

INSTRUCTION MANUAL FOR

**Installation and use of high  
capacity  
Vacuum regulator**

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## 1 GENERAL

Vacuum regulator (chlorinator) is designed for dosing gas chlorine into water and thus maintains its bacteriological purity. Chlorinators are applied in water disinfection, at locations where water has to be treated (drinking water-supply systems, waste water treatment plants, pools...)

- Chlorine gas dosing takes place via the **vacuum regulator** wall mounted and connected to several containers containing pressurized liquid chlorine or chlorine evaporator.
- Chlorine containers and vacuum regulators are installed at the chlorination station which can be protected by chlorine detector and neutralization system. (c.f. 10.1, 10.2, 10.3)
- When replacing the cylinder or container it is absolutely necessary to use a gas mask for protection. Access to the chlorine station is allowed only to a person qualified for work with dangerous materials. When handling gas cylinders or containers, attention must be paid to the following points:
  - gas container may be transported only with the safety lid screwed on.
  - gas containers must be, according to the safety regulations, protected against direct heat irradiation (even solar) and mechanic damage.
  - gas container must be equipped with wall holders for protection against falling.

## 2 THE CHLORINE GAS DOSING SYSTEM

### 2.1 Parts of the chlorine gas dosing system

- 1 **Vacuum regulator**
- 2 Rotameter (gas flow meter) with dosing valve
- 3 Chlorine gas filter (optional)
- 4 Pressure gauge
- 5 Vacuum gauge (optional)
- 6 Ejector

### 2.2 Dosing regulation

- The necessary dosing amount of chlorine depends on the water quality.
- The amount of chlorine gas dosage can be read on the measuring tube of the rotameter.
- The necessary dosing amount is determined after at least 4 tests of increasing the amount of chlorine to the presence of active free residual chlorine in water of 0.3 – 0.5 mg/l.

### 3 MOUNTING THE VACUUM REGULATOR

- Mount the vacuum regulator on the wall with proper screws which can carry the weight of the vacuum regulator
- Connect the chlorine gas inlet piping to the counter flange on the vacuum regulator
- Clean the outlet seat of booth flanges
- Fit the flanges with a new washer and screw the connection tightly.
- The WASHER must be replaced at EACH dismantling of the system.

**NOTE! Before mounting the chlorine gas inlet connection to the vacuum regulator make sure that the flange connections are clean in order not to damage the washer!**

### 4 STARTING UP

#### 4.1 Testing the vacuum regulator leakage

- The ejector operates , the chlorine gas inlet to the system is closed:
  - The ball rests at the bottom of the measuring tube – NO LEAKAGE.
  - The ball does NOT rest at the bottom of the flow meter.
    - a) The screw connection between the chlorine gas inlet and the system LEAKS.
    - b) The vacuum regulator LEAKS (Contact the producer Controlmatik ABW or an authorized service.)

#### 4.3.1 The system leaks

- First wet a piece of cloth with ammonia and hold it under the connection between the chlorine gas inlet connection and the system. In case of chlorine leakage there is a reaction to ammonia in shape of cigarette smoke. Therefore check if the nuts are screwed tightly (if necessary remove the vacuum regulator or chlorine gas filter and check the washer).

#### 4.3.2 No leakage in the system

- If the connection between the chlorine gas inlet and the system (chlorine gas filter and vacuum regulator) and vacuum regulator does not leak, dosing can begin.
- Open the chlorine gas inlet so the chlorine gas can go into the system.
- Switch on the ejector pump and set the desired amount on the measuring tube by means of the dosing valve.
- To read the amount of chlorine gases look on the middle of the float in the measuring tube.

## 5 DOSING REGULATION

- Depending on its bacteriological state water is being chlorinated continually in order to prevent infections. The dosing amount of chlorine gas depends on the quality of water.
- Regulation is carried out by means of a dosing valve on the flow meter -rotameter.

## 6 SWITCHING ON

- Check if the blocking elements of the water part are open and the pump for increasing pressure turns in the right direction. The pressure gauge on the booster pump must show the NECESSARY overpressure according to the pressure in the main pipeline. After removal of a vacuum tube from any of the vacuum side of the system in the chlorination station, vacuum has to be felt if one puts a finger on the tube inlet and there should be no doubt that the vacuum exists. Place the plastic tubes back onto the vacuum regulator. As the chlorine gas inlet to the system is still closed, the measuring tube must not show any sign of flow. If the ball rises a little, this means that there must be some leakage somewhere on the way from the chlorine inlet to the system and to the measuring tube. The leakage must be seen too.
- Using a cloth soaked up with ammonia check if chlorine leaks at the chlorine gas inlet, washer or vacuum regulator. In case of leakage there is smoke similar to that of a cigarette.
- To read the amount of chlorine gas look at the middle of the float in the measuring tube.

