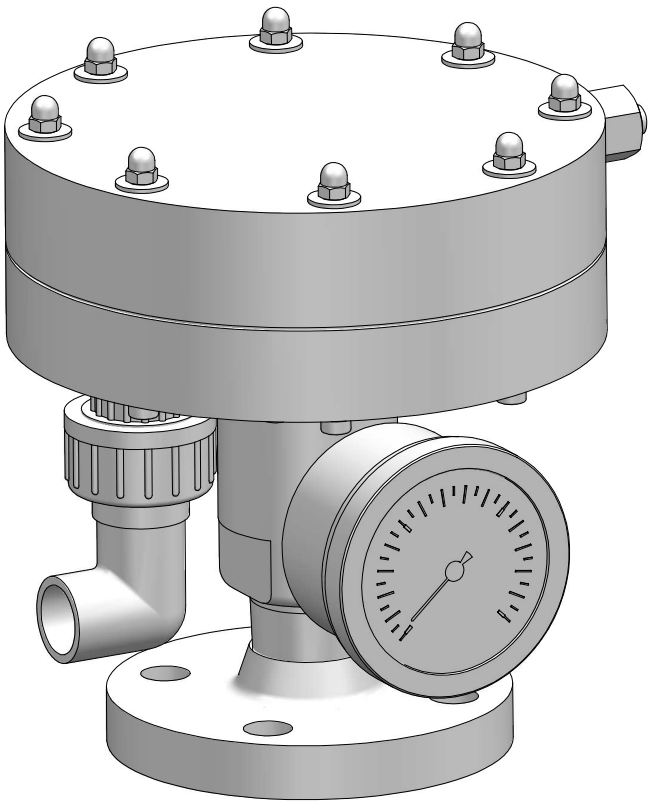
Vacuum regulator
C 2525-V
Operating instructions



Read the operating manual!

The user is responsible for installation and operation related mistakes!

Original operating instructions

BA-20810-02-V01

Dosing Conveying Control | Liquids Gases Systems

Table of Contents

1 Notes for the Reader

This operating manual contains information and behaviour rules for the safe and designated operation of the device.

Observe the following principles:

- Read the entire operating manual prior to starting-up the device.
- Ensure that everyone who works with or on the device has read the operating manual and follows it.
- Maintain the operating manual throughout the service life of the device.
- Pass the operating manual on to any subsequent owner of the device.

1.1 General non-discrimination

In this operating manual, only the male gender is used where grammar allows gender allocation. The purpose of this is to make the text easy to read. Men and women are always referred to equally. We would like to ask female readers for understanding of this text simplification.

1.2 Explanation of the signal words

Different signal words in combination with warning signs are used in this operating manual. Signal words illustrate the gravity of possible injuries if the risk is ignored:

Signal word	Meaning
DANGER	Refers to imminent danger. Ignoring this sign may lead to death or the most serious injuries.
WARNING	Refers to a potentially hazardous situation. Failure to follow this instruction may lead to death or severe injuries.
CAUTION	Refers to a potentially hazardous situation. Failure to follow this instruction may lead to minor injury or damage to property.
NOTE	Refers to a danger which, if ignored, may lead to risk to the machine and its function.

Table 1: Explanation of the signal words

1.3 Explanation of the warning signs

Warning signs represent the type and source of a danger:

Warning sign	Type of danger
	General danger
	Danger from poisonous substances
	Danger of damage to machine or functional influences

Table 2: Explanation of the warning signs

1.4 Identification of warnings

Warnings are intended to help you recognise risks and avoid negative consequences.

This is how warnings are identified:

Warning sign	**SIGNAL WORD**
Description of danger. Consequences if ignored. ⇨ The arrow signals a safety precaution to be taken to eliminate the danger.	

1.5 Instruction for action identification

This is how pre-conditions for action are identified:

✓ Pre-condition for action which must be met before taking action.

🛠 A resource such as a tool or auxiliary materials required to perform the operating instructions.

This is how instructions for action are identified:

➔ Separate step with no follow-up action.

1. First step in a series of steps.
2. Second step in a series of steps.

▸ Result of the above action.

✓ **Action completed, aim achieved.**

2 Safety

2.1 General warnings

The following warnings are intended to help you eliminate the dangers that can arise while handling the device. Risk prevention measures always apply regardless of any specific action.

Safety instructions warning against risks arising from specific activities or situations can be found in the respective sub-chapters.

DANGER

Danger to life from chlorine poisoning!

Chlorine is poisonous. In severe cases, breathing in chlorine may lead to death. It irritates the eyes, the respiratory system and the skin.

- ⇨ Use sufficient personal protective equipment.
- ⇨ When carrying out any work on the system, use a respirator mask with a Type B gas filter that complies with EN 14387.
- ⇨ If chlorine gas escapes, wear a Type 2 self-contained breathing apparatus that complies with EN 137.
- ⇨ Install a gas warning device.
- ⇨ Always comply with the accident prevention regulations that apply at the place of use.
- ⇨ Get rid of leaks without delay. Together with the humidity, chlorine forms hydrochloric acid and corrosion results in rapidly increasing leakage.
- ⇨ Use only chlorine-resistant seals.
- ⇨ Only use seals once. Reusing them leads to leaks.

CAUTION

Increased risk of accidents due to insufficient qualification of personnel!

The device may only be installed, operated and maintained by personnel with sufficient qualifications. Insufficient qualification will increase the risk of accidents.

- ⇨ Ensure that all action is taken only by personnel with sufficient and corresponding qualifications.
- ⇨ Prevent access to the system for unauthorised persons.
- ⇨ Follow the specifications of section 2.5 “Personal protective equipment” on page 6.

NOTE

Damage to the plant due to the formation of hydrochloric acid

Chlorine gas is highly hygroscopic. This means that humidity enters the system at any open connection on devices or pipes, which results in the formation of hydrochloric acid and contamination. thus inevitably causing damage to the units.

- ⇨ Keep all connections (including in the vacuum system and on all devices not currently in use) closed at all times.
- ⇨ After maintenance work is complete, remove all water residues from the system before placing it into operation.

2.2 Information about chlorine

Chlorine is a hazardous substance. The chemical element chlorine is a greenish-yellow, toxic gas with a pungent odour, which can be detected in the air at concentrations below 1 ppm (= 1 ml/m³).

Chlorine is 2.5 times heavier than air and accumulates at ground level.

Chlorine is extremely toxic for water organisms. The reason for the toxicity of chlorine is its extraordinary reactivity. It reacts with animal and vegetable tissue and thus destroys it.

Air with a chlorine gas content of 0.5 -1% leads to a quick death in mammals and humans, as it attacks the respiratory tract and the pulmonary alveolus (formation of hydrogen chloride or hydrochloride acid).

NOTE

Faults due to insufficient chlorine quality

Impurities in the chlorine gas form deposits in devices and valves and can attack the components chemically. This can lead to malfunctions.

- ⇨ Only use technically pure chlorine that meets the following requirements:
  - Mass content chlorine at least 99.5%
  - Water content max. 20 mg / kg

  Chlorine according to EN 937 meets these requirements.

2.3 Hazards due to non-compliance with the safety instructions

Failure to follow the safety instructions may endanger not only persons, but also the environment and the device.

The specific consequences can be:

- Failure of important functions of the device and the system,
- failure of required maintenance and repair methods,
- danger for individuals through dangerous dosing media,
- danger to the environment caused by chlorine leaking from the system.

2.4 Working in a safety-conscious manner

Besides the safety instructions specified in this operating manual, further safety rules apply and must be followed:

- Accident prevention regulations,
- safety and operating provisions,
- safety regulations on handling hazardous substances,
- environmental protection provisions,
- applicable standards and legislation.

2.5 Personal protective equipment

Based on the degree of risk posed by the dosing medium and the type of work you are carrying out, you must use corresponding protective equipment. Read the Accident Prevention Regulations and the Safety Data Sheets to the dosing media find out what protective equipment you need.

You will require the minimum of the following personal protective equipment:

Personal protective equipment required	
	Respirator mask
	Protective clothing
	Safety shoes
	Protective gloves

Table 3: Personal protective equipment required

Wear the following personal protective equipment when performing the following tasks:

- Commissioning,
- All work on gas-bearing sections of the plant,
- Changing the chlorine tank,
- Shut-down,
- Maintenance work,
- Disposal.

2.6 Personnel qualification

Any personnel who work on the device must have appropriate special knowledge and skills.

Anybody who works on the device must meet the conditions below:

- Attendance at all the training courses offered by the owner,
- personal suitability for the respective activity,
- sufficient qualification for the respective activity,
- training in how to handle the device,
- knowledge of safety equipment and the way this equipment functions,
- knowledge of this operating manual, particularly of safety instructions and sections relevant for the activity,
- Knowledge of fundamental regulations regarding health and safety and accident prevention.

