1. General

Chlorine gas changeover units of type C2006 are designed and built according to the highest safety standards in compliance with DIN 19606. The changeover unit C2006 permits continuous chlorination by automatically changing over to the standby cylinders. The changeover unit operates without any auxiliary energy and need only be serviced once a year. So-called full-vacuum systems can be built up with these units, with vacuum directly from the chlorine cylinder. Even in the case of line rupture, chlorine gas cannot escape from a system installed in this way.

2. Delivery scope

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

3. Safety instructions

⇒ JESCO chlorinators have to be maintained and tested by specialist staff at least once a year (cf. also local rules or specifications, e.g. GUV 8.15).

⇒ Chlorine gas may be dangerous for your health or life. Utmost care must therefore always be taken 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. In Germany the Accident Prevention Rule Chlorination of Water (VBG 65) of the German Professional Association is valid. It can be obtained in its current version from the German Municipality Accident Insurance Association (Gemeindeunfallversicherungsverband).

⇒ The valves on the chlorine cylinders must always be closed before starting any work on the chlorine gas metering system. All lines carrying chlorine must be discharged using the ejector.

⇒ Before startup of the chlorine gas metering systems, all connections must be carried out properly and tightened using the suitable tools. The tightness of the entire system must be tested using ammonia (ammonium hydroxide solution).

⇒ Chlorine gas is extremely hygroscopic. Atmospheric humidity can consequently penetrate 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 (including those on vacuum units and vacuum lines) must be closed at all times.

⇒ If chlorinators are to be used for gases other than chlorine gas, the chemical resistance of the units must be checked after consultating the manufacturer.

4. Installation

Installation of the chlorinators usually is carried out according to the drawing of the planning department. Examples for installation diagrams are illustrated in data sheet MB 2 04 13. It also includes references to other data sheets that should be taken into consideration.

The changeover valve includes a wall bracket (refer to spare parts sheet ET 2 04 13/2). It is screwed onto the wall bracket with the two hexagon socket head screws. The connection of the changeover unit must point downwards. A space of roughly 20 cm should be left to the right and left of the changeover unit in order to permit adjustments after installation.

In addition to any locally applicable regulations, Accident Prevention Rule VBG 65 must also be observed when installing the equipment. Installation work should be carried out by specialist staff, since even minor installation errors may cause faulty metering or even destroy the unit.

Always use appropriate tools for the installation. For example when tightening union nuts a second tool must be used for counter-holding in order to avoid distortion of the units . Otherwise mechanical stress may cause damage of the components.

Before mounting all threads should be lubricated using silicone grease or PTFE spray. This will make it easier to unscrew the threads even after a long operation time.

Note:

Vaseline should not be used for lubricating chlorine system components. Because of its hygroscopic effect, chlorine gas will extract water from the Vaseline and cause it to harden.

All devices must be mounted in the position 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.

5. Chlorine supply and vacuum lines

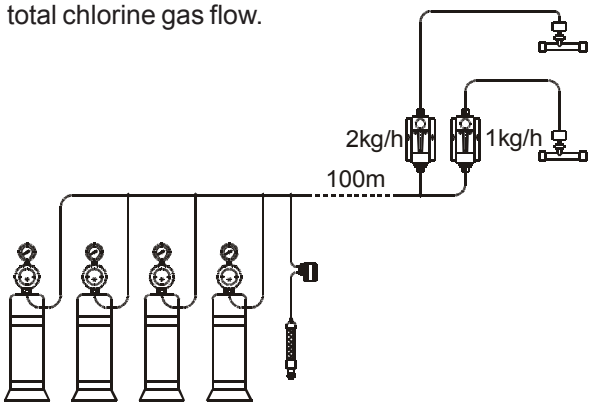
Inelastic PVC tubes and flexible PE tubings are used for the vacuum lines. PVC tubing are normally not suitable for use with vacuums. Fabric reinforcements to make the tubing vacuum-proof are not resistant to diffusing chlorine gas.

