

**WATER SUPPLIES DEPARTMENT**  
**STANDARD SPECIFICATION EM-02-02**  
**CHLORINATOR**

This specification shall be read in conjunction with EM-02-01 for Chlorine Plant - General and Design and EM-02-09 for Chlorine Pressure Gauges.

1. **DESIGN**

1.1 **General**

The chlorinator supplied shall be of the vacuum type design consisting of an ejector, a chlorine gas flow rate control unit, a vacuum regulator-check unit and other auxiliaries/accessories. The chlorinator system shall operate under a vacuum pressure created at the ejector so as to reduce the risk of chlorine leakage during operation. The vacuum operation of the system shall commence from downstream of the vacuum regulating valve of the chlorine gas supply.

1.2 **Ejector**

The ejector shall be water-operated and designed to resist both the corrosive effect of moist chlorine and the erosion from high water velocity. The ejector shall generate the required vacuum pressure for the chlorinator and to allow mixing of chlorine gas with water. The ejector shall be able to overcome the back pressure at downstream of the system in meeting the maximum chlorine dosage requirement as specified in the Particular Specification. Head losses of pipes and fittings shall be taken into account when sizing the ejector and the booster pump, if required, for the water supply system. The ejector may be mounted inside the chlorine gas flow rate control unit or separately mounted in other location approved by the Engineer.

1.3 **Chlorine Gas Flow Rate Control Unit**

The chlorine gas flow rate shall be adjustable by changing the position of a variable orifice at the chlorine gas flow rate control unit. The displacement of the orifice shall be linearly proportional to chlorine gas flow rate. Unless otherwise specified, the gas feed rate shall be controlled either manually through a knob on the panel of the control unit or automatically by a 4-20 mA d.c. signal sent out from a controller. The selection of manual or automatic control shall be facilitated by means of a selector switch on the panel of the control unit. The chlorine gas flow rate once set shall remain stable irrespective of variations in inlet chlorine gas pressure and inlet water pressure. The chlorine gas flow rate shall be indicated by a linearly scaled rotameter of scale length not less than 150 mm. The scale units shall be in kg/day with scale marking to BS 3693 and resolution to 5% of range.

Unless otherwise specified, a vacuum break valve shall be provided to safeguard excessive vacuum developed in the system by admitting air to the control unit.

1.4 **Vacuum Regulator-Check Unit**

The vacuum regulator-check unit shall consist of a vacuum regulating valve, a pressure check valve and a pressure relief valve. The vacuum regulating valve shall be of the spring loaded type such that a normal operating vacuum must be present before it will open and shall be automatically shut off on loss of vacuum. The pressure check valve shall be designed to prevent positive pressure chlorine gas from passing through when the vacuum regulating valve fails to shut off on loss of vacuum. In the extremely unlikely event that the pressure check valve also fails and passes gas on loss of vacuum, the pressure relief valve shall permit relief of the chlorine gas to the vent, which is connected to the chlorine absorber.

Unless otherwise specified, the vacuum regulator-check unit can be either mounted with the chlorine gas flow rate control unit or separately close to the source of chlorine gas supply.

#### 1.4.1 Additional Requirements for Liquid Draw-off System

A low temperature alarm switch and electrically operated actuator shall be provided for the vacuum regulator-check unit. The actuator shall shut off the vacuum regulator-check unit on detection of low temperature, high/low water bath level or shutdown of chlorine evaporator.

Where specified or required, a gas heater shall be provided to prevent liquefied chlorine gas entering the vacuum regulating valve. It shall be designed to ensure proper operation and function of the vacuum regulating valve in a tropical climate with a maximum relative humidity of 100% and an ambient temperature ranging from 0 °C to 40 °C.

Unless otherwise approved, an additional pressure reducing/regulating valve shall be provided ahead of the vacuum regulator-check unit for reducing the chlorine pressure in steps so as to ensure smooth operation of the vacuum regulator-check unit to meet the required maximum gas throughput without a big pressure drop. A chlorine pressure gauge in compliance with WSD Standard Specification EM-02-09 shall be provided after the pressure reducing/regulating valve.

## 2. CONSTRUCTION

### 2.1 General

The control equipment and components of the chlorinator shall be housed in an enclosure with a degree of protection of IP65 to IEC 60529 for protection against corrosive chlorine gas. All materials shall be fully corrosion resistant to chlorine, including the high concentration of chlorine due to leakage. Metal parts normally in contact with chlorine shall be of silver-plated, Hastelloy C or equivalent. External metallic parts such as nameplates, bolts and nuts shall be of stainless steel grade 316. Parts not designed to be in contact with chlorine shall be totally enclosed with a degree of protection of IP54 to IEC 60529.

### 2.2 Ejector

The ejector shall be capable of withstanding the chlorinator inlet water pressure and suitable for dosing the required chlorine concentration as specified in the Particular Specification. A check valve shall be provided together with the ejector to prevent any back flow of water from the ejector into the chlorine gas flow rate control unit. The check valve shall be made of similar corrosion resistant material as for the ejector.

### 2.3 Chlorine Gas Flow Rate Control Unit

The chlorine gas flow rate control unit shall be designed for modular construction. Its components shall be housed in an enclosure of fibre reinforced plastic and shall be readily accessible for cleaning, inspection and maintenance without disturbing the adjacent parts.

### 2.4 Pipes and Fittings for Chlorine Gas Vacuum Lines

UPVC/PTFE pipes and fittings shall be used for chlorine gas vacuum lines and comply with WSD Standard Specification EM-02-11 for Piping, Valves and Accessories for Chlorination Plant.

## 3. ACCURACY

The system accuracy shall be within 4% of indicated flow rate. The sensitivity shall be within 0.5% of the full scale.

When selected for automatic control, the gas feed rate shall be linear with the control signal and the deadband at any point shall not exceed 3% of the dosage applied.

## 4. AUXILIARIES/ACCESSORIES

### 4.1 The following auxiliaries/accessories shall be provided with the chlorinator to form a complete system :-

- (a) Chlorine gas filter/strainer at source of chlorine gas supply to the chlorinator.
- (b) Water strainer for ejector, where specified or required.
- (c) Vacuum gauges at the gas inlet to the chlorine gas flow rate control unit and ejector gas suction for indication of vacuum pressures. The vacuum gauges shall be supplied by the same manufacturer of the chlorinator to ensure compatibility and quality. The vacuum gauges may form an integral part of the chlorine gas flow rate control unit or separately mounted in other locations approved by the Engineer.
- (d) Water pressure gauge shall be provided at ejector water inlet for indication of water pressure. The pressure gauge shall comply with BS EN 837.

- (e) Two individual switches or one combined switch for determining the high and low vacuum pressure at the gas vacuum line shall be provided between the vacuum regulator-check unit and chlorine gas flow rate control unit. The switch shall be of a type manufactured for chlorine applications. Each switch shall be of the changeover type rated at 2A 220V a.c. 50 Hz and 3A 24V d.c. and complete with an isolation valve. The low vacuum switch shall be wired for initiation of the "Vacuum Failed" alarm on the control panel on loss of vacuum, which shall trip at approximately 100 mm water vacuum. The high vacuum switch shall trip at approximately 750 mm water vacuum, which shall be wired for initiation of the "Gas Supply Failed" alarm on the control panel.
  - (f) Sufficient length of chlorine gas piping and fittings for connection.
- 4.2 Consumables sufficient for one year of continuous operation shall be supplied. Hand tools recommended for use with the chlorinator shall be supplied in sheet steel box in duplicate sets.

- End of this Specification -