Commonwealth of Pennsylvania
Department of Environmental Protection (DEP)
Bureau of Point and Non-Point Source Management
Harrisburg, PA

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Technology: Eljen Geotextile Sand Filter (Eljen GSF®)

Classification Type: Alternate technology (Listing #A2010-0007-0005)

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In accordance with Title 25, Chapter 73, Section 73.72, DEP classifies the Eljen Geotextile Sand Filter (Eljen GSF®) for use as an alternate onlot sewage treatment system in the Commonwealth of Pennsylvania. This classification permits the use of the Eljen GSF as an advanced treatment system used for the specific purposes of reducing $CBOD_5$ and TSS in the sewage effluent. This system has demonstrated that it can produce an effluent which shall not exceed 10 mg/l $CBOD_5$ and 10 mg/L TSS as monthly averages.

I. Technology Description

The Eljen GSF is a modular treatment component integrated with a soil absorption system comprised of an anti-siltation fabrics, perforated pipes, Bio-Matt fabrics, cuspated plastic cores, and a layer of sand situated above the native soil. The Eljen GSF design provides increased surface area for biological treatment that exceeds the module's footprint. Anti-siltation geotextile fabric covers the top and sides of the Eljen GSF module to protect the specified sand and soil from fines that can clog the sand while maintaining effluent storage within the module. Open air channels within the B43 module support aerobic bacteria growth on the Bio-Matt geotextile fabric interface.

II. Design Requirements

A. Location: The Eljen GSF must be installed for the treatment of domestic strength wastewater only (as defined by Table 1 of Miscellaneous Data to be used in Conjunction with PA DEP listings) serving a new construction or as a repair.

B. Treatment Tank:

(1) Tank installations must consist of either a two-compartment rectangular tank, two rectangular tanks in series, or otherwise conform to meet the requirements of Section 73.31. Vertically aligned circular (round) tanks are not permitted.

(2) Measures to control flotation of the tank must be implemented when the tank is installed in areas below any indication of a water table.
(3) An effluent filter bearing the seal of NSF indicating testing and approval by that agency under Standard No. 46 must be installed on the outlet of the final tank or compartment.

C. Dosing:
(1) Distribution of effluent from the septic tank or pump chamber to the absorption area may be by either gravity or pressure distribution.
(2) If a pump is required to lift effluent to the filter, a timed dose is required.
(3) Pressurized systems or lift pump/gravity systems shall have both a dosing volume less than 4 gallons/dose/module and less than 30 gallons per day/module.

D. Construction: The Eljen GSF must be installed with the following criteria:
(1) Per the manufacturer's installation instructions as described in the Pennsylvania Design and Installation Manual. The manual can be obtained from the manufacturer's website.
(2) Only B43 modules (48" L, 36" W, and 7" H) may be used. If the number of modules required is fractional, round up the nearest whole number. Modules may not be cut or otherwise resized.
(3) In calculating the number of modules necessary, the effective bottom absorption area will be either 16 ft^2 per module for percolation rates between 3 min/in to 60 min/in or 24 ft^2 per module for percolation rates between 61 min/in to 180 min/in. Additional modules may be necessary to meet the dosing requirements prescribed by II.C.3.
(4) The aggregate used must be a medium to coarse, washed, silica sand meeting the uniform size and grading requirements in ASTM C33 (sand) specifications. The aggregate must have less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Alternatively, PA DOT Type A (Cement Concrete Sand) sand may be used.
(5) The minimum amount of sand required at the beginning and end of each module row is six inches (6") of sand.
(6) A minimum of 12" of specified sand must be placed underneath the B43 modules.
(7) For percolation rates ranging between 3 min/in to 60 min/in, a minimum of six inches (6") of sand must be placed at the perimeter of the modules. For percolation rates ranging from 61 min/in to 180 min/in, a minimum of eighteen inches (18") of sand will be required along both sides of the B43 modules while a minimum of six inches (6") of sand will be required at the beginning and end of each Module row.
(8) A minimum of twelve inches (12") of specified sand must be used between rows of modules in beds with percolations rates between 3 min/in to 60 min/in. For percolation rates between 61 min/in to 180 min/in, thirty-six inches (36") of specified sand between rows of modules in beds must be used.
(9) For gravity systems, the PVC pipe distributing effluent to the B43 modules shall meet the following specifications:
a) The diameter of the SDR-35 or equivalent pipe shall be 4 inches.
b) The perforations shall be located at both the 4 o'clock and 8 o'clock positions.