All persons must generally have the following minimum qualification:

- Training as specialists to carry out work on the device unsupervised,
- sufficient training that they can work on the device under the supervision and guidance of a trained specialist.

These operating instructions differentiate between these user groups:

2.6.1 Specialist staff

Thanks to their professional training, knowledge, experience and knowledge of the relevant specifications, specialist staff are able to perform the job allocated to them and recognise and/or eliminate any possible dangers by themselves.

2.6.2 Trained persons

Trained persons have received training from the operator about the tasks they are to perform and about the dangers stemming from improper behaviour.

Trained persons have attended all trainings offered by the operator.

2.6.3 Personnel tasks

In the table below you can check what qualifications are the pre-condition for the respective tasks. Only people with appropriate qualifications are allowed to perform these tasks!

Qualification	Activities
Specialist staff	■ Assembly ■ Commissioning ■ Taking out of operation ■ Fault rectification ■ Maintenance ■ Repairs ■ Disposal ■ Fault rectification
Trained persons	■ Storage ■ Transportation ■ Control

Table 4: Personnel qualification

3 Intended use

3.1 Notes on product warranty

Any non-designated use of the device can impair its function and the protection provided. This leads to invalidation of any warranty claims!

Please note that liability is on the side of the user in the following cases:

- the device is operated in a manner which is not consistent with these operating instructions, particularly safety instructions, handling instructions and the section "Intended Use".
- Information on usage and environment (see section 5 “Technical data” on page 10) is not adhered to.
- If people operate the device who are not adequately qualified to carry out their respective activities.
- No original spare parts or accessories of Lutz-Jesco GmbH are used.
- Unauthorised changes are made to the device.
- Maintenance and inspection intervals are not adhered to as required or not adhered to at all.
- The device is commissioned before it or the corresponding system has been correctly and completely installed.
- Safety equipment has been bridged, removed or made inoperative in any other way.

3.2 Intended purpose

The vacuum regulator is intended exclusively for use with chlorine gas dosing systems in accordance with the vacuum procedure. The vacuum regulator is supplied exclusively with gaseous chlorine. It reduces the positive pressure from the chlorine gas supply to a pressure lower than the atmospheric air pressure.

It may only be used with technically pure chlorine with a minimum mass content of 99.5%

3.3 Permissible dosing media

The device may only be used for the following media and substances:

- Gaseous chlorine.
- Technically pure chlorine with a mass content of more than 99.5%.

3.4 Foreseeable misuse

Information is outlined below regarding the device applications which are classified as non-intended use. This section is intended to allow you to detect possible misuse in advance and to avoid it.

Foreseeable misuse is assigned to the individual stages of the product lifetime:

3.4.1 Incorrect assembly

- Use of old or unsuitable seals on the connections.
- Inadequate attachment of the components
- Unauthorised modification of the device

3.4.2 Incorrect start-up

- The commissioning of a damaged or incorrectly fitted device.
- Commissioning by untrained personnel.
- Commissioning with improperly functioning safety and protection devices (e.g. gas warning device).

3.4.3 Incorrect operation

- No leak test after maintenance and repair work.

3.4.4 Incorrect maintenance

- Carrying out maintenance and repair work during ongoing operation.
- Failure to comply with the instructions during maintenance.
- Use of unsuitable spare parts.
- Use of incorrect disassembly tools.

3.4.5 Incorrect disposal

- No proper disposal of device components and of replacement parts

4 Product description

4.1 Scope of delivery

Please compare the delivery note with the scope of delivery. The following items are part of the scope of delivery:

- Vacuum regulator with inlet valve and integrated safety valve
- Optional pressure gauge
- Flange connection at the chlorine inlet, including screws and seal (optional)
- 5 m hose with fastening material as a blow-off line
- Ammonia solution for leakage test
- Operating instructions

4.2 Design and function

4.2.1 Structure of a vacuum dosing system

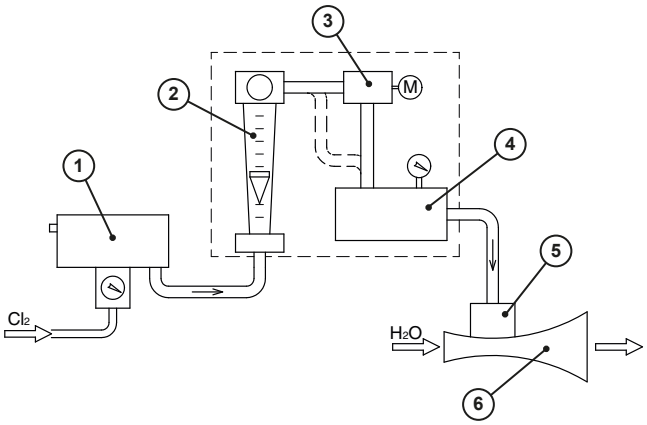


Fig. 1: Structure of a vacuum dosing system

The chlorine gas leaves the chlorine tank with positive pressure. The vacuum regulator (1) only permits the chlorine to flow if a vacuum at the output of the device generates suction. A chlorine leak is not possible following a line fracture behind the vacuum regulator.

The dosing device consists of a flow meter (2) with a manual regulation valve, usually an electrically-actuated regulation valve (3) and a pressure regulator (4).

The injector (6) generates the vacuum and mixes the chlorine gas into the motive water flow. If there is a water standstill, the chlorine dosing is interrupted immediately and the non-return valve (5) prevents water from entering the dosing devices.

4.2.2 Structure of the device

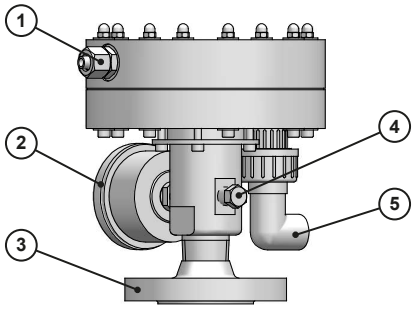


Fig. 2: Device design

No.	Description
1	Safety valve outlet
2	Optional pressure gauge
3	Input
4	Plugs
5	Output

Table 5: Components

4.2.3 Function description

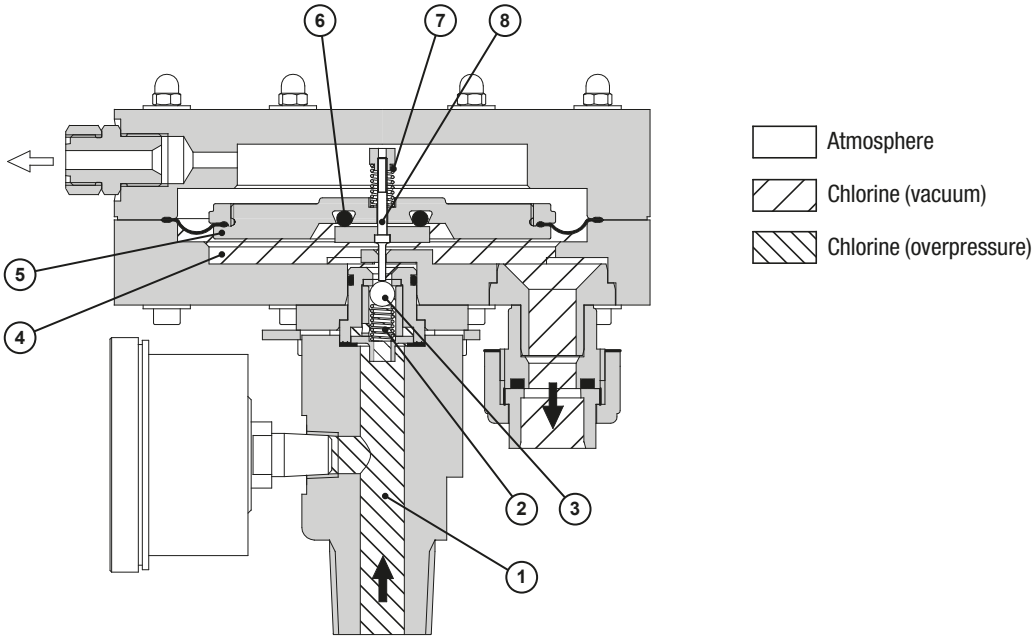


Fig. 3: Vacuum Regulator C 2525-V

Chlorine gas flows under pressure out of the chlorine barrel into the vacuum regulator. The vacuum regulator consists of an inlet valve (1) and the diaphragm chamber (4). The chlorine gas in the inlet valve is under positive pressure; a vacuum is in the diaphragm chamber.

The PVC outlet of the vacuum regulator is connected to the injector. Sufficient vacuum sucks the diaphragm disc (5) downwards and pushes the valve ball (3) downwards from the valve seat against the force of the spring (2) via the valve pin (8). The inlet valve opens and the required amount of chlorine flows into the membrane chamber (4). With insufficient vacuum, the spring closes the system. This produces a constant vacuum in the subsequent piping.

