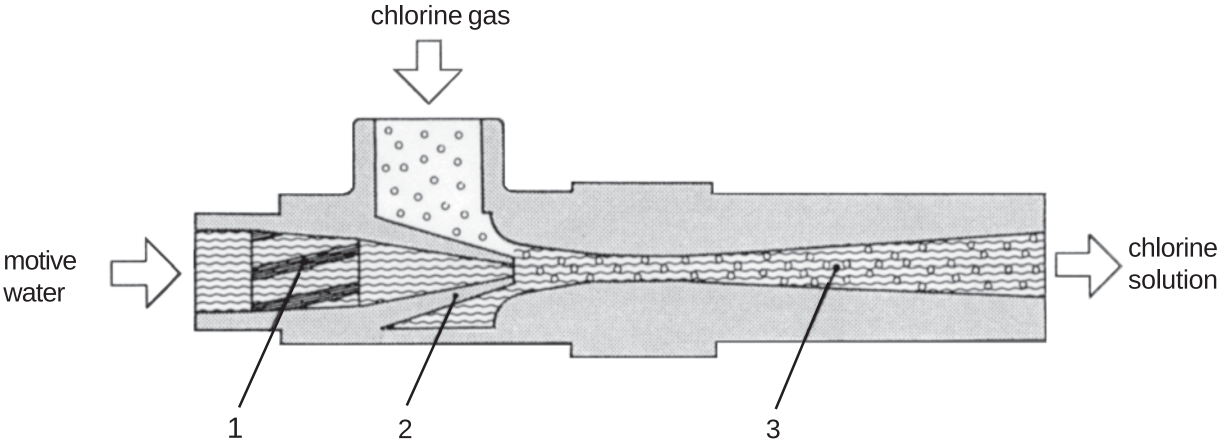
# Standard Ejectors

## General

A characteristic feature of chlorination systems to DIN 19 606 is that the chlorine gas to be metered is maintained at subatmospheric pressure and therefore in a range which is proof against leakages. Any leaks would merely cause air to enter the system, but would not allow chlorine gas to escape.
The water jet pump or ejector as it is commonly known has proved its value here for decades, since the ejector does not have any moving parts subject to wear and because it not only generates a vacuum, but also mixes the chlorine gas and water. The water required for operation of the ejector is mixed with the chlorine gas to form a chlorine solution which is added to the drinking or bathing water to be treated.

## Functional description

The water is swirled by swirl units (1) as shown in the drawing on this page and emerges through the nozzle (2) at high speed, the diameter of the jet widening as a result of the centrifugal force of its rotational movement. This jet has a piston-like effect in the opposing diffuser (3). Chlorine gas is entrained from the vacuum area by the water droplets and enters into a solution with the water. More and more chlorine gas is entrained as the vacuum is constantly regenerated.



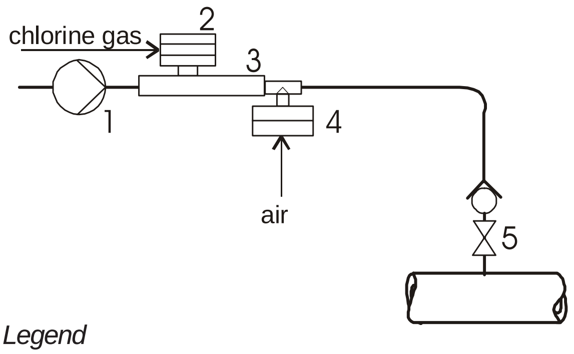

However, this very simple physical process presupposes that the motive pressure, backpressure and suction pressure are all correct. If they are not, the ejector may be unable to prime chlorine gas or cannot restart when switched off or simply cannot extract the required volume of chlorine gas.

Important !
Ejectors of the sizes discussed here are volume pumps. The vacuum generated for the extraction should therefore be no lower than necessary, otherwise the volume required by the gas law would be unnecessarily large.

## Decarbonization

Hard water can precipitate out through decarbonization and leave deposits in the ejector. These deposits can significantly impair the ejector performance or cause it to fail completely. Hard-water deposits are normally destroyed by the hydrochloric acid contained in the chlorine solution. If the volume of motive water remains unchanged but the amount of chlorine is significantly reduced, the resultant smaller quantity of hydrochloric acid can no longer clear the hard-water deposits from the diffuser. In such cases, it is therefore advisable either to increase the amount of chlorine at regular intervals or to adjust the volume of motive water in accordance with lower, constant amount of chlorine.
If the ejector fails on account of hard-water deposits, it must be pickled with hydrochloric acid (10%), but not cleaned by mechanical means.

