

The following positional indications are referred to the system diagramme on page 5.

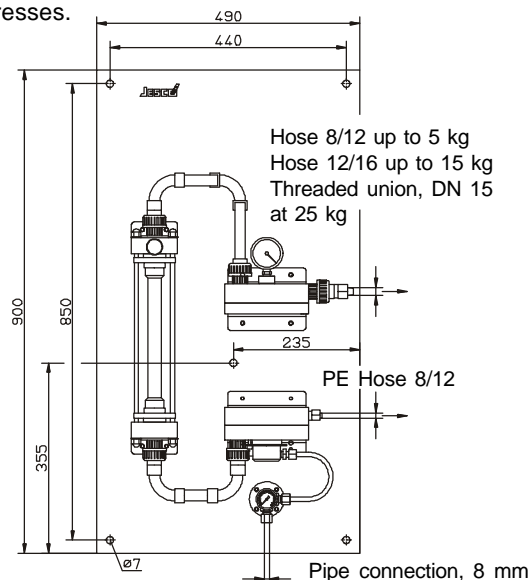
Packaging

Chlorine metering equipment and accessories are packaged individually because of the size of the units and variation of accessories. The actual extent of delivery is indicated on the bill of delivery. Upon unpacking, the packaging material should be carefully inspected for forgotten or concealed items.

Conditions to be ensured before installation

Prior to the beginning of installation, rooms shall be inspected for compliance with the local stipulations of professional associations.

- The floors of the rooms concerned shall be situated above ground level.
- It shall be ensured that no escaping chlorine gas penetrates into rooms, shafts, pits, or channels situated at a lower level.
- No connection is permissible between the chlorine rooms and other rooms; the rooms shall be isolated from other rooms in a fireproof and gas-proof manner. The doors shall open to the outside and be designed in such a way that they can be opened from the inside without the need of a key.
- Each room shall be provided with the smallest possible ventilation apertures at the floor and ceiling levels; these ducts shall be routed immediately to the exterior, and their cross-sectional area shall not exceed 40 cm².
- In unfavourable construction zones, for instance in the proximity of schoolyards or parks, etc., chlorine gas alarm devices with optical and acoustic indications shall be installed; these devices shall be coupled with an automatic sprinkler system. Delayed activation is permissible.
- The consistent use of appropriate tools is vital. In particular, two fork spanners shall be employed for loosening and tightening the chlorine conduits, in order to avoid subjecting the components to excessive stresses.



Attention! The flow meter sight glass must be mounted vertically.

Injector water supply

The injector, 14, shall be installed horizontally with the check valve, 13, facing upward. For increasing safety, the motor-driven ball valve, 12, shall be installed between the check valve and chlorine gas metering unit, in addition. The water supply line should be routed without bends for about one metre upstream and downstream from the injector.

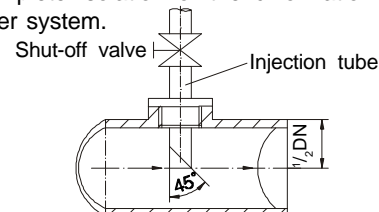
The full suction power of the injector is achieved only if the water pressure prevailing upstream and downstream from the injector as well as the flow rate of propellant water correspond with the values indicated in the instruction sheets. For this purpose, see data sheets MB 2 31 01 or 2 31 02, or the special instruction sheets associated with the consignment.

Chlorine solution line

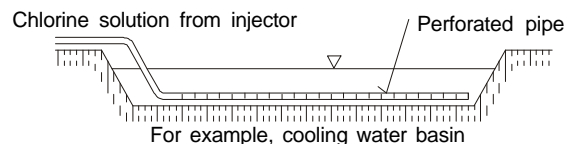
The highly corrosive chlorine solution shall be transported only in corrosion-resistant plastic (PVC) tubing, or metal pipes provided with an appropriate internal coating. For avoiding unnecessary pressure loss, which might impair the function of the injector, the flow velocity should not exceed 1 to 1.5 m/s, and the piping should not be unnecessarily long.

