Listing Evaluation Criteria for
Point of Entry Anion Exchange – Nitrate Reduction

Working Group
Draft A4 (6/23/2020)
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Foreword
This foreword shall not be considered a part of the listing evaluation criteria (LEC); however, it is offered to provide background information.

ASSE standards and LECs are developed in the interest of consumer safety.

ASSE International considers LEC's to be of great value in the development of improved plumbing systems.

The working group that developed this LEC was set up within the framework of the Product Standards Committee of ASSE International.

The main sources of nitrate contamination found in drinking water come from fertilizers and animal/septic tank waste. Water supplies that are vulnerable to nitrate contamination are typically found in agricultural areas in private and public wells. The US EPA has found over a 1000 public wells in violation of the 10 mg/L (as N) maximum contaminant level (MCL). Higher numbers of private wells are believed to exceed the MCL. A 2006 United States Geological Survey (USGS) study suggests more than 1 million private well owners are located in areas with groundwater risk above the MCL. This LEC provides test protocols to verify the ability of Anion Exchange water treatment systems to reduce Nitrate from drinking water below the MCL.

Recognition is made of the time volunteered by members of the working group and of the support of the manufacturers who also participated in meetings for this LEC.

This LEC does not imply ASSE’s endorsement of a product which conforms to these requirements. Compliance with this LEC does not imply acceptance by any code body.

It is recommended that these devices be installed consistent with local codes by qualified and trained professionals. It is recommended that these devices be maintained and serviced per the manufacturer’s recommendation, filters are replaced at regular intervals per the manufacturer's instructions.
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Performance Requirements for Point of Entry Anion Exchange – Nitrate Reduction

1. General

1.1 Application
Point of Entry anion exchange water treatment products covered in this Listing Evaluation Criteria (LEC) are intended to be used in residential and commercial applications to reduce nitrate from drinking water.

1.2 Scope

1.2.1 Description
The water treatment systems covered in this LEC shall be self-regeneration anion exchange systems designed to reduce Nitrate from drinking water. Depending on the influent water quality, anion exchange systems if not regenerated correctly can dump or increase the amount of Nitrate in the drinking water if other anions such as sulfates are exchanged by the resin. Non-regenerating residential water treatment systems designed to reduce Nitrates shall be tested to NSF/ANSI 53.

1.2.2 Connections
Pipe threads and other connections shall conform to the applicable standards.
- Tapered pipe threads shall comply with ASME B1.20.1.
- Dry seal pipe threads shall comply with ASME B1.20.3.
- Compression assemblies shall comply with SAE J512.
- Soldered connections shall comply with ASME B16.18 or ASME B16.22.
- Push fit connections shall comply with ASSE 1061.
- Press connections shall comply with ASME B16.51.

1.2.3 Size Range
POE anion exchange systems shall be equal to or greater than ¾” inlet connections with a media volume of equal to or greater than ½ cubic feet of anion exchange resin.

1.2.4 Flow Range
\[ \geq 4.0 \text{ gpm (15.1 lpm)} \]

1.2.5 Temperature Range
34 – 100 °F (1 – 38 °C)

1.2.6 Pressure Range
20 – 125 psig
1.3 Reference Documents

Referenced industry standards shall be to the revision stated below.

- ASME B1.20.1-2013, Pipe Threads, General Purpose (Inch)
- ASME B1.20.3-1976 (R2013), Dryseal Pipe Threads (Inch)
- ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings
- ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
- ASME B16.51-2013, Copper and Copper Alloy Press-Connect Pressure Fittings
- ASSE 1061-2015, Performance Requirements for Push-Fit Fittings
- ASSE 1087-2018, Commercial and Food Service Water Treatment Equipment Utilizing Drinking Water
- NSF/ANSI 53-2019, Drinking Water Treatment Units – Health Effects
- NSF/ANSI/CAN 61-2019, Drinking Water System Components – Health Effects
- NSF/ANSI 372-2016, Drinking Water System Components – Lead Content
2. Test Specimens and Test Laboratory

2.1 Samples Submitted
A sufficient number of samples of each type, model and size shall be submitted by the manufacturer for testing per the requirements of the laboratory.

2.2 Samples Tested
The testing agency shall select the appropriate number of systems of each type, model and size for the full test. There is no required testing order.

2.3 Documentation
Assembly drawings, installation instructions and other data which are needed to enable a testing agency to determine compliance with this standard shall accompany devices when submitted for examination and performance tests under this standard.

