INSTRUCTION MANUAL FOR

Installation and use of the M 20 series Vacuum Regulator and Ejector Capacity up to 10kg/h

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1 GENERAL

- Chlorine gas supply takes place via the vacuum regulator which can be direct Chlorine cylinder mounted or gas header mounted for multiple cylinder connections and the remote mounted ejector check valve assembly.
- Chlorine cylinders and vacuum regulators are normally installed in the secure cylinder room which can be protected by Chlorine gas detection, emergency shutdown or gas scrubber systems. (refer to sections 10.1, 10.2, 10.3)

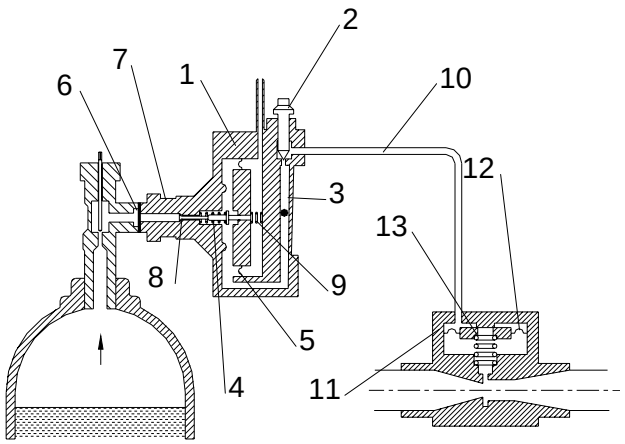
NOTE: When replacing the Chlorine cylinders it is necessary to use compressed air breathing apparatus or at the very least an emergency escape mask with canister type filter. Access to the Chlorine station should only be allowed only to a suitably trained and qualified person. When handling Chlorine cylinders, attention must be paid to the following:

- cylinders may only be transported only with the safety protection cap screwed onto the cylinder valve.
- cylinders are not to be stored or left in direct sun light and protected from mechanical damage.
- cylinders must have a clamping arrangement for securing them against falling or theft.

2 THE M20RC CHLORINE GAS DOSING SYSTEM

2.1 Individual parts for the Chlorine gas dosing system are:

1 Vacuum regulator
2 Rate valve
3 Flow meter
4 Inlet spring
5 Diaphragm
6 Lead washer
7 Yoke adapter
8 Inlet valve
9 Vent spring
10 Vacuum line
11 Ejector body
12 Ejector diaphragm
13 Ejector check (non-return) valve



Picture 1 Parts for the Chlorine gas dosing system.

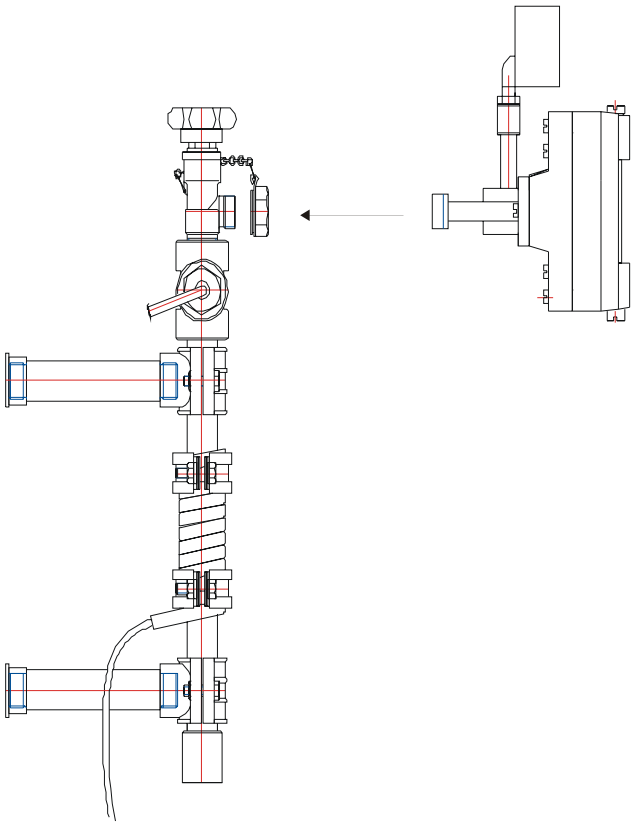
2.2 Gas feed regulation via rate valve and flowmeter

