TOSHCON JESCO

OPERATION & MAINTENANCE MANUAL

VACUUM CHLORINATOR

MODEL TJ-C2211+

SOLD & SERVICED BY :

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Purpose of full-vacuum chlorinators

Chlorine gas is important for the disinfection of potable and swimming pool water but also represents a source of danger as far as handling, transportation and storage are concerned. Therefore the vacuum principle has been used in chlorination installations already for decades. According to this principle, the pressure of the chlorine gas is reduced to vacuum, and only then, if the vacuum is sufficient, will chlorine gas flow to the metering point.
The main safety aspect is that the escape of chlorine gas is actually avoided. Even in the case of a line rupture chlorine gas cannot escape but only ambient air can be primed.

Full-vacuum chlorinator TJ-C2211+

The full-vacuum chlorinator used as pressure reducing valve is of central importance for the safety in vacuum installations. For this reason the TJ-C2211+ version has been designed in accordance with the latest findings. The device combines several functions in one housing:
(all numbers in brackets refers to the schematic diagram on the following page)

a) Vacuum regulation

In the initial position the ball (1) rests on the valve seat (2). It is pressed onto the seat by the locking spring (3) and the chlorine cylinder pressure and closes the system. After switching on the ejector (water-jet pump), a vacuum is generated. The vacuum applies a force to the working diaphragm (7) of the full-vacuum chlorinator, which is directed to the right. This force is transferred to the valve ball (1) by the valve rod (8) so that chlorine gas enters the vacuum system. If the vacuum breaks down, the valve ball falls back immediately onto the valve seat and stops the chlorine gas supply.

b) Simultaneous delivery

The constant volume of chlorine gas delivered per hour from one chlorine cylinder must not exceed 1 % of the original contents. Consequently the maximum rate for e.g. a 65 kg cylinder is 650 g Cl_2/h.
In most application, chlorine delivery from one cylinder is not sufficient because much more chlorine is required than 650 g Cl_2/h. In these cases, chlorine is supplied simultaneously from several cylinders in so-called battery operation.
In order to make sure that the cylinders are emptied uniformly, all full-vacuum chlorinators must start working at the same vacuum. For this purpose JESCO TJ-C2211+ chlorinators are fitted with an opening pressure adjusting device. The adjusting screw (4) is used to set the effect of forces between springs (9) and (3). As a result, it is ensured that the opening pressure is the same for all chlorinators and that the chlorine gas is delivered almost simultaneously from all connected cylinders.
Simultaneously delivery works with rate of approximately 200 g/h and more. In order not to remain under this rate, make sure that the number of connected cylinders is not larger than necessary.

c) Flow limiter

If some cylinders of a battery are already emptied and the full metering capacity is required, the delivery rate of the partly filled cylinders becomes inadmissibly high, thus causing icing of the cylinders. To avoid this, a flow limiter (11) is integrated in the vacuum connection, which allows a maximum delivery rate of approx. 1000 g/h.
If the full-vacuum chlorinator is mounted on chlorine barrels or in the case of sufficient chlorine supply from other sources, the device enables rates of up to 10 kg/h. For this purpose, the flow limiter can easily be removed.
(As a standard the flow limiter is an integrated part of the delivery).

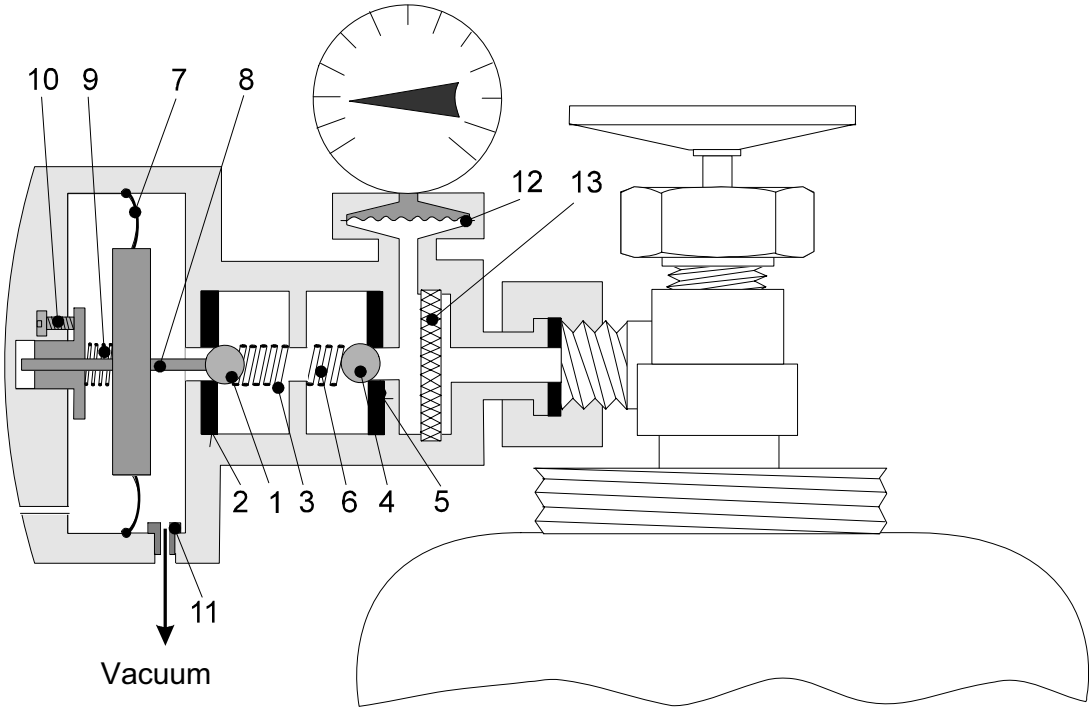
d) Residual pressure preservation

While emptying the chlorine cylinder, the cylinder pressure decreases until it is too low to remove the ball (4) against the spring (6) from the valve seat (5). A residual pressure of approx. 0.1 bar remains in the cylinder.
Thus humidity cannot enter the cylinder during replacement. The humidity of the entering air would cause the chlorine cylinder to corrode internally so that the chlorine gas could be contaminated. Consequently, the residual pressure preservation helps to extend the operational life of the chlorine cylinder.

e) Pressure gauge

The TJ-C 2211+ chlorinator is equipped with a pressure gauge for the indication of the cylinder pressure. The gauge is protected by a silicone-diaphragm separator transmitting the pressure harmlessly, and has a hydraulically coupled, splash-proof measuring element in a plastic housing. The separating diaphragm (12) is coated with a silver film as a protection against the chlorine gas. In order not to damage it by dirt particles the chlorine gas is directed through an integrated filter (13) before reaching the pressure gauge.
The measuring range of the pressure gauge is -1...0...15 bar so that also the residual pressure preservation function can be controlled.

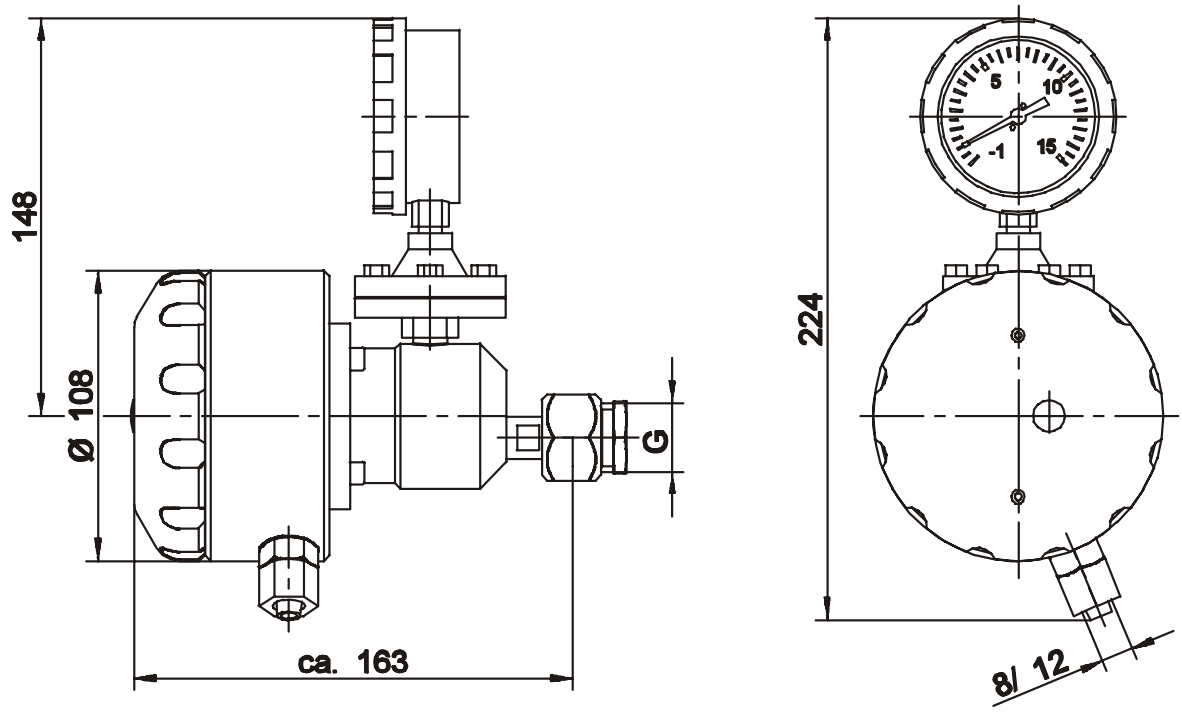
Schematic diagram of the full-vacuum chlorinator TJ-C2211+



Technical data of the full-vacuum chlorinator

Materials	chlorine-resistant such as nickel-plated brass, Hastelloy, PVC, Viton
Max. capacity	
with flow limiter	approx. 1 kg/h
without flow limiter	10 kg/h
Operating vacuum	80 mbar (for 200 g/h)
Weight	2200 g
Pressure stage	PN16
Pressure connection	union nut W1", G5/8, G3/4
Metering connection	PE tubing d 8/12

Dimensions TJ-C2211+



Full-vacuum chlorinator TJ-C2211+

Union nut W 1"	Part No. 20401100
Union nut G 5/8	Part No. 20401101
Union nut G 3/4	Part No. 20401102

Tubing / Accessories

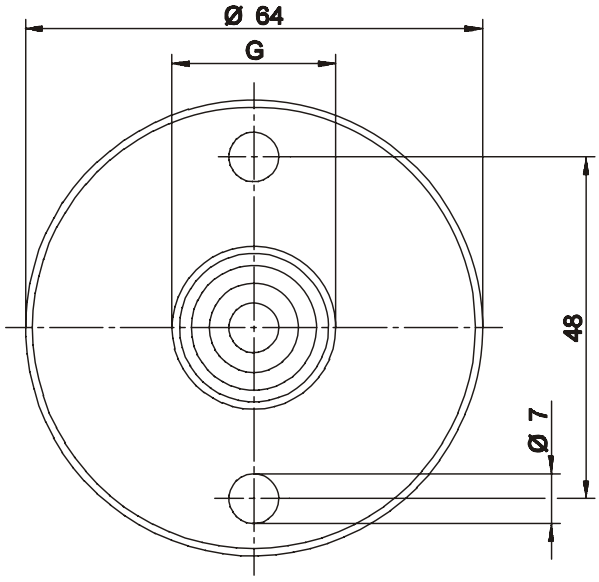
PE d 8/12	Part No. 97124
PVC d 8/12	Part No. 97561
PE d 12/16	Part No. 97176
Ammonia bottle (30ml)	Part No. 13513
Accessories kit (5m PE tubing, mounting brackets, ammonia)	Part No. 22412
Fork wrench SW32	Part No. 15901

Wall holder

Two different wall holders are available:
A PVC wall holder is used to receive the chlorinator while cylinder is exchanged and closes the pressure connection at the same time. Thus the entry of humid air is avoided effectively also during replacement of the cylinder.

A steel wall holder (see MB 2 23 03) is used as a permanent connection unit. The chlorinator is mounted onto the wall holder and supplied simultaneously from several chlorine cylinders via a manifold. Thus it is possible to meter large quantites with just one chlorinator.

Dimensions and Part Nos.



PVC wall holders for TJ-C2211+

Threaded pin W 1"	Part No. 28380
Threaded pin G 5/8	Part No. 29752
Threaded pin G 3/4	Part No. 28360

(Delivery incl. mounting material)

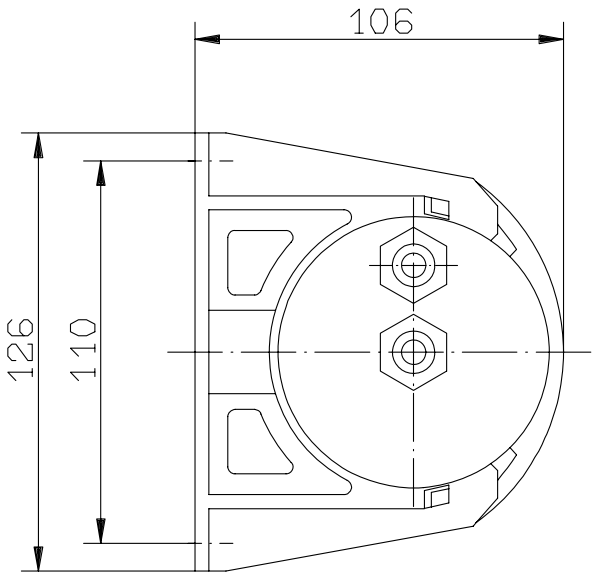
Safety valve

If the inlet valve of the vacuum chlorinator does not close completely due to impurities, it is possible that an excessive pressure develops in the vacuum piping system which causes undesired chlorination. To avoid this, the safety valve is used. It opens at the lowest excessive pressure and discharges the piping system. The end of the blowdown pipe is run near the gas sensor. Thus an immediate alarm signaling is ensured.

Technical data

Materials:	PVC, Viton, Hastelloy
Opening pressure:	20 mbar
Connection:	PE tubing d 8/12
Weight:	350 g

Dimensions and Part No.



Safety valve Part No. 32843
(Delivery incl. mounting material)

Activated-carbon cartridge

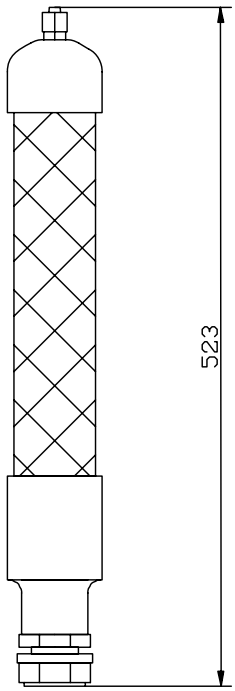
In almost any installation incl. vacuum systems, temporary shock pressures may occur, which cause the extremely sensitive safety valve to respond briefly so that gas warning device is activated.
In order to make sure that only a "real" dangerous situation is indicated by the gas warning device, an activated-carbon cartridge is integrated in the blowdown pipe, thus avoiding faulty alarms. Only if larger amounts of chlorine escape will an alarm be reported.

