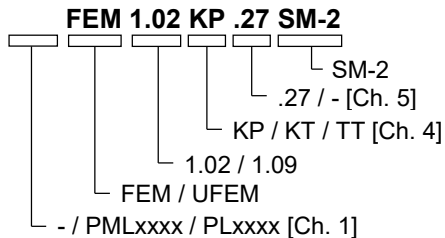


DIAPHRAGM METERING PUMP

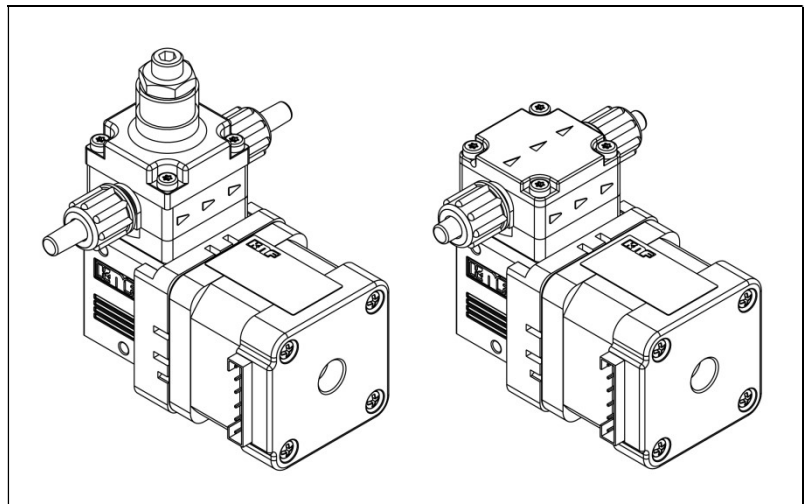
FEM 1.02, FEM 1.09



Operating and Installation Instructions

Read and observe these Operating and Installation Instructions.

An additional letter prefixing the FEM model code is a country-specific designation, and does not have any technical relevance.



KNF Flodos AG
 Wassermatte 2
 6210 Sursee, Switzerland
 Tel. +41 (0)41 925 00 25
 Fax +41 (0)41 925 00 35
 www.knf.com
 info.flodos@knf.com

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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
DANGER	warns of immediate danger	Consequences include death or serious injuries and/or serious property damage.
WARNING	warns of potential danger	Death or serious injuries and/or serious property damage are possible.
CAUTION	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 fully assembled 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 range (see Chapter 4).

The pumped 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 a potentially explosive atmosphere.

The maximum ambient temperature must not exceed 40°C.

Do not use the pump controller in a damp environment or under condensing conditions.

The controller must be protected against contamination, and contact with liquids, solvents or vapours must be avoided.

The pump controller must only be operated when adapted to meet the ESD (Electrostatic Discharge) safety standards.

Do not establish uncontrolled connections between the controller and conductive cables and materials.

For special modifications to the pumps outside the standard technical specifications please contact a 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 can result during their use which 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	Observe the accident prevention and safety regulations when performing any work on the pump and during operation.
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 for the disposal of end-of-life equipment. Used pumps</p>



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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:</p> <p>When used in conjunction with the 2-phase stepping motor controller, Id. No. 157870 or Id. No. 160536, with up to 1 metre of supply cable, all FEM 1.02, FEM 1.09 and UFEM 1.09 pumps meet the following standards:</p> <ul style="list-style-type: none">▪ EN 61000-6-2▪ EN 61000-6-4 <p>i Please note: when used in conjunction with controllers from other manufacturers, compliance with the above standards cannot be guaranteed.</p> <p>i Please note: when used in conjunction with controllers from other manufacturers, compliance with CE standards must be verified by the customer.</p>
Customer services and repairs	<p>All repairs to the pump(s) must be carried out by the relevant KNF Customer Service team.</p> <p>Only use genuine parts from KNF for servicing work.</p>

4. Technical data

Pump materials

The pump type **KP** stands for:

Assembly	Material ¹⁾
Pump head*	PP
Valve plate	EPDM
Diaphragm	PTFE

Tab. 2 ¹⁾ according to DIN ISO 1629 and 1043.1

The pump type **KT** stands for:

Assembly	Material ¹⁾
Pump head*	PP
Valve plate	FFKM
Diaphragm	PTFE

Tab. 3 ¹⁾ according to DIN ISO 1629 and 1043.1

The pump type **TT** stands for:

Assembly	Material ¹⁾
Pump head*	PVDF
Valve plate	FFKM
Diaphragm	PTFE

Tab. 4 ¹⁾ according to DIN ISO 1629 and 1043.1

- * The pump head comprises a connecting plate and an intermediate plate (Chapter 8.3, items 3 and 4)

Hydraulic ratings

Parameter	Value
Flow rate FEM 1.02 [ml/min] ^{1), 2)}	0.2 – 20
Flow rate FEM 1.09 [ml/min] ^{1), 2)}	0.9 – 90
Permissible pressure [bar _g]	6
Suction head [mWG]	4

Tab. 5

- 1) Measured with water at 23 °C at atmospheric pressure
- 2) Flow rates may vary from the values shown, depending on fluid viscosity, pump head material and the hoses/hose connectors used.

