



## Technology for Vacuum Systems

### Instructions for use



**MZ 1C**  
**MD 1C**  
**MD 1C + AK + EK**  
**MD 1C VARIO-SP**

**Chemistry diaphragm pumps**

Dear customer,

Your VACUUBRAND diaphragm pumps are designed to provide you with many years of trouble-free service with optimal performance. Our many years of practical experience allow us to provide a wealth of application and safety information. Please read these instructions for use before the initial operation of your pump.

VACUUBRAND diaphragm pumps combine our many years of experience in design, construction and practical operation, with the latest developments in material and manufacturing technology.

Our quality maxim is the "zero defect" principle:

Every diaphragm pump, before leaving our factory, is tested intensively, including an endurance run of 18 hours. Any faults, even those which occur rarely, are identified and can be eliminated immediately.

After completion of the endurance run, every pump is tested, and must achieve specifications before shipment.

We are committed to providing our customers only pumps that meet this high quality standard.

While our pumps cannot eliminate all of your work, we design, manufacture and test them to ensure that they will be an effective and trouble-free tool to assist you in that work.

Yours,

VACUUBRAND GMBH + CO KG

### **After sales service:**

**Contact your local dealer or call +49 9342 808-193.**

### **Trademark index:**

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# Contents

<b>Safety information!</b> .....	<b>4</b>
Important information! .....	4
General information .....	6
Intended use.....	6
Setting up and installing the equipment .....	7
Ambient conditions .....	9
Operating conditions .....	10
Safety during operation .....	11
Maintenance and repair.....	15
<b>Technical data</b> .....	<b>17</b>
Gas inlet temperatures .....	19
Wetted parts .....	20
Abbreviations.....	21
Pump parts .....	21
<b>Use and operation</b> .....	<b>27</b>
Controlling the MD 1C VARIO-SP .....	27
Installing a pump in a vacuum system .....	30
During operation.....	34
Important notes regarding the use of gas ballast .....	36
Important notes concerning the operation of the exhaust waste vapor condenser .....	37
Shutdown & storage .....	39
<b>Accessories</b> .....	<b>40</b>
<b>Troubleshooting</b> .....	<b>41</b>
<b>Replacing diaphragms and valves</b> .....	<b>43</b>
Cleaning and inspecting the pump heads .....	45
Replacing the diaphragm .....	48
Assembling the pump heads .....	49
Assembling the fitting .....	51
<b>Cleaning and replacing components</b> .....	<b>52</b>
<b>Notes on return to the factory</b> .....	<b>53</b>
<b>Warranty</b> .....	<b>56</b>
<b>Health and safety clearance form</b> .....	<b>57</b>

# Safety information!

## *Important information!*

### **NOTICE**

This manual is an integral part of the equipment described therein. It describes the safe and proper use of the vacuum pump.

**Keep this manual complete and accessible to personnel at all times!**

**Make operating personnel aware of dangers arising from the pump and the pumped substances.**

**Read this manual carefully before installing or operating the equipment. Observe the instructions contained in this manual.**

**VACUUBRAND disclaims any liability for inappropriate use of these pumps and for damage resulting from disregarding the instructions contained in this manual.**

**Do not modify the equipment without authorization.**

This manual is only to be used and distributed completely and unchanged. It is strictly the users' responsibility to check carefully the validity of this manual with respect to his product.

Manual-no.: 999098 / 07/29/2010

**The following signal word panels and safety symbols are used throughout this manual:**



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



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



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



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



NOTICE is used to address practices not related to personal injury.



Caution! Hot surface!



Disconnect equipment from power.

### Formatting used in this manual:

**Note:** The signal word panels in all sections of this manual always refer to all paragraphs of the same format (➡ / ☞ / • / plain text) following each signal word panel.

## ***General information***

### **NOTICE**

Remove all packing material from the packing box. Remove the product from its packing-box and retain all packaging until the equipment is inspected and tested. Remove the protective caps from the inlet and outlet ports and retain for future use. Inspect the equipment promptly and carefully.

If the equipment arrives damaged, notify the supplier and the carrier in writing within three days. Retain all packing material for inspection. State the item number of the product together with the order number and the supplier's invoice number. Failure to check and give notice of damage will void any and all warranty claims for those deficiencies.

Replace the protective caps, if the equipment is not used immediately. Store the equipment in dry and non-corrosive conditions (see also "Technical data", pg. 17).


Use the mounted handle or the recessed grips when moving the pump.


### **! WARNING**


 **Do not use any damaged equipment.**


## ***Intended use***


### **! WARNING**

 Do not use the pump or any system parts on humans or animals.

 Prevent any part of the human body from coming into contact with vacuum.

 Ensure that the individual components are only connected, combined and operated according to their design and as indicated in the instructions for use.

 Comply with all notes on correct vacuum and electrical connections; see section "Use and operation", pg. 27.

 Use the equipment **only as intended**, that is, for generation of vacuum in vessels designed for that purpose. Any other use will automatically invalidate all warranty and liability claims. Remain aware of safety and risks.

☞ Do not use the pump to generate pressure.

## NOTICE

The pumps are designed for **ambient temperatures** during operation between +50°F and +104°F (+10°C and +40°C). Check the maximum temperatures if installing the pump in a cabinet or a housing. Make sure ventilation is adequate to maintain recommended operating temperature. Install an external automatic ventilation system if necessary. If pumping hot process gases, make sure that the maximum permitted gas inlet temperature is not exceeded. The maximum permitted gas inlet temperature depends on several parameters like inlet pressure and ambient temperature (see "Technical data", pg. 17).

Do not aspirate particles and dust.

Do not pump liquids.

Ensure that the pump is chemically resistant to the pumped substances prior to operation.

## *Setting up and installing the equipment*

### DANGER

➔ Equipment must be connected only to a **suitable electrical supply** and a suitable ground point. As such, the plug (pumps with AC motor) must be plugged into an outlet that is properly grounded. Provide a slow blow fuse according to the electrical supply (see "Technical data", pg. 17). Failure to connect the motor to ground may result in deadly electrical shock.

The supply cable (pumps with AC motor) may be fitted with a molded European IEC plug or a plug suitable for your local electrical supply. The cable contains wires color coded as follows: green or green and yellow: ground; blue or white: neutral; brown or black: hot.

### WARNING

☞ Due to the high compression ratio, the pump may generate overpressure at the outlet. Check pressure compatibility with system components (e.g., exhaust pipeline or exhaust valve) at the outlet.



- ☞ Do not permit any **uncontrolled pressurizing**. Make sure that the exhaust pipeline cannot become blocked. If there is an exhaust isolation valve, make sure that you cannot operate the equipment with the valve closed to avoid a **risk of bursting!**
- ☞ Always provide a free and pressureless exhaust outlet to avoid damage to pump valves and risk of bursting of condenser glassware.
- ☞ Check the overpressure safety relief device at the exhaust waste vapor condenser at appropriate intervals.



- Provide a firm, level platform for the equipment. Check that the system which you are going to evacuate is mechanically stable. Check that all fittings are secure. Ensure a stable position of the pump without any mechanical contact other than the pump feet. Comply with all applicable safety regulations.
- Comply with **maximum permissible pressures** at inlet and outlet and with **maximum permissible pressure differences** between inlet and outlet. See section "Technical data", pg. 17. Do not operate the pump with overpressure at the inlet.
- Avoid overpressure of more than 17.5 psi absolute (1.2 bar absolute) in the event that inert gas is connected to the pump, to the gas ballast or to a venting valve.
- Ensure that the **coolant outlet pipe** is always free and that it cannot get blocked. If installing an optional coolant valve, it must always be in the supply line of the exhaust waste vapor condenser.
- Keep the electrical power cord away from heated surfaces.
- **Note:** Flexible elements will shrink when evacuated.
- Ensure that no liquids can flow on or into the pump motor when assembling or disassembling vacuum lines at the pump. Risk of corrosion and/or short circuit!



**NOTICE**

Check the power source and the pump's rating plate to be sure that the power source and the equipment match in voltage, phase, and frequency.

On pumps with a dual-voltage motor, check that the voltage selection switch is set correctly. Do not change the setting of the voltage selection switch while the pump is connected to AC power. **Unplug the pump before setting the voltage selection switch.**

**Note:** If the pump is switched on with wrong voltage selection, the motor may be damaged!

Keep a minimum distance of 8 in (20 cm) between the cooling fan and surrounding items (e.g., housing, walls, etc.). Check fan regularly for dust/dirt. Clean fan guard grill if necessary to avoid a reduction of ventilation.

Use only hoses at the inlet and outlet of the pump with an inner diameter at least as large as the diameter of the pump's tubing (to avoid overpressure at the outlet, and reduction of pumping speed at the inlet).

Connect hoses gas tight at inlet and outlet of the pump. Secure coolant hoses at the hose nozzles (e.g., with hose clamp) to prevent their accidental slipping.

Allow the equipment to equilibrate to ambient temperature if you bring it from cold environment into a room prior to operation. Notice if there is water condensation on cold surfaces.

Ensure that no foreign objects can be drawn into the pump.

Comply with all **applicable and relevant safety requirements** (regulations and guidelines). **Implement the required actions and adopt suitable safety measures.**

### ***Ambient conditions***



Do not use this product in an area where it can fall or be pulled into water or other liquids.

**! DANGER**

- ➔ Do not reach for this product if it has fallen into liquid. There is a risk of deadly electrical shock. Unplug the system immediately.

**NOTICE**

To the best of our knowledge the equipment is in compliance with the requirements of the applicable EC-directives and harmonized standards (see "Declaration of Conformity") with regard to design, type and model. Directive EN 61010-1 gives in detail the conditions under which the equipment can be operated safely (see also IP degree of protection, "Technical data", pg. 17).

Adopt suitable measures in case of differences from recommended conditions, e.g., using the equipment outdoors, installation in altitudes of more than 3300 ft (1000 m) above mean sea level, conductive pollution or external condensation on the pump.

Pay attention to the **permissible maximum ambient and gas inlet temperatures** (see "Technical data", pg. 17).

Do not operate this product near flames.

### *Operating conditions*

**! DANGER**

- ➔ These pumps are not approved for operation in potentially explosive atmospheres. Do not operate the pumps in potentially explosive atmospheres.
- ➔ These pumps are not approved for the pumping of potentially explosive atmospheres. Do not pump potentially explosive atmospheres.
- ➔ The pumps are **not suitable** to pump any of the substances listed below.
- Do not pump:**
- **unstable substances**
  - substances which react explosively under **impact** (mechanical stress) without air
  - substances which react explosively when being exposed to **elevated temperatures** without air,

- **self inflammable** substances,
- substances which are **inflammable without air**
- **explosive substances**.

## NOTICE

**Do not pump** substances which may form **deposits** inside the pump. The pumps are not suitable for pumping substances which may form deposits inside the pump. Deposits and condensate in the pump may lead to increased temperatures even to the point of exceeding the maximum permitted temperatures.

Check the inlet and outlet of the pump, if there is a danger of forming **deposits** inside the pump, e.g., in the pump chambers (the pump chamber is the part between diaphragm and head cover. See section "Replacing diaphragms and valves", pg. 43). Inspect the pump chambers regularly and clean if necessary.

The pumps are **not suitable** for pumping dust and they are **not approved** for operation below ground.

**Do not pump dust** and **do not operate** the pump **below ground**.

When changing the substances pumped, we recommend to purge the pump with air or inert gas prior to changing the pumped media. Purging the pump will pump out residues and it will reduce the possibility of reactions of the pumped substances with each other and with the pump's materials.

**Consider interactions and chemical reactions of the pumped media.** Ensure that the materials of the pump's wetted parts are compatible with the pumped substances, see section "Technical data", pg. 17.

## *Safety during operation*

### DANGER

- ➔ Adopt suitable measures to prevent the release of dangerous, toxic, explosive, corrosive, noxious or polluting fluids, vapors and gases. To prevent any emission of such substances from the pump outlet, install an appropriate collecting and disposal system and take pro-

protective action for pump and environment.

