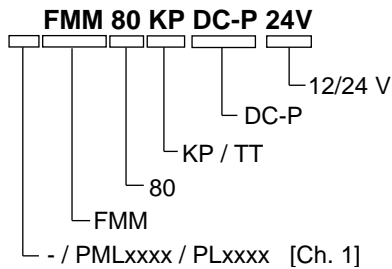


# DIAPHRAGM LIQUID PUMP WITH LINEAR DRIVE

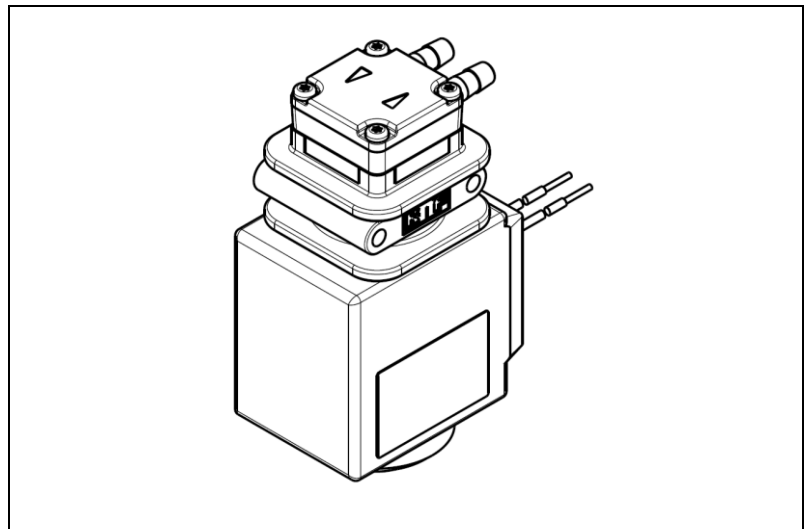
## FMM 80



### Operating and Installation Instructions

Read and observe these Operating and Installation Instructions!

An additional letter prefixing the FMM 80 model code is a country-specific designation, with no technical relevance.



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## 1. About this document

### 1.1. Use of the Operating and Installation Instructions

The Operating and Installation Instructions are part of the pump.

- ➔ Forward the Operating and Installation Instructions to any subsequent owners of the pump.

Project pumps

Customer-specific project pumps (pump models which begin with "PL" or "PML") may differ from the Operating and Installation Instructions.

- ➔ In the case of project pumps, take note of any additionally agreed specifications.

### 1.2. Symbols and markings

#### Warning



**WARNING**

This symbol indicates a potential danger.

It also indicates the possible consequences of failure to observe the warning. The signal word (e.g. "Warning") indicates the level of danger.

- ➔ Here you will see actions for avoiding the danger and potential consequences.

#### Danger levels

Signal word	Meaning	Consequences if not observed
<b>DANGER</b>	warns of immediate danger	Consequences include death or serious injuries and/or serious property damage
<b>WARNING</b>	warns of potential danger	Death or serious injuries and/or serious property damage are possible
<b>CAUTION</b>	warns of a potentially dangerous situation	Minor injuries or damage to property are possible

Tab. 1

#### Other information and symbols

- ➔ This indicates an activity (step) that must be carried out.
- 1. This indicates the first step of an activity to be carried out. Any additional steps required are numbered consecutively.



This symbol indicates important information.

## 2. Use

### 2.1. Intended use

The pumps are intended for transferring and metering liquids.

#### Owner's responsibility

Operating parameters and conditions

Only install and operate the pumps under the operating parameters and conditions described in *Chapter 4*, Technical Data.

Only completely installed pumps may be taken into service.

Requirements for transferred medium

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

Before using a medium, check the compatibility of the materials of the pump head, pump housing, diaphragm and valves with the medium.

The temperature of the medium must lie within the permissible temperature range (see *Chapter 4*).

The transferred medium should not contain particles as these can prevent the pump from working correctly. If this cannot be ensured, a < 50 µm filter with a sufficiently large filter area must be used upstream of the pump.

### 2.2. Improper use

The pumps must not be operated in an explosive atmosphere.

For special modifications outside the standard technical specifications, please contact your KNF technical adviser.

### 3. Safety

**i** Observe the safety precautions in *Chapters 6. Installation and connection and 7. Operation*

The pumps are built according to the generally recognised rules of technology and in accordance with the pertinent occupational safety and accident prevention regulations. Nevertheless, dangers may occur during their use which may lead to injuries to the user or others, or to damage to the pump or other property.