FEM27 Hydraulic ratings, option .27

Parameter	Value
Min. overflow pressure [bar]	0.5
Max. overflow pressure [bar]	6.5

Tab. 6

Hydraulic connections

Pump type	Connection type
FEM 1.02 (internal thread)	UNF 1/4"-28
FEM 1.02 (hose fitting)	4/6 mm
UFEM 1.09 (hose fitting)	1/8"/1/4"

Tab. 7

Electrical specifications FEM 1.02 / FEM 1.09

Motor voltage	SM-2
Nominal voltage [V] ¹⁾	5.52
Current [A/Phase] rms ¹⁾	0.6
Inductivity [mH/phase]	14.6
Resistance [Ohms/phase]	9.2
Power consumption [W]	15
Maximum speed [rpm]	200
Step angle	1.8°
Connection type	Connector with leads

Tab. 8

¹⁾ Nominal voltage and current.

²⁾ The weight may differ slightly from the stated value, depending on the version.

Other parameters

Parameter	Value
Permissible ambient temperature range [°C]	+5 to +40
Permissible media temperature range [°C]	+5 to +80
Permissible kinematic viscosity of medium [cSt]	≤150
Protection class [-]	IP40
Weight ²⁾ [g]	340

Tab. 9

Accuracy/reproducibility

Accuracy The accuracy of the calibrated metering pump is appropriately characterised by the maximum absolute error A (dependent on the nominal value) and the maximum relative error B (dependent on the setting value):

$$\rightarrow \text{max. inaccuracy} \leq (A + B)$$

FEM 1.02

Error	Value
Absolute error A	$\leq \pm 0.1\%$ of nominal value
Relative error B	$\leq \pm 1.0\%$ of setting value

Tab. 10

FEM 1.09

Error	Value
Absolute error A	$\leq \pm 0.1\%$ of nominal value
Relative error B	$\leq \pm 1.0\%$ of setting value

Tab. 11

Example: FEM 1.09; the nominal value for stroke volume is 500 μl

For a setting of 260 μl , the accuracy should therefore be within the following error limits:

$$\begin{aligned} \text{Inaccuracy} &\leq (\pm 0.1\% \times 500 \mu\text{l}) + (\pm 1.0\% \times 260 \mu\text{l}) \\ &\leq (\pm 0.5 \mu\text{l}) + (\pm 2.6 \mu\text{l}) \\ &\leq \pm 3.1 \mu\text{l} \\ &\approx \pm 1.2\% \text{ of setting value} \end{aligned}$$

Reproducibility Under constant environmental conditions the pump achieves a reproducibility of less than $\pm 1\%$.

i Greater inaccuracies may occur for fluids with a viscosity of > 150 cSt or with a tendency to outgas. Appropriate adjustments may be made during calibration.

i The accuracy of the pump is ultimately a matter of the measurement and pumping system and the parameters with which the pump is operated. The hose types used and the design of the hose end at the pressure side play an important part in precise metering.

Factory calibration FEM 1.02 ... SM-2 and FEM 1.09 ... SM-2 are not calibrated in the factory.

Calibration The pump must be calibrated electronically via the controller in the customer system.

The flow rate may differ from the calibrated value in some applications. This is influenced by the following factors: type of medium, its viscosity, density and temperature, pressure and installation type (e.g. cross-section constrictions). For accurate metering it is therefore recommended that the metering pump be calibrated.

5. Assembly and function

Assembly without overpressure relief valve

- 1 Inlet
- 2 Outlet
- 3 Pump head
- 4 Stepping motor (2-phase)
- 5 Stepping motor plug

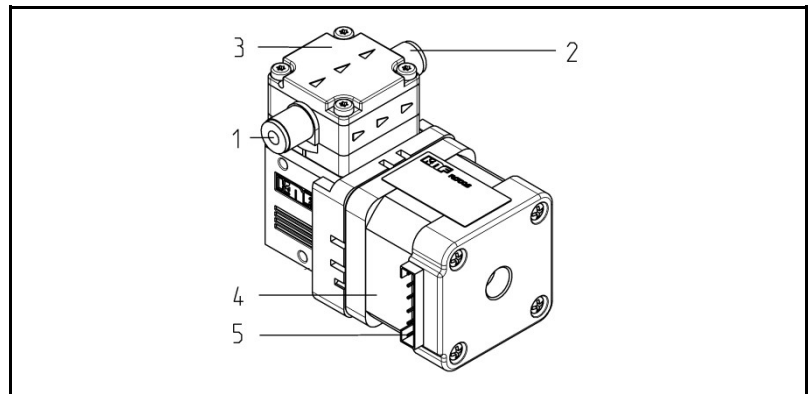


Fig. 1: Stepping motor diaphragm metering pump FEM 1.02

Assembly with overpressure relief valve

- 1 Inlet
- 2 Outlet
- 3 Pump head
- 4 Stepping motor (2-phase)
- 5 Stepping motor plug
- 6 Overpressure relief valve (.27)