**WARNING**

- ☞ Never operate this pump if it has a damaged cord or plug. If the pump is not working properly, has been dropped or has fallen into water, contact your pump service provider.
- ☞ Prevent any part of the human body from coming into contact with vacuum.
- ☞ Make sure that the exhaust pipeline cannot become blocked.
- ☞ You must take suitable precautions to prevent any formation of explosive mixtures in the pump chamber or at the outlet of the pump. In case, e.g., of a diaphragm failure, mechanically generated sparks, hot surfaces or static electricity may ignite these mixtures. Use inert gas for gas ballast or venting, if necessary.
- ☞ Drain appropriately or otherwise remove any potentially explosive mixtures at the outlet of the pump, or dilute them with inert gas to non-explosive concentrations.
- ☞ Comply with applicable regulations when disposing of chemicals. Take into consideration that chemicals may be contaminated. Take adequate precautions to protect people from the effects of dangerous substances (chemicals, thermal decomposition products of fluoroelastomers). Use appropriate protective clothing and safety goggles.
- ☞ Use only **original manufacturer's spare parts and accessories**. Otherwise the safety and performance of the equipment, as well as the electromagnetic compatibility of the equipment might be reduced. The CE mark or the cTÜVus mark may be voided if not using original manufacturer's spare parts.

**CAUTION**

- Ensure that no parts of your clothing, hair or fingers can be caught or drawn in at the inlet of the pump. Never insert fingers or drop any other object into the inlet or



outlet.

- Pay attention to the safety symbol "hot surfaces" on the equipment. Hot parts may cause burns if touched. Adopt suitable measures to prevent any danger arising from hot surfaces or electric sparks. Ensure that hot surfaces of the pump do not cause burns. Provide a suitable contact guard if necessary.
- Pumping at high inlet pressure may lead to overpressure at the gas ballast valve. Pumped gases or condensate might be expelled if the valve is open. If an inert gas supply is connected to the gas ballast, ensure that its inlet pipeline is not contaminated.
- Ensure that the **coolant outlet pipe** at the waste vapor condenser is always free and that it cannot get blocked.
- Failure of the pump (e.g., due to power interruption), failure of connected components or of parts of the supply, or a change of parameters must not be allowed to lead to a dangerous situation under any circumstances. In case of a diaphragm failure or in case of a leak in the manifold, pumped substances might be released into the environment or into the pump housing or motor. Especially comply with notes on use and operation and maintenance.
- The residual **leak rate of the equipment** might render possible an exchange of gas, albeit extremely slight, between the environment and the vacuum system. Adopt suitable measures to prevent contamination of the pumped substances or the environment.

## NOTICE

Do not start the pump if the pressure difference between inlet and outlet exceeds 16 psi (1.1 bar) at maximum. Prevent the backpressure of gases and the backflow of condensates at the outlet.

Never aspirate liquids or dust into the pump.

Check the liquid level in the catchpots regularly and drain condensate in time to prevent overflowing.

Provide appropriate protective measures to allow for the possibility of failure and **malfunction**. The protective measures must also allow for the requirements of the respective application.

### **Pumps with AC motor:**

In case of overload, the motor is shut down by a **self-hold thermal cutout** in the winding.

**Note:** Only manual reset is possible. Switch off the pump and disconnect from the power source. Identify and eliminate the cause of failure. Wait approx. five minutes before restarting the pump.



- **Note:** In case of **supply voltage below 100V**, the lock of the cutout might be impaired and the pump may restart on its own after sufficient cooling down. Take appropriate precautions, if an automatic restart of the pump may lead to a dangerous situation.

### **NOTICE**

### **Pumps with DC motor:**

A temperature sensor at the circuit board protects the motor: Current limitation in case the temperature at the circuit board raises above 158°F (70°C). At temperatures above 185°F (85°C) the pump is switched off. In case of a motor blockage (after 10 start-up attempts) the pump is switched off.

**Note:** Only manual reset is possible. Disconnect the pump from the power source. Identify and eliminate the cause of failure.

The A-weighted emission sound pressure level of the pump does not exceed 70 dB(A). Measurement according to EN ISO 2151:2004 and EN ISO 3744:1995 with standard silencer or exhaust tube at outlet.



## ***Maintenance and repair***

### **NOTICE**

In order to comply with laws (occupational, health and safety regulations, safety at work law and regulations for environmental protection) vacuum pumps, components and measuring instruments can only be returned when certain procedures (see section "**Notes on return to the factory**", pg. 53) are followed.

Take advantage of our service seminars, which put special focus on the maintenance and repair of vacuum pumps. For details see [www.vacuubrand.com](http://www.vacuubrand.com).

**Wear parts have to be replaced regularly.** In case of normal wear, the lifetime of the diaphragms and valves is > 10000 operating hours. Bearings have a typical durability of 40000 h. Motor capacitors have a typical durability in the range of 10000 to 40000 h depending strongly on operation conditions including ambient temperature, humidity or load.

### **WARNING**

☞ **Ensure that the pump cannot be operated accidentally. Never operate the pump if covers or other parts of the pump are disassembled. Never operate a defective or damaged pump.**



☞ **Switch off the pump. Disconnect the electrical power cord and wait two minutes** before starting maintenance to allow the capacitors to discharge.

☞ **Note:** The pump may be contaminated with process chemicals, which have been pumped during operation. Ensure that the pump is completely decontaminated before maintenance commences. Take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred. Use appropriate protective clothing, safety goggles and protective gloves.

### **CAUTION**

- Check every motor capacitor regularly by measuring its capacity and estimating its time in operation. Re-



place old capacitors early enough to prevent a failure in operation. If an old motor capacitor fails, the capacitor may get hot. It may even melt or emit a flame, which could be **dangerous for persons and equipment in the vicinity**. The capacitors have to be replaced by an electrician.

- Vent the pump before starting maintenance. Isolate the pump and other components from the vacuum system. Allow sufficient cooling of the pump. Separate the pump from the coolant circuit and drain condensate, if applicable.
- Ensure that **maintenance** is done only by suitably trained and supervised technicians. Ensure that the maintenance technician is familiar with the safety procedures, which relate to the products processed by the pumping system.  
Only dismantle the pump as far as necessary.

# Technical data

Type		MD 1C MD 1C + AK + EK	MZ 1C	MD 1C VARIO-SP
Maximum pumping speed 50/60 Hz (ISO 21360)	cfm (m <sup>3</sup> /h)	0.77 / 0.88* (1.3/ 1.5*)	0.44 / 0.5* (0.75 /0.9*)	1.0 (1.7)
Ultimate vacuum (absolute) without gas ballast	Torr (mbar)	1.5 (2)	9 (12)	1.5** (2**)
Ultimate vacuum (absolute) with gas ballast	Torr (mbar)	3 (4)	15 (20)	3** (4**)
Maximum permissible inlet pressure (absolute)	psi (bar)	16 (1.1)		
Maximum permissible outlet pressure (absolute)	psi (bar)	16 (1.1)		
Maximum pressure difference between inlet and outlet	psi (bar)	16 (1.1)		
Maximum permissible pressure (absolute) at gas ballast valve	psi (mbar)	17.5 (1.2)		
Permissible ambient tempera- ture storage / operation	°F (°C)	14 to 140 / 50 to 104 (-10 to +60 / +10 to +40)		
Permissible relative atmo- spheric moisture during operation (no condensation)	%	30 to 85		
Rated motor power	hp (kW)	0.01 (0.08)		0.086 (0.064)
No-load speed	rpm	1500 / 1800 *		0 - 2200 ***
Maximum permissible range of supply voltage ( ±10% ) Attention: Observe specifications of rating plate!		100-120 V~ 50/60 Hz 200-230 V~ 50/60 Hz 120V~ 60 Hz		24 V DC safe extra low voltage (SELV)*****
Maximum rated current at:				
100-120 V~ 50/60 Hz	A	1.6 / 1.7		-
200-230 V~ 50/60 Hz	A	0.8 / 0.85		-
120 V~ 60 Hz	A	1.7		-
24 V DC	A	-		7
Motor protection		thermal cutout, manual reset**** MD 1 C/US: additional fuse 2.5AT		current limi- tation (temperature sensor on the circuit board)

Type		MD 1C MD 1C + AK + EK	MZ 1C	MD 1C VARIO-SP
Degree of protection IEC 529		IP 44**** MD 1C + AK + EK: IP 40		IP 20
Inlet		hose nozzle for tubing I.D. 3/8" (hose nozzle DN 10 mm)		
Outlet		hose nozzle for tubing I.D. 5/16" (hose nozzle DN 8 mm) MD 1C + AK + EK: hose nozzle for tubing I.D. 3/8" (hose nozzle DN 10 mm)		
Coolant connection (waste vapor condenser, only "AK + EK")		hose nozzle for tubing I.D. 1/4" - 5/16" (hose nozzle DN 6-8 mm)		
Maximum permissible pres- sure of coolant at waste vapor condenser (only "AK + EK")	psi (bar)	87 (absolute) (6 (absolute))		
Permissible range of coolant temperature (waste vapor condenser, only "AK + EK")	°F (°C)	5 to 68 (-15 to +20)		
Volume of catchpot (only "AK + EK")	quarts (ml)	0.52 (500)		
Dimensions L x W x H approx.	in  (mm)	12.4 x 5.6 x 6.9 (316 x 143 x 175)	12.2 x 5.6 x 7.9 (311 x 143 x 200)	9.3 x 5.6 x 6.9 (235 x 143 x 175)
MD 1C C/US	in  (mm)	12.8 x 5.6 x 6.9 (326 x 143 x 175)	-  -	-  -
MD 1C + AK + EK	in  (mm)	12.4 x 9.4 x 15.9 (316 x 239 x 405)	-  -	-  -
Weight approx.	lbs. (kg)	15.2 (6.9)	13.2 (6.0)	9.3 (4.2)
MD 1C C/US	lbs. (kg)	15.7 (7.1)	-	-
MD 1C + AK + EK	lbs. (kg)	22.5 (10.2)	-	-
MD 1C + AK + EK C/US	lbs. (kg)	22.9 (10.4)	-	-

- \* at 50/60 Hz
- \*\* at 1500 rpm
- \*\*\* running smoothly only at motor speeds higher than 200 rpm
- \*\*\*\* In case of supply voltage below 100V, the lock of the cutout might be restricted.
- \*\*\*\*\* Pumps with voltage changeover switch: IP 40
- \*\*\*\*\* The pump is designed for operation with safe extra low voltage. Accordingly only safe extra low voltage (SELV) may be connected to the voltage supply connections.

