4.5 Drip Distribution System

Revision: August 18, 2016
Installer registration permit: Complex
Licensed professional engineer required: Yes

4.5.1 Description

Drip distribution systems are comprised of a shallow network of thin-walled, small-diameter, flexible tubing with self-cleaning emitters to discharge filtered septic tank effluent or pretreated effluent into the root zone of the receiving soils. The drip system is flushed either continuously or noncontinuously depending upon the system design. Minimum system components include, but are not limited to, the following:

1. Septic tank
2. Pretreatment system (not required in gray water system designs or septic tank effluent drip distribution designs):
    a. Intermittent sand filter
    b. Recirculating gravel filter
    c. Extended treatment package system
3. Filtering system (septic tank effluent systems only): spin filters (screen filter), cartridge or disk filters (flushable filter cartridge), and filter flush return line
4. Effluent dosing system: dosing chamber pump, and timed dosing control
5. Process controller: programmable logic controller (PLC)
6. Flow meter
7. Drip tubing network, associated valving, supply line and manifold, pressure regulators (nonpressure compensating emitters only), return manifold and line, and air/vacuum relief valves

4.5.2 Approval Conditions

1. Site may not exceed 45%.
2. All components in contact with wastewater must be rated by the manufacturer for wastewater applications.
3. All pressurized distribution components and design elements of the drip distribution system that do not have design criteria specified within section 4.5 shall follow the design guidance provided in section 4.19.
4. System must be designed by a PE licensed in Idaho.
5. The design engineer shall provide an O&M manual for the system to the health district prior to permit issuance.

4.5.3 Design Requirements

Many considerations need to be made in the design of a drip distribution system based on site-, flow-, and effluent-specific characteristics. These characteristics will affect several system components depending on each specific design scenario. The design of a drip distribution system

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should be approached as an integrated system rather than individual components. System design should account for, but is not be limited to:

1. Tubing material and emitter type
2. Brand of drip tubing to be used and associated proprietary components
3. Level and type of pretreatment to be provided
4. System configuration based on site conditions and constraints
5. Extent of automation, monitoring, and timing of critical operation processes and procedures.

Design requirements vary dependent upon the allowable effluent quality and system flushing. Requirements based on these system parameters are included in the subsequent sections.

4.5.3.1 Basic Design Requirements

The following minimum design elements apply to both septic tank and pretreated effluent systems and continuous and noncontinuous flush drip distribution systems:

1. Drip distribution tubes are placed directly in native soil at a depth of 6–18 inches with a minimum final cover of 12 inches.
2. Drip distribution tubes should be placed on contour and slightly slope towards the manifold for proper drainage.
    a. Installations on slopes must account for depressurization flow and be designed to prevent movement of the wastewater to the bottom of the drip distribution zone during this time.
    b. Manifold design must allow for all the associated drip tubing to drain back to the manifold and prevent wastewater from drip tubing at higher elevations from draining into drip tubing at the lowest elevations.
3. A minimum of two zones are recommended, but not required, regardless of system size, and zones should be kept as small as is reasonable.
    a. Individual lateral lengths should be designed to provide equal discharge volumes across the lateral emitters (lateral length is calculated from the connection point on the supply line to the connection point on the return line).
    b. Lateral lengths may differ within a zone as long as the minimum flushing velocity can be maintained at the terminal end of each lateral.
    c. Zones within a system should be close to equal in size to achieve efficient and consistent application of wastewater.
    d. In lower permeability soils (i.e., clayey soils), it is recommended that drip tubing and emitter spacing be reduced while maintaining the minimum square footage to increase the emission points and maintaining the dosing volume to decrease wastewater travel distance through the soil.
4. The design application rate is based on the most restrictive soil type encountered within the minimum effective depth of soil below the drip distribution tubing required to meet the necessary separation distance to limiting layers.
5. Septic tank effluent drip distribution systems are required to be adequately filtered with a 100–115 micron or smaller spin/screen filters or disk filters that are flushable or

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nonflushable before discharge into the drip distribution tubing network. Filters are not required for pretreated effluent drip distribution systems but are recommended.