Technical data

Material:	PVC
Contents:	1.2 l
Connection:	PE tubing d 8/12
Weight:	1200g

Note:
It is sensible to use a transparent PVC tubing as the connecting line to the activated-carbon cartridge instead of the standard PE tubing. As soon as the PVC tubing gets in contact with chlorine it changes from transparent to milky green. In the case of a chlorine outbreak, the point of leakage can thus be noticed at a glance.

Dimensions and Part No.



Activated-carbon cartridge Part No. 12032301
(Delivery incl. mounting material)

Measuring glass holder

The measuring glass holder combines two functions: It monitors and adjusts the chlorine glas flow. Flow meters with maximum rates of 25...4,000 g Cl_2/h are available. The chlorine gas flow is adjusted using the needle valve of the measuring glass holder.
The measuring glass holder is fixed anywhere in line between the full-vacuum chlorinator and the ejector non-return valve. Twofold or threefold measuring glass holders, which allow to distribute the chlorine gas flow to several metering points, are also available.

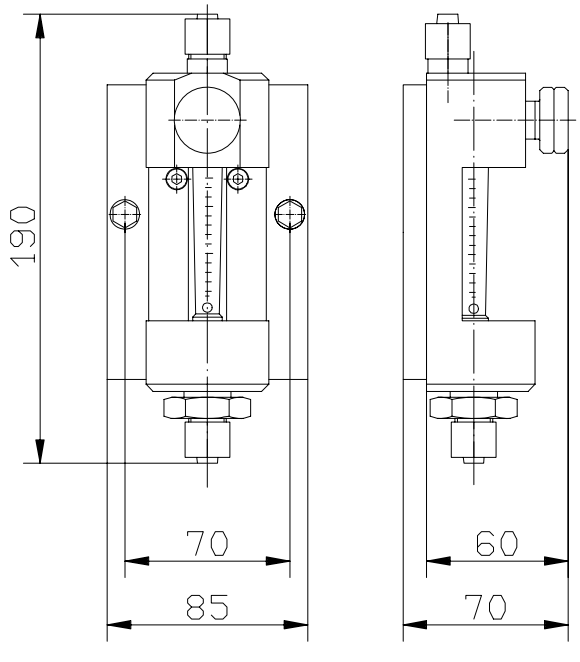
Note:
If the chlorination installation is to correspond to the international safety standards, a back-pressure regulator must be used, which avoids pressure fluctuations in the system. The back-pressure is integrated in the non-return valve (see MB 2 32 01).

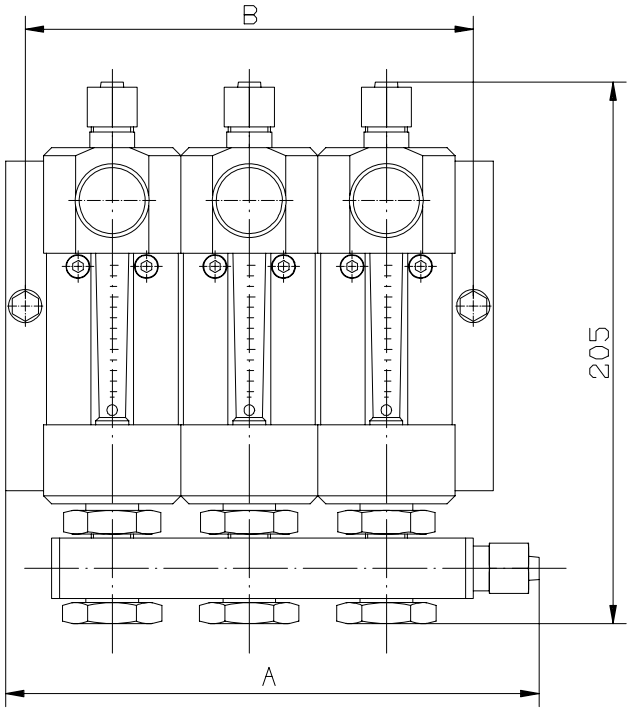
Technical data

Materials:	PVC, Viton, Ceramic, PMMA
Measuring ranges:	1...25 g Cl_2/h up to 200...4000 g Cl_2/h
Setting ration:	1:20
Accuracy:	+/- 6% of final scale reading
Connections:	PE tubing d 8/12
Weight:	400 g

Note:
If the chlorine gas flow is to be adjusted remotely in an automatic control system, a chlorine control valve (see MB 2 07 10) is integrated in the vacuum line between measuring glass and back-pressure regulator.

Dimensions and Part Nos.





Due to the large number of combination possibilities twofold and threefold measuring glas holder are combined from individual measuring glasses and an assembly kit. Please specify the required measuring ranges when ordering.

Measuring range g Cl_2/h	Single measuring glass	Measuring glass in distribtion block
1 ... 25	33367	33359
4 ... 80	33368	33360
10 ... 200	33369	33361
25 ... 500	33370	33362
50 ... 1000	33371	33363
100 ... 2000	33372	33364
125 ... 2500	33373	33365
200 ... 4000	33374	33366

Assembly kit	Dim. A	Dim. B	Part No.
2-fold	152	120	33375
3-fold	202	170	33376

(Delivery incl. mounting material)
Measuring glasses for larger metering capacities are also available.

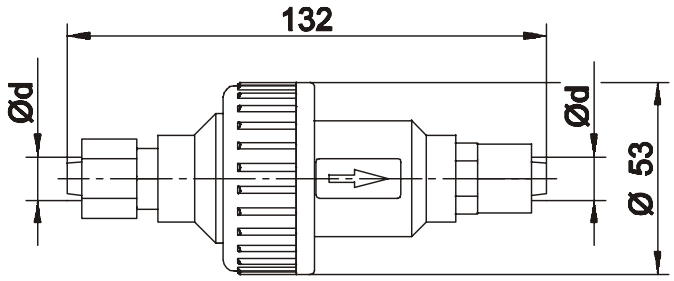
Back stop / back-pressure valve

It is an experience that even the best ejector non-return valve may become untight sometime because of impurities. Therefore the installation of an additional back stop is prescribed by law in some countries. Its function is to prevent water from entering the chlorinators even in the case of a failure so that these devices are not damaged.
The backstop has a second safety function. It requires a small differential pressure to open. The value of this differential pressure has been chosen so that it slightly exceeds the minimum repsonse pressure of the safety valve. Even in the case of creeping chlorine leakage at the full-vacuum chlorinator, the safety valve responds exactly thus avoiding the development of excessive pressure in the vacuum system.

Technical data

Materials:	PVC, Viton, glass, Hastelloy
Response pressure:	40 mbar
Flow rate:	up to 10 kg Cl_2/h
Connections:	PE tubing d 8/12 or PE tubing d12/16
Weight:	150 g

Dimensions and Part Nos.



Back stop with connections for:

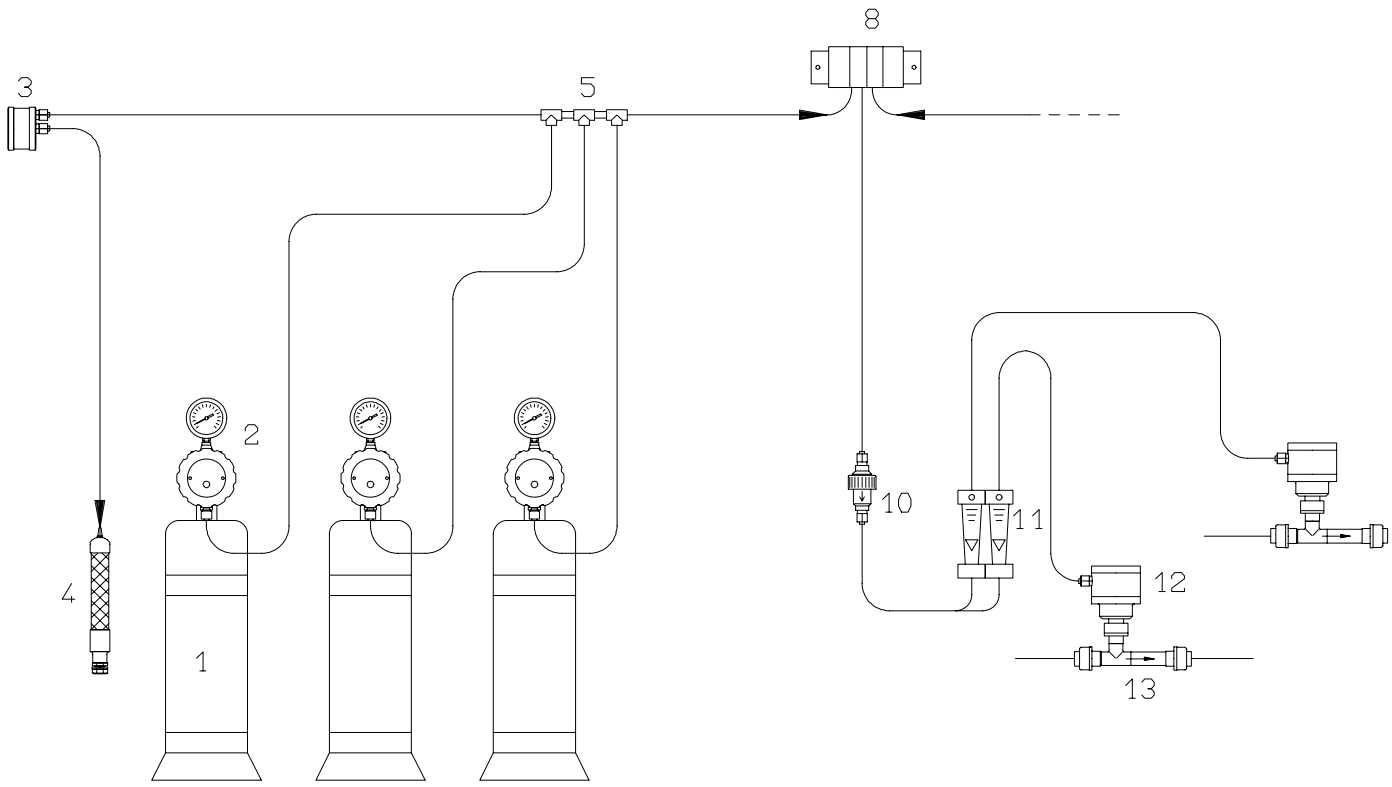
Tubing d 8/12	Part No. 20400060
Tubing d 12/16	Part No. 20400061
PVC d 16i	Part No. 20435118

Safety Shutoff Valve

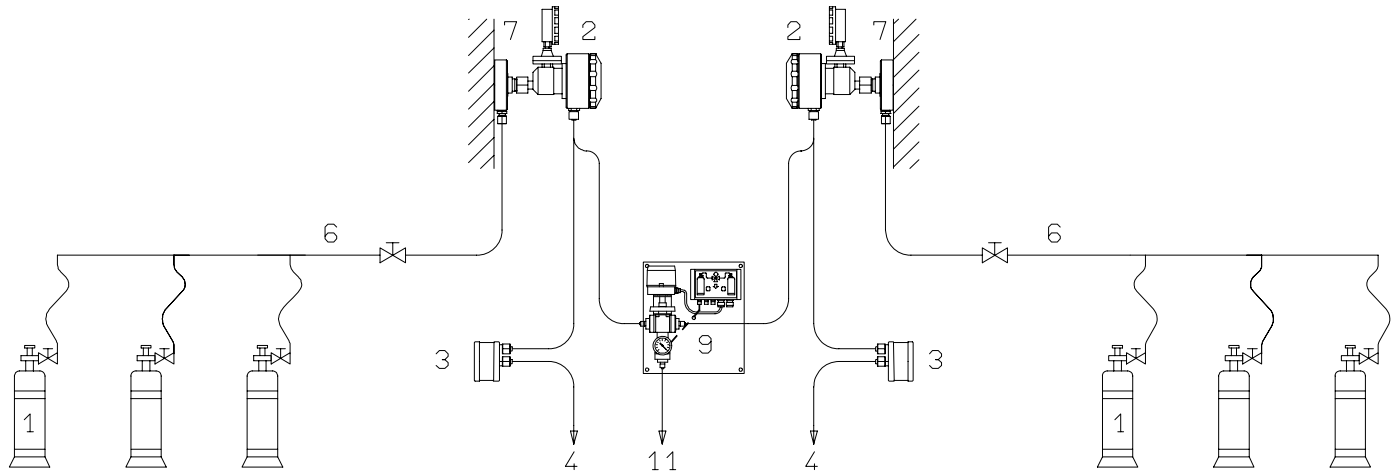
Often the use of a valve is required which opens only if the ejector is under vacuum and which is completely closed during system standstill. The safety shutoff valve ensures this function. It is installed instead of the back stop. (Description see MB 2 04 06).

Installation examples

Several full-vacuum chlorinators mounted directly on the chlorine cylinders



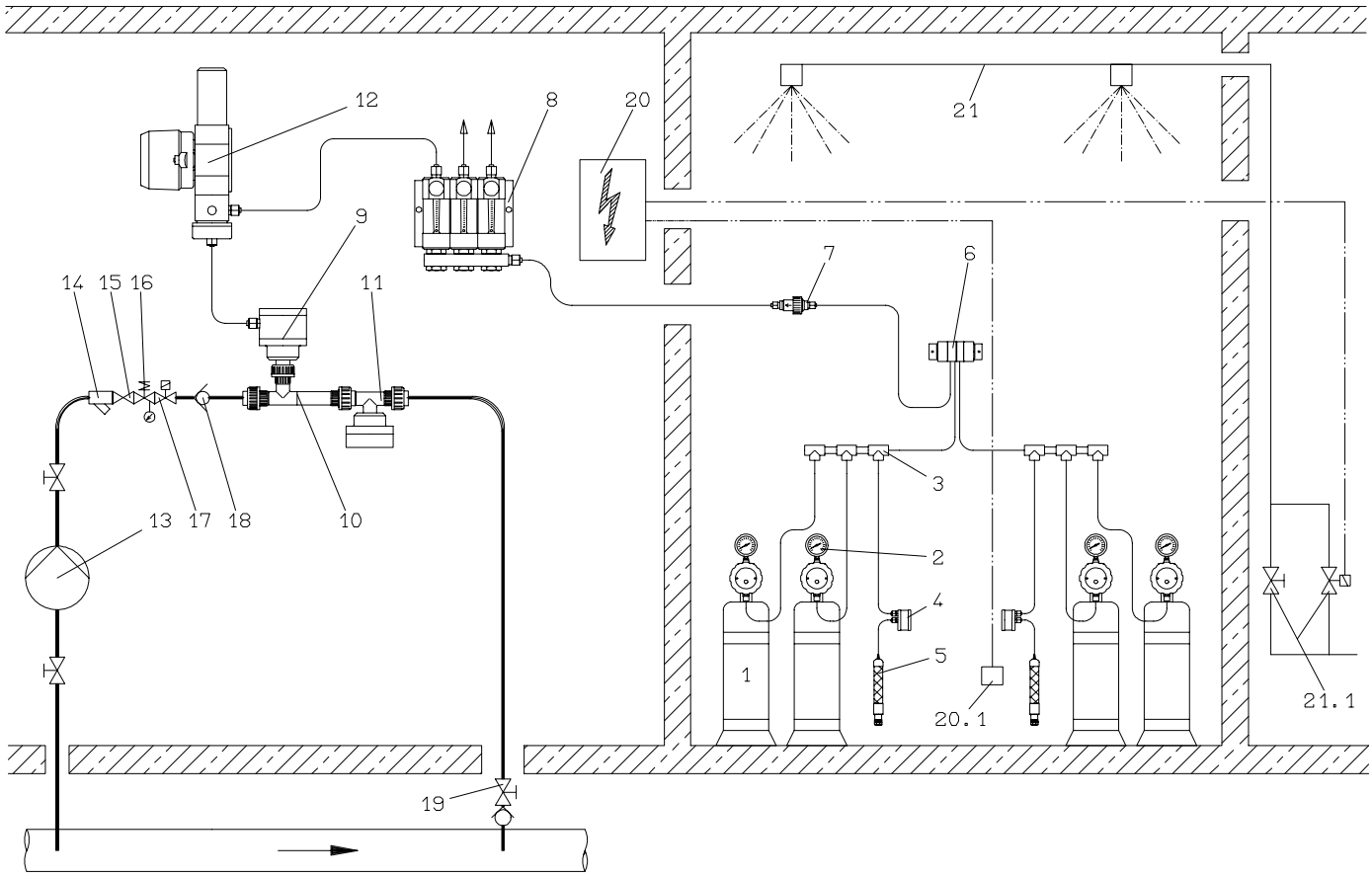
Several chlorine cylinders combined on the discharge side with one full-vacuum chlorinator per cylinder



