillage	First aid in case of human contact
1.				
2.				
3.				
4.				
5.				

5. Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate. The despatch of the contaminated vacuum equipment and components will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of organisation or company: _____

Address: _____ Post code: _____

Tel.: _____

Fax: _____ Telex: _____

Name: _____

Job title: _____

Date: _____ Company stamp:

Legally binding signature: _____

 Order No.: 2121

GA 05.125/4.02 - 03/99

Fax to: Service LV
Fax#: (0049) 221 347 1945

Form TMP-1 ... Turbopump Field Failure Report

Field Service IR No.: RMA No. (if returning to factory):

Service Center:

Customer:

Turbopump Model: Turbopump Pump Part Number:

Turbopump Serial Number:

Complaint:

Process:

OEM Equipment Name and Model:

Process Gas:

Was the turbopump replaced? ❒ Yes; ❒ No.

If yes, replacement pump P/N: replacement pump S/N:

Date Installed: Date Removed:

Date Received:

Date Examined: Examined by:

Received Condition:

Findings:

Cause of Failure:

Recommendations:

Remarks/Questions:

EEC Manufacturer's Declaration

in the sense of EEC Directive on Machinery 89/392/EWG, Annex IIb

We - Leybold Vakuum GmbH - herewith declare that operation of the incomplete machine defined below, is not permiss-ible until it has been determined that the machine into which this incomplete machine is to be installed, meets the regulations of the EEC Directive on Machinery.

At the same time we herewith certify conformity with EEC Directive on Low-Voltages 73/23/EWG.

When using the appropriate Leybold accessories, e.g. connector lines or valves, and when powering the pump with the specified Leybold frequency converters, the protection level prescribed in the EMC Guidelines will be attained.

Designation: Turbomolecular pump

Models: MAG
- 400 C
- 400 CT
- 410 C
- 410 CT

Catalog Numbers:
- 894 52/62
- 894 53/63
- 894 65
- 894 54/64

Applied harmonized standards:

• EN 292 Part 1 & 2	Nov. 1991
• EN 1012 Part 2	1996
• EN 60 204	1993

Applied national standards and technical specifications:

• DIN 31 001	April 1983
• DIN ISO 1940	Dec. 1993

Cologne, March 11, 1999

Dr. Mattern-Klosson, Business Area Manager
Turbomolecular pumps

Cologne, March 11, 1999

Hofmann, Design Department Manager
Turbomolecular pumps

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