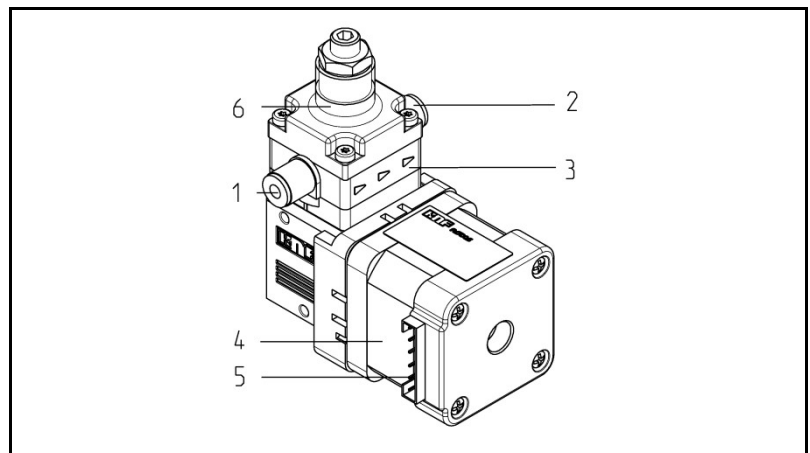


Fig. 2: Stepping motor diaphragm metering pump FEM 1.0227

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

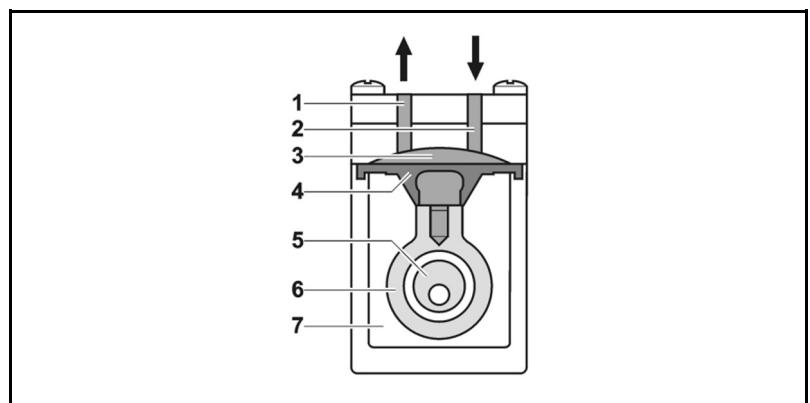


Fig. 3: Pump assembly

Stepping motor diaphragm metering pumps are based on reciprocating displacement pump technology. The elastic diaphragm (4) is moved up and down by the eccentric (5) and the connecting rod (6). In the downward stroke it aspirates the medium to be transferred via the inlet valve (2). In the upward stroke, the diaphragm pushes the medium out of the pump head via the outlet valve (1). The diaphragm hermetically seals off the working chamber (3) from the pump drive (7).

FEM ...	<p>FEM ... -Version (standard version)</p> <p>This pump type represents this product in its simplest form and is intended for continuous delivery at an exact delivery rate.</p>
FEM27	<p>FEM27-Version (with overpressure limitation)</p> <p>If the metering pump is operating against a closed system, the delivery pressure quickly exceeds the maximum permissible values. To prevent this happening, an overflow valve is integrated in the top part of the pump head. If the pressure exceeds the variable limit range (min. 0.5 to max. 6.0 barg), the valve opens and the liquid circulates from the pressure side to the suction side via an internal bypass system. This prevents any further rise in pressure.</p>
FEM55	<p>FEM55 version (with single-stroke metering)</p> <p>The .55 version was specially developed for the KNF stepping motor partial stroke controller FE Z5. The pumps have a Hall effect sensor for determining the position of the diaphragms. This is needed during partial stroke metering or with customer-specific operating profiles.</p> <p>i Please note:</p> <ul style="list-style-type: none"> ➔ The FEM55 is compatible with KNF controllers FE Z4 and FE Z5. ➔ The FE Z5 stepping motor partial stroke controller from KNF can only be used in combination with the FEM55.
FEM55 RC	<p>FEM55 RC version (single-stroke metering incl. controller)</p> <p>In the .55 RD version the FE Z5 stepping motor partial stroke controller from KNF is integrated in the pump and is supplied as a single unit. Detailed information can be found in the relevant operating instructions.</p>
KNF stepping motor controller	<p>The stepping motor controllers from KNF are available as accessories, see accessory list in chapter 10. Two different controllers are available.</p> <ol style="list-style-type: none"> 1. Stepping motor controller FE Z4 2-phase stepper standard controller, single speed controller for variable delivery volume, pulse input for maximum programming capability etc. 2. Stepping motor partial stroke FE Z5 Dispense partial stroke controller, partial stroke metering using potentiometer or analogue signals possible, alarm output etc. <p>More information about the functionality of the KNF controllers FE Z4 and FE Z5 can be found in the relevant operating instructions.</p>

6. Installation and connection

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

Observe the 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. 4 to 6)