Injection sites

At the injection site, the chlorine solution is added to the water being treated. It is recommended that the injection tube be dimensioned in such a way that the chlorine emerges approximately at the centre line of the water pipeline. Optimal mixing is thus ensured. The injection site should be provided with a shut-off ball valve, in order to permit complete isolation of the chlorination facility from the water system.



The chlorine can be added in open basins, channels, or suction intake shafts by means of long perforated pipes closed at one end and anchored at the bottom under water. A fine distribution of chlorine solution over a large surface area is achieved by means of the perforation.



Safety exhaust line

For protection against overpressure, the chlorine gas metering units are equipped with an overflow safety valve, by means of which the chlorine gas is discharged as necessary in the event of leakage at the intake valve. The exhaust line should preferentially be routed from the metering unit with a slope up to about 0.5 m along the floor (with the end of the hose facing downward). The sensor of a gas alarm device should be located here at a lateral distance of about 0.5 m (see sketch). This arrangement ensures a rapid alarm signal, but also avoids triggering of a false alarm even at a slight exhaust flow rate.

Gas supply

Direct gas withdrawal

Chlorine is supplied in steel cylinders with a capacity of 65 kg and in steel drums of 500 and 1000 kg capacity. In view of the larger quantities withdrawn, however, the use of drums is recommended, since only 1 per cent of the full volume can be withdrawn hourly as gas at an ambient temperature of 20° C. At a chlorine withdrawal rate of 25 kg/h, at least three drums with a capacity of 1000 kg each should be connected for direct gas withdrawal.

Chlorine vaporization

For economic reasons, sustained withdrawal of chlorine at a rate of 25 kg/h should proceed from the liquid state. With the use of an evaporator in conformance with instruction sheet MB 2 05 01, the liquid chlorine is converted to gas by electrical heating and then supplied to the metering unit as already described.

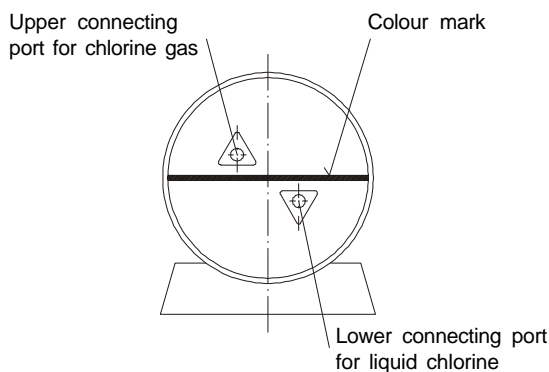
Installation of the chlorine drums and connection with the equipment

The drums shall be positioned horizontally in supporting saddles. The protective cap shall not be removed from the valve until immediately before connection to the piping.

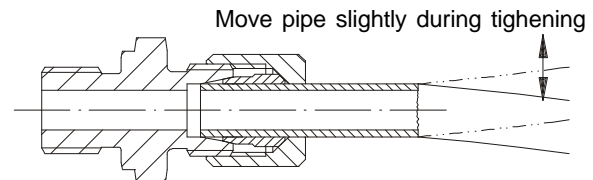
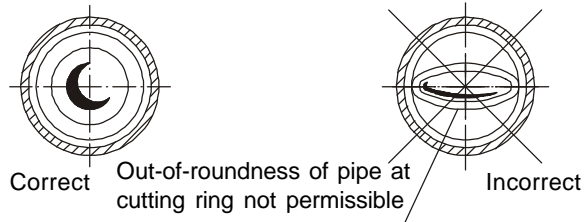
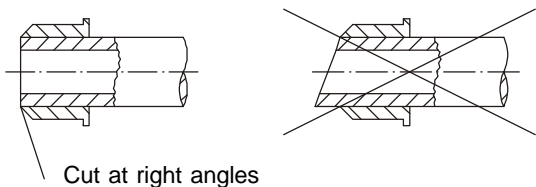
Attention:

In connecting the drums, it shall be ensured that the gas port is connected, and not the liquid chlorine port, if no evaporator is employed.