The risk of chlorine gas condensing in the vacuum lines is almost excluded due to the low pressure. Such condensation is only to be expected at temperatures below –30 °C. However, temperature must never be allowed to drop so low, otherwise the materials will become brittle.
The vacuum required to transport the chlorine gas is built up by the ejector. Theoretically a vacuum of up to 1 bar is theoretically possible, but the ejector primes only at a technically reasonable lower vacuum. The pressure loss resulting from pipe friction in the vacuum lines must consequently not be higher than 50 mbar. The required cross-section is shown in the following table as a function of the line length and metered capacity.

Maximum tubing length for vacuum lines

Tubing 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 size of the vacuum line is determined by the total chlorine gas flow. If the line is divided into two lanes directly before the metering point, for instance, the long line must be dimensioned considering the total chlorine gas flow.



In this example, the long distance is carried out with DN12 and the relatively short connecting lines with 8/12 PE tubing.

6. Leakage and function tests

Before startup of the chlorinators a leakage test of all plant components must be carried out.
During normal operation of the system, the chlorine changeover unit will switch over to the standby chlorine cylinder or battery as the vacuum increases because of chlorine shortage.
The condition “Cylinder empty” can also be simulated by closing the cylinder valve by hand – the changeover valve must then switch over to the full cylinder automatically.
Manual operation:
The changeover valve can be switched by hand. The connected cylinder is activated immediately when the actuator button for that side is pressed.
The following steps should be taken to protect the equipment prior to extended breaks in operation (e.g. when closing outdoor swimming pools for the winter).
- Rinse all lines (overpressure and vacuum lines) and devices with dry air or nitrogen for approx. 5 minutes.
- Dismount the changeover unit in unheated or damp rooms and store in a dry place.
- Dismantle and service the unit. Lightly coat all screw threads and elastomer parts with silicone grease.
- Tightly seal all connections so that atmospheric humidity cannot enter and cause damage to the equipment.

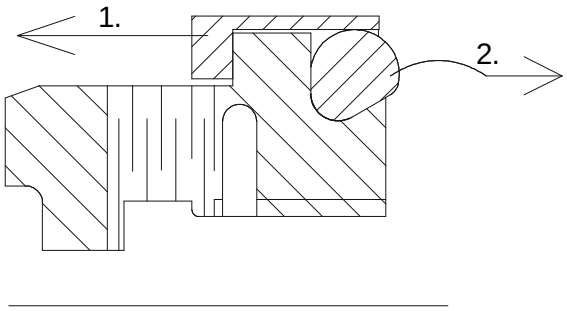
If these points are followed during operation interruptions of the changeover unit, it can be restarted without difficulty even after longer periods out of operation.

7. Maintenance

Regular maintenance spares yourself a lot of trouble! A maintenance contract 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.
Please make sure that the chlorine containers are closed before starting any work on the chlorinator. The system must be evacuated with the ejector until the reading in the metering glass is zero.
For maintenance, the changeover unit has to be disassembled, cleaned and wearing parts have to be exchanged. All other components are visually examined and only replaced if necessary. The usual wearing parts are combined in a maintenance kit (refer to the spare parts sheet).
Warm water or isopropyl alcohol can be used to clean the components. They have to be dried thoroughly before being re-assembled.
Gaskets and diaphragms must be lightly coated with silicone grease. Never use Vaseline as it will harden because of dehumidification and may then cause malfunctions.
Compression springs are not really wearing parts. However, they can become chemically corroded by moisture and must then be replaced. Compression springs must never be tested by compressing them completely, as this will overstress them.