A constant vacuum constitutes the highest safety standard for the system: If there is a leak, the ambient air is sucked into the pipe without a dangerous amount of chlorine gas escaping into the atmosphere.

If the valve ball does not close completely due to heavy soiling, a slight overpressure builds up in the membrane chamber. With this particular malfunction, the integrated safety valve opens: The diaphragm disc (5) is lifted from the O-ring (6), compressing the spring (7). This opens up a flow channel in the diaphragm holder and vents the system to a neutralisation system such as a chlorine destroyer or an activated carbon cartridge.

4.3 Rating plate

There is information on the equipment about safety or the product's way of functioning. The information must stay legible for the duration of the service life of the product.

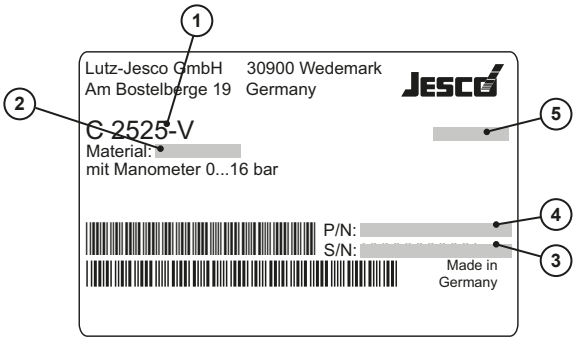


Fig. 4: Rating plate C 2525-V

No.	Description
1	Product name
2	Components coming into contact with the media
3	Serial number
4	Part number
5	Month / year of manufacture

Table 6: Rating plate

5 Technical data

Information		Value
Throughput		up to 25 kg/h
Inlet pressure		1.5 - 16 bar
Operating vacuum		-50 ... -100 mbar
Opening pressure of the safety valve		50 mbar
Optional pressure gauge		0 - 16 / Ø 63 mm
Materials	Inlet valve	Brass (chemically nickel plated), Monel, Hastelloy
	Diaphragms	FPM
	Vacuum housing	PVC
	Seals	FPM, PTFE
Weight with flange and manometer		approx. 6 kg
Ambient temperature		10 – 50 °C (no direct sunlight)

Table 7: Technical data

6 Dimensions

All dimensions in millimetres (mm).

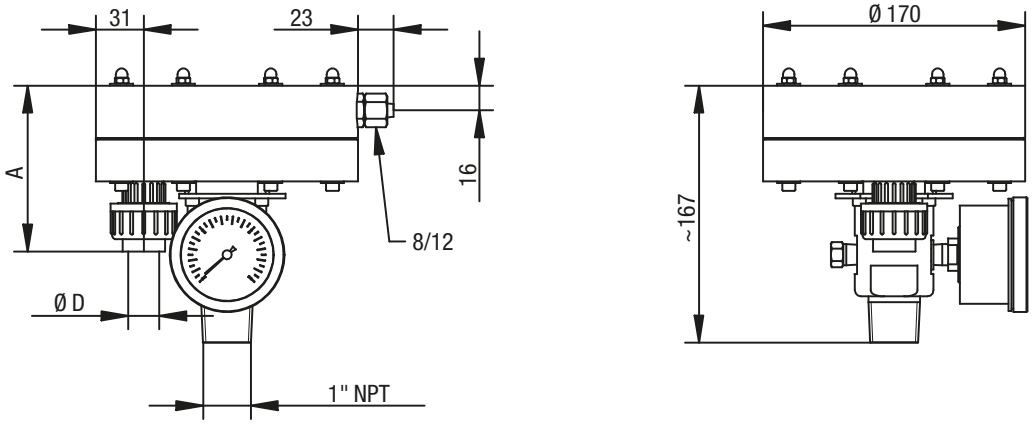
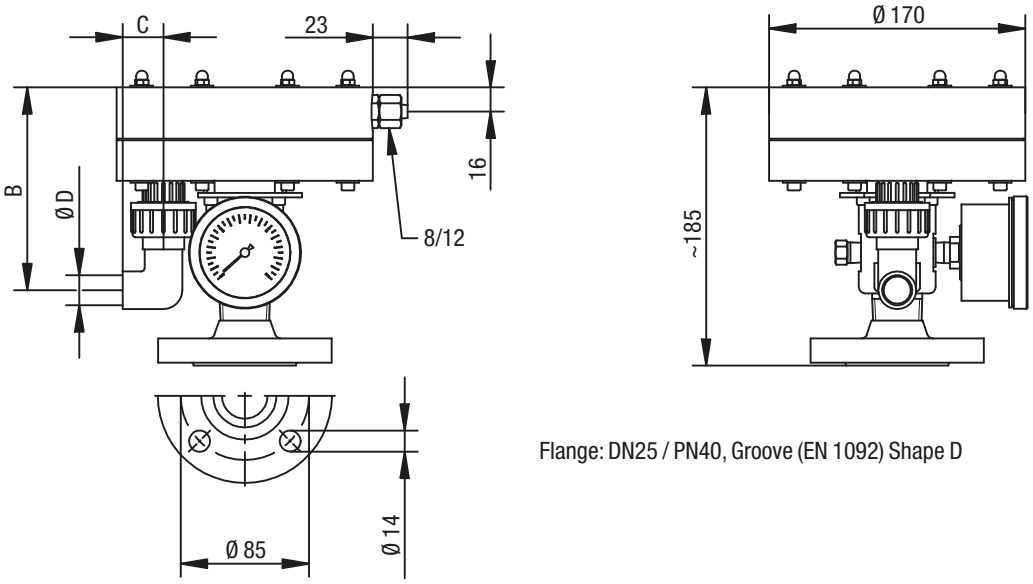


Fig. 5: Dimensional drawing Vacuum regulator with threaded connection



Flange: DN25 / PN40, Groove (EN 1092) Shape D

Fig. 6: Dimensional drawing Vacuum regulator with flange connection

Scale	Value
A	107.5 mm
B	134.5 mm
C	27 mm
Ø D	20 mm

Table 8: Dimensions

7 Installation

NOTE

Damage to the system due to incorrect installation

The failure to observe installation instructions (e.g. use of unsuitable tools, incorrect torque) can damage the system parts.

⇨ Only apply the appropriate amount of force to the plastic parts. Plastic threads (especially PVC threads) can be tightened and loosened more easily by applying a thin layer of amount of silicone grease or PRFE grease.

⇨ Note the specified torque.

7.1 Installation location

Starting from the flow direction of the chlorine, the vacuum regulator represents the last device in the installation which is operated with overpressure. Therefore, the vacuum regulator must be installed in the same room as the chlorine supply, which is monitored by a gas warning device (see "Installation examples" on page 16).

All the downstream devices and lines have a lower pressure compared to the atmosphere. These devices are usually installed in the dosing device room.

The device may not be exposed to direct sunlight.

7.2 Mounting position

The device input must point downwards.

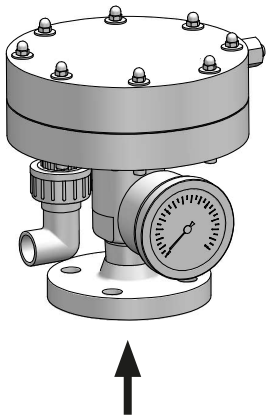


Fig. 7: Mounting position

7.3 Installing the device

7.3.1 Chlorine inlet (pressure line)

NOTE

Damage to the system by liquid chlorine

The vacuum regulator is only suited for gaseous chlorine. Liquid chlorine destroys PVC parts.

⇨ When the supply is with liquid chlorine, install a chlorine evaporator before the vacuum regulator. An additional pressure reducer prevents the chlorine gas from condensing in the installation downstream of the chlorine evaporator.

⇨ For systems without a pressure reducer, the highest temperature must be present in the pipeline immediately before the vacuum regulator. This can be achieved by heating the line directly in front of the inlet valve with a heating sleeve or by equipping the entire pipeline with a heating band. This prevents condensation of chlorine gas.

⇨ Install a moisture eliminator with a heating collar at the input to this vacuum regulator, in order to evaporate any residual chlorine.

The vacuum regulator should be installed directly on the supply line. It can be carried by the line and does not need to be fixed separately. However, the line must be adequately fixed.

The line from the chlorine barrel to the vacuum regulator must be installed at a constant uphill gradient.

A shut-off valve should be installed before each vacuum regulator.

In order to supply the vacuum regulator with sufficient pressure, the pressure loss in the pressure line from the pressure cylinder to the vacuum regulator should not exceed 0.5 bar. For this reason, seamless pipes with nominal width DN25 (1") are used.

