NSF/ANSI Standard
for Wastewater Treatment Systems —

Gravelless Trench Products for Onsite Wastewater Treatment and Distribution Systems

1 General

1.1 Purpose

The purpose of this Standard is to establish minimum materials, design and construction, and performance requirements for gravelless trench products used in place of conventional gravel onsite wastewater treatment and distribution systems. This standard also specifies the minimum literature that manufacturers shall supply to authorized representatives and owners.

1.2 Scope

This Standard contains minimum requirements for products that are designed for, and used in place of, gravity dosed gravel distribution systems treating septic tank effluent for onsite wastewater treatment.

1.3 Alternate materials, design, and construction

While specific materials, designs, and constructions may be stipulated in this Standard, products that incorporate alternate materials, designs, or constructions may be acceptable when it is verified that such products meet the applicable requirements.

1.4 Performance classification

For the purpose of this Standard, systems are classified according to the hydraulic performance of the product in comparison with a control system as determined by the performance testing and evaluations described herein. All systems within a manufacturer’s model series must be tested.

2 Normative references

The following documents contain provisions that, through reference in this text, constitute provisions of this Standard. At the time of publication, the indicated editions were valid. All standards are subject to revision, and parties are encouraged to investigate the possibility of applying the recent editions of the standards indicated below.


1 American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126
2 National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269

Draft 4.0
2/29/08
3 Definitions

3.1 authorized representative: An organization, group, individual, or other entity that is authorized by the manufacturer to distribute, sell, install, or service certified gravelless trench products.

3.2 average: The sum of individual measurements taken during a given period divided by the total number of measurements taken during the same period.

3.3 biochemical oxygen demand (BOD₅): The concentration of oxygen (expressed as mg/L) utilized by microorganisms in the oxidation of organic matter during a five-day period at a temperature of 20 °C (68 °F).

3.4 carbonaceous 5-day biochemical oxygen demand (CBOD₅): The concentration of oxygen (expressed as mg/L) utilized by microorganisms in the non-nitrogenous oxidation of organic matter during a 5-day period at a temperature of 20 °C (68 °F).

3.5 components: All of the physical, mechanical, and electrical parts of the product.

3.6 manufacturer: The entity that develops, designs, and produces residential wastewater treatment systems.

3.7 Product: Insert definition here.

3.7 residential wastewater (wastewater): Human body waste and liquid waste generated by the occupants of an individual residence.

3.8 residential wastewater treatment system: An organized and coordinated system of components that functions to treat wastewater generated by individual residences.

3.9 total nitrogen: The sum of the total Kjeldahl nitrogen (TKN), nitrite (NO₂) and nitrate (NO₃) in a sample, expressed as mg/L as N.

3.10 total suspended solids (TSS): The quantity of solids (expressed as mg/L) which can be readily removed from a well-mixed sample with standard laboratory filtering procedures.

3.11 upset: An exceptional incident in which there is unintentional and temporary noncompliance with designated effluent limitations because of factors beyond the reasonable control of the manufacturer.

4 Materials

Materials shall be durable and capable of withstanding stresses and wear during shipping, assembly, installation, and operation. Product materials shall not be adversely affected when subjected to the use environment.
NOTE – Because there are numerous design criteria suitable for the manufacture of residential wastewater treatment systems, manufacturers should acquire appropriate engineering expertise in evaluating the design of the system.

4.1 Interior surfaces

The interior surfaces of the product shall be free of burrs, spalls, honeycombs, and pits, with the exception that rough surfaces intended to support microbiological growth shall be permitted. Interior surfaces shall show no visible signs of structural change following performance testing and evaluation including, but not limited to, flaking, pitting, or the formation of structurally significant cracks. The product shall show no permanent deformation following performance testing.

4.2 Exterior surfaces

Exterior surfaces shall show no visible signs of structural change following performance testing and evaluation including, but not limited to, flaking, pitting, or the formation of structurally significant cracks.

NOTE – Small surface cracks exhibited by concrete tanks are normally expected in some circumstances and shall not be considered structural deterioration.

4.3 Welding

Welded seams and deposited weld material shall meet the requirements of sections 4.1 and 4.2. Welds and welding methods shall conform to ANSI/AWS D1.1 for steel 1/8 in (3.2 mm) and thicker or ANSI/AWS D1.3 for steel that is less that 1/8 in (3.2 mm). The welds shall be visually inspected and shall be acceptable if the criteria of Table 6.1 of ANSI/AWS D1.1 are satisfied.

