

# NSF/ANSI Standard 40 - 2023 Requirements

## 8 Performance testing and evaluation

This section describes the methods used to evaluate the performance of residential wastewater treatment systems. Systems shall be designated as Class I or Class II. The performance classification shall be based upon the evaluation of effluent samples collected from the system over a 6-mo period.

### 8.1 Preparations for testing and evaluation

**8.1.1** The system shall be assembled, installed, and filled in accordance with the manufacturer's instructions.

**8.1.2** The manufacturer shall inspect the system for proper installation. If no defects are detected and the system is judged to be structurally sound, it shall be placed into operation in accordance with the manufacturer's start-up procedures. If the manufacturer does not provide a filling procedure,  $\frac{2}{3}$  of the system's capacity shall be filled with water and the remaining  $\frac{1}{3}$  shall be filled with residential wastewater.

**8.1.3** The system shall undergo design loading (see Section [8.2.2.1](#)) until testing and evaluations are initiated. Sample collection and analysis shall be initiated within 3 wk of filling the system and, except as specified in Section [8.5.1.2](#), shall continue without interruption until the end of the evaluation period.

**8.1.4** If conditions at the testing site preclude installation of the system at its normally prescribed depth, the manufacturer shall be permitted to cover the system with soil to achieve normal installation depth.

**8.1.5** Performance testing and evaluation of systems shall not be restricted to specific seasons.

**8.1.6** When possible, electrical or mechanical defects shall be repaired to prevent evaluation delays. All repairs made during the performance testing and evaluation shall be documented in the final report.

**8.1.7** The system shall be operated in accordance with the manufacturer's instructions. However, routine service and maintenance of the system shall not be permitted during the performance testing and evaluation period.

The manufacturer may recommend or offer more frequent service and maintenance of the system but for the purpose of performance testing and evaluation, service and maintenance shall not be performed beyond what is specified in this standard.

**8.1.8** Prior to initiation of design loading, the air delivery component (if one is utilized) – either air compressor or blower – shall be connected to the system and run for a minimum of 4 h. Air pressure shall be measured by a pressure gauge installed near the exhaust port of the air delivery component and that reading recorded.

**8.1.9** When it is not possible to measure pressure on the system under test, the measurement may be completed with a separate air delivery component plumbed to a different tank. All plumbing and air distribution components used in the tested system shall be installed with the air delivery component. Potable water or wastewater shall be used. Air distribution outlets or diffusers shall be located at the same depth as in the tested system. The air delivery component shall be run for a minimum of 4 h. Air pressure shall be measured by a pressure gauge installed near the exhaust port of the air delivery component and that reading recorded.

**8.1.10** Following the pressure measurement, a separate air delivery component shall be tested for flow. This air delivery component shall be plumbed into the rig diagrammed below. After adjusting the backpressure to the pressure measured in Sections [8.1.8](#) or [8.1.9](#), the air delivery component shall run for a minimum of 4 h. After the 4-h minimum run time, backpressure shall be adjusted if needed to match pressure measured in Sections [8.1.8](#) or [8.1.9](#) and then flow shall be measured and recorded.

