

Operating and Installation Instructions

Diaphragm

Vacuum Pumps and

Compressors

Type range

N 86 AT 16

N 86 ST.16

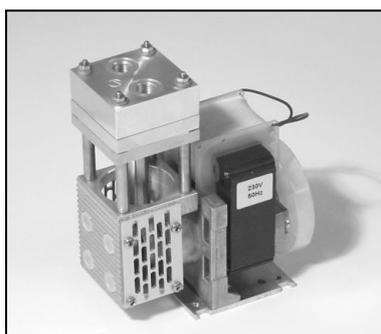


Fig. 1: N 86 AT.16 with IP 00-Motor

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 and Installation 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. With 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

KNF pumps in the N 086.16 range transfer, evacuate and compress 100% oil-free. In operation they are gas-tight (leak rate: 6×10^{-3} mbar x l/sec), and maintenance-free.

They have temperature-resistant pump heads for media temperatures up to 240 °C.

1.1. Electrical Equipment

See the type-plate for full electrical data of the motor.

The protection class of standard version is IP00.

1.2. Operating Conditions

Handling air, gases, and vapours at temperatures between + 5 °C ... + 240 °C.

For maximum permissible operating pressure, ultimate vacuum, and flow capacity see section 10.

The pumps must not be used in areas where there is a danger of explosion.

Before pumping a medium, the compatibility of materials of pump head, diaphragm and valves with the medium must be checked (for pump materials: see section 10).

These pumps must not be used for liquids. You will find suitable liquid pumps in our Product Program.

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 Conditions

When the pump is operating the following ambient conditions must be maintained:

- Ambient temperature during operation: between + 5 °C ... + 40 °C.
- The pumps must be protected from the effects of dust and water.
- The pumps must not be used in areas where there is a danger of explosion.
- During operation an adequate supply of air for cooling must be provided.

1.4. Pump materials

See section 10.

2. Safety

The pumps have Protection Class 00, and so offer no protection against contact or foreign bodies. It is therefore essential to provide protection for persons against contact with live parts (e.g. electrical connections, motor windings), and moving parts (e.g. fan). Protection against the entry of foreign bodies must also be provided.

The pump has no protection against water. In this case too, as far as is relevant, measures to protect the pump must be taken before putting it into service.

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.

For vacuum pumps, the exhaust gases must be safely disposed.

Components connected to the pump must be designed to withstand the pneumatic performance of the pump.

Take care that safety regulations are observed when connecting the pump to the electricity supply.

For pumps with thermal switch: When the operation of the pump is interrupted by the thermal switch, the pump will re-start automatically after cooling down. Take all care necessary to prevent this leading to a dangerous situation.

Specific safety instructions for the media being handled must be observed.

When using hot media, the pneumatic pump suction and pressure lines heat up, as does the pump head. Do not touch these parts; they could burn you.

Use only original KNF spare parts.

EC Directives / Standards

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 is in conformity with the provisions of the Machinery Directive 2006/42/EC. The following essential requirements of Annex I of Directive 2006/42/EC (general principles) are applied and observed:

- General Principles No. 1
- No. 1.1.2. / 1.1.3. / 1.3.1. / 1.3.3. / 1.3.4. / 1.4.1. / 1.5.1. / 1.5.2. / 1.5.8. / 1.5.9. / 1.7.4. / 1.7.4.1. / 1.7.4.3.

As these partly completed machinery are OEM-models the power supplies and the equipment for disconnecting and switching-off the partly completed machinery respectively have to be considered when mounting as well as over-current and overload protective gear.

In addition a protection against mechanical parts in motion and hot parts, if existing, has to be provided when mounting.



The pumps conform to the Directive 2011/65/EU (RoHS2).

The following harmonized standards have been used:

- DIN EN 50581
- DIN EN 55014-1/2
- DIN EN 61000-3-2/3
- DIN EN 60335-1

3. Installation

The pumps are OEM models intended for installation in equipment. When installing them make certain that accident prevention regulations, and safety instructions, including those for subsequent operation are observed. The safety instructions in section 2 must be observed.