The drum is marked with a transverse stripe on the front end face. It shall be positioned in the support in such a way that this marking stripe is horizontal. The upper connecting port is employed for withdrawing chlorine gas; liquid chlorine can be withdrawn from the lower connecting port for operation with an evaporator.



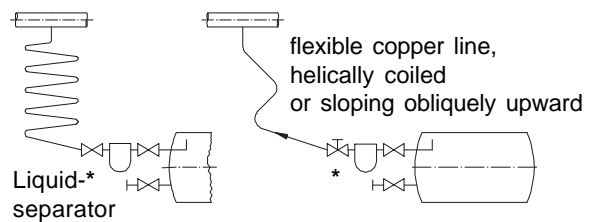
New sealing elements shall always be employed for connecting the piping and valves. The flexible copper connecting lines shall be cut at right angles at both ends before assembly and inserted with great care into the threaded unions with cutting ring.



With the use of an appropriate forked spanner, the threaded nipple is held fast; the retaining nut is tightened with a second forked spanner.

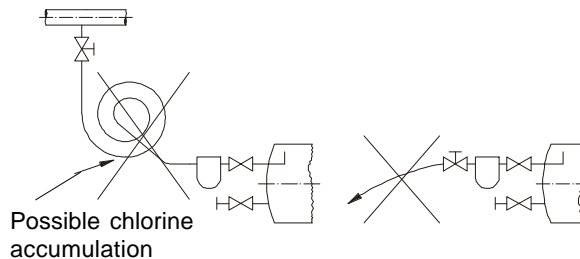
The line must always be routed with an upward slope toward the metering unit.

Correct installation



* The liquid separator can be omitted if the attached piping is appropriately dimensioned for accommodating about 150 cm³ of liquid chlorine without its entering the chlorine metering unit.

Incorrect installation



The piping can be routed arbitrarily, and the liquid separator can be omitted, if the valve for liquid chlorine is connected for the purpose of chlorine vaporization.

If several canisters are employed, they are first connected with the manifold line, 3, to form a unit. A main valve, 4, is installed at the outlet. From this valve, steel or copper piping is installed and routed all the way to the intake valve of the chlorine metering unit.

A solenoid valve, 6, can be installed for automatically interrupting the supply of chlorine gas in the event of alarm; this valve is controlled by the gas alarm device, 25. All pipes and fittings exposed to chlorine gas shall be sealed with liquid DIACRYLATE plastic. The use of organic substances, such as hemp, for this purpose is not permissible!

In the case of severely contaminated chlorine gas, the installation of a chlorine gas filter (9) in the line is recommended.

For continuous operation, the installation of an automatically actuated valve system (5) for the chlorine canisters is useful. This valve system is installed between two sets of canisters and ensures an uninterrupted supply in conjunction with the chlorine gas contact gauge (7). Pilot lamps on a switch box supplied with the actuating device indicate the set of canisters from which chlorine gas is currently being withdrawn. Chlorine canisters as well as chlorine distribution systems shall be protected against direct sunlight or heating by radiators. It is absolutely necessary to avoid a decrease in temperature along the gas supply line below the cylinder temperature, since condensation of chlorine can cause severe damage to the equipment. If there is a hazard of chlorine condensation, a chlorine pressure regulator (8) shall be installed downstream from the cylinder.

Because of the risk of chlorine condensation, it shall be ensured that the preset room heating temperature is not decreased at night, since the chlorine lines cool faster than the drums. Cool nights after hot summer days can give rise to similar problems.

Tightness test

Propellant water and chlorine solution line

After waiting until the adhesive in the joints has cured, the propellant water and chlorine solution line shall be subjected to pressure in combination with the injector and check valve. For this purpose, the propellant water pump is switched on, or the propellant water supply line is opened, and the injection site is closed. The line, now under pressure, must remain free of leaks. No escape of water from the check valve is permissible with the chlorine gas line removed.

