11 Chlorination devices

11.1 Scope

This section establishes the requirements for chlorinators used to disperse controlled amounts of chlorine into the effluent of secondary treated residential wastewater. It is intended for devices that deliver chlorine in the absence of a contact chamber (hereafter referred to as chlorine dispensers) and for devices that deliver chlorine and provide a contact chamber for demonstrating fecal coliform reduction (hereafter referred to as a chlorine disinfection devices). The rated capacities for both chlorine dispensers and for chlorine disinfection devices shall be between 757 L/d (200 gal/d) and 5678 L/d (1500 gal/d).

Chlorine products may also be evaluated to the requirements of this Standard. The chlorine product manufacturer shall specify and provide a chlorination device for the purpose of the evaluation. The results of the evaluation may be applied to chlorination devices that have also been evaluated to the requirements of this Standard, allowing use of the alternate chlorine product in the absence of additional testing of the chlorination device. The chlorination device shall be similar in design, construction, and materials, and equivalent in the dimension of the chlorine product reservoir, to the chlorination device used for the evaluation of the alternate chlorine product.

All chlorine products used in the evaluation of chlorination devices shall be acceptable for wastewater applications.

11.6 Performance testing and evaluation

Performance testing and evaluation of chlorination devices shall consist of the following procedures:

1) chlorine resistance test (see 11.6.1);
2) life test (see 11.6.2); and
3) chlorination test (see 11.6.3).

These tests shall be conducted on one or more chlorination devices. However, the life test and chlorination test shall be conducted on a single device in the order indicated above.

In addition to the testing and evaluation specified in 11.6, components or devices that have positive displacement pumps or are designed to operate with increased hydraulic pressure shall be tested and evaluated to the applicable requirements specified in 11.7 and 11.8, respectively.

11.6.1 Chlorine resistance test

Parts normally in contact with chlorine shall be exposed, as they would be in field applications, to the maximum in-use concentration or maximum output for a period of 100 d.

11.6.1.1 Method
1) Fill the chlorine device to the maximum level with the applicable chemicals as specified by the manufacturer.

2) Fill the chlorine device flow path with a potable water supply that meets the requirements of Section Water and shall completely pass from inlet to outlet.

3) Seal all inlet and outlet ports with the exception of one port above the flood level to allow any generated gases to escape. Water shall fill the flow path from inlet to outlet when sealed.

4) Expose for a period of 100 d ± 6 h at an ambient room temperature of 20 ± 5 °C (68 ± 10 °F).

5) Examine the feeder approximately every 20 d and check for any signs of leakage, damage, or any other noticeable changes. Once the test period has elapsed, drain the feeder and examine.

11.6.1.2 Criteria

At the conclusion of this test, no component of the chlorination device shall show any visible sign of chemical attack or structural deformation.

11.6.2 Life test

Chlorination devices shall be capable of operating for 30 d. During the life test, no maintenance shall be performed on the chlorination device.

– Chlorination devices shall be assembled, installed, and operated in accordance with the manufacturer's specifications.

– The manufacturer shall specify all key elements for effective chlorination, including, but not limited to, design flow conditions, minimum contact time, and mixing requirements. If a chlorine dispenser is submitted for testing without a manufacturer-specified mixing tank or contact chamber, it shall be tested and evaluated by attaching the device to a default tank (hereafter referred to as “test contact chamber”). This tank shall be a mixing tank or contact chamber designed to allow for the minimum contact time specified by the manufacturer. The tank shall also be tested by tracer study to confirm that it provides the minimum contact time specified by the manufacturer (see annex D).

– The manufacturer shall specify the maximum and minimum gallons per day wastewater flow rates for which the device is designed and minimum contact time required between the wastewater and the chlorine disinfectant.

– The manufacturer shall specify the chlorine to be used with the device. In the case of tablets, the manufacturer shall specify the manufacturer and model of the tablet. In the case of liquid, the manufacturer shall specify the proper use concentration. This test shall be repeated for alternate tablets, if varying in tablet formulation and size, and alternate liquids, if varying in chlorine concentration.

