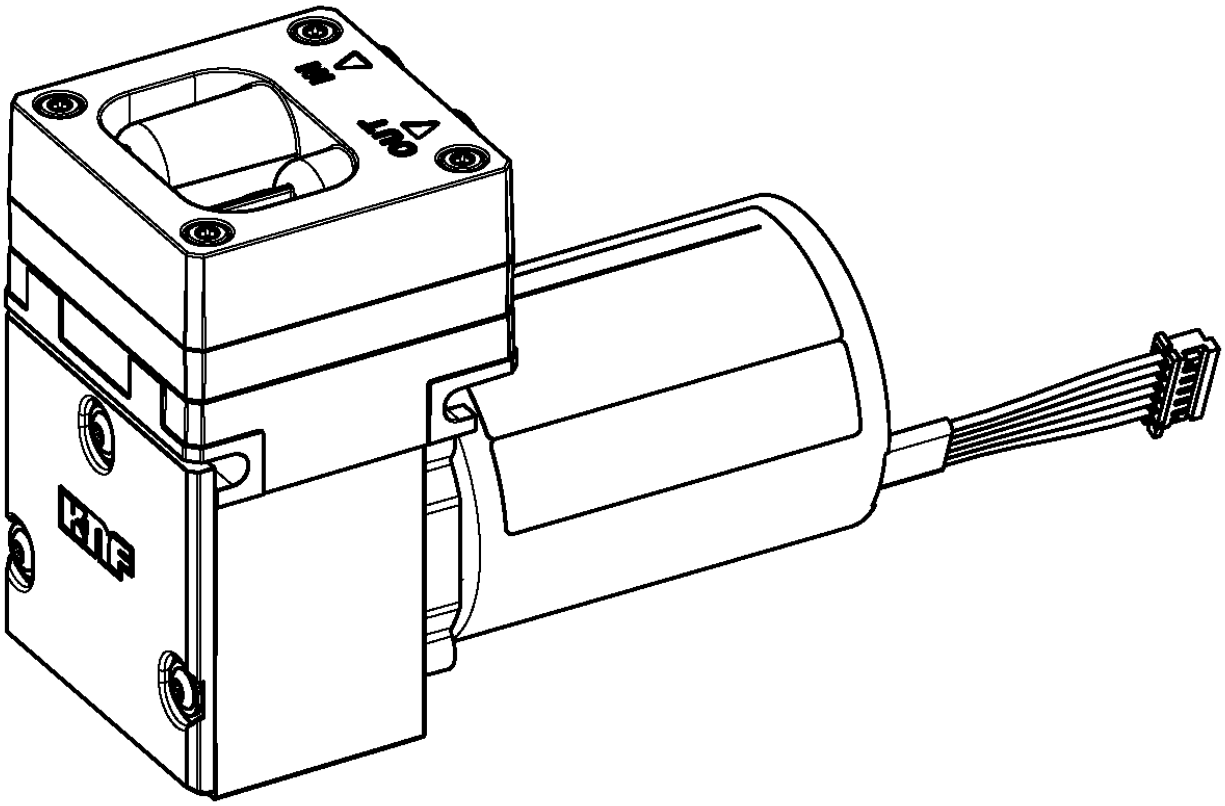
OEM

N96
TRANSLATION OF ORIGINAL OPERATING AND INSTALLATION INSTRUCTION
ENGLISH

DIAPHRAGM PUMP



Notice!
Before operating the pump and the accessories, read the operating and installation instructions and observe the safety notices!

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1 About this document

1.1 Using the operating and installation instructions

The operating and installation instructions are part of the pump.

→ In the event of uncertainties with regard to the content of the operating and installation instructions, please contact the manufacturer (contact data: see www.knf.com). Please have the type designation and serial number of the pump ready.

→ Read the operating and installation instructions before you commission the pump.

→ Give the operating and installation instructions to the next owner.

→ Keep the operating and installation instructions within reach at all times.

Project pumps

For customer-specific project pumps (pump models that begin with "PJ" or "PM"), there may be deviations from the operating and installation instructions.

→ For project pumps, also observe the agreed specifications.

1.2 Exclusion of liability

The manufacturer assumes no liability for damages and malfunctions resulting from failure to observe the operating and installation instructions.

The manufacturer assumes no liability for damages and malfunctions resulting from changes or modifications to the device and improper handling.

The manufacturer assumes no liability for damages and malfunctions resulting from impermissible spare parts and accessories.

1.3 Symbols and markings

Warning notice

A notice that warns you of danger is located here.

Possible consequences of a failure to observe the warning notice are specified here. The signal word, e.g., warning, indicates the danger level.

→ Measures for avoiding the danger and its consequences are specified here.

Danger levels

Signal word	Meaning	Consequences if not observed
DANGER	warns of immediate danger	Death or serious injury or serious damage will result.
WARNING	warns of possible danger	Death or serious injury or serious damage is possible.
CAUTION	warns of a possibly dangerous situation	Minor injuries or damage is possible.

Tab.1

Explanations of pictograms

Pictogram	Meaning
	General warning symbol
	Warning of hot surface
	Warning of electrical voltage
	Warning of explosive materials
	Warning of poisonous substances
	Warning of hand injuries through crushing
	Observe the operating instructions

Tab.3

Other notices and symbols

→ An activity to be carried out is specified here (a step).

1. The first step of an activity to be carried out is specified here.
   Follow other sequentially numbered steps.

i This symbol indicates important information.

2 Use

2.1 Proper use

The pumps are intended exclusively for transferring gases and vapors.

Responsibility of the owner

Operating parameters and conditions

Only install and operate the pumps in accordance with the operating parameters and conditions described in Chapter *4 Technical data*.

Only pumps that are fully assembled and in the condition as delivered may be operated.

Make sure that the installation location is dry and that the pump is protected against rain, splash, gushing, and drip water as well as from other contaminants.

Check the tightness of the connections between the pipes of the application and the pump (or the connection of the pump) at regular intervals. Leaky connections carry the risk of releasing dangerous gases and vapors from the pump system.

Requirements for the transferred medium

Before transferring a medium, check whether the medium can be transferred danger-free in the specific application.

Before using a medium, check the compatibility of the media-contacting components (see *4 Technical data*) with the medium.

Risk of dangerous gas mixtures during pump operation if diaphragm breaks: Depending on the medium being transferred, breakage of the diaphragm can result in a dangerous mixture if the medium mixes with the air in the compressor housing or the surroundings.

Only transfer gases that remain stable under the pressures and temperatures that arise in the pump.

2.2 Improper use

The pumps are not allowed to be operated in explosive atmospheres.

The pumps are not suitable for delivering:

- Dusts
- Fluids
- Aerosols
- Biological and microbiological substances
- Fuel
- Explosive substances and flammable materials
- Fibers
- Oxidants
- Food

Pumps that can generate both a vacuum and overpressure must not be used for the simultaneous generation of a vacuum and overpressure. This function can be made possible on a project basis following consultation with KNF Customer Service.

No overpressure may be applied to the suction side of the pump. This function can be made possible on a project basis following consultation with KNF Customer Service.

3 Safety

Observe the safety instructions in the Chapters *7 Installation and Connection* and *8.1 Operation*.

The pumps are built in accordance with the generally recognized rules of engineering and the occupational health and safety and accident prevention regulations. Nevertheless, dangers can arise during their use that lead to injuries to the user or third parties or to damage to the pump or other property.

Only use the pumps if in technically perfect condition, in accordance with their intended use, in a safety-conscious and danger-conscious manner and in compliance with the operating and installation instructions.

The components that are to be connected to the pumps must be designed according to the pneumatic data of the pumps.

When connecting the pumps to the electrical mains, observe the corresponding safety rules.

Personnel

Make sure that only trained and instructed personnel or qualified personnel work on the pumps. This applies, in particular, to assembly, connection and servicing work.

Make sure that the personnel have read and understood the operating and installation instructions, especially the Chapter Safety.

Working in a safety conscious manner

Observe the regulations on accident prevention and safety during all work on the pumps and during operation.

Avoid contact with the heads and housing parts as the pump heats up during operation.

When working on the pump, make certain that the pump is disconnected from the mains and is de-energized.