Legend

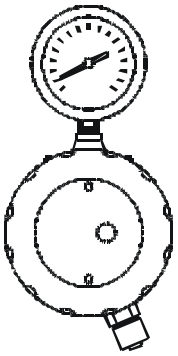
1 Chlorine cylinder
2 Full-vacuum chlorinator
3 Safety valve
4 Activated-carbon cartridge
5 Vacuum manifold
6 Overpressure manifold
7 Wall connection block
8 Changeover equipment C 2005
9 Changeover equipment C 7512
10 Back stop
11 Measuring glass
12 Ejector non-return valve
13 Ejector

Schematic diagram of a complete chlorination installation



Legend

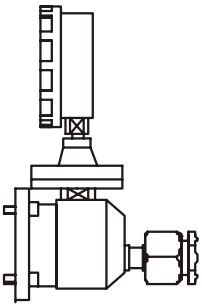
1	Chlorine cylinder	
2	Full-vacuum chlorinator	MB 2 04 11
3	Vacuum manifold	MB 2 23 02
4	Safety valve	MB 2 04 11
5	Activated-carbon cartridge	MB 2 04 11
6	Chlorine changeover equipment C 2005	MB 2 04 05
7	Back stop	MB 2 04 11
	or Safety Shutoff Valve	MB 2 04 06
8	Measuring glasses / distribution block	MB 2 04 11
9	Ejector non-return valve	MB 2 32 01
10	Ejector	MB 2 31 01
11	Vacuum breaker	MB 2 33 02
12	Control valve C 7700	MB 2 07 10
13	Booster pump	MB 2 29 01
14	Ditr trap	MB 2 29 04
15	Shutoff valve	MB 2 29 04
16	Pressure reducing valve with pressure gauge	MB 2 29 04
17	Solenoid valve	MB 2 29 04
18	Ball non-return valve	
19	Chlorine solution injector	MB 2 34 01
20	Chlorine gas warning device	MB 2 36 04
20.1	Sensor for gas warning device	MB 2 36 04
21	Sprinkler installation	MB 2 41 00
21.1	Accessories for sprinkler installation	



Maintenance kits for chlorinator TJ-C2211+

Full-vacuum chlorinator TJ-C2211+ **ET 2 04 11 / 2**

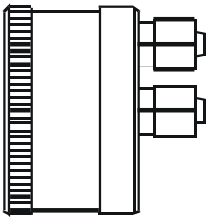
Maintenance kit for chlorinator without inlet valve:
1 diaphragm, 2 O-rings, 1 screw Part No. 35039



Inlet valve **ET 2 04 11 / 3+4**

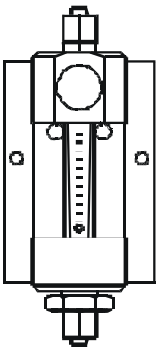
Maintenance kit for inlet valve:
1 filter, 4 O-rings, 2 valve seats, 2 balls,
1 joint washer, 8 screws

chlorine cylinder connection G 5/8 and 1": Part No. 35037
chlorine cylinder connection G 3/4: Part No. 35038



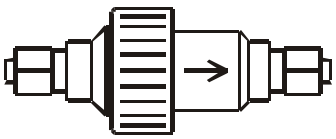
Safety valve **ET 2 04 11 / 6**

Maintenance kit for safety valve:
1 diaphragm, 1 valve seat Part No. 33390



Measuring glasses **ET 2 04 11 / 7+8**

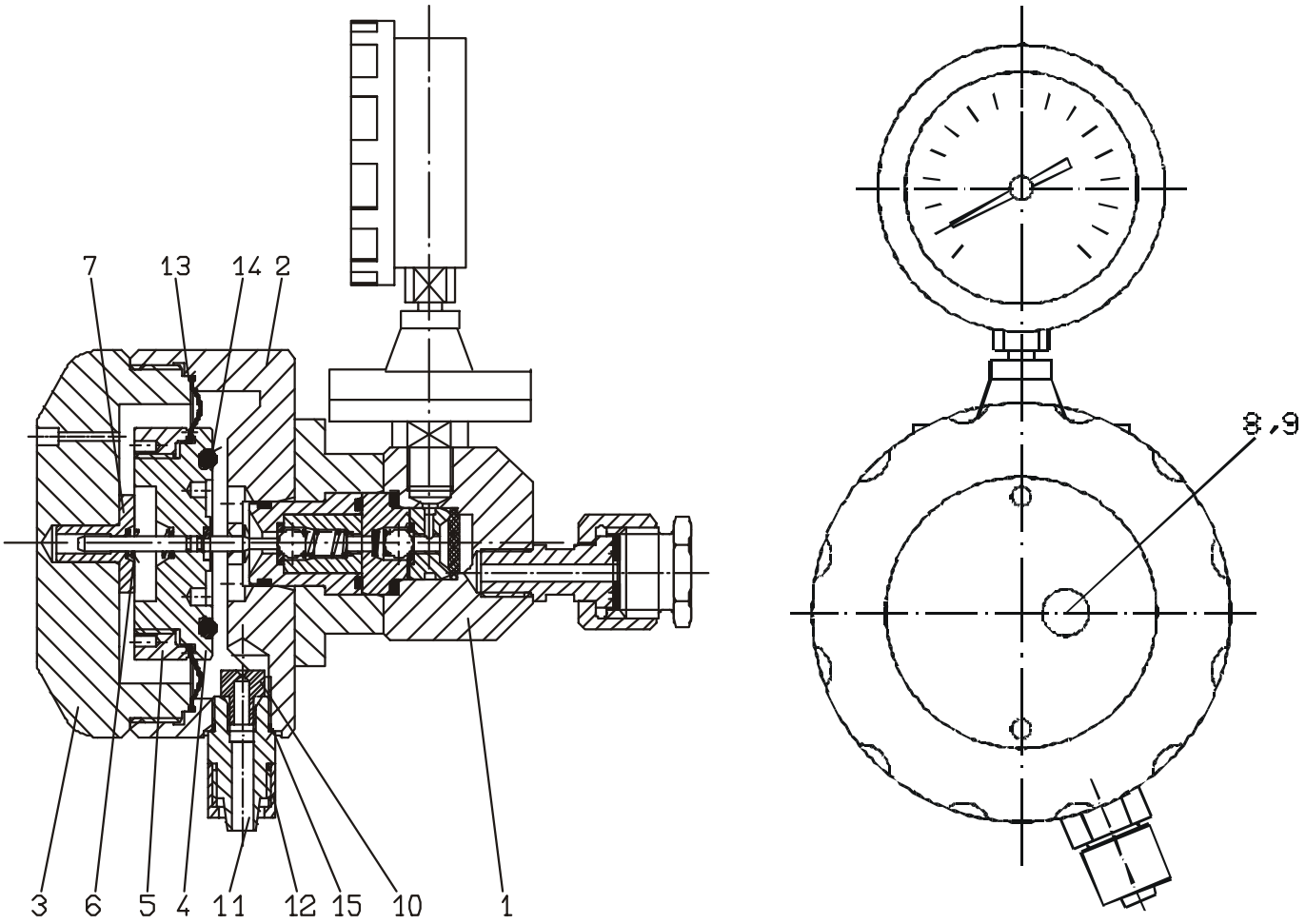
Maintenance kits for measuring glasses:
all O-rings, 2 screws
for single measuring glass Part No. 29717
for multiple measuring glasses
(1x per measuring glass) Part No. 33391



Back stop **ET 2 04 11 / 5**

Maintenance kit for back stop:
2 O-rings, 1 ball Part No. 35062

Chlorinator assembly



Item	Description	Material	Qty	Part No.
1	Inlet valve assembly W1" G 5/8 G 3/4	misc.	1	35007 35008 35009
2	Housing bottom with bushings	PVC / brass	1	35010
3	Housing cover with bushing	PE / brass	1	35011
4	Diaphragm disc (valve pin cemented with PVC diaphragm disc)	PVC / silver	1	35014
5	Threaded ring	PVC	1	28806
6	Pressure spring d 7.6x14mm	Hastelloy	1	28967
7	Adjusting bushing	PVDF	1	35015
8	Adjusting screw M4x16	brass, nickel-plated	1	83766
9	Cap	Plastic	1	83851
10	Flow limiter d1.2mm - M8	PVC	1	35016
11	Clamping conn. d 8/12 - G 3/8 - M8	PVC	1	35017
12	Union nut d 8/12	PVC	1	10365
13*	Ring diaphragm	Viton	1	81599
14*	O-ring d 40. 65x5.34 mm	Viton	1	80078
15*	O-ring d 14x1.78 mm	Viton	1	80003
	Complete unit W 1" (increased residual pressure W 1") G 5/8 G 3/4			20401100 (20401104) 20401101 20401102

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1. General description

TJ-C2211+ Chlorinators are designed according to the highest safety standard with several functions going beyond that standard. With these devices so-called full-vacuum installations can be set up with vacuum beginning directly at the chlorine cylinder. Even in the case of a line rupture chlorine gas cannot escape.

The full-vacuum chlorinator is of central importance for the safety in vacuum installations and provides the following functions in addition to the vacuum regulation which is the basic function: (for a detailed description cf. MB 2 04 11).

Residual pressure preservation
against a complete evacuation of the cylinder in order to avoid corrosion caused by humidity of the entering air.

Filter
for protecting the valves against dirt particles from the cylinder or from the connection area.

Cylinder pressure gauge
for the indication of the cylinder pressure with diaphragm pressure transmitter as a double-safety feature.

Simultaneous delivery
for a uniform chlorine delivery to a large extent from several cylinders in so-called battery operation.

Flow limiter
against icing of the cylinders as a result of an inadmissably high chlorine delivery rate.

All other functions, as for example safety valve, flow meter and ejector, are designed as separate devices. Thus a flexible installation of the system perfectly adapted to the conditions on site is possible. The back-pressure regulator required according to the international standards, is used to avoid metering faults as a result of priming pressure fluctuations of the ejector. It is integrated in the ejector non-return valve and therefore does not require additional installation space or time.

Besides the generally required components, a large number of useful supplementary devices are available.

For example distributor units allow to distribute the chlorine gas flow to several metering points and backstops increase the safety of the system even beyond the required range.
For a constant chlorine delivery even if chlorine cylinders are becoming empty, an automatic switch-over is required. Several versions are available. One version up to a rate of 4 kg/h even works without auxiliary energy.
Electrically actuated control valves are installed at an arbitrary point between flow meter and ejector back-pressure valve in the vacuum line.Therefore the installation of automatically working systems is easily possible.

2. Scope of delivery

Be careful when unpacking the chlorinators and order-related accessories in order not to miss small parts, as for example fixing screws for wall installation. Compare the scope of delivery with the delivery note. If there are any discrepancies, try to find out the reason.

3. Safety instructions

⇒ Chlorine gas may be dangerous for your health and life. Therefore the highest caution must be spent when working on chlorine gas metering systems. All working steps on the system require special knowledge and safety precautions and may only be carried out by specialist staff.

⇒ When working on chlorine gas metering systems make sure that local accident prevention rules are observed.

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⇒ Before starting work on chlorine gas metering systems the cylinder valves must be closed. All chlorine leading pipes must be evacuated using the ejector.

⇒ Liquid chlorine must never enter chlorinators not being explicitly authorized for liquid chlorine. If necessary, a pressure reducing valve, a catch pot or a pipe heating must be provided.

⇒ When changing the cylinders make sure that a protective mask is used. The cylinder valve (and if necessary the cylinder auxiliary valve) must be closed. In case that the pressure gauge at the vacuum regulator still indicates a pressure, the pressure has to be discharged using the ejector.

⇒ Before startup of the chlorination installation all connections must be carried out properly and tightened using the suitable tools. The tightness of the whole installation must be tested using ammonia solution.

⇒ Chlorine gas is highly hygroscopic. Therefore humidity penetrates the system at every open connection of the units or pipes resulting in the formation of hydrochloric acid thus inevitably causing damage of the units. Therefore all connections (at the vacuum units and vacuum pipes as well) must be closed at any time.
⇒ If chlorinators must be used with other gases than chlorine gas, the chemical resistance of the unit must be checked after consulting the manufacturer.

4. Installation

The installation of the chlorinators usually is carried out according to the drawings of the planning department. Examples for installation diagrams are presented in MB 2 04 11. There you can also find hints to other data sheets that should be taken into consideration.
Besides the possible local rules the **Accident Prevention Rule VBG 65** must also be observed.
The installation must be carried out by specialist staff as already small mistakes during installation may cause faulty metering or even destroy the units.

Always use **appropriate tools** for the installation, for example when tightening the union nut a second wrench must be used for counter-holding in order to avoid a distortion of the units. Otherwise mechanical stress may cause damage of the components.
Before mounting, **the threads** should be lubricated using silicone grease or PTFE-spray. In that case the threads can be unscrewed more easily even after a long operation time.

Note:
Vaseline is not suited for lubricating chlorine system components. Because of its hygroscopic effect chlorine gas extracts water out of the vaseline so that it hardens.

All units must be mounted in the position that is shown in the installation examples. Otherwise malfunction or even damage of the units caused by liquid chlorine cannot be excluded.
For fixing wall holders or mounting clamps use the screws, washers and pegs included in the scope of delivery as they are perfectly suitable for this purpose regarding material choice and dimensioning .