Heating elements

i Since the insulating material of the heating elements is hygroscopic, before connecting the heating element, it may be necessary to check the insulation resistance with a suitable measuring instrument (megaohmmeter with 500 V DC test voltage, $R_{min} = 5 \text{ M}\Omega$), depending on the type of heating element and the storage conditions (e.g. high humidity). If necessary, the heating element should be dried at an increased temperature (at about 120 °C in the oven. Time: some hours, until acceptable measured values are reached).

Mechanical

The dimensions of the mountings are given in the Data Sheet.

Install the pump so that the fan can draw in sufficient cooling air.

Install the pump so as accidental finger contact is with the fan is impossible.

Fit the pump at the highest point in the system, so that condensate cannot collect in the head of the pump - that prolongs working life.

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.

Compare the supply data with the data on the motor-plate. The voltage must not vary by more than +10% and -10% from that shown on the type-plate.

The earth (ground) wire must be connected to the motor.

In the electrical installation, arrangements (complying with EN 60335-1) must be made for disconnecting the pump motor from the electrical supply.

The pump must be installed so that contact with live parts (e.g. electrical connection) is impossible.

We recommend that a fuse is installed in the supply circuit; the operating current is given in Data Sheet.

Pneumatic

Remove the protection plugs from the port threads.

Connect the suction and pressure lines (for size of the port threads see section 10). 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).

4. Operation

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.

If combustible media are used:

- Hazard of fires and explosions due to excessively high media temperature.
- Be aware that the pumps are not designed to be explosion-proof.
- Make sure the temperature of the medium is always sufficiently below the ignition temperature of the medium, to avoid ignition or explosion. This also applies for unusual operational situations.
- Note that the temperature of the medium increases when the pump compresses the medium.
- Hence, make sure the temperature of the medium is 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 the technical specifications (section 10).
- If necessary, consider any external sources of energy, such as radiation, that may add heat to the medium.
- In case of doubt, consult the KNF customer service.

Before pumping a medium, the compatibility of material of pump head, diaphragm and valves with the medium must be checked (for pump material: see section 10).

The pump must not start against pressure or vacuum. When it is switched on the pressure in the suction and pressure lines must be atmospheric. This must be so even when the pump restarts after the power has been cut off for a short period.

The maximum permissible operating pressure (see section 10) 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 exceeded.

When the pump is at a standstill the inlet and outlet must be at normal atmospheric pressure.

The pumps must not be used to produce vacuum and pressure at the same time.

For pumps with a thermal switch: When the operation of the pump is interrupted by the thermal switch, the pump will re-start automatically after cooling down. Take all care necessary to prevent this leading to a dangerous situation.

Diaphragm and valve plate are the only parts subject to wear. Wear is usually indicated by a drastic reduction in the pneumatic performance. When replacing parts proceed as described in section 5.

Ambient conditions: see section 1.3.

5. Servicing

Before working on the pump, isolate the power supply securely, then check that the lines are not live.

Diaphragm and valve plate are the only parts of the pump subject to wear. They are simple to change.

Always change diaphragm, valve plate and sealing ring at the same time. If diaphragm and valve plate 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.

After opening the pump head, or replacing the diaphragm and valve plate the initial gas-tightness is no longer guaranteed. A leak test is able to verify that the original standard of gas-tightness has been achieved.

Parts required

Spare part*	Quantity
Valve plate	1
Wave diaphragm (assembly consisting of two equivalent parts)	1
O-ring	1

Tab. 1

* According to Spare parts list, section 8

Tools/material required

Tools/Material
Fork wrench or socket wrench 5.5 mm
Pin-wrench for two hole nuts, pin diameter 4 mm (available as "wrench for retainer plate", a KNF accessory, see section 9)
Holding tool (see accessories, section 9)
Heat-resistant thread adhesive (e.g. DELO ML 5327)
Felt-tip pen

Tab. 2

Change the structured diaphragm and valve plate in the following sequence:

- a) Preparatory step
- b) Removing pump head

- c) Changing diaphragm
- d) Changing valve plate and sealing ring
- e) Refitting pump head
- f) Final step