Make certain that no dangers arise from flows when gas connections are open, from the effects of noise or from hot, corrosive, dangerous and environmentally hazardous gases.

Make sure that EMC-compliant installation of the pump is guaranteed at all times and that no danger situation can arise as a result.

Handling of hazardous media

Upon breakage of the diaphragm and/or leaks, the transferred medium mixes with the air in the surroundings and/or in the pump housing. Make sure that a dangerous situation cannot arise as a result.

When pumping hazardous media, observe the safety regulations for the handling of these media.

Handling of combustible media

Take heed that the pumps are not designed to be explosion-proof.

Make certain that the temperature of the medium is always sufficiently below the ignition temperature of the medium so as to prevent ignition or explosion. This also applies for abnormal operating situations.

Bear in mind that the temperature of the medium increases when the pump compresses the medium.

Therefore, make certain that the temperature of the medium also remains sufficiently below the ignition temperature of the medium even when it is compressed to the maximum permissible operating pressure of the pump. The maximum permissible operating pressure of the pump is stated in Chapter *4 Technical data*.

Make certain that the permissible ambient temperature (*4 Technical data*) is not exceeded.

If applicable, also take into consideration external energy sources (e.g. radiation sources) that could additionally heat the medium.

In case of doubt, contact KNF Customer Service.

Environmental protection

Store and dispose of all replacement parts in accordance with the environmental regulations. Observe the respective national and international regulations. This applies in particular to parts that are contaminated with toxic substances.

EU/EC directives/standards

With respect to the Machinery Directive 2006/42/EC, the pumps are partly completed machinery and are, therefore, to be regarded as not ready for use. Partly completed machinery may not be commissioned until it has been determined that the machine into which the partly completed machinery is to be installed complies with the provisions of the Machinery Directive 2006/42/EC. The following fundamental requirements of Annex I of Directive 2006/42/EC (general principles) are applied and observed:

- General principles no. 1

As these partly completed machines are built-in devices, the mains connections and equipment for disconnecting and switching off the partly completed machinery as well as overcurrent and overload protection gear must be considered when mounting.

Furthermore, protection against contact with moving and hot parts, if present, must be provided during installation.

The pumps comply with Directive 2011/65/EU.

The following harmonized standards are met:

- DIN EN 50581
- DIN EN 61000-6-2/3

Customer service and repairs

The pumps are maintenance-free. KNF does, however, recommend periodically inspecting the pumps for conspicuous changes in the noises and vibrations.

Only have repairs to the pumps performed by the responsible KNF Customer Service.

Housings with live components may only be opened by specialist personnel.

Use only original parts from KNF during servicing work.

4 Technical data

Technical data

Pump materials

Assembly	Material KN	Material KT
Pump head	PPS	PPS
Diaphragm	EPDM	PTFE-coated
Valves	FKM	FKM

Tab.5 Pump materials KN/KT variant

Pneumatic values

N96KNDC-B-M

Parameter	Value
Max. permissible operating pressure [bar rel*]	2.5
Ultimate vacuum [mbar abs.]	<100
Flow rate at atm. pressure [l/min]**	8.5 ± 10%

Tab.7
**Bar rel related to 1013 hPa*
***Liters in standard state (1013 hPa, 20°C)*

N96KTDC-B-M

Parameter	Value
Max. permissible operating pressure [bar rel*]	2.5
Ultimate vacuum [mbar abs.]	<130
Flow rate at atm. pressure [l/min]**	7.0 ± 10%

Tab.9
**Bar rel related to 1013 hPa*
***Liters in standard state (1013 hPa, 20°C)*

Pneumatic connections

Pump type	Value	Value
N96KNDC-B-M	G1/8	NPT 1/8
N96KTDC-B-M	G1/8	NPT 1/8

Tab.11

Electrical data

Parameter	Value	
Voltage [V]	24	
Frequency [Hz]	-	
Power P_1 [W]	KN	KT
	23	19
Max. permissible mains voltage fluctuations	± 10%	
Motor protection class	IP20	
Rated current consumption [A]	KN	KT
	1,05	0.9

Tab.13

The motor controller has a current limit of max. 2.5 A RMS. In the event of an error, the power of the motor is limited to prevent the current limit from being exceeded.

Weight

Pump type	Value [kg]
N96K_DC-B-M	0.6

Tab.15

Other parameters

Parameter	Value	
Permissible ambient temperature [°C]	+ 5 to see Fig. 1 0 if non-condensing (frost-free)	
Permissible media temperature [°C]	See Fig. 2	
Dimensions	See Fig. 5, Chapter *7.1 Installing the pump*	
Highest permissible relative air humidity of the environment	80% for temperatures to 31°C, decreasing linearly to 50% at 40°C.	
Maximum installation altitude [m above sea level]	2000	
Gas tightness* of the pump head (leak rate)	Leak rate < 6 x 10^{-3} mbar l/s**	
Protection class of pump	IP20	
Starts against	KN	KT
- Vacuum	100	130
- Pressure	2.5	2.5

Tab.17
*** The gas tightness of the pump head is no longer ensured after the pump head is opened or after replacing diaphragms and valve plates. A leak test can be used to determine whether the original gas tightness is again achieved.*
***Values apply for helium leak test*