## *Gas inlet temperatures*

Operating condition	Inlet pressure	Permitted range of gas temperatures at inlet
Continuous operation	> 75 Torr (100 mbar) (high gas load)	➡ 50 °F to 104 °F (+10°C to +40°C)
Continuous operation	< 75 Torr (100 mbar) (low gas load)	➡ 32 °F to 140 °F (0°C to +60°C)
Short-time (< 5 minutes)	< 75 Torr (100 mbar) (low gas load)	➡ 14 °F to 176 °F (-10°C to +80°C)

**We reserve the right for technical modification without prior notice!**

## Wetted parts

Components	Wetted materials
<b>Pump</b>	
Housing cover insert	PTFE carbon reinforced
Head cover	ETFE
Diaphragm clamping disc	ETFE carbon fiber reinforced
Diaphragm	PTFE
Valves	FFKM
Inlet / outlet	ETFE
Fittings	ETFE
Tubing	PTFE
<b>Pumping unit</b>	
Inlet pumping unit	PP
Outlet pumping unit	PET
Distribution head (inlet)	PPS glass fiber reinforced
Tubing	PTFE
Fittings	ETFE
O-ring at catchpot	FPM
Blind plug (inlet)	PP
Overpressure safety relief device	PTFE / silicone rubber
Exhaust waste vapor condenser / catchpot	Borosilicate glass

**We reserve the right for technical modification without prior notice!**

## Abbreviations

<b>AK:</b>	separator for condensates, catchpot at inlet or outlet
<b>EK:</b>	exhaust vapor condenser
<b>ETFE:</b>	Ethylene/Tetrafluoroethylene
<b>FPM:</b>	Fluoroelastomer
<b>FFKM:</b>	Perfluoro elastomer
<b>GND:</b>	Ground
<b>PET:</b>	Polyethylene terephthalate
<b>PP:</b>	Polypropylene
<b>PPS:</b>	Polyphenylene sulfide
<b>PTFE:</b>	Polytetrafluoroethylene
<b>PWM:</b>	Pulse width modulation

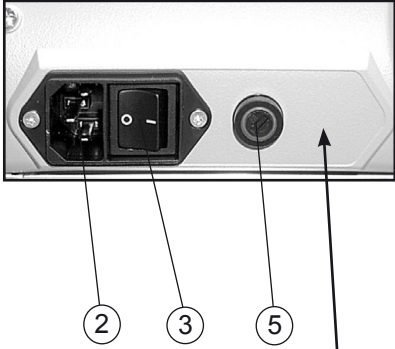
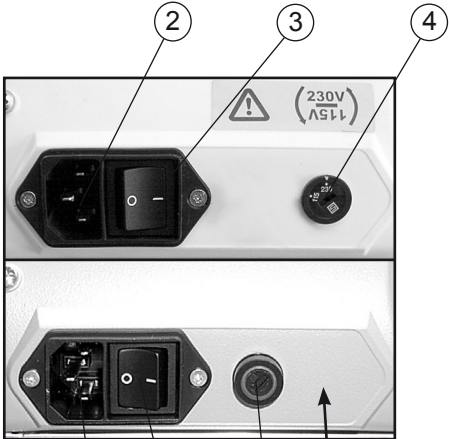
## Pump parts

Position	Component
1	Chemistry diaphragm pump MD 1C
2	Power connection
3	ON/OFF switch
4	Voltage selection switch
5	Fuse holder
6	Pump rating plate
7	Inlet
8	Outlet
9	Fan
10	Gas ballast valve

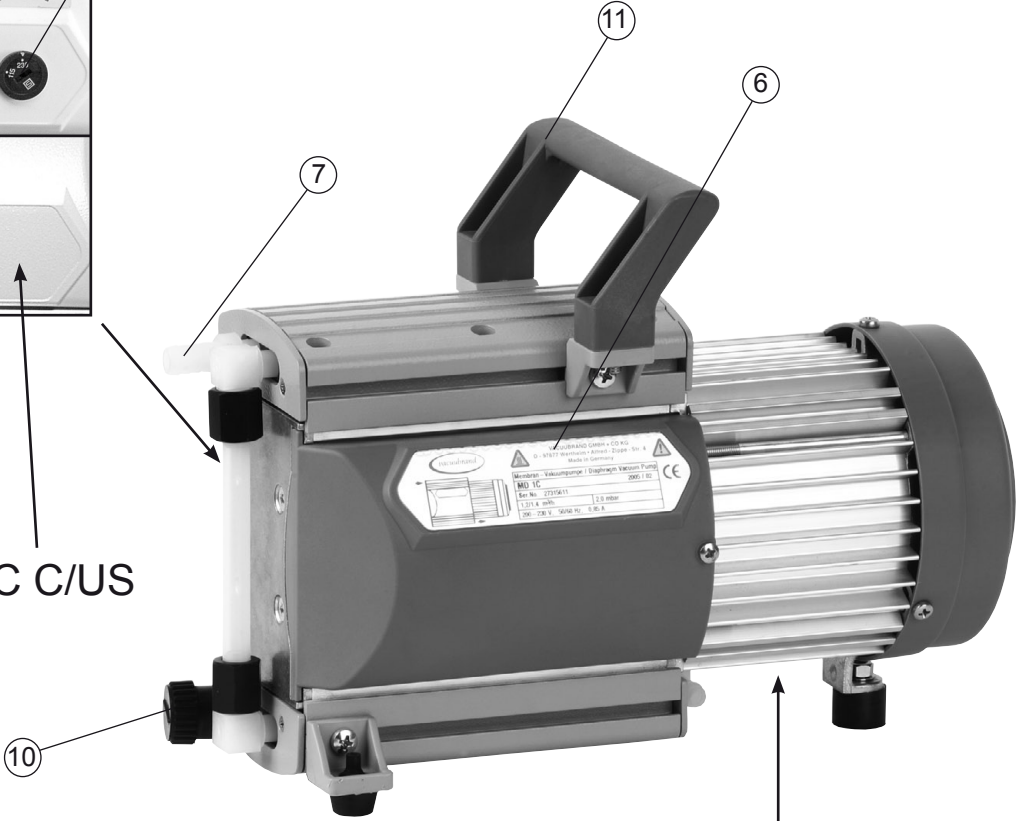
Position	Component
11	Recessed grip / handle
12	Control line
13	Exhaust waste vapor condenser
14	Catchpot
15	Coolant inlet
16	Coolant outlet
17	Overpressure safety relief device
18	Distribution head
19	Blind plug

# MD 1C

only pump with dual-voltage motor



MD 1C C/US



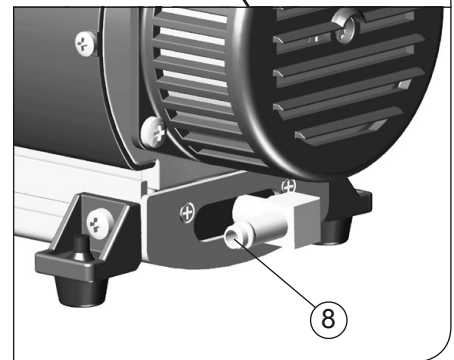




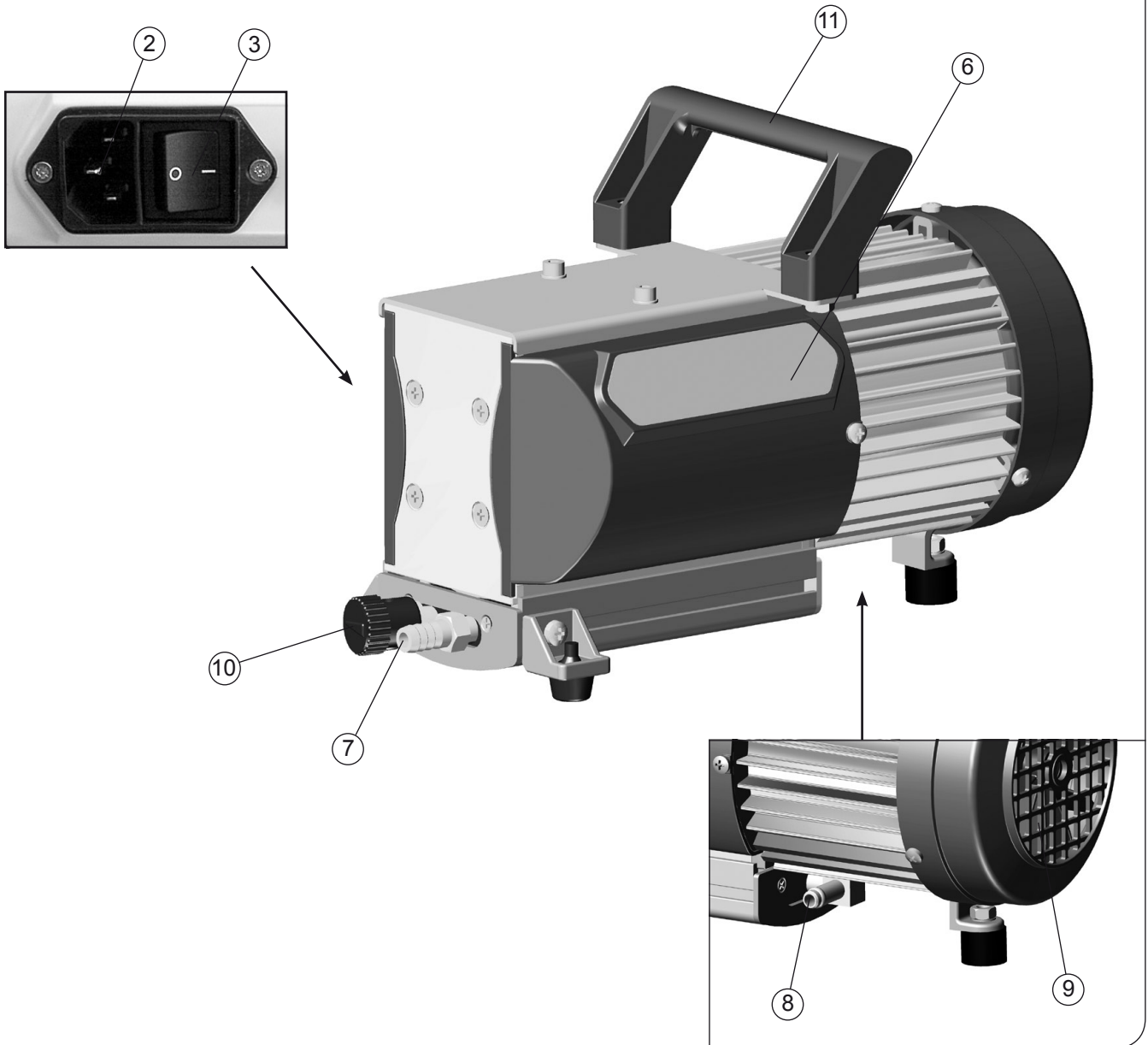
# MD 1C VARIO-SP




**Ensure sufficient venting  
of the pump!**



# MZ 1C





**Only pumps with dual-voltage motor!**

voltage selection switch

**Change the selection at the voltage selection switch only if the pump is unplugged from the power source.**

**Voltage selection switch:**


- 1. Disconnect the electrical power cord.**
- Use a screw driver to adjust the **voltage selection switch** to the supply voltage:

”115” corresponds to 90-132 V and  
”230” corresponds to 180-253 V.

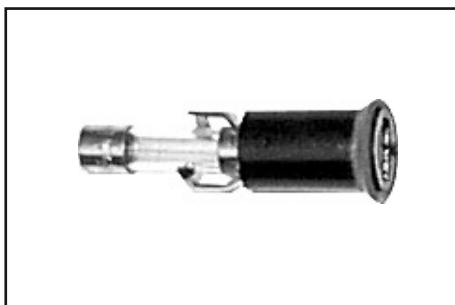
☞ Check that the voltage selection switch is positioned correctly. Check every time before starting the pump.

**Note:** If the pump is switched on with wrong voltage selection, the motor may be damaged!

**Change the selection at the voltage selection switch only if the pump is unplugged from the power source.**



### Replacing the device fuse (only MD 1C C/US)



- ➡ Unscrew the fuse holder at the side of the pump using a slotted screw driver.
- ➡ Replace the defective fuse by a fuse of the same type (see "Technical data", pg. 17). Reassemble holder with fuse to the pump.

# Use and operation

## Controlling the MD 1C VARIO-SP

### Connecting the cable:

The connecting cable contains four differently colored wires.

wire in connecting cable	assignment
red	+24V DC (supply voltage, max 7A)
blue	GND (24V)
white	voltage input: 0V to 10V DC (max. 24V) or PWM: 5V to max. 24V (depending on the control signal input for motor speed)
black	GND Signal

### External setting of the motor speed via PWM (*factory set*):

**PWM** (5V - max. 24V), frame frequency: 100Hz to 1.5kHz

0% to 100% PWM: Linear increase of the motor speed:

0 rpm (at 0% PWM) to 2200 rpm (at 100% PWM)

Pump will run smoothly only at motor speeds higher than 200 rpm, e.g., at a frame frequency of 100 Hz

and 25% PWM: pulse-width 2.5 ms

### **NOTICE**

As set at the factory, the pump is designed for operation with a control signal; i.e., without a control signal, the pump does not start!