Only use the pumps when they are in a good technical and proper working order, in accordance with their intended use, observing the safety advice within the Operating and Installation Instructions, at all times.

Personnel	<p>Make sure that only trained and instructed personnel or specially trained personnel work on the pumps. This especially applies to assembly, connection and servicing work.</p> <p>Make sure that all personnel have read and understood the Operating and Installation Instructions, and in particular the "Safety" chapter.</p>
Working in a safety-conscious manner	Always ensure adherence to all pertinent accident prevention and safety regulations when working on and operating the pump.
Handling dangerous media	When transferring dangerous media, observe the safety regulations for handling such media.
Notes	Always ensure adherence to all information stickers on the pumps, such as flow direction arrows and type plates, and keep stickers in legible condition.
Environmental protection	All replacement parts should be properly stored and disposed of in accordance with the applicable environmental protection regulations. Ensure adherence to the pertinent national and international regulations. This especially applies to parts contaminated with toxic substances.
Disposal	<p>Dispose of all packaging in an environmentally-appropriate manner. The packaging materials are recyclable.</p> <p>Ensure that the old appliance is disposed of in an environmentally-appropriate manner. Use appropriate waste collection systems for the disposal of end-of-life equipment. Used pumps contain valuable recyclable materials.</p>



EU directives/standards	<p>The pumps are in accordance with the requirements of the guidelines 2011/65/EU (ROHS2)</p> <p>For the purposes of the Machinery Directive 2006/42/EC, pumps are “partly completed machinery”, and are therefore to be regarded as not ready for use. Partly completed machinery may not be commissioned until such time as it has been determined that the machine in which the partly completed machinery is to be assembled conforms to the provisions of the Machinery Directive 2006/42/EC. The essential requirements of Annex I of Directive 2006/42/EC (general principles) are applied and observed.</p> <p>The following harmonised standards are met (operation with electronic control FE Z6):</p> <ul style="list-style-type: none"><li data-bbox="692 674 1249 705">▪ EN 61000-6-3 (incl. EN 55022 / EN 55011)</li></ul>
Customer service and repairs	<p>The pumps must only be serviced and repaired by the relevant KNF Customer Service team.</p>

## 4. Technical Data

### Pump materials

The pump type **KP** stands for:

Assembly	Material <sup>1)</sup>
Pump head*	PP
Valves/ seals	EPDM
Diaphragm	EPDM
Resonating diaphragm	EPDM

Tab. 2

The pump type **TT** stands for:

Assembly	Material <sup>1)</sup>
Pump head*	PVDF
Valves/ seals	FFKM
Diaphragm	PTFE coated
Resonating diaphragm	FFKM

Tab. 3

<sup>1)</sup> according to DIN ISO 1629 and 1043.1

\* The pump head comprises an intermediate plate and a connecting plate (Fig. 1).

### Hydraulic Data FMM 80 DC-P

Parameter	Value
Nominal stroke volume	80 $\mu\text{l}$ <sup>2)</sup>
Stroke volume calibration range	30 - 80 $\mu\text{l}$
Flowrate	48 ml/min <sup>3)</sup> 80 ml/min <sup>4)</sup>
Max. permitted pressure <sup>3)</sup>	1.0 bar
Flow tight in both directions	>1.0 bar
Suction head	>4 mWS <sup>5)</sup>

Tab. 4

During the adjustment of the pump at KNF, ten consecutive strokes are measured. The nominal stroke volume is their average value, which lays between 79 and 81  $\mu\text{l}$ .

<sup>3)</sup> Continuous operation at 10 Hz

<sup>4)</sup> Short-time operation at 16.7 Hz (max. ED 16.7 % / max. 20 minutes), see Chapter 7.5.