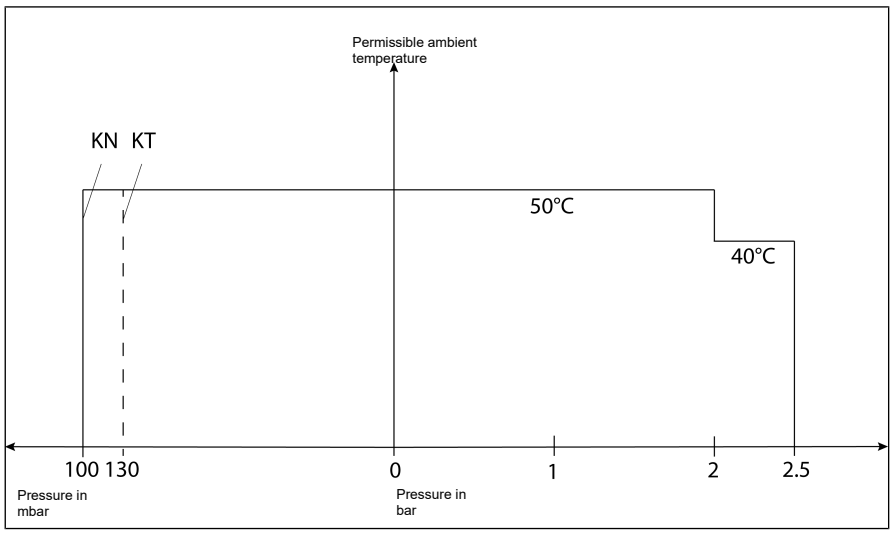

Fig.1 Permissible ambient temperature

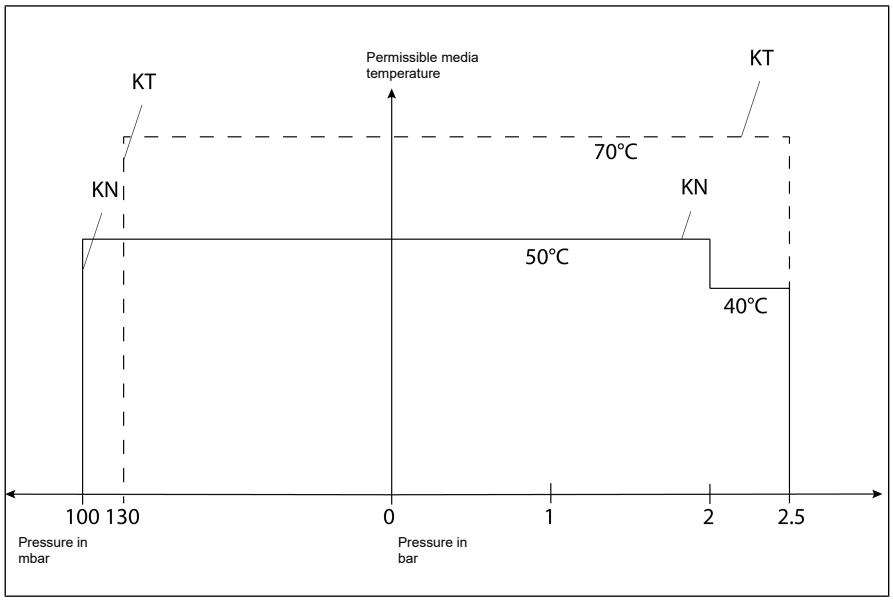

Fig.2 Permissible media temperature

5 Design and function

Design

1 Pneumatic pump inlet
2 Pneumatic pump outlet
3 Motor
4 Electrical connection

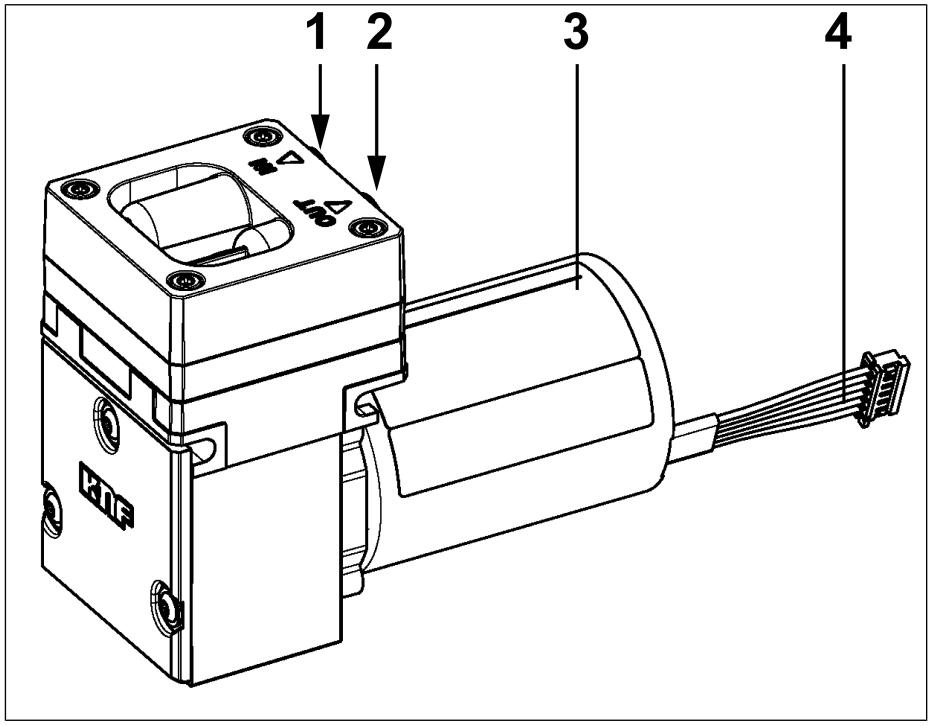

Fig.3 Design N96

Function of a diaphragm pump

1 Outlet valve
2 Inlet valve
3 Transfer chamber
4 Diaphragm
5 Eccentric
6 Connecting rod
7 Pump drive

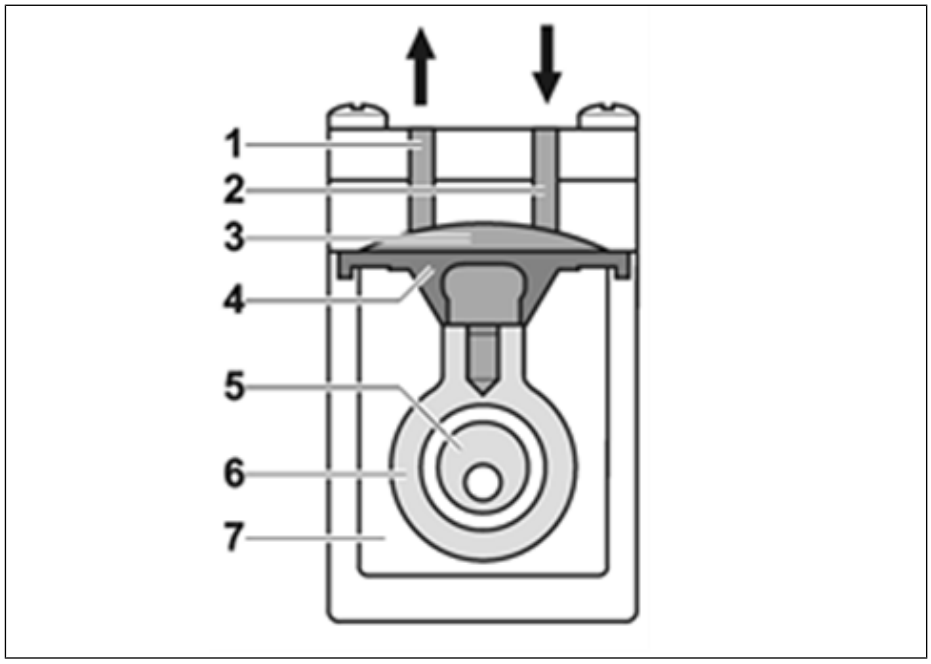

Fig.4 Function of a diaphragm pump

Diaphragm pumps transfer, compress (depending on the version) and evacuate gases and vapors.

The elastic diaphragm (4) is moved up and down by the eccentric (5) and the connecting rod (6). In the downwards stroke, it aspirates the gas to be transferred via the inlet valve (2). In the upwards stroke, the diaphragm presses the medium out of the pump head via the outlet valve (1). The transfer chamber (3) is hermetically separated from the pump drive (7) by the diaphragm.

6 Transport

General

CAUTION

Personal injury and/or property damage due to incorrect or improper transport of the pump

In the event of incorrect or improper transport, the pump can fall down, be damaged or injure persons.

→ Use suitable auxiliary means if necessary (carrying strap, lifting gear, etc.).

→ Where appropriate, wear suitable personal protective equipment (e.g., safety shoes, safety gloves).

CAUTION

Risk of injury from sharp edges on the packaging

There is a risk of injury from cutting on the sharp edges when grabbing corners or when opening the packaging.

→ Where appropriate, wear suitable personal protective equipment (e.g., safety shoes, safety gloves).

→ Transport the pump in the original packaging to the installation location.

→ Store the original packaging of the pump (e.g., for later storage).

→ Inspect the pump for transport damage after receiving it.

→ Document any transport damage in writing.

→ Remove any transport safeguards on the pump prior to commissioning.

Parameter

Parameter	Value
Storage temperature [°C]	+ 5 to + 40
Transport temperature [°C]	- 10 to + 60
Permissible humidity (non-condensing) [%]	30 to 85

Tab.19 Transport parameters

Before putting into operation, make sure that the pump has reached the ambient temperature (*4 Technical data*).

7 Installation and connection

Install the pumps only in accordance with the operating parameters and conditions described in Chapter *4 Technical data*.

→ Observe the safety instructions (see Chapter *3 Safety*).

DANGER

Risk of dangerous gas mixtures during pump operation

Depending on the medium being transferred, breakage of the media-contacting components can result in a dangerous mixture if the medium mixes with the air in the compressor housing or the surroundings.

→ Before using a medium, check the compatibility of the media-contacting components (see *4 Technical data*) with the medium.

7.1 Installing the pump

→ Store the pump at the installation site prior to installation to bring it up to the ambient temperature.

CAUTION

Risk of injury from freely rotating shaft end

Touching the pump at the end of the shaft may result in injury through burning and crushing.

→ Take protective measures to safeguard against touching moving and hot parts.

→ Wear appropriate personal protective equipment if necessary.

CAUTION

Risk of injury from sharp edges on motor

There is a risk of injury from cutting on the sharp edges when grabbing the pump on the motor.

→ Where appropriate, wear suitable personal protective equipment (e.g., safety shoes, safety gloves).