11.6.2.1 Hydraulic loading

Flow conditions shall be as follows:

<table>
<thead>
<tr>
<th>Time</th>
<th>Flow Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 a.m. to 9 a.m.</td>
<td>35% of total minimum daily flow</td>
</tr>
<tr>
<td>11 a.m. to 2 p.m.</td>
<td>25% of total minimum daily flow</td>
</tr>
<tr>
<td>5 p.m. to 8 p.m.</td>
<td>40% of total minimum daily flow</td>
</tr>
</tbody>
</table>

11.6.2.2 Influent wastewater characteristics

11.6.2.2.1 Chlorine dispenser

Influent water shall be from a potable water supply. If the water supply is chlorinated, the water shall be dechlorinated prior to use.
**11.6.2.2 Chlorine disinfection device**

Influent water shall be secondary treated residential wastewater meeting the following specifications: (average of 24-h composite samples collected on day 1, 8, 15, 22, and 30 of the test for a total of five samples, with the exception of ammonia, which is to be collected on days 29 and 30):

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBOD₅</td>
<td>≤ 25 mg/L</td>
</tr>
<tr>
<td>TSS</td>
<td>≤ 30 mg/L</td>
</tr>
<tr>
<td>fecal coliform</td>
<td>10⁴ to 10⁶ organisms / 100 mL</td>
</tr>
<tr>
<td>pH</td>
<td>6.0 to 9.0</td>
</tr>
<tr>
<td>temperature</td>
<td>60 ± 5 °F (16 ± 2.5 °C)</td>
</tr>
<tr>
<td>ammonia¹</td>
<td>≤ 2.0 mg/L</td>
</tr>
</tbody>
</table>

**11.6.2.3 Analytical methods**

Influent challenge water samples shall be analyzed according to *Standard Methods*.

**11.6.2.4 Criteria**

At the conclusion of the test, there shall be no visible signs of damage or structural change that may adversely affect proper operation of any components of the chlorination device.

**NOTE –** This evaluation is performed following completion of the chlorination test, as specified in 11.6.3.

**11.6.3 Chlorination test**

The chlorination test shall be conducted immediately following the life test using the same chlorination device that was tested and evaluated during the life test. No maintenance shall be performed between the life test and the chlorination test. Chlorination devices with two or more disinfectant feed settings shall be tested at the minimum and maximum feed settings.

**11.6.3.1 Hydraulic loading**

For each feed setting (maximum and minimum), flow shall be introduced to the chlorination device continuously over a 3-h period at approximately 40% of the rated minimum and maximum daily hydraulic capacity.

**NOTE –** This specification requires that hydraulic loading be carried out at 3 h per combination of feed and flow rates (four different combinations) for a total of 12 h. The four combinations are as follows:

<table>
<thead>
<tr>
<th>Combination</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>maximum feed at 40% of maximum flow</td>
</tr>
<tr>
<td>2</td>
<td>maximum feed at 40% of minimum flow</td>
</tr>
<tr>
<td>3</td>
<td>minimum feed at 40% of maximum flow</td>
</tr>
<tr>
<td>4</td>
<td>minimum feed at 40% of minimum flow</td>
</tr>
</tbody>
</table>

**11.6.3.2 Influent water characteristics**

Influent water shall meet the specifications of 11.6.2.2.

**11.6.3.3 Effluent sampling and analysis**

- ¹ The level of ≤ 2.0 mg/L shall be met only during the final 48 h of the test. All other times do not need to be tested for ammonia.
A total of 5 grab samples shall be collected, beginning after a minimum of 2 chamber volumes of the influent wastewater has passed through the device, and continuing at 10-min intervals. Chamber volume includes the contact chamber volume.

### 11.6.3.3 Chlorine dispensers

Effluent samples for chlorine dispensers shall be collected after the test contact chamber. Analysis shall be performed immediately for total residual chlorine concentration.

### 11.6.3.3.2 Chlorine disinfection devices

Sample containers shall contain disinfection neutralizer sufficient to halt the disinfecting action. Analysis shall be performed within 24 h of sample collection.

### 11.6.3.4 Analytical methods

Influent challenge water and final effluent samples shall be analyzed according to *Standard Methods*.

### 11.6.3.5 Criteria

#### 11.6.3.5.1 Chlorine dispensers

The average chlorine concentration of all hydraulic loading conditions shall be $\geq 15$ mg/L.

#### 11.6.3.5.2 Chlorine disinfection devices

Chlorine disinfection devices shall achieve an average fecal coliform concentration of all hydraulic loading conditions of $\leq 200$ organisms / 100 mL.

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