GSF®

Geotextile Sand Filter

Kentucky
Design & Installation Manual

eljen
CORPORATION

Innovative Onsite Products & Solutions Since 1970

April 2016

www.eljen.com

Table of Contents

SUBJECT PAGE

GSF DRAWINGS AND TABLES

DRAWINGS

TABLES

B43 Module 48” x 36” x 7” (L x W x H)

Cover Fabric The geotextile cover fabric (provided by manufacturer) that is placed over the GSF modules.

Design Flow The estimated peak flow that is used to size a GSF system is derived from the state and local code. 120 gpd per bedroom for single family homes.

Distribution Box A plastic or concrete box that receives effluent from a septic tank and splits the flow to pipes placed above the GSF modules. For equal distribution, the outlet pipe orifices are typically set at the same elevation to equalize the flow to each line.

Flow Dial/Equalizer Special insert placed in the end of distribution pipes within the distribution box to compensate for possible unlevel installation and promote favorable flow to the distribution pipes.

GSF The Eljen Geotextile Sand Filter Modules and the 6-inch sand layer at the base and 6 inches along the sides of the modules.

GSF Module The individual module of a GSF system. The module is comprised of a cuspated plastic core and corrugated geotextile fabric.

Specified Sand To ensure proper system operation, the system must be installed using ASTM C33 sand with less than 10% passing a #100 sieve and less than 5% passing a #200 sieve. Listed below is a chart outlining the sieve requirements for the Specified Sand. Ask your material supplier for a sieve analysis to verify that your material meets the required specifications.

TABLE 1: SPECIFIED SAND SIEVE REQUIREMENTS

ASTM C33 Sand Specification		
Sieve Size	Sieve Square Opening Size	Specification Percent Passing (Wet Sieve)
3/8 inch	9.52 mm	100
No. 4	4.76 mm	95 - 100
No. 8	2.38 mm	80 - 100
No. 16	1.19 mm	50 - 85
No. 30	590 µm	25 - 60
No. 50	297 µm	5 - 30
No. 100	149 µm	0 - 10
No. 200	75 µm	0 - 5

Primary Treatment Zone

- Perforated pipe is centered above the GSF module to distribute septic effluent over and into corrugations created by the cuspated core of the geotextile module.
- Septic effluent is filtered through the Bio-Matt fabric. The module's unique design provides increased surface area for biological treatment that greatly exceeds the module's footprint.
- Open air channels within the module support aerobic bacterial growth on the modules geotextile fabric interface, surpassing the surface area required for traditional absorption systems.
- An anti-siltation geotextile fabric covers the top and sides of the GSF module and protects the Specified Sand and soil from clogging, while maintaining effluent storage within the module.

Secondary Treatment Zone

- Effluent drips into the Specified Sand layer and supports unsaturated flow into the native soil. This Specified Sand/soil interface maintains soil structure, thereby maximizing the available absorption interface in the native soil. The Specified Sand supports nitrification of the effluent, which reduces oxygen demand in the soil, thus minimizing soil clogging from anaerobic bacteria.
- The Specified Sand layer also protects the soil from compaction and helps maintain cracks and crevices in the soil. This preserves the soil's natural infiltration capacity, which is especially important in finer textured soils, where these large channels are critical for long-term performance.
- Native soil provides final filtration and allows for groundwater recharge.