6. When installed, effluent filters are required to be:
    a. Automatically backflushed to flush the solids off the filter surface and return them to the inlet pipe of the septic tank, or
    b. Inspected periodically and hand cleaned if necessary.
7. A minimum of two vacuum relief valves are required per zone.
    a. The valves are located at the highest points on both the distribution and return manifolds.
    b. Vacuum relief valves are located in a valve box that is adequately drained and insulated to prevent freezing.
8. Pressure compensating emitters shall be used in all drip distribution installations.
10. The hydraulic design of the drip distribution system should achieve discharge rates and volumes that vary no more than ±10% between all the emitters within a zone during a complete dosing event.
    a. Consideration should be given to the unequal distribution during flow pressurizing and depressurizing periods.
    b. The designer must be able to mathematically support the design for equal distribution.
10. Dosing requirements in all drip distribution systems include the following:
    a. Timed dosing is required.
    b. Dosing will only occur when the dosing chamber has sufficient volume to deliver a full design dose to the drip distribution system.
    c. Sufficient rest time shall be programmed to provide time for effluent to distribute away from the drip lines.
    d. Shall include a flow meter or run time/event counter.
    e. The capability to monitor flow rates both during dosing and flushing events.
    f. Small, frequent doses should be avoided and dose volumes should be several times the total supply and return manifold and drip tubing volumes within the dosing zone.
11. Dosing chambers shall provide sufficient storage for equalization of peak flows and meet the requirement of section 4.19.3.3.2 and 4.19.3.4.
12. Each valve, filter, pressure regulator, and any other nondrip tube or piping component is required to be accessible from grade and should be insulated to prevent freezing.

4.5.3.2 Additional Design Requirements for Septic Tank Effluent Drip Distribution Systems

Septic tank effluent drip distribution systems discharge filtered effluent that has only passed through an appropriately sized septic tank, dosing chamber, and 100–115 micron filters before entering the drip distribution tubing. The following additional minimum design elements apply only to septic tank effluent drip distribution systems:

1. Effective soil depth to limiting layers below the drip tubes shall meet the minimum depths specified in IDAPA 58.01.03.008.02.c (section 7.1) for daily design flows

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<2,500 gallons per day (GPD) or IDAPA 58.01.03.013.04.c (section 7.1) for daily design flows ≥2,500 GPD.

2. Total drip distribution area shall be determined by dividing the daily design flow by the soil application rates in Table 2-4.
3. Minimum drip tubing length that must be installed shall be determined by dividing the total drip distribution area by 2.
    a. The minimum tubing length and drip tube spacing must create a system layout that equals or exceeds the total drip distribution area calculated in 2.
    b. It is recommended that extra tubing be included in the system design for systems being placed in soil design group C soils.
4. Drip distribution tubes may be placed on a minimum of 2-foot centers.
5. Emitter spacing may be a maximum of 12 inches.
6. Emitter flow rate shall be ≤0.6 gallons per hour.
7. Filters shall be back flushed at the start of each dosing cycle, and zones should be flushed every 20–50 dosing cycles with a minimum fluid velocity of 2 feet per second designed at the distal end of the lateral connection.

4.5.3.3 Additional Design Requirements for Pretreated Effluent Drip Distribution Systems

Pretreated effluent drip distribution systems discharge effluent that has passed through an appropriately sized septic tank, pretreatment system, and dosing chamber before entering the drip tubing. The following additional minimum design elements apply only to pretreated effluent drip distribution systems:

1. Effective soil depth to limiting layers below the drip tubes shall meet the minimum depths specified in section 4.21.5, Table 4-20.
2. Total drip distribution area shall be determined by dividing the daily design flow by the soil application rates in Table 4-21.
3. Minimum drip tubing length that must be installed shall be determined by dividing the total drip distribution area by 2.
    a. The minimum tubing length and drip tube spacing must equal or exceed the total drip distribution area calculated in 2.
    b. It is recommended that extra tubing be included in the system design for systems being placed in soil design group C soils.
4. Drip distribution tubes may be placed on a minimum of 2-foot centers.
5. Emitter spacing may be a maximum of 24 inches.
6. Emitter flow rate shall be ≤1.1 gallons per hour.
7. If filters are flushed, it is recommended that frequency be once per week.
8. Drip distribution zones should be flushed every 2 weeks.