## Installation example




*Legend*
1 Motive water pump
2 Ejector non-return valve
3 Ejector
4 Vacuum breaker
5 Chlorine solution inlet

## Pipe dimensions

On the inlet side to the ejector, a pipe can be installed with the same nominal width as the discharge connection of the booster pump, but can also be reduced to the size of the ejector connection. On the outlet side of the ejector, the pipe should be installed in such a way as to limit the flow rate to not more than 1.0 m/s. This is the only way to prevent an unnecessarily high loss of pressure which acts as a backpressure to the ejector and reduces its performance. Since the loss of pressure increases with the length of the pipe, every effort should be made to keep the line to the injection point as short as possible.
Unavoidable changes of direction in the pipe routing must be realized with the aid of bends and not with sharp corners.

## 1. Installation of the injector

The injector is installed in a horizontal position. The injector non-return valve is mounted directly on the upward facing intake port of the injector. The injector may also be installed vertically, in which case the injector non-return valve must be mounted with a bracket to restore the correct position. On the input side, the piping should be straight for at least three times the injector length and with the same nominal width as the injector. The same also applies for one injector length on the delivery side of the injector.

## Fittings to protect equipment and increase safety

The motive water may run back when the booster pump is switched off, with the result that chlorine solution could enter the pressure reducer fitting and solenoid valves and cause considerable damage. The installation of a non-return valve is advisable in such cases.
A non-return valve must always be installed on the chlorine gas side to prevent water flowing to the chlorinator when the system is switched off.
On the outlet side of the ejector, a vacuum breaker must be installed if there is any risk of water draining from the ejector to geodetically lower parts of the piping when the system is switched off. This would create a vacuum and inadvertently entrain chlorine gas. This is prevented by installing a vacuum breaker as blow valve to break up the vacuum.

## 1. Injector design

Injector performance declines
- in the presence of a lower motive water pressure / motive water flow
- in the presence of a higher backpressure
- in the presence of a strong vacuum (lower intake pressure) e.g. 0.7 bar abs =85% of the injector performance at 0.8 bar abs (refer to the diagram of performance as a function of intake pressure).
- in the presence of a higher motive water temperature e.g. 30 °C=76%, 40 °C=63% of the injector performance at 20 °C. This depends on the temperature-dependent solubility of chlorine in water (refer to the diagram of temperature dependence).

All pressures / temperatures are measured directly at the injector!
Note that the injectors are made of PVC, i.e. the maximum permissible operating pressure decreases with increasing temperature (only PN 10 instead of PN 16 at 40 °C).

