STANDARD 40 - 2019
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 six-month 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, ⅔ of the system's capacity shall be filled with water and the remaining ⅓ shall be filled with residential wastewater.

8.1.3 The system shall undergo design loading (see 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 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.

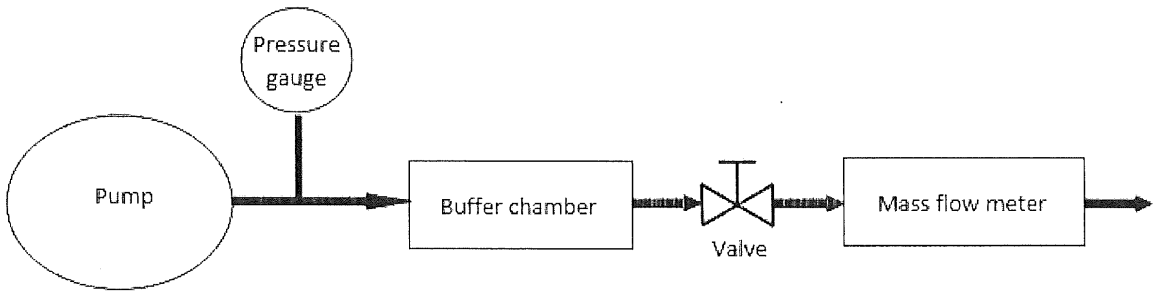
8.1.7 The system shall be operated in accordance with the manufacturer’s instructions. However, routine service and maintenance of the system shall not be permitted during the performance testing and evaluation period.

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 the 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 four hours. 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 hours. 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 hours. After the 4 hour 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.



8.2 TESTING AND EVALUATION CONDITIONS, HYDRAULIC LOADING, AND SCHEDULES

8.2.1 Influent wastewater characteristics

The 30-d average BOD5 concentration of the wastewater delivered to the system shall be between 100 mg/L and 300 mg/L.

The 30-d average TSS concentration of the wastewater delivered to the system shall be between 100 mg/L and 350 mg/L.

The average wastewater alkalinity of the wastewater delivered to the system over the course of testing shall be greater than 175 mg/L $CACO_3$ (alkalinity may be adjusted if inadequate). Unless requested by the manufacturer, the raw influent shall be supplemented with sodium bicarbonate if the wastewater is found to be deficient in alkalinity.

8.2.2 Hydraulic loading and schedules

The performance of the system shall be evaluated for 26 consecutive wk. During the testing and evaluation period, the system shall be subjected to 16 wk of design loading, followed by 7.5 wk (52 days) of stress loading, and then an additional 2.5 wk (18 days) of design loading.

8.2.2.1 Design loading

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

Time Frame	Approximate % Rated Daily Hydraulic Capacity
6 AM to 9 AM	35
11 AM to 2 PM	25
5 PM to 8 PM	40

NOTE – The individual dosage shall be no more than 10 gallons 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

Stress loading is designed to evaluate a system's performance under four non-ideal conditions. Systems shall be subjected to each stress condition once during the 6-month testing and evaluation period, and each of the four stress conditions shall be separated by 7 days of design loading (see 8.2.2.1).

8.2.2.2.1 Wash-day stress

The wash day stress shall consist of 3 wash days in a 5-day period. Each wash day shall be separated by a 24-h period. During a wash-day, the system shall be loaded at times and capacities similar to those delivered during design loading (see 8.2.2.1),

however during the first two dosing periods per day, the design loading shall include 3 wash loads (3 wash cycles and 6 rinse cycles).

8.2.2.2.2 Working-parent stress

For 5 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 1 wash load (1 wash cycle and 2 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 1 wash load (1 wash cycle and 2 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 8 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 3 wash loads (3 wash cycles and 6 rinse cycles).

8.2.3 Dosing volumes

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

> NOTE – 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-month 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 – 16), the period of stress loading (weeks 17 – 23.5), and the second phase of design loading (weeks 23.5 – 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 or maintenance shall be performed on the system whether the time period to achieve the 96 data days falls within or exceeds 26 wk.

> **NOTE** – In the event that a catastrophic site problem occurs, as described in 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 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, daily composite effluent samples shall be collected and analyzed 5 days a week.

8.3.3 Stress loading

During stress loading, influent and effluent 24-h composite samples shall be collected on the day each stress condition is initiated. Twenty-four h after the completion of washday, working-parent, and vacation stresses, influent and effluent 24-h composite samples shall be collected for 6 consecutive days. Forty-eight h after the completion of

the power/equipment failure stress, influent and effluent 24-h composite samples shall be collected for 5 consecutive days.

8.4 ANALYTICAL DESCRIPTIONS

8.4.1 pH, TSS, BOD5, and CBOD5

The pH, TSS, and BOD5 of the collected influent and the pH, TSS and CBOD5 of the collected effluent 24-h composite samples shall be determined with the appropriate methods in Standard Methods.

NOTE – Standard Methods requires pH and temperature to be sampled as grab samples.

8.4.2 Color, odor, oily film, and foam

8.4.2.1 General

The effluent composite samples shall be diluted 1:1000 with distilled water. Three composite effluent samples shall be tested during the 6-month evaluation period.

8.4.2.2 Color

The apparent color of the diluted effluent samples shall be determined with the visual comparison method described in Standard Methods.

8.4.2.3 Odor

A panel consisting of at least 5 evaluators shall qualitatively rate 200 mL aliquots of the diluted effluent samples as offensive or non-offensive when compared to odor-free water prepared in accordance with Standard Methods.

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.

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.

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 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-d and 30-d averages of effluent measurements. Rationale for all data exclusions shall be documented in the final report.

8.5.1.2 In the event that 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 7-d and 30-d averages of effluent measurements.

  NOTE – Pre-existing conditions shall be defined as the point when the results of 3 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 3 data days. If a calendar week contains less than 3 data days, sufficient data days may be transferred from the preceding calendar week to constitute a 7-d average discharge value. If there are not sufficient data days available in the preceding calendar week, the transfer of data days may take place from the following calendar week 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 month. If a calendar month contains less than

the required number of data days, sufficient data days may be transferred from the preceding calendar month to constitute a 30-d average discharge value. If there are not sufficient data days available in the preceding calendar month, the transfer of data days may take place from the following calendar month 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 wash-day, working-parent, power/equipment failure, and vacation stress loading periods, data shall be collected from a minimum of ⅔ of the total scheduled sampling days and from at least 2 of the scheduled sampling days during any single stress recovery.

8.5.2 Class I systems

The following criteria shall be met in order 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 8.5.2.2.

NOTE – Section 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.

8.5.2.1 EPA secondary treatment guideline parameters

8.5.2.1.1 CBOD5

The 30-d average of CBOD5 concentrations of effluent samples shall not exceed 25 mg/L.

The 7-d average of CBOD5 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 pH of individual effluent samples shall be between 6.0 and 9.0.

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 calendar month of performance testing and evaluation, 7-d average and 30-d average effluent CBOD5 and TSS concentrations do not equal or exceed 1.4 times the effluent limits specified in 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 calendar month 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 USEPA Technical Review Criteria for Group I Pollutants, including CBOD5 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 diluted composite effluent samples shall be reported. There are no criteria that these values shall meet.

8.5.2.3.2 Odor

The overall rating of each of the three diluted composite effluent samples shall be non-offensive.

8.5.2.3.3 Oily Film and Foam

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.

8.5.3.1 CBOD5

Not more than 10% of the effluent CBOD5 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 aerators following the test.