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4.5.3.4 Additional Design Requirements for Noncontinuous Flush Drip Distribution Systems

The following additional minimum design elements apply only to noncontinuous flush drip distribution systems:

1. In noncontinuous flush systems, drip distribution laterals are flushed at regular intervals, but at least every 2 weeks, to prevent biofilm and solids buildup in the tubing network.
   a. Minimum flushing velocity is based on the tubing manufacturer's recommendations for the return ends of the distribution lines and in the drip distribution tubing during field flush cycles; must be high enough to scour the drip distribution tubing; and is recommended to exceed the manufacturer's recommended velocity.
   b. The minimum flushing duration is long enough to fill all lines and achieve several pipe volume changes in each lateral.
2. In noncontinuous flush systems, the return manifold is required to drain back to the dosing chamber.
3. In noncontinuous flush systems, timed or event-counted backflushing of the filters is required when filters are installed.
4. In noncontinuous flush systems, filters (when installed), flush valves, and a pressure gauge shall be placed in a head works (between the dose pump and drip field) and on the return manifold.

4.5.3.5 Additional Design Requirements for Continuous Flush Drip Distribution Systems

The following additional minimum design elements apply only to continuous flush drip distribution systems:

1. If flushing filters are installed, then they shall be backwashed according to the manufacturer's recommendations, and the process must be automated.
2. Drip distribution laterals are flushed during the dosing cycle.
   a. The continuous flush system must be designed to the manufacturer's minimum recommended flow velocity, must be high enough to scour the drip distribution tubing, and is recommended to exceed the manufacturer's recommended velocity.
   b. The dose duration must be long enough to achieve several pipe volume changes in each drip tubing lateral to adequately accomplish flushing the drip tubing lines.
3. Filters (when used) and pressure gauges may be placed in a head works (between the dose tank and drip distribution tubing).
4. Supply and return pressure gauges are needed to ensure that the field pressurization is within the required range specified by the drip tube manufacturer.
5. In continuous flush systems, both supply and return manifolds are required to drain back to the dosing chamber.
6. Due to the nature of the continuous flush process, the filter shall be examined after initial start-up and cleaned if necessary to prevent incorrect rate of low readings for the controller.

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7. The drip distribution system will operate to the manufacturer's minimum recommended flow velocity for the duration of each cycle, and the total flow minus the emitter uptake flow would be the return and flushing flow.

4.5.4 Construction

1. No wet weather installation is allowed.
2. Excavation and grading must be completed before installing the subsurface drip distribution system.
3. Drip distribution tubing may be installed using a trencher, static plow, or vibratory plow.
    a. Care must be taken when using a trencher to ensure the tubing is in contact with the trench bottom and does not have many high and low points in the line.
    b. Trenchers may limit the potential for smearing in clay soils.
    c. When using a static or vibratory plow, care must be taken to ensure the drip distribution tubing does not snag and stretch when unrolling.
    d. Use of a gage wheel with a static plow will assist in installing tubing to grade on level sites.
    e. Vibratory plows allow for minimal site disturbance and may be best for cutting through roots in the soil.
4. Drip distribution systems may not be installed in unsettled fill material.
5. No construction activity or heavy equipment may be operated on the drip distribution area other than the minimum to install the drip distribution system.
6. Do not park or store materials on the drip distribution area.
7. For freezing conditions, the bottom drip distribution line must be higher than the supply and return line elevation at the dosing chamber.
8. All PVC pipe and fittings shall be PVC schedule 40 type 1 or higher rated for pressure applications**.**
9. Flexible PVC pipe should be used for connecting individual drip lines together when making turns in laterals and may be used for connecting drip laterals to supply and return manifolds.
10. All glued joints shall be cleaned and primed with purple (dyed) PVC primer before being glued.
11. All cutting of PVC pipe, flexible PVC, or drip tubing should be completed using pipe cutters.
12. Sawing PVC, flexible PVC, or drip distribution tubing is allowed only if followed by cleaning off any residual burs from the tubing or pipe and removing all shavings retained in the tubing or pipe.
13. All open PVC pipes, flexible PVC, or drip distribution tubing in the work area shall have the ends covered during storage and construction to prevent construction debris and insects from entering the tubing or pipe.
14. Before gluing, all glue joints and tube or pipe interior shall be inspected and cleared of construction or foreign debris.