FIGURE 1: GSF SYSTEM OPERATION

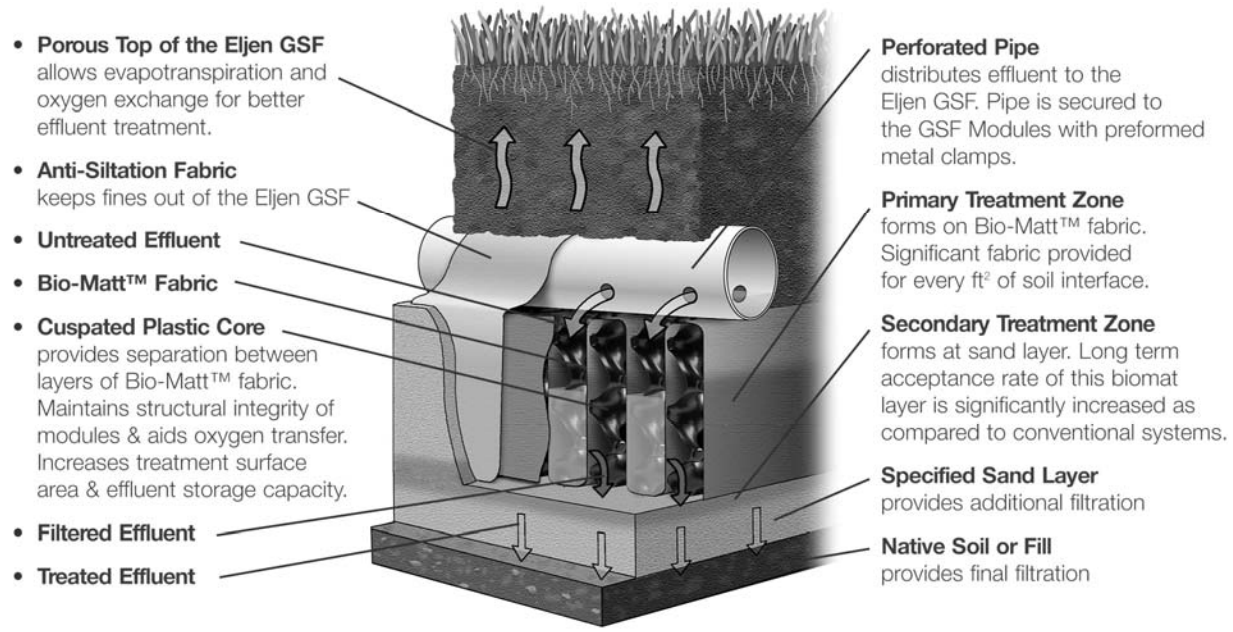
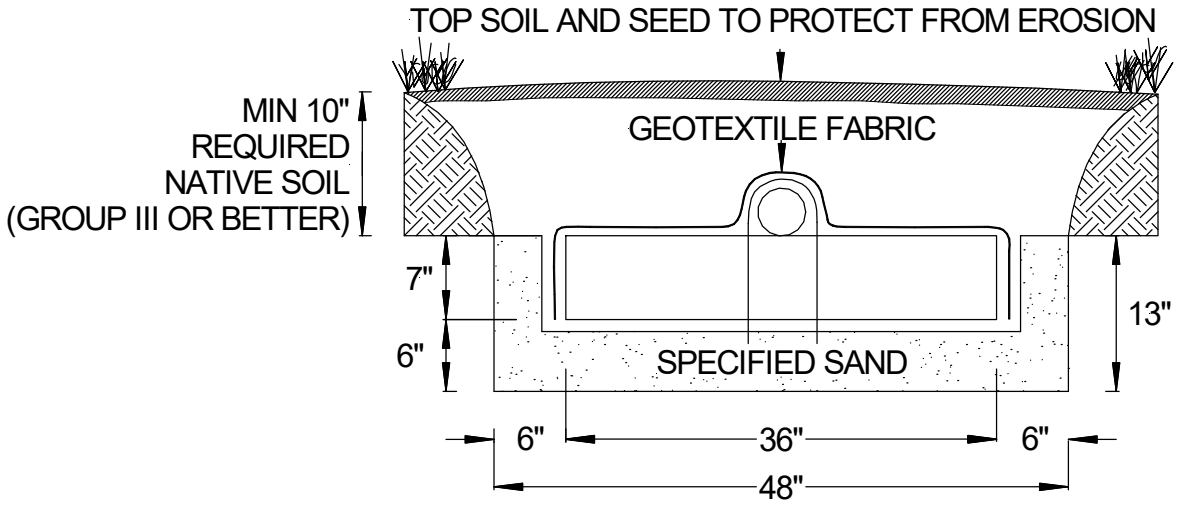


FIGURE 2: TYPICAL B43 GSF CROSS SECTION



B43 MODULE (L x W x H) 48" x 36" x 7"

- 6 inches of Specified Sand is at the edges of the GSF module.
- 6 inches of Specified Sand is at the beginning and end of each GSF Trench.
- 6 inches of Specified Sand is directly below the GSF module.
- Minimum 10 inches of native soil fill (group III or better) above the module.

1.1 REQUIREMENTS: GSF systems must meet the local rules and regulations except as outlined in this manual. 902 KAR 10:085. Kentucky on-site sewage disposal systems, and the local regulations will be referred to as the *guidelines* in this manual. Sizing and installation shall be in accordance with the Kentucky Design & Installation Manual, 902 KAR 10:085 and 902 KAR 10:081 Regulations. Kentucky 902 KAR 10:085 will take precedence in any case of conflict between the two documents.

Please contact Eljen's Technical Resource Department at 1-800-444-1359 for design information on commercial systems.

1.2 SPECIFIED SAND SPECIFICATION FOR TRENCH SYSTEMS: The first 6 inches of sand immediately under and the 6 inches of sand around the perimeter of the GSF system must be an ***ASTM C33 WASHED CONCRETE SAND WITH LESS THAN 10% PASSING A #100 SIEVE AND LESS THAN 5% PASSING A #200 SIEVE.*** Please place a prominent note to this effect on each design drawing. See Table 1 for more information on the ASTM C33 sand and sieve specifications.

1.3 CONNECTIONS AND FITTINGS: Connections of lines to tanks and distribution boxes must be made using watertight mechanical seals. Use of any grouting material is not permitted.

1.4 PLACING GSF MODULES: The “White Stripe” on the GSF modules indicates the top of the module and is not intended to indicate the location of the distribution pipe. With the white stripe facing up, all rows of GSF modules are set level, end to end on the Specified Sand layer. No mechanical connection is required between modules.

1.5 DISTRIBUTION PIPE: SDR-35 or equivalent is required. Place perforated pipe on top of GSF modules with holes at 5 and 7 o’clock. Secure pipe to GSF modules with provided wire clamps, one clamp per Eljen module. All piping must meet state and local regulations.

1.6 DISTRIBUTION BOX: Set the gravity system D-box outlet invert a minimum of ⅛ inch drop in elevation per linear foot to the top first module in the trench. Set a 2-inch minimum drop for dosed systems from the D-box to the modules. Ensure that the distribution box and pipes feeding the system are placed on settled soil. Flow Dials may be used in either Gravity or Dosed installations.