# NSF/ANSI Standard 40 - 2023 Requirements

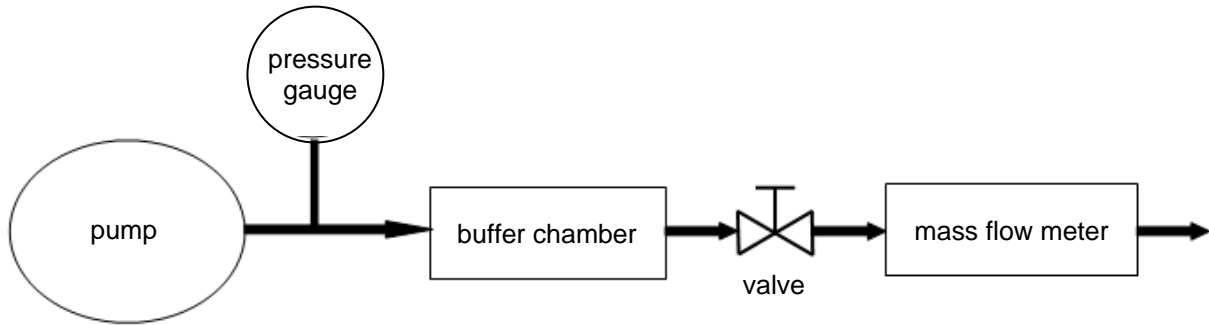


Figure 1

## 8.2 Testing and evaluation conditions, hydraulic loading, and schedules

### 8.2.1 Influent wastewater characteristics

The 30-d average wastewater characteristics delivered to the system over the course of the testing shall fall within:

- **BOD<sub>5</sub>**: 100 to 300 mg/L;
- **TSS**: 100 to 350 mg/L; and
- **alkalinity**:  $\geq 175$  mg/L as CaCO<sub>3</sub>.

The raw influent shall be supplemented with sodium bicarbonate to meet the required influent alkalinity.

### 8.2.2 Hydraulic loading and schedules

The performance of the system shall be evaluated for 26 consecutive weeks. During the testing and evaluation period, the system shall be subjected to  $16 \pm 1$  wk of design loading, followed by 7.5 wk (52 d) of stress loading, and then an additional period of design loading to complete the 26 consecutive week evaluation period.

#### 8.2.2.1 Design loading

The system shall be dosed 7 d/wk with a wastewater volume equivalent to the daily hydraulic capacity of the system. The following schedule shall be adhered to for dosing:

Time frame	Rated daily hydraulic capacity (%)
6:00 a.m. to 9:00 a.m.	approximately 35
11:00 a.m. to 2:00 p.m.	approximately 25
5:00 p.m. to 8:00 p.m.	approximately 40

The individual dosage shall be no more than 10 gal per dose, unless the dosage system is based on a continuous flow and be uniformly applied over the dosing periods.

#### 8.2.2.2 Stress loading

# NSF/ANSI Standard 40 - 2023 Requirements

Stress loading sequences shall begin in Week 17  $\pm$  1 wk of the testing and will be completed in the order listed in the following sections. Each stress sequence shall be separated by 7 d of design loading, as described in Section [8.2.2.1](#).

## **8.2.2.2.1 Washday stress**

The washday stress shall consist of three washdays in a 5-d period. Each washday shall be separated by a 24-h period. During a washday, the system shall be loaded at times and capacities similar to those delivered during design loading (see Section [8.2.2.1](#)), however during the first two dosing periods per day, the design loading shall include three wash loads (three wash cycles and six rinse cycles).

## **8.2.2.2.2 Working-parent stress**

For five consecutive days, the system shall be subjected to a working-parent stress. During this stress, the system shall be dosed with 40% of its daily hydraulic capacity between 6:00 a.m. and 9:00 a.m. Between 5:00 p.m. and 8:00 p.m., the system shall be dosed with the remaining 60% of its daily hydraulic capacity, which shall include one wash load (one wash cycle and two rinse cycles).

## **8.2.2.2.3 Power / equipment failure stress**

The system shall be dosed with 40% of its daily hydraulic capacity between 5:00 p.m. and 8:00 p.m. on the day the power / equipment failure stress is initiated. Power to the system shall then be turned off at 9:00 p.m. and dosing shall be discontinued for 48 h. After 48 h, power shall be restored and the system shall be dosed over a 3-h period with 60% of its daily hydraulic capacity, which shall include one wash load (one wash cycle and two rinse cycles).