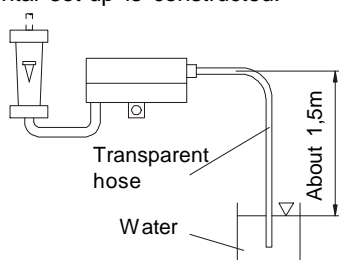
Injector suction efficiency

With a proper supply of propellant water, the suction efficiency of the injector can be tested in accordance with the data sheets by drawing air by suction without an attached chlorine cylinder, and observing an indication of 50 to 70 per cent on the flow meter sight glass.

Vacuum tightness test on the chlorine gas metering unit

The safety exhaust system installed in the chlorine metering unit (in combination with the transparent PE discharge hose to the chlorine gas alarm device) must be absolutely gas-tight for proper operation.

If the valve were not tight, air would be drawn by suction from the atmosphere through the hose and falsify the indication (as though the chlorination rate were lower). For testing the tightness of this valve, the following experimental set-up is constructed:



The end of the hose is immersed in water; the water level shall thereby be situated below the chlorination unit by at least 1.5 m. (The lateral distance is thereby immaterial.) If the chlorination unit is switched on, the water level in the transparent hose must rise by only a certain amount, in correspondence with the displacing volume of the regulator diaphragm, but not indefinitely. In the event of leakage, the water continues to rise indefinitely. In this case, the test is discontinued immediately, before water penetrates into the chlorination unit.

Test on the gas pressure line

Attention: The stuffing box glands of the canister connecting valves may have set since manufacture. In order to prevent the escape of gas from the start, the stuffing box gland should be retensioned before the beginning of operation. See "Canister connecting valves".

The tightness test on the system components exposed to chlorine gas in the gauge pressure range is performed after slow, brief opening of the canister connecting valve, 2, and subsequent blowing of the lines, especially of the fittings, with ammonia from the bottle. If chlorine gas escapes, a white mist forms. Because of the extreme corrosivity of moist chlorine gas, all leaks rapidly become more severe in the course of time.

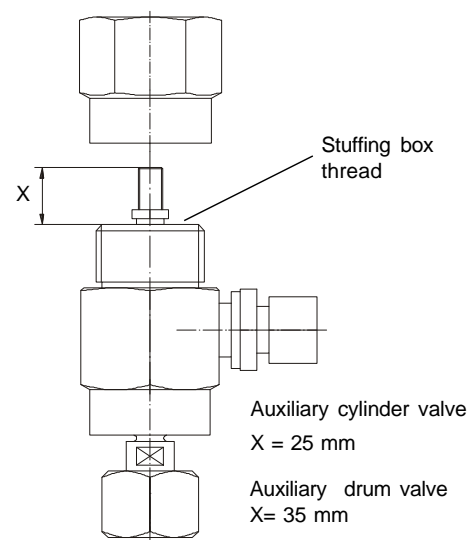
THEREFORE, EVEN THE SLIGHTEST LEAKAGE MUST BE ELIMINATED IMMEDIATELY!

For this purpose, the line with injector shall be evacuated by suction, and the sites of leakage shall be carefully cleaned and dried before resealing.

Canister connecting valves

If the canister connecting valve, 2, is leaky, the threaded stuffing box retaining nut must be retensioned by about one-fourth of a turn.

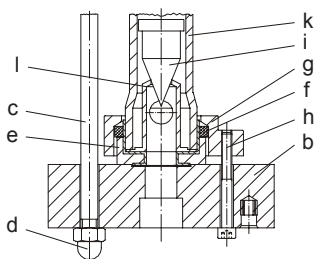
For this purpose, the handwheel must be completely removed from the valve. This operation can be performed under chlorine pressure, since the valve stem cannot fall out.