<sup>5)</sup> At nominal stroke volume

**Hydraulic connections**

Parameter	Value
Recommended hose ID	$3 \leq ID \leq 4$ mm

Tab. 5

**Electrical Data FMM 80 DC-P**

Rated voltage	12 V	24 V
Max. current consumption	2 A	1 A
Mean current consumption at 10Hz	0.42 A	0.21 A
Power rating at 10 Hz	5 W	
Max. permitted frequency	10 Hz <sup>5)</sup> (16.7 Hz <sup>6)</sup> )	
ON-Time pulse	30 ms	
Min. OFF-Time pulse	>70 ms <sup>5)</sup> (>30 ms <sup>6)</sup> )	
Leads	AWG22	
Built-in Transient Voltage Suppressor <sup>8)</sup>	Limits transient voltage caused by mutual induction when deactivating the solenoid to a max. of 70 V	
EMC Directive <sup>9)</sup>	EN 61000-6-3 (incl. EN 55022 / EN 55011)	
Protection class	IP 54	

Tab. 6

<sup>8)</sup> Control electronics must not have any diodes (see Chapter 7.2).

<sup>9)</sup> When operating with electronic module FE Z6 (see Chapter 10.1).

**Other parameters**

Parameter	Value
Service life	500 million cycles
Noise emission	$\leq 40$ dBA <sup>10)</sup>
Weight	210 g <sup>11)</sup>
Stroke volume adjustment	Allen key 5 mm
Permissible ambient temperature	+5 to +40 °C
Permissible media temperature	+5 to +80 °C
Permissible kinematic viscosity of medium	$\leq 150$ cSt

Tab. 7

<sup>10)</sup> According to DIN 45635, when operated with water but without counteressure.

<sup>11)</sup> The weight may differ slightly from the stated value, depending on the version.

## 5. Assembly and function

### Assembly

- 1 Outlet
- 2 Inlet
- 3 Head plate
- 4 Connecting plate
- 5 Intermediate plate
- 6 Pump housing
- 7 Solenoid coil
- 8 Connecting leads
- 9 Calibrating screw
- 10 Diaphragm
- 11 Spring
- 12 Armature
- 13 Sleeve