## **8.2.2.2.4 Vacation stress**

On the day that the vacation stress is initiated, the system shall be dosed at 35% of its daily hydraulic capacity between 6:00 a.m. and 9:00 a.m., and at 25% between 11:00 a.m. and 2:00 p.m. Dosing shall then be discontinued for eight consecutive days (power shall continue to be supplied to the system). Between 5:00 p.m. and 8:00 p.m. of the ninth day, the system shall be dosed with 60% of its daily hydraulic capacity, which shall include three wash loads (three wash cycles and six rinse cycles).

## **8.2.3 Dosing volumes**

The 30-d average volume of the wastewater delivered to the system shall be within 100%  $\pm$  10% of the system's rated hydraulic capacity.

All dosing days, except those with dosing requirements less than the daily hydraulic capacity, shall be included in the 30-d average calculation.

## **8.2.4 Color, odor, foam, and oily film assessments**

During the 6-mo testing and evaluation, a total of three effluent samples shall be assessed for color, odor, foam, and oily film. The assessments shall be conducted on effluent composite samples selected randomly during the first phase of design loading (Weeks 1 to 16), the period of stress loading (Weeks 17 to 23.5), and the second phase of design loading (Weeks 23.5 to 26).

## **8.3 Sample collection**

### **8.3.1 General**

**8.3.1.1** A minimum of 96 data days shall be required during system performance testing and evaluation. The maximum length of the test to obtain the 96 data days shall be no more than 34 wk. No routine service

# NSF/ANSI Standard 40 - 2023 Requirements

or maintenance shall be performed on the system whether the time period to achieve the 96 data days falls within or exceeds 26 wk.

If a catastrophic site problem occurs, as described in Section [8.5.1.2](#), the maximum length of the test shall be no more than 37 wk.

**8.3.1.2** All sample collection methods shall be in accordance with *Standard Methods*<sup>4</sup> unless otherwise specified.

**8.3.1.3** Influent wastewater samples shall be flow-proportional, 24-h composites obtained during periods of system dosing. Effluent samples shall be flow-proportional, 24-h composites obtained during periods of system discharge. Effluent samples shall be representative of all treated effluent discharged from the system, as sampled from a central point of collection of all treated effluent.

## 8.3.2 Design loading

During periods of design loading, samples shall be collected and analyzed according to the following schedule:

Parameter	Collection frequency	Sample type	Influent	Effluent
CBOD <sub>5</sub>	5 d/wk	24-h composite	NA	X
BOD <sub>5</sub>	5 d/wk	24-h composite	X	NA
TSS	5 d/wk	24-h composite	X	X
pH	5 times per week	grab	X	X
alkalinity	1 d/wk	24-h composite	X	NA
color, odor, oily film and foam	1 d first 16 wk, 1 d last 2.5 wk	24-h composite	NA	X

## 8.3.3 Stress loading

During stress loading, samples shall be collected on the day each stress condition is initiated. 24 h after the completion of washday (WD), working-parent (WP), and vacation (V) stresses, and 48 h after the completion of the power / equipment failure (PF) stress, samples shall be collected according to the following schedule:

# NSF/ANSI Standard 40 - 2023 Requirements

Parameter	Collection frequency	Sample type	Influent	Effluent
CBOD <sub>5</sub> (WD, WP, V)	6 consecutive days	24-h composite	NA	X
CBOD <sub>5</sub> (PF)	5 consecutive days	24-h composite	NA	X
BOD <sub>5</sub> (WD, WP, V)	6 consecutive days	24-h composite	X	NA
BOD <sub>5</sub> (PF)	5 consecutive days	24-h composite	X	NA
TSS (WD, WP, V)	6 consecutive days	24-h composite	X	X
TSS (PF)	5 consecutive days	24-h composite	X	X
pH (WD, WP, V)	6 consecutive days	grab	X	X
pH (PF)	5 d/wk	grab	X	X
alkalinity	1 d per stress recovery	24-h composite	X	NA
color, odor, oily film and foam	1 d during stress sampling	24-h composite	NA	X

## 8.4 Analytical descriptions

### 8.4.1 pH, TSS, BOD<sub>5</sub>, and CBOD<sub>5</sub>

The pH, TSS, and BOD<sub>5</sub> of the collected influent and the pH, TSS and CBOD<sub>5</sub> of the collected effluent 24-h composite samples shall be determined with the appropriate methods in *Standard Methods*<sup>4</sup> for each listed parameter. Grab samples shall be collected during the morning dosing period for gravity flow systems and during a time of discharge for systems that are pump discharged.