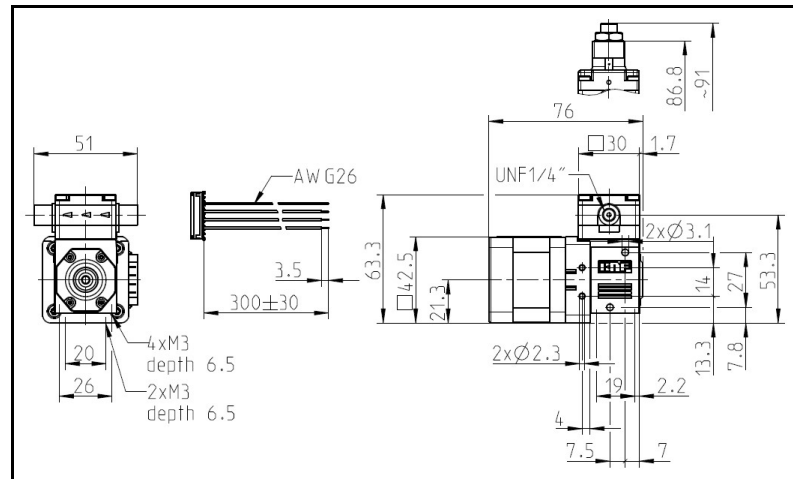


Fig. 4: Mounting dimensions FEM 1.02, FEM 1.02 .27

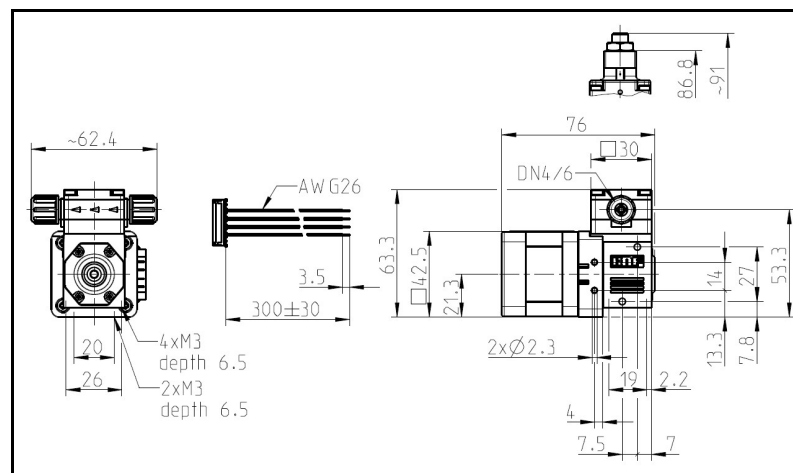


Fig. 5: Mounting dimensions FEM 1.09, FEM 1.09 .27

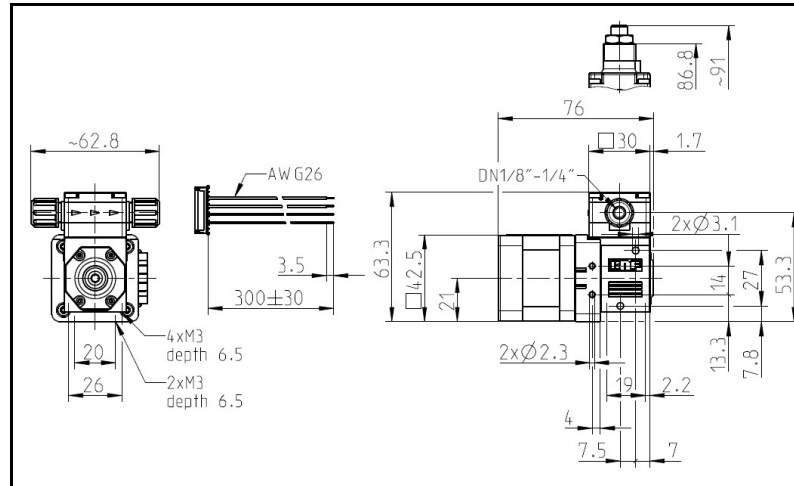


Fig. 6: Mounting dimensions UFEM 1.09, UFEM 1.09 .27

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 the vertical pumping direction should ideally run from bottom to top (fig. 7).

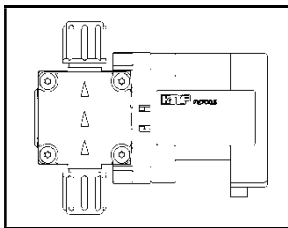


Fig. 7: Optimum installation position from bottom to top

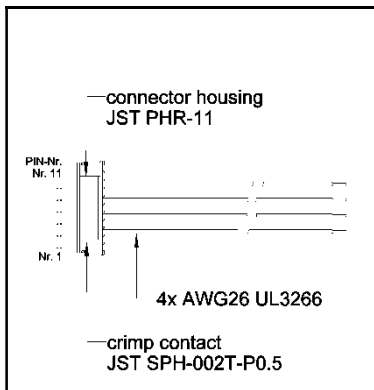


Fig. 8: Lead assignment

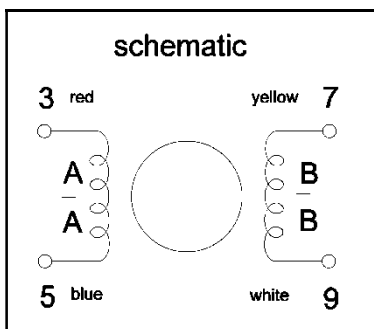


Fig. 9: Bipolar winding assignment

6.2. Electrical connection

- Only have the pump connected by an authorized specialist.
 - Only have the pump connected when the power supply is disconnected.
 - When connecting the device to a power source, the relevant norms, directives, regulations and technical standards must be observed.
- i** The controller must only be operated in accordance with the ESD (Electrostatic Discharge) safety standards.

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.
2. Check actuation algorithm for 2-phase stepping motor (e.g. with KNF controller see accessory list in chapter 10)

- i** KNF recommendation: Bipolar winding assignment, current-driven actuation (chopper operation), key data can be found on the type plate and the data sheet.

The latest algorithms can be found in the literature.

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, Technical data).
- 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.

6.3.1. Connecting the pump

i Arrows on the pump head indicate the flow direction.

FEM 1.02 - Screw-in connection fitting with internal thread

- 1 Hose
- 2 Hose connector
- 3 Clamp ring
- 4 Connector

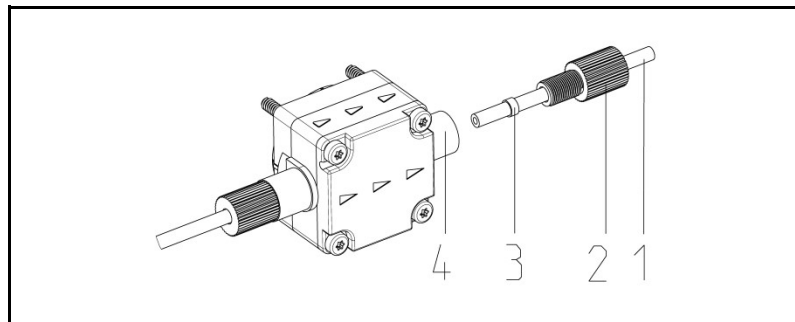


Fig. 10: Hose connector 1.6 x 3.2 mm (FEM)