Mounting dimensions

→ For mounting dimensions, see the following illustrations:

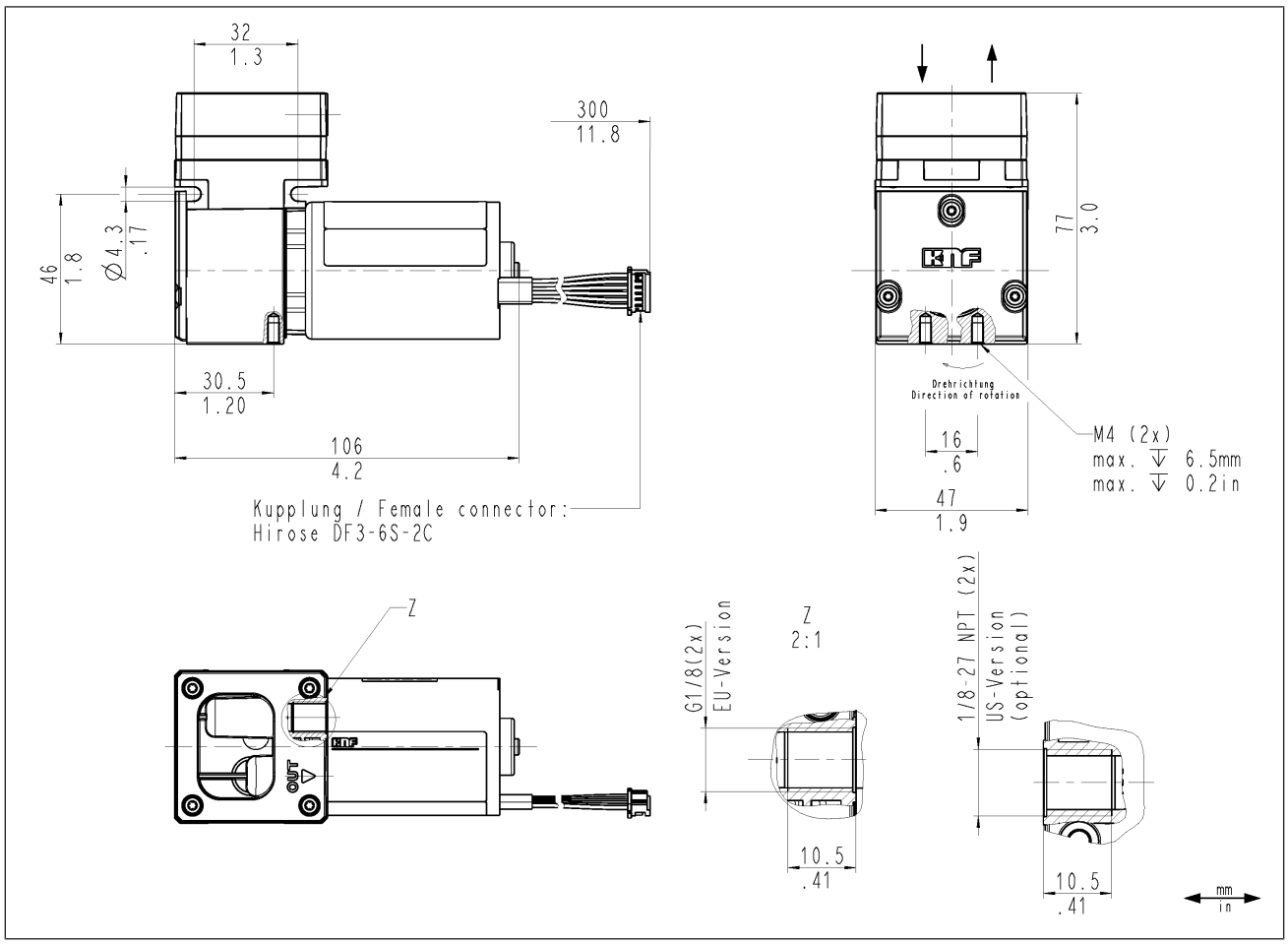

Fig.5 Mounting dimensions pump series N96

Cooling air supply

WARNING

Danger of burning on hot surfaces

Hot surfaces could occur if the pump overheats.

→ When installing the pump, make sure that sufficient cooling air infeed and discharge is ensured.

Immediate environment of the hot pump parts

→ During installation, make sure that no combustible or thermally deformable objects are positioned in the immediate environment of the hot pump parts (head, motor).

Installation location

→ Make sure that the installation location is dry and that the pump is protected against rain, splash water, gushing water, dripping water and other contaminants.

→ Make sure that the installation location is accessible for service.

i The IP protection class of the pump motor is specified on the type plate.

→ Mount the pump at the highest point in the system to prevent condensate from collecting in the pump head.

→ Protect the pump from dust.

→ Protect the pump from vibration and impact.

Protection against foreign objects

→ Protect the pump against contact and the ingress of foreign bodies.

7.2 Aligning gas connections

Tool

Quantity	Tool/material
1	Torx TX10 screwdriver

Tab.21

i To keep the hose routing as compact as possible, the gas connections can be oriented according to the system conditions. For this purpose, the pump head can be rotated in increments of 90° and mounted.

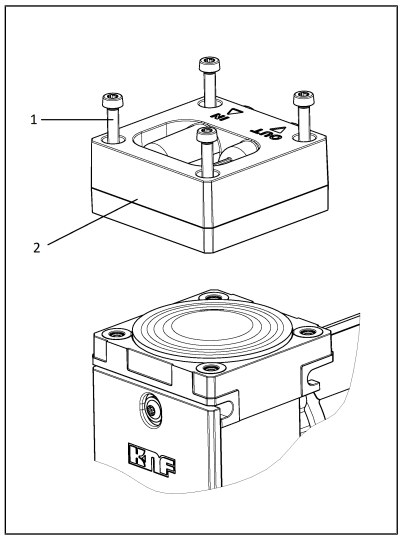

Fig.6 Aligning gas connections

1. Loosen the four head plate screws (1) and remove the pump head (2) from the compressor housing.
2. Turn the pump head to the desired position.

i Direction of rotation according to the alignment of the gas connections, see following figure.

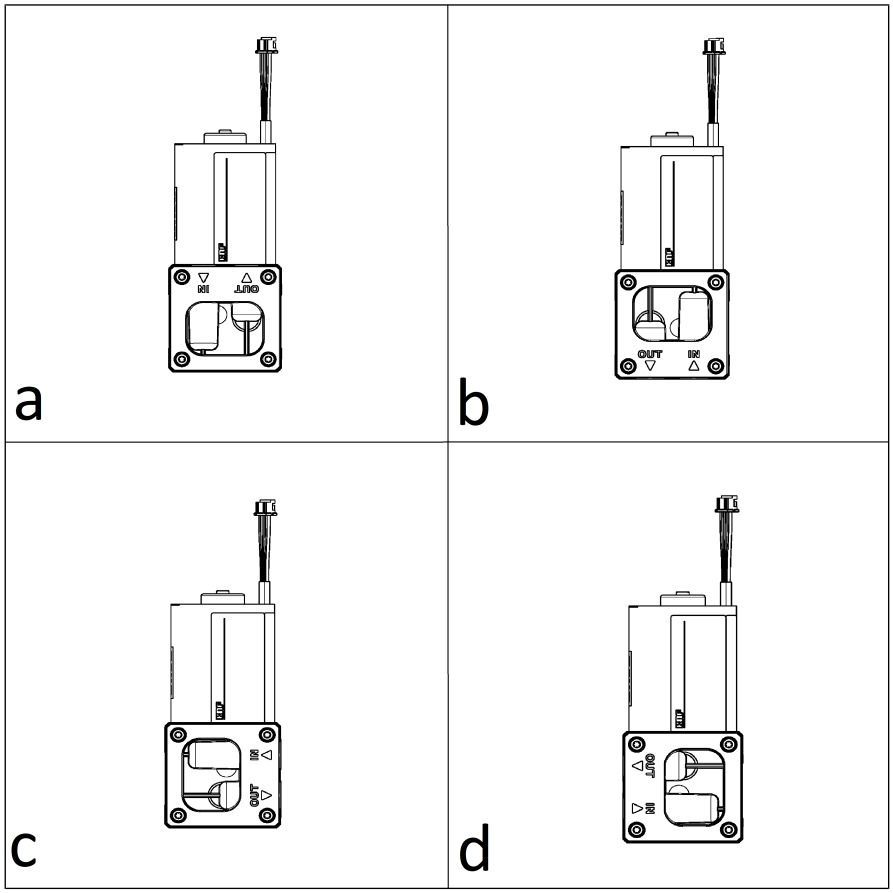

Fig.7 Aligning gas connections

A	Gas connections via motor: Direction of rotation: CW
B	Gas connections at front: Direction of rotation: CCW
C	Gas connections at right: Direction of rotation: CW
D	Gas connections at left: Direction of rotation: CCW

i Connection definition of the direction of rotation, see Fig. 8, Fig. 9.