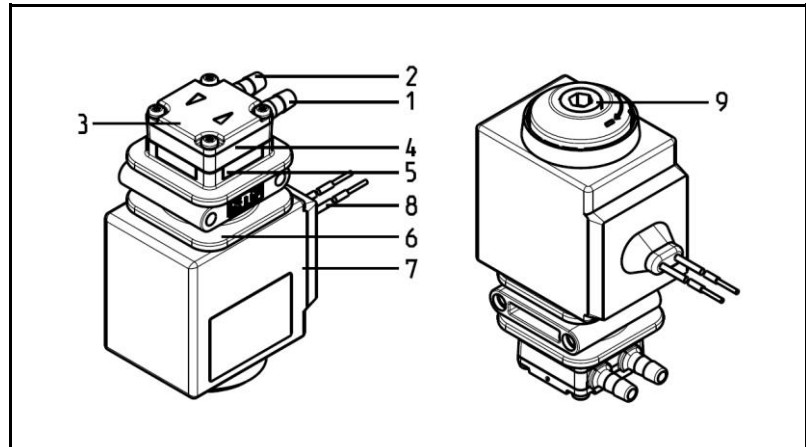


Fig. 1: Magnetic diaphragm metering pump FMM 80

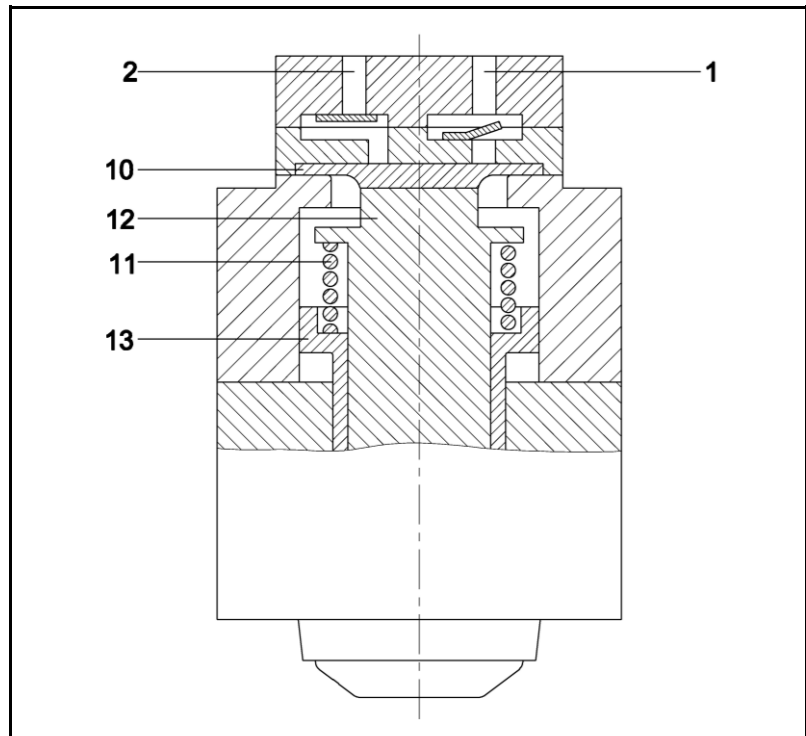


Fig. 2: Pump assembly

Supplying the magnetic coil with the specified electrical voltage (see *Chapter 4*) produces a magnetic field. This magnetic field pulls the armature (12) and the attached diaphragm (10) back to an adjustable limit stop. This causes the diaphragm chamber to be filled with the pumped medium via the inlet (2). In the upward stroke, the spring tension on the diaphragm forces the medium out of the pump head via the outlet (1). Once the upward stroke is completed, the spring (11) pushes the diaphragm into the diaphragm chamber until the next pulse. This closes the suction and pressure lines. The stroke volume of the pump can be adjusted via the limit stop. The height of the limit stop is adjusted by turning the calibrating screw (9).



## 6. Installation and connection

Install the pumps only under the operating parameters and conditions described in *Chapter 4 Technical Data*.

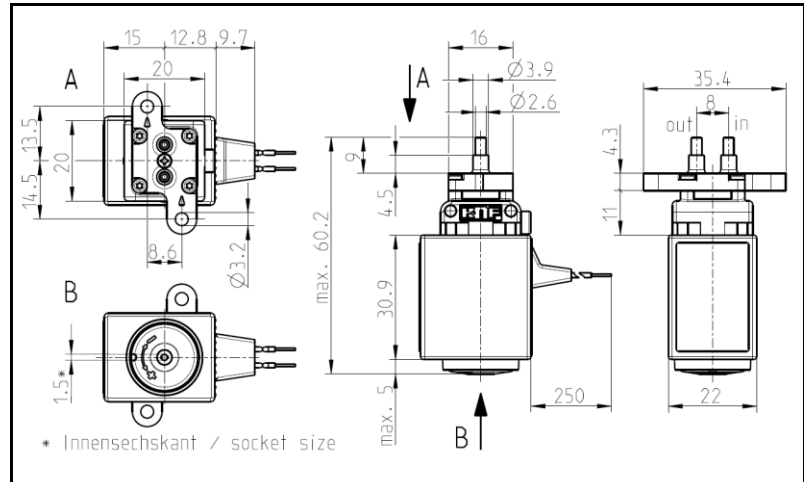
Observe all safety precautions (see *Chapter 3*).

### 6.1. Installation

→ Before installation, store the pump at the installation location to bring it up to ambient temperature.

Mounting dimensions

→ Mounting dimensions (see *Fig. 3*)



*Fig. 3: Mounting dimensions FMM 80*

Installation location

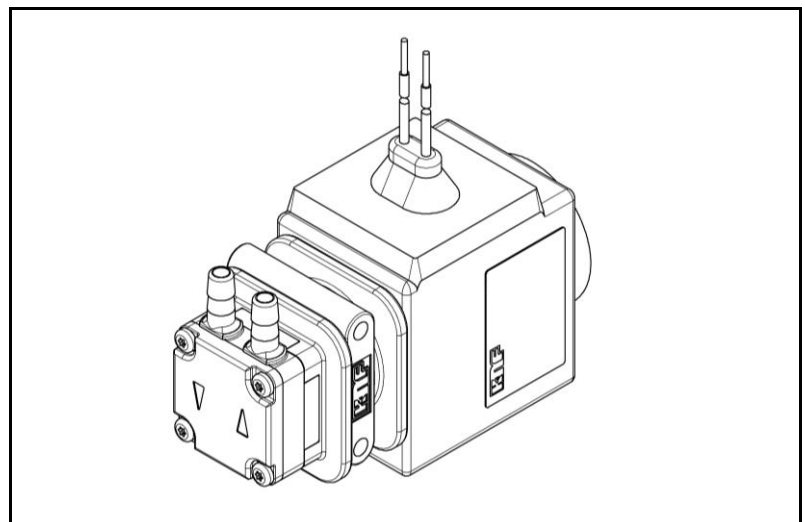
→ Make sure that the installation location is dry and the pump is protected against water in the form of rain, spray, splashes and drips.