For very long lines (> 200 m) or when several vacuum regulators are connected to a supply line, a supply line with a larger nominal width may have to be used.

Installing the connection with flange

Precondition for action:

✓ The inside of the supply line is clean and dry.

✓ The transport protection is removed.

✓ The sealing surfaces are free of contamination and damage.

✓ Seals must be clean, undamaged and dry.

✓ Bolts, nuts and washers are clean and undamaged.

🛠 Fitting grease (e.g. Molykote Longterm W2)

🛠 Flat gasket

Any bolts, nuts and washers that are removed during assembly work must be replaced with new ones if they are damaged. Used bolts, nuts and washers may only be installed if they are in new condition.

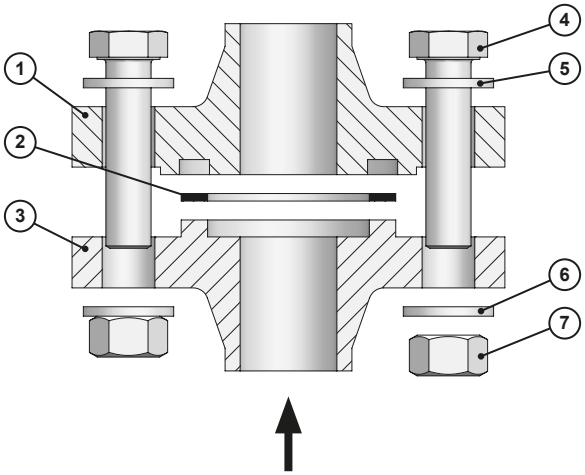


Fig. 8: Installing the flange connection

Perform the following working steps:

1. Lubricate the sliding faces and thread of bolts, nuts and washers using fitting grease.
2. Place the flat gasket (2) into the protruding spring of the connection flange (3). Assemble the seal in dry condition.
3. Put on the groove flange (1) of the vacuum regulator. Make sure that the flat gasket does not slip.
4. Fit the bolts (4), washers (5, 6) and nuts (7) by hand.
5. Tighten the bolts evenly alternately crosswise in three stages: 20 Nm, 35 Nm, 50 Nm. After this, retighten all the bolts to the full target tightening torque (50 Nm).
6. Setting the seal (adapting to the flange seal surface) can make it necessary to retighten the bolts. For this reason, retighten the bolts to 50 Nm after a few hours.

✓ **Install the chlorine inlet to the flange connection.**

Installing the connection with thread

DANGER

Lethal hazard due to incorrect sealant.

Pipe connections and fittings in pressurized lines must be sealed with chlorine-resistant substances. Unsuitable sealants react with the chlorine and lead to leakages.

⇨ Use only sealants that are resistant in contact with chlorine (e.g. anaerobic sealants).

Precondition for action:

✓ The inside of the supply line is clean and dry.

✓ The transport protection is removed.

✓ The threads are metallic bright.

🛠 Fat-dissolving cleaning agent (e.g. isopropyl alcohol)

🛠 Threaded sealant (Omnifit FD20)

Perform the following working steps:

1. Clean the thread with a fat-dissolving cleaning agent.
2. Allow the thread to dry completely.
3. Apply the thread sealant to the external thread in a circular motion to the start of the thread. Leave the first thread clear. Apply the thread sealant all the way down to the root of the thread to thoroughly grease the thread flank.

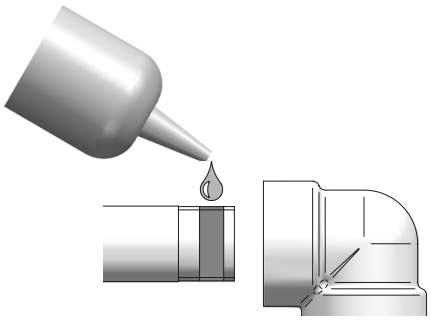


Fig. 9: Seal in the thread

NOTE

Leakage due to incorrect installation

To ensure that the connection is correctly aligned, it is necessary under certain circumstances to turn the thread anticlockwise. When the connection is loosened, bubbles form in the sealant, which can lead to leakages.

⇨ Only turn the thread anti-clockwise.

⇨ If the orientation is not correct after the connection has been tightened, repeat steps 1 - 5.

4. Insert the threaded pin into the internal thread and apply a little sealant to the internal thread. Screw the parts by hand.
5. Use a tool to tighten the connection. The tool should only engage the metallic inlet valve, not the PVC part of the vacuum regulator. The thread size 1" NPT requires approx. 150 Nm.
6. Remove excess sealant with a cloth.
7. Allow the connection to harden for at least 12 hours prior to the leak test.

✓ **Install the chlorine inlet to the threaded connection.**

If the manometer on the inlet valve shows in the wrong direction after the chlorine supply has been installed, the manometer can be mounted on the opposite side. To do so, swap the pressure gauge and the threaded plug. They are fitted with PTFE strips.

7.3.2 Chlorine outlet (vacuum line)

PVC-U pipes must be used as vacuum lines. For short distances the pipe should be selected in the nominal width of the vacuum connection. For long distances a larger pipe must be used. If several devices are connected to a line, the line must be calculated for the total chlorine flow.

The following nominal widths are recommended for the vacuum line (pressure loss max. 25 bar, calculated at 0.9 bar with 4x90° angles):

Mass flow of chlorine	Length of the vacuum line					
	5 m	10 m	20 m	30 m	50 m	100 m
5 kg/hr	DN15	DN15	DN15	DN15	DN15	DN15
10 kg/hr	DN15	DN15	DN15	DN15	DN15	DN15
15 kg/hr	DN15	DN15	DN15	DN15	DN15	DN15
20 kg/hr	DN15	DN15	DN15	DN15	DN15	DN20
25 kg/hr	DN15	DN15	DN15	DN15	DN20	DN20

Table 9: Length of the vacuum lines

Where necessary, a large distance can be installed in a large nominal width and a connection in the nominal width of the device can be selected for shorter sections shortly before and after the device:

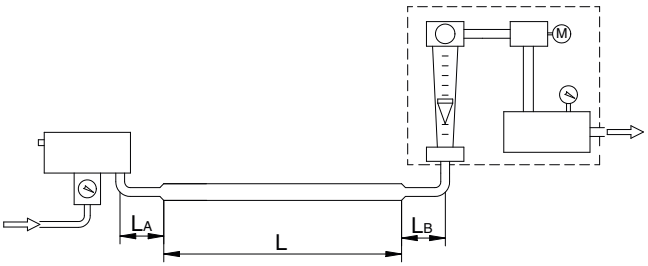


Fig. 10: Long vacuum line

Position	Description
1	Vacuum regulator
2	Dosing device
L_A	Line connected to the vacuum regulator with approx. 0.5 m in the connection nominal width
L	Large distance in a larger nominal width
L_B	Lines connected to the dosing device with approx. 0.5 m in the connection nominal width

Table 10: Legend Fig. 10

Installing the vacuum line

Precondition for action:

✓ The chlorine input of the vacuum regulator has been fitted.

✓ The vacuum line is fixed with sufficient pipe clamps and meets the vacuum regulator outlet in an un-tensioned state.

✓ All parts are clean and dry.

✓ The transport protection of vacuum regulator output is removed.

🛠 PVC adhesive

Perform the following working steps:

1. Cut the PVC pipe at right angles. Make a chamfer on the pipe exterior (approx. 3mmx20°).
2. Clean the pipe and the bushing with the cleaning agent recommended by the manufacturer of the adhesive.
3. Glue the pipe in the connection. Follow the instructions on the PVC adhesive.

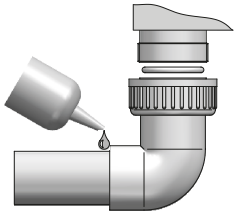


Fig. 11: Installing chlorine outlet

4. Mount the connection on the device. Ensure that the O-ring is fitted.
5. Tighten the union nut by hand.
6. Allow the bond to harden for at least 3 hours prior to the leak test.

✓ **Assembled vacuum line.**

7.3.3 Safety valve

A hose serves as a blow-off line, the open end of which ends in proximity to the gas sensor. It is recommended to mount an activated carbon cartridge at the open end of the hose which prevents an alarm when the system is subjected to short pressure surges.

> Transparent PVC tubing is well suited as a blow-off line. With the first chlorine contact, it becomes milky and makes it possible to identify malfunctions at an early stage.

Installing the blow-off line

Precondition for action:

- ✓ The chlorine input of the vacuum regulator has been fitted.
- ✓ The chlorine output of the vacuum regulator has been fitted.
- ✓ The transport protection on the safety valve has been removed.