Replacing the flow meter sight glass

For replacing the flow meter sight glass, the retaining screws are loosened, and the sight glass is removed together with the recipient blocks (b). The stay bolts (c) may be extracted after removal of the cap nut (d). After removal of the screws (h), the recipient blocks (b) can be removed. The procedure for assembly is as follows:

The two recipient blocks (b) are prepared by inserting the flange bushing (e) into the milled opening in the recipient block and sliding the rubber ring (f) over same. The flange (g) (still without the sight glass) is then fastened hand-tight with the screws (h) against the recipient blocks (b). The flow meter sight glass (k) is prepared by inserting the float (i) into the sight glass with the point facing downward and inserting the stops (l) into the ends of the sight glass. Subsequently, the premounted recipient blocks are slid over the ends of the sight glass. The stay bolts (c) are inserted, and the fastening nuts are tightened.



Start of operation

Before starting operation of the system, it shall be ensured that sufficient chlorine canisters have been connected, in order to limit the hourly withdrawal of gas to 1 per cent of the canister contents. The operation shall start successively from the site of injection to the chlorine drum.

- The injection station is opened.
- The propellant water supply is switched on.
- The main valves of the chlorine canisters are opened.
- The auxiliary chlorine valves are opened slowly, in order to prevent possible entrainment of liquid chlorine.
- The desired chlorine flow rate is adjusted by means of the flow meter sight glass.

The procedure in the order indicated ensures as far as possible that chlorine can be quickly withdrawn by suction in the event of unexpected leakage.

Switching the system off

The canister connecting valves are closed, and operation of the system is continued until the float in the flow meter indicates zero.

Attention! Before prolonged shut-down, the piping and other system components exposed to gas shall be flushed with nitrogen or dry air for about five minutes. The auxiliary valve should then be disconnected from the cylinder and closed with a threaded plug. If there is a risk of freezing, the components which contain water shall be drained.

Maintenance

Maintenance at regular intervals prevents trouble. A service agreement is recommended.

If there are no rules/specifications (e.g. GUV 8.15) or special annotations prescribing shorter maintenance intervals, all JESCO chlorinators have to be maintained and tested by an authorized specialist firm at least once a year. Preferably this should happen at the beginning of a high-rate period, prior to a downtime or a restart. The vacuum system just described requires little maintenance. Nevertheless, a chlorination facility should never remain unobserved.

Even the slightest leak quickly increases because of the corrosive action of air-humidified chlorine gas; this in turn results in corrosion of other system components.

Hence: Whenever leakage is detected, the facility must be shut down, and the site of damage eliminated immediately.

Work on the pressurized gas line, canister replacement

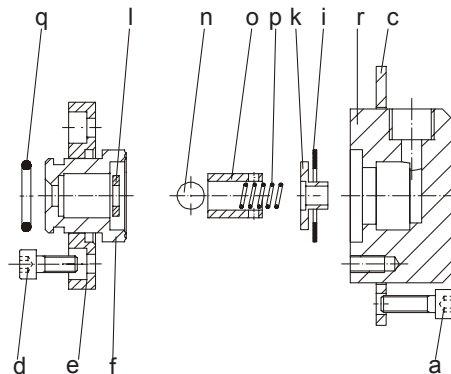
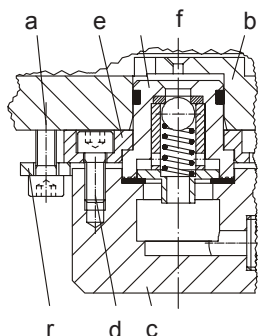
If a defective component has been detected, the chlorine canister valves shall be closed, and the gas shall be withdrawn by suction by actuation of the system. The defective component shall be dismantled, and the remaining gas line shall be protected against moisture (for instance, by inserting a dry rag into the end of the pipe).

MOISTURE IN THE GAS LINE CAUSES PITTING CORROSION.

Before changing the chlorine canisters, the main valve is firmly closed and detached from the chlorine canister with the use of a forked spanner. The protective cap is placed on the chlorine canister. The full canister is placed in the supporting saddle, and the protective cap is removed. For further details, see "Gas supply". The auxiliary canister valve is provided with a new sealing element and connected to the main valve. The main valve is briefly opened, and the connection is checked for gas tightness with the use of ammonia. Upon resuming operation, it shall be ensured that the newly connected canister is at room temperature. Under no circumstances shall the canister be warmer than the surroundings.