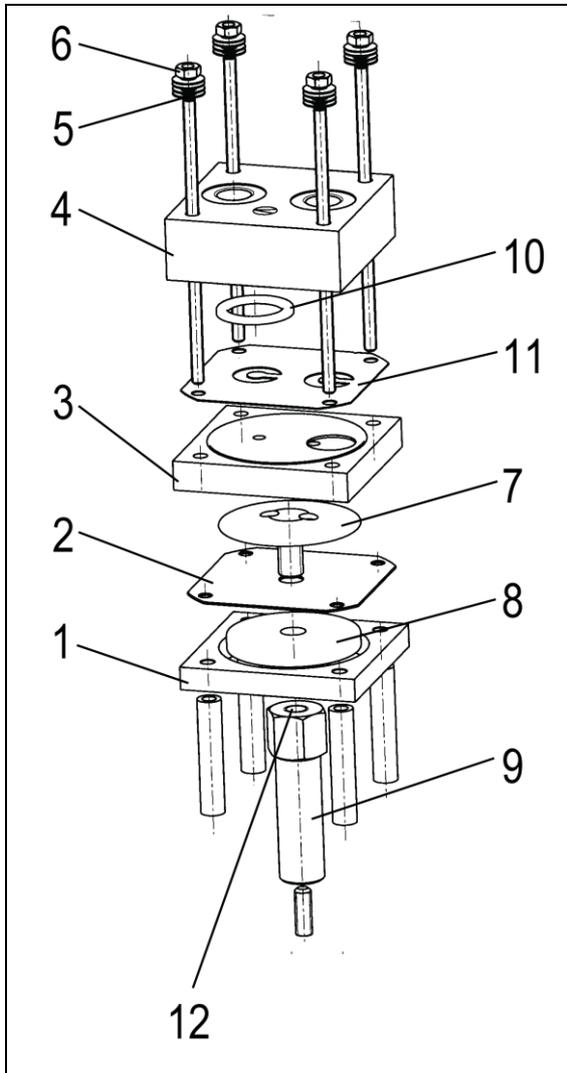


Fig. 3: Pump head (exploded drawing)

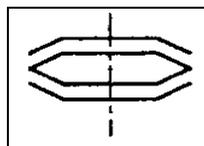


Fig. 4: Orientation of disk springs (5)

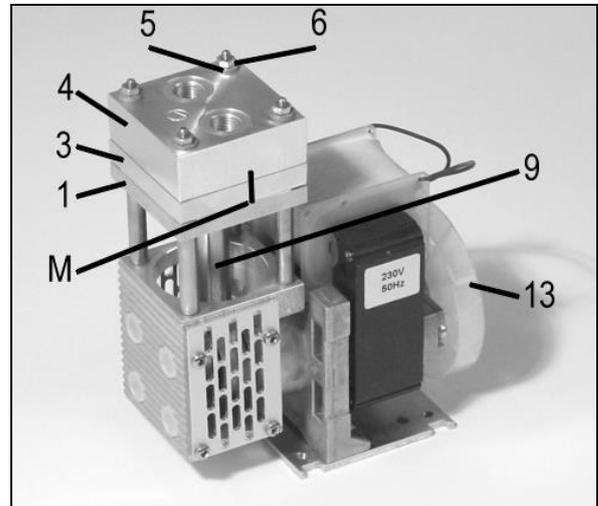


Fig. 2: N 86.16 AT.16

Specification

Pos. Description

- 1 Carrier
- 2 Wave diaphragm
- 3 Intermediate plate
- 4 Head plate
- 5 Disk spring
- 6 Nut
- 7 Retainer plate
- 8 Diaphragm support
- 9 Connecting rod extension
- 10 O-ring
- 11 Valve plate
- 12 Washer
- 13 Fan
- M Mark

The item numbers in the following instructions refer to figs. 2 to 4.
Proceed as follows:

a) Preparatory step

1. Disconnect the pump from the power supply; check that the pump is electrically dead and secure this.

b) Removing pump head

1. Mark the position of carrier (1), intermediate plate (3), and head plate (4) relative to each other by a drawing line (M) with a felt-tip marker. This is to ensure that the parts will be reassembled in correct position at a later stage.
2. Release the nuts (6) and remove them together with the disk springs (5).
The disk springs are fitted in order to maintain the tension of the wave diaphragm right across the temperature range of the pump.
3. Remove head plate (4).
4. Remove O-ring (10) from head plate (4).
5. Remove the valve plate (11) and the intermediate plate (3).