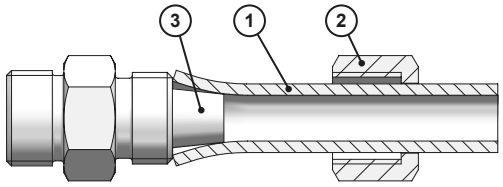


Fig. 12: Fitting the hose connection

Perform the following working steps:

1. Cut the hose (1) a at right angles.
2. Slide the union nut (2) onto the hose.
3. Slide the hose end onto the cone of the hose connection (3).
4. Tighten the union nut by hand.
5. Fix the hose to the wall.
6. If necessary, install the activated carbon cartridge at the open hose end.

✓ **Assembled blow-off line.**

7.4 Completing the installation

After completing installation, you must check that all the connections are leak-proof (see sections 8.1 “Inspecting the pressure system” on page 18 and 8.2 “Checking the vacuum system” on page 19).

> All exposed bright metal surfaces must be painted as the atmosphere in chlorine gas rooms is highly corrosive. RAL1003 yellow 2-component epoxy resin paint, for example, is suitable. Paint must only be applied after a successful leak test has been completed.

7.5 Installation examples

7.5.1 Installation without a chlorine evaporator

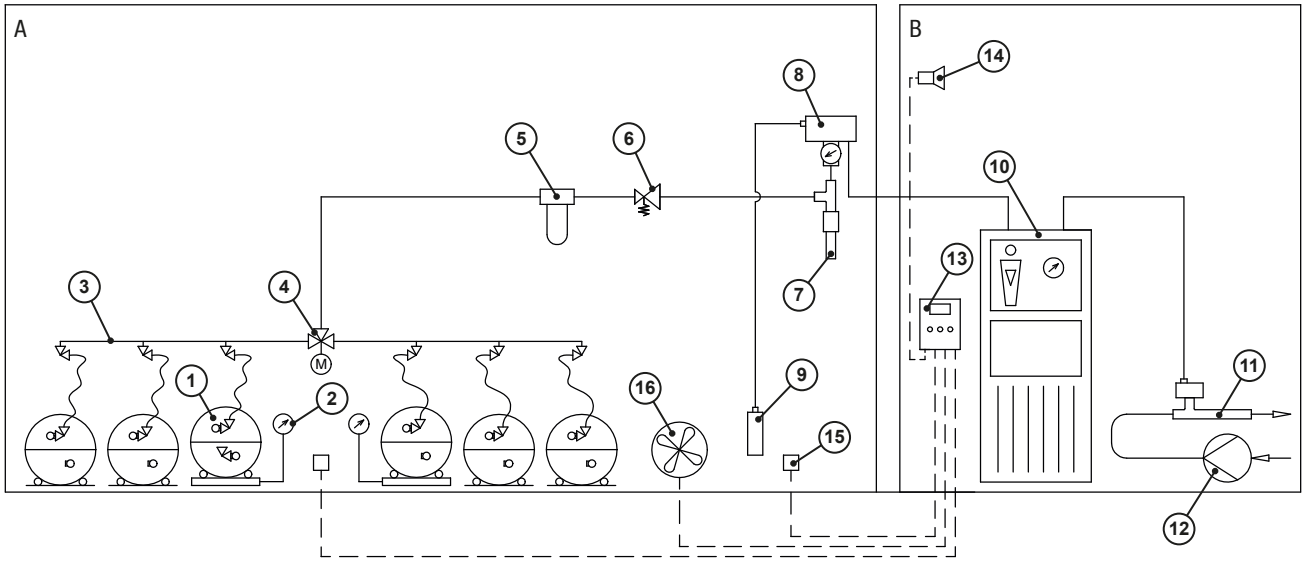


Fig. 13: Installation without a chlorine evaporator

Position	Description
A	Room for the chlorine supply
B	Dosing device room
1	Chlorine barrel
2	Chlorine barrel scale
3	Manifold
4	Changeover switch
5	Chlorine gas filter
6	Pressure reducing valve
7	Moisture eliminator with heating collar

Table 11: Installation without a chlorine evaporator

Position	Description
8	Vacuum regulator
9	Activated carbon cartridge
10	Dosing device
11	Injector with non-return valve
12	Motive water pump
13	Gas warning device
14	Horn
15	Gas sensor
16	Entrance port of the chlorine eliminator

Table 11: Installation without a chlorine evaporator

7.5.2 Installation with a chlorine evaporator

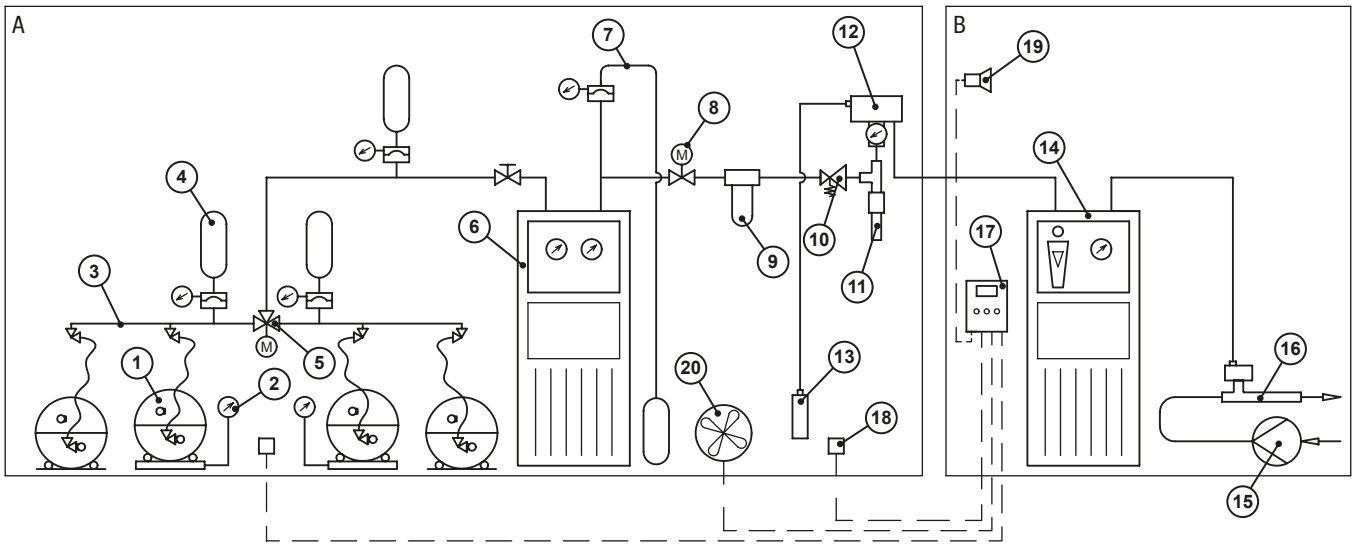


Fig. 14: Installation with a chlorine evaporator

Position	Description
A	Room for the chlorine supply
B	Dosing device room
1	Chlorine barrel
2	Chlorine barrel scale
3	Manifold
4	Rupture disk with expansion container
5	Changeover switch
6	Chlorine evaporator
7	Expansion system
8	Quick-action valve
9	Chlorine gas filter

Table 12: Installation with a chlorine evaporator

Position	Description
10	Pressure reducing valve
11	Moisture eliminator with heating collar
12	Vacuum regulator
13	Activated carbon cartridge
14	Dosing device
15	Motive water pump
16	Injector with non-return valve
17	Gas warning device
18	Gas sensor
19	Horn
20	Entrance port of the chlorine eliminator

Table 12: Installation with a chlorine evaporator

8 Commissioning

8.1 Inspecting the pressure system

Check the pressure system of the chlorine tank for leaks up to the vacuum regulator in two stages:

8.1.1 Carrying out the leak test with nitrogen

You are strongly recommended to carry out this inspection before carrying out the leak test with chlorine, since it shows leaks in the pressure system without the risk of chlorine escaping. As an alternative, you can carry out the inspection using dry compressed air.

Precondition for action:

- ✓ All the open connections of the pressure system were closed correctly.
- ✓ All the shut-off valves in the pipe system were opened.
- ✓ A nitrogen cylinder was connected.

Perform the following working steps:

1. Slowly raise the system pressure at the nitrogen cylinder's pressure reducer to 10 bar.
2. Close the nitrogen cylinder's valve.
3. Apply soap solution to all the potential leaks.
   ▶ Bubbles will appear at leak locations.
4. Close the outlet on the nitrogen cylinder's pressure reducer and observe the pressure gauge in the installation.
5. The pressure must not drop within one hour.
6. If necessary, repair leaks and repeat the leak test.

✓ **Leak test with nitrogen carried out.**

8.1.2 Carrying out the leak test with chlorine

DANGER

Danger to life from chlorine poisoning!

If you start the leak test with chlorine gas before the entire system has been installed and the injectors are ready for operation, chlorine gas may not be extracted immediately in the event of a leak.