## 7 CHLORINE CYLINDER REPLACEMENT

- Close the CHLORINE GAS connection to the vacuum regulator.
- Wait until the vacuum regulator vacuum has sucked all the chlorine gas in the line. You can check this on the flow meter – rotameter when the float in the measuring tube has fallen to position zero.
- After about a minute the ball must still be in position zero (in case the float moves restlessly or if it has not fallen to position zero, it is possible that the inlet of chlorine gas has not been totally closed).
- After all the remaining chlorine gas has been sucked out and the float seats still on the zero position in the measuring tube the motive water for ejector can be closed.
- Unscrew the connecting nut between the chlorine gas inlet connection and chlorine gas filter.
- Remove the old washer, check and clean the surface of the flange and the chlorinator and put a new washer in. Screw the connection back.

- Quickly open and close the inlet of chlorine gas to the vacuum regulator. By means of ammonia check chlorine leakage.
- Open the chlorine gas inlet to the vacuum regulator
- Open motive water to the ejector.
- During the replacement use protection means or act according to the regulations for work with dangerous materials.

## 8 SWITCHING OFF

- Switch off the ejector booster pump.
- Close the chlorine gas inlet to the vacuum regulator.

## 9 SERVICE

The Controlmatik vacuum regulator will require minimum service if everything is mounted correctly.

### 9.1 Chlorine leak

There is a very few possibility of chlorine leak, but if a chlorine leak is detected, it should be immediately located and corrected. Immediate reaction increases safety and prevents corrosion on the equipment in the area. To detect leaks follow the procedure described in 4.2. (Start-up: check the **vacuum regulator**).

#### a) Chlorine Supply Valve

If leak exists at valve, try to close the valve. If it doesn't help, turn on the neutralization device of chlorine in the air and call the chlorine supplier.

#### b) Lead Gasket Seals

A leak at these points, first tightens the connections, but be careful, don't tighten them excessively.

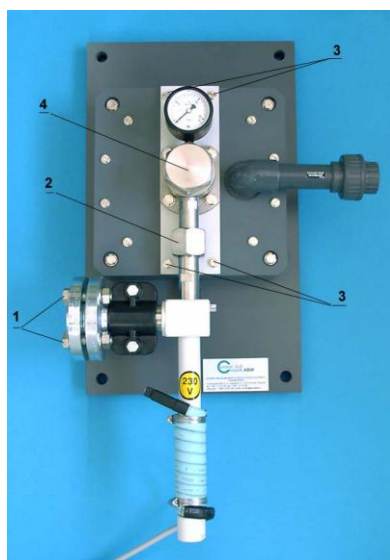
Each time you change the chlorine bottle or container, use new lead gaskets. Make certain the gaskets surfaces are clean, smooth, and have no mechanic injuries. All chlorine installation needs to be checked regularly and replaced if necessary.

#### c) Chlorine leaking out of the vent line

This is usually an indication of dirt on the inlet valve of the **vacuum regulator**. To make certain if the problem is a leak at the inlet valve, follow these steps:

- (1) Shut off water supply to ejector.
- (2) Submerge the end of the vent tubing in a glass of water. Continuous bubbling is an indication of a chlorine leak.
- (3) To disassemble the **vacuum regulator**, first close the chlorine gas supply valve. Turn on the water supply to ejector and allow the **vacuum regulator** to operate until the chlorine flow indicator on the rotameter (gas flow meter) drops to the bottom of the measuring tube. Keep systems operating for a few minutes until all chlorine gas remaining in the system is removed

Refer to the part to the photo and go through the following procedures to clean or service the **vacuum regulator**:





- a) Remove the four screws on the flange (pos 1)
- b) Unscrew the nut (pos 2)
- c) Remove the 4 screws from the assembly yoke plate (pos 3)
- d) Separate the metal plate from the back panel and remove it from the unit.
- e) To disassemble the inlet valve housing remove the filter cap (pos 4) and then remove the secondary inlet filter. Insert appropriate screwdriver in the inlet to hold the inlet valve plug in the seat. Unscrew the vent screw. The inlet valve plug, spring retainer, spring and vent plug may now be removed. Unscrew the adapter and remove the valve seat.
- f) Examine and clean the PTFE valve seat and the inlet valve plug. NEVER use a sharp tool; a piece of clean cloth should suffice. Sometimes a varnish appearing substance forms on the valve plug. This can be removed with acetone or alcohol.
- g) Assemble the unit in the reverse order making certain that that spring and plug of the inlet valve are aligned. Screw the adapter hand tight ONLY. An excessive seal of "O" ring seal can cause damage. Make certain that all "O" rings are placed in their respective places. If the device has been operating during a long period, it is necessary to replace all the gaskets.