1.7 COVER FABRIC: Geotextile cover fabric is provided by Eljen Corporation for all GSF systems. It is placed over the top and sides of the module rows to prevent long term siltation and failure. **Cover fabric substitution is not allowed.** Fabric should drape vertically over the pipe and must *not* block holes in the distribution pipe or be stretched from the top of the pipe to the outside edge of the modules. “Tenting” will cause undue stress on fabric and pipe.

1.8 BACKFILL & FINISH GRADING: Complete backfill with 10 inches of clean porous fill measured from the top of modules. Backfill material shall be a well graded sandy fill, clean, porous and devoid of rocks larger than 2 inches, with a maximu of 10% passing the #200 sieve. Do not use wheeled equipment over the system. A light track machine may be used with caution, avoiding crushing or shifting of the pipe assembly. Divert surface runoff from the Effluent Disposal Area, (EDA). Finish grade to prevent surface ponding. Topsoil and seed system area to protect from erosion.

1.9 ADDITIONAL FACTORS EFFECTING RESIDENTIAL SYSTEM SIZE: Homes with expected higher than normal water usage may consider increasing the septic tank volume as well as incorporating a multiple compartment septic tank. Consideration for disposal area may be up-sized for expected higher than normal water use.

For example:

- Luxury homes, homes with a Jacuzzi style tubs, and other high use fixtures.
- Homes with known higher than normal occupancy.

1.10 GARBAGE DISPOSALS: Design drawings shall include a note “GARAGE DISPOSALS SHALL NOT BE USED WITH THIS SYSTEM.” If the property owner insists on installing a disposal, a properly sized 2-compartment septic tank and an effluent filter shall be required.

1.11 WATER SOFTENERS/CONDITIONERS: At no time should water softener/conditioner backwash be disposed of in the septic system. Water softener backwash should be discharged to a separate soil absorption field.

1.12 SEPTIC TANKS: Many designers are now specifying dual compartment tanks for all their systems. Eljen supports this practice as it helps to promote long system life by reducing TSS and BOD to the effluent disposal area. Gas baffles are also recommended.

1.13 SEPTIC TANK FILTERS: Wastewater filters are required as a means of preventing solids from leaving the tank and entering your system. Filter manufactures require that filters be cleaned from time to time. Ask your installer or designer for specific cleaning requirements based on the type or make of the filter installed. Eljen requires the septic tank to be pumped every three years or as needed which would be a good time to check and conduct filter maintenance.

1.14 DEPTH TO GROUND WATER OR RESTRICTIVE LAYER: As required by 902 KAR 10:085 for all septic systems.

1.15 SIZING GSF SYSTEM FOR TRENCHES, BEDS: The tables below show the number of modules required per bedroom. Determine the number of units required per bedroom from the soil group and the system configuration**.** Multiply that number by the number of bedrooms to determine the units required.

TABLE 2: GSF TRENCH SIZING TABLE

Soil Type	Application Rate	Linear Ft per Gallon	Min Basal sq. ft. per Bedroom	2 Bedroom Sizing Sand Base sq. ft.	3 Bedroom Sizing Sand Base sq. ft.	4 Bedroom Sizing Sand Base sq. ft.	Minimum Units per Bedroom
Group I Sand	1.2	0.42	100	200	300	400	5
Group I Loamy Sand	0.9	0.56	134	267	400	534	6
Group II	0.7	0.72	172	343	515	686	7
Group III w/ suitable structure	0.5	1	240	480	720	960	8
Group III w/ provisionally-suitable structure	0.37	1.35	325	649	973	1298	9
Group IV	0.27	1.85	445	889	1334	1778	11

2.0 Trench Installation Sizing and Guidelines

Trench Example:

House size: 4 Bedrooms
Soil Type: Group III w/ suitable structure
Absorption Field Type: Trench

Calculate Minimum Absorption Area
Lookup minimum Basal Table 2:

Soil Type	Application Rate	Linear Ft per Gallon	Min Basal sq. ft. per Bedroom	2 Bedroom Sizing Sand Base sq. ft.	3 Bedroom Sizing Sand Base sq. ft.	4 Bedroom Sizing Sand Base sq. ft.	Minimum Units per Bedroom
Group III w/ suitable structure	0.5	1	240	480	720	960	8

Minimum Sand Base required: 960 ft^2

B43 units required
960 ft^2 ÷ 16 ft^2/module = 60 Modules
Round to: 60 B43 Modules

Calculate Minimum Trench Length = Units required x 4 ft/unit

B43: 60 Units x 4 ft/unit = 240 linear ft

Trench Width

B43: 4 ft

Final Dimension Layout
(Note: System layout and number of rows will vary based on site constraints)

B43

Min. Product Length	240 ft
(note: 6 inches sand required at each end of trench which makes the minimum trench length 241 ft)	
Trench Width	4 ft
Minimum Number of Units	60 B43 Modules