- The required feed of Chlorine gas depends upon the water quality.
- The amount of chlorine gas feed can be seen via the flowmeter.
- The necessary residual may be measured each time by repeated DPD tests and increasing the Chlorine gas flow rate. Typical 'Free Chlorine' in water residual levels are 0.3 – 0.5 mg/l.

3 INSTALLATION OF THE CHLORINE GAS DOSING SYSTEM

3.1 Mounting the Vacuum Regulator

- Remove the cylinder valve safety protection cap.
- Unscrew the safety nut on the valve outlet.
- Clean the outlet seat of the cylinder or container valve.
- If manifold mounted remove all old lead washers and clean all the valve seats and replace with new lead washer(s).
- Fit the yoke inlet valve of the vacuum regulator with a new lead washer.
- The LEAD WASHER must be replaced when EACH cylinder or tonne drum is changed.
- Before mounting the vacuum regulator make sure that the cylinder, tonne drum or manifold valves nuts and threads are compatible in order not to damage the lead washer and provide a good seal.



3.2 Mounting the Ejector

- The ejector operates only when there is sufficient water flow and pressure available to create a vacuum (correct choice of the motive water booster pump).
- The ejector can be mounted in all positions onto the water main (usually vertically or horizontally).
- When horizontal mounting make sure the vacuum connection is on the upper side of the ejector body.
- The motive water and Chlorine solution connections are carried out with a rubber hose or rigid UPVC (Schedule 80 or Class ‘E’) pipework.

4 START UP

4.1 Testing the Ejector

For the vacuum regulator to function correctly the ejector has to generate sufficient vacuum, hence the ejector is tested first, as follows:

- Remove the vacuum tube if connected to the ejector.
- Open any valves in the motive water and Chlorine solution lines.
- Switch on the motive water booster pump.
- Check the generated vacuum via a vacuum gauge connected to the ejector vacuum line (at least minus 0,3 bar).
- If satisfactory connect the vacuum tube back to the ejector.

4.2 If the Ejector generates too little vacuum

- The ejector nozzle may be blocked.
- The ejector motive water or vacuum lines may not be properly connected.
- The motive water booster pump is wrongly sized.

4.3 Testing the Vacuum Regulator for vacuum integrity

- The ejector is started, and the cylinder valve is closed.
- a) The ball rests at the bottom of the measuring tube – NO FLOW. Therefore vacuum integrity.
  b) The ball does N0T rest at the bottom of the flow meter:
  - The Chlorine cylinder valve LEAKS.
  - The vacuum regulator has not got vacuum integrity. (Contact the manufacturer Controlmatic Ltd or an authorised dealer.)

4.3.1 Connection to the Chlorine cylinder leak test

- Wet cotton wool with Ammonia solution in a puffer bottle and force Ammonia fumes slowly around the cylinder valve joint. Any Chlorine leaking will react with the Ammonia to give thick White Ammonium Chloride fumes. In this case check that the vacuum regulator nut is screwed tightly, (if necessary remove the vacuum regulator and check/replace the lead washer).

4.3.2 System working correctly

If the connection between the cylinder and vacuum regulator does not leak, dosing can begin.

a. Open the cylinder valve half a turn.
b. Switch on the ejector pump and set the desired amount on the gas flow meter by means of the rate valve.
c. To read the amount of chlorine gas being dosed read the centre of the ball in the flowmeter tube.

5 DOSING CONTINUITY

- To maintain bacteriological quality water has to be continuously chlorinated in order to prevent disease. The amount of Chlorine gas being dosed depends on the quality of the water.
- Regulation is carried out by means of a rate valve on the flow meter.

