

Operating Instructions

SECTION 960.12

Diaphragm Roughing Pump with Diaphragm Stabilization System

Type range

N 920 AP.18

N 920 APE

N 920 APDCB



Fig. 1:
Diaphragm Roughing Pump N 920 AP.18



Fig. 2:
Diaphragm Roughing Pump N 920 APE



Fig. 3:
Diaphragm Roughing Pump N 920 APDCB

You have selected a high-quality KNF product; the following tips will help you operate it safely, and reliably over a long period of time.

Carefully study the operating instructions before using the pumps and observe at all times the relevant instructions to avoid dangerous situations.

The manual was produced for the serial pumps stated above. Within customer-specified projects (pump types starting with "PJ" or "PM") there could be differences in detail. For customer-specified projects please therefore take into account any agreed technical specifications, as well as these instructions.

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1. Description, Operating Conditions

The diaphragm roughing pumps N 920 transfer and pump down completely oil free.

These pumps were developed specifically for use as roughing vacuum pumps at turbomolecular pumps and for other demanding vacuum applications. They are equipped with a diaphragm stabilization system which significantly increases the pump's suction speed. A patent application has been filed for this system.

These pumps are driven by a brushless universal motor with outstanding efficiency, great power density and compact size. The pumps are available in 24-V DC and 100 - 240-V AC versions, at 50/60 Hz. In all cases, they deliver the specified pneumatic performance. The motor electronics ensures that the pumps will run at the desired operating speed, independent of the applied electrical voltage.

Thanks to the powerful motor, the pumps starts against vacuum over the entire voltage range, even against ultimate vacuum. This makes the processes very reliable, even in extreme situations.

These pumps are available in three different versions:

- without regulation of the flow rate
- with regulation of the flow rate, by means of a potentiometer
- with regulation of the flow rate, via external control

1.1 Electrical Equipment

- See section 8 for full electrical data.
- The protection class of standard versions is IP 20 (N 920 AP.18, N 920 APE) or IP 00 (N 920 APDCB).
- The pumps are protected against overcurrent, via the motor electronics.

1.2 Operating Conditions

- ⚠ The pumps must not be used in areas where there is a danger of explosion.
- Handling air, gases, and vapours at

temperatures between + 5 °C ... + 40 °C.

- For maximum permissible operating pressure, ultimate vacuum, and flow capacity: see section 8.
- The pumps are not suitable for aggressive media. For aggressive media, there are pumps in the KNF product programme - please ask us for details.
- The pumps must not be used for liquids. You will find suitable liquid pumps in our product programme.

If your potential application lies outside the above limits discuss it with our technical adviser (see last page for contact telephone number).

1.3 Ambient Condition

When the pumps are operating the following ambient conditions must be maintained:

- Ambient temperature during operation: between + 10 °C + 40 °C.
- During operation an adequate supply of air for cooling must be provided.
- The pumps must not be used in areas where there is a danger of explosion.

1.4 Pump materials

See section 8.

2. Safety

- Note that the pumps may only be used for their intended purpose.
- ⚠ The pumps must not be used in areas where there is a danger of explosion.
- ⚠ Components connected to the pumps must be designed to withstand the pneumatic performance of the pumps (see section 8).
- For AC versions: Plug the pump only into properly installed grounded outlets.
- The gas discharge at the pressure side must be drained off safely and reliably.
- ⚠ Specific safety instructions and measures for the media being handled must be observed.
- Parts of the casing marked with the sign below are only allowed to be opened after disconnecting

the power supply.



- Use only original KNF spare parts.
- For N 920 APDCB:
The standard pumps have Protection Class 00, and so offer no protection against contact or foreign bodies. Before putting the pump into service it is therefore essential to protect personnel against contact with live parts (e.g. electrical connections, motor windings), and moving parts (e.g. fan). Protection against the ingress of particulate matter must also be provided.
The pumps are not protected against water. In this case too, as far as is relevant, measures to protect the pump must be taken before putting it into service.

3. Installation

- Choose a safe location (flat surface) for the pump.
- Install the pump so as to ensure adequate flow of air cooling.