## 9.2 Flooded Vacuum regulator

In case that dirt becomes lodged on the non-return valve seat to ejector or on the vacuum entrance point to the cabinet, water may back up into the various components of the vacuum regulator, when the system is not operating.

In such case do the following:

- a) Close water supply to ejector and clean a non-return valve on the ejector. Change the gasket!
- b) If there is a cabinet between ejector and vacuum regulator than unscrew the union connection on the vacuum line at the entrance point to the cabinet, take apart the non-return valve, clean it and change the gaskets if necessary.
- c) To clean the rotameter (self standing or inside the cabinet) unscrew the union connection on the bottom side of union to drain system. Unscrew the metering tube, take it from the seat and carefully remove the float and clean the tube with a clean soft swab until dry. Unscrew the union at the entrance point to differential regulator to let the water out.
- d) Unscrew the union connection on the vacuum regulator and let the water run out.
- e) Let the water to the ejector and check if it leaks. Tighten again all the connections on the vacuum line hand tight only and replace the metering tube to rotameter.
- f) Open water supply valve to ejector and make certain there is enough vacuum (use your hand).

- g) Connect the vacuum line to ejector and open the chlorine supply valve. The operation of the system will eliminate any moisture that has been trapped.

## 10 ARRANGEMENT AND PROTECTION OF THE CHLORINATION STATION

### 10.1 General

- 1) Chlorine gas in steel cylinders is used for chlorine dosing. Chlorine cylinders/containers and vacuum regulators must be kept in a special room (chlorination station).
- 2) On the outside of the chlorination station there is a cabinet for the protective mask and gloves.
- 3) Before entering the chlorination station the ventilator must be turned on.
- 4) The room should be equipped with an indicator of free chlorine in the air connected to the alarm device which gives the staff the alarm about possible defects on the cylinders or the dosing device.
- 5) The floor in the chlorination station must be declined towards the sewage outlet or the neutralization pit.

### 10.2 Chlorine neutralization pit

- 1) It is filled with the  $\text{Ca}(\text{OH})_2$  solution – ( a solution of lime and water at a ratio of 1 to 1).
- 2) The pit dimensions depend on the number of the cylinders in the chlorination station. The required depth is at least 70cm from the upper level of the solution.
- 3) The damaged cylinders heavily leaking chlorine must be immersed in the neutralization solution to protect the surroundings.

### 10.3 Neutralizing chlorine via the ejector

- 1) The indicator of chlorine gas (probe) or the manual switch-on activates the neutralization system.
- 2) The ejector pump is activated to get sufficient vacuum for sucking chlorine from the storage room.
- 3) The pump propels the reductive which neutralizes all the absorbed chlorine.

The constituent parts of the neutralization system are:

- Tank
- Centrifugal pump
- Vacuum ejector
- Chemicals

Automatic operation beside the above mentioned parts requires also the following:

- Chlorine gas detector.

- Equipment for determining the concentration of the reductive in the tank.
- Device for checking the acidity or alkalinity of solutions (pH – meter).
- Equipment for determining residual chlorine.

## 11 PROTECTION AT WORK

- 1) Chlorine gas is toxic, 2.5 times heavier than the air and aggressive in a humid atmosphere. In a small concentration chlorine is not dangerous and only irritates the mucous membrane.
- 2) At a higher concentration hydrochloric and hypo-chloric acids develop on moist mucous membranes, which injure their tissues and causes spasmodic bursts of cough. Continuous inhalation of a higher concentration may cause edema of the lungs and consequently death.
- 3) Chlorine also affects the central nervous system so much that it paralyzes it.
- 4) The MDK value is 1 ppm (the maximal allowed concentration of chlorine at the workplace is 3mg in 1 m<sup>3</sup> of the air or 1 cm<sup>3</sup> in 1 m<sup>3</sup> of the air.)

<b>Physiological effects in relation to the concentration of chlorine in the air</b>	
<b>Concentration of chlorine in the air in ppm (cm<sup>3</sup> / m<sup>3</sup>)</b>	<b>Effect on the surroundings</b>
0,02 - 0,05	Limit at which chlorine is felt its odor.
0,10	Limit value at long-time inhalation.
1,00	Maximal allowed concentration at the workplace.
3,00	Heavy irritation. Work at such concentration is highly aggravated.
5,00	Maximal dose for a momentary action.
20,00	Concentration dangerous to life when inhaling over 30 min.
50,00	Death takes place at 30 - 60 min inhalation.