5.1 The MR21C Chlorination system

Consists of:

- Two vacuum regulators which are to be mounted on two Chlorine cylinders.
- A mechanical switch-over device that automatically switches from an empty Chlorine cylinder to a full one.
- Common Chlorine gas flow meter with rate valve.
- Common Ejector check valve assembly.
- 30 m of vacuum tube.

6 SWITCHING ON

- Check that the valves in the motive water and Chlorine solution lines are open and water is being pumped in the correct direction. The pump outlet pressure gauge must show the NECESSARY overpressure according to the pressure in the main pipeline at the point of application for the ejector to function. Remove the vacuum tube from each of the vacuum regulators. Vacuum can be felt by putting a finger on the vacuum tube. This will cause the automatic switchover to operate and change to the standby vacuum line. On opening the first tube and closing the second

the switch-over has to return to the original position. Thus the automatic switch-over has been tested and it has also been checked that the ejector generates sufficient vacuum.

- Place the vacuum tubes back onto their vacuum regulators. As the cylinder valves are 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 air ingress somewhere from the cylinder valve to the flow meter. This must be attended to as in 4.3 b).
- Open both chlorine cylinder valves and check if both vacuum regulators are functioning. If necessary turn the »reset« knob.
- Wet cotton wool with Ammonia solution in a puffer bottle and force Ammonia fumes slowly around the cylinder valve joint. Any Chlorine leaking will react with the Ammonia to give thick White Ammonium Chloride fumes. In this case check that the vacuum regulator nut is screwed tightly, (if necessary remove the vacuum regulator and check/replace the lead washer).
- To read the amount of Chlorine gas feed see the middle of the ball in the flow meter tube.

7 CHLORINE CYLINDER REPLACEMENT

- During Chlorine cylinder replacement use the required Personal Protective Equipment (PPE) according to the recognised Method Statement and Risk Assessment.
- Close the cylinder valve clockwise.
- Wait until the ball in the flow meter tube falls to zero.
- After about a minute the ball must still be in the zero position (in the case of the ball moving or if it has not fallen to zero, it is possible that the cylinder valve has not been fully closed and chlorine is still flowing).
- Once gas flow has ceased unscrew the connecting nut between the cylinder valve and vacuum regulator and remove the vacuum regulator to a safe position.
- Replace the chlorine cylinder.
- Remove the old lead washer, check and clean the mating surface of the cylinder valve and the chlorinator and put a new lead washer in. Screw the vacuum regulator onto the new cylinder valve.
- Quickly open and close the cylinder valve. By means of ammonia puffer bottle check for chlorine leakage. In case of leakage attempt to tighten the connecting nut and retest until leak free.
- Open the cylinder valve for approximately 1 to 2 turns.
- Connect the vacuum regulator vacuum line to the ejector.
- If the Chlorine cylinder valve cannot be opened by hand normally, warm it up with boiling water over a cloth wrapped around the Chlorine cylinder valve. Wait 1 – 2 minutes and try to open the valve again. Never use a naked flame on the cylinder valve.
- During Chlorine cylinder replacement use the required Personal Protective Equipment (PPE) according to the recognised Method Statement and Risk Assessment.

8 SWITCHING OFF

- Close all the valves in the right order :
- First close the cylinder valves or tonne container valves
- Close all the isolating valves
- Close all the header valve
- Switch off the ejector pump.

NOTE !
First close all the chlorine gas valves and then do not switch off the motive water booster pump in order to allow the ejector to empty the vacuum line.

9 MAINTENANCE AND FAULT FINDING

9.1 Chlorine leakage

This occurs very rarely. But if it does, quick steps must be taken as chlorine gas is toxic and aggressive. The leakage point can be discovered by wetting cotton wool with Ammonia solution in a puffer bottle and force Ammonia fumes slowly around the cylinder valve joint. Any Chlorine leaking will react with the Ammonia to give thick White Ammonium Chloride fumes.