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15. Dig the return manifold trench along a line marked on the ground and back to the dosing chamber.
    a. The return manifold trench should start at the farthest end of the manifold from the dosing chamber.
    b. The return manifold must slope back to the dosing chamber.
16. Before start-up of the drip distribution system, the air release valves shall be removed and each zone in the system shall be flushed as follows:
    a. System flushing is accomplished by the manufacturer or engineer using the control panel's manual override.
    b. Use an appropriate length of flexible PVC pipe with a male fitting and attach it to the air release connection to direct the flush water away from the construction and drip distribution system area.
    c. Flush each zone with a volume of clean water at least two times the volume of all piping and tubing from the dosing chamber to the air release valve with the zone being flushed.

    Note: filters are not backflushed during start-up as any clogging could cause incorrect rate of flow readings for the controller.
17. If existing septic tanks or dosing chambers are to be used, they shall be pumped out by a permitted septic tank pumper, checked for structural or component problems, and repaired or replaced if necessary.
    a. After a tank is emptied, the tank shall be rinsed with clean water, pumped again, refilled with clean water, and leak tested.
    b. Debris in any tank should be kept to a minimum because it may clog the filters during start-up.
18. Once completed, cap the drip distribution areas for shallow installations (less than 12 inches) with 6–8 inches of clean soil and suitably vegetate.
    a. Cap fill material shall be the same as or one soil group finer than that of the site material, except that no fill material finer than clay loam may be used.
    b. Cap fill shall be free of debris, stones, frozen clods, or ice.
    c. The cap should be crowned to promote drainage of rainfall or runoff away from the drip area.
    d. Suitable vegetation should consist of typical lawn grasses or other appropriate low-profile vegetation that will provide thermal insulation in cold climates.
    e. Trees, shrubs, and any other vegetation that aggressively seeks water should not be planted within 50 feet of the drip tubing network.
19. Development of a diversion berm around the drip distribution area will aid in the diversion of runoff around the system.

4.5.5 Inspection

1. A preconstruction meeting between the health district, responsible charge engineer, and installer should occur before commencing any construction activities.

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2. The health district shall inspect all components and fill material used in constructing the drip distribution system before backfilling or cap fill placement.
3. The responsible charge engineer should conduct as many inspections as necessary to verify system and component compliance with the engineered plans.
4. The responsible charge engineer shall provide the health district with a written statement that the system was constructed and functions in compliance with the approved plans and specifications. Additionally, the responsible charge engineer shall provide as-built plans to the health district if any construction deviations occur from the permitted construction plans. (IDAPA 58.01.03.005.15)

4.5.6 Operation and Maintenance

1. The drip distribution system design engineer shall provide a copy of the system's OMM procedures to the health district as part of the permit application and prior to subsurface sewage disposal permit issuance (IDAPA 58.01.03.005.04.k).
2. Minimum OMM requirements should follow each system component manufacturer's recommendations.
   a. Monitoring should be based on the most limiting process in the system design.
   b. Regular monitoring of flow rates and pressures should be specified to diagnose possible overuse.
3. Additional OMM may be required for the pretreatment component of the drip distribution system.
   a. The minimum OMM of the pretreatment component will be based on the manufacturer's recommendations and the minimum requirements specified within this manual for the specific pretreatment system.
   b. Additional OMM may be based on specific site conditions or pretreatment component type.

4.5.7 Suggested Design Example

1. Determine square feet needed for the septic tank effluent drip distribution system, as follows.
   a. Wastewater flow in GPD is divided by the soil application rate (based on the soil classification from an on-site evaluation).
   b. Result is the square feet (ft^2) needed for the system.

   Example conditions: three-bedroom home discharging pretreated effluent in subgroup C-2 soils.

   Example calculation: (250 GPD)/(0.2 gallons/ft^2) = 1,250 ft^2
2. System design will use an application area of 2 ft^2/ft of drip distribution tube. Divide the required square feet by the drip distribution tube application area (2 ft^2/ft). This will determine the minimum length of drip distribution tube needed for the system.