The location, type and size of welds shall be shown on the drawings required in Section 7. Welds that do not conform to the manufacturer’s drawings, based on visual examination of the weld, shall be repaired prior to testing and the repairs noted in the final report. The system shall be free from cracks at the interface between the base metal and the weld, or within the weld metal.

4.4 Dissimilar metals

Dissimilar metal materials, not considered compatible at the electromotive level, shall not be in direct contact. An electrically nonconductive insulating fitting shall be provided at the junction between such dissimilar metal parts or components.

5 Design and construction

5.1 Exposed surfaces

All exposed surfaces shall be free from nonfunctional rough or sharp edges that may cause injury to persons using, installing, maintaining, or servicing the system.

5.2 Structural integrity

The product, when filled or empty, shall maintain its structural integrity when subjected to earth and hydrostatic pressures. An in situ visual evaluation shall be performed during (if accessible) and after the performance testing and evaluation.

5.3 Access ports

The product shall be demonstrated to have ground-level access port(s) that are located to facilitate the examination of the installed product. The port(s) shall be of sufficient size and located so as to allow for
determination of the operating condition within the product. Products without ground-level access shall provide a means to locate the opening to the product.

5.4 Flow design

Products shall have a designated flow path that is reflective of the entire treatment process. During periods of normal product operation, as well as periods of product malfunction, the design and construction of the system shall preclude alternative flow paths and prevent the discharge of wastewater from an opening external to the designated flow path.

NOTE – The discharge of wastewater from access ports shall be permissible during system malfunction.

5.5 Data plate and service label

A permanent and legible data plate shall be affixed to the product, which shall include:

– manufacturer’s name and address;
– model designation; and
– the product’s rated percent reduction from conventional drainfield size.

6 Product literature

6.1 Owner’s manual

Each product shall be accompanied by a manufacturer-prepared owner’s manual. The authorized representative shall provide the manual to the owner at the time of system installation. The manual shall be written so as to be easily understood by the intended reader and shall include, at a minimum:

– the product's model designation;
– a statement confirming that the product meets the requirements in NSF/ANSI XXX;
– a functional description of product operation, preferably including diagrams illustrating basic product design and flow path;
– a clear statement of examples of the types of waste that can be effectively treated by the product; and
– a list of household substances that, if discharged to the product, may adversely affect the product, the process, or the environment.

6.2 Additional product literature

Manufacturers shall provide authorized representatives with additional product literature intended to accommodate all persons who may be involved in the installation, upkeep, or repair of the product. Each product shall be accompanied by manufacturer-prepared literature including specific instruction for product installation, operation and maintenance, and troubleshooting and repair. This information may be provided in the form of discrete manuals or may be combined into a comprehensive manual(s) as the manufacturer deems appropriate.

6.2.1 Installation manual
Manufacturers shall specify who is authorized to install their product, and provide comprehensive and detailed installation instructions to these authorized representatives. The manual shall be written so as to be easily understood by the intended reader and shall include, at a minimum:

- a numbered list of product components and an accompanying illustration, photograph, or print in which the components are respectively identified;
- design, construction, and material specifications for the product's components;
- off-loading and unpacking instructions including safety considerations, identification of fragile components, and measures to be taken to avoid damage to the product;
- a clear definition of product installation requirements including plumbing requirements, miscellaneous fittings and appurtenances, soils materials and slope;
- a sequential installation procedure from the septic tank; and
- repair or replacement instructions in the event that a product possesses flaws that would inhibit proper functioning and a list of sources where replacement components can be obtained.

7 Other documentation

The manufacturer shall prepare and maintain documentation for each product including, at a minimum:

- a basic description of the product;
- complete drawings of the product;
- design basis data, including operating parameters (aeration requirements, recycle rates, etc.) essential for proper operation of the product under differing field conditions; and
- a comprehensive and detailed discussion of product fundamentals.

8 Performance testing and evaluation

This section describes the methods used to evaluate the performance of gravelless trench products. Performance testing and evaluation shall be independent of design and construction (see Section 5). However, structural weaknesses and other defects and failures occurring before and during the test shall be described in the final report (see Section 9).

8.1 Model series classification

Gravelless trench products within a manufacturer’s model series may be classified according to the performance testing and evaluation of the most representative model within the series. (Note: This could be a sticky wicket. Who says which model is the most representative? How does a series get defined (only change in one dimension)?) Performance testing and evaluation may be completed through pilot scale testing described in section 8.2 through 8.6 or through field evaluation described in Section 8.7.