(10) For pressurized systems, the PVC pipe distributing effluent to the B43 modules shall meet the following specifications:
   a) The diameter of the SDR-35 or equivalent pipe shall be 4 inches.
   b) The perforations shall be located at both the 4 o'clock and 8 o'clock positions.
   c) The pipe may have perforations that conform to either II.D.10.c.i or II.D.10.c.ii configuration:
      i. Pipe purchased from a manufacturer shall have a 3-hole perforation with the 5/8" diameter holes located at the 4 o'clock, 6 o'clock, and 8 o'clock positions.
      ii. Pipe purchased from a manufacturer shall have a 2-hole perforation with the $^{5}/_{8}$" diameter holes located at the 4 o'clock and 8 o'clock positions. Additional perforations at the 6 o'clock position are acceptable provided that there are three 6 o'clock perforations in the pipe for each B43 module. The perforations shall be placed such that the first hole be placed 8" from the end of the B43 module. Subsequent perforations shall be placed 16" center to center. (i.e. One 6 o'clock perforation 8" from the end of each module and one 6 o'clock perforation in the center of the B43 module.). The diameter of the perforations at the 6 o'clock shall be either $^{5}/_{8}$" diameter or ¾" diameter.

(11) For pressurized systems, the orifices for the inner pipe must:
   a) Conform to Section 73.44 with the exception that the orifices must be placed at the 12 o'clock position.
   b) Include a minimum of one ¼" diameter drain hole at the 6 o'clock position for each lateral.

(12) For pressurized distribution designs, laterals shall meet the general requirements for pressure distribution design provided by Section 73.44. Distribution of effluent to the individual laterals shall be by a central manifold extending into the absorption area from the delivery pipe or header or from an end feed manifold. The overall length of the laterals may exceed 51 feet.

(13) Where absorption area sizing reductions are proposed, they are not cumulative. No additional sizing reduction is allowed for use of an aerobic tank.

(14) If absorption area sizing reductions are proposed, where the system is used to serve a new dwelling, the soil profile evaluations and percolation testing must document that sufficient area is available for installation of a full-sized absorption area (prior to the calculation of the 40% reduction).

(15) The absorption area must be designed to take full advantage of the slope to move effluent out from under the absorption area and downgradient with the laterals placed parallel to the contour.

E. Siting requirements for sites described in Chapter 73 other than IRSIS. Up to a 40 percent reduction in the size of the absorption area is allowed where the percolation rate is in the range of 3 to 60 minutes per inch (min/in), inclusive. However, where the percolation rate is in the range of 61 to 180 min/in, inclusive, no reduction in absorption area sizing is permitted.

F. Construction requirements for sites described in Chapter 73 other than IRSIS must adhere to Chapter 73 regulations.

G. For siting requirements exhibiting limiting zones **greater than or equal to 20 inches** from the mineral soil surface, the following conditions apply. These specifications are absorption areas built above the ground surface.
   (1) The slope of the installation must not exceed 15 percent.
   (2) The soil profile must show that there is a minimum of 20 inches of suitable soil between the bottom of the proposed absorption area and the limiting zone.
   (3) The percolation test must be sized in accordance with the requirement of Section 73.16(c)(Table A), using the column under "Subsurface Sand Filters and Elevated Sand Mounds." No sizing reduction is permitted for use of an aerobic tank.
   (4) Where the percolation rate is in the range of 3 to 60 minutes per inch, inclusive, up to a 40% reduction in the size of the absorption area is allowed. However, where the percolation rate is in the range of 61 to 180 min/in, inclusive, no reduction in absorption area sizing is permitted.
   (5) Designing the location of multiple absorption areas so that one absorption area is placed hydraulically upgradient or downgradient from the other may cause the lower absorption area to fail because of excessive hydraulic loading from the upper absorption area. In new land development applications, unless the applicant shows the potential for such an impact is nonexistent through the experimental system process, this type of absorption area placement is prohibited.

H. Construction requirements for sites exhibiting limiting zones **greater than or equal to 20 inches** from the mineral soil surface. These specifications are for absorption areas built above the ground surface.
   (1) Design requirements for the laterals shall meet the general requirements for pressure distribution design provided by Section 73.44.
   (2) Distribution of effluent to the individual laterals shall be by a central manifold extending into the absorption area from the delivery pipe or header or from an end feed manifold. The pressure distribution design shall consist of a minimum of 2 laterals. The overall length of the laterals may exceed 51 feet.
   (3) All laterals shall have end cleanouts extended to the soil surface and be constructed using either 90 degree bends or two 45 degree bends. Laterals shall be fitted with end caps.
   (4) The distribution system must include a minimum of 3 feet of head at the terminal ends of the laterals.
   (5) A minimum 2:1 aggregate slope shall be maintained on all sides of the aggregate.
   (6) A minimum 4:1 length to width ratio shall be used for slopes ranging from 8% to 12%. Slopes ranging from 12% to 15% shall utilize a 6:1 length to width ratio or greater.