→ Protect the pump against dust.

→ Protect the pump against vibration and impact.

Installation position

→ Generally speaking, the pump can be mounted in any installation position. For maximum precision and rapid venting, install pump in the optimum position (*Fig. 4: Optimum installation position*).



*Fig. 4: Optimum installation position*

## 6.2. Electrical connection

- Only have the pump connected by an authorized specialist.
- Only have the pump connected when the power supply is disconnected.
- The electrical installation must be fitted with a device that disconnects the magnetic coil from the mains (acc. to EN 60335-1)
- When connecting the device to a power source, the relevant norms, directives, regulations and technical standards must be observed.

### Connecting the pump

1. Make sure that the power supply data match the data on the motor's type plate. The current consumption can be found on the type plate.
  - i** The supply voltage must not deviate more than  $\pm 10\%$  from the specifications on the type plate.
2. Connect the voltage supply cables to the two pump leads.
  - i** The polarity is irrelevant.

**CAUTION**

- Do not connect the pump to a continuous direct voltage. Information on the control signal (see *Chapter 7*).
  - As a consequence of the built-in transient voltage suppressor, the special requirements for the control electronics must be observed (see *Chapter 7.2*).
-

### 6.3. Hydraulic connection

Connected components

➔ Only connect components to the pump that are designed to handle the hydraulic data of the pump (see *Chapter 4*).

Hoses

➔ Only use hoses that are suitable for the maximum operating pressure of the pump (see *Chapter 4*).

➔ Only use hoses that are sufficiently chemically resistant to the liquids being pumped.

The hydraulic connection can be made using hoses (*Section 6.3.1*)

#### 6.3.1. Connecting the pump

**i** Arrows on the pump head indicate the flow direction.

1. Remove the protective caps from the connections.
2. Connect the suction and pressure lines.

**i** Keep the suction line as short as possible in order to keep the priming process as brief as possible.

3. If the pump is used to build up pressure, make sure that all transition joints between hose and pump are secure in order to ensure that the hoses cannot come off.
4. Check that the hoses and transition joints are fitted correctly and securely.
5. Check that the system is leak-tight.

## 7. Operation

### 7.1. General points

- Operate the pumps only under the operating parameters and conditions described in *Chapter 4 Technical Data*.
- Ensure that the pumps are being used correctly (see *Chapter 2.1*).
- Avoid improper use of the pumps (see *Chapter 2.2*).
- Observe all safety precautions (see *Chapter 3*).
- The pumps are components that are intended to be incorporated into another machine. Before putting them into service it must be established that the machinery or equipment in which they are installed meet the relevant regulations.



**CAUTION**

Risk of burning

The magnetic coil of the pump heats up

- Avoid contact with the pump drive.
- Avoid contact with flammable materials.



**WARNING**

**Danger of bursting of the fluid system due to overpressure.**

The pump builds up pressure. A closed system can cause the max. permitted operating pressure to be exceeded. This can cause injuries or damage to the pump and the system.

- Avoid operation against a closed system.
- Only use wetted parts that are rated for at least the operating pressure of the pump.
- If necessary, limit the maximum system pressure by suitable measures.

- i** Excessive pressure and the inherent dangers thereof can be prevented by placing a bypass line with a pressure relief valve between the pressure and suction side of the pump. For further information, contact your KNF technical adviser (Telephone number: see first page).

- Pump standstill → If the pump stops running, restore the system to normal atmospheric pressure.
- Check the pump → Check the pump regularly for external damage or leaks

**Switching on the pump**

- In order to guarantee that the pump can start every time it is advisable to reduce the counterpressure to an acceptable level. If you experience a brief power interruption, check for the presence of pressure or vacuum before restarting.

**i** For more specific information contact your KNF technical adviser.

**Switching off the pump**

- KNF recommends: if transferring aggressive liquids, the pump should be flushed thoroughly prior to switch off (see *Section 8.2.1*), as this will help to extend the service life of the diaphragm.
- Restore the system to normal atmospheric pressure (release hydraulic pressure in pump).

### 7.2. Electromechanical design

The FMM 80 DC-P has a fixed transient voltage suppressor. Alternating control signals cause inductive voltage spikes on the solenoid. The transient voltage suppressor allows a controlled discharge of the mutual induction voltage generated at the solenoid to take place, thus preventing damage to the electronic control system. However, the circuit breaker must be able to handle voltages of at least 70 V.