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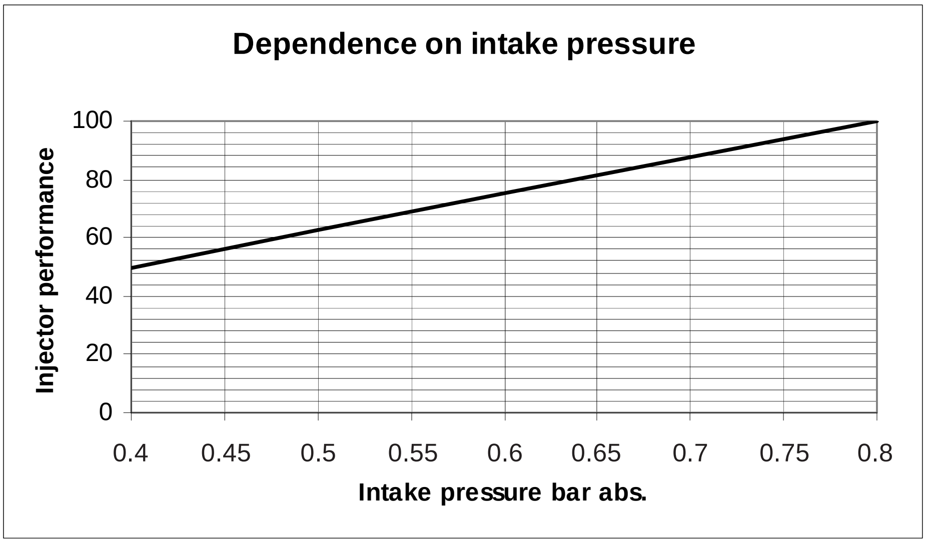
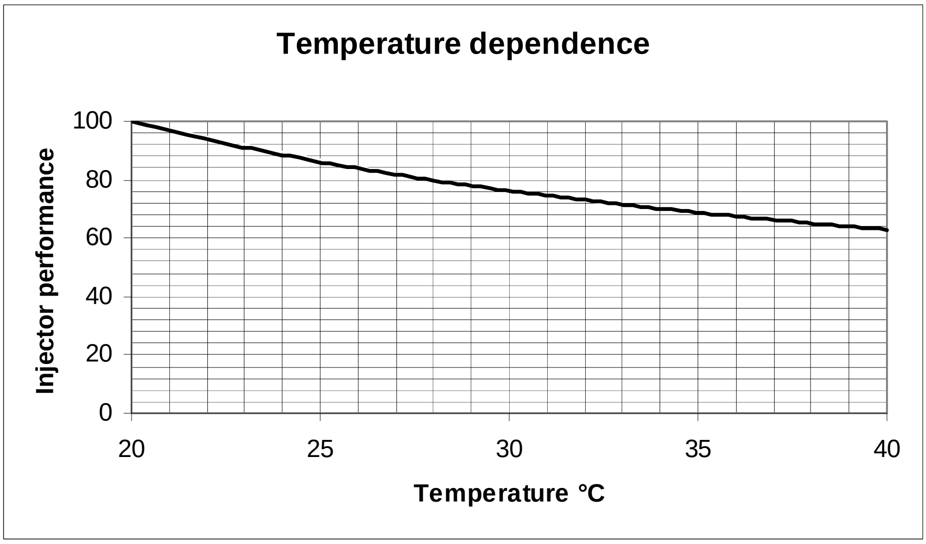
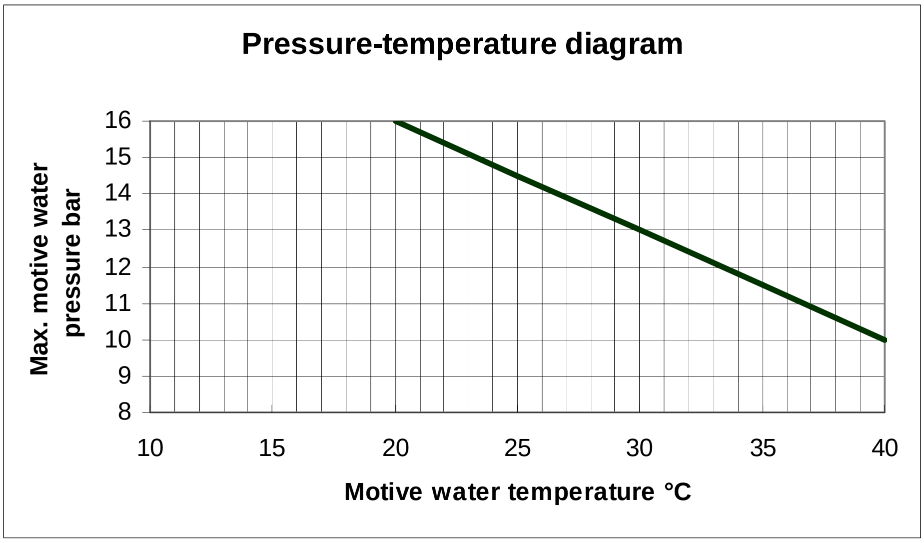
Example: Motive water temperature 30°C = 76%,
Intake pressure 0.6 bar = 75%
76% x 75% = 57% altogether, i.e. 43% lower intake performance as compared with the working curve.



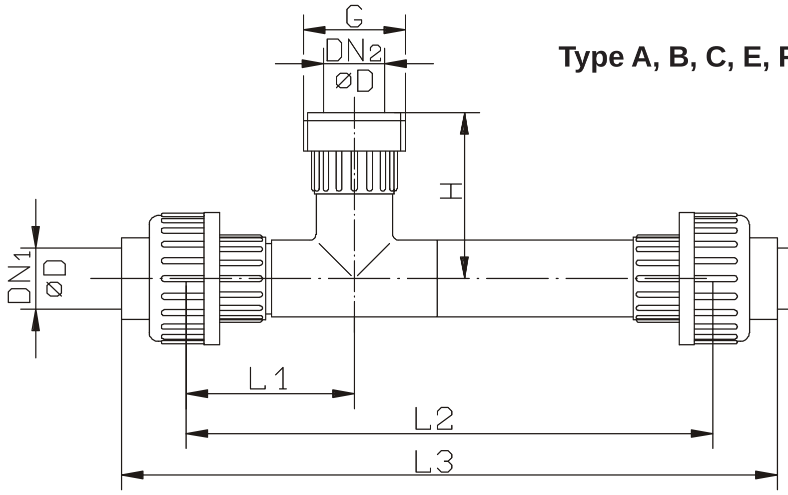
Injectors can be selected on the basis of the following parameters and corresponding working curves, with due regard for the motive water temperature (max. 40 °C).