FIGURE 3: PLAN VIEW – B43 TRENCH SYSTEM – LEVEL SITE

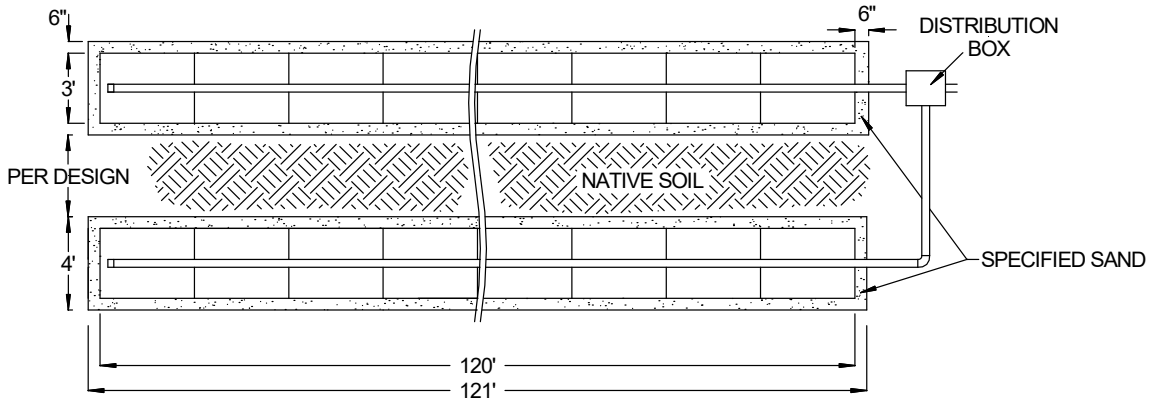


FIGURE 4: SECTION VIEW – B43 TRENCH SYSTEM – LEVEL SITE

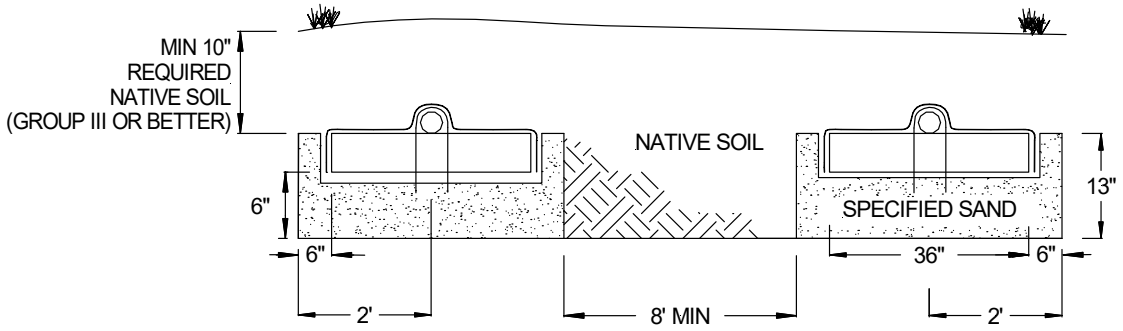
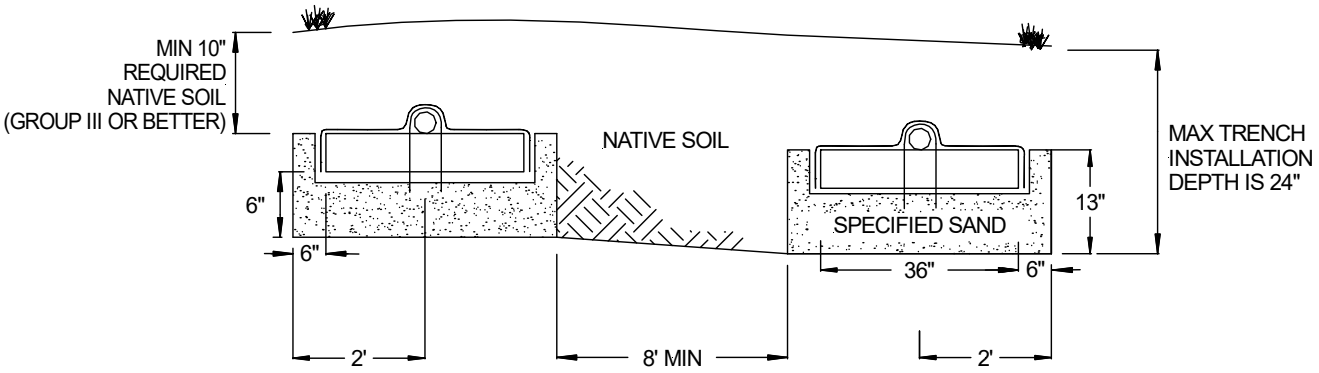