1. Remove protective caps
2. Connect the suction and pressure lines
(Recommendation: UNF 1/4"-28 flangeless connection with 1/16" hose, see accessories list in Chapter 10)

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

3. Check that the hoses (1) and transition joints (hose connector/hose) are fitted correctly and securely
4. Check that the system is leak-tight

FEM 1.09 / UFEM 1.09 - Clamp ring hose connection fitting

- 1 Hose
- 2 Union nut
- 3 Clamp ring
- 4 Connector

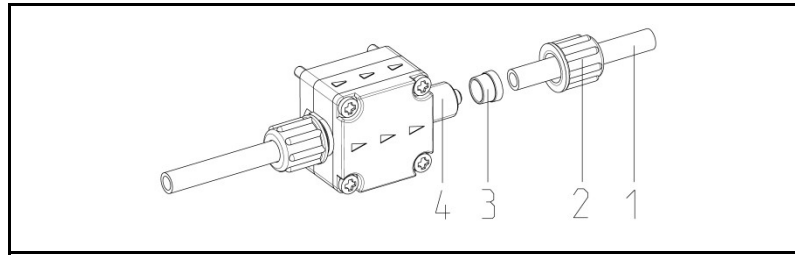


Fig. 11: 4/6 mm hose connection fitting with clamp ring (FEM)
1/8"/1/4" hose connection fitting with clamp ring (UFEM)

1. Remove protective plugs from connections
2. Using a sharp knife, cut the suction and pressure lines (FEM: hose ID 4 mm, OD 6 mm; UFEM: hose ID 1/8", OD 1/4") to the required length, with straight square edges
3. Push the union nut (2) and clamp ring (3) onto the hose (1).
4. Push the hoses onto the connectors as far as they will go
5. Hand-tighten the union nut (2).
6. Check that the hoses and transition joints (hose connector/hose) are fitted correctly and securely
7. Check that the system is leak-tight

7. Operation

- Operate the pumps only under the operating parameters and conditions described in Chapter 4, Technical data.
- Make sure the pumps are being used properly (see Chapter 2.1).
- Avoid improper use of the pumps (see Chapter 2.2).
- Observe the 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 stepping motor heats up even when at a standstill if the motor is actuated!

- 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.

Switching off the pump

- KNF recommends that after transferring aggressive media the pump should be flushed thoroughly prior to switch off (see Chapter 8.2.1) in order to prolong the life of the membrane.
- Restore the system to normal atmospheric pressure (release hydraulic pressure in pump).

Suction side filter

The pumped 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.

7.1. Setting the delivery volume

The delivery volume can be set by adapting the speed. Actuation and control must be ensured using a suitable stepping motor controller, see chapters 5 and 6.

i Accessories:

- ➔ Stepping motor controller FE Z4 (standard controller)
- ➔ Stepping motor partial stroke controller FE Z5 in combination with FEM55 (partial stroke controller)

Delivery rate FEM 1.02 ... SM-2

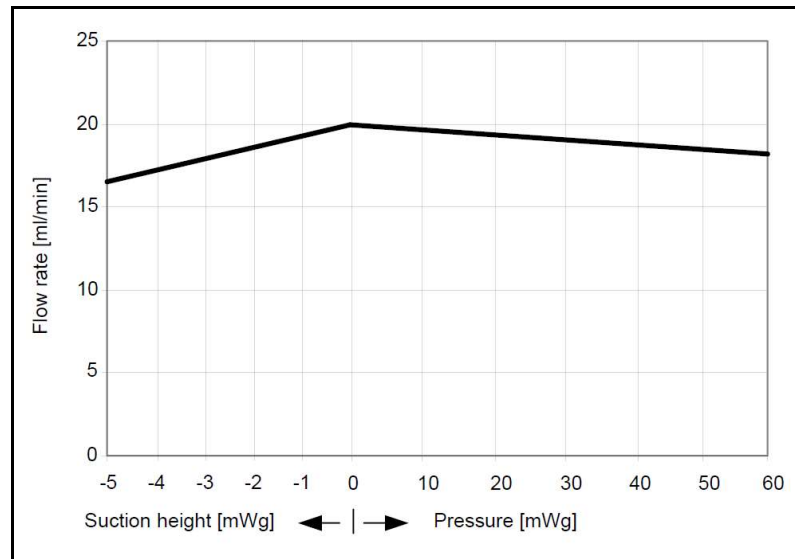


Fig. 12: Delivery rate of pump FEM 1.02 with KNF controller FE Z4

Delivery rate FEM 1.09 ... SM-2 / UFEM 1.09 ... SM-2

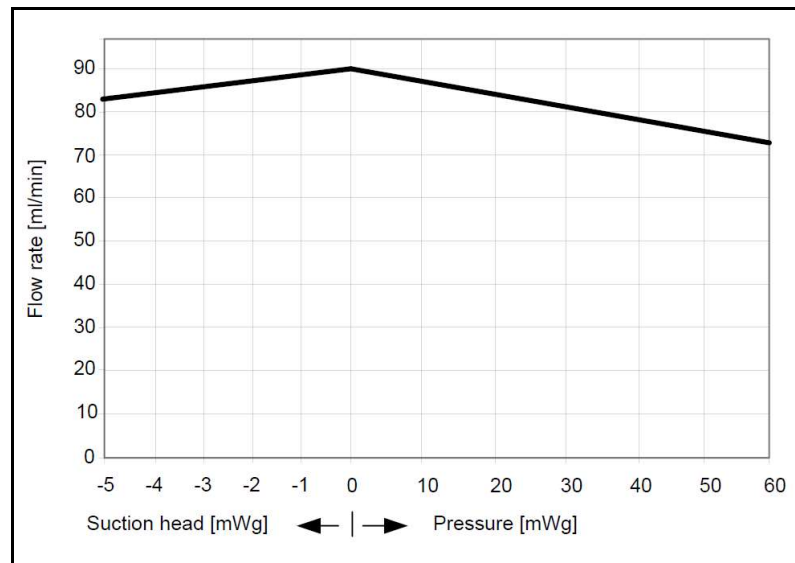


Fig. 13: Delivery rate of pump FEM 1.09 with KNF controller FE Z4

7.2. Metered volume

Options:

1. Keep speed constant and adjust the metering volume by varying the operating time.
2. Keep operating time constant and adjust the metering volume by varying the speed.

Both variants provide extremely accurate metering volumes.

7.3. FEM27 version overpressure relief valve adjustment

If the diaphragm metering pump is operating against a closed system, the delivery pressure quickly exceeds the maximum permissible value. To prevent this happening, an overflow valve is integrated in the top part of the pump head. If the pressure exceeds the variable limit range (min. 0.5 to max. 6.5 bar_g), the valve opens and the liquid circulates from the pressure side to the suction side via an internal bypass system. This prevents any further rise in pressure.

1. Connect pressure gauge to pressure side of pump
2. Undo lock nut using an Allen wrench and an open-ended spanner.
3. Switching on the pump
4. Set the required pressure using an Allen wrench
5. Hold Allen wrench and counterhold the nut using the open-ended spanner
6. Re-check the pressure setting



→ The permissible pressure on the type plate must not be exceeded under any circumstances.

→ The system or the pump may rupture.

WARNING

Qty.	Tools/materials
1	Pressure gauge (with sufficient accuracy)
1	Allen wrench 4 mm
1	Open-ended spanner 13 mm

Tab. 12

Make sure that the container (a), pump (b), pressure gauge (c) and valve (d) are as level as possible (± 15 cm)

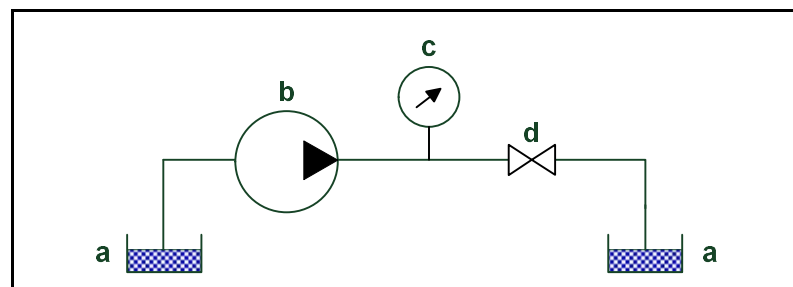


Fig. 14: Test set-up for overflow

8. Servicing

8.1. Servicing schedule

Component	Servicing interval
Pump	- Regular inspection for external damage or leaks
Pump head	- Clean if the flow rate decreases, the pump does not work or no vacuum is created (Chapter 8.2)
Diaphragm and valve disks	- Change as soon as pumping capacity decreases, preferably sooner

Tab. 13

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

- If transferring aggressive media, KNF recommends flushing the pump with air under atmospheric conditions for several minutes prior to switch off (if necessary for safety reasons: use an inert gas). This will extend the service life of the diaphragm.

8.2.2. Cleaning the pump

- Where possible, wipe the components dry with a cloth. Do not use cleaning solvents as these may corrode plastic parts.
- If there is compressed air available, blow off components.

Prior requirements

- Pump or drive disconnected from the mains and de-energized.
- The pump must be free of any hazardous substances
- Hoses must be disconnected from the pump head
- We recommend replacing the diaphragm when head parts are removed.

Tool

Qty.	Tool
1	Torx screwdriver no. 10
1	Allen wrench 4 mm (for .27 only)
1	Open-ended spanner 13 mm (for .27 only)

Tab. 14

8.3. Dismantling the pump head (FEM 1.02 / FEM 1.09 / UFEM 1.09)

1. Use a screwdriver to undo the head screws (1)
2. Remove the head plate (2), connecting plate (3) and intermediate plate (4)

Removing the valves and seals

3. Remove valve seats (5)
4. Remove seals (6), valve disks (7) and O-rings (8)

Cleaning the parts

5. Clean the diaphragm (9), valve disk (7), seals (6) and O-rings (8) with a cloth and then blow off with compressed air
6. Blow off the intermediate plate (4) and the connecting plate (3) with compressed air

Mounting the valves and seals

7. Mount O-rings (8) and valve disk (7) on valve seat (5)
8. Insert seal (6) in connecting plate (3)
9. Insert valve seats with valve disks (7) and O-rings (8) into connecting plate (3) (slight pressure required)
10. Insert the seal (6) in the intermediate plate (4)

Mounting the pump head

11. Assemble the intermediate plate (4), connecting plate (3) and head plate (2)
12. Push the assembled components onto the pump housing with finger pressure
13. Secure the pump head to the housing using the 4 head screws (1)

i The maximum tightening torque for the head screws is 1 Nm.

i Head screws that have been undone before should be carefully screwed in by hand so that the screws engage in the existing threads.