3. Place the pump head (2) on the compressor housing.
4. Tighten the four head plate screws (1) crosswise (tightening torque: 190 – 200 Ncm).

7.3 Electrical connection

DANGER

Danger to life from electric shock

→ Only have the pump connected by an authorized specialist.

→ Only have the pump connected if the power supply is disconnected.

→ When connecting to a power source, observe the applicable standards, directives, regulations and technical standards.

→ Install in the electrical wiring system a device to disconnect the pump motor from the electrical supply network (in acc. with EN 60335-1).

→ Protect the pump motors in accordance with EN 60204-1 (overcurrent protection, overload protection).

→ The motors may only be operated in an SELV circuit.

i The control lines of the BLDC motor are only protected to a voltage of up to 1.5 kV (acc. to HBM ESD rating).
If higher ESD requirements are needed, measures are to be provided by the owner himself.

i Refer to the type plate for the maximum current consumption of the pump.

→ It is recommended that an additional EMERGENCY-STOP device be installed.

→ Mount the pumps in such a way that it is not possible to touch the electrically live parts (electrical connection).

i The ground potential of the power supply, the interface(s) and the pump housing are to be at the same potential. Compensating currents via the motor controller are to be prevented as they may result in the destruction of the electronics. A sufficient potential equalization in accordance with EN 60479-1 is to be dimensioned.

Fastening the connection cables

→ Fasten the connection cables so that

- the cables do not come into contact with movable or hot parts.
- the cables cannot be worn or damaged on sharp corners or edges
- no tensile and pressure forces are exerted on the connection point of the cables (strain relief)

Connecting the pump

1. Compare the data of the supply voltage with the information on the motor type plate. See the pump type plate for the maximum current consumption of the pump.

   The supply voltage may deviate by maximum +10% or –10% from the values on the type plate.

2. Electrically connect the pump.

   Take into account the direction of rotation according to the orientation of the gas connections (see Fig. 7, Fig. 9 and Fig. 8).

   Control voltage may only be applied if the motor controller is supplied with an operating voltage. The motor controller may otherwise be damaged.

   Ensure the correct polarity. With brushless three-phase motors (indicated by a B at the end of the type designation), incorrect polarity will result in destruction of the electronics.

Connection diagram for motor controller

Motor				
Rated voltage		[V]	24	
Voltage range		[V]	9 – 26.4	
Coupling: Hirose DF3-6S-2C				
Leads connections / PIN assignment				
Function	**Wire lead color**	**Signal name**	**Size**	**PIN**
+ Supply voltage	Red	U_+	AWG 26 / UL 3266	6
- Supply voltage (0 V)	Black	U_- / GND	AWG 26 / UL 3266	1
Input signal for speed control	Blue	U_{Ctrl}	AWG 26 / UL 3266	3
Output signal for speed	Green	U_{Spd}	AWG 26 / UL 3266	4
Input signal for remote ON/OFF	White	U_{Rmt}	AWG 26 / UL 3266	2
Input signal for direction of motor rotation	Yellow	U_{Rot}	AWG 26 / UL 3266	5
Input signal for speed specification Uctrl PWM signal*				
PWM-signal	PWM frequency range	[kHz]	20 [10 … 30]	
	Input level "high"	[V]	5 [2.5…5.5]	
	Input level "low"	[V]	0 [0…0.8]	
	Duty cycle range, see Fig. 10, Fig. 11	[%]	KN: 30…0	KT: 55…0
	Input impedance @ 1 kHz	[kΩ]	≥ 10	
Output signal for speed USpd				
Pulses per revolution		[-]	6	
Pulse duty cycle		[%]	50	
Output level "high"		[V]	5 [2.5…6.0]	
Output level "low"		[V]	0 [0…0.8]	
Max. current carrying capacity		[mA]	2	
Input impedance @ 1 kHz		[kΩ]	≥ 10	
Input signal for remote ON/OFF URmt				
Input level "high" → Motor ON		[V]	5 [2.5…5.5 or open contact]	
Input level "low" → Motor OFF		[V]	0 [0…0.8]	
Input impedance @ 1 kHz		[kΩ]	≥ 10	
Input signal for direction of motor rotation URot				
Standard for pump Input level "high" → Motor CCW		[V]	5 [2.5…5.5 or open contact]	
Not recommended for pump Input level "low" → Motor CW		[V]	0 [0…0.8]	
Input impedance @ 1 kHz		[kΩ]	≥ 10	