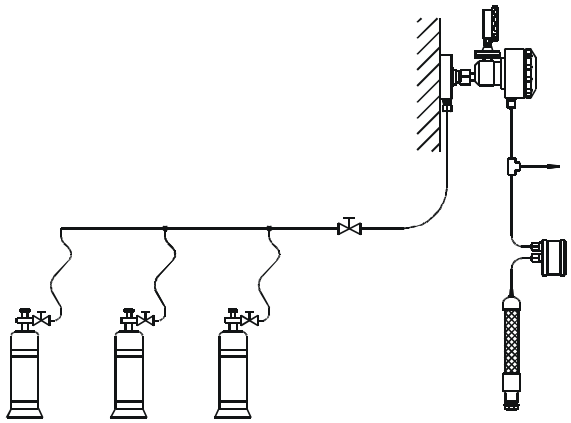
4.1 Chlorine delivery

4.1.1 Limited delivery quantity

The constant volume of chlorine gas delivered per hour from one chlorine cylinder or barrel must not exceed 1% of the original contents. Otherwise the energy loss resulting from chlorine evaporation may cause the risk of cylinder icing and consequently an inadmissably high pressure loss in the chlorine cylinder. This means that the maximum rate for e.g. a 65 kg cylinder is 650 g Cl2/h at an ambient temperature of 10°C. The maximum delivery rate increases up to e.g.1,000 g Cl_2/h at 15°C if a room heating is used.
For a higher metering capacity several chlorine cylinders must be connected simultaneously in so-called battery operation. A difference is made between cylinder batteries connected under pressure or connected under vacuum.

4.1.2 Pressure batteries

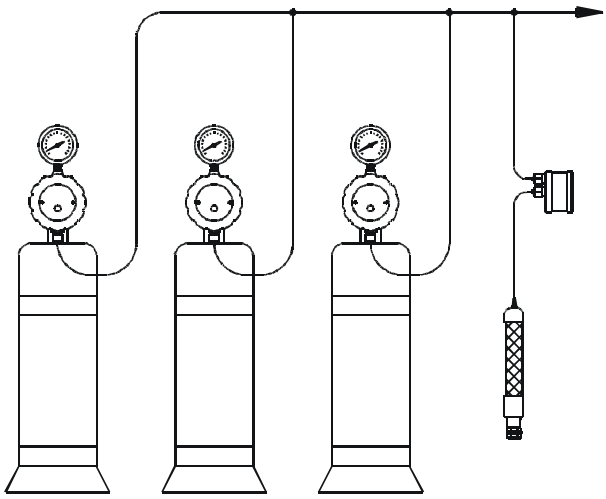
Typical installation example:



A collective pipe connects all cylinders forming one pressure system so that chlorine is supplied simultaneously from all cylinders. For connecting the chlorine cylinders with the collective pipe flexible copper pipes are used. Each flexible copper pipe is equipped at the end with an cylinder auxiliary valve which is closed when exchanging the cylinders so that the escape of chlorine gas is avoided.

4.1.3 Vacuum batteries

Installation example:



This type of installation ensures the highest possible safety standard as the vacuum is already present at the cylinder. Even in the case of a line rupture chlorine gas cannot escape but only ambient air can be sucked in.

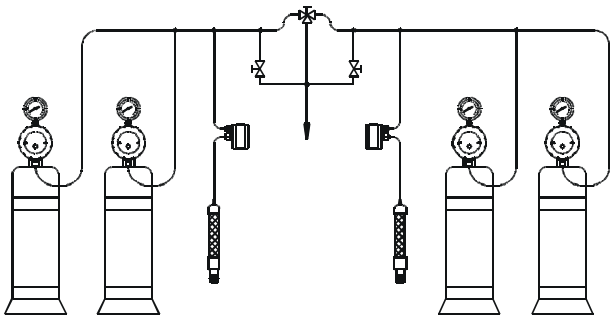
JESCO developed an adjustment method for equalization of each individual vacuum regulator which allows simoultaneous gas supply from several cylinders even with this type of installation .

4.1.4 Simultaneous delivery under vacuum

In order to make sure that the cylinders are emptied uniformly under vacuum several conditions must be provided:

Sufficient chlorine delivery

The delivery rate per cylinder should not be lower than 200g/h. Please be especially careful during night operation in swimming pools.
In many cases both cylinder batteries are designed according to the highest delivery rate to be expected. As a result, the delivery rate per cylinder under normal operation conditions often falls below 200 g/h. By using collective pipes with short-circuit lines the number of cylinders per battery can be divided in two.



For a shock chlorination the short-circuit lines are opened and both cylinder batteries simultaneously will deliver chlorine gas.

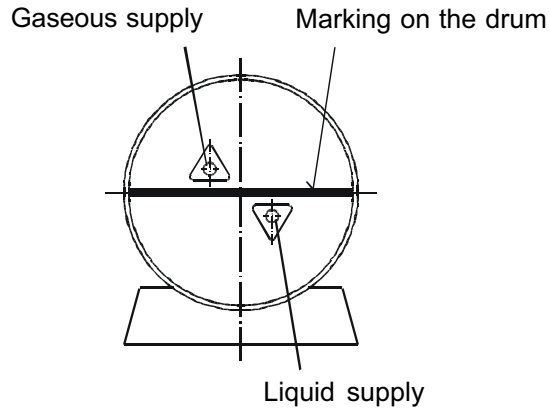
Uniform cylinder pressure

As the cylinder pressure directly depends on the temperature, the temperature must be equally high in all cylinders. So please make sure that the cylinders are not located near an radiator or close to a window where they are exposed to direct sunlight.
As the cylinder temperature falls down slower or faster depending on the filling capacity, the chlorine cylinders must be filled uniformly when starting parallel supply.

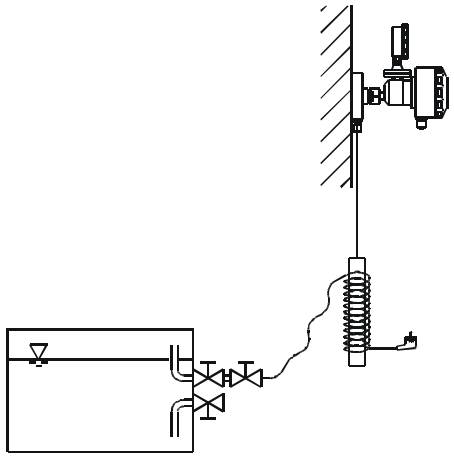
4.1.5 Comments regarding chlorine drums

At higher metering capacities chlorine drums are often used. Depending on the ambient temperature, up to 7 kg/h chlorine gas may be supplied from a 1,000 kg drum (10°C:3kg/h, 15°C:5kg/h, 20°C:7kg/h).

Chlorine drums are equipped with two connections, one for gaseous chlorine supply (top) and one for liquid chlorine supply (bottom).



The position of the drum on the support must be such that the feedpipe in the barrel is vertical (marking on the drum horizontal). In this case the position of the connecting valves needs not be observed as they are staggered. After transportation the feedpipe is mostly filled with liquid chlorine which must not penetrate the metering units. Therefore a catch pot should be provided. The installation of a heating element for evaporating the liquid may also be useful.

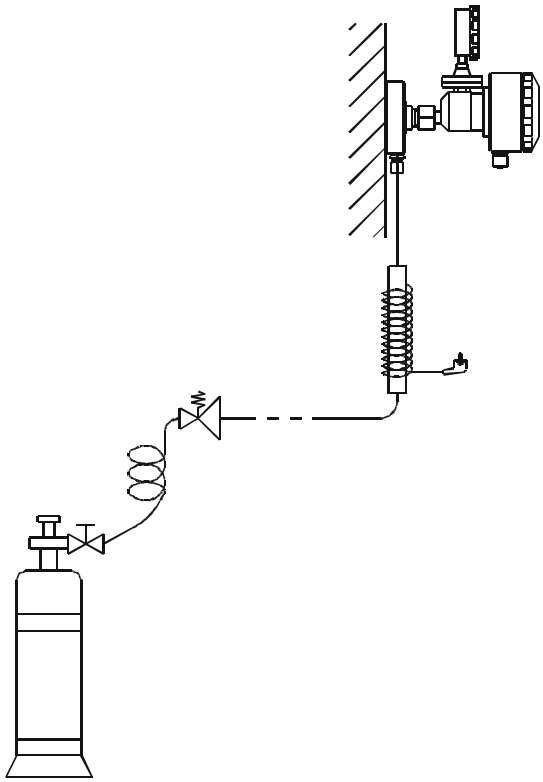


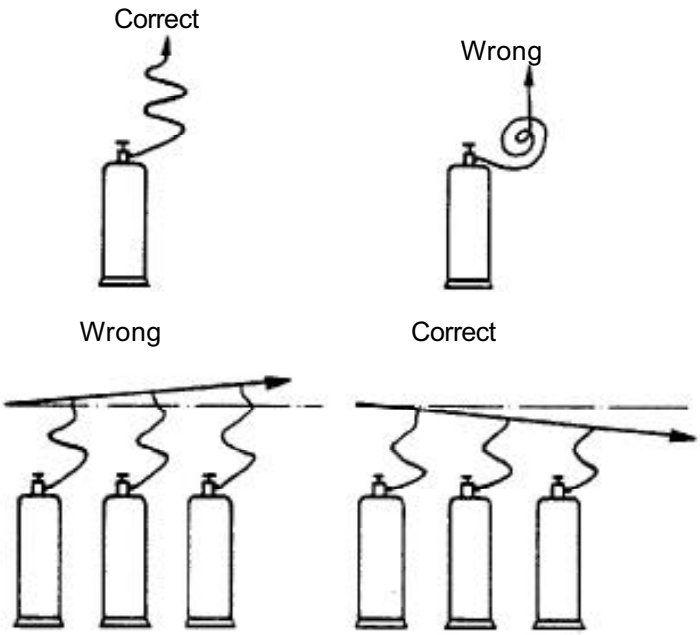
4.2 Design of the piping system

For leading the chlorine gas metal and plastic pipes are used. In the overpressure range metal pipes are mandatory, in the vacuum range mainly plastic pipes are installed.

4.2.1 Overpressure pipes

Chlorine gas metering units are perfectly suitable for gaseous chlorine. However, liquid chlorine chemically attacks the unit. Therefore the penetration of liquid chlorine into the units must be avoided. Overpressure pipes must be run upwards in direction of the metering units. This also applies for flexible connection pipes. Therefore the turns of the flexible copper pipes must be positioned horizontally so that
condensate drops may flow back into the cylinder.





As a result of temperature variations, chlorine gas may condense to liquid chlorine in the overpressure system. Therefore a uniform ambient temperature must be provided. A room heating is recommended.

If a uniform temperature is not possible because of structural reasons, a pressure reducing valve has to be installed in order to reduce the temperature at which condensation starts. If necessary, the chlorine has to be heated up using a chlorine heating block before entering the metering unit.

As **solid lines,** seamless pipes are used for overpressure piping. An internal corrosion protection is not required as steel (e.g. St37-2) is chemically resistant against chlorine. Please make sure that the entering of humidity is avoided so that hydrochloric acid cannot be formed. Permanent thread connections are usually made tight using diacrylate sealing compound. Organic substances, e.g. hemp, must not be used at all.

For connecting **flexible lines,** cutting ring connectors are used.The installation of these connectors is described in detail in data sheet SD 2 01 03.
As a result of the mechanical strain, the service life of flexible cop per pipes is limited. Accident Prevention Rule VBG65 for example stipulates an exchange of these lines after two years at the latest.

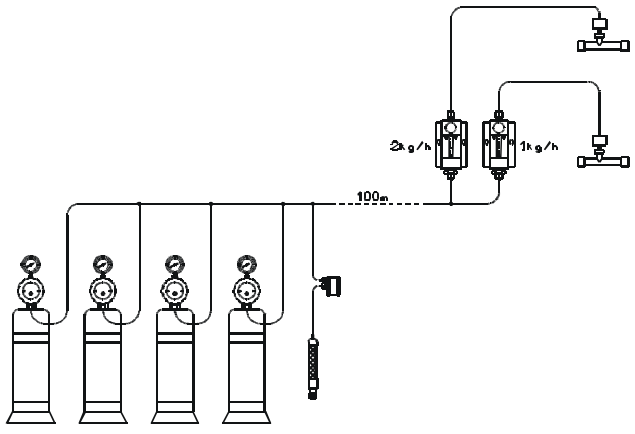
4.2.2 Vacuum lines

As vacuum lines, inelastic PVC pipes and flexible PE tubes are used. In most cases PVC hoses are not suitable for vacuum and even fabric reinforced hoses which should be vacuum-proof are diffused by the chlorine gas and therefore not resistant.
Because of the low pressure, chlorine gas condensation in the vacuum lines is almost impossible. Only below -30°C it might become possible. However, temperature must never decrease to such a low level because considering the embrittlement of the materials.
The ejector builds up the vacuum which is necessary for transporting the chlorine gas. Theoretically the vacuum could amount to a maximum of 1 bar, but the ejector primes only at a technically reasonable slight vacuum. Therefore the pressure loss resulting from pipe friction in the vacuum lines must not be higher than 50 mbar. The following table shows the required line cross section in relation to the length of line and the metering capacity.

Maximum tube length for vacuum lines

Tube length	d 8/12 mm	d 12/16 mm
10m	7 kg Cl_2/h	20 kg Cl_2/h
20m	5 kg Cl_2/h	15 kg Cl_2/h
50m	3 kg Cl_2/h	9 kg Cl_2/h
100m	2 kg Cl_2/h	6 kg Cl_2/h

The total value of the chlorine gas flow is decisive for the line dimensioning. If for example the line is divided into two lanes directly in front of the ejectors, the long lane must be dimensioned considering the whole chlorine gas flow.

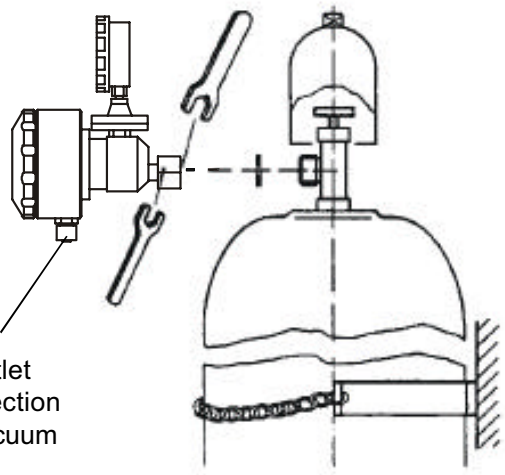


In this example the long distance is carried out in DN12, and for the relatively short unit connections a 8/12 PE tube is used.