FIGURE 5: SECTION VIEW – B43 TRENCH SYSTEM – SLOPING SITE



Trench Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the trench sizing example.
Plan all Drainage Requirements	Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.
Excavating the Trench Area	Scarify the receiving layer to maximize interface between the native soil and Specified Sand. Minimize walking in the trench prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in a 6-inch lift and compact. The compacted Specified Sand height below the GSF module must be a minimum of 6 inches. A hand tamping tool or vibrating compactor are both acceptable.
Place GSF Modules	Place the GSF Modules, ***PAINTED STRIPE FACING UP***, end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes Gravity & Lift Pump/Gravity Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Distribution Pipes: Pressure Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. Insert a pressure pipe (size per design and code) into the standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 9. Each pressure lateral will have a drain hole at the 6 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Place Geotextile Cover Fabric	***Cover fabric substitution is not allowed.*** The installer should lay the Eljen provided geotextile cover fabric lengthwise down the trench, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by: • Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe. • Place shovel full's of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
Placing Specified Sand after Cover Fabric is in place	Place 6 inches of Specified Sand along both sides of the modules edge. A minimum of 6 inches of Specified Sand is placed at the beginning and end of each trench.
Backfilling the System	Complete backfill with a minimum of 10 inches of native soil (group III or better) over the GSF modules. Fill must be clean, porous and devoid of rocks. Do not use wheeled equipment over the system during backfill operation. A light track machine may be used with extreme caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff. Finish grade to prevent surface ponding. Topsoil and seed to protect from erosion.

3.0 Bed Installation Sizing and Guidelines

Bed Example:

Bed Example:
House size: 3 Bedrooms
Classification: Group II
Absorption Field Type: Bed
Desired Bed Width: 9 feet

Calculate Minimum Absorption Area
Lookup linear feet per gallon from Table 2:

Soil Type	Application Rate	Linear Ft per Gallon	Min Sand Base per Bedroom sq. ft.	2 Bedroom Sizing Sand Base sq. ft.	3 Bedroom Sizing Sand Base sq. ft.	4 Bedroom Sizing Sand Base sq. ft.	Minimum Units per Bedroom
Group II	0.7	0.72	172	343	515	686	7

Minimum Sand Base required: 515 ft^2

Soil Type	Application Rate	Linear Ft per Gallon	Min Sand Base per Bedroom sq. ft.	2 Bedroom Sizing Sand Base sq. ft.	3 Bedroom Sizing Sand Base sq. ft.	4 Bedroom Sizing Sand Base sq. ft.	Minimum Units per Bedroom
Group II	0.7	0.72	172	343	515	686	7

Number of units required = Bedrooms x Minimum Number of Units per Bedroom

B43 units required
3 bedrooms x 7 modules per bedroom = 21 Modules

Units per Row (This design will use two rows)
21 Modules ÷ 2 = 10.5, round to 11 Modules per Row

Determine Bed Length

Minimum Sand Base ÷ Desired Bed Width = Bed Length
515 ft^2 ÷ 9 ft = 57.2, round up to 58 ft

Determine Spacing from Edge of Units to Edge of Bed
Spacing from Bed Edge to Unit Edge (length) = (Bed Length – (Units per row x 4)) ÷ 2

(58 ft – (11 x 4 ft)) ÷ 2
(58 ft – (44 ft)) ÷ 2
(14) ÷ 2
7 ft

Determine Lateral Spacing
Lateral to Lateral Spacing = Bed Width ÷ Number of Rows
2 Rows
B43: 9 ft ÷ 2 rows 4.5 ft

Lateral to Edge Spacing = Lateral to Lateral Spacing ÷ 2
B43: 4.5 ft ÷ 2 rows 2.25 ft

Final Dimension Layout
(Note: System layout and number of rows will vary based on site constraints)

B43

Bed Length	58 ft	Unit edge to Bed edge	5.5 ft
Bed Width	9 ft	Lateral to Lateral spacing	4.5 ft
Number of Units	22 B43 Modules	Lateral to Edge spacing	2.25 ft