- Required chlorine gas flow in kg $Cl_2$/h
- Required intake pressure
- Backpressure directly after the injector in bar (note the subsequent pressure loss in the line!)
- Performance data of the motive water pump to be used

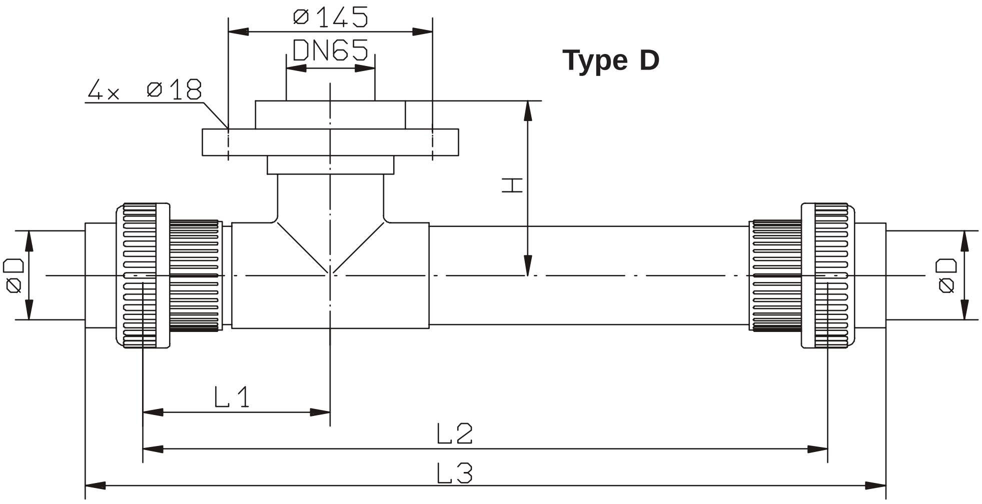
Please contact us if exceptional operating parameters are involved.

**Dimensions**

**Type A, B, C, E, F**




**Type D**




| Ejector type | max. capacity kg $Cl_2$/h | DN mm | DN2 mm | D mm | G | H mm | L1 mm | L2 mm | L3 mm |
|---|---|---|---|---|---|---|---|---|---|
| A | 1.6 | 15 | 15 | 20 | G 1 | 54 | 55 | 173 | 214 |
| AH | 2.0 | 15 | 15 | 20 | G 1 | 54 | 55 | 173 | 214 |
| B | 3.2 | 15 | 15 | 20 | G 1 | 54 | 55 | 173 | 214 |
| E | 6.4 | 15 | 15 | 20 | G 1 | 54 | 55 | 173 | 214 |
| BH | 4.0 | 20 | 15 | 32 | G 1 | 59.5 | 65 | 210 | 254 |
| C | 20.0 | 32 | 32 | 40 | G 2 | 87.5 | 93.5 | 276 | 335 |
| CH | 8.0 | 32 | 32 | 40 | G 2 | 87.5 | 93.5 | 276 | 335 |
| F | 24.0 | 32 | 32 | 40 | G 2 | 87.5 | 93.5 | 276 | 335 |
| DH | 16.0 | 40 | 40 | 50 | 2 1/4 | 104.5 | 114 | 413 | 483 |
| D | 60.0 | 50 | 65 | 63 | Flange | 125 | 128 | 474 | 556 |

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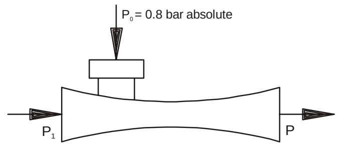
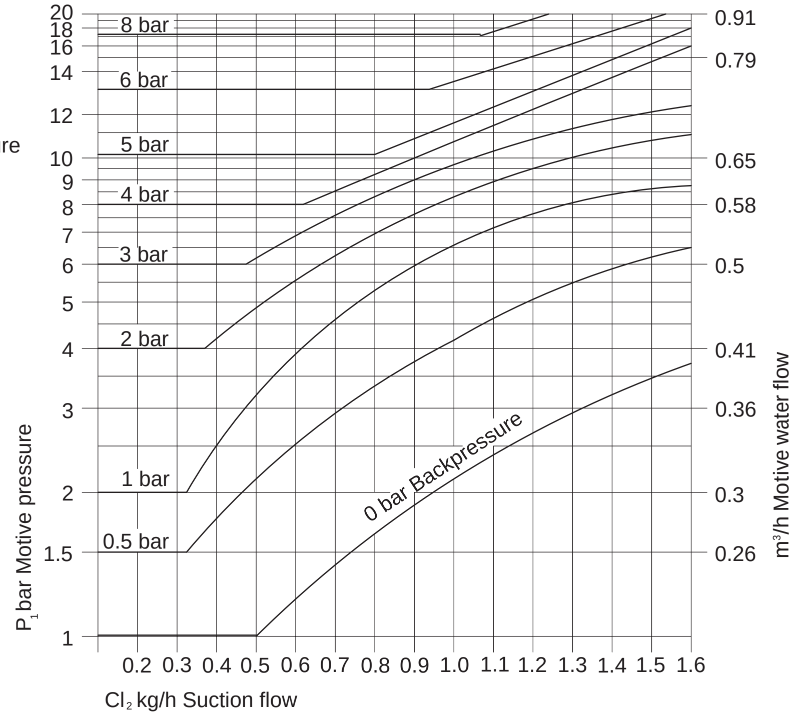
## Ejector curves