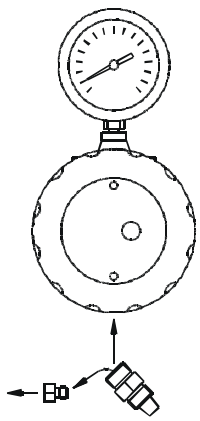
4.3 Installation of units

4.3.1 Installation of vacuum regulator

The chlorine cylinders must be secured by wall holders when being s. Before connecting the units, the cylinders should have reached room temperature and the cylinder contents must have calmed down after transportation.
When using chlorine drums make sure that the marking of the drum is in horizontal position. For a supply of gaseous chlorine the upper connection is used.(See also 4.1.5 *Comments regarding chlorine drums*).
The vacuum regulators are either mounted directly on the chlorine cylinder valve or on the wall holder with the metering connection pointing downwards. In order to make the exchange of the vacuum regulator easy, always use a new flat gasket which is slightly lubricated when connecting the vacuum regulator. The union nut for connecting the cylinder is tightended gently and the unit is secured against distorsion using a secowrench.

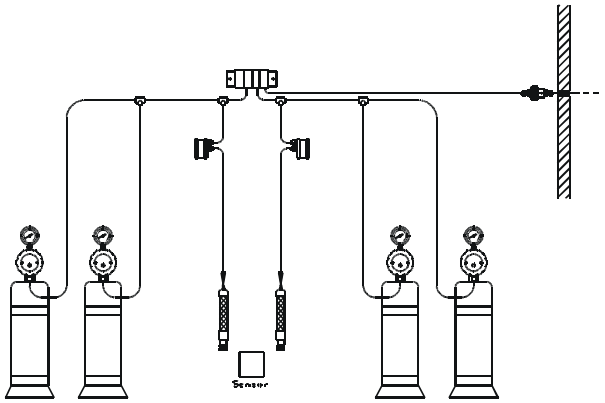


Remark:
If the vacuum regulator is fed from a chlorine drum or from several cylinders the flow limiter must be removed from the tube connection. The flow limiter delimits the metering capacity to 1kg Cl_2/h. Without flow limiter up to 10kg/h can be metered from one vacuum regulator.



4.3.2 Installation of safety blowoff valve

For each cylinder battery one safety valve must be installed which is either connected to a free connection point of the vacuum collective line or using a T-piece in the metering line. It is quite reasonable to run the blowoff connection close to the gas sensor so that in the case of malfunction an alarm signal can be released immediately.
The integration of an activated-carbon cartridge at the outlet of the safety valve avoids faulty alarms resulting from system-related temporary shock pressures.
It is advisable to use a PVC tubing for connecting the active-carbon cartridge. As soon as a chlorine contact occurs the appearance of the tubing changes from transparent to milky thus signalling a leakage.



4.3.3 Installation of backstop/safety shutoff valve

According to the regulations in some countries the integration of a valve is recommended which prevents water from entering the metering units even if the ejector nonreturn valve is untight. This function can be provided by two different valves.

a) Backstop

The backstop is an additional spring-loaded ball nonreturn valve being installed in the vacuum line.

b) Safety shutoff valve

The safety shutoff valve is a diaphragm valve opening only in the case of ejector vacuum thus having a dual function:

- It prevents water from flowing back if the ejector nonreturn valve is untight.
- It prevents chlorine gas from escaping in the case of a faulty vacuum regulator even if the vacuum line is untight (e.g. maintenance work).

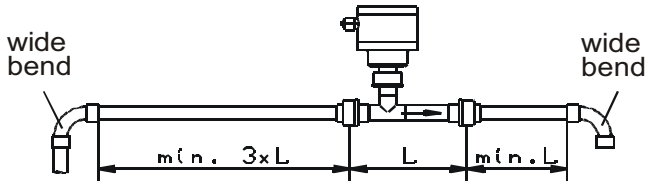
It is quite reasonable to mount the backstop or safety shutoff valve at a point in the vacuum line outside the area being monitored by the gas warning device, i.e. directly at the end of the chlorine cylinder room (see above drawing). A pipe clamp is delivered with the valves.

4.3.4 Installation of measuring glass

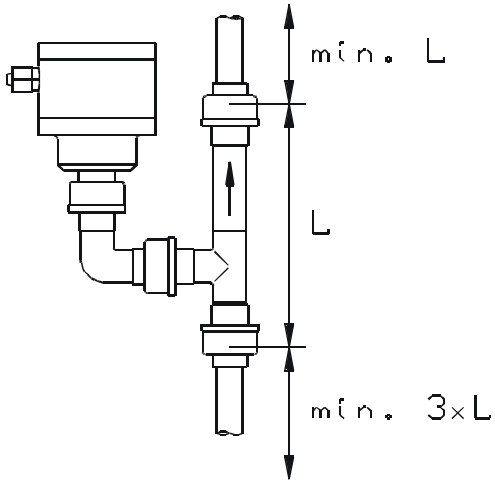
For mounting the measuring glass the vacuum line to the ejector is cut off at an arbitrary point and the measuring glass holder is mounted with the tubing connections. The manual adjusting valve is on the top.
In automatically controlled systems an electrically actuated control valve is used which is mounted between measuring glass and ejector. Often the measuring glass and the control valve are mounted together.

4.3.5 Installation of ejector

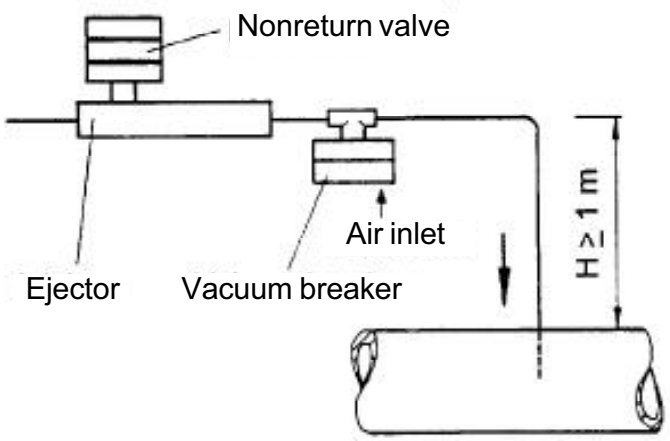
The ejector is mounted horizontally. The ejector nonreturn valve is mounted directly to the suction connection on top of the ejector.
On the feed side the pipe line should be run at least 3 ejector lenghts in straight direction and the width should correspond to the nominal width of the ejector. The same applies for one ejector length at the outlet of the ejector. Please use wide bends rather than sharp angles for the pipe line.



A backpressure regulator is integrated in the ejector nonreturn valve
(up to 6 kg/h). It regulates pressure fluctuations of the ejector resulting from the changing water pressure. For higher metering capacities separate backpressure regulators are available.
If the ejector must be installed vertically for space reasons the nonreturn valve must be connected using a 90° angle so that the diaphragm of the nonreturn valve is in horizontal position.

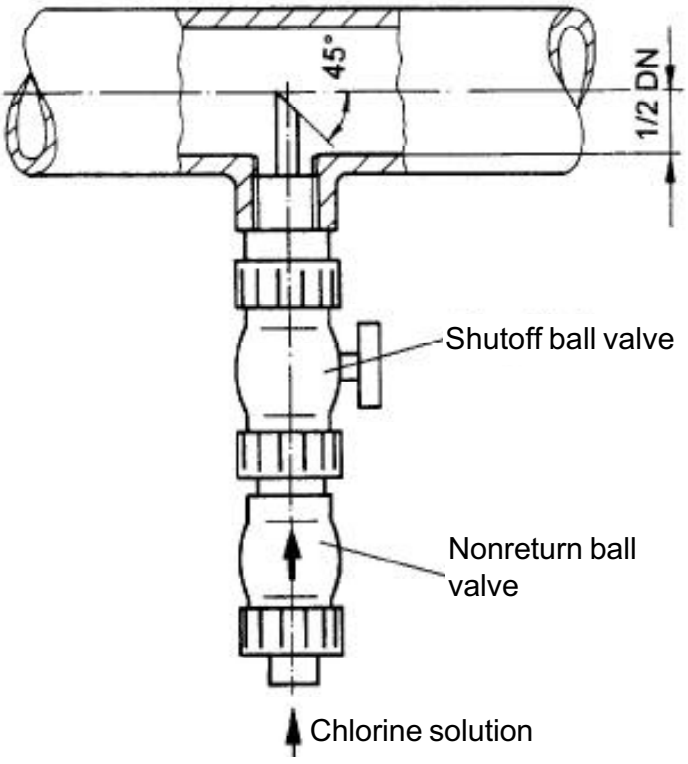


Due to the vacuum in the piping system undesired chlorine metering might occur if the booster pump is switched off, e.g. as a result of the syphon effect if the injection point is mounted more than 1 m below the ejector. This effect can be avoided by using a vacuum breaker (anti-syphon-valve) which is mounted directly to the ejector and allows air to enter the water line thus eliminating the syphon effect.



4.3.6 Installation of the solution inlet

Via the solution inlet the chlorine solution is led to the water to be treated. We recommend to dimension the injection pipe so that the chlorine solution penetrates the water line in the center if possible thus ensuring an optimal mixing. In addition to the nonreturn valve the solution inlet should be equipped with a shutoff ball valve in order to completely separate the chlorination plant from the water system.



5. Startup

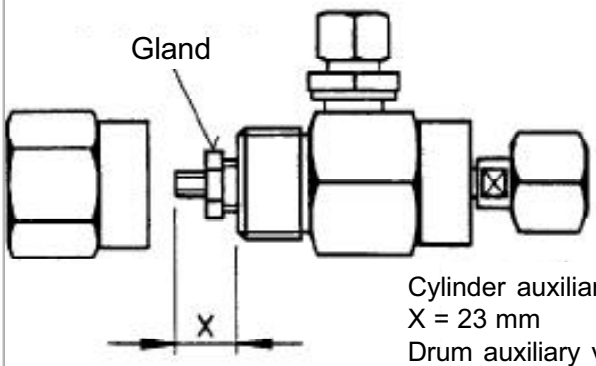
5.1 Leakage test

Before starting the chlorinators a leakage test of all plant components must be carried out. Make sure that both, plant components under overpressure and plant components under vacuum, are tested.

5.1.1 Overpressure lines

If the vacuum regulator is mounted directly to the cylinder only the cylinder connection and the inlet valve must be tested. With all other plants the whole piping system as well as the vacuum regulator have to be tested.
In order to carry out the test, the chlorine cylinder is opened slowly and all connection points are tested using ammonia (=ammonium hydroxide solution). One can either carry out pumping movements with the ammonia bottle in the proximity of the connection or hold a cloth soaked with ammonia close to the connection. Leaking chlorine gas and ammonia form a white dust .

ATTENTION!
Due to the high corrosivity of humid chlorine gas all leaking points rapidly aggravate in the course of time. Therefore even the smallest leakage must be removed immediately.
Note:
In the case of cylinder auxiliary valves the packing sealing might have settled since manufacturing. For tightening it again the handwheel is unscrewed completely and the gland is tightened by approx a 1/2 turning. When remounting the handwheel, the measure „x“ from the sketch below must be observed.



Cylinder auxiliary valve
X = 23 mm
Drum auxiliary valve
X = 35 mm

5.1.2 Vacuum lines

Leaking vacuum lines are not noticed during normal operation as chlorine gas does not escape but only ambient air is primed. However, at the same time humidity enters the piping system forming deposits along with the chlorine gas. This is why vacuum lines must also be leakage-tested carefully.
Switch on the ejector while the cylinder valve is closed. After a short period of time the ball in the flow meter will not move anymore. If it does, a leakage test of all components including the vacuum regulator must be carried out in order to remove the leaking point. Make sure that no water penetrates the vacuum line after switching off the ejector.Water penetrates the vacuum line only if the ejector non-return valve doesn't work perfectly.
For troubleshooting of the individual components, please also see paragraph 9, Maintenance.

5.2 Starting

For starting the plant the chlorine cylinder main valve must be opened first. Then the injection valve and the motive water supply must be opened. In the case of perfect operation conditions, a vacuum is produced in the ejector and will be transmitted via the non-return valve and the vacuum line to the vacuum controller thus opening the chlorine inlet valve. The pressurized chlorine gas is reduced to vacuum in the inlet valve.
The chlorine gas flow is adjusted using the needle valve of the measuring glass and can be read off at the largest ball diameter.
With automatic control systems the regulating valve is first arrested to 100 % opening and the chlorine gas flow is then adjusted using the manual valve. As soon as manual samples indicate a chlorine content in the treated water the measuring system is calibrated and the plant switches over to automatic operation.

6. Operation

During normal operation of the plant the chlorine gas flow is either adjusted automatically using the regulating valve or manually using the adjusting valve of the measuring glass holder. In the case of automatic control systems the measuring amplifier must be checked regularly by means of comparison measurements and must then be calibrated if necessary.

7. Cylinder exchange

If a cylinder is empty the pressure gauge will indicate a decreasing cylinder pressure. The residual pressure in the cylinder will amount to approx. 0,1..0,2 bar, thus preventing damaging air humidity from penetrating the cylinder and the inlet valve. At this residual pressure all liquid chlorine in the bottle is evaporated and there are only residual amounts of gaseous chlorine.
In the case of battery operation only complete cylinder batteries may be exchanged thus ensuring an optimum parallel delivery. Please make sure that all cylinders have the same temperature.
When exchanging the cylinders, please proceed as follows:

- Close the cylinder valve (and if necessary the cylinder auxiliary valve)
- Evacuate possible residual chlorine amounts using the ejector until the ball in the measuring glass lies still.
- Unscrew the union nut of the cylinder connection and remove the old flat gasket (Attention: Do not damage the gasket surface!)
- Close the connection of the metering unit (using a PVC plug or by mounting it to the PVC wall holder)
- Close the cylinder connection with the screwed cap.
- Attach protection cap on the cylinder valve (if possible lubricate the thread using silicone grease)
- Exchange the cylinder
- Attach the new cylinder to the wall holder before connecting it in order to prevent it from falling down. Make sure that the cylinder content quiets down. The cylinder must have ambient temperature before connecting a metering unit.
- Always use new flat gaskets and lubricate them slightly with silicone grease when connecting the metering unit.
- Carry out leakage test using ammonia.

Comment:
As a result of the residual pressure of 0.1..0.2 bar, a very small amount of chlorine will escape when opening the cylinder connection. Extremely sensitive sensors are able to detect even such small amounts. Therefore it is permitted to deactivate the sprinkler system during cylinder exchange, if it will be reactivated after the cylinder exchange (e.g. by means of a door contact switch).

8. Switching off

For short operation interruptions the cylinder valves are closed and the pipes are evacuated until the ball in the flow meter indicates that there is no more flow. Then the motive water is switched off and the shut-off valves in front and behind the ejector are closed.
For longer operation interruptions (e.g. in open-air pools during winter time) the following steps should be taken in order to protect the units.

- Rinse all pipes (pressure and vacuum lines) and all units approx. 5 minutes with dry air or nitrogen.
- Close the chlorine cylinder tight. The protection cap for the connection thread must be slipped on.
- Dismount at least the vacuum regulators from unheated or humid rooms and keep them dry.
- If possible dismantle all units and service them. Please slightly lubricate all threads and elastomeres with silicone grease.
- Close all units and piping connections tight in order to prevent air humidity from penetrating and damaging the units.
- Exhaust all water leading lines in case of danger of frost.
- Turn all valves in middle position so that they can be released in both directions when they are re-started.