I. For siting requirements exhibiting limiting zones **less than 20 inches** from the mineral soil surface, the following apply.
   (1) The slope of the installation must not exceed 15 percent.
   (2) The vertical isolation distance from the bottom of the absorption area must be at least either of the following:

a) At least 10 inches to the seasonal high water table whether perched or regional, determined by direct observation of the water table or indicated by soil redoximorphic depletions.
b) At least 16 inches to rock or a rock formation with open joints, fracture or solution channels, or masses of loose rock fragments, including gravel, with insufficient fine soil to fill the voids between the fragments.

(3) The absorption area must be placed on a contour that is uniform (i.e. straight) and/or convex. Placement of the absorption area on concave slope shapes must be avoided.
(4) An area downgradient from the absorption area must be protected as specified by the soil scientist during testing, construction, and during the use of the absorption area.
(5) A soil scientist who is a professional member of the Pennsylvania Association of Professional Soil Scientists (PAPSS) or who is a "Qualified Soil Scientist" as defined in Chapter 73 of the regulations must perform a soil morphological test.
(6) Preparation of a soils report which includes the following at a minimum:
a) Inclusion of project name, project location, date of investigation, soils series, slope, and site conditions.
b) A minimum of four soil profile test pits shall be evaluated to verify the morphology of the proposed absorption site. The profiles should adhere to the following:
i. Inclusion of results addressing: (1) color (Munsell notation), (2) textural classes, (3) rock fragment modifiers, (4) redoximorphic features (mottles), (5) grade and type of structure, (6) consistence, and (7) boundary.
ii. Two soil profile evaluations on contour, bracketing the proposed absorption area.
iii. Two soil profile evaluations on contour with the downgradient distance determined by the soil scientist.
iv. The soil profiles must be conducted on-contour and the probes cannot be spaced more than 100 feet apart. In cases where the calculated aggregate area length exceeds 100 feet, additional test pit evaluations are required to verify the soil morphology of both the absorption area and the downgradient area.
v. Additional soil profiles may be required to verify the soil morphology of both the absorption area and the downgradient area in finer textured soils or higher flow rate projects that result on longer length absorption beds.
c) Determination of whether subsurface soil conditions are suitable for the absorption area as evidenced by the depth to the seasonal high water table limiting zone and/or the depth to the rock limiting zone.
d) Determination of the soil drainage classification and the appropriate loading rate and horizontal linear load from the HLLR table based upon the soils which are the most restrictive. Overall site suitability will be limited by the most restrictive depth to the seasonal high water table, depth to rock formation and soil morphology from all of the soil test pits evaluated.
e) The soil must have a consistence of "very firm" or less to be suitable.

f) Distribution of the effluent in the absorption area will be determined by the soil profile evaluations and the vertical depth between the bottom of the aggregate and the top of the seasonal high water table or rock formation.

g) The loading rate (required to calculate aggregate area square footage) and hydraulic loading rate (required to calculate aggregate area length) shall be determined with the HLLR table by using the most restrictive results from the soil profile evaluations bracketing the absorption area. The shape and grade of structure, as well as textural classification of the mineral soil from the profile horizon above the seasonal high water table or restrictive horizon, is used to determine these rates.

h) The report should identify and offer recommendations to address site conditions (i.e. soil quality, slope, stoniness, vegetation, surface drainage, site preparation, etc.) that could affect the design and or field investigation.

i) Signature of the qualified soil scientist (a professional member of the Pennsylvania Association of Professional Soil Scientists (PAPSS) or is a qualified soil scientist as defined in Section 73.1) certifying the contents of the soils report which includes the items in Section II.H.

(7) Designing the location of multiple absorption areas so that one absorption area is placed hydraulically upgradient or downgradient from the other may cause the lower absorption area to fail because of excessive hydraulic loading from the upper absorption area. In new land development applications, unless the applicant shows the potential for such an impact is nonexistent through the experimental system process, this type of absorption area placement is prohibited.

J. For construction requirements for sites exhibiting limiting zones **less than 20 inches** from the mineral soil surface, the following apply.

(1) Design requirements for the laterals shall meet the general requirements for pressure distribution design requirements by Section 73.44.

(2) Distribution of effluent to the individual laterals shall be by a central manifold extending into the absorption area from the delivery pipe or header or by an end feed manifold. The pressure distribution design shall consist of a single lateral or single pair of laterals placed on the same contour. The overall length of the laterals may exceed 51 feet.