FIGURE 6: PLAN VIEW – B43 BED SYSTEM – SLOPING SITE

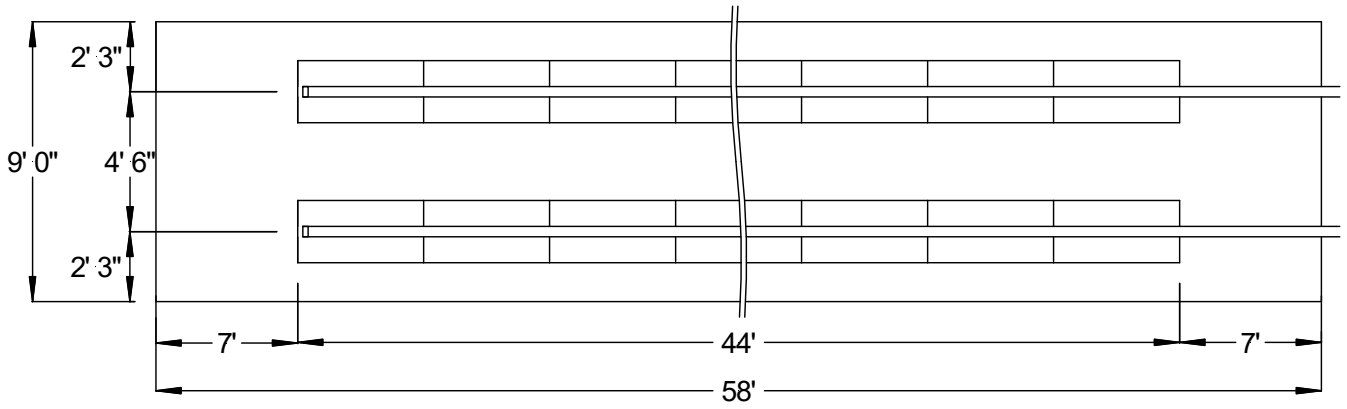


FIGURE 7: SECTION VIEW – B43 BED SYSTEM – LEVEL SITE

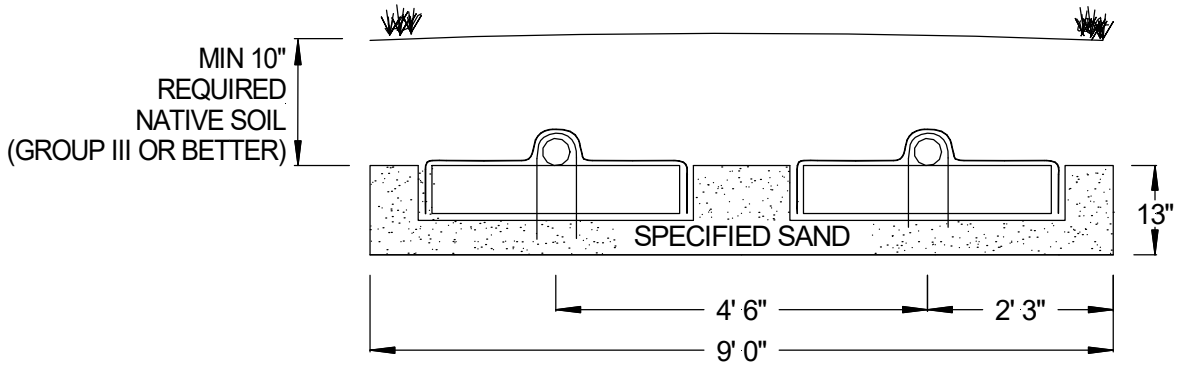
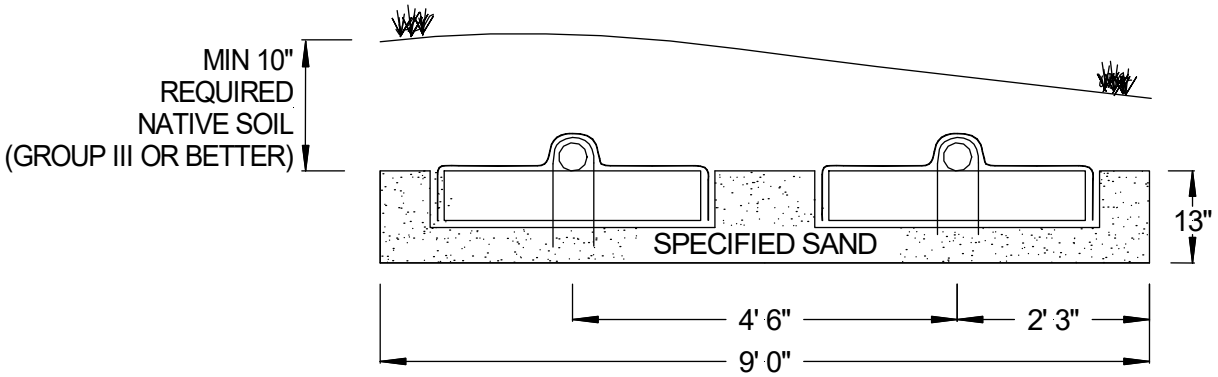


FIGURE 8: SECTION VIEW – B43 BED SYSTEM – SLOPING SITE



3.1 Bed Installation Sizing and Guidelines

Bed Installation Guidelines Additional guidance in State and Local regulations	
Determine the Number Modules	Determine the number of GSF Modules required using the bed sizing example.
Plan all Drainage Requirements	Plan all drainage requirements above (up-slope) of the system. Set soil grades to ensure that storm water drainage and ground water is diverted away from the absorption area once the system is complete.
Excavating the Bed Area	Scarify the receiving layer to maximize the interface between the native soil and Specified Sand. Minimize walking in the bed prior to placement of the Specified Sand to avoid soil compaction.
Placing Specified Sand Base	Place Specified Sand in a 6-inch lift and compact. The compacted Specified Sand height below the GSF module must be a minimum of 6 inches. A hand tamping tool or vibrating compactor are both acceptable.
Place GSF Modules	Place the GSF Modules, ***PAINTED STRIPE FACING UP***, end to end on top of the Specified Sand along their 4-foot length.
Distribution Pipes Gravity & Lift Pump/Gravity Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Distribution Pipes Pressure Systems	A standard 4-inch perforated pipe, SDR 35 or equivalent, is centered along the modules 4-foot length. Orifices are set at the 5 & 7 o'clock position. Insert a pressure pipe *(size per design and code)* into a standard 4-inch perforated pipe. The pressure pipe orifices are set at the 12 o'clock position as shown in Figure 9. Each pressure lateral will have a drain hole at the 6 o'clock position. All 4-inch pipes are secured with manufacturers supplied wire clamps, one per module.
Place Geotextile Cover Fabric	***Cover fabric substitution is not allowed.*** The installer should lay the Eljen provided geotextile cover fabric lengthwise down the row, with the fabric fitted to the perforated pipe on top of the GSF modules. Fabric should be neither too loose, nor too tight. The correct tension of the cover fabric is set by: • Spreading the cover fabric over the top of the module and down both sides of the module with the cover fabric tented over the top of the perforated distribution pipe. • Place shovel full's of Specified Sand directly over the pipe area allowing the cover fabric to form a mostly vertical orientation along the sides of the pipe. Repeat this step moving down the pipe.
Placing Specified Sand after Cover Fabric is in place	Place 6 inches minimum of Specified Sand along both sides of the modules and a minimum of 6 inches of Specified Sand is placed at the beginning and end of each row.
Backfilling the System	Complete backfill with a minimum of 10 inches of native soil (group III or better) over the GSF modules. Fill must be clean, porous and devoid of rocks. Do not use wheeled equipment over the system during backfill operation. A light track machine may be used with extreme caution, avoiding crushing or shifting of pipe assembly. Divert surface runoff. Finish grade to prevent surface ponding. Topsoil and seed to protect from erosion.