2.4 Rejection
Failure of one device or one test shall result in a rejection of that type, model and size.

2.5 Product Families
Products that utilize the same control valve, anion exchange resin, under bedding media, mineral tank style, and distributor shall be bracket into a product family. The unit with the least media contact time shall be used for testing the Nitrate capacity.
3. Performance Requirements and Compliance Testing

3.1 Nitrate Reduction

3.1.1 Purpose
The purpose of the nitrate reduction test shall determine if the system design is capable of reducing the challenge water Nitrate levels below 10 mg/L (as N) throughout the service cycle of the system.

3.1.2 Procedure
3.1.2.a. One system shall be installed and conditioned per the manufactures instructions. Enough salt shall be added to the brine tank to cover 10 regeneration cycles.
3.1.2.b. Challenge water, a public water supply or synthetic water supply shall be used. The water shall be and adjusted with the following specific characteristics maintained throughout the test.

<table>
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<th>Characteristics</th>
<th>Specification</th>
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<tr>
<td>pH</td>
<td>7.5 ± 0.5</td>
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<tr>
<td>Temperature</td>
<td>70 ± 15 °F (21 ± 6 °C)</td>
</tr>
<tr>
<td>Total dissolved solids (TDS)</td>
<td>250 – 500 mg/L</td>
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<tr>
<td>Turbidity</td>
<td>&lt; 1 NTU</td>
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<tr>
<td>Sulfates</td>
<td>200 – 250 mg/L</td>
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<tr>
<td>Nitrate</td>
<td>30 ± 10% mg/L (as N)</td>
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3.1.2.c. The unit shall be tested at the service flow rate specified by the manufacturer, challenged with the water specified in section 3.1.2.b to exhaustion. Exhaustion of the system is when the influent Nitrate levels equals the effluent Nitrate levels. The anti-dumping safety mechanisms shall be disengaged during the exhaustion step. After the system reaches exhaustion an additional 50 gallons (189 L) shall be run through the system, influent and effluent samples shall be collected and used for compliance with section 3.3.

3.1.2.d. After the system is exhausted it shall be regenerated per the manufactures instructions using the system’s brine tank, recommended salt type and recommended salt setting. When multiple salt settings are used by the system, the lowest salt setting shall be tested first.

3.1.2.e. After regeneration is complete the system shall be returned to service and tested with the challenge water per section 3.1.2.b. The system shall be operated per the manufacturer’s instructions, run at the recommended service flow rate and tested to the rated capacity of the system. Influent and effluent nitrate samples shall be collected upon start up and every 20% of the rated capacity. The final sample shall be collected just prior to the systems automatic regeneration is initiated. The system shall automatically regenerate when the rated capacity is reached per the valve settings. This test shall be repeated three times. If the valve can be set to different salt settings the system shall be tested at the
lowest and highest salt settings to verify Nitrate reduction at the lowest and highest capacity of the system.

The first run after the initial exhaustion shall be discarded because the system was run past its exhaustion point during conditioning.

3.1.3 Criteria
The Influent Nitrate shall be reduced below 10 mg/L (as N) for each of the 3 capacity tests at each effluent sample point.

3.2 Salt Used per Regeneration

3.2.1 Purpose
The purpose of this test is to ensure the system’s regeneration of the ion exchange media uses a similar quantity of salt at each regeneration cycle per the system’s salt setting(s).

3.2.2 Procedure
3.2.2.a. During section 3.1 test set up, the brine tank shall be placed on a scale to measure the weight of the salt used after each regeneration cycle. For cabinet style systems the entire system shall be placed on a scale to measure the weight of the salt used after each regeneration cycle.

3.2.2.b. The weight of the brine tank or cabinet style system shall be recorded after the regeneration cycle after the exhaustion step in section 3.1.2.d. The weight of the brine tank or cabinet style system shall be recorded after each regeneration in section 3.1.2.e. The amount of salt used after each regeneration shall be calculated by subtracting the weight of the brine tank or cabinet style system after each regeneration cycle.

3.2.3 Criteria
The amount of salt used per regeneration shall be within 15% of the amount specified by the manufacturer or as inducted by the control valve for salt settings less than 7 pounds. The amount of salt used per regeneration shall be within 10% of the amount specified by the manufacturer or as inducted by the control valve for salt setting greater than 7 pounds.

3.3 Nitrate Dumping – Automatic Regeneration Failure Test

3.3.1 Purpose
The systems shall use anion exchange media that prevents Nitrate dumping. If Nitrate dumping occurs the Nitrate levels in the treated water may be higher than the influent water.