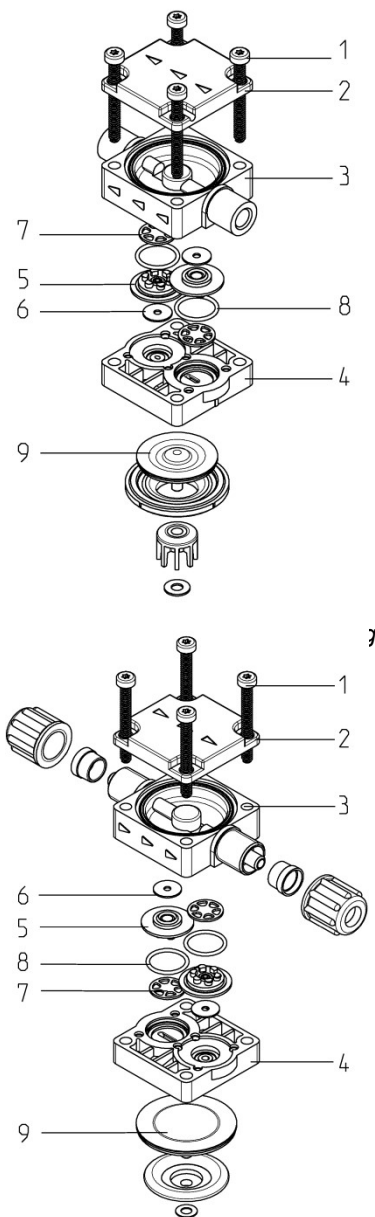


Fig. 16: FEM 1.09 head cleaning

- 1 Head screw
- 2 Head plate
- 3 Connecting plate
- 4 Intermediate plate
- 5 Valve seat
- 6 Seal
- 7 Valve disk
- 8 O-ring
- 9 Diaphragm

8.4. Dismantling the pump head (FEM 1.02 .27 / FEM 1.09 .27 / UFEM 1.09 .27)

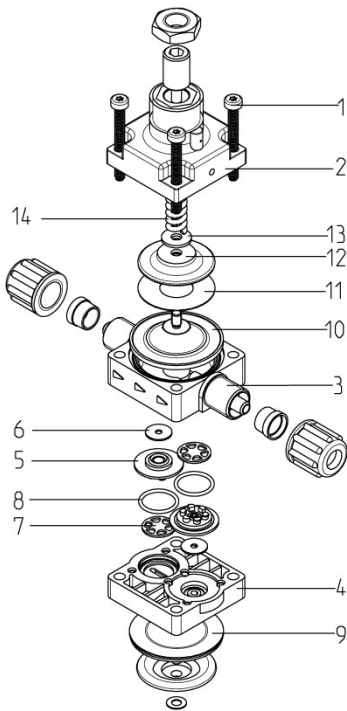


Fig. 17: FEM 1.09 .27
head cleaning

- 1 Head screw
- 2 Head plate .27
- 3 Connecting plate
- 4 Intermediate plate
- 5 Valve seat
- 6 Seal
- 7 Valve disk
- 8 O-Ring
- 9 Diaphragm
- 10 Overflow diaphragm .27
- 11 Sliding disk
- 12 Support
- 13 Spacer
- 14 Spring



WARNING

It must be ensured that the overflow pressure can be accurately set again after dismantling!

- Too much pressure can cause leaks or make the system rupture!
- Not enough pressure can adversely affect the operation of your system.

1. Reduce overflow with the aid of the Allen wrench and the open-ended spanner
2. Use a screwdriver to undo the head screws (1)
3. Remove the head plate .27 (2), the connecting plate (3) and the intermediate plate (4)

Removing the valves and seals

4. Remove overflow diaphragms .27 (10), sliding disk (11), support (12), spacer (13) and spring (14)
5. Remove valve seats (5)
6. Remove seals (6), valve disks (7) and O-rings (8)

Cleaning the parts

7. Clean the diaphragms (9), the overflow diaphragms .27 (10), the valve disk (7), the seals (6) and the O-rings (8) with a cloth and then blow off with compressed air
8. Blow off the intermediate plate (4) and the connecting plate (3) with compressed air

Mounting the valves and seals

9. Mount O-rings (8) and valve disk (7) on valve seat
10. Insert seal (6) and insert valve seat with valve disk and O-rings (8) into connecting plate (3) (slight pressure required)
11. Insert overflow diaphragms .27 (10), sliding disk (11), support (12), spacer (13) and spring (14)

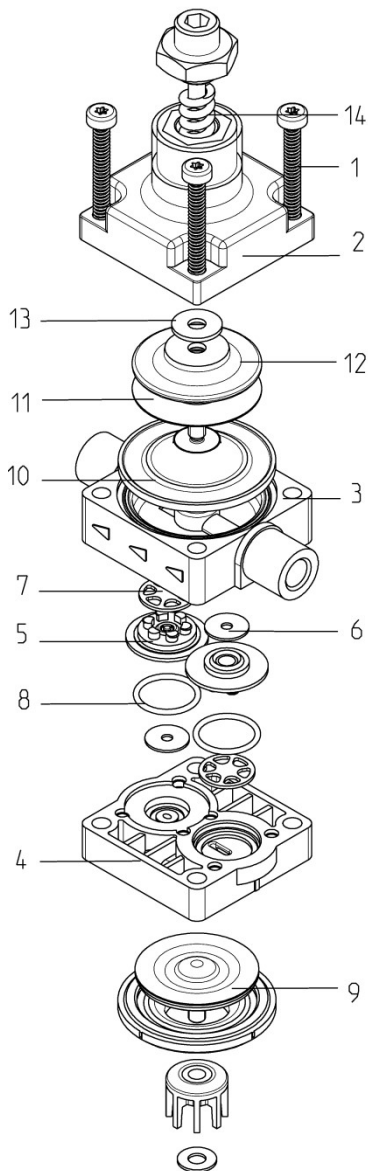


Fig. 18: FEM 1.09 .27
head cleaning

Mounting the pump head

12. Assemble the intermediate plate (4), connecting plate (3) and head plate (2)
13. Push the assembled components onto the pump housing with finger pressure
14. Secure the pump head to the housing using the 4 head screws (1)
15. Re-adjust overflow using Allen wrench and open-ended spanner. (Use pressure gauge, see also Chapter 7.3)

i The maximum tightening torque for the head screws is 1 Nm.

i Head screws that have been undone before should be carefully screwed in by hand so that the screws engage in the existing threads.