4.0 Dosing Distribution Guidance

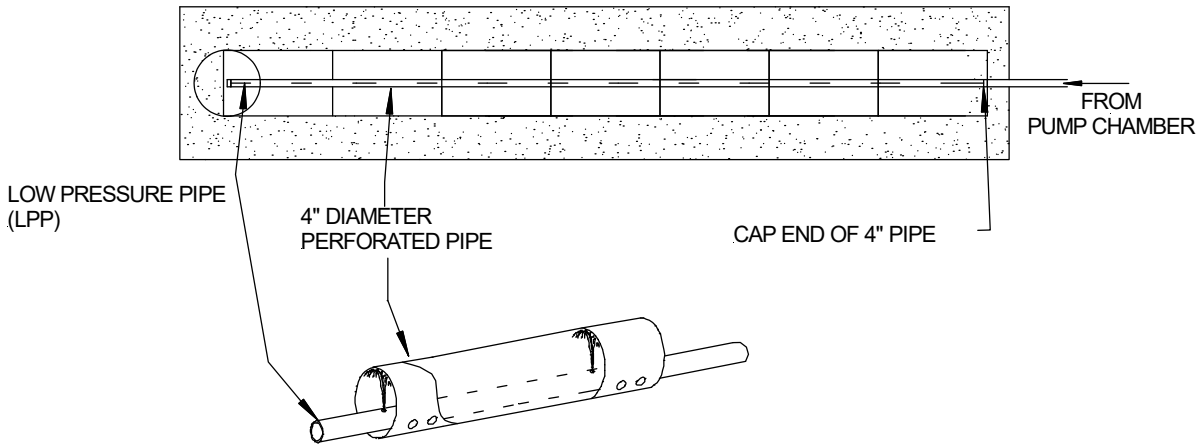
4.1 PUMP TO A DISTRIBUTION BOX: Specify an oversized distribution box for pumped systems. Provide velocity reduction in the D-box with a tee or baffle. Set D-box invert 2 inches higher than invert of perforated pipe over GSF modules.

4.2 DOSING DESIGN CRITERIA: Dosing volume must be set to deliver a maximum of 4 gallons per B43 Module per dosing cycle with low head high volume pumps preferred. Adjust pump gallons per minute and run time to achieve the above maximum dose. Use a minimum pump run time of one minute. Longevity of currently available effluent pumps is not affected by shorter run times. Choose force main diameter to minimize percentage of dose drain back. Effluent velocity in force main should fall between approximately 3 and 5 ft/sec. Pump flow rate shall be less than 30 G.P.M. in residential systems.

5.0 Pressure Distribution Guidance

Standard procedures for design of pressure distribution networks apply to the GSF filter. Orifices shall be a minimum of 4-foot on center spacing so the orifices fall in the center of each module. A minimum orifice size of ¼ inch shall be maintained. A ¼ inch diameter drain hole is required at the 6 o'clock position of each pressure lateral for drainage purposes. The lateral pipe network *(size per design and code)* is placed within a standard 4-inch perforated pipe. The perforation in the 4-inch outer pipe are set at the 4 and 8 o'clock position, the drilled orifices on the pressure pipe are set to spray at the 12 o'clock position directly to the top of the 4-inch perforated pipe as shown below.