⇨ Make sure that all the components in the plant are installed correctly and the injectors are ready for operation before starting the leak test with chlorine gas.

⇨ Put on protective clothing before carrying out the leak test with chlorine gas.

Precondition for action:

- ✓ The leak test with nitrogen has been carried out successfully.
- ✓ All the open connections of the pressure system were closed correctly.
- ✓ A chlorine container was connected.
- ✓ The injector is ready for operation.

Perform the following working steps:

1. Briefly open the chlorine container valve and close it again.
2. Carry out the ammonia test on the entire pressure system: Ammonia steam with chlorine forms a white vapour and makes even very small leaks visible. Hold an open bottle containing the ammonia solution close to the pipe and make slight pumping motions with the plastic bottle.

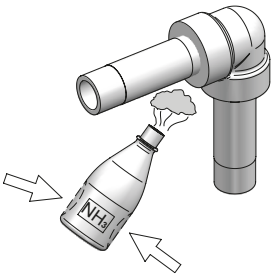


Fig. 15: Leak test with ammonia

NOTE

Damage to the plant by the ammonia solution

If the ammonia solution comes into contact with the plant, this leads to corrosion on the equipment.

⇨ Make sure that you do not spill any ammonia.

3. If you find leaks: Use the injector to suck off the chlorine immediately! Eliminate the leak and repeat the leak test.
4. If you do not find any leaks: Briefly open the chlorine container valve and leave it open.
5. Carry out the leak test again.
6. Close the chlorine container valve and suck up the chlorine using the injector.

✓ **Leak test with chlorine carried out.**

8.2 Checking the vacuum system

NOTE

Operating faults through leakages in the vacuum system

Small leaks in the vacuum system will not be recognised in normal operation, since no chlorine escapes. Air will enter the system with moisture. The moisture can combine with the chlorine to create deposits and operating malfunctions.

With the injector switched off, there may be a slight chlorine smell.

⇨ Check the vacuum system.

⇨ Ensure that all action is taken only by personnel with sufficient and corresponding qualifications.

8.2.1 Carry out the leak test on the vacuum system

Tightness of the vacuum system is inspected together with the dosing unit.

Precondition for action:

✓ The vacuum system is fully assembled.

✓ All the open connections of the vacuum system were closed.

✓ The injector is ready for operation.

Perform the following working steps:

1. Connect the chlorine supply e.g. to the chlorine tank valves or a valve in the vacuum regulator supply line.
2. Open the valve on the dosing device to adjust the dosing quantity.
3. Switch on the injector and wait until the vacuum manometer on the dosing unit displays at least 0.5 bar under-pressure.

A number of dosing devices contain a valve which protects the injector against too strong a vacuum. For example, if this valve is set to 0.4 bar negative pressure, no negative pressure of 0.5 bar can be achieved with the leakage test.

4. Switch off the injector.
   ▶ The vacuum must stay unchanged for at least five minutes.
5. If the vacuum collapses quickly, eliminate the leak (see 8.2.2 “Localising leakages in the vacuum system” on page 19) and repeat the check on the vacuum system.

✓ **A leak test was performed in the vacuum system.**

8.2.2 Localising leakages in the vacuum system

Leaks in the vacuum system are localised with the help of compressed air or nitrogen at a slight positive pressure and a soap solution.

NOTE

Damage to the plant due to excessive pressure

When using positive pressure to localise leaks, components in the vacuum system, e.g. membranes or springs, may be mechanically overloaded.

⇨ Use a maximum positive pressure of 0.5 bar.

Precondition for action:

✓ When checking the tightness of the vacuum system, a leak was detected.

✓ The vacuum system is fully assembled.

✓ All the open connections of the vacuum system were closed correctly.

✓ The valves on the chlorine supply have been closed.

✓ If the system was previously operated with chlorine, the residual chlorine has been extracted with the injector and the system operated for approx. 5 minutes using nitrogen or dry compressed air.

✓ The injector was switched off.

Perform the following working steps:

1. Close the water valves upstream and downstream of the injector.
2. Connect the supply of nitrogen or dry compressed air to the vacuum system.
3. Slowly raise the system pressure to approx. 0.2 - 0.4 bar.
4. Apply soap solution to all the potential leaks.
   ▶ Bubbles will appear at leak locations.

✓ **Leakage in the vacuum system localised.**

8.3 Switch the system on

The vacuum regulator not require any special operation. The device opens given a sufficient vacuum and sufficient chlorine supply and the chlorine supply stops if the vacuum is too low.

9 Operation

Shutting down in an emergency

DANGER

Chlorine gas can escape due to systems that are leaky or not installed correctly!

Chlorinators constitute an increased safety risk if they have not been properly installed, if an adequate leak test has not been performed or if the devices are not in good condition.

- ⇨ Before placing the system into operation, have it checked by technical personnel to ensure that it is in the proper condition and leak tight.
- ⇨ The condition of the installation must be checked for adequate tightness on a regular basis.
- ⇨ Ensure that all action is taken only by personnel with sufficient and corresponding qualifications.

The vacuum regulator not require any special operation. The device opens given a sufficient vacuum and sufficient chlorine supply. When the vacuum is interrupted, it stops the chlorine flow.

An unfavourable combination of supply pressure, pipe length and dosing volume can cause vibrations at the vacuum regulator.
The vibrations can be prevented by adjusting the pre-pressure or slight throttling at the shut-off valve before the vacuum regulator.

Test intervals

You must check the components of the chlorinator for leaks on a daily basis and after maintenance or commissioning work.

10 Shut-down

10.1 Short-term shut-down

Perform the following working steps:

1. Close the chlorine tank valves.
2. Use the injector to suck off the remaining chlorine gas.
3. Switch off the injector.

✓ **Chlorinator shut down for the short term.**

10.2 Long-term shut-down

Perform the following working steps:

1. Close the chlorine tank valves.
2. Use the injector to suck off the remaining chlorine gas.
3. Run the chlorinator for approximately five minutes with nitrogen or dry compressed air.
4. Close all the connections to protect the lines and devices from humidity and dirt.
5. Switch off the injector.

✓ **Chlorinator shut down for the long term.**

10.3 Disposal

- Before disposing of the old device, you must clean off the remaining chlorine gas by rinsing it with air.
- The device must be disposed of in accordance with applicable local laws and regulations. It should not be included with domestic waste.

As the disposal regulations may differ from country to country, please consult your supplier if necessary.

In Germany, the manufacturer must provide free-of-charge disposal. provided the device has been safely returned along with a declaration of no objection (see page 27).

11 Maintenance

DANGER

Danger to life from chlorine poisoning!

Do not carry out maintenance or any other work on the chlorinator until the system has been decommissioned and all of the chlorine gas has been removed from the lines. The failure to follow this instruction presents a significant risk of injury.

⇨ Prior to any maintenance work, prepare the system in accordance with section 11.3 “Preparing the system for maintenance” on page 21.

⇨ Wear personal protective equipment when performing any work on the system.

11.1 Maintenance intervals

This table gives you an overview of maintenance work and the intervals at which you must carry it out. The next few sections contain instructions for carrying out this work.

Interval	Maintenance
After 1 year	Minor maintenance: ■ Cleaning the device ■ Replace highly loaded seals at the inlet valve.
After 3 year	Major maintenance: ■ Replace all elastomers ■ Replace ball guide and inlet valve spring
After 5 years	■ Replace the pressure gauge

Table 13: Maintenance intervals

In some cases, regional regulations may require shorter maintenance intervals.

Maintenance intervals depend only on how frequently the equipment is used. Chemical wear of rubber parts, for example, begins with the initial medium contact and continues irrespective of the usage.

11.2 Maintenance accessories

Description
Silicone grease, medium viscosity for application to seals
Fitting grease for lubricating the sliding faces and threads
Liquid sealant for bonding thread 1" NPT
Ammonia solution for the leak test
Plastic tools for dismantling O-rings

Table 14: Maintenance accessories

11.3 Preparing the system for maintenance

Perform the following working steps:

1. Close the chlorine tank valves.
2. Use the injector to suck off the remaining chlorine.
3. Switch off the injector.
4. Run the chlorinator for approximately five minutes with nitrogen or dry compressed air.
5. Close all the connections to protect the lines and devices from humidity and dirt.

✓ **The system is prepared for maintenance.**

11.4 Maintenance of the inlet valve

Precondition for action:

✓ The system has been prepared for maintenance.

✓ A maintenance set is available.