8.2 Preparation for testing and evaluation

Testing of gravelless trench product shall be completed using control trenches for comparison with the gravelless test systems. The control trench and gravelless test system shall be installed and tested simultaneously with five replicates under conditions described in this section. Each control trench and
gravelless test system shall be constructed within a liner designed to contain the percolate wastewater passing through the trench or test system, and precipitation falling on ground containing the trench/test system.

If conditions at the testing site preclude installation of the gravelless product at its normally prescribed depth, the manufacturer shall be permitted to cover the system with soil to achieve normal installation depth. If this should be required, the gravel control trenches shall be installed with the same cover arrangements. Unless specified by a manufacturer, a minimum of 1 ft (0.3 m) of cover shall be provided to either the gravelless product or the control trench. Most soil scientists would state better oxygen diffusion and soil characteristics make a better system with minimum soil cover. An additional two-inch layer of pea gravel (approximately 1/8 inch diameter) shall be placed at the ground surface over the final soil cover at the control and test systems.

Performance testing and evaluation of gravelless products shall not be restricted to specific seasons.

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.

The gravelless product shall be operated in accordance with the manufacturer’s instructions, especially loading rate (in gallons per square foot per day). However, routine service and maintenance of the product shall not be permitted during the performance testing and evaluation period.

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

8.2.1 Constructed Soil matrix

The control trenches and gravelless test products shall be installed in a constructed soil matrix made of concrete sand meeting the requirements of ASTM C33 Standard Specification for Concrete Aggregates. This also has a fineness modulus spec. Did you check that? The soil matrix shall be constructed as described in this section. Each control trench and gravelless product test unit shall be installed inside a liner designed to contain the water applied to that trench or test system, as well as precipitation falling on the ground surface above the trench or test system.

8.2.1.1 Sand characterization

The sand material shall meet the following requirements:

(Insert sieve analysis of sand used at MASSTC – four different sources will be obtained to establish the ranges appropriate for this section)

Uniformity coefficient \((C_u) = xx \pm x\) (where \(C_u = D_{60} ÷ D_{10}\) and \(D_{xx}\) is the grain size at which \(xx\) percent of the soil is finer by weight)

Median size \((D_{50}) = xx \pm x\)

Effective size \((D_{10}) = xx \pm x\)

Finest quartile \((D_{25}) = xx \pm x\)

\(D_{15} = xx \pm x\)

\(D_{200} = < xx \% 1.5\% by weight? 2% by weight?\)

8.2.1.2 Soil construction

The liners for each trench or test system shall be impermeable (Thickness and material spec) and sized to contain a sufficient volume of soil material to provide assurance that water collected within the liner will not rise to a level less than 2 ft (0.6 m) from the gravel or test system interface with the soil matrix. A means must be provided for draining the collected water from the liner to maintain non-saturated conditions in the cell, or
at a minimum, the 2 ft (0.6 m) non-saturated zone, as well as for collection of samples of the water collected below the control and test systems. The liner shall extend a minimum of 3 ft (0.9 m) beyond all boundaries of the trench or test system, and shall rise to the ground surface.

The sand used for constructing the soil matrix shall be placed in the trenches in 6 in. (0.15 m) lifts and means shall be taken to try to achieve 90 ± 5% compaction of each lift of the sand. Should this be an absolute requirement, or a goal for the placement of the sand? If a requirement, methods to confirm that the compaction was achieved will need to be indicated.

8.2.2 Installation of the control trenches

8.2.2.1 Gravel specifications

The gravel used for construction of the control trenches shall be double washed coarse aggregate ranging in size from ½ in. to 1½ in. (1.27 to 3.8 cm). The gravel shall have the following sieve analysis:

\[ \text{(Insert sieve analysis of gravel used at MASSTC)} \]

Let's talk about a DOT size or multiple sizes. Don't tie yourselves in too tightly. What if a test center wants to be opened in Wisconsin?

Fines (< 0.053 mm) shall not be more than 2.75% of the total weight of the gravel. The rock shall be durable and resistant to breakdown. (LA Abrasion? Sodium Soundness? Moh's hardness scale? This sentence sounds vague.) Crushed limestone shall not be used. IF this statement stays, the standard has no value in Florida. Of the remaining 90% of the systems installed in the US if they all also prohibit limestone, this may be acceptable.