Pneumatic

- Remove the protection plugs from the port threads.
- Connect the suction and pressure lines (size of port threads: G 1/8'). For flow direction see marking on the pump head or data sheet.
- Arrange the suction and pressure lines so that condensate cannot run into the pump (sloping lines).
- The gas discharge at the pressure side must be drained off safely and reliably.

Electrical

- When making the electrical installation the safety regulations must be observed. In particular make sure that the electricity supply is isolated before trying to connect the pump.

AC Versions:

- Plug the pump only into properly installed grounded outlets.
- Compare the supply data with the electrical data of the pump. The voltage must not vary by more than + 10 % and - 10 % from that shown on the type-plate.

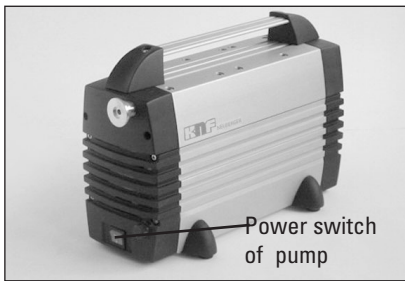


Fig. 4:
Power switch of the pump

DC Version:

- Connect the pump with power supply.
- With dc motors the wires must be connected to the correct polarity:
red wire: +
black wire: -
- In the electrical installation, arrangements (complying with EN 60335-1) must be made for disconnecting the pump motor from the electrical supply.

4. Operation

4.1 Operating conditions

- ⚠ The pumps must not be used in areas where there is a danger of explosion.
- ⚠ Specific safety instructions for the media being handled must be observed.
- ⚠ Before pumping a medium, the compatibility of materials of pump head, diaphragms, and valves with the medium must be checked (for pump materials: see section 8).
- The pumps must not start against pressure. This also applies when the pump restarts after the power has been cut off for a short period.
- ⚠ Components connected to the pumps must be designed to withstand the pneumatic performance of the pumps (see section 8).
- ⚠ The maximum permissible operating pressure (0.5 bar g) must not be exceeded.
- To prevent the maximum permissible operating pressure being exceeded, restriction or control of the air or gas flow should only be carried out in the suction line.
- If restriction or control of the air or gas flow is made on the pressure side ensure that the maximum permissible operating pressure is not