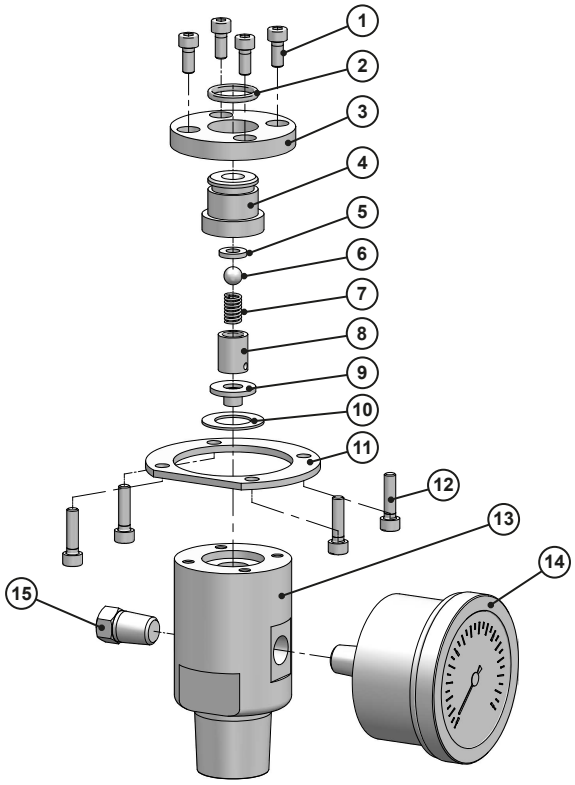


Fig. 16: Exploded view of the inlet valve

11.4.1 Dismantling the inlet valve

Perform the following working steps:

1. Remove the four screws (12) that secure the clamping plate (11) to the plastic part of the vacuum regulator.
2. Pull the inlet valve out of the plastic part with a turning movement.
3. Remove the O-ring (2).
4. Loosen the four screws (1).
   ▶ The spring (7) pushes the valve apart.
5. Lift the clamping ring (3) off the valve cap (4) and the clamping plate (11).
6. Remove the valve cap together with components (5 to 10) from the valve body (13).
7. If you want to clean the valve with water, unscrew the manometer (14). Close the manometer so that no humidity penetrates.

✓ **Inlet valve dismantled.**

11.4.2 Clean the inlet valve

1. Clean all parts that are not exchanged thoroughly. Warm water or isopropyl alcohol is suitable for this purpose. Do not immerse the manometer in water!
2. The parts not included in the maintenance kit should be subjected to a visual inspection and replaced if damaged.

✓ **Inlet valve cleaned.**

11.4.3 Fitting the inlet valve

Pre-conditions for actions:

✓ All parts have been dried well after cleaning.

✓ All parts are in a good condition.

✓ Consumables are available.

Perform the following working steps:

1. Insert the valve cap (4) through the clamping ring (3)
2. Grease the O-ring (2) lightly with silicone grease and insert the O-ring in the groove of the valve cap.
3. Place the seal (10) into the borehole of the valve body (13).
4. Place the clamping plate (11) on the valve body.
5. Mount the valve seat (5) into the valve cap.
6. Insert the ball guide (8) into the valve cap.
7. Place the valve ball (6) in the ball guide and place the spring (7) on the ball.
8. Place the spring-cap (9) with the pivot upwards on the spring. The spring centres itself in the cylindrical recess of the spring-cap.
9. Press the spring-cap slightly into the cylindrical recess of the valve cap until the cap touches the ball guide.
10. Hold the spring-cap in this position and place the valve cap on the seal (10). Make sure that the clamping plate (11) does not slip.
11. Press the clamping ring (3) onto the clamping plate and loosely install the screws (1) with a fitting grease on the valve body (13)
12. Align the clamping plate so that the manometer is correctly aligned after the inlet valve has been fitted to the plastic part.
13. Tighten the screws crosswise with approx. 3 Nm.
14. Fit the manometer (14) with approx. 3 long PTFE strips.

✓ **Inlet valve fitted.**

11.4.4 Checking the inlet valve

Precondition for action:

✓ The valve is fully assembled.

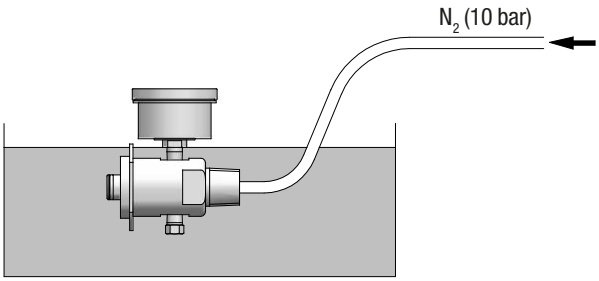


Fig. 17: Checking the inlet valve

Perform the following working steps:

1. Connect nitrogen or compressed dry air to the valve input and set the pressure to approx. 10 bar.
2. Push the inlet valve under water. Do not immerse the manometer in water!
3. Observe the valve for a number of minutes. No bubbles may rise.
4. If a leak develops on the valve output, take the valve from the water, exert forceful pressure on the valve rod to open and repeat the test. If it is not yet tight, the valve seat or the valve cone must be replaced.
5. Allow the inlet valve to dry well before fitting it.

✓ **Inlet valve checked.**

11.5 Perform maintenance on the vacuum unit.

Precondition for action:

- ✓ The chlorinator was prepared in accordance with section 11.3 “Preparing the system for maintenance” on page 21.
- ✓ A maintenance set is available.
- ✓ The inlet valve is removed.

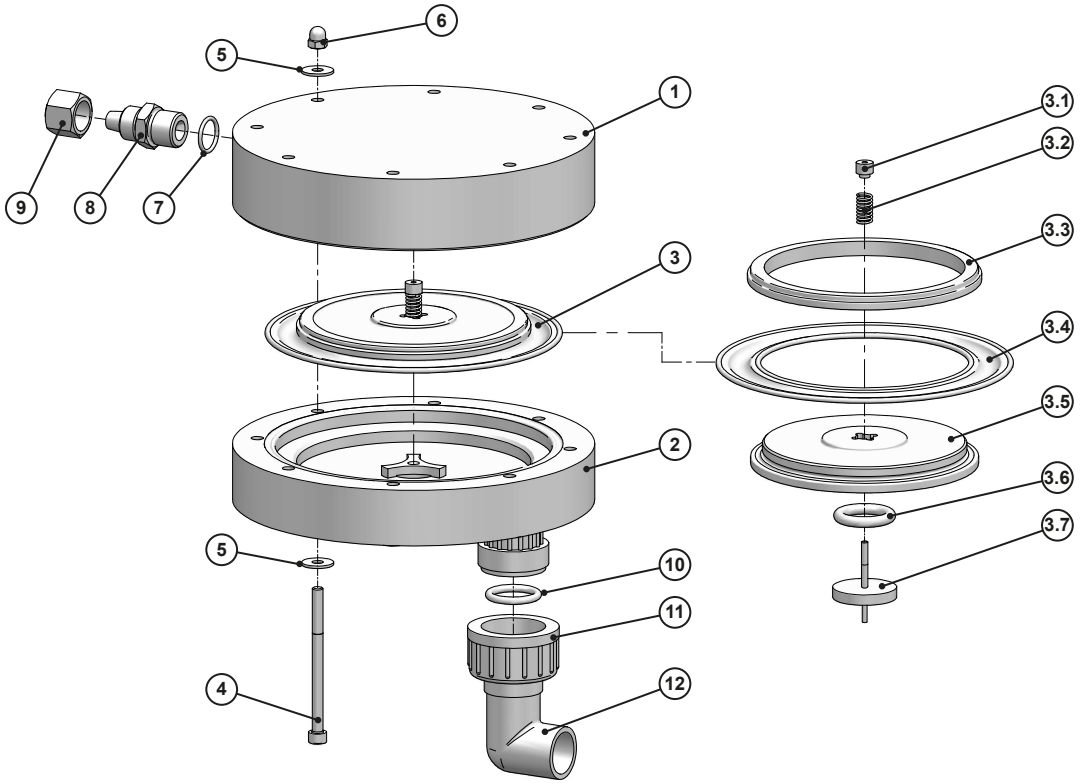


Fig. 18: Exploded view of the vacuum part

11.5.1 Disassembling the vacuum part

Perform the following working steps:

1. Loosen and remove the screws (4 - 6).
2. Remove the diaphragm holder (3) from the device.
3. Remove the O-rings (7, 10).
4. Remove the clamping ring (3.3) and take-out the diaphragm (3.4).
5. Unscrew the round nut (3.1) from the valve pin (3.7) and pull the valve pin downwards out of the diaphragm disc (3.5).
6. Remove the O-ring (3.6).

✓ **Vacuum part disassembled**

11.5.2 Clean the vacuum part

Perform the following working steps:

1. Clean all parts that are not exchanged thoroughly. Warm water or isopropyl alcohol is suitable for this purpose.
2. The parts not included in the maintenance kit should be subjected to a visual inspection and replaced if damaged. Pay attention to the contours for the diaphragm (3.4) on the clamping ring (3.3) and on the housing (1, 2).