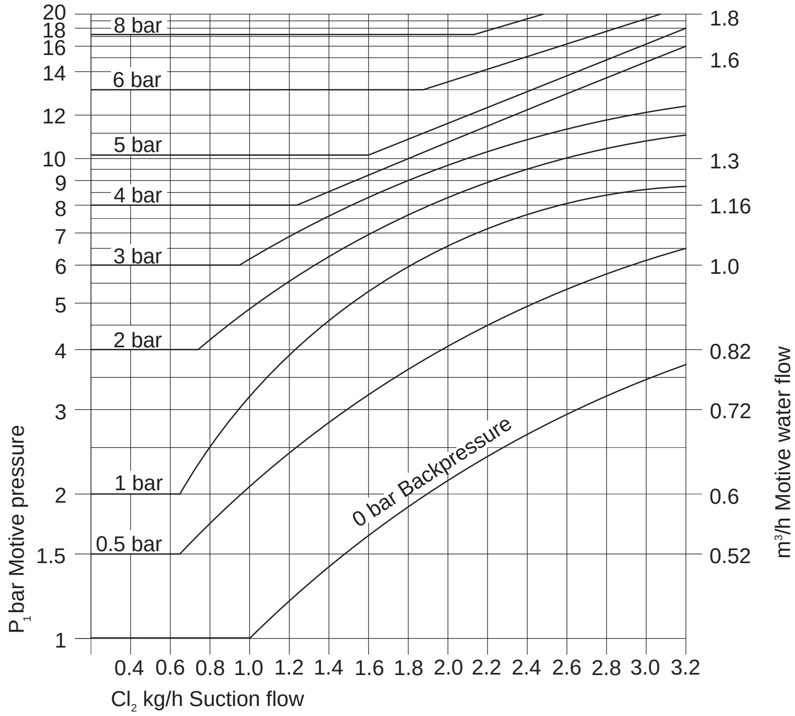



$P_0$ bar (absolute) — $Cl_2$ Intake pressure
$P_1$ bar (excess press.) — Motive pressure
P bar (excess press.) — Backpressure

### Typ A




### Typ B



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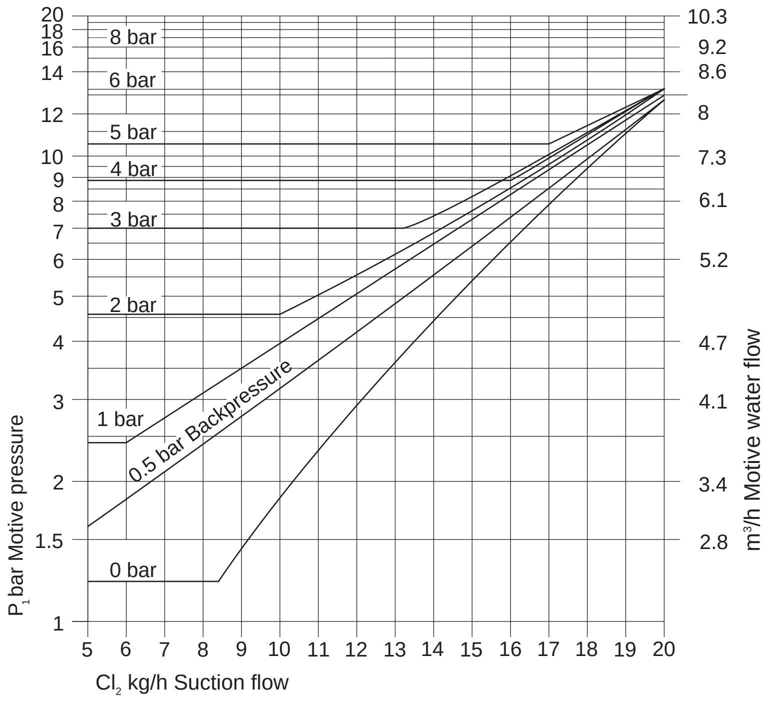
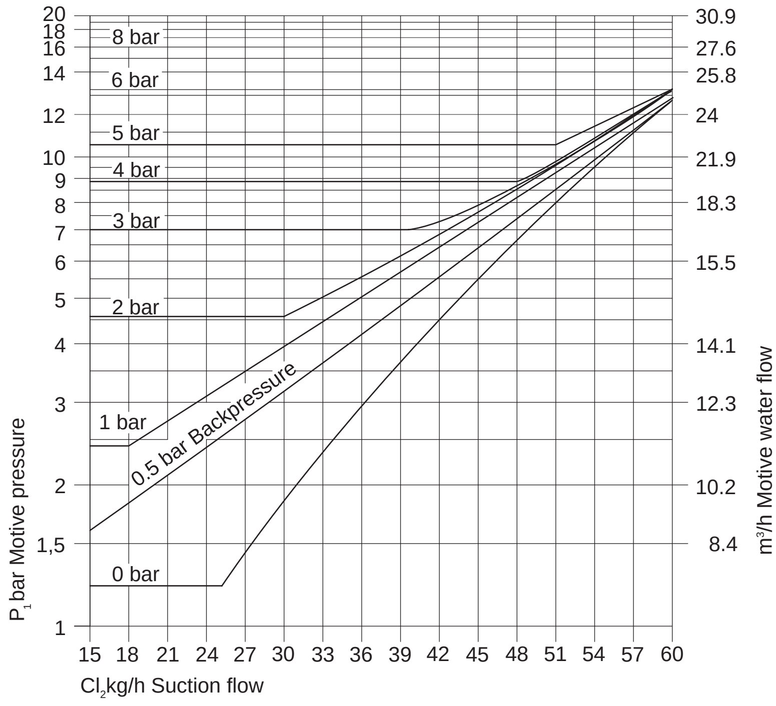
## Typ C