WARNING

It must be ensured that the overflow pressure can be accurately set again after dismantling!

→ Too much pressure can cause leaks or make the system rupture!

→ Not enough pressure can adversely affect the operation of your system.

8.5. Replacing diaphragm, valves and seals

The components of the pump head are available as spare parts (Chapter 10 Spare parts and accessories)

Avoid damage to the diaphragm surface when replacing the diaphragm.

Ensure that the support and the spacers beneath the diaphragm are correctly arranged and all present.

Tighten the diaphragm finger-tight.

9. Troubleshooting

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

Pump does not work	
Cause	Fault remedy
Pump not connected to mains power supply	➔ Connect pump to mains supply
Power supply is not switched on	➔ Switch on power supply
Connections or hoses are blocked	➔ Check connections and hoses ➔ Remove blockage
External valve is closed or filter is clogged.	➔ Check external valves and filters
Diaphragm or valve disk are worn	➔ Replace diaphragm and valve disk (see Chapter 8.3)

Tab. 15

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
Pump head is filled with gas. System unable to handle pressure at pressure side	➔ Reduce pressure at pressure side
Particles in the pump	➔ Clean pump head (see Chapter 8.2)
The pump parts are not resistant to the medium to be pumped	➔ Replace the pump head with a compatible version
Incorrect interchange of outlet and inlet line connections	➔ Remove pressure and suction lines and re-connect correctly

Tab. 16

Flow rate, suction head or pressure head is too low	
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	➔ Clean the pump head, install suction-side filter if required (see Chapter 8.2)
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
The generated pressure is greater than the overflow setting (.27)	➔ Reduce pressure if possible ➔ Set the overflow higher (maximum specification must not be exceeded)

Tab. 17

Fault cannot be rectified

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

1. Flush the pump to clear the pump head of any hazardous or aggressive fluids (see Chapter 8.2.1)
2. Remove the pump
3. Clean the pump (see Chapter 8.2.2)
4. Send the pump, with completed decontamination declaration (see Chapter 11), to KNF stating the nature of the pumped medium

10. Spare parts and accessories

Spare parts kit for FEM 1.02

Spare part	Order no.
Spare parts kit FEM1.02 KP	157875
Spare parts kit FEM1.02 KT	157876
Spare parts kit FEM1.02 TT	157877
Spare parts kit FEM1.02 KP.27	157878
Spare parts kit FEM1.02 KT.27	157879
Spare parts kit FEM1.02 TT.27	157880

Tab. 18

Spare parts kit for FEM 1.09

Spare part	Order no.
Spare parts kit FEM1.09 KP	157881
Spare parts kit FEM1.09 KT	157882
Spare parts kit FEM1.09 TT	157887
Spare parts kit FEM1.09 KP.27	157888
Spare parts kit FEM1.09 KT.27	157889
Spare parts kit FEM1.09 TT.27	157890

Tab. 19

Accessories

Accessories	Order no.			
		FEM 1.02	FEM 1.09	UFEM 1.09
Stepping motor controller FE Z4 2-phase stepper	157870	x	x	x
Stepping motor partial stroke controller FE Z5 Dispense	160536	x ¹⁾	x ¹⁾	x ¹⁾
Screw-in nipple, PP (1/8" or 3 mm)	151762	x		
Screw-in nipple, PVDF (1/8" or 3 mm)	151763	x		
Connection fitting UNF 1/4"-28 (1/8"/1/4")	157858	x		
Hose, DN 4/6, PA	019490		x	
Hose, DN 4/6, PE	019491		x	
Hose, DN 4/6, PTFE	019241		x	
Hose, DN 4/6, silicone	019238		x	
Hose, PTFE, 1.6 x 3.2 mm	069684	x		
Hose, PTFE, with UNF 1/4", 1 m	069963	x		
Hose, PTFE, with UNF 1/4", 2 m	069964	x		
Hose, PTFE, with UNF 1/4", 3 m	069965	x		
UNF adapter, PP, for hose ID 2.25 mm (3/32")	151340	x		
UNF adapter, PP, for hose ID 3.2 mm (1/8")	151762	x		
UNF adapter, PP, for hose ID 4.75 mm (3/16")	150520	(x)		

Accessories	Order no.	FEM 1.02	FEM 1.09	UFEM 1.09
UNF adapter, PP, for hose ID 6.4 mm (1/4")	068272	(x)		
UNF adapter, PVDF, for hose ID 2.25 mm (3/32")	151339	x		
UNF adapter, PVDF, for hose ID 3.2 mm (1/8")	151763	x		
UNF adapter, PVDF, with female Luer	150988	x		
UNF flangeless connection, 1.6 x 3.2 mm	150213	x		

Tab. 20

¹⁾ only possible in combination with FEM55

10.1. Optional versions

The pumps can be configured to meet requirements on a project basis. Further information is available from your KNF technical adviser (telephone number: see last page).

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.

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

KNF worldwide

Please find your local KNF partners at: www.knf.com