If these points are observed during operation interruptions the units will restart without any problems even after longer periods out of operation.

9. Maintenance

Regular maintenance spares yourself a lot of trouble!

A maintenance contract is advisable.

Please make sure that the chlorine cylinders are closed before starting work on the chlorinator. The plant must be evacuated using the ejector until the measuring glass indication is zero.

The vacuum regulator is then dismantled, cleaned and parts subject to wear are exchanged. All other parts are inspected visually and exchanged if necessary. The generally required parts subject to wear are included in the maintenance kit (also cf. ET sheet).

For cleaning the components, warm water or isopropyl alcohol are perfectly suited. Before remounting the components, make sure that they are dry.

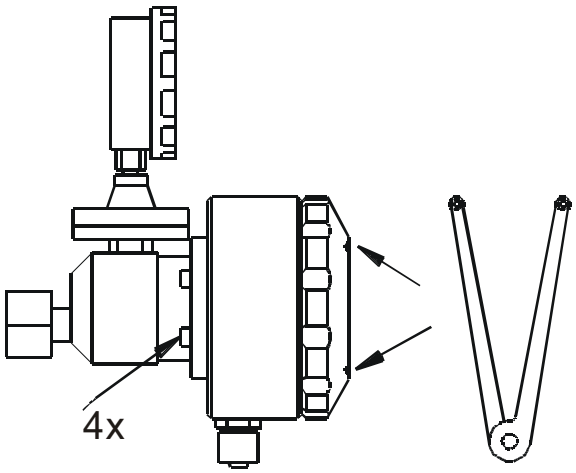
Gaskets and diaphragms should be lubricated slightly using silicone grease. Do not use vaseline at any rates as it hardens because of dehumidification and thus may cause malfunction.

Pressure springs are no parts subject to wear in the original meaning of the word. However, they can also be attacked chemically by humidity. In that case they have to be exchanged. Pressure springs must never be compressed completely for testing because this will result in overstress.

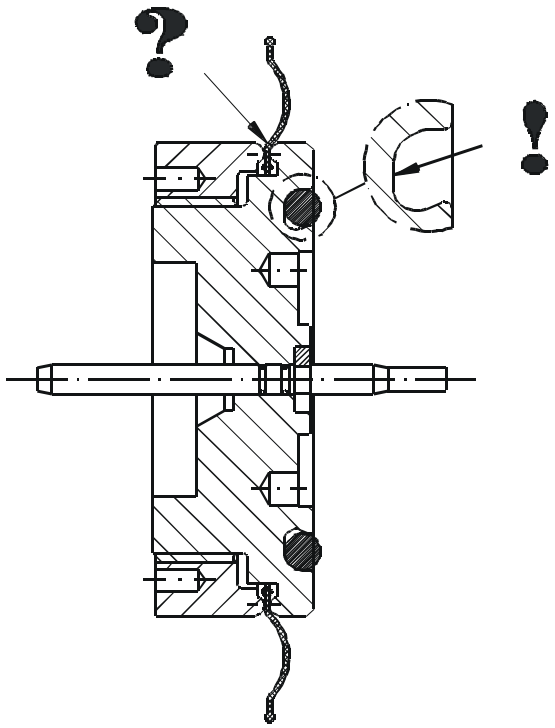
9.1 Vacuum regulator

9.1.1 Dismounting of vacuum regulator

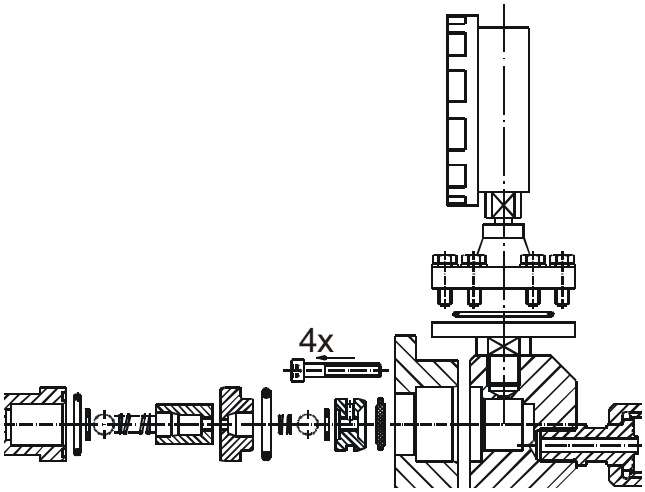
First the inlet valve is separated from the plastic vacuum part by unscrewing the four screws. The housing of the vacuum part is screwed. If it may not be possible to dismount it by hand, use the corresponding face spanner.



For dismounting the diaphragm, special clamping wrenches (part no. 31617) or face spanner (spigot-ø 3mm and 4mm) are used. The diaphragm must be exchanged if it is defective or embrittled. The O-ring in the diaphragm disc should always be exchanged. In doing so be careful not to damage the bottom of the O-ring groove.



For dismounting the inlet valve, remove the four screws so that the springs inside the inlet valve pull it apart. If this should not be the case, lay down the inlet valve for some time in warm water. Do not immerse the pressure gauge! In order to simplify the dismounting, the ball guide and seat holder have an M5 internal thread. The felt filter can be pushed out through the cylinder connection using a thin screw driver or wire.



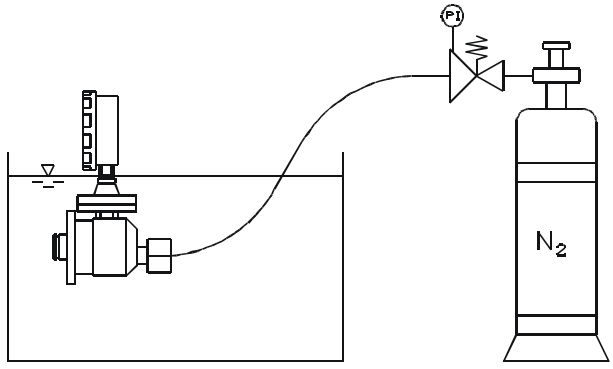
For cleaning purposes, the pressure gauge flange can be opened without problems by unscrewing the six screws so that the silver diaphragm becomes visible. It must be wiped off carefully using a soft cloth. Do not use a sharp-edged tool at any rate.
Under no circumstances the gauge may be unscrewed from the diaphragm flange. The connecting piece ist filled with a liquid and the gauge is calibrated. A new calibration can only be carried out by specialist staff.
If there are red spots on the nickel-plating of the inlet valve, it can be used further on. Only if the spots are located on a sealing surface for the O-rings the component should be exchanged because otherwise chlorine easily could pass the sealing. In most cases damages of the nickel-plating are resulting from humidity penetrating the inlet valve if the cylinder is exchanged or stored without using a sealing plug.

9.1.2 Mounting of vacuum regulator

A PVC wall holder is quite useful when mounting the inlet valve. Attach the inlet valve to the wall holder using the union nut and then put it down. Now you have both hands free for carrying out the actual mounting work.
After cleaning and drying, the inlet valve is mounted in reverse order. All gaskets, balls and filters are exchanged. All O-rings are slightly lubricated using silicone grease except for the valve seats which are mounted without being lubricated. Make sure that the felt filter is seated properly.
To be on the safe side, the screws should be exchanged as stainless steel embrittles after being used in chlorous atmosphere which is not visible with the naked eye. They also should be lubricated and tightened crosswise until the gap of the inlet valve housing is closed.
Before mounting the diaphragm to the diaphragm disc the diaphragm bulges should also be lubricated with silicone grease. The threaded ring is first tightened by hand and then not more than 1/4 turn using a tool. Make sure that the diaphragm does not warp. Lubricate the O-ring with silicone grease, insert it and smooth it down with the thumb until it lies flat in the groove.
Make sure that the diaphragm is properly positioned when assembling the plastic housing. The housing is tightened by hand.

9.1.3 Inlet valve check

The inlet valve is the main safety component of the whole chlorination plant. That's why it has to be checked particularly carefully. For the check you need dry compressed air or nitrogen.
Using an edgeless object (e.g.a biro without reservoir) press in the ball of the inlet valve and then let it off in order to make sure that it is properly seated. Connect the inlet valve using a hose to the compressed air and immerse it in water. Immerse the pressure gauge only up to the pressure transmitter.



Neither at high pressures (e.g. 6 bar) nor at low pressures (e.g. 0.5 bar) bubbles must rise.
After the check the inlet valve is dried thoroughly and then inserted into the vacuum part by turning it slightly. The O-ring has to be lubricated .
The four screws for fixing the inlet valve are also exchanged, lubricated with silicone grease and tightened slightly.

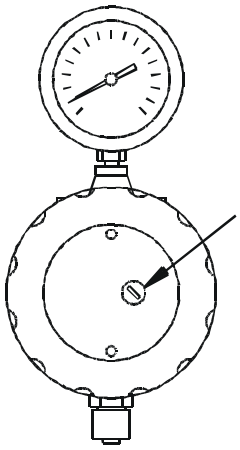
9.1.4 Vacuum regulator check

The whole vacuum regulator must be checked on vacuum tightness. For this purpose the vacuum regulator has to be mounted to the wall holder or

the closed chlorine cylinder. Shortly after switching on the ejector the flow meter must indicate zero.

9.1.5 Adjustment of simultaneous delivery

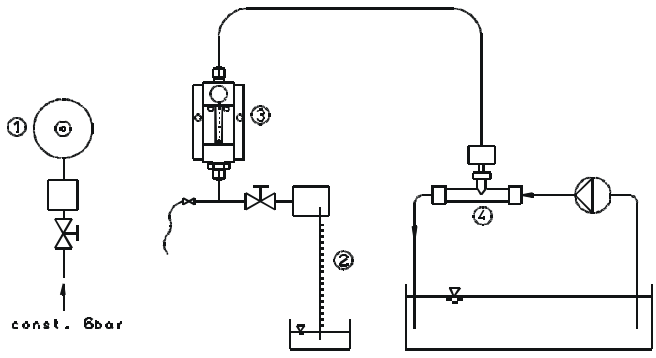
Simultaneous delivery should only be set if it is really used. If not the adjustment screw should be unscrewed until the screw head extends into the housing approx. 3mm.



There are two possibilities for a simultaneous delivery adjustment.

9.1.5.1 Adjustment by means of water column

This type of adjustment is the right possibility if maintenance of the units is carried out in a workshop. The advantage is that all units are adjusted to exactly the same working point and that they can be exchanged for one another or replaced by new units without problems.
A testing station has to be installed in the workshop.



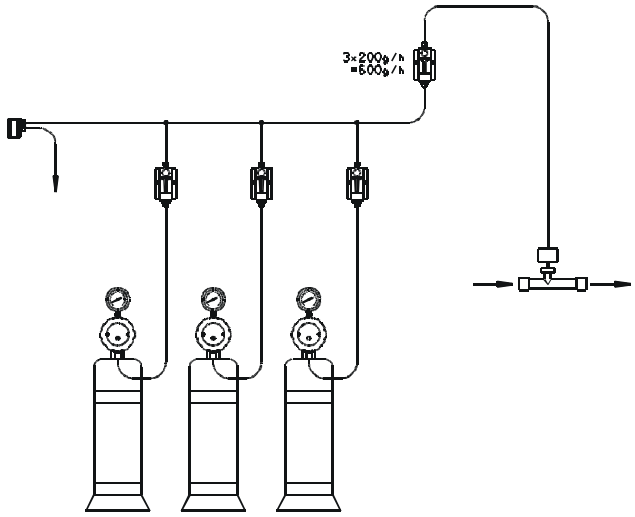
1 Wall holder for vacuum regulator with cylinder for pressurized air (approx.0.5 dm³) const. 6 bar
2 Water column (at least 1200mm) with stop valve and collecting tank at the top of the water column (larger than tank at the bottom of the water column)
3 Measuring glass 200 g/h
4 Ejector with non-return valve and water supply

How to proceed:

- Mount the vacuum regulator with flat gasket to the wall holder and connect the vacuum tubing with the measuring glass. The flow limiter is mounted into the hose connector of the vacuum regulator!
- Close the ball valve in direction of water column.
- Open stop valve for pressurized air and set pressure reducer to 6 bar .
- Switch-on ejector and adjust flow rate at measuring glass to exactly 200 g/h .
- Open ball valve in direction of water column.
- Set adjusting screw such that water column indicates 1100mm. (For units with a higher residual pressure - approx.1 bar - the set value is 1050mm.)
- Close ball valve in direction of water column.
- Switch off ejector.

9.1.5.2 Adjustment by means of flow meters

This method can be applied directly in the plant. The required number of measuring glass holders corresponds to the number of vacuum regulators in the cylinder battery. The measuring glass holders (measuring range 200 g/h) are only required during adjustment.

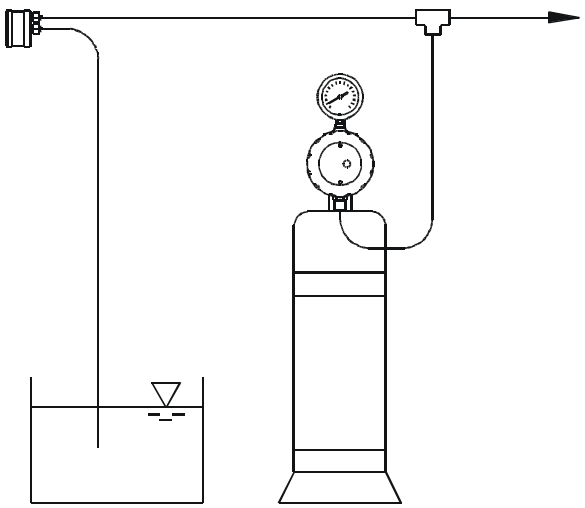


During adjustment all batteries must have the same pressure (see also 4.1.4.) in order to insure a precise adjustment.
Also make sure that the flow limiters are mounted into the regulator hose connectors. Before adjustment all adjustment screws of the vacuum regulators have to be unscrewed until the screw head extends into the housing approx. 3mm.

How to proceed:
- Open all cylinders of the battery.
- Switch on ejector.
- Completely open the adjustment valves of all measuring glasses mounted for adjustment.
- Reduce flow rate of central measuring glass to approx. 200g/h for every connected vacuum regulator.
- Set all flow meters to the same value by turning the screws of the vacuum regulators. Screwing in corresponds to a higher rate whilst unscrewing means a lower flow rate.

ATTENTION!
However, the vacuum regulators adjusted this way are set to the same value within one cylinder battery, but are not identical to another cylinder battery adjusted in the same way. Therefore it is not permitted to exchange single units of the cylinder batteries. In that case a readjustment is absolutely necessary.