Tab.23 Connection diagram for motor controller N96_DC-B-M

**see Chapter 8.3 Control functions DC-B-M*

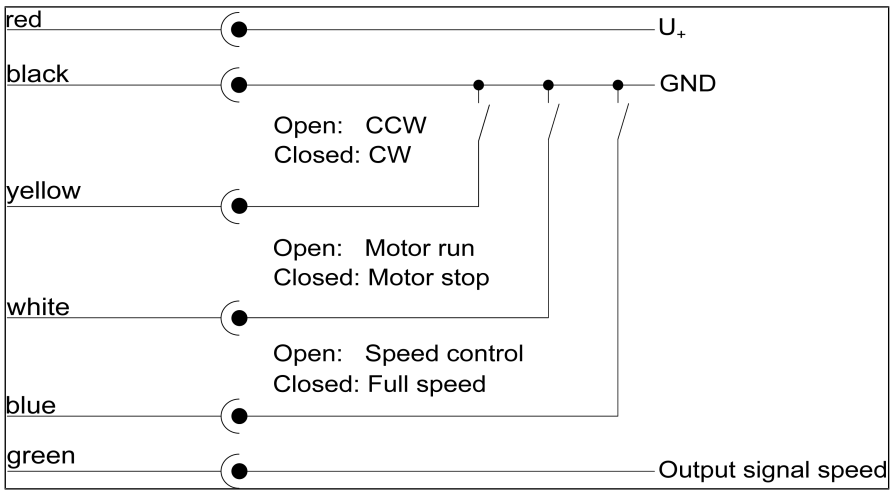

Fig.8 Connection diagram without external speed setting

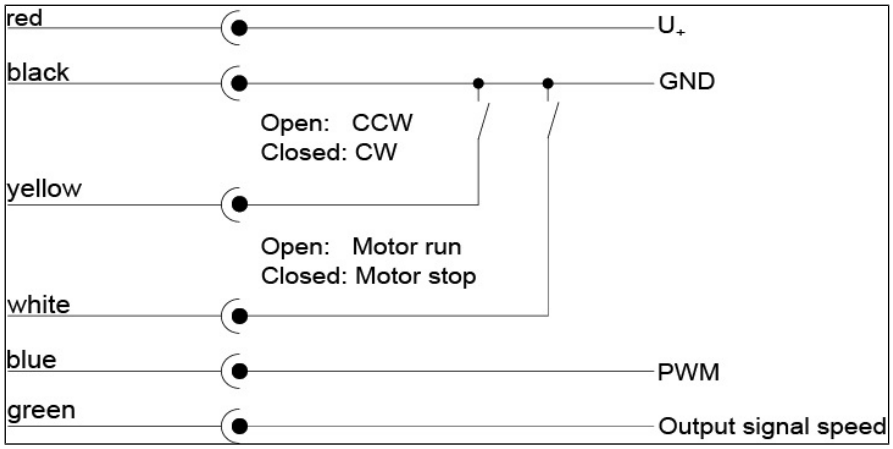

Fig.9 Connection diagram with external speed setting

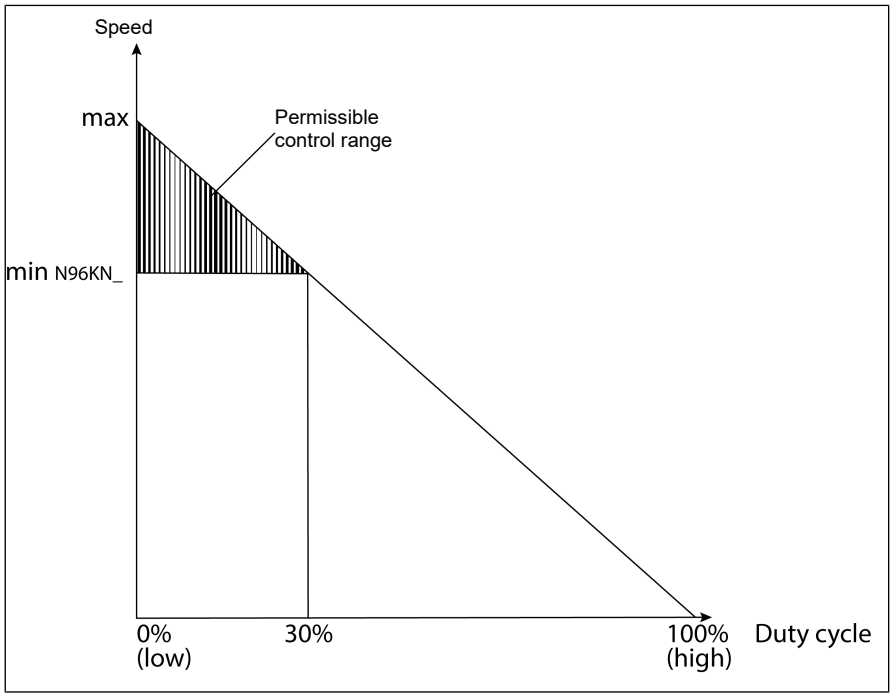

*Fig.10 Duty cycle range N96KN_*

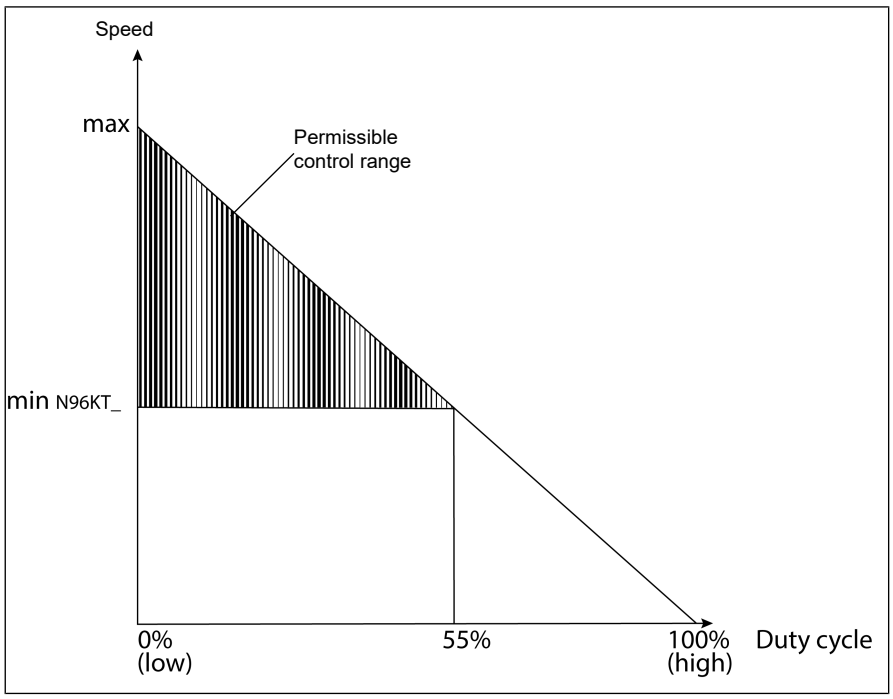

*Fig.11 Duty cycle range N96KT_*

For expanded permissible duty cycle range, please contact your KNF Customer Service (contact data: see www.knf.com).

7.4 Pneumatic connection

CAUTION

Personal injury or property damage through ejected plugs

If not removed, the plugs on the pressure side of the pump can be ejected during operation by the resulting overpressure.

→ Remove the plugs during installation.

→ Wear appropriate personal protective equipment.

Connected components

→ Only connect components to the pump that are designed for the pneumatic data and thermal requirements of the pump. (see Chapter *4 Technical data*).

Pressure relief device

→ Protect the compressors by means of a pressure relief device between the pressure-side connections of the compressor and the first shut-off valve.

Pump discharge

→ If the pump is being used as a vacuum pump, safely (relating to the medium and noise) discharge the possibly hot pump discharge via the pneumatic outlet of the pump.

Decoupling

→ KNF recommends mechanically decoupling the pump from the pipe system, e.g., through the use of flexible hoses or pipes. In this way it is possible to prevent the transfer of possible pump vibrations and noises to the system.

Connecting the pump

A marking on the pump head indicates the flow direction.

Risk of injury from mixing up suction side and pressure side

Mixing up the suction side and pressure side can result in breakage of connected components on the suction side and pressure side.

→ Observe the marking of inlet and outlet on the pump head.

1. Remove the protective plugs from the hose connection threads.
2. Connect the suction line and the pressure line (for mounting dimensions, see Chapter *4 Technical data*).
3. Lay the suction line and pressure line with a descent so that no condensate can run into the pump.

Pneumatic noises can be reduced or dissipated by using a silencer (see Chapter *11.2 Accessories*).

Secure the pressure-side connections with a fastener (e.g., hose/ pipe clamp) to prevent the hoses from slipping down from the connection.

8 Operation

8.1 General

WARNING

Risk of burns from hot pump parts and/or hot medium

Some pump parts may be hot during or after operation of the pump.

→ Allow the pump to cool after operation.

→ Take protective measures to protect against touching hot parts.

CAUTION

Risk of injury from bursting hoses during pressure applications due to excessively high temperatures

When operating the pump in pressure applications, hoses that are not designed for the head temperatures of the pump at the respective operating point could become porous and burst.

→ Use temperature-resistant pressure hoses at the pneumatic connections.

→ Wear protective equipment if necessary (e.g., safety gloves, hearing protection).

WARNING

Injury to eyes

Coming too close to the inlet/outlet of the pump may result in injury to the eyes due to the present vacuum/operating pressure.

→ Do not look into the pump inlet/outlet during operation.

CAUTION

Risk of injury from freely rotating shaft end

Touching the pump at the end of the shaft may result in injury through burning and crushing.

→ Take protective measures to safeguard against touching moving and hot parts.

→ Wear appropriate personal protective equipment if necessary.

→ Only operate the pumps under the operating parameters and operating conditions as described in Chapter *4 Technical data*.

→ Ensure the proper use of the pumps (See Chapter *2.1 Proper use*).

→ Eliminate the possibility of improper use of the pumps (see Chapter *2.2 Improper use*).

→ Observe the safety instructions (Chapter *3 Safety*).

→ The pumps are built-in devices. Before they are commissioned, it must be ensured that the machines or systems into which the pumps are installed comply with the relevant provisions.

WARNING

Risk of pump head bursting due to excessive pressure increase

→ Do not exceed the maximum permissible operating pressure (see *4 Technical data*).

→ Monitor the pressure during operation.

→ If the pressure exceeds the maximum permissible operating pressure of the pump: immediately switch off the pump and remedy the fault (see Chapter *10 Troubleshooting*).

→ Only throttle or regulate the air or gas quantity on the suction line to prevent the maximum permissible operating pressure from being exceeded.

→ If the air quantity or gas quantity on the pressure line is throttled or regulated, make sure that the maximum permissible operating pressure at the pump is not exceeded.

→ Ensure that the pump outlet is not closed or restricted.

Excessive pressure, with all of the associated hazards, can be prevented by means of a bypass line with a pressure relief valve between the pressure side and suction side of the pump. Further information is available from KNF Customer Service (contact data: see www.knf.com).

WARNING

Risk of dangerous gas mixtures during pump operation if diaphragm breaks

If the diaphragm should break, the medium will mix with the air in the compressor housing or in the surroundings.

→ Stop pump immediately.

→ Replace the diaphragm prior to further operation (see Chapter *9 Servicing*).

Operation with open suction-side gas connection can result in contaminants and objects being drawn in.