(3) All laterals shall have end cleanouts extended to the soil surface and be constructed using either 90 degree bends or two 45 degree bends. Laterals shall be fitted with end caps.

(4) The distribution system must include a minimum of 3 feet of head at the terminal ends of the laterals.

(5) A minimum 2:1 aggregate slope shall be maintained on all sides of the aggregate.

(6) On these sites, the treatment and disposal distribution configuration is based on the horizontal linear loading rate derived from the soil morphological analysis and the Hydraulic Linear Loading Rate (HLLR) described by Table 1. The absorption area must be sized in accordance with Table 1- Hydraulic Linear Loading Rate Table. The length and width of the infiltration field are determined by Equations (1) and (2) as follows:

$$Length\ of\ Infiltration\ Field = \frac{Peak\ Daily\ Sewage\ Flow\ Rate}{HLLR} \qquad \text{Eq (1)}$$

$$Width\ of\ Infiltration\ Field = \frac{HLLR}{ILR} \qquad \text{Eq (2)}$$

where: HLLR = Hydraulic Linear Loading Rate
ILR = Infiltration Loading Rate

(7) The HLLR Table is used to calculate the dimensions of the absorption area. The following conditions apply:

a) The minimum number of modules is determined by Eq. (3). Additional modules may be necessary to meet the dosing requirements prescribed by II.C.3

$$Min.\ Number\ of\ B43\ Modules = \frac{Length\ of\ Infiltration\ Field\ from\ HLLR\ Table}{4\ ft} \qquad \text{Eq. (3)}$$

b) The minimum amount of sand required on each side of the modules is 6" (six) inches. Additional sand will be required to meet the width required by the HLLR Table (i.e. Minimum Width Specified by HLLR Table rounded up to the nearest whole number ≤ Sand on Upslope Side of Modules + 3 feet Width of B43 Module + Sand on Downslope Side of the Modules). The width calculated from the HLLR Table should be rounded up to the nearest whole foot (i.e. If width required by HLLR is 4.2 feet, round the width to 5 feet.)

c) The minimum amount of sand required at the beginning and end of each module row is six inches (6") of sand.

K. Berm Specifications:

(1) The absorption area shall be surrounded by a berm consisting of mineral soil containing less than 20% coarse fragments with no coarse fragments greater than 4 inches in diameter, more stable and less permeable than the fine aggregate, and lightly compacted during construction to contain and protect the absorption area interior. The width of this berm shall be a minimum of 3 feet at the top of the aggregate. (Section 73.55(b)(7)).

(2) Upon completion, the outside slope of the berm on slopes of 8% or less may be no greater than 2:1, on slopes of 8% to 12% the outside slope of the berm shall be no greater than 3:1. On sites with slopes ranging 12% to 15%, the outside slope of the berm may be no greater than 25% (4:1) downslope and no greater than 3:1 upslope, with the downslope berm no greater than 4:1.

(3) The cover over the aggregate shall be a minimum of 8 inches of soil suitable for the growth of vegetation and shall be seeded to assure the stability of the berm.

L. Installation:

(1) An onsite preconstruction conference attended by the sewage enforcement officer, designer, installer, and the property owner prior to construction is recommended.

(2) Construction of this system must comply with Chapter 73, Section 73.51(b) and 73.51(c).

(3) The surface shall be chisel plowed across the slope, including the area under the berm, as described in Section 73.55(b)(2).

(4) Immediately after plowing, aggregate shall be placed over the exposed plowed surface. The aggregate shall be placed from the upslope side of the bed using only lightweight equipment. Under no circumstance may equipment travel on the plowed soil surface until the aggregate is in place.

(5) Due to the assembly of the Eljen GSF, the following apply:

a) Section 73.52(b)(11) is not required.

b) The distribution pipe and the modules are covered with an anti-siltation geotextile fabric to prevent backfill material from settling into the aggregate.

(6) The area around the absorption area and treatment tanks shall be graded for diversion of surface waters.

III. Minimum Maintenance Standards

A. The manufacturer's representative must meet with the property owner within one (1) month of system start-up and/or occupancy of the dwelling and with the local agency's SEO upon request, to explain the operation and maintenance of the system and provide written instructions to the property owner that includes:

(1) GSF Septic System Owner's Manual;

(2) Instructions on the operation and maintenance of the system;

(3) The locations of all parts of the system;

(4) A commitment that the manufacturer's service provider will investigate and troubleshoot system problems;

(5) Contact information for the manufacturer, the manufacturers' representatives, and manufacturer's service provider;

B. Warranty: The manufacturer of the Eljen GSF must provide a minimum 2-year warranty on all defects due to materials or workmanship.