## 11.1 Personal protection means

- 1) The best way to prevent accidents is professional staff instruction (handling chlorine devices, dangers at work). Access to the chlorine station is allowed only to people running it.
- 2) Before the entrance to the station there must be the protection equipment. The protective mask must be carefully stored and often checked.
- 3) For protection against inhaling chlorine the protective mask with »B« filter (a filter against acidic gases) must be used.
- 4) Protection means:
  - Protective mask
  - Rubber gloves
  - Protective goggles
  - Apron

## 12 FIRST AID

If despite all protection steps injuries occur, the injured person must be given first aid.

- 1) The injured person is taken from the contaminated room to the fresh air or warm place to lie still.
- 2) The person should lie on the back with the head and the upper part of the body slightly lifted.
- 3) The person should on no condition be given artificial respiration.
- 4) Call for the doctor at once.
- 5) If the person's clothes are soaked up with chlorine, they should be immediately taken off. Cover the injured person with blankets.
- 6) If the eyes are injured, it is necessary to bathe them with a lot of water.
- 7) The injured person may not consume any alcohol, but may drink coffee or milk to palliate throat irritation.

## 13 TROUBLESHOOTING

### PROBLEMS AND SOLUTIONS

PROBLEM TYPE	POSSIBLE REASONS FOR THE PROBLEM	PROBLEM SOLUTION
Rotameter shows zero or not enough	Chlorine container is empty (pressure gauge control - pressure is to low)	Change the container.
	The chlorine container valve is closed.	Open the chlorine container valve
	The chlorine supply pipe is bended or plugged.	Close the chlorine container valve and empty the chlorine pipe line with vacuum. Close the water supply to ejector. Disassemble the damaged chlorine line and change it.
	The inlet valve filter is plugged. Vacuum gauge shows strong vacuum in spite of small amount of chlorine on the rotameter.	Clean or change the filter.
	Water pressure on ejector is to low.	Compare ejectors (Q-H) diagram to the diagram of the pump to start-up the ejector. Back pressure may be too high.
	Pressure on the dirt catcher by water supply to ejector drops too much.	Disassemble and clean the dirt catcher.
	Diffuser is plugged because of mechanical pieces or carbonate sediments.	Disassemble the ejector and wash the throat with some droplets of hydrochloric acid. Wash out with clean water. Adjust the water flow through ejector to minimum, in order to dose maximum amount of chlorine necessary.
	Pipe for hypochlorite acid supply to the point of injection is plugged.	Disconnect and wash up the inlet pipe and check if the valve is entirely opened.
	The back pressure is too high for bended or plugged pipes of the chlorine solution. Pressure in pipelines and fittings drops too much.	The pipes should have elbows of appropriate sizes. Check if there has come to any movement or plugging by sticking them to the pipes. This can be the cause of insufficient water flow.
	Flow indicator in rotameter is stuck because of mechanical filth.	Rotameter needs to be cleaned - see the instruction manual.
	Fittings under vacuum suck the outside atmosphere.	Check the rotameter and tighten connections on rotameter and on entire vacuum line if necessary.
	In spite of opening the dosing valve the dosage is not increasing.	The inlet valve is stained.
Ejector does not create enough vacuum.		Water supply to ejector is plugged.

PROBLEM TYPE	POSSIBLE REASONS FOR THE PROBLEM	PROBLEM SOLUTION
	Flow indicator in rotameter is stuck.	Clean the rotameter- look Instruction manual.
Smell of chlorine is detected in the room.	Under or over tight connections, or incorrect installation.	Close the chlorine container valve immediately and empty the chlorine installations with ejector. Check the chlorine installations as described in Instruction manual under Start-up.
	Safety valve is leaking. Inlet valve is dirty or damaged.	Clean the inlet valve.
Vent valve sucks air with the ejector operating.	Diaphragm is torn or does not seal well.	Disassemble the vacuum regulator, carefully check all the parts and re-assemble it with precision.
Flooded chlorinator	Damaged non-return valve in the ejector.	Disassemble a non-return valve, clean it and change the damaged parts.
Liquefied chlorine in the chlorinator, yellow stains on rotameter glass, damage on gaskets and plastic.	Temperature difference between the chlorinator room and chlorine container room is too big.	Rise a temperature in the chlorinator room; build a heater in a chlorine trap.
Freezing up	Too much chlorine is taken from one container.	Connect an additional chlorine container.

- 1) All rights for technical changes reserved.
- 2) Service and installation is carried out by **Controlmatik ABW** or an authorized service.