NOTE — *Standards Methods*<sup>4</sup> requires pH and temperature to be sampled as grab samples.

### 8.4.2 Color, odor, oily film, and foam

#### 8.4.2.1 General

Three composite effluent samples shall be tested during the 6-mo evaluation period.

#### 8.4.2.2 Color

The apparent color of an undiluted effluent sample shall be determined with the visual comparison method described in Method 2120 B of *Standard Methods*.<sup>4</sup>

#### 8.4.2.3 Odor

The odor of undiluted effluent sample shall be determined by a panel consisting of at least five evaluators tested in accordance with Method 2150 B of *Standard Methods*.<sup>4</sup>

#### 8.4.2.4 Oily film and foam

Diluted effluent sample aliquots shall be visually evaluated for the presence of an oily film or foaming. The effluent composite samples shall be diluted 1:1,000 with deionized water.

### 8.4.3 Pressure and flow

Air pressure shall be measured using a gauge with accuracy of 2% or better. Airflow shall be measured using a flow meter with accuracy of 10% or better.

# NSF/ANSI Standard 40 - 2023 Requirements

## 8.5 Criteria

### 8.5.1 General

**8.5.1.1** If conditions during the testing and evaluation period result in system upset, improper sampling, improper dosing, or influent characteristics outside of the ranges specified in Section [8.2.1](#), an assessment shall be conducted to determine the extent to which these conditions adversely affected the performance of the system. Based on this assessment, specific data points may be excluded from the 7- and 30-d averages of effluent measurements. Rationale for all data exclusions shall be documented in the final report.

When the 30-d average BOD<sub>5</sub> or TSS concentration is less than the required minimum value, individual data days may be excluded to bring the 30-d period within range. When influent data is excluded from the averages, all influent and effluent data from that day shall be excluded from the 7- and 30-d averages. All data exclusions shall be noted in the final report.

**8.5.1.2** If a catastrophic site problem not described in this standard, including but not limited to influent characteristics, malfunctions of test apparatus, and acts of God, jeopardizes the validity of the performance testing and evaluation, manufacturers shall be given the choice to:

- perform maintenance on the system, reinitiate system start-up procedures, and restart the performance testing and evaluation; or
- with no routine maintenance performed, have the system brought back to pre-existing conditions and resume testing within 3 wk after the site problem has been identified and corrected. Data collected during the system recovery period shall be excluded from the 7- and 30-d averages of effluent measurements. Pre-existing conditions shall be defined as the point when the results of three consecutive data days are within 15% of the previous 30-d average(s).

**8.5.1.3** A 7-d average discharge value shall consist of a minimum of three data days. If a 7-d period contains less than three data days, sufficient data days may be transferred from the preceding 7-d period to constitute a 7-d average discharge value. If there are not sufficient data days available in the preceding 7-d period, the transfer of data days may take place from the following 7-d period to constitute a 7-d average discharge value. No data day shall be included in more than one 7-d average discharge value.

**8.5.1.4** A 30-d average discharge value shall consist of a minimum of 50% of the regularly scheduled sampling days per 30-d period. If a 30-d period contains less than the required number of data days, sufficient data days may be transferred from the preceding 30-d period to constitute a 30-d average discharge value. If there are not sufficient data days available in the preceding 30-d period, the transfer of data days may take place from the following 30-d period to constitute a 30-d average discharge value. No data day shall be included in more than one 30-d average discharge value.