- **The cylinder valve leaks**
  - Chlorine cylinder valves must be tested by the Chlorine chemical supplier.
  - In case of valve leakage the cylinder must be fitted with a safety lid and the chemical supplier informed.
- **The screw connection between the vacuum regulator and the cylinder valve leaks.**
  - Replace the washer and clean the seat of the threaded connection on the cylinder and the regulator nut (not to be screwed too tightly).

- **The vacuum regulator inlet valve leaks.**
  If chlorine comes out at the vent connection (VENT TO OUTSIDE), this indicates chlorine leakage at the vacuum regulator inlet valve. The reason in most cases is dirt on the seat of the inlet valve. To find this out make the following test:
  - Switch off the ejector pump.
  - Locate the outlet of the vent pipe (VENT TO OUTSIDE) Wet cotton wool with Ammonia solution in a puffer bottle and force Ammonia fumes slowly around the cylinder valve joint. Any Chlorine leaking will react with the Ammonia to give thick White Ammonium Chloride fumes. Send the vacuum regulator for a service.

9.2 Water in the flow meter

- Check the check valve and the ejector diaphragm. Service all parts that have been contaminated with water.

10 HEALTH & SAFETY IN THE CHLORINE STORAGE AREA

10.1 General

- Chlorine liquid in cylinders or drums is used for chlorine dosing. Chlorine cylinders or drums with vacuum regulators must be kept in a specific storage room.
- On the outside of this room should be a cabinet for the Personal Protective Equipment (PPE).
- Before entering the Chlorine storage area the ventilation system must be switched on.
- The Chlorine storage area should be equipped with a gas detection system interlocked to audible and visual alarms as well as an emergency shutdown device or gas scrubber system.
- All ducts into and out of this area are to be sealed.
-

11 PROTECTION AT WORK

- 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.
- At a higher concentration Hydrochloric and Hypochlorous acids develop on moist mucous membranes, which injure their tissues and causes spasmodic bursts of coughing and breathing difficulties. Continuous inhalation of a higher concentration may cause oedema of the lungs and consequently death.
- Chlorine can also affect the central nervous system so much that it causes paralysis.
- The maximum allowable concentration of chlorine at the workplace is 1mg.

Physiological effects in relation to the concentration of chlorine in the air	
Concentration of chlorine in the air in ppm (cm^3 / m^3)	**Effect on the surroundings**
0.02 – 0.05	Limit at which chlorine is detected as an odour.
0.10	Long term inhalation limited value.

1.00	Maximal allowable concentration in the workplace.
3.00	Heavy irritation. Work at such concentration extremely difficult and uncomfortable.
5.00	Maximal concentration before immediate exit from area.
20.00	This concentration endangers life when inhaled for over 30 minutes.
50.00	Death takes place at 30 - 60 minutes of inhalation.
100.00	Instantaneous death.

11.1 Personal protection means

- The optimum way to prevent accidents is using professional trained Engineers who have had specific training for handling chlorine equipment, and related Health & Safety guidelines. Access to the chlorine storage area should only be allowed to trained staff.
- Before the entering the storage area Personal Protective Equipment to be tested and worn.
- Protective devices:
  - Positive pressure breathing apparatus
  - Face mask with Filter ‘B’ protection
  - Rubber gloves
  - Protective goggles
  - Chemical suit