Freewheeling diode



Whatever type of control is used (Fig. 5 and Fig. 6), no additional freewheeling diodes may be used in the control circuit.

**CAUTION** → If used, they may adversely affect signal quality, resulting in a reduction in precision.

- 1 Solenoid
- 2 Transient voltage suppressor
- 3 Freewheeling diode not permitted.

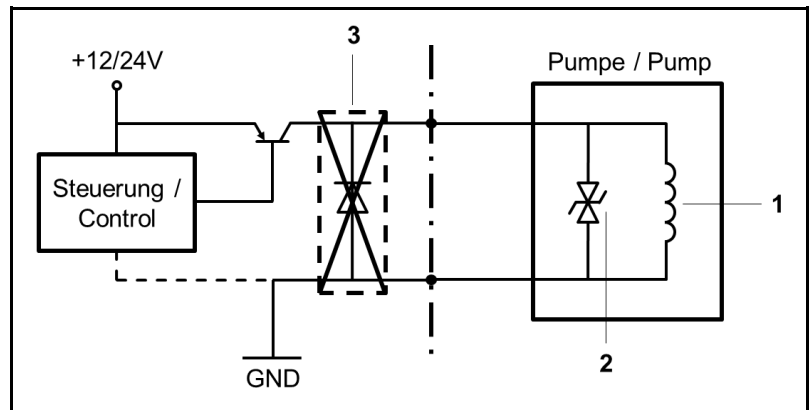


Fig. 5: Diagram – Supply reference control

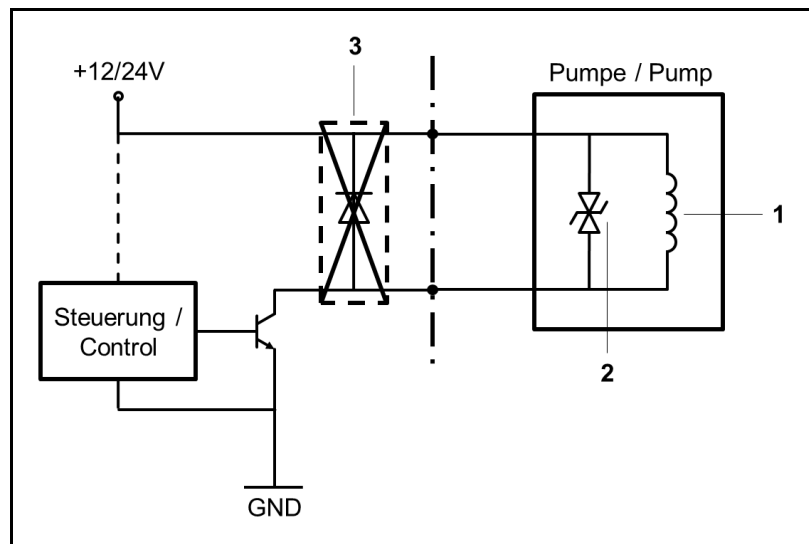


Fig. 6: Diagram – Ground reference control

### 7.3. Executing single strokes

When the voltage is applied, the pump sucks in liquid. When the voltage is removed, the previously sucked-in liquid is ejected.

**i** For operational purposes, the suction time, i.e. the time that the magnetic coil is energised, must be 30 ms.

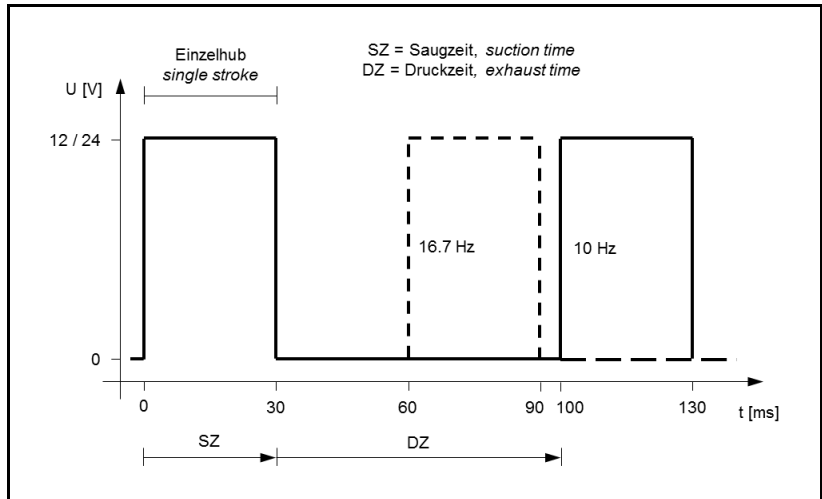


Fig. 7: Control signal (pulse)

### 7.4. Executing several strokes

The stroke frequency can be adjusted via the voltage frequency.