**8.5.1.5** During the stress loading sequence, consisting of washday, working-parent, power / equipment failure, and vacation stress loading periods, data shall be collected from a minimum of  $\frac{2}{3}$  of the total scheduled sampling days and from at least two of the scheduled sampling days during any single stress recovery.

### 8.5.2 Class I systems

The following criteria shall be met for a system to be classified as a Class I residential wastewater treatment system. All requirements for each parameter shall be achieved except as provided for in Section [8.5.2.2](#). Sections [8.5.1.3](#), [8.5.1.4](#), and [8.5.1.5](#) are testing minimums. These minimums shall be attained to be considered a valid test.

# NSF/ANSI Standard 40 - 2023 Requirements

## 8.5.2.1 EPA secondary treatment guideline parameters<sup>3</sup>

### 8.5.2.1.1 CBOD<sub>5</sub>

The 30-d average of CBOD<sub>5</sub> concentrations of effluent samples shall not exceed 25 mg/L.

The 7-d average of CBOD<sub>5</sub> concentrations of effluent samples shall not exceed 40 mg/L.

### 8.5.2.1.2 TSS

The 30-d average of TSS concentrations of effluent samples shall not exceed 30 mg/L.

The 7-d average of TSS concentrations of effluent samples shall not exceed 45 mg/L.

### 8.5.2.1.3 pH

The average pH of all individual effluent samples shall be between 6.0 and 9.0. The average pH is the sum of individual antilog (base-10) of the negative of the pH measurements taken during a given period, divided by the total number of measurements taken during the same period, transformed to a log (base-10) value. This will return a negative value. Change the sign from negative to positive to get the average pH.

## 8.5.2.2 Effluent concentration excursions

System performance shall not be considered outside the limits established for Class I systems if, during the first 30-d average of performance testing and evaluation, 7- and 30-d average effluent CBOD<sub>5</sub> and TSS concentrations do not equal or exceed 1.4 times the effluent limits specified in Section [8.5.2.1](#).

NOTE — The technology utilized in many residential wastewater treatment systems is biologically based. The allowance of excursions from the effluent limits established in this standard during the first 30-d of performance testing and evaluation reflects the fact that an immature culture of microorganisms within the system may require additional time to achieve adequate treatment efficiency.

The value of 1.4 is based on the U.S. EPA *Technical Review Criteria for Group I Pollutants*, including CBOD<sub>5</sub> and TSS.

## 8.5.2.3 Color, odor, oily film, and foam

### 8.5.2.3.1 Color

The color rating of each of the three undiluted composite effluent samples shall be reported. There are no criteria that these values shall meet.

### 8.5.2.3.2 Odor

The odor rating of each of the three undiluted composite effluent samples shall be reported. There are no criteria that these values shall meet.

### 8.5.2.3.3 Oily film and foam

Oily films and foaming shall not be visually detected in any of the diluted composite effluent samples.

## 8.5.3 Class II systems

The following criteria shall be met in order for a system to be classified as a Class II residential wastewater treatment system.

# NSF/ANSI Standard 40 - 2023 Requirements

## 8.5.3.1 CBOD<sub>5</sub>

Not more than 10% of the effluent CBOD<sub>5</sub> values shall exceed 60 mg/L.

## 8.5.3.2 TSS

Not more than 10% of the effluent TSS values shall exceed 100 mg/L.

## 8.5.4 Air pressure and flow

There are no criteria for aerator pressure or flow. Pressure and flow are measured for the purpose of qualifying alternate aerators following the test.

## 9 Final report

A final report shall be prepared that presents the following:

- all data collected in accordance with the testing and evaluations specified within this standard;
- calculation of the pounds BOD<sub>5</sub> loaded during the test and the pounds removed;
- any adjustments made to the alkalinity of the influent wastewater;
- copy of the current edition of the Owner's Manual; and
- process description and detailed dimensioned drawings of the tested system.

A supplemental report shall be prepared for any system(s) approved under the performance classification in Section 1.4, including process description(s) and dimensioned drawing(s).