Seat replacement

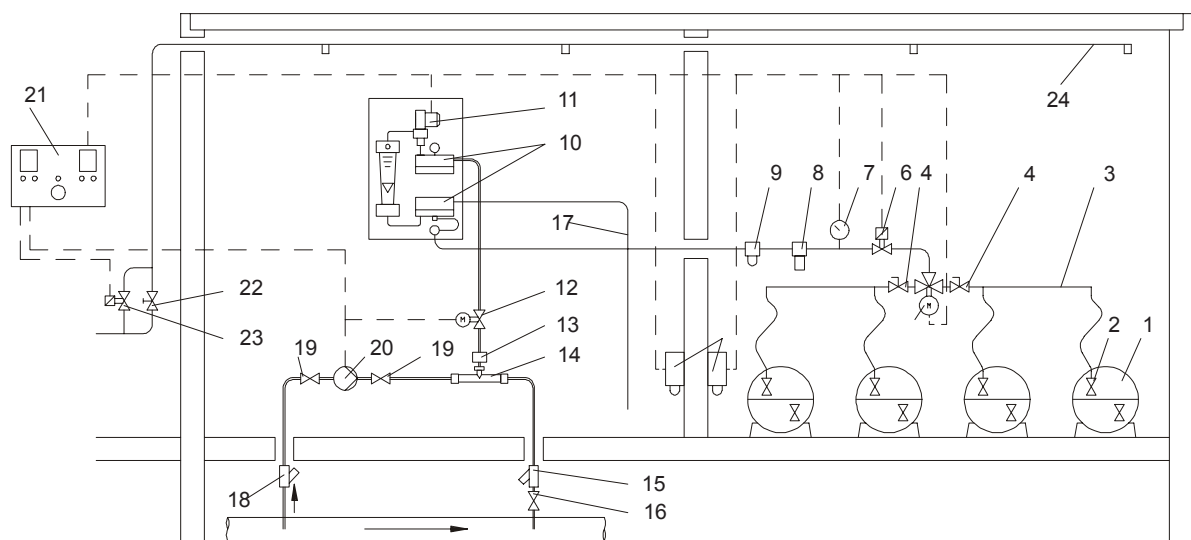
Before removing the connecting lines from the chlorine gas metering unit, the system shall be evacuated until the pressure gauges and flow meter indicate zero for several minutes. Disassembly can then begin. After removing the screws (a), the clamping ring (r) can be removed downward. The complete intake valve (c-f) can be removed from the unit housing by slight rotation. After loosening of the screws (d) and removal of the clamping ring (e), the valve cap (f) is withdrawn. All components shall be cleaned with carbon tetrachloride, isopropanol, or warm water, and then thoroughly dried. New sealing elements and seats shall be employed for reassembly!



The intake valve is reassembled as follows:
All components are slightly lubricated with Vaseline or silicone grease.

The upper section of the valve is first prepared: the valve cap (f) is inserted through the clamping ring (e), and the valve seat (l), ball (n), tubular spacer (o), and spring (p) are inserted in succession. The upper and lower sections are now combined and fastened with the screws (d) with crosswise tightening. The O- ring (q) is pulled on with Vaseline. The complete intake valve is then connected with the chlorine gas metering unit.

Installation diagramme



Note

Not all system components shown are absolutely necessary. The extent of installation should be carefully planned by a specialist. Chlorine butter can present serious problems. A reliable remedial measure is the use of the pressure reducing valve (8) in the system as indicated in the dimensional sheet, MB 2 07 01.