   Example: (1,250 ft^2)/(2 ft^2/ft) = 625 feet of drip tube
3. Determine pumping rate by finding the total number of emitters and multiplying by the flow rate per emitter (0.9 gallons/hour/emitter at 20 psi). Adjust output to GPM and add

1.5 GPM per connection for flushing to achieve, for example, a 2 feet/second flushing velocity.

Note: For continuous flush systems, the number of emitters will vary depending on the product selected.

Example: (625 feet)/(2 feet/emitter) = 312.5, use 313 emitters

(313 emitters) x (0.9 gallons/hour/emitter) = 281.7 gallons/hour

(281.7 gallons/hour)/(60 minutes/hour) = 4.695 GPM, or 5 GPM

10 connections at 1.5 GPM per connection = 15 GPM

Pumping rate: 5 GPM + 15 GPM = 20 GPM

4. Determine feet of head. Multiply the system design pressure (20 psi for this example—values can vary depending on the drip distribution tube used) by 2.31 feet/psi to get the head required to pump against.

   Example: (20 psi) x (2.31 feet/psi) = 46.2 feet of head

   Add in the frictional head loss from the drip distribution tubing and piping.

5. Select a pump. Determine the size of the pump based on gallons per minute (step 3 of suggested design example) and total head (step 4 of suggested design example) needed to deliver a dose to the system. The pump selected for this example must achieve a minimum of 20 GPM plus the flush volume at 46.2 feet of head.

Figure 4-7 shows an overhead view of a typical drip distribution system. Figure 4-8 shows a potential layout of a filter, valve, and meter assembly, and Figure 4-9 illustrates a cross-sectional view of the filter, valve, and meter assembly. Figure 4-10 provides a view of the continuous flush system filter and meter assembly.

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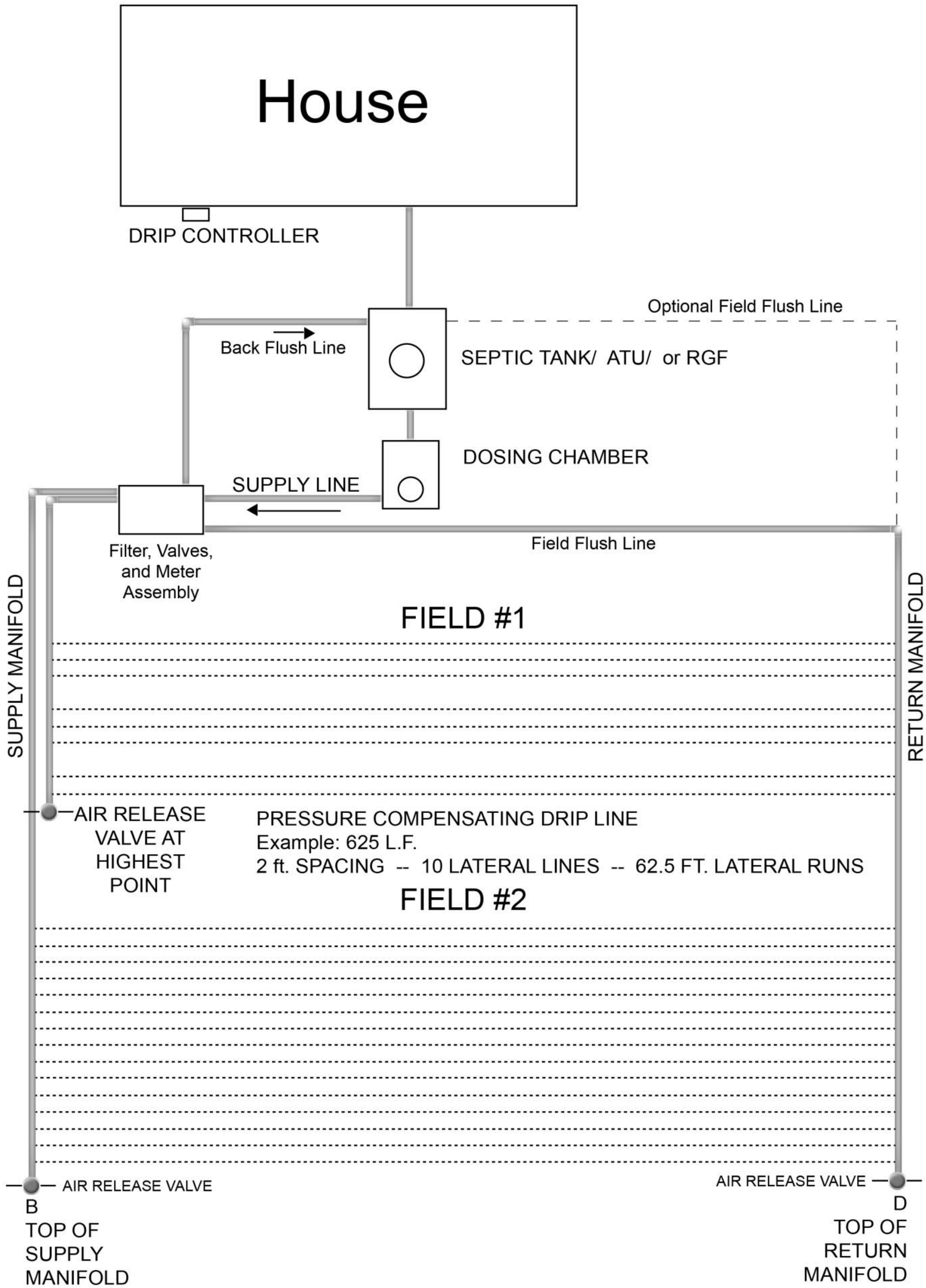