✓ **Vacuum part cleaned.**

11.5.3 Mounting the vacuum part

Precondition for action:

- ✓ All parts have been dried well after cleaning.
- ✓ All parts are in a good condition.
- ✓ Consumables are available.

Perform the following working steps:

1. Rub the edges of the diaphragm (3.4) with silicone grease lightly.
2. Place the diaphragm on the diaphragm disc (3.5) with the dome pointing downwards and screw it on the clamping ring (3.3).
3. Check the correct seating of the diaphragm (3.5).
4. Grease the O-ring (3.6) lightly with silicone grease and mount it in the groove in the diaphragm disc (3.5).
5. Insert the valve pin (3.7) from below through the borehole in the diaphragm disc (3.5).
6. Insert the spring (3.2) over the valve pin and then screw the round nut (3.1) onto the valve pin.
7. Insert the diaphragm holder (3) with the valve pin into the central borehole in the lower housing part (2) and ensure that the diaphragm is correctly seated.
8. Place on the upper housing (1) section. Slightly press the housing parts against each other to ensure the diaphragm is seated well.

✓ **Diaphragm holder mounted.**

9. Place on the upper housing (1). Slightly press the housing parts against each other to ensure the diaphragm (3.5) is seated well.
10. Fit the screws (4 - 6) with a little fitting grease. Tighten the screws crosswise with approx. 2 Nm.
11. Screw-in the hose connection (8) by hand with the O-ring (7).
12. Mount the O-ring (10) at the outlet and tighten the union nut (11) by hand.

✓ **Vacuum part assembled.**

11.5.4 Check vacuum part

Check for leaks

Precondition for action:

✓ The vacuum part is assembled.

✓ The inlet valve was checked successfully, well dried and fitted to the vacuum regulator.

✓ The injector is ready for operation.

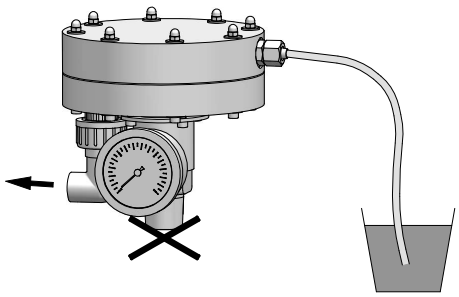


Fig. 19: Check for leaks

Perform the following working steps:

1. Connect the inlet of the vacuum regulator.
2. Connect the injector to the vacuum regulator output.
3. Switch on the injector.
4. Connect a hose onto the connection of the safety valve after ½ minute.
5. Push the open end under water.

▸ The water may not rise in the hose.

✓ **Leakage test concluded.**

Check the function of the safety valve

Precondition for action:

✓ Leakage test is concluded.

✓ Compressed air or nitrogen with an appropriate pressure-relief valve are available.

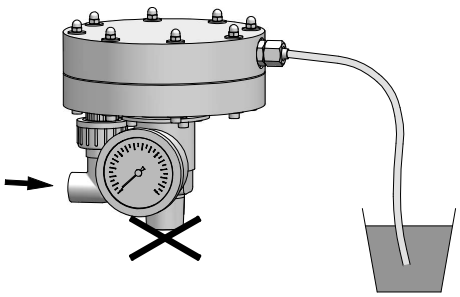


Fig. 20: Check the safety valve

Perform the following working steps:

1. Connect the inlet of the vacuum regulator.
2. Connect the compressed air or nitrogen to the output of the vacuum regulator.
3. Mount a hose at the safety valve connection.
4. Push the open end under water.
5. Increase the pressure slowly starting from 0 bar.

▸ Initially there is no permanent flow. Bubbles form only when the pressure increases. From about 0.5 bar a permanent flow can be observed.

6. Slowly lower the pressure. The safety valve must be closed below 0.1 bar.

✓ **Check of the safety valve completed.**

11.6 Finishing maintenance

Perform the following working steps:

1. Make a note of the date and scope of the maintenance performed.
2. Attach a sticker displaying the maintenance date to the device.
3. Fit the vacuum regulator in the system.
4. To restart the system, proceed in accordance with the instructions in section 8 “Commissioning” on page 18.

✓ **Maintenance completed.**

12 Troubleshooting

See below for information about how to rectify faults on the device or the system. If you cannot eliminate the fault, please consult with the manufacturer on further measures or return the device for repair.

Fault	Possible cause	Remedy
No or insufficient dosing.	The chlorine tank is empty.	Connect a new chlorine tank.
	The tank valve or a valve in the chlorine supply is closed or not fully open.	Open valves fully.
	The connection line on the chlorine tank is buckled or blocked.	Clean or replace the line.
	The filter in the chlorine gas is blocked (recognisable via the low pressure on the vacuum regulator input).	Clean or replace the filter. Use a better quality of chlorine gas.
	The supply pressure for the vacuum regulator is too low.	Increase the outlet pressure of the pressure reducing valve.
	Insufficient vacuum due: ■ A leak in the line. ■ A leak on the dosing unit. ■ A reduced injector performance. ■ A leak in the vacuum regulator (recognisable by the permanent suction of air at the vent line.)	 ■ Tighten all screw connections in the vacuum line. Check the O-rings. ■ Consult the troubleshooting in the operating instructions of the dosing unit. ■ Consult the troubleshooting in the operating instructions of the injector. ■ Perform maintenance on the vacuum unit.
Vent line takes in air constantly.	Membrane is torn.	Perform maintenance on the vacuum unit.
	In the safety valve, there is dirt, rubber hose piece is defective, or PVC pivot below the rubber hose piece is injured.	Perform maintenance on the vacuum unit.
Chlorine smell in the room.	The safety valve opens because the inlet valve does not close completely due to contamination.	Maintenance of the inlet valve. If necessary, install a chlorine gas filter.
	A leakage on the overpressure line	Locate and seal leaks using the ammonia test.
	The injector non-return valve has a leak and back-flowing water generates positive pressure in the vacuum line. The safety valve is activated.	Perform maintenance on the injector non-return valve.
PVC parts strongly attacked or liquid chlorine in the flow meter.	Chlorine gas condenses to liquid chlorine because the temperature in the inlet valve is lower than that in the chlorine barrel.	Mount the pressure reducing valve. Install the pipe heating directly in front of the inlet valve. Install the moisture eliminator.
	Condensed chlorine collects at the lowest point of the pipe system and enters the vacuum regulator.	Install the vacuum regulator at the highest point. Connect the inflow line at a constant uphill gradient.
Ice or too much condensation at the inlet valve or pressure line.	Chlorine withdrawal is too high.	Connect additional chlorine drums.
	Pressure loss at valves not fully opened causes strong cooling due to expansion	Open valves fully.
Water in the device.	The injector non-return valve has a leak.	Perform maintenance on the injector non-return valve. If necessary, install a second check valve.
Vibrations in the system.	The installation happens to be the resonant frequency of the vacuum regulator.	Adjust the pressure reducing valve or close a shut-off valve slightly before the vacuum regulator.

Table 15: Troubleshooting

13 Declaration of no objection

Please copy the declaration, stick it to the outside of the packaging and return it with the device.

Declaration of no objection

Please fill out a separate form for each appliance!

We forward the following device for repairs:

Device and device type: ..... Part-no.: .....

Order No.: ..... Date of delivery: .....

Reason for repair: .....

.....

.....

Dosing medium

Description: ..... Irritating: ☐ Yes ☐ No

Properties: ..... Corrosive: ☐ Yes ☐ No

We hereby certify, that the product has been cleaned thoroughly inside and outside before returning, that it is free from hazardous material (i.e. chemical, biological, toxic, flammable, and radioactive material) and that the lubricant has been drained.

If the manufacturer finds it necessary to carry out further cleaning work, we accept the charge will be made to us.

We assure that the aforementioned information is correct and complete and that the unit is dispatched according to the legal requirements.

Company / address: ..... Phone: .....

..... Fax: .....

..... Email: .....

Customer No.: ..... Contact person: .....

Date, Signature: .....

14 Warranty claim

Warranty claim

Please copy and send it back with the unit!

If the device breaks down within the period of warranty, please return it in a cleaned condition with the complete warranty claim.

Sender

Company: ..... Phone: ..... Date: .....

Address: .....

Contact person: .....

Manufacturer order no.: ..... Date of delivery: .....

Device type: ..... Serial number: .....

Nominal capacity / nominal pressure: .....

Description of fault: .....

.....

.....

.....

.....

.....

.....

.....

Service conditions of the device

Point of use / system designation: .....

.....

.....

Accessories used (suction line etc.): .....

.....

.....

.....

.....

Commissioning (date): .....

Duty period (approx. operating hours): .....

Please describe the specific installation and enclose a simple drawing or picture of the chemical feed system, showing materials of construction, diameters, lengths and heights of suction and discharge lines.

15 Index