3.3.2 Procedure
During section 3.1.2c testing, influent and effluent samples shall be collected 50 gallons (189 L) of water has passed through the system after exhaustion. The samples shall be analyzed for Nitrate concentration.

3.3.3 Criteria
The effluent Nitrate concentration shall not be more than 1 mg/L (as N) higher than the influent concentration.
3.4 Service flow capacity shall be conducted per ASSE 1087
3.5 Flow capacity – Point of Entry System shall be conducted per ASSE 1087
3.6 Backsiphonage during system regeneration shall be conducted per ASSE 1087
3.7 Bypass flow capacity during system regeneration shall be conducted per ASSE 1087
3.8 24-hour pressure loss shall be conducted per ASSE 1087
3.9 Pressure shock (Water Hammer) shall be conducted per ASSE 1087
3.10 Structural Integrity – Hydrostatic shall be conducted per ASSE 1087
3.11 Structural Integrity – Cycle test shall be conducted per ASSE 1087
4. Detailed Requirements

4.1 Materials
Devices covered by this standard shall comply with NSF/ANSI 61 section 8.

Fittings and devices intended to convey or dispense water for human consumption through drinking or cooking shall not contain a weighted average lead content in excess of 0.25% when evaluated in accordance with the test method specified in NSF 372.

4.2 Documentation

4.2.1 Drawings
Assembly drawings, schematics and other data which is helpful to the installer and needed by the testing agency to determine compliance with shall accompany the product when submitted for examination and testing under this standard.

4.2.2 Installation Instructions
Instructions for installation, maintenance and testing shall be packaged with the device. These instructions shall provide information necessary to allow a correct installation, show the correct installation position, field maintenance, field repair and field testing.

The installation instructions shall include the following information:
   a. Maximum sulfate concentration and other competing anions allowed in the influent water, if applicable.
   b. Inlet and outlet connection sizes.
   c. Manufacturer’s maximum working pressure.
   d. Manufacturer’s maximum flow rate.
   e. Instructions for installing, adjusting, and maintaining the device.
   f. Explanation or diagram of proper air gap for the drain line.

The device shall be installed in an accessible location and sized per the plumbing code having jurisdiction.

4.2.3 Specification Sheets
The specification sheet or performance data sheet shall specify that competing anions may cause Nitrate dumping. Specifications for the amounts of competing anions such as sulfate and silica shall be provided to ensure proper system function.
   a. Average influent concentration of Nitrate determined by testing.
   b. Maximum effluent concentration of Nitrate determined by testing.
   c. Average percent reduction of Nitrate determined by testing.
4.3  Markings

4.3.1  Marking of Devices
Each device shall have the following information marked on it where it shall be visible after the device has been installed:
   A. Name of manufacturer or trademark
   B. Type and model number of the device
   C. Warning statement about Nitrate dumping.

The markings shall be either etched, cast, stamped or engraved on the body of the device or on a plate made of a corrosion resistant material securely attached to the device with a corrosion resistant means.
5. **Definitions**
Definitions not located in this section are located in the Plumbing Dictionary, Sixth Edition, published by ASSE.

**Anion Exchange Resin** – Anion exchange is the process by which anions in solution are exchanged for other anions from an ion exchange resin using positively charged resins.

**Brine Tank** – Large container that holds salt is used to regenerate the anion exchange system.

**Nitrate Dumping** – Although all strong base anion resins prefer nitrate over chloride, at TDS suitable for potable water, the standard type I and type II resins prefer sulfate over nitrate. This preference can result in dumping nitrates, a condition where the resin adds nitrate to the finished water instead of removing it.

**Nitrate Selective Resin** – Resin that has a unique functionality that increases selectivity for nitrate and decreases selectivity for sulfate. This results in higher operating capacity, lower leakage, and freedom from nitrate dumping if operated past sulfate breakthrough.

**Point of Entry** – A water treatment device which installs at the main inlet to a building and acts as centralized treatment.

**Regeneration (anion exchange)** – The steps taken by an ion exchange conditioner to replace ions that have accumulated (in this standard Nitrate ions) on the resin during the normal service with chloride ions exchanged up during the brine cycle.

**Secondary MCL Sulfate** – 250 mg/L, EPA has established National Secondary Drinking Water Regulations (NSDWRs) that set non-mandatory water quality standards for 15 contaminants. EPA does not enforce these "secondary maximum contaminant levels" (SMCLs). They are established as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. These contaminants are not considered to present a risk to human health at the SMCL.