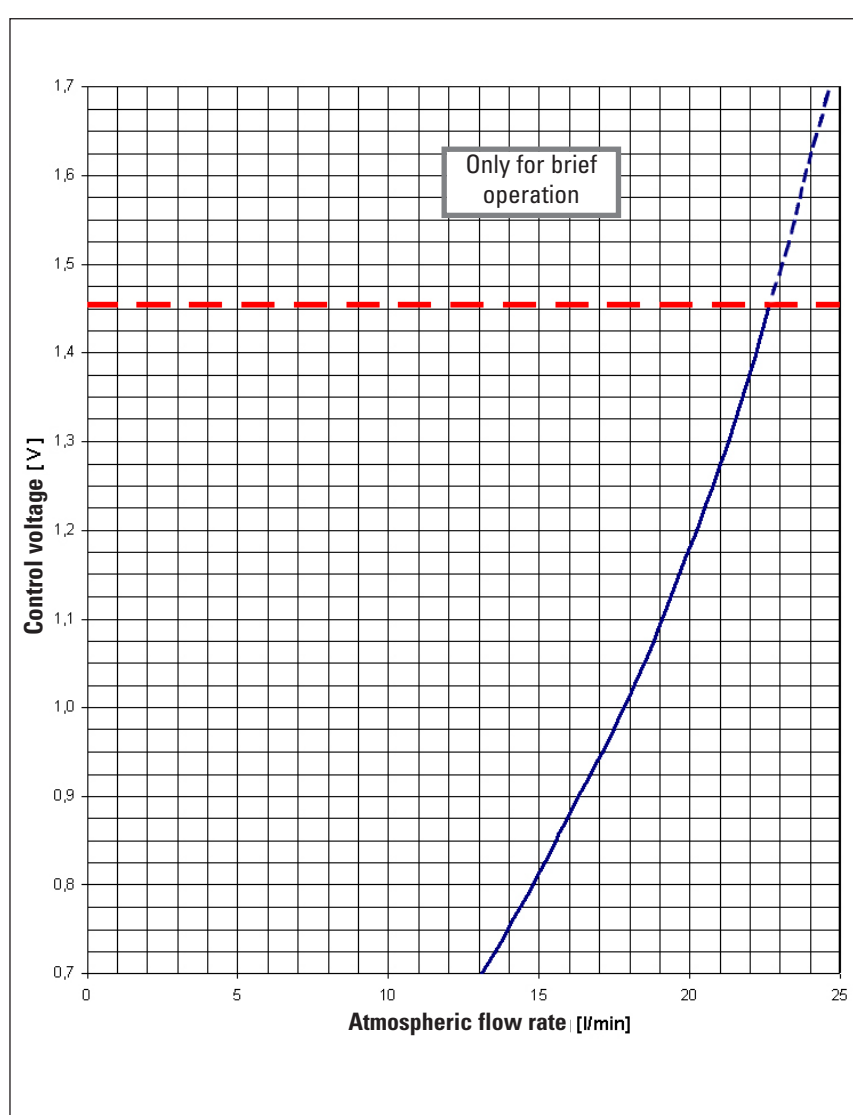


Fig. 5:
Atmospheric flow rate of the pump, as a function of the applied control voltage (only for versions with external control)

- exceeded.
- The gas discharge at the pressure side must be drained off safely and reliably.
- When the pump is at a standstill for a longer time the inlet and exhaust must be at normal atmospheric pressure.
- ⚠ Ensure the pump outlet is not closed or restricted.
- Diaphragms and valve plates are the only parts subject to wear. Wear is usually indicated by a drastic reduction in the pneumatic performance (vacuum, pressure, delivery). When replacing parts, proceed as described in section 5.
- Ambient conditions: see chapter 1.3.

4.2 Start-up/Shut down of the pump

Start-up of pump

Check:

- ① Tubing for correct pneumatic connection (suction side/pressure side).
 - ② Voltage of the electrical supply; figures for electrical voltage and frequency must correspond with those on the type plate of the pump.
 - ③ Electrical connections for correct connection.
- For AC versions: Turn on pump using the power switch (see fig. 4)
 - ▶ Depending on the level of the applied electrical voltage, initialization of the electronics can take up to one second, before the pump starts.

Shut the pump down after pumping

down/after the process:

- ➊ Rinse the pump with air for around 5 minutes, at the full flow rate.
- ➋ Disconnect the pump from the electrical supply. For AC versions: Switch the pump off at the power switch on the pump.

4.3 Adjusting the flow rate

Basic version of the pump

The flow rate cannot be varied.

Versions with potentiometer

- The potentiometer is located at the front side of the pump, next to the power switch.
- The pump's speed can be varied between around 750 and 1,700 RPM, via the potentiometer. The flow rate can be adjusted this way.

Versions with external control

- The pump's speed is regulated via a control voltage.
- Fig. 5 shows the atmospheric flow rate of the pump as a function of the applied control voltage.
- The control voltage is provided via the cables of the screwed cable gland next to the IEC connector (AC version) respectively via a separate wire (DC version).
- Control voltages of < 0,7 V are not permitted (fig. 5). This ensures that the pump operates smoothly.
- The control voltage is only permitted to be between 1.45 V and 1.68 V for short times (Fig. 5). The mechanical and electrical components are stressed, shortening the pump's service life. The control voltage is not allowed to exceed 1.68 V.
- The pumps are available with an optional start/stop remote control. Contact your KNF specialist (see last page for contact telephone number).

5. Servicing:

Changing of structured diaphragms and valve plates

- ⚠ **Before working on the pump, disconnect it from the electricity supply by pulling the plug out.**

- Structured diaphragms and valve plates are the only parts subject to wear. Wear is usually indicated by

a drastic reduction in the pneumatic performance (vacuum, pressure, delivery).

- Always change the structured diaphragm in all of the three pump heads at the same time. If the structured diaphragm is not changed in all three heads at the same time or the structured diaphragm and the valve plates are not changed at the same time, the nominal performance of the pump is not guaranteed after the service.
- If aggressive, toxic or other types of gases hazardous to health have been pumped please observe:
- 1.) Clean the pump and its components before servicing.
 - 2.) Ensure that the service personnel is not subject to a health hazard during diaphragm and valve plate changes. Apply the necessary safety measures (example: the use of protective gloves).
 - 3.) Ensure that the discarded parts and materials are safely and correctly disposed of.
- Use only original KNF replacement parts.