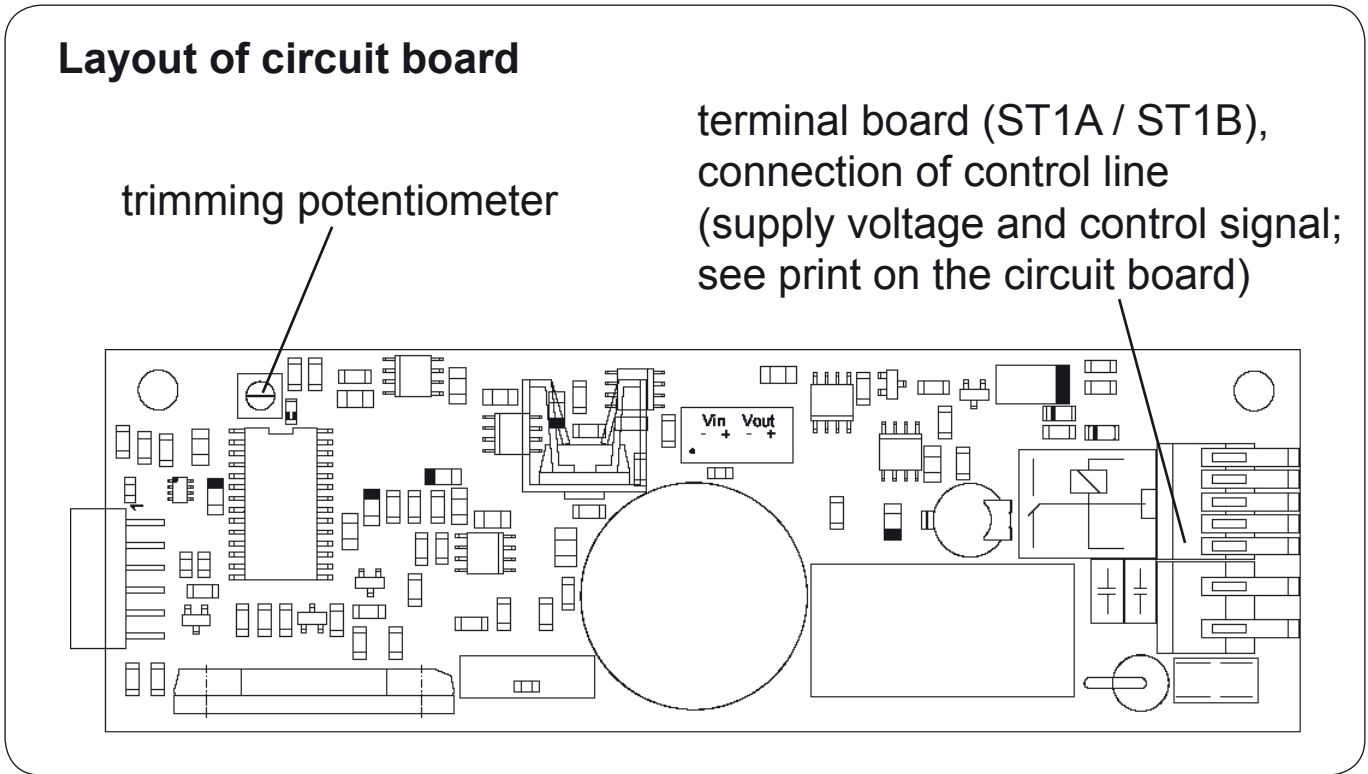
To operate the pump without a control signal, change the settings on the circuit board (see below)!

### Selecting the control signal input: (PWM / voltage / internal setting)

To select a control signal input other than the factory set one (PWM), the control line at the terminal board has to be reconnected.

Remove the screw affixing the plastic cover with the cable duct. Slide the cover aside carefully and only as far as necessary.

**Attention:** All work related to the circuit board must be carried out in a ESD protected area or under ESD protective measures! Reassemble the cover after having completed the changes.

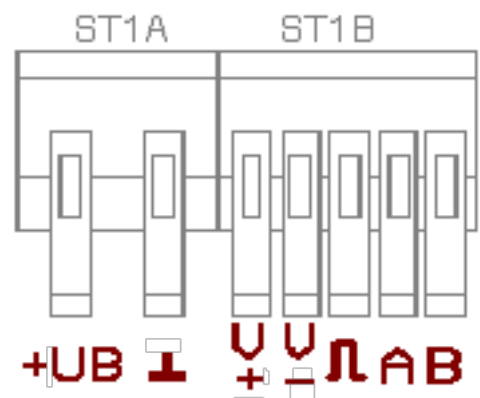


### Terminal board

(Connection of the control line on the circuit board)

#### Voltage supply:

Terminal ST1A	+UB	GND ⏚
Supply voltage	red	blue



#### Control signal (setting the motor speed):

Terminal ST1B	V+	V-	PWM ⏏	A	B
PWM	-	black	white	-	-
Voltage 0-10V DC	white	black	-	-	-
Internal setting of the motor speed	-	-	-	-	-

### ***External setting of the motor speed via voltage input:***

#### **Voltage input: analog 0V .... 10V DC (max. 24V !)**

- ➡ Connect the black and the white wire accordingly to the terminal board ST1B (see table above).

0V to 10V:

Linear increase of the motor speed (0 rpm (at 0V) to 2200 rpm (at 10V))  
(Pump will run smoothly only at motor speeds higher than 200 rpm.)

### ***Internal setting of the motor speed via trimming potentiometer:***

- ☞ Ensure that no control signal is applied, e.g., by removing the white and the black wires from the terminal board ST1B.
- ☞ Supply the pump with the required supply voltage of 24V DC.

### ***Adjusting the motor speed with the trimming potentiometer:***

Turning the trimming potentiometer to the right increases the motor speed (maximum 2200 rpm);

Turning the trimming potentiometer to the left decreases the motor speed (minimum 0 rpm). Pump will run smoothly only at motor speeds higher than 200 rpm)

- ☞ To stop pump, disconnect pump from DC voltage supply.

### ***Notes regarding the motor speed***

Pumping at **high motor speed** increases the **pumping speed** of the pump. Ensure sufficient cooling of the pump!

Pumping at **low motor speed** increases the lifetime of diaphragms and valves!

The pump attains the best ultimate vacuum in the low speed range between approx. 600 and 1000 rpm.



## ***Installing a pump in a vacuum system***

### **WARNING**

- ✎ Connect a gas-tight exhaust line at the pump outlet if necessary. Always vent exhaust gases appropriately (e.g., into a fume hood). If dangerous or polluting fluids could be released at the outlet, install an appropriate system to catch and dispose of those fluids.
- ✎ Never block the gas outlet. The exhaust line must always be free of obstructions (no back pressure) to ensure an unimpeded discharge of gas. The cross-section of the outlet tubing must be at least the size of the pump's exhaust connection.

### **CAUTION**

- Reduce the transmission of vibration. Prevent mechanical load due to rigid pipelines. Insert elastic hoses or flexible elements as couplings between the pump and rigid pipes. **Note:** Flexible elements will compress or flatten when evacuated if not designed for use under vacuum.

### **NOTICE**

Hose connections at the pump inlet must always be gas tight. Particles and dust must not be aspirated. If necessary, you must install appropriate filters. You must ensure their suitability concerning gas flow, chemical resistance and resistance to clogging prior to use.

Make sure ventilation is adequate, especially if the pump is installed in an enclosure, or if the ambient temperature is elevated. Provide external ventilation, if necessary. Keep a distance of minimum 8 in (20 cm) between fan and adjacent equipment or casework.

A power failure may cause accidental ventilation of the pump, especially if the gas ballast valve is open. If this constitutes a potential source of danger, take appropriate safety measures.

Check the power source and the pump's rating plate to be sure that the power source and the equipment match in voltage, phase, and frequency.

**Pump with dual-voltage motor:** Check that the voltage selection switch is positioned correctly. Check every time before starting the pump.

**Note:** If the pump is switched on with wrong voltage selection, the motor may be damaged!

**Change the selection at the voltage selection switch only if the pump is unplugged from the power source.**

**Voltage selection switch:**

- 1. Disconnect the electrical power cord.**
- Use a screw driver to adjust the **voltage selection switch** to the supply voltage:

"115" corresponds to 90-132 V and  
"230" corresponds to 180-253 V.



voltage selection switch



Use connecting hoses with large diameter and keep them as short as possible to avoid flow losses. Locate the pump as closely as possible to the application.

Always install outlet tubing descending from the pump to avoid backflow of condensate towards the pump.

Use a suitable valve to isolate the pump from the vacuum application. This is to allow the pump to warm up before pumping condensable vapors and to clean the pump after use before it is switched off.

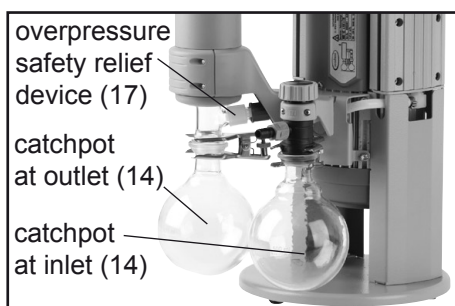
When assembling, ensure **vacuum-tightness**. After assembly, check the whole system for leaks.

Secure hose connections at the pump appropriately, e.g., with hose clamps, to protect against accidental detachment.

## ***Separator (inlet) and exhaust waste vapor condenser (outlet)***

### **Assembling the hose nozzle with union nut:**

- ➔ Take the hose nozzle with attached compression ferrule and union nut out of the catchpot and put onto inlet connection.
- ➔ Tighten the union nut by hand until you can feel the stop. Then tighten an additional 1/4 rotation with an open-ended wrench (size 17mm) for final installation.



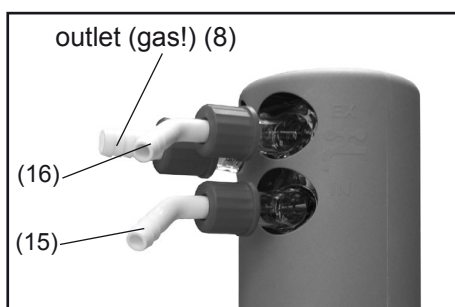
### **Catchpots:**

The catchpot at the inlet protects against droplets and particles from entering the pump.

- ☞ Enhances lifetimes of diaphragms and valves.
- ☞ Improves vacuum performance in applications with condensable vapors.

Both catchpots are coated with a protective layer to protect against shattering in case of breakage or implosion.

- ➔ Assemble the catchpots at the inlet and at the outlet using joint clips.



### **Exhaust waste vapor condenser:**

- ➔ Assemble the hose nozzles for coolant inlet (15) and coolant outlet (16) tubing at the exhaust waste vapor condenser.

The **exhaust waste vapor condenser** enables an efficient condensation of the pumped vapors at the outlet.

- ☞ No backflow of condensates.
- ☞ Controlled recovery of condensates.
- ☞ Close to 100% solvent recovery.
- ☞ The isolation cover protects against glass splinters in case of breakage, acts as thermal isolation to avoid condensation of humidity and is intended to absorb shocks.

**WARNING**

- ☞ Never block the gas outlet ((8) hose nozzle for tubing I.D. 3/8" (10 mm)). The exhaust hose has always to be unobstructed and without back pressure to enable an unhindered discharge of gases and protect the pump valves from damage.
- ☞ Prevent the discharge of dangerous gases and vapors to the surrounding atmosphere. If appropriate, connect the exhaust line to a suitable treatment system.

**CAUTION**

- **Note:** Install the hoses of the cooling system in a way to avoid the flow / dripping of condensed water onto the pumping unit (especially cables and electronic parts).
- Ensure that the **coolant outlet tubing** is always unobstructed and that it cannot get blocked.
- Maximum permissible coolant pressure at the exhaust waste vapor condenser: 87 psi (6 bar) absolute. Outlet flow must always be unhindered.
- Comply with the maximum permissible coolant pressures of additional components in the coolant circuit (e.g., coolant valve).
- Avoid overpressure in the coolant circuit (e.g., caused by blocked or squeezed coolant hoses).
- Only install the optional coolant valve in the supply line of the exhaust waste vapor condenser.

**NOTICE**

Attach the tubing of the coolant circuit to the respective hose nozzles (hose nozzles for tubing I.D. 1/4"-5/16" (6-8 mm), see image) at the waste vapor condenser. Check all hose connections prior to starting operation of the cooling system.