FIGURE 9: PRESSURE PIPE PLACEMENT



PRESSURE PIPE CROSS SECTION FOR ALL APPLICATIONS

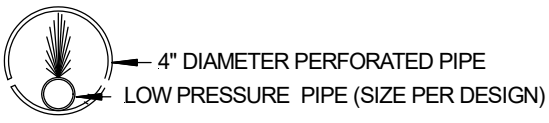
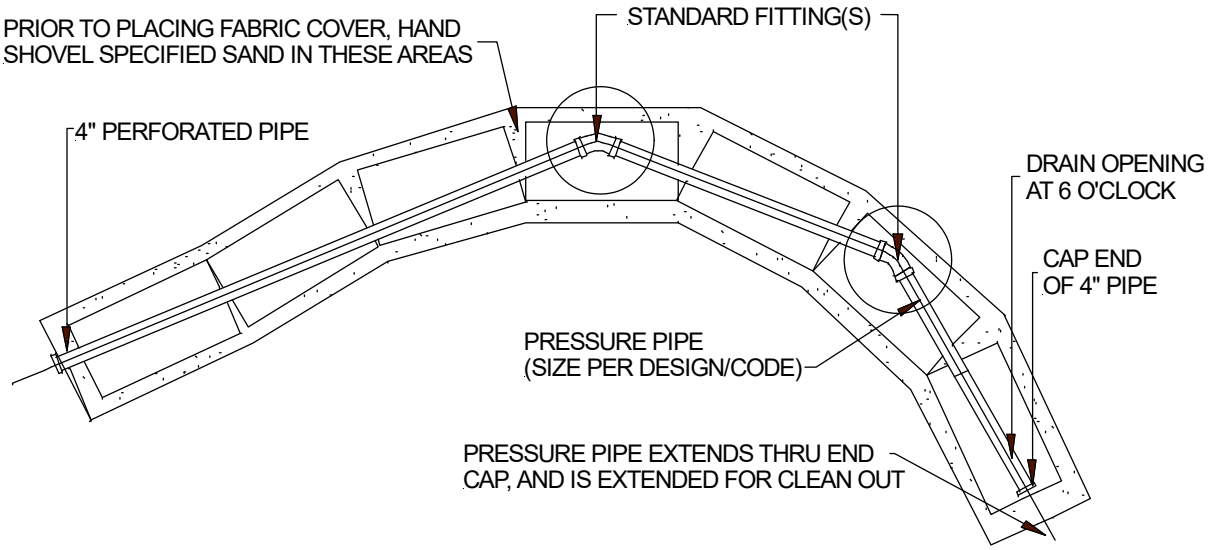


FIGURE 10: CONTOURED TRENCH PRESSURE DISTRIBUTION



GSF Pressure Distribution trench placed on a contour or winding trenches to maintain horizontal separation distances may also be used in Dosed or Gravity system by removing the pressure pipe and using the 4-inch diameter perforated distribution pipe.

6.0 Pump Controls

Demand and Pressure Dosed controlled systems will include an electrical control system that has the alarm circuit independent of the pump circuit, controls and components that are listed by UL or equivalent, is located outside, within line of sight of the pump chamber and is secure from tampering and resistant to weather (minimum of NEMA 4). The control panel shall be equipped with cycle counters and elapsed time meters. Where a water supply water meter is available it may be possible to eliminate the counters or timers.

The control panel shall be equipped with both audible and visual high liquid level alarms installed in a conspicuous location. Float switches shall be mounted independent of the pump and force main so that they can be easily replaced and/or adjusted without removing the pump.

7.0 GSF Inspection Check List

Geotextile Sand Filter, (GSF) Checklist				
Facility Owner:				
Facility Address:				
Installation Date: (MDY)				
Previous Inspection Date: (MDY)				
Date of Inspection : (MDY)				
Residential Number of Bedrooms:				
Is this a Commercial Design? If yes what type:	Yes	No		
What is the estimated BOD5 and TSS strength?	BOD5	TSS	Comments	
Observation Port Location(s):	1		2	3
Inspection Data, (complete all fields)				
Is daily flow within the system design flow? If no, explain:	Yes	No		
Does the owner verify the system use as described above? If no, explain:	Yes	No		
Septic tank last inspection date:	Date			
Inspected by:				
Septic tank last pumped date:				
Is pumping recommended?	Yes	No		
Condition of the soil absorption system: Wet, Dry, Firm, Soft, Vegetative, or Other. If Other, explain:	W	D	S	F	V
Is there evidence of storm water flows or erosion over the septic system? If yes, explain:	Yes	No		

9.0 GSF Inspection Check List

Is there evidence of soil slump or compaction by traffic or other means in the vicinity of the soil absorption system? If yes, describe:	Yes	No	Comments
Is effluent visible through the observation port? If yes, describe the condition and the fluid level:	Yes	No	Comments
Is there a garbage disposal in the home?	Yes	No	Comments
Is a water softer connected to the system?	Yes	No	Comments
Are solids visible through the observation port? If yes, describe the condition and depth of solids:	Yes	No	Comments
Is there evidence of surcharging or effluent ponding in the D-Box? If yes, describe and measure:	Yes	No	Comments
Are the system vents in place?	Yes	No	Comments
Are they operational? If no, describe conditions and location:	Yes	No	
Describe any other pertinent issues:			

Inspected by:	
License Number:	
Date:	
Time:	
Print Name & Signature of Inspector:	
I certify I have inspected the system at the above address, completed this report, and the information reported is true, accurate, and complete.	

COMPANY HISTORY

Established in 1970, Eljen Corporation created the world's first prefabricated drainage system for foundation drainage and erosion control applications. In the mid-1980s, we introduced our Geotextile Sand Filter products for the passive advanced treatment of onsite wastewater in both residential and commercial applications. Today, Eljen is a global leader in providing innovative products and solutions for protecting our environment and public health.

COMPANY PHILOSOPHY

Eljen Corporation is committed to advancing the onsite industry through continuous development of innovative new products, delivering high quality products and services to our customers at the best price, and building lasting partnerships with our employees, suppliers, and customers.

eljen CORPORATION

90 Meadow Road, Windsor, CT 06095 • Tel: 800-444-1359 • Fax: 860-610-0427

www.eljen.com

Printed in U.S.A. on recycled paper