c) Changing diaphragm

1. Release the retainer plate (7) by turning it anti-clockwise with a pin wrench or a wrench for retainer plate. While doing so, hold the connecting rod extension (9) in place with holding tool.
Take care to ensure that the washer (12) does not slip under the diaphragm support (8)
2. Remove wave diaphragm (2).
3. Check that all parts are free from dirt and clean them if necessary (see section 6. *Cleaning*).
4. Slide a new wave diaphragm (2) onto the threaded bolt of the retainer plate (7).
The wave diaphragm assembly consists of two equivalent parts placed on top of one another; the top and bottom are identical.
5. Apply a small amount of heat-resistant thread adhesive (e.g., DELO ML 5327) to the thread of the retainer plate (7).
6. Screw the retainer plate (7) with wave diaphragm (2) into the connecting rod extension (9); to tighten the retainer plate, use the wrench for retainer plate/the pin wrench to turn it clockwise (torque: 4.6 Nm). While doing so, hold the connecting rod extension (9) in place with the holding tool; and hold the wave diaphragms so that they do not twist.

d) Changing valve plate and sealing

1. Check that intermediate plate and head plate are clean. If damages, distortion, or corrosion are evident on these parts they should be replaced.
2. Place the intermediate plate (3) on the carrier (1) in the position indicated by the felt tip pen mark (M).
3. Lay the new valve plate (11) onto the intermediate plate (3).
Regarding the placement of the valve plate:
The notch on outer edge of the valve plate must be at the left rear, when looking at the pump from the motor.
4. Fit the new O-ring (10) in the head plate (4).

e) Refitting pump head

1. Place the head plate (4) on the intermediate plate (3) in the position indicated by the felt-tip pen marking.
2. Place disk springs (5).
For position see fig. 4.
3. Put the nuts (6) in place and tighten them diagonally, until each of them lies level on the top spring washer; realign the pump head.
From when you start applying pressure on the disk springs, tighten the nuts through an angle of 340°. That is equivalent to a torque of 80 Ncm.

f) Final step

1. Reconnect the pump to the electricity supply.

If you have any questions about servicing call our technical adviser (see last page for contact telephone number).

6. Cleaning

When changing valve plate and wave diaphragm, inspect all parts for dirt before assembling the pump head, and clean them if necessary.

If a compressed air line is available, blow the parts out with it.

7. Trouble Shooting

Before working on the pump isolate the power supply securely, then check that the lines are not live.

The following tips for fault-finding are best employed in the sequence shown.

Pump produces no flow

- Pumps with thermal switch: The thermal switch has opened due to over-heating.
 - ▶ Disconnect pump from mains and allow to cool. Trace cause of over-heating and eliminate it.
- Connections or lines are blocked
- An external valve is closed, or a filter blocked.
- Liquid (condensate) has collected in the pump head.
 - ▶ Let the pump run for a few minutes pumping air (if necessary for safety reasons: pumping an inert gas.)
 - ▶ Install the pump at the highest point in the system.
- Diaphragm or valve plate is worn.
 - ▶ Section 5 *Servicing*.

Flow, pressure, or vacuum too low

- Compare the actual performance with the figures in section 10 or the data sheet.
- There is pressure on the pressure side, and at the same time vacuum, or a pressure above atmospheric, on the suction side.
 - ▶ The pump is not designed for this condition.
- Liquid (condensate) has collected in the pump head.
 - ▶ Let the pump run for a few minutes pumping air (if necessary for safety reasons: pumping an inert gas.)
 - ▶ Install the pump at the highest point in the system.
- The cross-section of pneumatic lines, or connected components is too small, or they are restricted.
 - ▶ To measure the performance, disconnect the pump from the system (small diameter tubing or a valve can significantly affect performance).
- There is a leak at a connector, in a line, or in the pump head.
- Diaphragm or valve plate is worn, or dirt is in the head:
 - ▶ Section 5 *Servicing*.