C. Inspection and Maintenance:

(1) Inspection of the area around soil absorption area every 6 months by the homeowner to ensure that there is no ponding of effluent or downgradient seepage.

(2) The Eljen GSF system should be maintained per the manufacturer's Septic System Owner's Manual.
(3) The service provider shall inspect at least the following items at an interval frequency recommended by the manufacturer's requirements:
   a) Inspect septic tanks, dosing tanks, and lift pump tanks for structural integrity of the tank, inlet and outlet baffles, solids retainer, pumps, siphons, and electrical connections;
   b) Ensure that the pumping system is operational;
   c) Ensure that the absorption area cleanouts and/or vents are in proper working condition;
   d) Ensure that the septic effluent filter is in proper working condition.
(4) The service provider shall inspect and pump excess solids in accordance with the manufacturer's requirements.

IV. Permitting Requirements

A. An SEO who has successfully completed an appropriate Department sponsored training course that included this specific technology or has received review delegation in writing from the Department may independently review the design and issue the permit for systems including components designed under this listing. All other system proposals under this listing must be submitted to the Department for review and comment.
B. Sand suppliers shall provide certification in writing to the sewage enforcement officer and permittee with the first delivery to the job site from every sand source confirming that the aggregate meets the requirements of Section II.D(4). The following information must be included in the written certification and be attached to the permit: Name of the supplier of the aggregate, testing results, testing date, amount of material purchased, and the delivery date of the aggregate.
C. The sewage enforcement officer shall include on both the *Application for An Onlot Sewage Disposal* permit (Part III, Section 1) and the permit, the classification number itemized in the Classification Type of this listing.
D. Copies of the plans and specifications and the designer's report are to be attached to the applicant's, sewage enforcements officer's, and the Department's copy of the application for sewage permit.

V. Planning Requirements

Not Applicable

Table 1
Hydraulic Linear Loading Rate Table

Soil Characteristics			Infiltration Loading Rate, gal/ft²/d	Hydraulic Liner Loading Rate, gal/ft/d					
				Slope					
				0-4%		5-9%		>10%	
Texture	Structure			Infiltration Distance, Inch		Infiltration Distance, Inch		Infiltration Distance, Inch	
	Shape	Grade		10-12	12-20	10-12	12-20	10-12	12-20
COS, S, LCOS, LS	--	0SG	1.6	4.0	5.0	5.0	6.0	6.0	7.0
FS, VFS, LFS, LVFS	--	0SG	1.0	3.5	4.5	4.0	5.0	5.0	6.0
CSL, SL	--	0M	0.6	3.0	3.5	3.6	4.1	5.0	6.0
	PL	1	0.5	3.0	3.5	3.6	4.1	4.0	5.0
		2, 3							
	PR/BK /GR	1	0.7	3.5	4.5	4.0	5.0	5.0	6.0
		2, 3	1.0	3.5	4.5	4.0	5.0	5.0	6.0
FSL, VFSL	--	0M	0.5	2.0	2.3	2.4	2.7	2.7	3.2
	PL	1, 2, 3							
	PR/BK /GR	1	0.6	3.0	3.5	3.3	3.8	3.6	4.1
		2, 3	0.8	3.3	3.8	3.6	4.1	3.9	4.4
L	--	0M	0.5	2.0	2.3	2.4	2.7	2.7	3.2
	PL	1, 2, 3							
	PR/BK /GR	1	0.6	3.0	3.5	3.3	3.8	3.6	4.1
		2, 3	0.8	3.3	3.8	3.6	4.1	3.9	4.4
SIL	--	0M	0.2	2.0	2.5	2.2	2.7	2.4	2.9
	PL	1, 2, 3							
	PR/BK /GR	1	0.6	2.4	2.7	2.7	3.0	3.0	3.5
		2, 3	0.8	2.7	3.0	3.0	3.5	3.3	3.8
SCL, CL, SICL	--	0M							
	PL	1, 2, 3							
	PR/BK /GR	1	0.3	2.0	2.5	2.2	2.7	2.4	2.9
		2, 3	0.6	2.4	2.9	2.7	3.0	3.0	3.5
SC, C, SIC	--	0M							
	PL	1, 2, 3							
	PR/BK /GR	1							
		2, 3	0.3	2.0	2.5	2.2	2.7	2.4	2.9

Adapted from Tyler, 2000.
Width of Infiltration Field = Hydraulic Linear Loading Rate divided by Infiltration Hydraulic Loading Rate
Length of Infiltration Field = Wastewater Volume divided by Hydraulic Linear Loading Rate