## Typ D



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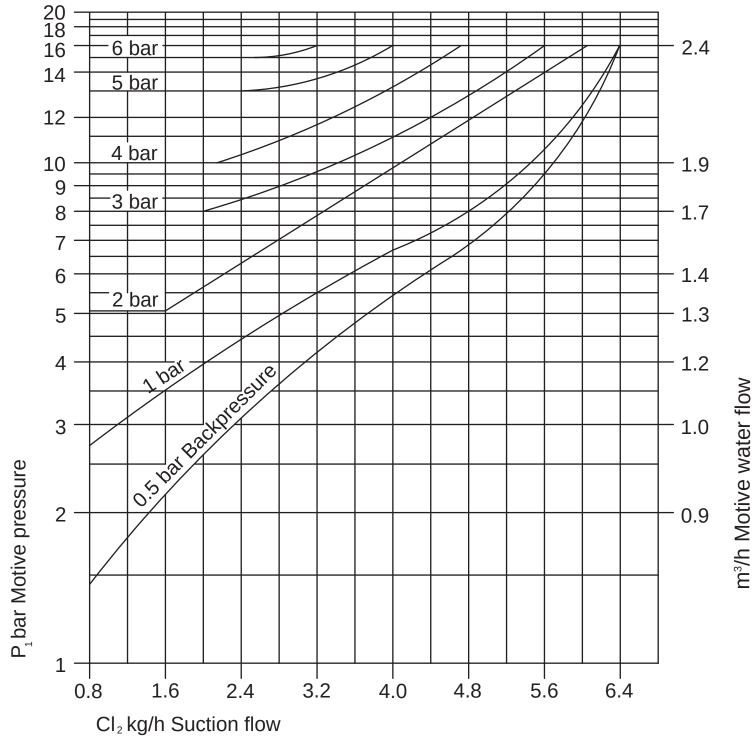
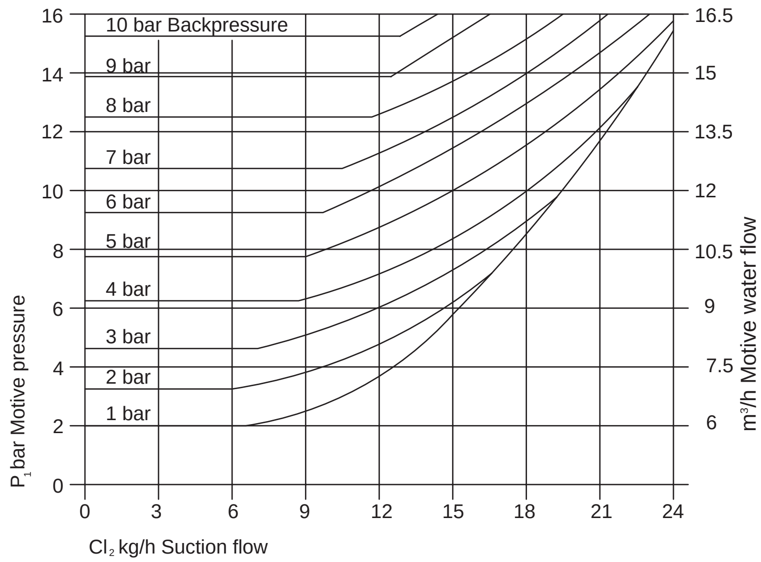
## Typ E