Parts/tools required:

- Service Set (see section 7)
- Allan key 4 mm
- Felt-tip pen

Changing the structured diaphragms, valve plates, and O-rings in the following sequence:

- a) Preparatory steps
- b) Remove pump head
- c) Mount structured diaphragms
- d) Mount valve plates, intermediate plates and head cover
- e) Final steps

- The numbered positions within the following operating instructions refer to figs. 4 to 7.

a.) Preparatory Steps

- ➊ Shut down pump (see section 4.2, including the disconnection of the pump from the power source (pull out plug).

- ➋ Remove tubing from the inlet and outlet connectors of the pump.

b.) Remove pump head

- ➌ Undo the 9 screws ➋ in the head cover ➊ and lift the head cover off the pump housing ➍ (see fig. 4).

- ➍ Mark the position of intermediate plate ➎ and adapter ➏ relative to each other by a drawing line (M) with a felt-tip pen. This helps avoid incorrect assembly later (fig. 5).

- ➎ Mark the position of intermediate plate ➐ and adapter ➏ relative to each other by two drawing lines (M) with a pencil (see fig. 5).

- ➏ Mark the position of intermediate plate ➑ and adapter ➏ relative to each other by three drawing lines (M) with a pencil (fig. 5).

- ➐ Lift the intermediate plates ➎, ➏ and ➑ off the adapter ➏ (fig. 5).

- ➑ Turn the three structured diaphragms ➒, ➓ and ➑ outwards with your hands, counter-clockwise (fig. 6). For this, turn the fan ➑ such that you can easily grip each structured diaphragm with your hands.

- For structured diaphragms ➒ and ➑:

Make sure the diaphragm spacers being between structured diaphragm and connecting rod do not fall into the pump housing.

If diaphragm spacers should adhere to the structured diaphragms, take them off and put them on the thread of the corresponding connecting rod.

The same number of diaphragm spacers must be mounted as were used for the previous assembly. This is necessary, in order to ensure the pump's pneumatic performance.

- ➒ Remove the valve plates ➑ and O-rings ➑ from the intermediate plates ➎, ➏ and ➑ (fig. 6).

- ➓ Remove O-ring ➑ from the intermediate plate ➎ (fig. 6).

- ➑ Remove O-ring ➑ from adapter ➏ (fig. 6).

c.) Mount structured diaphragms

- ➌ Screw the new structured diaphragm ➒ into the thread of the vacuum diaphragm ➑ and tighten it by hand (figs. 6 and 7).

- ➍ Screw the new structured diaphragm ➓ onto the connecting rod ➑ and tighten it by hand.

- Before you finally tighten the structured diaphragm, you are recommended to move the structured diaphragm to the