Frequency range: 0 to 10 Hz<sup>5)</sup> (max. 16.7 Hz<sup>6)</sup>).

**i** The exhaust time is at least 70ms<sup>5)</sup> in continuous operation and at least 30ms<sup>6)</sup> in short-time operation.

<sup>5)</sup> Continuous operation

<sup>6)</sup> Short-time operation (max. ED 16.7% / max. 20 minutes), see Chapter 7.5.

### 7.5. Short-time operation with a maximum frequency of 16.7Hz

Short-time operation with a maximum frequency is used to increase the flow rate, e.g. in order to fill the system quickly. When operating at the maximum frequency of 16.7 Hz (ON 30 ms, OFF: 30 ms) the permissible duty time (ED) must be observed.

In order to prevent the permissible coil temperature ( $T_{s\_max}$ ) from being exceeded, the pump must not be operated for more than 20 minutes at 16.7 Hz. This must be followed by a currentless interval (SP) lasting 100 minutes. If operated for a shorter time at 16.7 Hz, the currentless interval is reduced proportionately. For short-time operation at 16.7 Hz, this results in a %ED of no more than 16.7 % (see Fig. 8: Duty time in short-time operation, page 16).

For a given duty time, the minimum duration of the currentless interval is calculated as follows:  $SP \geq 5 \cdot ED$ .

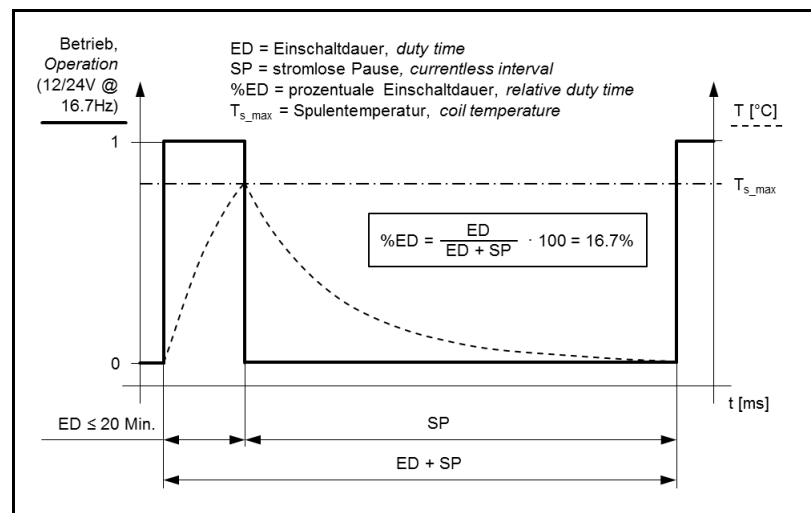


Fig. 8: Duty time in short-time operation



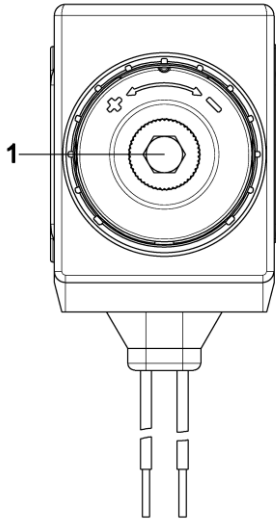


Fig. 9 Adjusting the stroke

## 7.6. Adjusting the stroke volume

The stroke volume, and thus the metering volume of the pumped media, can be adjusted by turning the calibrating screw (see Fig. 9, *item 1*) at the bottom of the pump.

Calibration range of metering volume per pump stroke: 30 – 80  $\mu$ l.

**i** A 5 mm Allen key is required to adjust the stroke.

## 7.7. Adjusting the flow rate

The flow rate can be adjusted via the stroke volume (*Chapter 7.6*) or by means of the stroke frequency (*Chapter 7.4*).