Legend

1 Chlorine drum	MB 2 21 01	13 Injector check valve	MB 2 32 01
2 Auxiliary valve on chlorine drum with flexible copper piping	MB 2 22 01	14 Injector	MB 2 31 02
3 Manifold pipe	MB 2 23 01	15 Check valve	
4 Main shut-off valve	MB 2 22 01	16 Shut-off valve with solution inlet	MB 2 34 01
5 Electrically actuated chlorine switching valve	MB 2 24 01	17 Safety exhaust line	
6 Emergency shutoff valve		18 Filter	
7 Contact gauge for chlorine switch-over	MB 2 40 01	19 Shut-off valve	
8 Pressure reducing valve	MB 2 07 01	20 Pressurizing pump	
9 Chlorine gas filter	MB 2 26 01	21 Control cabinet	
10 Chlorine gas metering unit C 2525	MB 2 02 25	22 Solenoid valve for sprinkler system	MB 2 36 10
11 Electrically actuated chlorine gas regulating valve	MB 2 07 10	23 Externally accessible, manually operated shut-off valve for sprinkler system	MB 2 36 10
12 Shut-off ball valve		24 Sprinkler nozzle	MB 2 36 10
		25 Sensors for gas alarm device	MB 2 36 01

Troubleshooting

Fault type	Possible cause	Remedy
No display or insufficient display on rotameter.	Chlorine cannister empty, indicated by low chlorine gas pressure.	Connect new drum.
	Connection valve closed.	Open valve.
	Chlorine gas line kinked or blocked.	Close connection, evacuate lines and unit, close propellant water valve, dismantle chlorine gas line and clean or replace.
	Blocked filter upstream of intake valve, indicated by low chlorine volume despite high vacuum.	Clean or replace filter.
	Propellant water pressure too low.	Compare injector characteristics sheet with actual pressure values, if necessary, install pressurizing pump. Open reducing valve. Counterpressure too high.
	Excessive pressure drop in dirt trap of propellant water.	Remove dirt cleaner from reducing valve and clean filter. Also flush water lines.
	Injector blocked, contaminated or restricted by deposits (possibly caused by decarbonization in the diffuser).	Remove injector, clean PVC intake nozzle and outlet borehole using hydrochloric acid and rinse well in water. If possible, apply higher concentration of chlorine (1 to 2 g/m ³) in the solution to obtain more HCl.
	Blocked solution intake.	Remove and clean solution intake and check whether valve is fully open.
	Excessive counterpressure caused by kinked or blocked solution line. Excessive pressure losses caused	Route line with sufficiently large bends. PVC lines may have restricted cross-sections due to incorrect jointing. Check joints. by friction in pipes and fittings.
	Plummet stuck in flow meter sight glass.	Clean rotameter as described under Maintenance.
Metered volume does not increase when intake valve is opened.	Vacuum components sucking in external air.	Check the suction line joints, check valve in injector and flow meter sight glass clamp.
	Intake valve contaminated.	Remove intake valve and clean as described under Maintenance.
	Injector sucks in too little vacuum.	See above.
Chlorine smell in room.	Plummet stuck in flow meter sight glass.	Clean flow meter sight glass as described under Maintenance.
	Leak in gas lines or safety valve of chlorine unit blows off.	Immediately close cannister connection valve and evacuate lines using injector. Perform a leakage test as described under Commissioning.
Vent line continuously sucks in air.	Internal safety valve in unit is leaking. Intake valve dirty or damaged.	Remove intake valve and clean as described under Maintenance. Replace damaged parts.
Safety exhaust line continuously sucks in air.	Diaphragm tension leaky or diaphragm is torn.	Dismantle unit and check all parts. Carefully reassemble.
Water in unit.	Check valve at injector defective: Diaphragm torn, sealing washer ripped out of holder, spring break, dirt on sealing surface.	Remove and dismantle check valve. Clean and replace defective parts. Mount motor-driven ball valve (see flow diagram, Item 12).
	End of vent line not protected against water.	Re-route vent line. Point line end down.
Re-liquifying chlorine, visible by yellow humidity in flow meter sight glass and chemical decomposition of PVC parts in regulator chamber.	Temperature in equipment room too low compared with chlorine storage room. Excessive extraction with full chlorine canisters.	Raise room temperature to chlorine storage room temperature. Install chlorine heater or reducing valve. Install drop separator. Do not extract more than 1% of canister content per hour. Slowly open valves.
Icing	Chlorine extraction too high.	Connect other chlorine canisters.