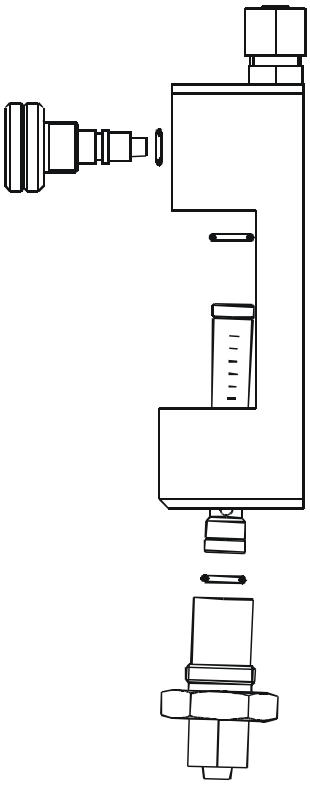
9.2 Safety valve
For maintenance purposes the safety valve has to be cleaned and inspected optically.
The valve seat and the diaphragm have to be exchanged. For dismounting the valve seat you can use pointed pliers for example. In doing so, make sure not to damage the PVC housing! The new valve seat and diaphragm have to be lubricated with silicone grease. The PVC threads also have to be lubricated with silicone grease in order to be able to unscrew them easily later on.
The safety valve leakage test is carried out by producing a vacuum using the ejector while the chlorine cylinder is closed. For this purpose a transparent tubing is connected to the blowoff connector (centric connector) with the other end immersed in water. The water must not rise in the tubing.



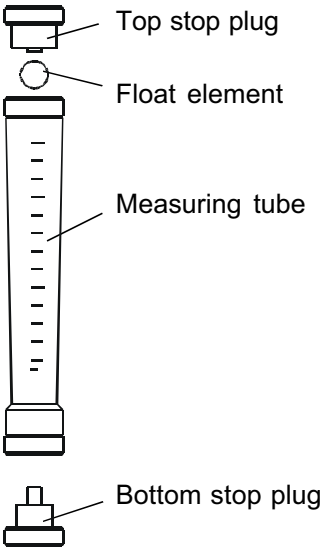
9.3 Activated-carbon cartridge
The filling of the activated-carbon cartridge has to be exchanged either if it is loaded with chlorine or if it gets lumpy due to humidity.

ATTENTION!
There is a strong chlorine smelling if activated carbon is loaded with chlorine gas. Therefore you should absolutely never exchange the filling in closed rooms or in the proximity of aspirating mouths of ventilating systems. For chlorine neutralization, sodium thiosulfate solution is perfectly suitable.

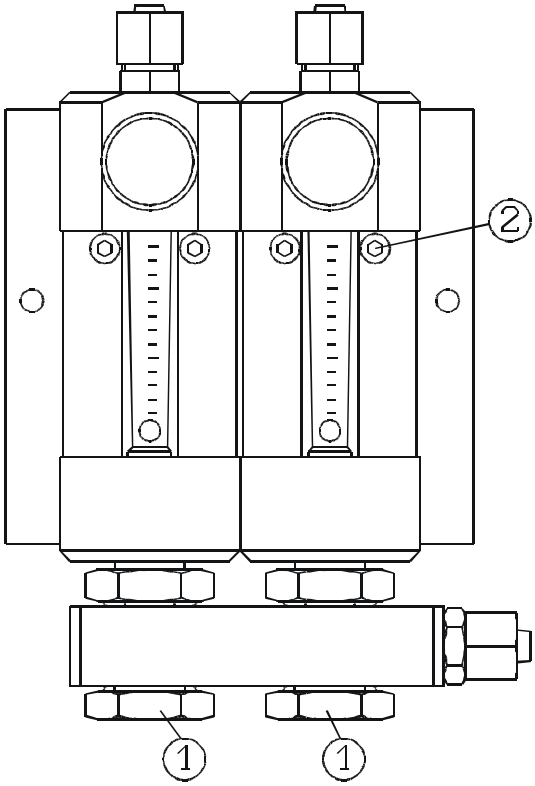
9.4 Measuring glass
For maintenance purposes the measuring glass holder and if necessary the measuring glass are cleaned and the gaskets are exchanged.
To dismount it the lower clamping screw is unscrewed and the O-rings are carefully pulled out of the drilling hole using an edgeless object. Do not damage the PVC!
The O-ring on the setting spindle is carefully removed in the same way. The thread of the adjustment screw is cleaned from crusted grease using a brush and is then lubricated with fresh silicone grease. Do not use vaseline! It hardens so that the thread becomes stiff.



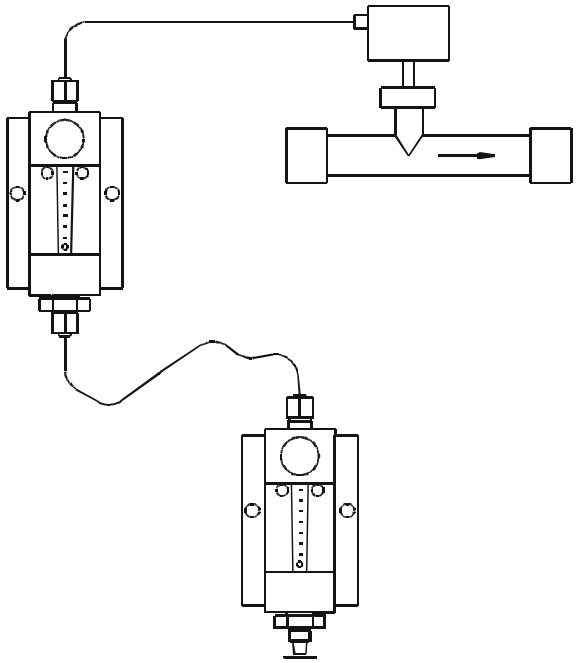
The plastic plugs of the measuring glass are carefully dismounted and the float element is removed. For cleaning isopropyl alcohol is perfectly suitable.
ATTENTION! Do not mix up the float element with other measuring glasses and make sure that it is not damaged!
When mounting the measuring glass to the measuring glass holder make sure that the O-rings are seated correctly.



In the case of twofold or threefold measuring glass holders the clamping screw for the distribution yoke ① is tightened first and then the screws for the wall fixing ② are tightened.

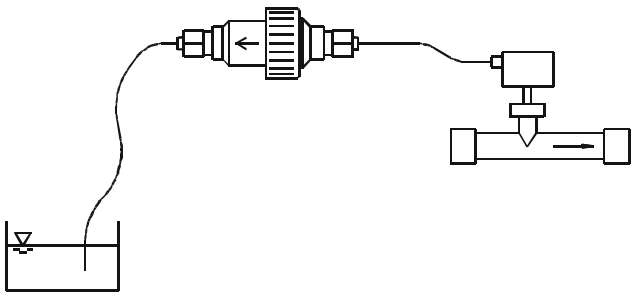


The measuring glass has to be checked on vacuum-tightness. The easiest way to do this is to use a second measuring glass and an ejector. If the bottom connection of the measuring glass to be checked is closed with a cap for example, the auxiliary measuring glass will indicate zero after a short time.



9.5 Back stop

The back stop is dismounted, cleaned and remounted along with new parts subject to wear. Please be especially careful when pulling the central O-ring out of the groove. Always use an edgeless object for this purpose.

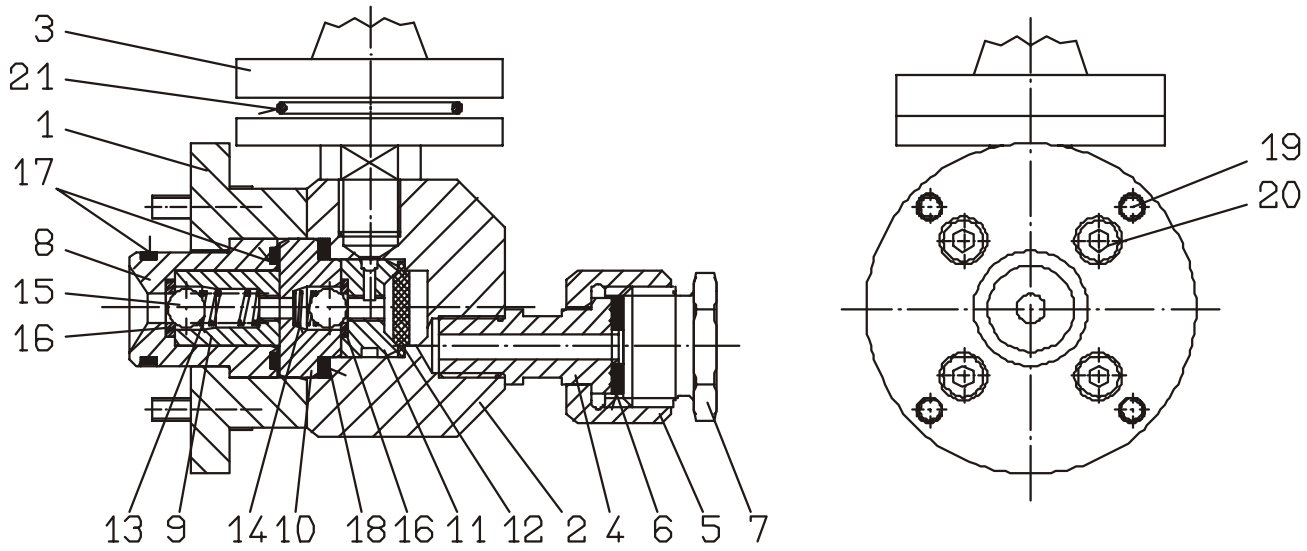


The check is carried out under vacuum contrary to the flow direction. Connect a transparent tubing to the open side and immerse its end into water. The water may not rise in the tubing.

10. Troubleshooting

Type of fault	Possible cause	Recommended action
No flow meter indication or indicated value too low.	Chlorine cylinder empty.	Connect new cylinder.
	Cylinder valve or auxiliary valve not open.	Open valves.
	Vacuum system is not completely tight so that ambient air is primed.	Open valves step by step in order to find and remove untight point.
	Changeover unit did not switch to full cylinder.	Actuate changeover unit by hand and check its function.
	Filter of inlet valve clogged.	Replace filter element.
	Floating element in flow meter clogged.	Dismantle and clean flow meter.
	Dirt screen in motive water line clogged.	Clean and exchange filter.
	Solution injection fitting clogged.	Clean solution injection fitting or open the stop valve.
	Ejector performance too low.	Exchange ejector, reduce back pressure or increase motive water pressure.
	Ejector clogged.	Clean ejector.
	Carbonate precipitations in ejector.	Remove precipitations (e.g.10% hydrochloric acid approx. 5 min.). If possible, set higher chlorine concentration (1..2 g/l) and reduce, motive water pressure, if necessary.
	High back pressure at ejector resulting from incorrect running of solution line.	Optimize solution line, avoid sharp bends and cross-sectional contractions (possibly caused by excessive cement.
	Vacuum lines too small.	Use larger vacuum lines or increase ejector priming output.
Chlorine smell or chlorine alarm.	Leaking overpressure system.	Close chlorine cylinder immediately (using protecting mask) and evacuate lines using ejector. Look for leaking points as described in section LEAKAGE TEST.
	Safety valve bleeds off in the case of overpressure resulting from clogged inlet valve.	Maintain inlet and safety valve as described in section MAINTENANCE and exchange loaded activated carbon if necessary. If there are heavy dirt deposits in inlet valve, check chlorine gas purity and provide for room heating (approx. 20°C).
White deposits in flow meter.	Vacuum system is leaky and air humidity condenses forming white fog.	Look for untight spots and remove them. Otherwise incrustations will be formed affecting valve functions.
Water in vacuum system.	Ejector nonreturn valve untight because defective or clogged.	Maintain ejector nonreturn valve, install backstop.
	End of blowoff line under water and safety valve untight.	Maintain safety valve and pull out end of blowoff line of the water.
Cylinder iced.	Delivery rate too high.	Max. 1% of cylinder filling per hour is permitted. Install flow limiter, increase room temperature.
Cylinders are not emptied uniformly.	Conditions for simultaneous delivery not provided.	See section INSTALLATION.
	Chlorination plant designed for much higher metering capacities than actually required. As a result the delivery rate per cylinder is reduced.	Connect only as many cylinders as really needed. Fix remaining vacuum regulators to PVC wall holder using flat gasket.
	Incorrect adjustment of simultaneous delivery.	Readjust units as described in section MAINTENANCE.

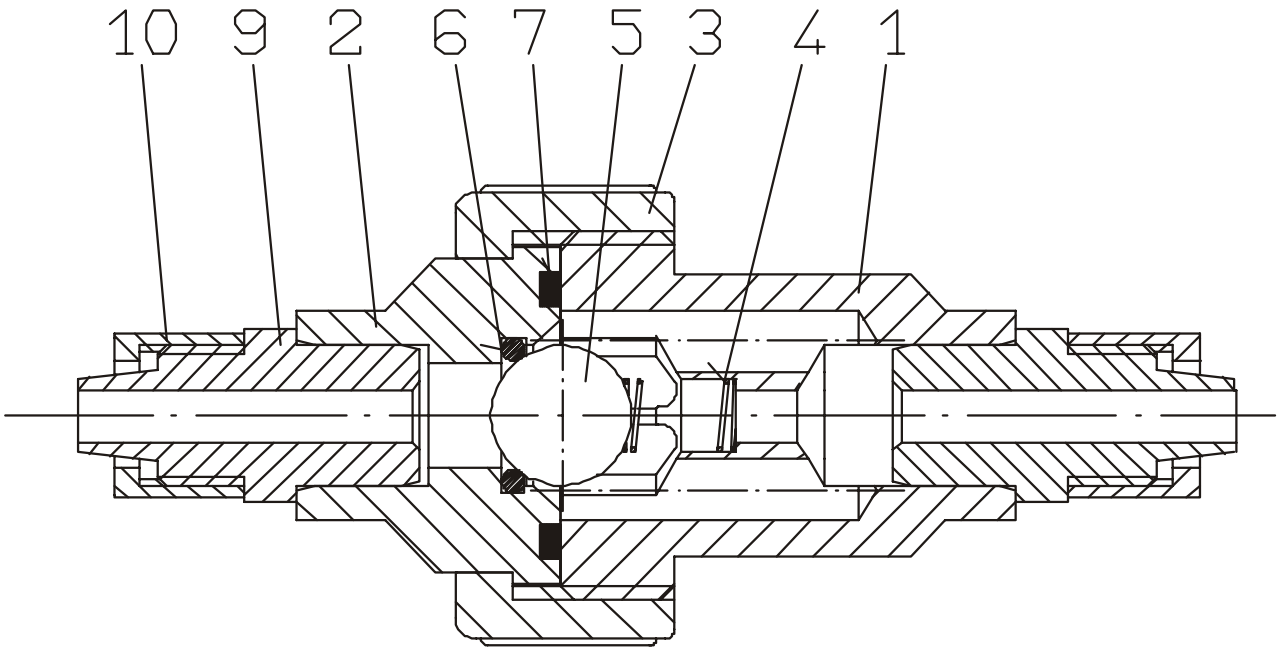
Inlet valve



Item	Description	Material	Qty	Part No.
1	Clamping ring	Brass. nickel-plated	1	35000
2	Valve body	Brass. nickel-plated	1	35001
3	Pressure gauge -1..0..15 bar	Brass/silver/ABS	1	24087576
4	Connecting part W 1". G 5/8 G 3/4	Monel	1	10157 15828
5	Union nut W 1" G 5/8 G 3/4	Brass. nickel-plated	1	10158 26089 15827
6*	Gasket W 1". G 5/8 G 3/4	AF	1	81043 81164
7	Plug W 1" G 5/8 G 3/4	PVC	1	26418 29797 26419
8	Valve cap	PVDF	1	35002
9	Ball guide	PVDF	1	35003
10	Spring support	PVDF	1	35004
11	Valve seat holder	PVDF	1	35005
12*	Filter d 20mm	PTFE-felt	1	35006
13	Pressure spring d 7.5x18mm	Hastelloy	1	10051
14	Pressure spring d 6.9x10mm	Hastelloy	1	28390
	(Pressure spring d 6.8x12mm for increased residual pressure)		1	(34388)
15*	Ball	Ceramic	2	10033
16*	Valve seat	Viton	2	10032
17*	O-ring d 19x2.5mm	Viton	2	80817
18*	O-ring d 21x3.5	Viton	1	80819
19*	Screw M5x16mm	A4	4	83796
20*	Screw M5x30mm	A4	4	83858
	Inlet valve assembly W1" (increased residual pressure W1") G 5/8 G 3/4			35007 (35220) 35008 35009
21*	O-ring d 35x2mm	Viton	1	80827

* contained in spare parts kit.