**i** For reasons of accuracy the suction time, or the energised time (SZ), must be kept constant and the stroke frequency must be adjusted via the exhaust time (DZ) (see *Fig. 7*).

**i** The pumps are checked and set to a suction/energised time of 30 ms by KNF Flodos.

## 8. Servicing

### 8.1. Servicing schedule

Component	Servicing interval
Pump	- Regular inspection for external damage or leaks

Tab. 8

### 8.2. Cleaning

Information on procedure



#### WARNING

Health hazard due to dangerous substances in the pump!

Depending on the substance transferred, caustic burns or poisoning are possible.

→ Wear protective clothing if necessary, e.g. protective gloves.

→ Flush the pump with a neutral liquid and pump empty.

#### 8.2.1. Flushing the pump

→ When transferring aggressive media, in order to extend the service life of valves and diaphragms, KNF recommends flushing the pump with air (if necessary on safety grounds: with an inert gas) or with a neutral liquid under atmospheric conditions for a few minutes before switching off.

#### 8.2.2. Cleaning the pump

→ Where possible, wipe the solenoid and the pump head with a dry cloth. Do not use cleaning solvents as these may corrode plastic parts.

## 9. Troubleshooting

- ➔ Disconnect the pump power supply before working on the pump.
- ➔ Make sure that the pump is de-energised.

Stroke not executed	
Cause	Fault remedy
Pump not connected to power supply	➔ Connect pump to power supply
Power supply is not switched on	➔ Switch on power supply
Connecting leads are damaged	➔ Check connecting leads for damage ➔ Check connecting lead entry on solenoid for damage
Connections or hoses are blocked	➔ Check connections and hoses ➔ Remove blockage
External valve is closed or filter is clogged.	➔ Check external valves and filters
Incorrect interchange of pressure and suction line connections	➔ Remove pressure and suction lines and re-connect correctly
Pressure on the pressure side is too high	➔ Reduce the pressure on the pressure side of the pump
Electrical signal is outside the defined range	➔ Adjust pulse signal (see <i>Chapter 7</i> )

Tab. 9

Pump is not priming	
Cause	Fault remedy
Suction side of pump not connected	➔ Connect the suction side of the pump
Liquid in the priming container is too low	➔ Fill priming container
Hose connections are not leak-tight	➔ Secure transition joints between hose and connections with clamps or other clamping elements
System valve is closed or filter is clogged	➔ Open system valve ➔ Clean filter
Particles in the pump	➔ Contact KNF
The pump parts are not resistant to the medium to be pumped	➔ Contact KNF
Incorrect interchange of pressure and suction line connections	➔ Remove pressure and suction lines and re-connect correctly

Tab. 10

<b>Flow rate, suction head or pressure head is too low</b>	
The pump does not achieve the performance stated in the technical data or on the data sheet.	
Cause	Fault remedy
Components in the system connected to the suction and pressure sides, such as hoses, valves or filters, are causing too much resistance	➔ Modify installation, check cross-sections of components
Hose connections are not leak-tight	➔ Secure transition joints between hose and hose connectors with clamps or other clamping elements
Particles in the pump	➔ Contact KNF
Viscosity of the transferred medium is too high	➔ Contact KNF
Incorrect interchange of pressure and suction line connections	➔ Remove pressure and suction lines and re-connect correctly
The pump parts are not resistant to the medium to be pumped	➔ Replace the pump head with a compatible version

Tab. 11

**Fault cannot be rectified**

If you are unable to identify any of the above causes, please send the pump to KNF customer service (see address on last page).

1. Flush the pump to clear the pump head of any hazardous or aggressive fluids (see *Section 8.2.1*).
2. Dismantle the pump.
3. Clean the pump (see *Section 8.2.2*).
4. Send the pump, with completed decontamination declaration (see *Chapter Fehler! Verweisquelle konnte nicht gefunden werden.*), to KNF stating the nature of the pumped medium.

## 10. Spare parts and accessories

### 10.1. Accessories

Accessories	Order No.
Starter-Kit FSK 4	165133

Tab. 12

## 11. Return of the pump

**i** KNF undertakes to repair the pump only under the condition that the customer provides a certificate of the pumped medium and cleaning of the pump. For this purpose, please follow the instructions on [www.knf.com/repairs](http://www.knf.com/repairs).

Please contact your KNF sales representative directly if you need additional support for your return service.



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