Secure coolant hoses at the hose nozzles (e.g., with hose clamps) to prevent their accidentally slipping off.

## *During operation*

### **WARNING**

☞ Vent and dispose of **potentially dangerous gases or vapors** at the outlet of the pump appropriately.

### **CAUTION**

- Due to the high compression ratio, the pump might generate overpressure at the outlet. Check pressure compatibility with system components (e.g., exhaust tubing or exhaust valve) at the outlet. Ensure that the pump outlet is neither blocked nor restricted.

### **NOTICE**

**Maximum ambient temperature:** 104 °F (40 °C)

Check the maximum temperatures, if installing the pump in a cabinet or a housing. Make sure ventilation is adequate, especially if the ambient temperature is elevated.

If pumping condensable vapors (water vapor, solvents, etc.), let the pump run with **gas ballast** to help purge any condensation in the pump.

If the pump is installed at an altitude of more than 3300 ft (1000 m) above mean sea level, check compatibility with applicable safety requirements, especially IEC 60034. There is a risk of the motor overheating due to insufficient cooling.

Do not start the pump, if the **pressure difference between inlet and outlet ports exceeds max. 16.0 psi (1.1 bar)**. Attempts to start the pump at higher pressure difference may cause stalling and damage of the motor.

Check compatibility with the **maximally permitted pressure** at outlet and the **maximum pressure difference** between inlet and outlet ports.

Prevent internal condensation, transfer of liquids or dust. The diaphragms and valves will be damaged if liquids are pumped in significant amounts.

Check the pump regularly for external soiling and deposits. Clean the pump if necessary to avoid an increase of the pump's operating temperature.

**Pumps with AC motor:**

In case of overload, the motor is shut down by a **self-hold thermal circuit breaker** in the winding.

**Note:** Only a manual reset is possible. Switch off the pump and disconnect the electrical power cord. Identify and eliminate the cause of failure. Wait approximately five minutes before restarting the pump.

**CAUTION**

- **Note:** In case of **supply voltage below 100V**, the lock of the breaker may not latch and the pump might restart on its own after sufficient cooling. Take appropriate precautions, if an automatic restart of the pump may lead to a dangerous situation.

**Pumps with DC motor:**

A temperature sensor at the circuit board protects the motor: Current limitation in case the temperature at the circuit board raises above 158°F (70°C). At temperatures above 185°F (85°C) the pump is switched off. In case of a motor blockage (after 10 start-up attempts) the pump is switched off.

**Note:** Only manual reset is possible. Disconnect the pump from the power source. Identify and eliminate the cause of failure.

**NOTICE**

A warm up period (approximately 15 min.) is required to ensure that the rated ultimate vacuum and pumping speed are attained. Avoid overheating (e.g., due to hot process gases).



## ***Important notes regarding the use of gas ballast***

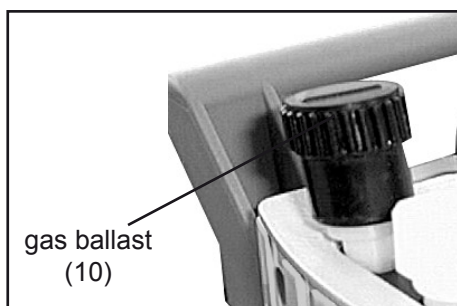
Gas ballast is a continuous purge to keep the pump's interior as clean as possible and to reduce the possibility of condensation inside the pump.

### **WARNING**

- ✎ Air and pumped media might react inside the pump or at the outlet of the pump and form hazardous or explosive mixtures, when you use air rather than inert gas for the gas ballast. This constitutes a risk of significant damage to equipment and/or facilities, a risk of personal injury or even loss of life.
- ✎ Make sure that air/gas intake through the gas ballast valve can never lead to hazardous, explosive or otherwise dangerous mixtures. If in doubt, use inert gas.

### **NOTICE**

To reduce condensation in the pump, do not pump vapor before the pump has reached its operating temperature. Open the gas ballast valve when pumping condensable vapors. Turn gas ballast cap to open valve.



For **condensable vapors** (water vapor, solvents, etc.):

- The gas ballast valve is open if the arrow on the gas ballast cap is pointing away from the pump (MD 1C / MD 1C VARIO-SP), respectively towards the pump (MD 1C + AK + EK) or away from the inlet (MZ 1C).
- With gas ballast valve open, the ultimate vacuum will be reduced.
- Use inert gas for gas ballast to avoid the formation of explosive mixtures.
- Close the gas ballast valve by turning the cap 180°.

In case of low boiling solvents (when the formation of condensate is unlikely), the use of gas ballast might be unnecessary. Operating the pump without gas ballast increases the solvent recovery rate at the exhaust waste vapor condenser.



## ***Important notes concerning the operation of the exhaust waste vapor condenser***

### **WARNING**

- ☞ Do never block the gas outlet ((8) hose nozzle for tubing I.D. 3/8" (10 mm)). The exhaust hose must always be unobstructed and pressureless to enable an unhindered discharge of gases.
- ☞ Connect the exhaust to a suitable treatment system to prevent the discharge of dangerous gases and vapors to the surrounding atmosphere.

### **CAUTION**

- Ensure that the **coolant outlet hose** is always free and that it cannot get blocked.
- Check the overpressure safety relief device (17) at the exhaust waste vapor condenser (13) regularly; replace if necessary. Check especially for deterioration, coalescence and cracks.
- Maximum permissible coolant pressure at the exhaust waste vapor condenser: 87 psi (6 bar) absolute
- Comply with the maximum permissible coolant pressures of additional components in the coolant circuit (e.g., coolant valve).
- We strongly recommend installing an optional coolant valve **in the supply line** of the exhaust vapor condenser to save water and reduce the risk of water spill.
- Avoid overpressure in the coolant circuit (e.g., caused by blocked or kinked coolant hoses).

### **NOTICE**

In case of **condensation**: Check the liquid level in both catchpots (14) during operation. Avoid overflowing of the catchpots. Install a level sensor (order-no. 699908) for monitoring, if necessary (VACUUBRAND controller CVC 3000 or VNC 2 is required).

Do not allow the catchpots to get overfilled. The maximum liquid level is at approximately 80% of the total filling level to avoid problems when removing the catchpots. Check the liquid level in both catchpots regularly. Drain catchpots in time to avoid overflow.

Permissible range of coolant temperature at the exhaust waste vapor condenser:

5 °F to 68 °F (-15°C to +20°C)

Check hose connections prior to starting operation of the cooling system.

Check coolant hoses regularly during operation.

### **Removing the catchpots:**

Catchpot at outlet:

Remove joint clip. Remove catchpot and drain condensate.

### **NOTICE**

Catchpot at inlet:

Admit air or inert gas (via the pump inlet) to restore atmospheric pressure in the catchpot before attempting removal. Remove joint clip. Remove catchpot and drain condensate.

- Reattach drained catchpots.

**Important:** Comply with regulations when disposing of solvents/condensates. Recycle if possible; purify if contaminated.

## ***Shutdown & storage***

The pump can be switched off under vacuum.

### **NOTICE**

#### **Short-term:**

Has the pump been exposed to condensate?

Allow the pump to continue to run at atmospheric pressure for a few minutes.

Has the pump been exposed to media which may damage the pump materials or form **deposits**?

Check and clean pump heads if necessary.

#### **Long-term:**

Take measures as described above regarding short-term shutdown.

Separate the pump from the application

Drain condensate.

Close inlet and outlet ports (e.g., with transport caps).

Close the gas ballast valve.

Store the pump under dry conditions.

# Accessories



**Digital vacuum gauge DVR 2** ..... **682902**

**Vacuum hose (caoutchouc) I.D. 3/8" (10 mm ID)** ..... **686002**  
**Silencer for hose nozzle 3/8" (DN 10 mm)** ..... **636588**

**Attention:** Dust-laden gases, deposits and condensed solvent vapor can restrict air flow out the silencer. The resultant back pressure can lead to damage of pump bearings, diaphragms, and valves. Under those conditions, a silencer must not be used.

## Upgrade possibilities for MD 1C + AK + EK:

**Upgrade kit SYNCHRO** ..... **699920**  
 to two inlets (valve block; replaces distribution head)  
**Modification kit for small flange KF DN 16**..... **699939**  
 at inlet of distribution head  
**Hose nozzle for tubing I.D. 1/4" / 3/8" (DN 6/10 mm),**..... **636635**  
 for inlet at distribution head  
**Elbow piece (90°) for PTFE tubing\*** ..... **637873**  
 for assembly at inlet of distribution head  
**Blind flange (C1) for assembly at valve block or distribution head** ..... **677136**  
**Flow control diaphragm valve (C2)** ..... **677137**  
 for assembly at valve block or distribution head  
**Solenoid operated valve (C3-B)** ..... **636668**  
 for assembly at valve block or distribution head  
**Manometer module (C5)** ..... **677100**  
 for assembly at valve block or distribution head  
**Controller CVC 3000** ..... **683160**  
**In-line valve VV-B 6C** ..... **674291**  
**Level sensor for catchpots** ..... **699908**  
**Elbow connecting piece (90°) for PTFE tubing\*** ..... **638434**  
**T-piece for PTFE tubing\*** ..... **638435**  
**PTFE tubing\* (sold by meter)**..... **638644**

\* PTFE tubing O.D. / I.D. 3/8" / 5/16" (DN 10/8 mm)

For additional accessories such as vacuum valves, small-flange components, vacuum gauges or vacuum controllers, refer to [www.vacuubrand.com](http://www.vacuubrand.com)

# Troubleshooting

Fault	Possible cause	Remedy
<input type="checkbox"/> Pump does not start or stops immediately.	<ul style="list-style-type: none"> <li>➔ Electrical power cord not plugged in, electrical supply failure?</li> <li>➔ Device fuse blown (if applicable)?</li> <li>➔ Overpressure in outlet line?</li> <li>➔ Motor overloaded?</li> </ul>	<ul style="list-style-type: none"> <li>✓ Plug in power cord. Check fuse. Check electrical supply voltage.</li> <li>✓ Identify cause of failure. Replace device fuse.</li> <li>✓ Remove blockage in line, open valve, or reduce overpressure.</li> <li>✓ Allow motor to cool down, identify and eliminate cause of failure. Manual reset is necessary. Switch off pump or unplug.</li> </ul>
<input type="checkbox"/> Pump does not achieve its ultimate vacuum or usual pumping speed.	<ul style="list-style-type: none"> <li>➔ Centring ring at small flange connection not correctly positioned, or leak in the pipeline or vacuum system?</li> <li>➔ Long, narrow vacuum line?</li> <li>➔ Pump has been exposed to condensate?</li> <li>➔ Deposits have been formed inside the pump?</li> <li>➔ Diaphragms or valves damaged?</li> <li>➔ Outgassing substances or vapor generated in the process?</li> <li>➔ Only <b>VARIO-SP</b> version: Pump temperature too high (motor speed reduced)?</li> </ul>	<ul style="list-style-type: none"> <li>✓ Check pump directly - connect vacuum gauge directly at pump inlet - then check connection, pipeline and vacuum system if necessary.</li> <li>✓ Use lines with larger diameter, length as short as possible.</li> <li>✓ Allow pump to run for some minutes with atmospheric pressure at the inlet to purge.</li> <li>✓ Clean and inspect the pump heads.</li> <li>✓ Replace diaphragms and/or valves.</li> <li>✓ Check process parameters.</li> <li>✓ Ensure sufficient cooling of the pump or reduce inlet pressure.</li> </ul>

Fault	Possible cause	Remedy
<input type="checkbox"/> Pump too noisy.	<ul style="list-style-type: none"> <li>➔ Atmospheric or high pressure at the pump inlet?</li> <li>➔ Diaphragm crack or diaphragm clamping disc loose?</li> <li>➔ Other than above mentioned causes?</li> </ul>	<ul style="list-style-type: none"> <li>✓ Connect hose or silencer to pump outlet. Be careful not to cause outlet over-pressure, especially with condensable vapors.</li> <li>✓ Perform maintenance.</li> <li>✓ Contact local distributor.</li> </ul>
<input type="checkbox"/> Pump seized.		<ul style="list-style-type: none"> <li>✓ Contact local distributor.</li> </ul>

- ➔ A service manual with exploded view drawings, spare parts list and directions for repair is available on request.
- 👉 The service manual is intended for trained service people only.