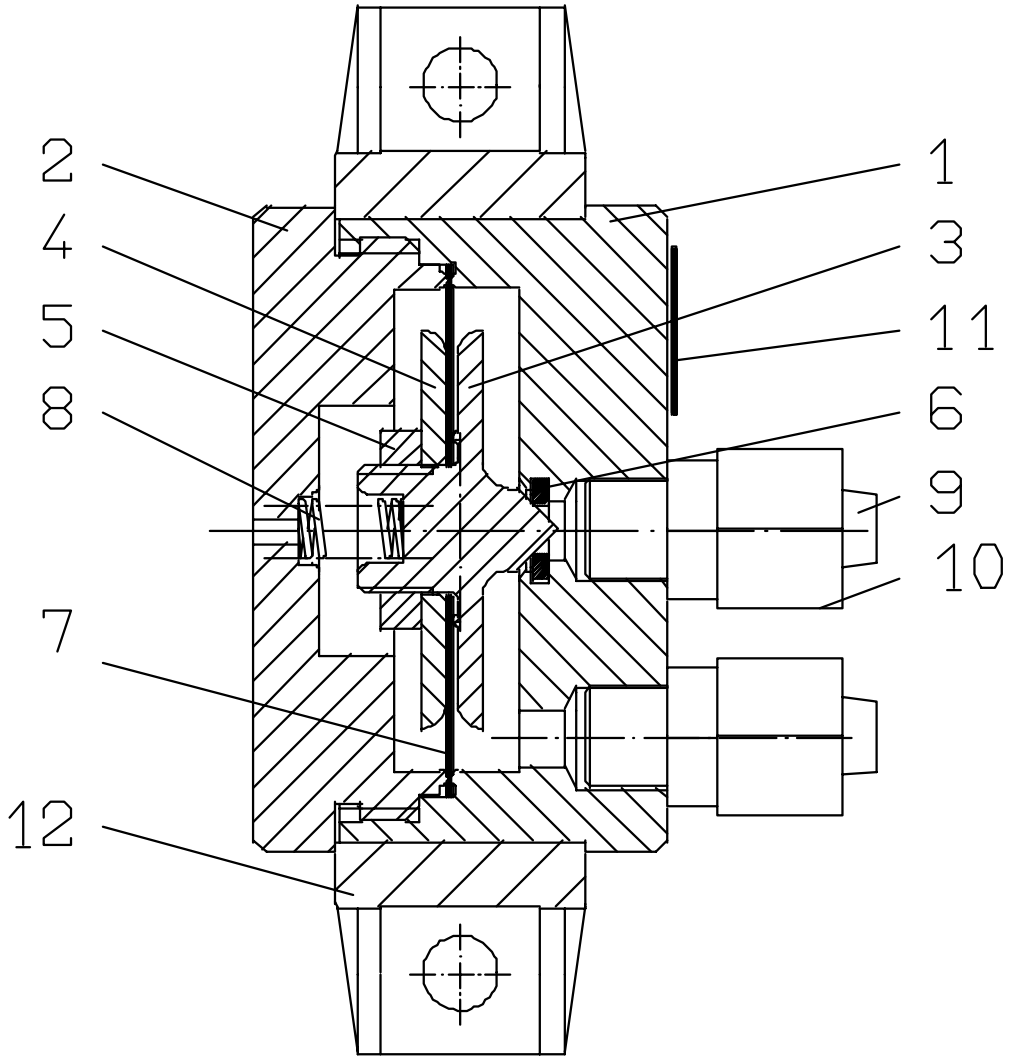
Back stop



Item	Description		Material	Qty	Part No.
1	Ball guide for back stop		PVC	1	35059
2	Seat holder for back stop		PVC	1	35058
3	Union nut G1 1/4		PVC	1	82213
4	Pressure spring d 8.1x27mm		Hastelloy	1	25082
5*	Ball d 16		Glass	1	82457
6*	O-ring d 12.4x2.62mm		Viton	1	80004
7*	O-ring d 25x3mm		Viton	1	80138
8	Arrow label		Adhesive film	1	87359
9	Tubing connection	8/12	PVC	2	33350
		12/16			15533
10	Union nut	8/12	PVC	2	10365
		12/16			15534
	Back stop assembly	8/12			20435060
		12/16			20435061
		d 16i			20435118

* contained in spare parts kit.

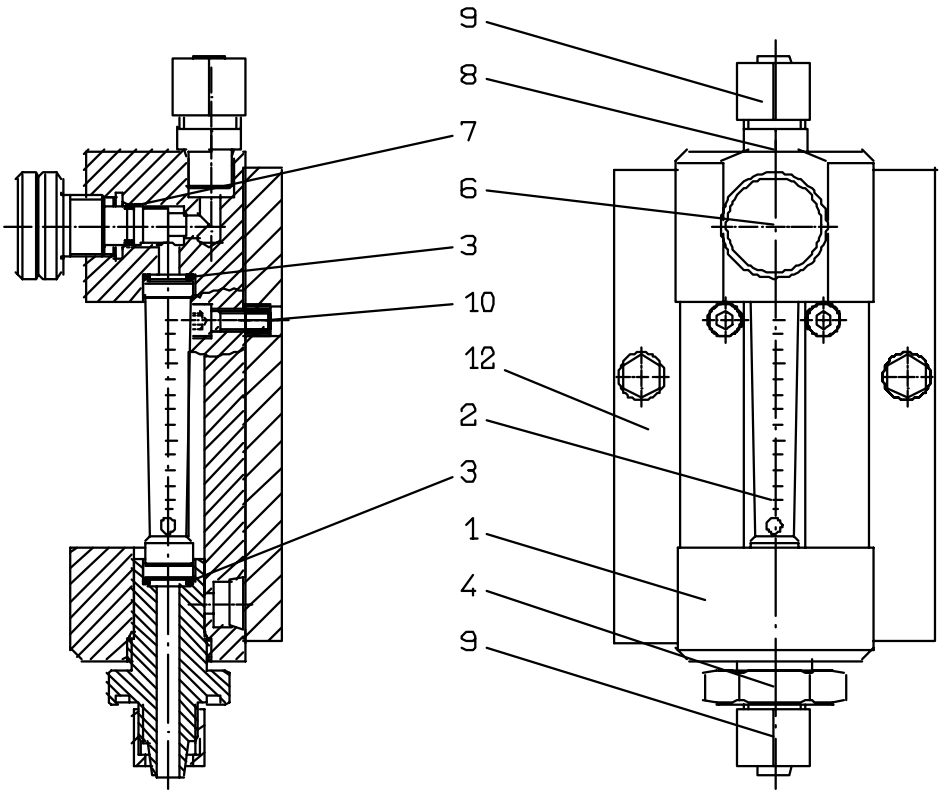
Safety valve



Item	Quantity	Description	Material	Part No.
1	1	Lower part	PVC	32841
2	1	Upper part	PVC	32840
3	1	Diaphragm holder	PVC	32839
4	1	Diaphragm disc	PVC	32842
5	1	Lock nut	PVC	33182
6*	1	Valve seat	Viton	10032
7*	1	Diaphragm	Viton	81682
8	1	Pressure spring (14mm)	Hastelloy	28967
9	2	Clamping connection	PVC	22325
10	2	Union nut	PVC	10365
11	1	"IN-OUT" label	Polyscript	87548
12	1	Pipe clamp	PE	32619
		Safety valve assembly for chlorine gas manifold		32843

* contained in spare parts kit.

Single measuring glass holder

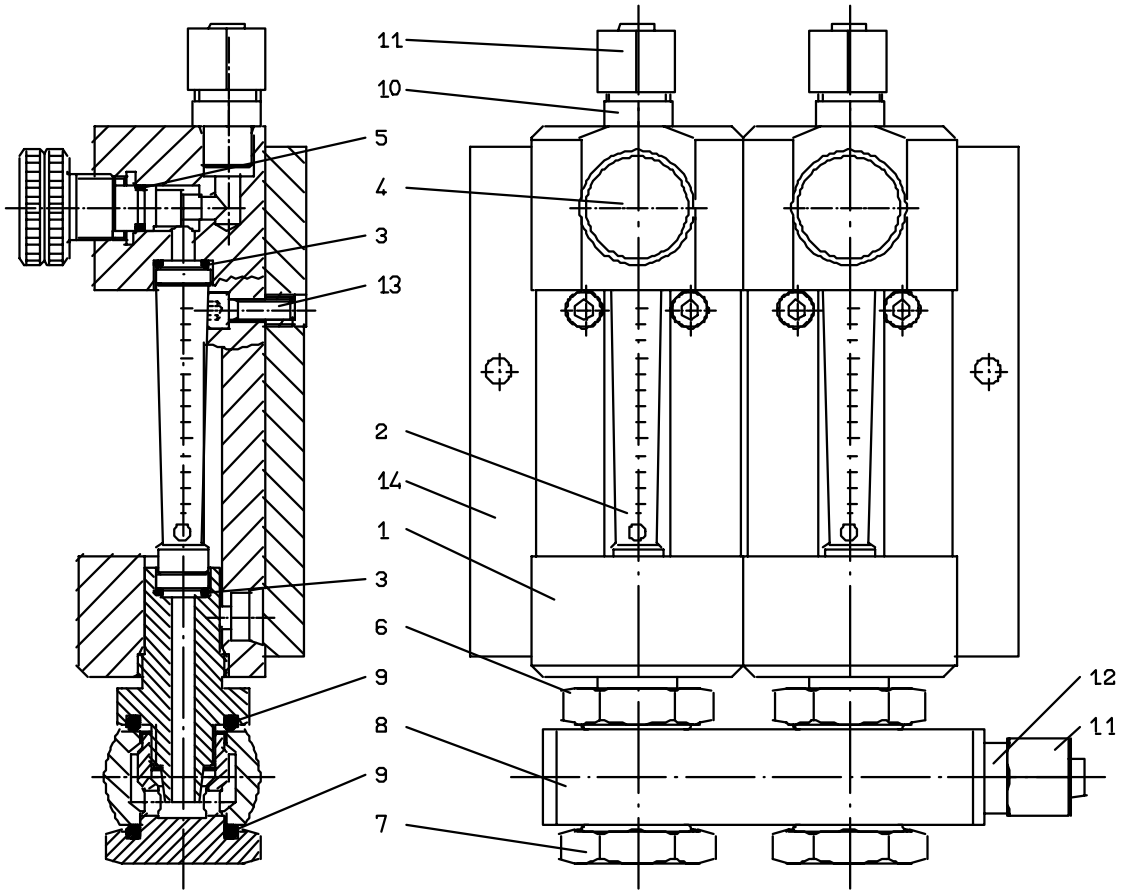


Measuring glass holder for wall mounting

Item	Quantity Wall mounting	Description					Material	Part No.
1	1	Measuring glass holder					PVC	33340
2	1	Measuring glass	1	...	25g	Cl_2/h	Glass/PE	87008
			4	...	80g	Cl_2/h	Glass/PE	87009
			10	...	200g	Cl_2/h	Glass/PE	87010
			25	...	500g	Cl_2/h	Glass/PE	87011
			50	...	1000g	Cl_2/h	Glass/PE	87012
			100	...	2000g	Cl_2/h	Glass/PE	87013
			125	...	2500g	Cl_2/h	Glass/PE	87014
			200	...	4000g	Cl_2/h	Glass/PE	87535
3*	2	O-ring					Viton	81384
4	1	Setscrew for measuring glass					PVC	33341
6	1	Adjusting screw		...	200g	Cl_2/h	PMMA	31107
				...	4000g	Cl_2/h	PMMA	28803
7*	1	O-ring					Viton	80006
8	1	Clamping connection					PVC	22325
9	2	Union nut					PVC	10365
10*	2	Screws					A4	83796
12	1	Mounting plate					PP/A2	33345

* contained in spare parts kit.

Multiple measuring glass holder



Item	Quantity		Description	Material	Part No.
	2-fold	3-fold			
1	2	3	Measuring glass holder	PVC	33340
2	2	3	Measuring glass 1 ... 25g Cl_2/h	Glass/PE	87008
			4 .. 80g Cl_2/h	Glass/PE	87009
			10 ... 200g Cl_2/h	Glass/PE	87010
			25 ... 500g Cl_2/h	Glass/PE	87011
			50 ... 1000g Cl_2/h	Glass/PE	87012
			100 ... 2000g Cl_2/h	Glass/PE	87013
			125 ... 2500g Cl_2/h	Glass/PE	87014
			200 ... 4000g Cl_2/h	Glass/PE	87535
3*	4	6	O-ring	Viton	81384
4	2	3	Adjusting screw ... 200g Cl_2/h	PMMA	31107
			... 4000g Cl_2/h	PMMA	28803
5*	2	3	O-ring	Viton	80006
6	2	3	Setscrew for measuring glass	PVC	33341
7	2	3	Setscrew for yoke	PVC	33342
8	1	—	Distributor yoke 2-fold	PVC	33343
	—	1	Distributor yoke 3-fold	PVC	33344
9*	4	6	O-ring	Viton	80075
10	2	3	Clamping connection	PVC	22325
11	3	4	Union nut d 8/12	PVC	10365
11a	3	4	Union nut d 12/16	PVC	optional (15534)
12	1	1	Clamping connection d 8/12	PVC	10366
12a	1	1	Clamping connection d 12/16	PVC	optional (15537)
13	4	6	Screw	A4	83796
14	1	—	Mounting plate	PP/Ms	33346
	—	1	Mounting plate	PP/Ms	33347

* contained in spare parts kit.