7.1 C2006 Dismounting

1. For easier understanding, it is advisable to consult the spare parts sheet ET 2 04 13 / 1.
2. Remove the wall mounting plate (Item 25) from the changeover unit.
3. Back off the four headless screws (Item 19) by approx. two turns.
4. Unscrew the two covers (Item 13) and the magnets (Item 12) from the two covers (Item 1) with the aid of the special tool (JESCO Part. No.: 31631). Caution: Do not lose the plugs (Item 18).
5. Unscrew the hat nuts (Item 17), remove the washers (Item 16) and place the C2006 on a clean and level surface (connections point upwards).
6. Completely remove the four stud bolts (Item 15) from the housing.
7. Unscrew the threaded bush (Item 14) and then the nut (Item 10) from the shaft (Item 5). These parts are released on either the right or the left, but this is of no significance for the subsequent steps. The housing is forced apart in the center by the action of the spring.
8. Remove the shaft. The remaining nut and the threaded bush can remain on the shaft.
9. Carefully pull the housing parts (Item 1-3) apart and separate all parts. Note any loose parts which could be lost.
10. Sort out the parts in front of you and check that they are complete.
11. Consult the spare parts sheet ET 2 04 13 / 3.
12. Draw the backup ring (Item 8) off the valve bellows (Item 2) as illustrated below.
13. Pull the O-ring (Item 1) off the valve bellows.



7.2. C2006 parts evaluation and examination

All O-rings and diaphragms are generally replaced during the annual maintenance. These parts are available as a maintenance kit (refer to the spare parts list ET 2 04 13).

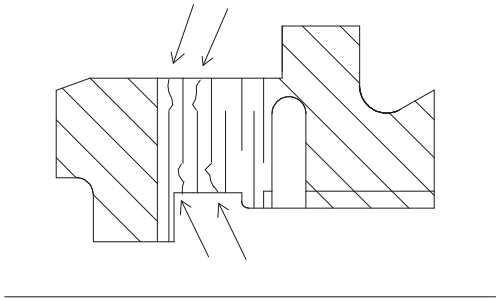
Examine all parts and clean or replace them as required. Hand-hot water can be used to clean the parts. All parts must be thoroughly dried before being re-assembled.

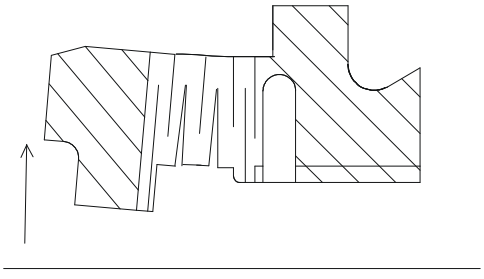
The surfaces of the PVC housing parts should be undamaged. Cratering or corroded surfaces indicate that liquid chlorine has penetrated inside the device. The parts affected must be replaced in this case. Discoloration of the internal surfaces is normal and unproblematic.

All seals, O-rings and diaphragms are made of Viton. These parts must be examined for embrittlement, cracking and hardening and replaced if necessary. Particular attention must be paid to the following parts:

Bellows:

If cracks appear in the concertina folds of the bellows, the unit will no longer be vacuum-tight and cannot switch correctly. The bellows may become deformed into the shape of a trumpet if the central shaft is tightened down excessively. Such bellows must also be replaced.





Steel discs and magnets:
The steel discs must lie flat on the magnets. Any deposits between the magnet and steel disc (side with the raised ring) or unevenness must be removed. The surface of the steel discs has been treated; if it is corroded, the steel discs must be replaced as the unprotected steel will corrode further in the atmosphere containing chlorine. Magnets and steel discs are slightly coated with silicone grease before being re-assembled. Magnets should always be replaced in pairs. The retaining force gradually declines with time, even in the case of a permanent magnet. Magnets of different strength make it more difficult to adjust the switching point.

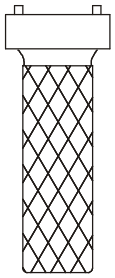
Springs:
The two springs must retain their original shape. The springs are approx. 25 mm long. Under no circumstances should the ends of the windings be bent inwards, as this would prevent the springs from gliding smoothly over the valve bellows. The springs must be replaced in pairs in order to ensure that they both exert the same force and to permit adjustment of the switching point.