# Replacing diaphragms and valves

- ☞ Please read section "Replacing diaphragms and valves" completely before starting maintenance.

The pictures may show other versions of pumps. This does not change the method of replacing diaphragms and valves.

## WARNING

- ☞ Never operate the pump if covers or other parts of the pump are disassembled.

**Never operate a defective or damaged pump.**



- ☞ Before starting maintenance, **disconnect the electrical power cord. Wait two minutes** after isolating the equipment from power to allow the capacitors to discharge.
- ☞ Ensure that the pump cannot be operated accidentally.

- ☞ **Note:** The pump might be contaminated with the process chemicals that have been pumped during operation. Ensure that the pump is decontaminated before maintenance. Take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred. Ensure that the maintenance technician is familiar with the safety procedures which relate to the products processed by the pumping system. Use appropriate protective clothing, safety goggles and protective gloves.

- ☞ Avoid the release of pollutants.

## CAUTION

- **Ensure that maintenance is done only by suitably trained and supervised technicians.**
- Check every motor capacitor regularly by measuring its capacity and estimating its service life. Replace old capacitors early enough to prevent a failure. The capacitors must be replaced by a trained electrician.
- Allow sufficient cooling of the pump before starting maintenance. Separate the pump from the coolant circuit and drain condensate, if applicable.

- **Vent the pump and isolate it from the vacuum system before you start maintenance.**

## NOTICE

The valves and diaphragms as well as the motor capacitors are wear parts. If the rated ultimate vacuum is no longer achieved or in case of increased noise level, the pump interior, the diaphragms and the valves must be cleaned and the diaphragms and valves must be checked for cracks or other damage.

All bearings are encapsulated and are filled with long-life lubricant. Under normal operating conditions, the drive system is maintenance free.

In demanding circumstances, it may be efficient to check and clean the pump heads on a regular basis. In normal use, the lifetime of the diaphragms and valves is more than 10,000 operating hours.

- Prevent internal condensation, transfer of liquids or dust. The diaphragms and valves will be damaged if liquid is pumped in significant amount.
- Carry out maintenance frequently if the pump is exposed to corrosive media or in case of deposits.
- Regular maintenance will improve the lifetime of the pump and also protect both users and the environment.

**Service kit for MD 1C** (diaphragms, valves, diaphragm key) ..... **696828**

**Service kit for MZ 1C** (diaphragms, valves, diaphragm key) ..... **696838**



### Tools required (metric):

- Diaphragm key width 46 mm
- Open end wrench width 14 / 17 mm
- 4 mm wide Allen key

### Additionally for MD 1C:

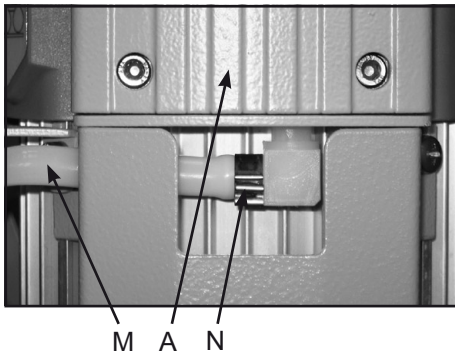
- Phillips screwdriver size 2

### Additionally for MD 1C + AK + EK:

- 2.5 mm wide slotted screwdriver
- Flat pliers
- 5 mm wide Allen key



## Cleaning and inspecting the pump heads



### MD 1C + AK + EK:

- ➔ Remove catchpots (14) at inlet and outlet (see "Use and operation", page 27).

Detach the coupling of the hose connection (M) to the inlet/outlet of the vacuum system below the housing cover (A).

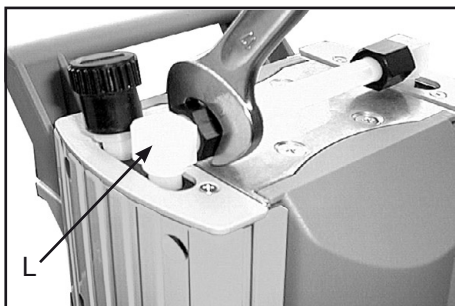
- ➔ Open the hose clip (N) with a slotted screwdriver.
- ➔ Pull the tubing off the hose connector.



### Opening the hose clip:

- ➔ Apply slotted screwdriver as shown and turn.

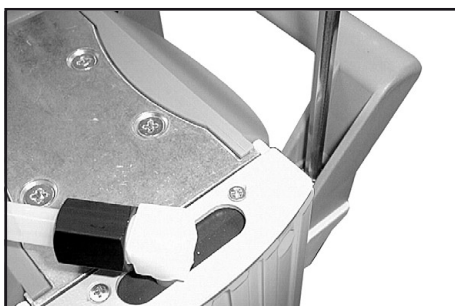
- ☞ Service only one side of the pump at a time to avoid the mixing of parts.



- ➔ Loosen the union nut (K) of the hose connection next to the gas ballast valve with an open-ended wrench (w/f 17).

- ➔ Turn the fitting (L) with an open-ended wrench (w/f 14) to detach the hose from the pump head (1/4 of a turn at maximum).

- ☞ Do not remove the elbow fitting from the pump head; during reassembly a leak may result.

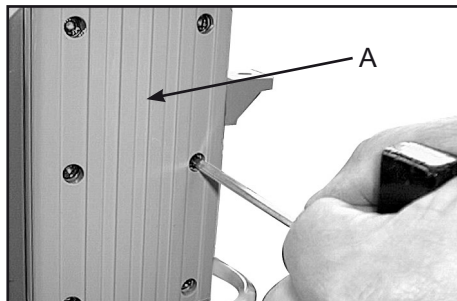


### MD 1C + AK + EK:

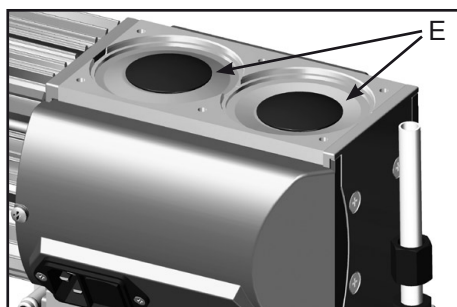
- ➔ Loosen the screw affixing the handle (use 5 mm wide Allen key) at one housing cover.
- ☞ It is not necessary to remove the waste vapor condenser.

**MD 1C:**

- Loosen slightly the two Phillips screws affixing the handle (use Phillips screw driver size 2) in order to move the handle.

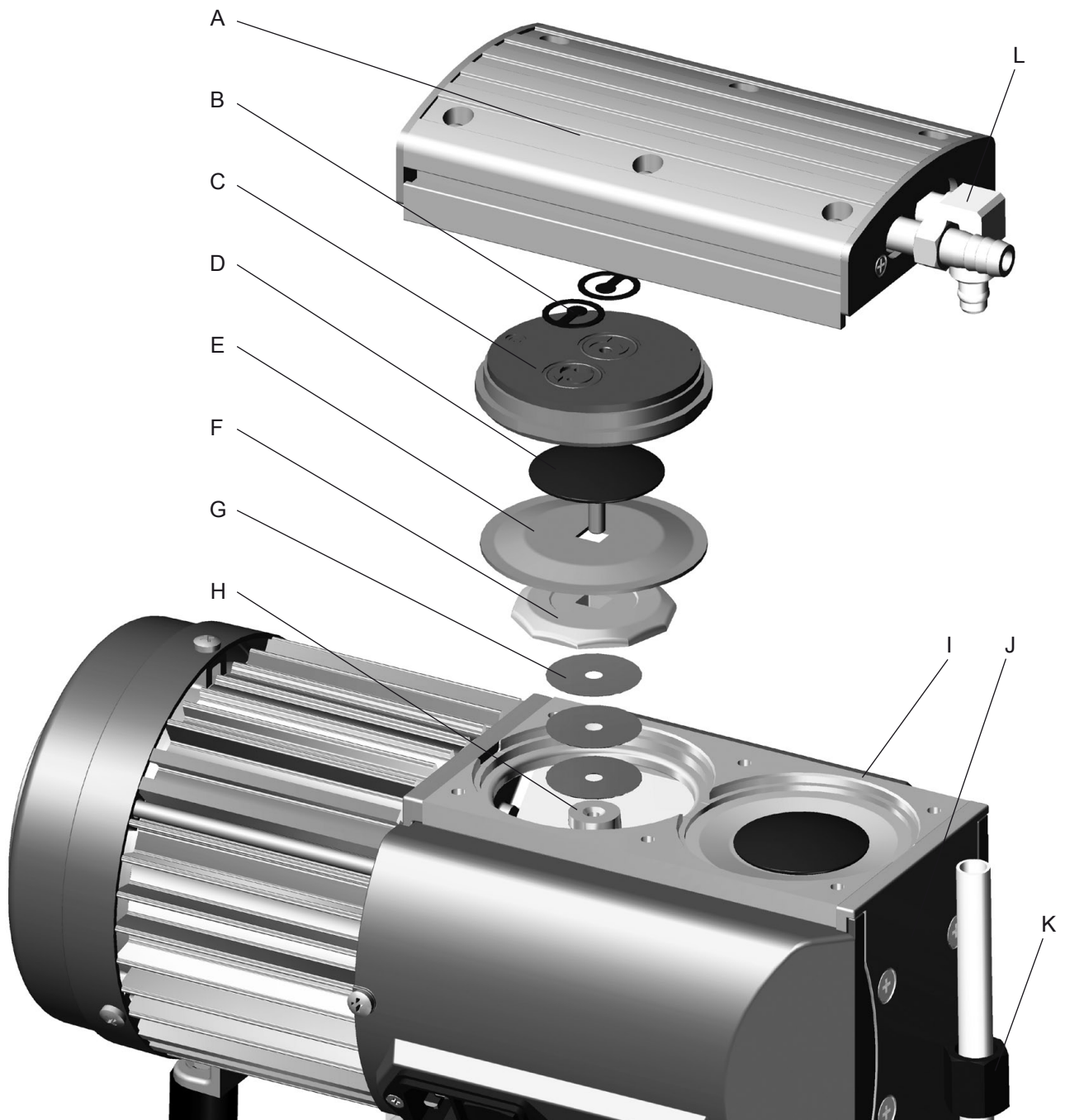


- Disassemble the housing cover (A) to check the valves (B).
- Unscrew six Allen screws with a 4mm wide Allen key. Remove the housing cover with housing cover insert (A) together with head covers (C) and valves (B).
- ⚠ Never use a pointed or sharp-edged tool to remove parts (e.g., screwdriver). We recommend using a rubber mallet or compressed air (to be blown carefully into port).



- Remove the head cover (C) carefully from the housing cover (A). Note position and alignment of valves (B). Remove the valves.
- ⚠ Replace valves if necessary.
- ⚠ Use petroleum ether or other industrial solvent to remove deposits. Do not inhale vapors.
- ⚠ Check diaphragms (E) for damage and replace if necessary.