## Typ F



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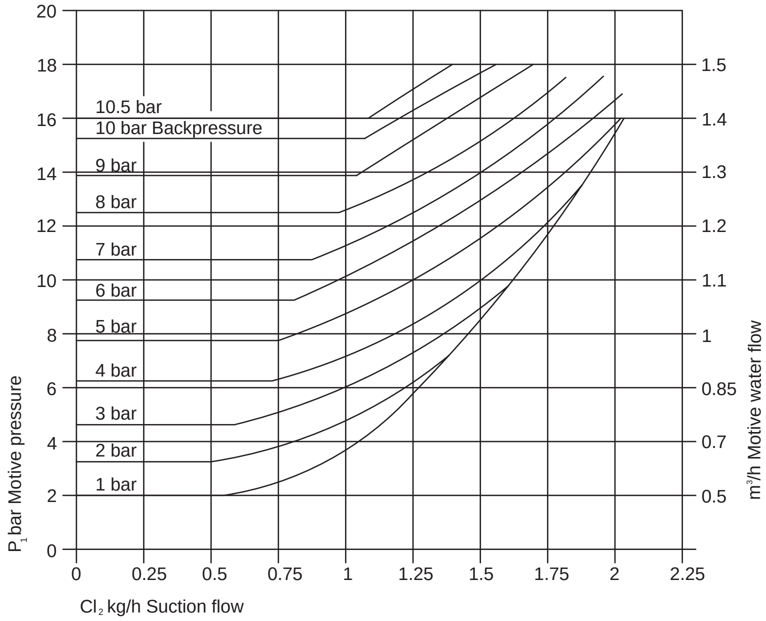
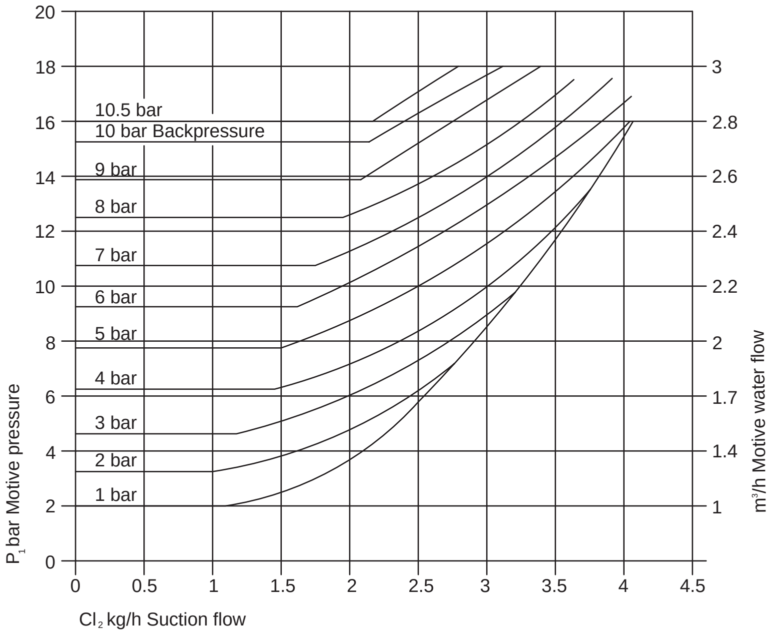
Note: Injectors AH and BH are custom designs for elevated back pressure and motive water current.