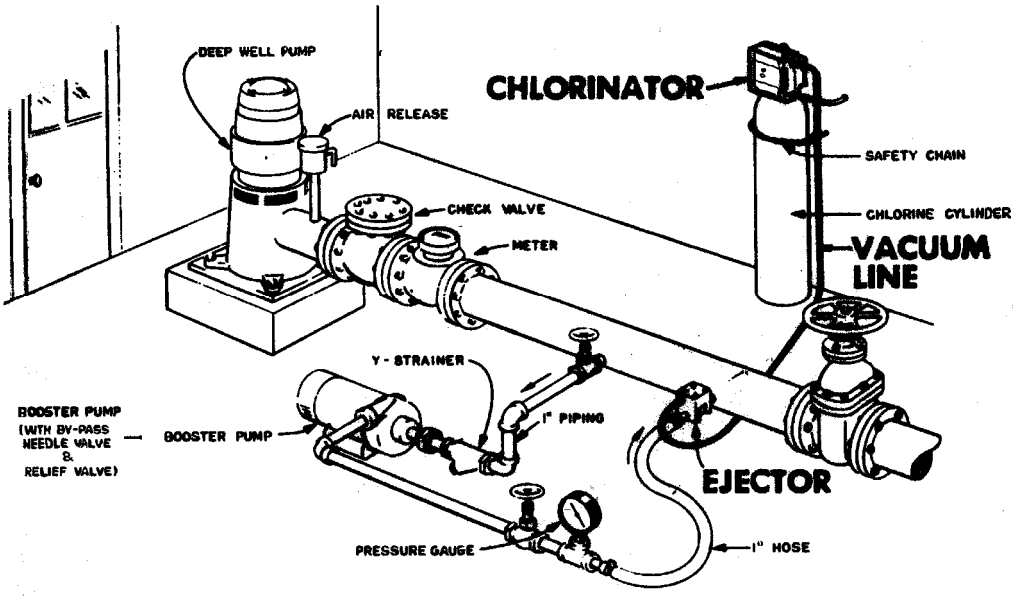
12 FIRST AID

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

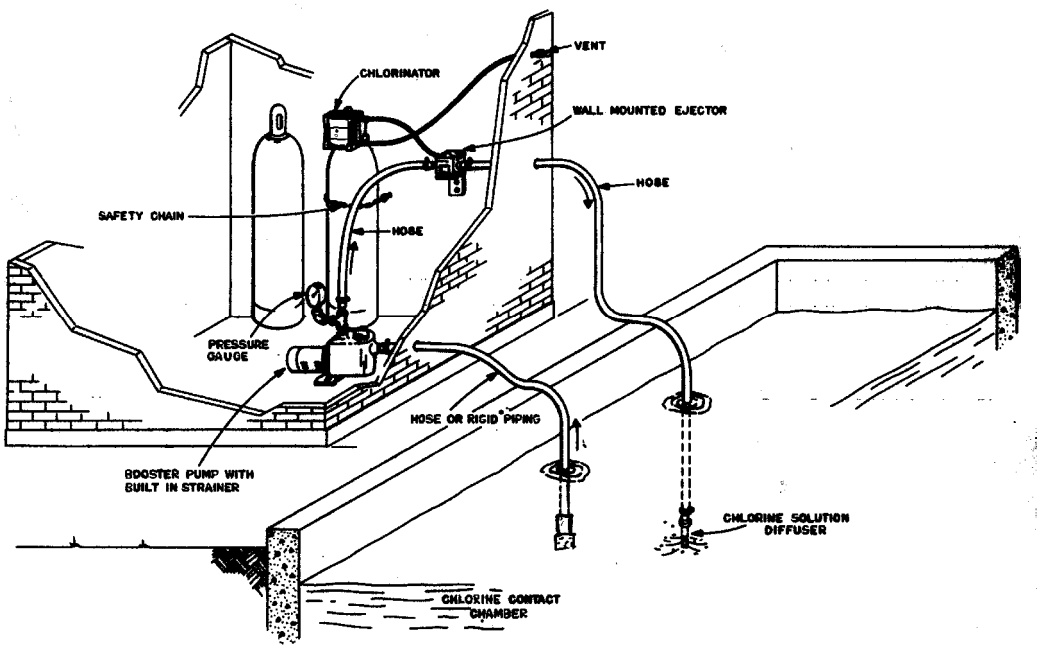
- The injured person is taken from the contaminated area to the outside with fresh air and a warm place to lie still.
- The person should lie on the back with the head and the upper part of the body slightly lifted.
- The person should on not be given mouth to mouth resuscitation.
- Oxygen may be administered.
- Call for the Emergency Services at once.
- If the person's clothes are soaked with chlorine, they should be immediately taken off. Cover the injured person with blankets.