7.3. C2006 assembly
Note: The magnets and cover discs are fitted last.

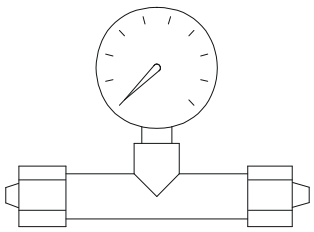
1. Completely coat the screw thread, magnets and steel discs with silicone grease.
2. First fit one side of the four stud bolts (Item 15) with a hat nut (Item 17) and washer (Item 16).
3. Fit one end of the shaft (Item 5) with a nut (Item 10), actuator button (Item 12), O-ring (Item 4), washer (Item 11) and flange sleeve (Item 9).
4. Attach the cover (Item 1) to the prepared shaft and the four stud bolts and place it on a flat surface. The venting bore must face towards you.
5. Now fit the diaphragm (Item 8), with the bead facing upwards, and then the bushing (Item 7).
6. Then position the housing part with two connections facing forwards (Item 3).
7. Place the O-ring (Item 6) in the mount.
8. Now consult the spare parts sheet ET 2 04 13/3.
9. Position the valve bellows with O-ring, backup ring (Item 2, 1 and 8) and O-ring (Item 6). The O-ring (Item 6) is secured with silicone grease.
10. Now fit the spring (Item 7).
11. Then add the washer (Item 5), O-ring (Item 3), diaphragm (Item 4) and another washer. Ensure that the smooth side faces outwards when fitting the washers.
12. Fit the second spring (Item 7).
13. Now position the valve bellows as described in step 9 (other direction).
14. Press the bellows down to check whether the spring glides completely over the valve bellows or whether the first turn stops between the backup washer and valve bellows.
15. Now position the housing part (Item 2) with the connection facing forwards.
16. It is advantageous to press the two housing parts together at this point and secure them with a strip of adhesive tape on each side.
17. Now consult the spare parts sheet ET 2 04 13/1 again.
18. Fit the bushing.
19. Insert the diaphragm (Item 8) with the bead facing downwards.
20. Fit the cover (venting bore facing forwards).
21. Screw the four hat nuts (Item 17) two or three turns onto the stud bolts with fitted washers (Item 16). Grease the screw thread of the stud bolts! Remove the strips of adhesive tape.
22. Fit the flange sleeve (Item 9) and O-ring (Item 4).
23. Position the washer (Item 11) with the smooth side inwards and the contour outwards.
24. Screw the nut (Item 10) tightly onto the shaft by hand.
25. ”Tip” the changeover unit to the right so that the connections face towards you.
26. Now screw the nut down tight (approx.10 Nm).
27. Screw in the threaded bush (Item 14).
28. Ensure that all four housing parts lie flat on the surface and are not twisted in relation to one another. Securely tighten the hat nuts (Item 17) working crosswise.
29. Ensure that all plugs (Item 18) have been fitted!
30. Screw the magnets approx. 6 mm deep (recessed) into the cover.
31. Adjust the switching point as described in 9.4.2
32. The headless screws are only tightened after adjustment.

7.4. Adjustment of the changeover unit

The following special tools are required for adjustment of the working point:



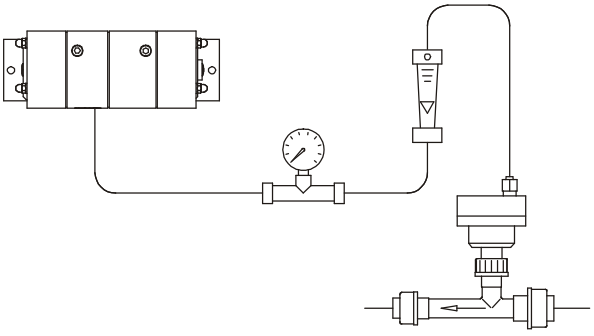
Adjusting wrench
(Part No. 31631)



Vacuum gauge on T-piece with tubing connections
(Part No. 32245)

7.4.1 Testing the switching point

To test the switching point, the vacuum gauge must be installed in the tubing line between changeover unit and ejector. It should indicate the vacuum directly at the suction nozzle of the changeover unit. The suction capacity of the ejector should be limited to max. 300 g/h via the adjusting valve of the metering glass, for example.