Pump stoppage

→ When the pump is at a standstill, establish normal atmospheric pressure in the lines.

Vapors as medium

The service life of the diaphragm can be extended, if no condensate forms in the pump. Therefore:

→ Perform any work with saturated or near-saturated vapors only with a warm pump.

→ KNF recommends: When pumping corrosive media, flush the pump before switching off (see Chapter *9.2.1 Flushing the pump*) to extend the service life of the diaphragm.

8.2 Information on switching the pump on and off

Switching on the pump

→ Ensure that normal atmospheric pressure is present in the lines when switching on.

Switching off/decommissioning the pump

→ Establish normal atmospheric pressure in the lines (relieve pump pneumatically).

Recommissioning → Before recommissioning, observe the applicable standards, guidelines, regulations and technical standards at the electrical connection.

Inspecting the pump → Inspect the pump periodically for external damage or leakage.

8.3 Control functions DC-B-M

8.3.1 Speed specification

Speed without external speed setting

The motor operates the pump with a non-variable speed over the entire permissible pressure range (see Fig. 8).

Speed with external speed setting

The motor operates the pump with a variable speed between n_{min} and n_{max} (see Fig. 9). The speed is specified by means of the control voltage (U_{Ctrl}).

Specification of the speed is performed via the blue lead (see Tab. 23).

8.3.2 Speed output

The speed is output via the green lead (see Tab. 23).

The motor controller generates a speed-synchronous square frequency (see Fig. 12).

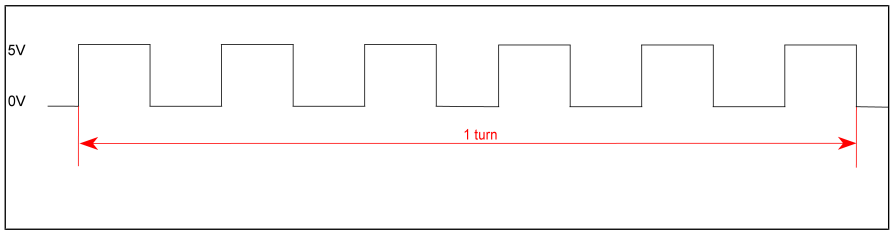

Fig.12 Speed output

8.3.3 Input signal for direction of motor rotation

The input signal for direction of motor rotation is applied via the yellow lead (see Tab. 23).

8.3.4 Input signal for remote ON/OFF

The input signal for remote ON/OFF is applied via the white lead (see Tab. 23).

9 Servicing

CAUTION

ESD-sensitive parts (ESDS)

Failure to observe the ESD protection provision acc. to IEC 61340-5-1 can result in total or partial damage to the pump.

→ Maintenance of the pump may only be performed by a qualified person in an ESD-protected area (EPA) acc. to directive IED 61340-5-1.

9.1 Servicing schedule

WARNING

Danger of injury through not using genuine spare parts

The functionality of the pump and its safety will be lost, if genuine spare parts are not used.
The validity of the CE conformity is rendered void if genuine parts are not used.

→ Use only genuine spare parts from KNF for servicing work.

Component	Servicing interval
Pump	→ Inspect the pump periodically for external damage or leakage → Check regularly for conspicuous changes in the noise and vibrations.
Gas connections	→ Inspect the pump periodically for external damage or leakage
Diaphragm and valve plates	→ At the latest, replace when the pump flow rate decreases.
Silencer (accessories)	→ Replace if soiled.

Tab.25

9.2 Cleaning

9.2.1 Flushing the pump

When transferring dangerous and environmentally hazardous media, KNF recommends flushing the pump at atmospheric pressure for a few minutes prior to switch-off (if necessary for safety reasons: with an inert gas) to extend the service life of the diaphragm.

→ Discharge the media safely.

9.2.2 Cleaning the pump

CAUTION

Risk of burns from hot pump parts

The pump head or motor may still be hot after operation of the pump.

→ Allow the pump to cool after operation.

WARNING

Health hazard due to dangerous substances in the pump

Depending on the medium being transferred, caustic burns or poisoning is possible.

→ Wear protective equipment if necessary, e.g., protective gloves, goggles.

→ Clean the pump with suitable measures.

i During cleaning work, ensure that no fluids enter the interior of the housing.

→ Solvents should only be used during cleaning if head materials are not corroded (ensure resistance of the material).

→ If possible, the parts should be cleaned dry with a cloth. Solvents should not be used during cleaning because they could attack the plastic parts.

→ If there is any compressed air left, blow out the parts.

9.3 Replacing diaphragm and valve plates

Requirements

→ Disconnect the pump from mains and ensure that it is voltage-free.

→ Clean the pump and free the pump of hazardous materials.

→ Remove the hoses from the pneumatic pump inlet and outlet.

Spare parts/tools

Spare part/tool	Quantity
Spare part set*	1
Torx TX10 screwdriver	1

*Tab.27 *acc. to Chapter 11 Spare parts and accessories*

Information on the procedure

Diaphragm and valve plates/seals are the only wear parts in the pumps. They are easy to replace.

Valve plates/seals and diaphragm should generally be replaced at the same time. If the diaphragm is not replaced at the same time as the valve plates/seals, the specified output of the pump can no longer be ensured after the maintenance is performed.

WARNING

Health hazard due to dangerous substances in the pump

Depending on the medium being transferred, caustic burns or poisoning is possible.

→ Wear protective equipment if necessary, e.g., protective gloves, goggles.

→ Clean the pump with suitable measures.

CAUTION

Risk of burns from hot pump parts

The pump head or motor may still be hot after operation of the pump.

→ Allow the pump to cool after operation.

The diaphragm and valve plates/seals are to be replaced in the following order:

a.) Preparatory steps

b.) Remove pump head

c.) Replace diaphragm

d.) Replace valve plates/seals

e.) Mount pump head

f.) Final steps

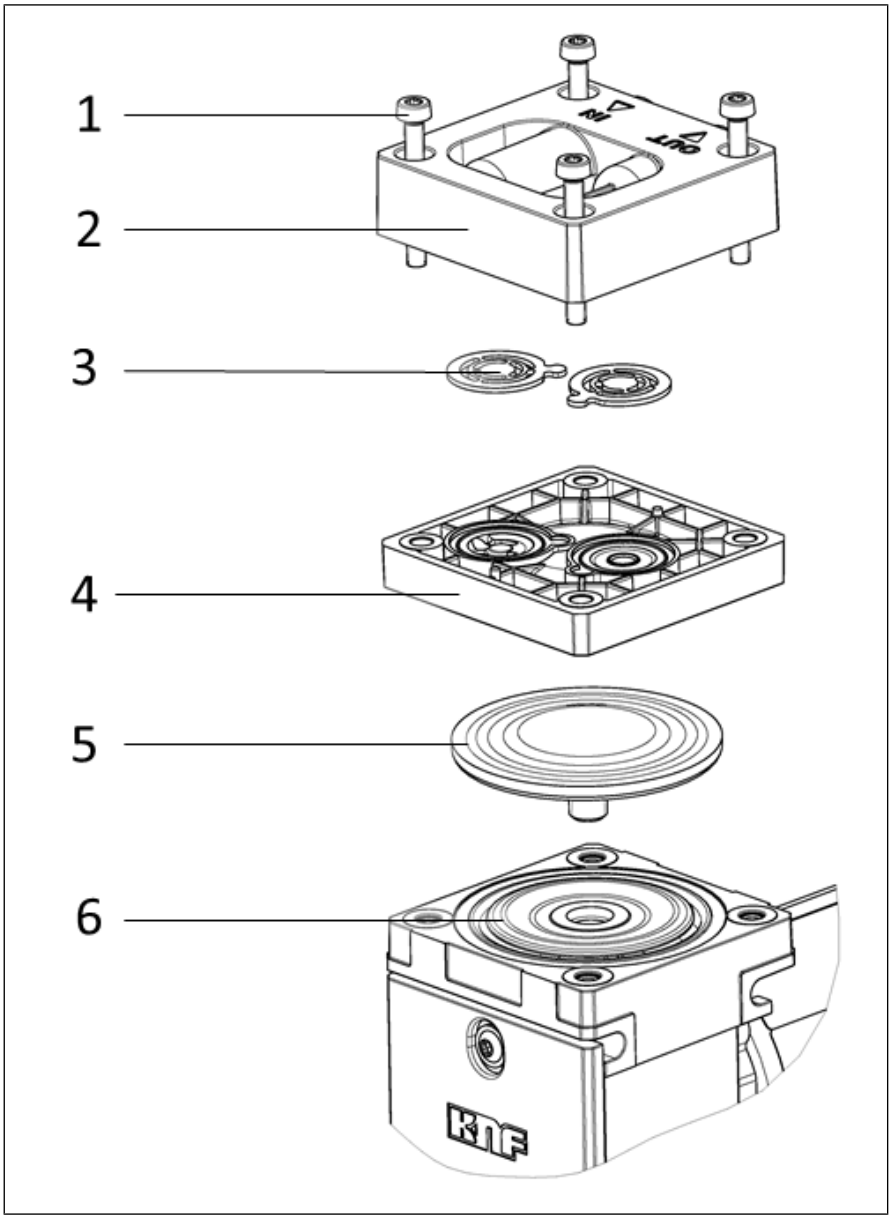

Fig.13 Exploded view

The item numbers within the following work instruction refer to Fig. 13.