## View of the disassembled pump head parts



### Pump head parts:

A: Housing cover with insert

B: Valves

C: Head cover

D: Diaphragm clamping disc  
with square head screw

E: Diaphragm

F: Diaphragm support disc

G: Washer

H: Connecting rod

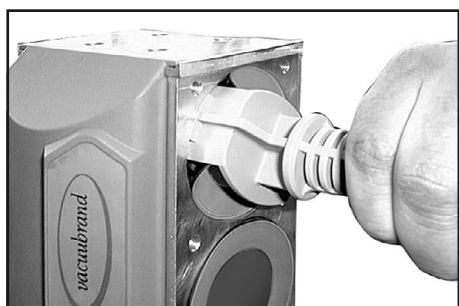
I: Housing

J: Housing bearing flange

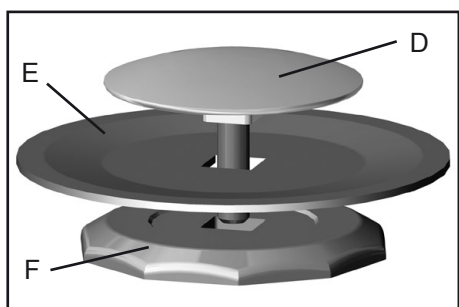
K: Union nut

L: Fitting

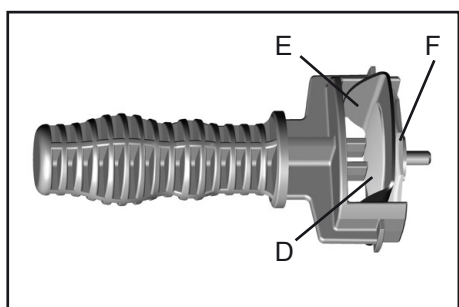
## Replacing the diaphragm



- Lift diaphragm carefully sidewise.
- ☞ Never use a pointed or sharp-edged tool to lift the diaphragm. If necessary, press down the diaphragm clamping disc of the adjacent pump head to bring the diaphragm into its upper turning point position.
- Use the diaphragm key to grip the diaphragm support disc (F) below the diaphragm.
- Unscrew diaphragm support disc (F) with diaphragm (E) and diaphragm clamping disc (D).
- Check for washers (G) between the diaphragm support disc (F) and the connecting rod (H). Do not mix the washers from the different pump heads, since these are set at the factory to ensure proper pump performance. Make sure that the original number is reassembled at the individual pump head.
- ☞ Too few washers: The pump will not attain vacuum specification. Too many washers: Diaphragm clamping disc will hit head cover, causing noisy operation and possibly causing the pump to seize up.
- ☞ If the old diaphragm is difficult to separate from the diaphragm support disc, immerse assembly in naphtha or petroleum ether. Do not inhale vapors!



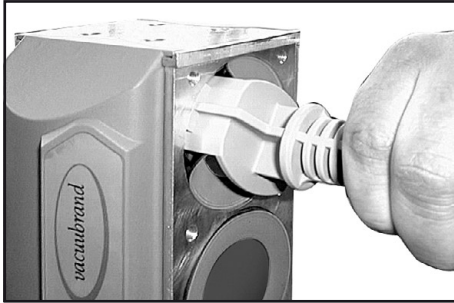
- Position new diaphragm (E) between diaphragm clamping disc with square head screw (D) and diaphragm support disc (F).
- ☞ **Note:** Position diaphragm with pale side towards diaphragm clamping disc (facing pump chamber).



- ☞ Make sure that the square head screw of the diaphragm clamping disc is correctly seated in the guide hole of the diaphragm support disc.
- Lift the diaphragm at the side. Place the diaphragm carefully together with diaphragm clamping disc and diaphragm support disc in the diaphragm key.



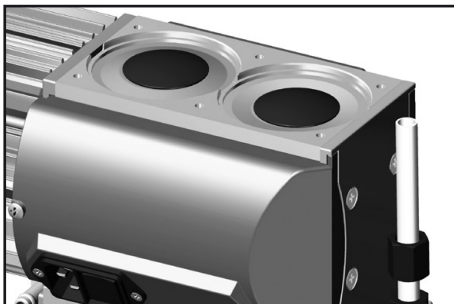
- ☞ Avoid damage of the diaphragm: Do not excessively bend or crease the diaphragm.



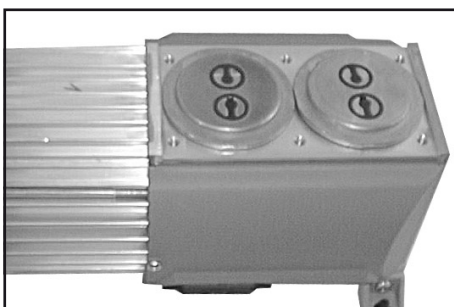
- ☞ Assemble the original number of washers (G) between diaphragm support disc (F) and connecting rod (H).
- ➔ Screw diaphragm clamping disc (D), diaphragm (E), diaphragm support disc (F), and washers (G) to connecting rod (H).

- ➔ Optimum torque for the diaphragm support disc: 3 ft·lb<sub>f</sub> (4 Nm).

## Assembling the pump heads



- ➔ Bring the diaphragms (E) into a position, in which they are in contact with the housing (I) and centered with respect to the bore.
- ☞ Lay the pump down and support it appropriately (MD 1C + AK + EK).

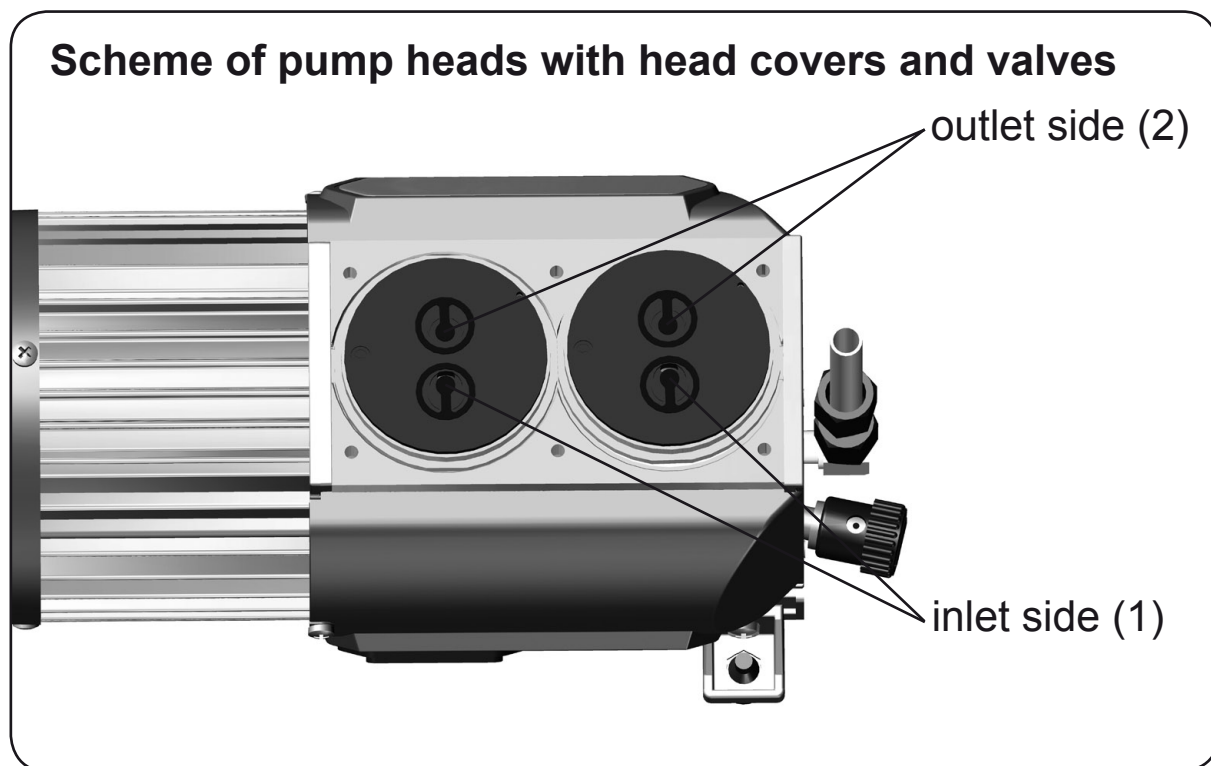


- ➔ Put on head covers (C).
- ☞ Pay attention to the correct orientation of the head covers (see figure below).
- ☞ Make sure that the diaphragms stay centered with respect to the bores so that they will become clamped uniformly between housing (I) and head covers (C).

- ➔ Put the valves (C) in place. See figure below for the correct position of the valves:

**Inlet side** of pump head: The valve tongue points at the kidney-shaped orifice in the valve seat (1).

**Outlet side** of pump head: The valve is oriented the opposite direction as the valve at the inlet side. Round orifice under the valve tongue (2).

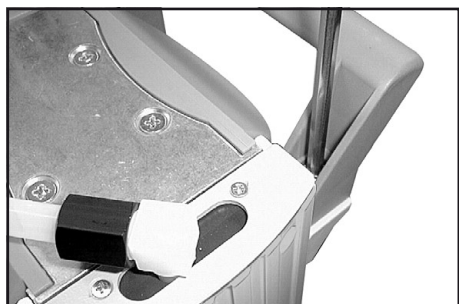


- ➔ Put on housing cover (A).
- ☞ Move housing cover slightly to ensure that the head covers are correctly positioned.



- ➔ Screw in the Allen head screws at the head covers diagonally at first slightly with a 4 mm wide Allen key, then tighten.
- ☞ Maximum torque: 4.4 ft·lb<sub>f</sub> (6 Nm).

**Replace diaphragms and valves of the opposite side of the pump in the same way (not applicable to MZ 1C)!**



- MD 1C + AK + EK:**
- ➔ Assemble handle with screws and tighten (use 5 mm wide Allen key).

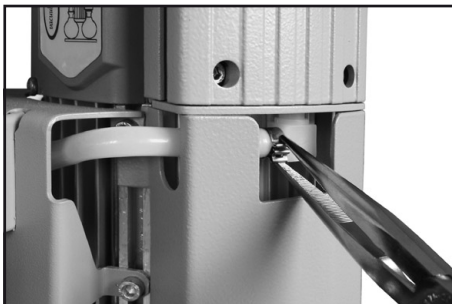
**MD 1C:**

- ☞ Ensure that the handle is positioned over the pump's center of gravity. The handle is correctly positioned if the end of the handle is flush with the end of the housing cover.
- ➔ Move handle into correct position and tighten screws (use Phillips screw driver size 2).

## Assembling the fitting



- ➔ Slip the hose onto the hose connector by turning the fitting (L) with an open-ended wrench w/f 14.
- ➔ Tighten the union nut (K) of the hose connection with an open-ended wrench w/f 17.
- ☞ Tighten union nuts first by hand and then tighten one full turn using the open ended wrench.

**MD 1C + AK + EK:**

- ☞ Affix the connection hose to the inlet or outlet of the vacuum system at the fitting below the housing cover.
- ➔ Slip connecting hose onto hose connection of fitting.
- ➔ Close hose clip with flat pliers.
- ➔ Assemble catchpots (14) with joint clips.

**If the pump does not achieve the ultimate vacuum:**

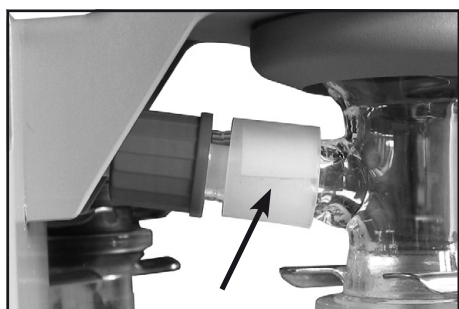
- Whenever the diaphragms and valves have been replaced, a break-in period of several hours is required before the pump achieves its ultimate vacuum.
- In case of an unusual noise, switch off pump immediately and check clamping disc positions.

If the specified ultimate vacuum is not achieved, and if this does not change after the break-in period:

Check hose connectors for leaks. If necessary recheck valve seats and diaphragms.



# Cleaning and replacing components



**Overpressure safety relief device** ..... **638821**  
(at exhaust waste vapor condenser)

- Remove catchpot (14) at outlet (see "Use and operation", page 27).
- Loosen the union nut at the inlet of the exhaust vapor condenser.



- Remove the 4 screws affixing the counter holder of the exhaust vapor condenser with a Torx driver T10. Remove the exhaust vapor condenser. In doing so pull the PTFE hose out of the inlet of the exhaust vapor condenser.
- In case pull off the old pressure relief valve and install the new one. Check for correct position of the PTFE-foil under the pressure relief valve.
- Feed the PTFE hose into the inlet of the exhaust vapor condenser. Mount the condenser with the counter holder (Torx screws T10) to the pump. Fasten union nut.