## Typ AH




## Typ BH



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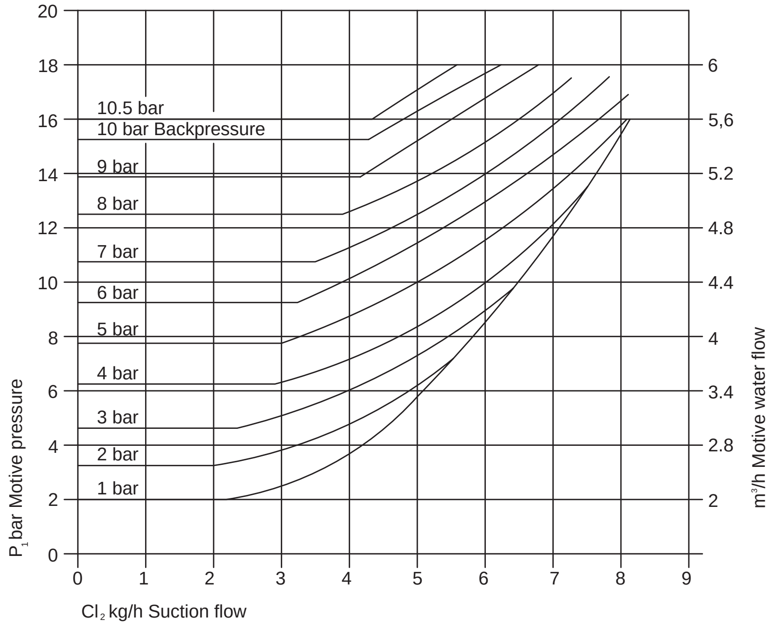
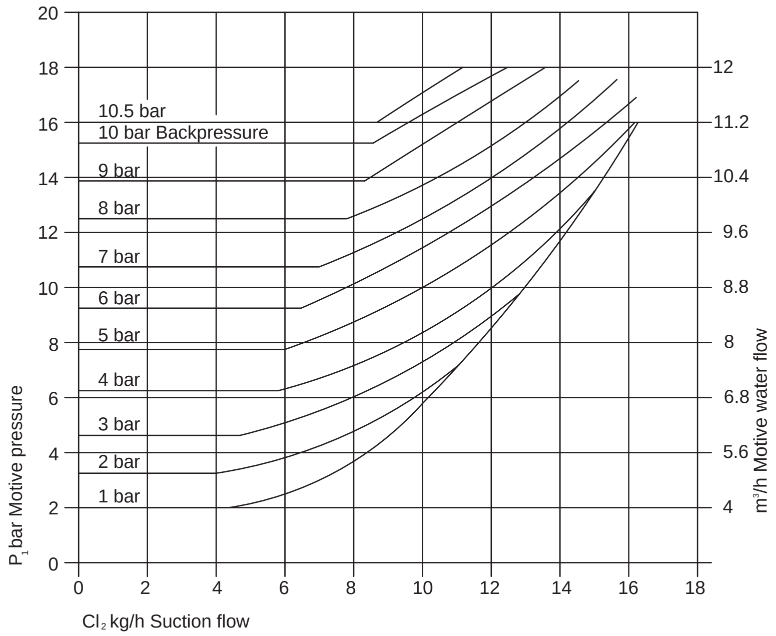
## Typ CH



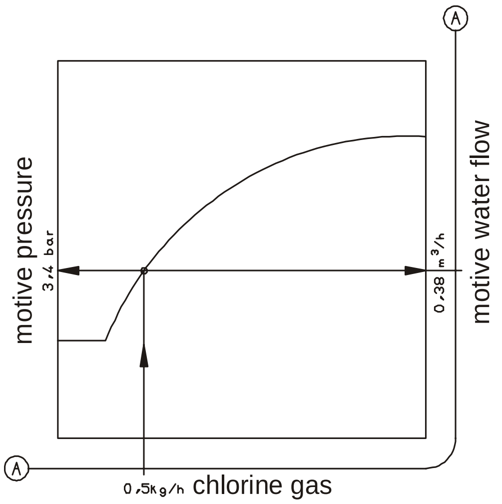

## Typ DH



**Example for ordering ejectors**

A swimming pool requires an ejector which withdraws 500 g/h chlorine gas and injects it with the solution water against a system pressure of 0.7 bar after the filter. The distance between the chlorine gas storage room and the injection point is to be covered by a 45 meter length of piping. The motive water required for the ejector is taken from the system at a pressure of 0.7 bar by a centrifugal pump.

The backpressure prevailing immediately behind the ejector is of great importance when selecting an ejector. The pressure loss over the 45 meter length of piping and any other fittings (e.g. non-return valve) must therefore also be taken into account, in addition to the system pressure of 0.7 bar. The pressure loss depends, among other things, on the pipe diameter and flow rate, which depends in turn on the volume of water. Since the latter is not yet known precisely, a mean value can be assumed in order to calculate the pressure drop. The ejector curves indicate that ejector A could be suitable for 0.5 kg/h chlorine gas. At an estimated backpressure of 1 bar, a water volume of 0.38 m³/h would have to be expected. The pressure loss should then be calculated on the basis of a pipe through which 0.38 m³/h could flow at a rate of approx. 1 m/s. A diameter of 12 mm would be sufficient. DN 15 would have to be selected, since 12 mm is not a standard size. The pressure loss over 45 meters length, at DN 15 in plastic piping, is calculated as approx. 0.18 bar using the formulae commonly found in the literature. This pressure must be added to the system pressure, thus yielding a backpressure of 0.7 + 0.18 = 0.88 bar for the ejector. The backpressure of 1 bar mentioned initially is not excessive. The ejector to be selected is consequently a type „A“ ejector for 0.5 kg/h chlorine gas for a maximum backpressure of 1 bar and requiring 380 l/h water at a motive pressure of 3.4 bar.




Since the booster pump has an inflow from the system with 0.7 bar, it needs only boost the pressure by 3.4 – 0.7 = 2.7 bar, at the required 0.38m³.