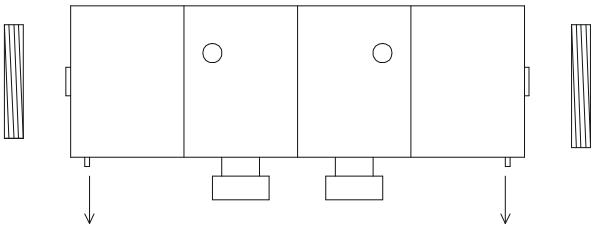
The vacuum required to switch the changeover unit can be read off on the vacuum gauge by sealing the active suction connection with a finger. The value should be uniformly

-0.35...-0.5 bar

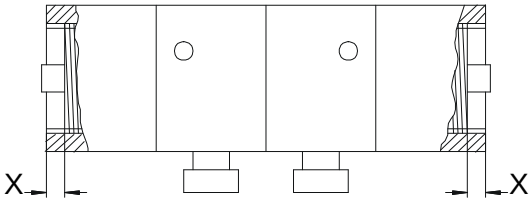
for both switching directions. The changeover unit must be re-adjusted if this is not the case.

7.4.2 Adjustment of the switching point

Unscrew the PVC cover discs over the magnets with the adjusting wrench. Slightly undo the four headless screws underneath the changeover unit.



The magnets must be screwed in to roughly the same depth on both sides. Value „x“ can be set to approx. 6 mm as a rough guide for the basic setting.



The switching point is adjusted by screwing the magnet opposite the connection concerned in or out:

Screw in: Unit switches at a greater vacuum

Screw out: Unit switches at a lower vacuum

The magnets should be screwed in and out in small steps since the working point changes considerably by the slightest magnet movement at the switching point.

When the adjustment is complete, the magnets are secured by tightening the headless screws underneath the changeover unit. Since the position of the magnets changes slightly in the screw thread at the same time, the switching points should subsequently be checked again and re-adjusted if necessary.

Finally, the PVC covers are screwed in without applying force to protect the magnets against water splashing from the sprinkler system.

Troubleshooting

Type of fault	Possible cause	Recommended action
Changeover unit does not switch	Ejector suction capacity not adequate	Locate fault in ejector
	Leak in suction line - therefore vacuum too low	Check vacuum lines
	Leak in diaphragms or O-rings	Perform maintenance routine
	Switching point not set correctly	Re-adjust changeover unit
	Dirt particles in the changeover unit prevent the O-ring sealing the flat surface of the housing	Perform maintenance routine
	Break / leak in bellows	Perform maintenance routine
Changeover unit only switches in one direction	Switching point not set correctly	Re-adjust changeover unit
	Leak in just one vacuum line makes a strong vacuum impossible	Locate and remedy the leak
	Dirt particles in the changeover unit prevent the O-ring sealing the flat surface of the housing	Perform maintenance routine
	Break / leak in bellows	Perform maintenance routine
Changeover unit cannot be switched even by hand	Corrosion or fouling inside the changeover unit	Perform maintenance routine / replace defective parts
	Magnets have been screwed in too far	Re-adjust changeover unit
Changeover unit switches although the cylinder concerned is not yet empty	Temporarily excessive withdrawal of chlorine - thus causing the cylinder to ice up and further reducing the maximum withdrawal rate	Ensure a uniform withdrawal rate (max. 1% of the total cylinder volume per hour). Adjust controller parameters if necessary.
	Not all the cylinders in a battery are used, the infeed is inadequate	Check / adjust simultaneous withdrawal
	Control by solenoid valves in the chlorine line causes a vacuum shock	Use valves with continuous control, e.g. C7700
	Changeover unit not set correctly	Re-adjust changeover unit