8.2.2.2 Trench specifications

The control trenches shall be constructed to the following specifications:

<table>
<thead>
<tr>
<th>Trench Parameter</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>Equal to the width of the test system (should there be absolute limits – 1’ to 3’?)</td>
</tr>
<tr>
<td>Length</td>
<td>&gt; 12 feet (3.66 m) based on module length of the gravelless test system</td>
</tr>
<tr>
<td>Depth of soil cover above gravel</td>
<td>1.5 (0.6) ft (0.3 m)</td>
</tr>
<tr>
<td>Depth of gravel in trench</td>
<td>1 ft (0.3 m)</td>
</tr>
<tr>
<td>Minimum distance between trenches</td>
<td>2 times trench width</td>
</tr>
</tbody>
</table>

End plates shall be installed 6 in. (15.2 cm) from each end of each control trench. (This doesn’t make sense. Earlier you said three feet to the edge of the box, so what is an end plate with respect to gravel?) Geotextile barrier material shall be placed on the surface of the gravel to prevent the backfilled soil from entering the gravel.

Suggestion made: Recommend using a serial loaded arrangement rather than a single cell arrangement.
8.2.2.3 Distribution pipe

The distribution pipe shall be 4 in. (0.1 m) diameter perforated PVC pipe. Specify holes at what position along the sides of the pipe? The pipe shall be embedded in the gravel with 6 in. (0.15 m) of gravel below the pipe. The pipe shall be placed at a level grade or sloped no more than 0.25% (approximately 0.6 in. (1.5 cm) in 20 ft (6 m)).

8.2.2.4 Observation ports

Two observation ports shall be provided in each trench. The ports shall consist of 4 in. (0.1 m) PVC pipes that extend from the infiltrative surface to above the ground surface, which shall be capped. The ports shall be perforated at the bottom from the infiltrative surface to a height of 1 foot (0.3 m), and shall be anchored to prevent having them pulled out when the cap is removed.

8.2.3 Installation of the test product

The gravelless and control trench systems shall be of the same length. The length of the trenches shall be such that the gravelless test system, if in segments, shall consist of a whole segment. In no case shall the trenches be less than 12 feet in length. The width of the cells shall be dictated by the width of the product under test. In the case of a gravelless drainfield product where the widest point of the product is not coincident with the infiltrative surface, the vertical projection of the product on the infiltrative surface shall be used to determine the basal area of the gravelless drainfield product.
Each test system shall be installed in the constructed soil matrix, as described in Section 8.2.1.2. The test systems shall be placed in random order within the test site. Each test system shall also be provided with two observation ports, as described in Section 8.2.2.4. The ports shall be installed at 33% and 67% of the length of test systems. More observation ports should be included in the test cells – at both ends and the middle. Suggest that ports be located at 5%, 50% and 95% of the cell.

The product shall be assembled, installed and covered in accordance with the manufacturer's instructions. 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.

8.3 Hydraulic loading

8.3.1 Challenge wastewater characteristics

Feeding of the control trenches and test systems shall be made with wastewater discharged from a 1,500 gallon, single-compartment septic tank. Effluent from the septic tank shall be collected for distribution to the control trenches and test systems. The wastewater dosed to the septic tank shall be primarily domestic wastewater meeting the following:

- 30-day average BOD$_5$ concentration of the wastewater delivered to the system shall be between 100 mg/L and 300 mg/L.
- 30-day average TSS concentration of the wastewater delivered to the system shall be between 100 mg/L and 350 mg/L.

Note if you are going to judge other parameters we want a range of TN and fecal coliform specified here too.

The average concentrations shall be based on 24-hr composite samples of the raw wastewater collected three times per week and averaged over a 30 calendar day period.

8.3.2 Septic tank loading

The septic tank shall be dosed 7 days a week with a wastewater volume required to provide the daily hydraulic loading requirements for the control trenches and test systems, but not less than 750 gpd. The effluent from the septic tank shall be directed by gravity to the control trenches and test systems, unless the test system is fed by a pressure distribution system, in which case the test trenches shall be fed as determined by the manufacturer. The following schedule shall be adhered to for dosing of the tank feeding the control trenches and test systems:

<table>
<thead>
<tr>
<th>Time period</th>
<th>Approximate % of daily volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:00 a.m. to 9:00 a.m.</td>
<td>35</td>
</tr>
<tr>
<td>11:00 a.m. to 2:00 p.m.</td>
<td>25</td>
</tr>
<tr>
<td>5:00 p.m. to 8:00 p.m.</td>
<td>40</td>
</tr>
</tbody>
</table>

8.3.3 Control and test system loading

The control trenches and test systems shall each be hydraulically loaded at the rate of 1.48 gallons/ft$^2$/day based on the basal area of the control trench. The hydraulic loading of the gravelless test systems shall be greater than the control trenches in proportion to the percent reduction in drainfield size indicated by the manufacturer for the test product. (the idea being that the test trench receives a greater hydraulic loading)
8.3.4 Precipitation

A means shall be provided at the test site to measure and record the precipitation occurring during the testing period. Daily climatological data, including precipitation, maximum-minimum temperature, and relative humidity shall be collected.