If the pump does not operate properly and you cannot find any of the above faults, send it to the KNF Service Department.

In order for KNF to repair the pump, the customer must provide a statement on the media which were pumped and on pump cleaning. Please fill out the corresponding KNF form, and submit it together with the pump. A sample statement for copying can be found in section 12 of these operating instructions.

8. Replacement parts

Spare part	Order-No.
Valve plate	006066
Wave diaphragm	012074
O-Ring	052713
Disk spring	005205

Tab. 3: Replacement parts

9. Accessoires

Accessory	Order-No.
Wrench for retainer plate	018812
Holding tool	055662

Tab. 4: Accessoires

10. Tables

Pump type	Max. permissible operating pressure (bar g)	Ultimate vacuum (mbar abs.)	Delivery rate* (l/min) at atm. pressure
N 86 AT.16 E	1.5	290	6
N 86 ST.16 E	1.5	290	6

Tab. 5: Pneumatic Data

*Liter at STP

Pump type	Material		
	Pump head	Wave diaphragm	Valve plate
N 86 AT.16 E	Aluminium alloy	PTFE	PTFE
N 86 ST.16 E	Stainless steel	PTFE	PTFE

Tab. 6: Pump materials

Pump type	Thread size
N 86 AT.16 E	G 1/8'
N 86 ST.16 E	G 1/8'

Tab. 7: Size of pneumatic port threads

11. Returns

Pumps and systems used in laboratories and process-based industries are exposed to a wide variety of conditions. This means that the components contacting pumped media could become contaminated by toxic, radioactive, or otherwise hazardous substances.

For this reason, customers who send any pumps or systems back to KNF must submit a Health and safety clearance and decontamination form in order to avoid a hazardous situation for KNF employees. This Health and safety clearance and decontamination form provides the following information, among other things:

- physiological safety
- whether medium-contacting parts have been cleaned
- whether the equipment has been decontaminated
- media that have been pumped or used

To ensure worker safety, work may not be started on pumps or systems without a signed Health and safety clearance and decontamination form.

For optimal processing of a return, a copy of this declaration should be sent in advance via e-mail, regular mail, or fax to KNF Customer Service (refer to final page for address). In order to avoid endangering employees who open the shipment's packaging, despite any residual hazards, the original version of the Health and safety clearance and decontamination form must accompany the delivery receipt on the outside of the packing.

The template for the Health and safety clearance and decontamination form is included with these Operating Instructions and may also be downloaded from the KNF website.

The customer must specify the device type(s) and serial number(s) in the Health and safety clearance and decontamination form in order to provide for the unambiguous assignment of the Declaration to the device that is sent to KNF.

In addition to the customer's declaration of physiological safety, information about operating conditions and the customer's application are also of importance to ensure that the return shipment is handled appropriately. Therefore, the Health and safety clearance and decontamination form requests this information as well.

12. Health and safety clearance and decontamination form



Health and safety clearance and decontamination form

Form: Rev. 02 / download: www.knf.com

This declaration must be present and complete (the original must accompany the shipment's delivery receipt) before the returned device can be examined.

Device type:

Serial number(s):

.....

.....

Reason for returning the device (please describe in detail):

(The device(s) was(were) in operation yes no)

.....

.....

.....

.....

.....

We confirm that the above device(s)

has(have) pumped exclusively **physiologically unobjectionable** media and that it(they) are free of hazardous materials and any materials that are harmful to health.

Pumped media:

The device(s) was(were) cleaned yes no

has(have) pumped media of the following category(categories) which are not physiologically unobjectionable and that cleaning of the device(s) (potentially only media-contacting parts) is required.

Name, chemical formula, Material Safety Data Sheet

aggressive

biological

radioactive

toxic

other

The device(s) was(were) decontaminated and work can proceed without special measures yes

Method / proof:

.....

The device(s) was(were) not decontaminated and special measures are required before starting work yes

Measures:

.....

Legally binding declaration

We herewith affirm that the information provided in this form is correct and complete. Shipment of the devices and components is in compliance with statutory regulations.

.....
Company (stamp)

.....
Date

.....
Name

.....
Authorized signature

.....
Position