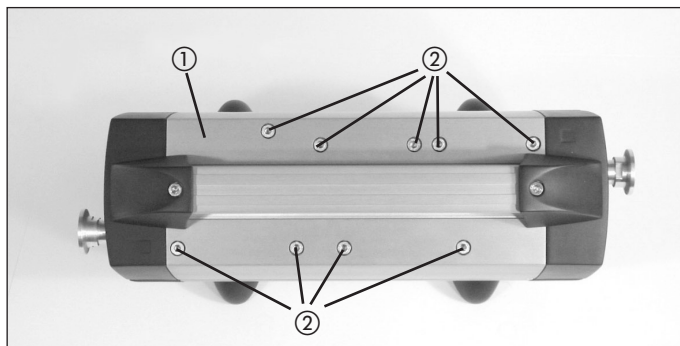


Fig. 4: Servicing level 1: before disassembling

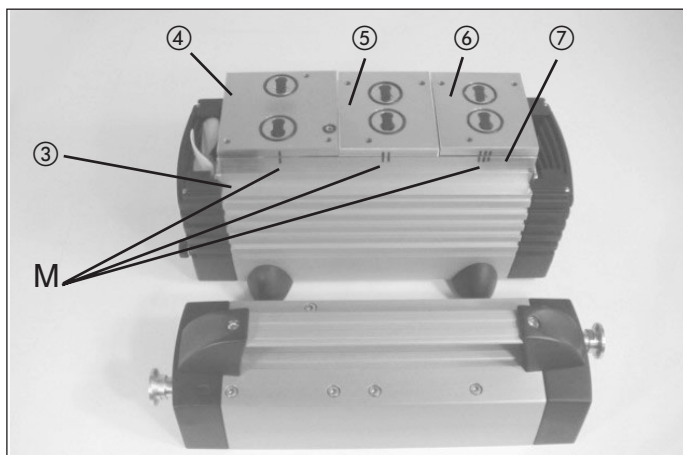


Fig. 5: Servicing level 2

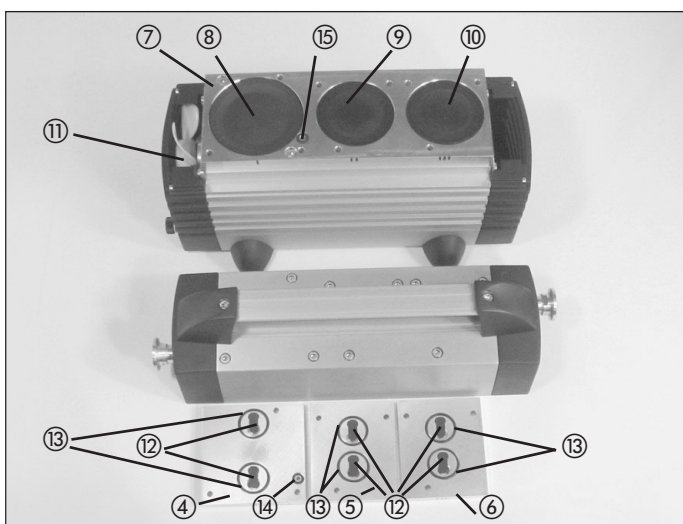


Fig. 6: Servicing level 3

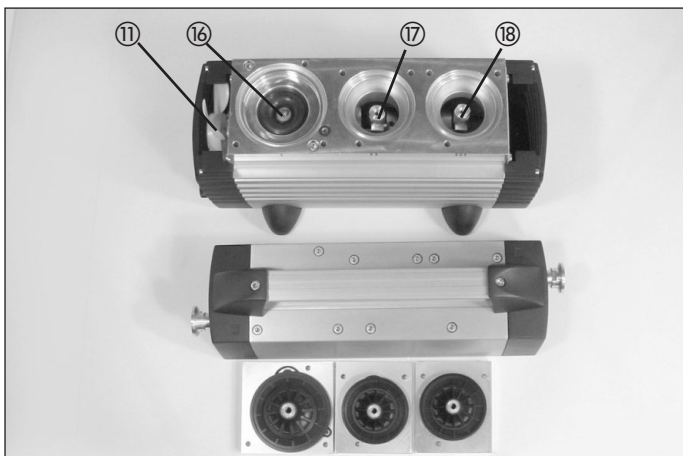


Fig. 7: Servicing level 4

Specification

- ① Head cover
- ② Screw
- ③ Pump Housing
- ④ Intermediate plate, head 1
- ⑤ Intermediate plate, head 2
- ⑥ Intermediate plate, head 3
- ⑦ Adapter
- ⑧ Structured diaphragm, head 1
- ⑨ Structured diaphragm, head 2
- ⑩ Structured diaphragm, head 3
- ⑪ Fan
- ⑫ Valve plate
- ⑬ O-Ring (ø 24 x 2)
- ⑭ O-Ring (ø 5.5 x 2)
- ⑮ O-Ring (ø 5.5 x 2)
- ⑯ Vacuum diaphragm
- ⑰ Connecting rod, head 2
- ⑱ Connecting rod, head 3

upper dead center by rotating the fan ⑪.

- ③ Screw the new structured diaphragm ⑩ onto the connecting rod ⑱ and tighten it by hand.

► Before you finally tighten the structured diaphragm, you are recommended to move the structured diaphragm to the upper dead center by rotating the fan ⑪.

d.) Mount valve plates, intermediate plates and head cover

- ① Lay the new O-ring ⑮ on the adapter ⑦ (fig. 6).
- ② Lay the new valve plates ⑫ and the new O-rings ⑬ on the intermediate plates ④, ⑤ and ⑥ (fig. 6).
 - Upper and lower sides of the valve plates are identical.
- ③ Lay the new O-ring ⑭ on the intermediate plate ④ (fig. 6).
- ④ Place the intermediate plates ④, ⑤ and ⑥ on the adapter ⑦ in the position indicated by the drawing lines (M).
- ⑤ Place the head cover ① on the pump housing ③; tighten the screws ② hand tight, evenly and diagonally.

e.) Final steps

- ① Reconnect system tubing.
- ② Reconnect pump to the electricity supply.