8.3.5 Distribution of the septic tank effluent wastewater

The distribution of the septic tank effluent wastewater to the control trenches and test systems shall provide a uniform split of the wastewater to each trench or test system. The control trenches shall be fed by gravity. The test systems shall also be fed by gravity unless the manufacturer specifies pressure distribution. If pressure distribution is used for the test systems, the distribution system shall be designed to assure that the delivery pressure will be dispersed to assure no physical disruption of the infiltrative surfaces by the residual pressure of the dose.

8.4 Hydraulic performance evaluation

The purpose of the hydraulic performance evaluation is to determine the impact of increased hydraulic loading for the gravelless trench system with a standard hydraulic loading of a gravel trench. The formation of a biomat within the test and control trenches will be determined by monitoring ponding of water within each system, and will be used to determine the comparability of the gravelless trench system with a standard gravel trench.

8.4.1 Duration of hydraulic performance evaluation

The control trench and gravelless product installations shall be operated until one of the following conditions is reached:

- All five control trenches reach sustained ponding (measurement of water accumulation above the infiltrative surface of the basal area to a minimum average depth of more than 1 in. (2.5 cm) for 7 consecutive days); or
- Testing reaches 52 weeks.

During this period, the water depth in each of the observation ports for the control trenches and test systems shall be observed at a minimum of one time per week, and the results of the observations shall be recorded. If water is observed to be accumulating above the infiltrative surface of a control trench or test system, observations shall be made and recorded daily until no water accumulation is observed for 3 consecutive days or one of the conditions indicated in this section is achieved.

8.4.2 Post-hydraulic performance stress test

(Should a post-hydraulic test be completed? Would this test be a surge/flooding test? If so, how would it be completed and what should be measured?) Comment received: No, I don’t think that would be necessary. Alternatively: Following the conclusion of the hydraulic test, both the control trenches and gravelless products shall be dosed for a three day period at 2 times the loading utilized during the hydraulic performance evaluation. This exercise is designed to verify system surge capacity is adequate to accommodate peak loads in addition to design loads.

8.5 Contaminant performance evaluation

(Should collection of samples from the water collected below the control and test systems be included in the...
evaluation? Analysis for BOD, SS, Total N, fecal coli?)
This really has not been a manufacturer’s claim to date. Let’s hear from regulators on that one.
What would be the impact on the price of an evaluation?

8.6 Criteria

8.6.1 General

If influent characteristics occur outside the ranges specified in Section 8.3.1, improper observations, or sample collection occurs during the testing, an assessment shall be conducted to determine the extent to which these conditions adversely affected the evaluation. Based on this assessment, specific observations or data points may be excluded from the determination of performance. Rationale for all exclusions shall be documented in the final report.

In the event of site problems not described in the previous paragraph, including, but not limited to improper dosing, malfunctions of test apparatus, and acts of God (such as heavy rains causing control trenches or test systems to saturate), jeopardize the validity of the performance testing and evaluation, manufacturers shall be given the choice to:

1) Perform maintenance and restart the performance testing; or
2) Discontinue dosing to the system for a period of time up to one month then resume testing to meet the requirements of Section 7.4.1.

8.6.2 Performance

8.6.2.1 Hydraulic performance

The gravelless trench product shall perform comparably or better than the gravel control trenches, as defined by:

Criteria need to be determined.

Suggestion submitted:

1) Throughput rates (volume per time) are statically equal or greater than the gravel control.
2) No surfacing of wastewater or ponding measurements recorded above the specified product height.
(These two criteria demonstrate equal hydraulic performance during normal use with adequate surge capacity during peak use periods.)

8.6.2.2 Contaminant removal performance (Not certain this will be part of Standard)

The gravelless trench product shall perform comparably or better than the gravel control trenches, as defined by:

(Suggestions? Would it be appropriate that the average concentrations from the three sets of test systems have values equal to or less than the averages for the control trenches? Other means for comparing the data?)