- If the eyes are injured, it is necessary to bathe them with a lot of fresh water.
- The injured person may consume milk to palliate throat irritation.

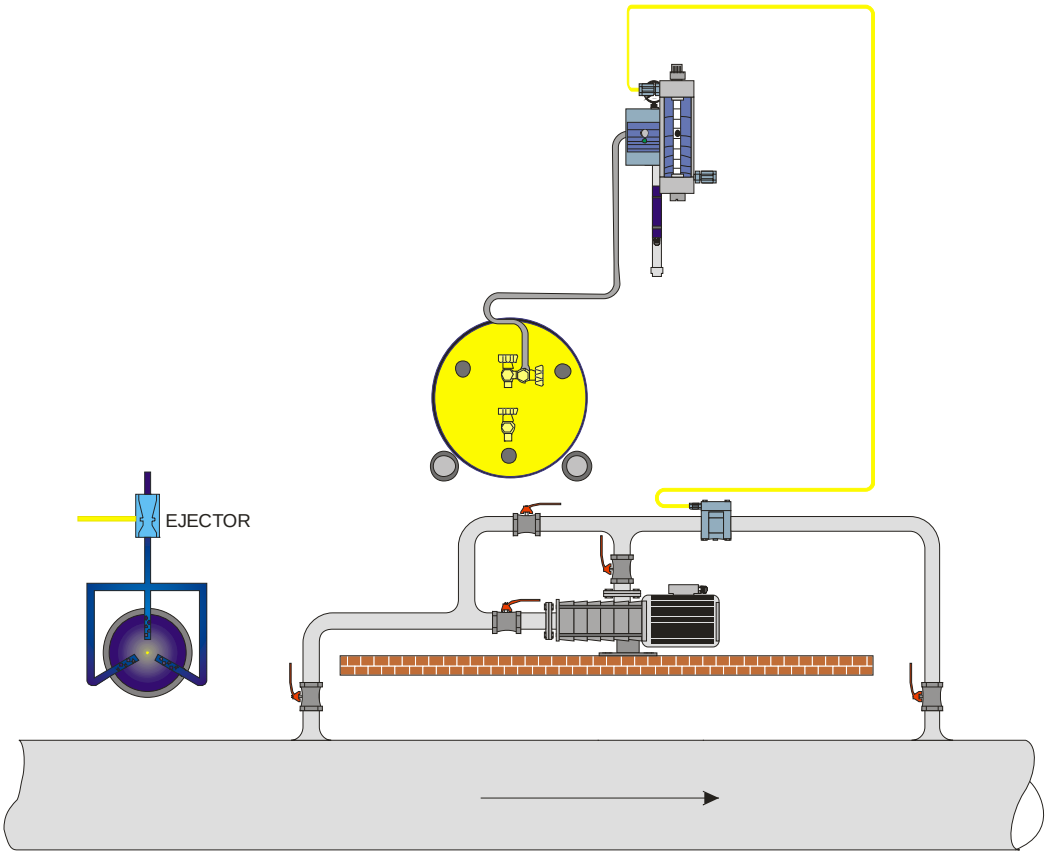
13 TYPICAL INSTALLATIONS



Vacuum regulator and ejector typical simple installation – main pipe dosing point



Vacuum regulator and ejector typical simple installation – reservoir dosing point



Vacuum regulator and ejector M 20 RC/9 capacity 10 Kg/hr – manifold mounted drum installation

Note:

- *All rights for technical changes reserved.*
- *Service and installation is carried out by **Controlmatik ABW** or an authorised dealer.*