**Catchpot**  
0.52 qt (500 ml), coated ..... **638497**

**O-ring 28 x 2.5**.....**3120553**  
(FPM) at the spherical ground joint of the catchpot at the inlet

# Notes on return to the factory

## Repair - return - DKD calibration

### **NOTICE**

Safety and health of our staff, laws and regulations regarding the handling of dangerous goods, occupational health and safety regulations and regulations regarding safe disposal of waste require that for all pumps and other products, the “**Health and safety clearance form**“, see pg. 57, must be sent to our office fully completed and signed before any equipment is shipped to the authorized service center.

Fax or mail a completed copy of the health and safety clearance form to us in advance. The declaration must arrive before the equipment. **Enclose a second completed copy with the product.** If the equipment is contaminated, you must notify the carrier.

**No repair / DKD calibration is possible unless the correctly completed form is returned. Inevitably, there will be a delay in processing the equipment if information is missing, or if this procedure is not followed.**

### **CAUTION**

If the product has come in contact with chemicals, radioactive substances or other substances dangerous to health or environment, the product must be decontaminated **prior to sending it back to the service center.**

- Return the product to us disassembled and cleaned and accompanied by a certificate verifying decontamination or
- Contact an industrial cleaning and **decontamination service** directly or
- Authorize us to send the product to an industrial cleaning facility **at your expense.**

To expedite repair and to reduce costs, please enclose a detailed description of the problem and the product's operating conditions with every product returned for repair.

We submit **repair quotations** only on request and always at the customer's expense. If an order is placed, the costs incurred for problem diagnosis are offset from the costs for repair or from the purchase price, if the customer prefers to buy a new product instead of repairing the defective one.

- **If you do not wish a repair on the basis of our quotation, the equipment may be returned to you disassembled and at your expense.**

In many cases, the **components must be cleaned in the factory** prior to repair.

For cleaning we use an environmentally friendly water-based process. Unfortunately the combined attack of elevated temperature, cleaning agent, ultrasonic treatment and mechanical stress (from pressurized water) may result in damage to the paint. Please mark in the health and safety clearance form, if you wish a **repaint at your expense** just in case such a damage should occur.

We will also replace parts for cosmetic reasons at your request and at your expense.

## **NOTICE**

Before returning the equipment, ensure that (if applicable):

- Equipment has been cleaned and/or decontaminated.
- All inlet and outlet ports have been capped.
- Equipment has been properly packed, (if necessary, please order original packaging materials at your cost), marked appropriately and the carrier has been notified of any possible contamination.
- The completed health and safety clearance form is enclosed.

We thank you in advance for your understanding of the necessity for these measures that protect our employees, and ensure that your pump is protected in shipment.

**Scrapping and waste disposal:**

Dispose of the equipment and any components removed from it safely in accordance with all local and national safety and environmental requirements. Particular care must be taken with components and waste oil which have been contaminated with dangerous substances from your processes. Do not incinerate fluoroelastomer seals and O-rings.

- You may authorize us to dispose of the equipment **at your expense.**

# Warranty

VACUUBRAND shall be liable for insuring that this product, including any agreed installation, has been free of defects at the time of the transfer of risk.

VACUUBRAND shall not be liable for the consequences of improper handling, use, servicing or operation of this product or the consequences of normal wear and tear of wearing parts such as diaphragms, seals, valves, vanes, condensers, oil and the breakage of glass or ceramic parts, for the consequences of chemical, electrochemical or electrical influences or the failure to follow the instructions in this manual.

Claims for defects against VACUUBRAND shall be limited to one year from delivery. The same shall apply to claims for damages irrespective of legal grounds.

For further information on general terms and conditions refer to [www.vacuubrand.com](http://www.vacuubrand.com).

# Health and safety clearance form

## Declaration concerning safety, potential hazards and safe disposal of waste, e.g., used oil.

Safety and health of our staff, laws and regulations regarding the handling of dangerous goods, occupational health and safety regulations, safety at work laws and regulations regarding safe disposal of waste, e.g., waste oil, require that for all pumps and other products, this form must be sent to our office fully completed and signed before any equipment is dispatched to our premises. **Products will not be accepted for any procedure, and handling and repair / DKD calibration will not start before we have received this declaration.**

- Fax or post a **completed copy of this form** to us in advance. The declaration must arrive before the equipment. **Enclose a second, completed copy with the product.** If the product is contaminated, you must notify the carrier. Comply with national and international transport regulations.
- Inevitably, the repair process will be delayed considerably if this information is missing or this procedure is not obeyed. We appreciate your understanding for these measures which are intended to protect our employees, and ask you that you assist us in expediting the repair procedure.
- Make sure that you know all about the substances which have been in contact with the equipment and that all questions have been answered correctly and in detail.**

<p><b>1. Product (Model):</b> .....</p> <p><b>2. Serial No.:</b> .....</p> <p><b>3. List of substances in contact with the equipment or reaction products:</b></p> <p><b>3.1 Chemical/substance name, chemical symbol:</b></p> <p>a) .....</p> <p>b) .....</p> <p>c) .....</p> <p>d) .....</p> <p><b>3.2 Important information and precautions, e.g., danger classification:</b></p> <p>a) .....</p> <p>b) .....</p> <p>c) .....</p> <p>d) .....</p> <p><b>4. Declaration (please mark as applicable):</b></p> <p><input type="checkbox"/> <b>4.1 for non dangerous goods:</b> We assure for the returned product that</p> <ul style="list-style-type: none"> <li>- neither toxic, corrosive, biologically active, explosive, radioactive nor contamination dangerous in any way has occurred.</li> <li>- the product is free of dangerous substances.</li> <li>- the oil or residues of pumped media have been drained.</li> </ul> <p><input type="checkbox"/> <b>4.2 for dangerous goods:</b> We assure for the returned product that</p> <ul style="list-style-type: none"> <li>- all substances, toxic, corrosive, biologically active, explosive, radioactive or dangerous in any way which have been pumped or been in contact with the product are listed in 3.1, that the information is complete and that we have not withheld any information.</li> <li>- the product, in accordance with regulations, has been</li> </ul> <p><input type="checkbox"/> cleaned   <input type="checkbox"/> decontaminated   <input type="checkbox"/> sterilized.</p>	<p><b>5. Method of transport / carrier:</b></p> <p>.....</p> <p>Date of dispatch to VACUUBRAND:</p> <p>.....</p> <p><b>If the paint is damaged, we wish a repaint or a replacement of parts for reason of appearance at our expense</b> (see "Notes on return to the factory", pg. 53):</p> <p><input type="checkbox"/> yes <input type="checkbox"/> no</p> <p><b>We declare that the following measures - where applicable - have been taken:</b></p> <p><input type="checkbox"/> The oil has been drained from the product. <b>Important: Dispose of according to national regulations.</b></p> <p><input type="checkbox"/> The interior of the product has been cleaned.</p> <p><input type="checkbox"/> All inlet and outlet ports of the product have been sealed.</p> <p><input type="checkbox"/> The product has been properly packed and marked as appropriate. If necessary, please order original packaging (costs will be charged).</p> <p><input type="checkbox"/> The carrier has been informed about the hazardous nature of the goods (if applicable).</p> <p><b>By our signature below we acknowledge</b> that we accept liability for any damage caused by providing incomplete or incorrect information and improper packaging and that we shall indemnify VACUUBRAND from any claims as regards damages from third parties.</p> <p><b>We are aware</b> that as expressed in § 823 BGB (Public Law Code of Germany) we are directly liable for injuries or damages suffered by third parties, particularly VACUUBRAND employees occupied with handling/repairing the product.</p> <p>Signature: .....</p> <p>Name (print): .....</p> <p>Job title (print): .....</p> <p>Company's seal: .....</p> <p>Date: .....</p>
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## Declaration of conformity

### Diaphragm pump

**MD 1C (230V; 696600, 696601, 696602)**  
**MD 1C + AK + EK (230V; 696620, 696621, 696622)**  
**MD 1C VARIO-SP (24V; 696110)**  
**MZ 1C (230V; 696220, 696222)**

We herewith declare that the product designated above is in compliance with the basic requirements of the applicable EC-directives stated below with regard to design, type and model sold by us. This certificate ceases to be valid if the product is modified without the agreement of the manufacturer.

Machine directive (with supplements)

2006/42/EG

Low-Voltage Directive (not applicable to MD 1C VARIO-SP (696110) 24V)

2006/95/EG

Electromagnetic Compatibility Directive

2004/108/EG

Harmonized Standards applied

DIN EN 12100-2, DIN EN 61010-1, DIN EN 1012-2, DIN EN 61326-1

Management systems

EN ISO 9001, EN ISO 14001 (1997-2006)

Wertheim, 23.07.2010

.....  
 place, date

.....  
 (Dr. F. Gitmans)  
 Managing Director

ppa.

.....  
 (Dr. J. Dirscherl)  
 Technical Director

**VACUUBRAND GMBH + CO KG**

-Technology for Vacuum Systems-

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 E-Mail: [info@vacuubrand.de](mailto:info@vacuubrand.de)  
 Web: [www.vacuubrand.com](http://www.vacuubrand.com)



# Certificate



Certificate no.

CU 72070564 01

**License Holder:**VACUUBRAND GMBH + Co. KG  
Alfred-Zippe-Str. 497877 Wertheim  
Germany**Manufacturing Plant:**VACUUBRAND GMBH + Co. KG  
Alfred-Zippe-Str. 497877 Wertheim  
Germany**Test report no.:** USA-RC 02271487 003**Client Reference:** Jürgen Dirscherl**Tested to:**UL 61010A-1:2002 R12.02  
CAN/CSA-C22.2 No. 1010.1-92+A2:97**Certified Product:** Diaphragm Vacuum Pump for Laboratory Use**License Fee - Units**

Model Designation: M v w x yy z

7

v=E,Z,D,V; w=0.5,1,1.5;

x=C,S,blank; y=A-Z, blank;

z=AK,EK,2AK,AK+EK,AK+EK TE,

AK+EK Peltronik,IK+EK,AK-SY+EK,blank

Rated Voltage: AC 100-120/200-230V, 50/60Hz

Rated Current: 1.7/0.85A

Protection Class: I

Special Remarks: Replaces Certificate CU72032013.

7

Appendix: 1, 1-2

Licensed Test mark:



Signatures

Date of Issue

(day/mo/yr)

01/03/2007

Stephan Schmitt  
President

Dipl.-Ing. M. Raap  
QA Certification Officer

**This certificate is only valid for pumps with the respective mark (Licensed Test mark) on the pump rating plate.**



# Certificate

Certificate no.

CU 72101050 01

**License Holder:**VACUUBRAND GMBH + Co. KG  
Alfred-Zippe-Str. 497877 Wertheim  
Germany**Manufacturing Plant:**VACUUBRAND GMBH + Co. KG  
Alfred-Zippe-Str. 497877 Wertheim  
Germany**Test report no.:** USA-DS 31081254 001**Client Reference:** M. von Przychowski**Tested to:** UL 61010-1:2004 R10.08

CAN/CSA-C22.2 NO. 61010-1-04+GI1 (R2009)

**Certified Product:** Diaphragm Vacuum Pump for Laboratory Use**License Fee - Units**

Model Designation: Mx yzzz VARIO-SP

7

x = E, Z, D, V

y = 0.5, 1, 1.5, 2x1, 2

z = A-Z, blank

Rated Voltage: DC 24V

Rated Current: 7A

Protection Class: III

7

Appendix: 1, 1

**Licensed Test mark:****Signature****Date of Issue**

(day/mo/yr)

31/05/2010

Dipl.-Ing. J. Engels

QA Certification Officer

TUV Rheinland of North America, Inc., 12 Commerce Road, Newtown, CT 06470, Tel (203) 426-0888 Fax (203) 426-4009

**This certificate is only valid for pumps with the respective mark (Licensed Test mark) on the pump rating plate.**

Disclaimer: Our technical literature is only intended to inform our customer. The validity for specific applications of general empirical values and results obtained under test conditions depends on a number of factors beyond our control. It is therefore strictly the users' responsibility to very carefully check the validity of application to their specific requirements. No claims arising from the information provided in this literature will, consequently, be entertained.



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