Proceed as follows:

a.) Preparatory steps

→ Disconnect the pump from the power supply and check and ensure that the pump is voltage-free.

b.) Remove pump head

→ Loosen the four head plate screws (1) and remove the head plate (2) from the pump housing together with the intermediate plate (4).

c.) Replace diaphragm

1. Lift the diaphragm (5) on opposing side edges. Then grasp the diaphragm (5) and move the diaphragm (5) to the upper reversal point. Unscrew the diaphragm (5) counterclockwise.
2. Check all parts for soiling and clean the parts if necessary (for further information, see Chapter *9.2 Cleaning*).

3. Screw the new diaphragm (5) onto the connecting rod (6) (clockwise) and hand tighten the diaphragm (5).

i When screwing in the diaphragm (5), ensure that it is not overtightened.
If overtightened, there is a risk that it could be damaged.

d.) Replacing valve plates

1. Separate the head plate (2) from the intermediate plate (4).
2. Remove the valve plates/seals (3) from the head plate (2).
3. Check valve seats, intermediate plate and head plate for cleanliness; replace these parts in the event of unevenness, scratches or corrosion (contact your KNF Customer Service in this case).

i Insert new valve plates/seals in the valve seats of the intermediate plate; the valve plates/seals are identical for the pressure and suction side; the same applies for the top and bottom of the valve plates/seals.

4. By slightly moving the valve plates/seals horizontally, ensure that they are not under tension.
5. Make certain that the valve plates/seals are centered in the valve seats of the intermediate plate.

e.) Mount pump head

1. Place the intermediate plate (4) with valve plates/seals (3) and head plate (2) on the housing.
2. Place head plate (2) on intermediate plate (4) according to the centering.

i Place pump head on the compressor housing according to the alignment of the gas connections.

3. Tighten the screws (1) crosswise (tightening torque: 190-200 Ncm).

f.) Final steps

WARNING

Risk of injury and poisoning from leaks

→ Before recommissioning the pump, check the pump heads and pneumatic connections for leaks. Leaks may lead to poisoning, chemical burns or similar injuries.

→ Connect the pump to the power supply.

If you have questions with regard to maintenance, please contact your KNF Customer Service (contact data: see www.knf.com).

10 Troubleshooting

DANGER

Danger to life from electric shock

→ All work on the pump may only be performed by an authorized specialist.

→ Disconnect the pump power supply before working on the pump.

→ Check and ensure that no voltage is present.

→ Check the pump (see following tables).

Pump not delivering	
Cause	**Fault remedy**
Pump is not connected to the electrical mains.	→ Connect the pump to the electrical mains.
No voltage in the electrical mains.	→ Check the room fuse and switch it on if necessary.
Connections or lines are blocked.	→ Check the connections and lines. → Remove the blockage.
External valve is closed or filter is clogged.	→ Check external valves and filters.
Condensate has collected in the pump head.	→ Separate the source of the condensate from the pump. → Flush the pump with air at atmospheric pressure for a few minutes (if necessary for safety reasons: with an inert gas). → Install the pump at the highest location in the system.
Max. voltage range of motor exceeded.	→ Disconnect pump from electrical mains. → The applied voltage must not exceed the value specified in Chapter *7.3 Electrical connection*.
Diaphragm and valves are worn or defective.	→ Replace diaphragm and valves (see Chapter *9.3 Replacing diaphragm and valve plates*).

Tab.29

Delivery rate, pressure or vacuum too low **The pump is not achieving the delivery rate specified in the technical specifications or on the data sheet.**	
Cause	**Fault remedy**
Condensate has collected in the pump head.	→ Separate the source of the condensate from the pump. → Flush the pump with air at atmospheric pressure for a few minutes (if necessary for safety reasons: with an inert gas). → Install the pump at the highest location in the system.
There is overpressure on the pressure side and at the same time vacuum or pressure above atmospheric pressure on the suction side.	→ Change the pneumatic conditions.
Pneumatic lines or connection parts have insufficient cross-sections or are throttled.	→ Disconnect the pump from the system to determine the output values. → Eliminate throttling (e.g. valve) if necessary. → Use lines or connection parts with a larger cross-section, if necessary.
Leaks occur at connections, lines or pump head.	→ Eliminate the leaks.
Connections or lines are completely or partially clogged.	→ Check the connections and lines. → Remove any parts and particles that are causing clogging.
Head parts are soiled.	→ Clean the head components.
Operating diaphragm broken	→ Shut down the pump immediately.
Diaphragm and valves are worn or defective.	→ Replace diaphragm and valves (see Chapter *9.3 Replacing diaphragm and valve plates*).

Tab.31

Pump exhibiting changed running noises and vibrations.	
Cause	**Fault remedy**
Pump bearing worn or defective.	→ Determine the cause. → Contact KNF Customer Service.
Motor worn or defective.	→ See operating instructions for the motor.

Tab.33

Fault cannot be rectified

If you are unable to identify any of the specified causes, send the pump to KNF Customer Service (contact data: see www.knf.com).

1. Flush the pump with air at atmospheric pressure for a few minutes (if necessary for safety reasons: with inert gas) to free the pump head of dangerous or aggressive gases (see Chapter *9.2.1 Flushing the pump*).
2. Clean the pump (see Chapter *9.2.2 Cleaning the pump*).
3. Send the pump together with completed Health and Safety Clearance and Decontamination Form to KNF, specifying the pumped medium.

11 Spare parts and accessories

11.1 Spare parts

Spare part set

A spare part set consists of:

Parts	Item number*	Quantity
Diaphragm	(5)	1
Valve plates/seals	(3)	2

*Tab.35 *see Chapter 9.3 Replacing diaphragm and valve plates*

Spare part set	Order number
N96KNDC-B-M	322637
N96KTDC-B-M	322636

Tab.37

11.2 Accessories

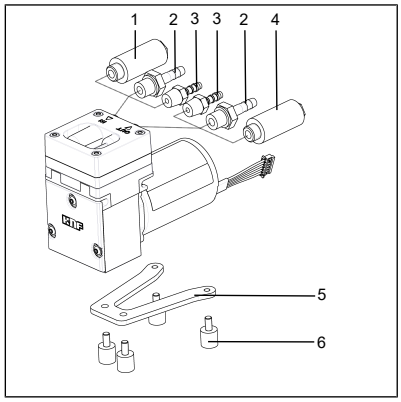

Fig.14 Accessories N96

Accessories	Item	Order number
Suction filter	(1)	000346
Hose connector made of PVDF	(2)	025671
Hose connector made of PA	(3)	001936
Silencer	(4)	000345
Base plate	(5)	321256
Rubber-bonded metals	(6)	320986

Tab.39

12 Returns

Prerequisite for repairing a pump by KNF is a completed Decontamination Form.

This is made available on the KNF website as a download.

- To find the form, select your country on the overview page (www.knf.com).

You can find the Decontamination Form in the download area.

If you have questions, please contact your sales partner (contact data: see www.knf.com).

KNF worldwide
You can find our local KNF partners at: www.knf.com