► If the pump does not reach the desired vacuum after changing

diaphragms and valve plates:

- ❶ Check whether the spacers have been mounted at all structured diaphragms.
 - ❷ Check the tubing for leaks.
 - ❸ Possibly the screws ❷ on the head cover ❶ are insufficiently tightened (carefully tighten them again crosswise).
- If you have any questions about servicing, call our technical adviser (see last page for contact telephone number).

6. Trouble shooting**► Ultimate vacuum is not reached****Possible reasons:**

- ❶ Tube connections are not tight.
- ❷ Condensate in the pump head.
 - Detach the condensate source from the pump.
 - Let the pump run for a few minutes pumping air.
 - Install the pump at the highest point in the system.
- ❸ Diaphragms and/or valve plates are worn out.
 - Change diaphragms and valve plates: see section 5.

► Pump is switched on, but does not run.**Possible reasons:**

- ❶ Pump is not connected with the power source.
 - ❷ No voltage in the power source.
 - ❸ The pump's overcurrent protection circuit has responded.
 - Remove the pump from the source of electrical power.
 - Determine and eliminate the cause of the overcurrent (e. g. improper pressure, liquid in the pump heads).
 - The pump must be unplugged for some seconds, before the electronics will allow you to restart it.
- If the pump does not operate properly and you cannot find any of the above faults, send it to the KNF Service Department.

- If you send your KNF pump to the KNF Service Department, please include information about the medium it was handling. In particular, if it was handling aggressive substances, our engineers must be informed.
- If you have been handling dangerous, or aggressive gases, please clean the pump before despatch.

7. Ordering information**7.1 Service Sets**

A Service Set contains all replacement parts needed for one complete service: 3 structured diaphragms, 6 O-rings (ø 24 x 2), 6 valve plates, and 2 O-rings (ø 5.5 x 2).

Order No.:	057456
7.2 Accessories	
Accessory	Order No.
Small flange connection for suction or pressure side KF 16	046625
Hose connector G 1/8	029113
Sealing for hose connector	026906
Silencer	007006

8. Specifications**N 920 AP.18, N 920 APE**

Maximum capacity*	21 l/min
Ultimate vacuum:	< 1.5 mbar abs.
Max. permissible operating pressure:	0.5 bar ^g
Weight of pump:	10 kg
Permissible ambient temperature:	+ 10 ... +40 °C
Permissible temperature of gas to be pumped:	+ 5 ... + 40 °C

* Litre at STP

Hose connection for tube G 1/8 '

Electrical Data:
100 - 240 V, 50/60 Hz
Power consumption: 120 W
Consumption of current: 1.3 A
IP 20

Pump materials:

Structured diaphragm:	EPDM
Valves:	EPDM
Pump head:	Aluminium

N 920 APDCB

Maximum capacity*:	21 l/min
Ultimate vacuum:	< 1.5 mbar abs.
Max. permissible operating pressure:	0.5 bar ^g
Weight of pump:	8, 5 kg
Permissible ambient temperature:	+ 10 ... +40 °C
Permissible temperature of gas to be pumped:	+ 5 ... + 40 °C

* Litre at STP

Hose connection for tube G 1/8 '

Electrical Data:

Voltage: 24 V DC
Power consumption: 100 W
Consumption of current: 4.2 A
(Starting current for a short time (200 ms): 7 A)
IP 00

Pump materials:

Structured diaphragm:	EPDM
Valves:	EPDM
Pump head:	Aluminium

► CE - Safety Demands

- These pumps correspond to the safety regulations of the EU low voltage directive 73/23 EWG and of the EU directive concerning electromagnetic compatibility 89/336 EWG.

The requirements of the following harmonised standards are fulfilled:

EN 61010 Part 1,
EN 61000-6-3,
EN 61000-6-1
EN 61326.

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