Comment received: This really has not been a manufacturer’s claim to date. Let’s hear from regulators on this.

8.7 Field Evaluation (This was suggested by a reviewer)

Gravelless products that have been in use for at least 5 years and installed in at least 10,000 onsite wastewater infiltration systems may be evaluated through a field evaluation of the gravelless system and a comparable set of control systems. The objective in conducting a field evaluation is to determine, with a 95%
confidence, that the measured failure rate for the set of gravelless products is less than 5 percentage points higher than the measured failure rate for the comparable set of control systems. This will confirm that the gravelless product performs the same as or better than the control system.

8.7.1 Sample size and site selection

A minimum sample size of 300 shall be used for both the gravelless product and control system. A sample size of 300 for both the gravelless product and control system results in a valid analysis, regardless of the total number of systems (population) from which the sample is chosen. A contingency shall be incorporated into the field evaluation method to account for the need to increase the population to allow for sites at which failure status could not be determined, such as inaccessible sites.

The available records for each type of system within the chosen geographic area shall be assigned a number. Individual sites shall be selected for inclusion in the sample on the basis of a random number generator, until the required number of systems to be inspected is achieved. The sample may be located within an individual state border.

The age of systems included in the sample shall be in the 7 to 12 year range.

8.7.2 Methods and materials

Field evaluation personnel shall be familiar with onsite industry issues, in addition to the characteristics of the gravelless product and control system. Previous experience by the field evaluation personnel that may result in a possible source of bias in the sample selection and field data acquisition, shall be eliminated to the maximum extent possible. At a minimum, field inspectors shall be third parties unaffiliated with the gravelless product manufacturer, as well as regulation of either the gravelless product or control systems within the geographic area where the sample is located.

Systems shall be surveyed during the historical wet time of year, in an effort to inspect systems during a period when the most failures are normally recorded and seasonal effects on failure rate are at peak levels.

Each system shall be inspected by two members of the survey team. No inspection shall be performed by a single individual. Only houses that are known to be occupied at the time the field evaluation is conducted shall be inspected. At the time of inspection, the survey team shall not be provided with information on whether the system is the gravelless product or control system.

All field data shall be recorded on standardized forms and retained for reporting.

8.7.3 Survey data collection

The field data collection process shall include a visual inspection of each site, as well as an interview with the occupants of the residence for the system.

8.7.3.1 Field survey

The following questions shall be answered with a yes or no by the survey team for each system inspected during the field evaluation (applies to both gravelless and control systems):

1) Is sewage ponded on the ground surface?
2) Does pressure to the soil surface with a shoe result in effluent coming to the ground surface?
3) Is there straight pipe?
4) Is there evidence of past failure?
5) Is there evidence of a repair (not associated with a system expansion due to an addition to the residence)?

8.7.3.2 Occupant interview
In addition, an attempt shall be made to interview the occupants at each survey site in person or by phone. Answers to the following questions shall be obtained during the interview:

1) Has your tank been pumped due to ponding of effluent on the ground surface or backing into the septic tank or residence?
2) Are you having any of the following problems with your system today: surfacing effluent on the ground; wet over system; odors; back up of effluent into the house; other?
3) Have you had problems with the system in the past: surfacing effluent on the ground; wet over system; odors; back up of effluent into the house; other? (Determine how the problem was solved and record this information.)
4) Has the system been repaired or replaced due to ponding of effluent on the ground surface or backing into the septic tank or residence?

8.7.4 Failure determination

An answer of “yes” for one or more of the questions posed in Section 8.7.3 by either the field survey observations or interviewing the site occupant shall be considered a failure of an individual site.

8.7.5 Data analysis

The data analysis shall consist of a “one sided” test of the difference between proportions. This shall include a statistical analysis of the field evaluation data to determine the percentage point difference in failure rate between the gravelless product sample and control system sample.

8.7.6 Performance evaluation criterion

If the data analysis shows a difference in failure rates between the gravelless product and control system that is greater than or equal to 5 percentage points (e.g. 9% failure rate for gravelless product and a 4% failure rate for control system), there should only be a 5% chance that the difference between the two samples would occur by chance. This is the “95% confidence level”. Using the above criterion, if a statistically significant higher failure rate was not detected in the gravelless product, then the conclusion shall be that the gravelless product performs the same as or better than the comparable control system.

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;
– 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).