Figure 4-7. Overhead view of typical drip distribution system.

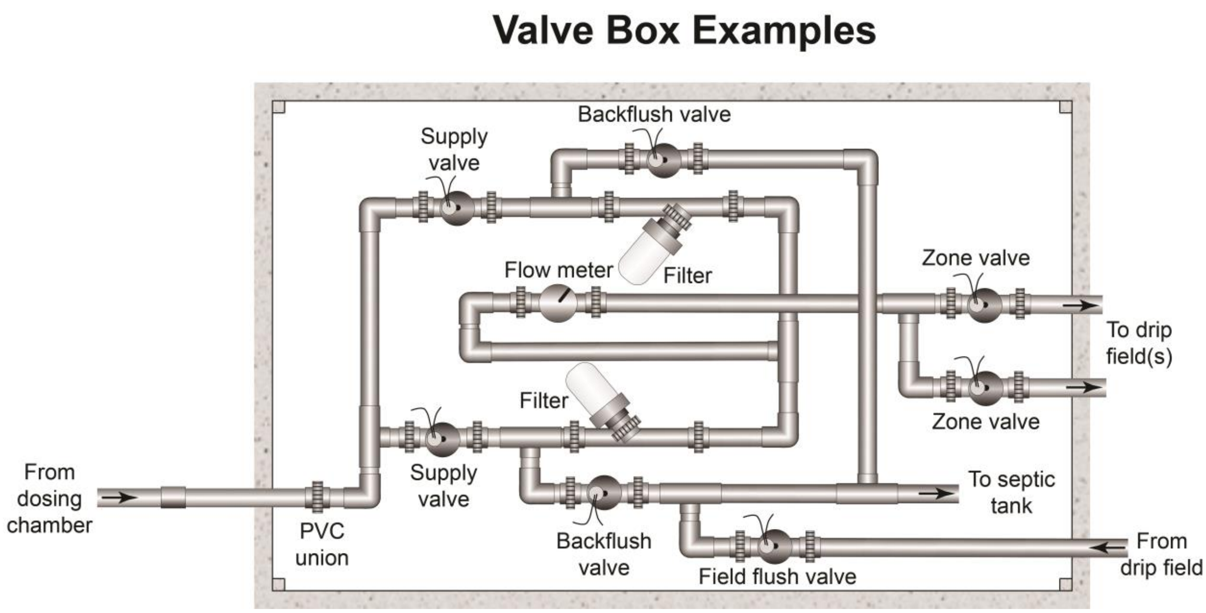

Figure 4-8. Overhead view of filter, valve, and meter assembly for a noncontinuous flush system.

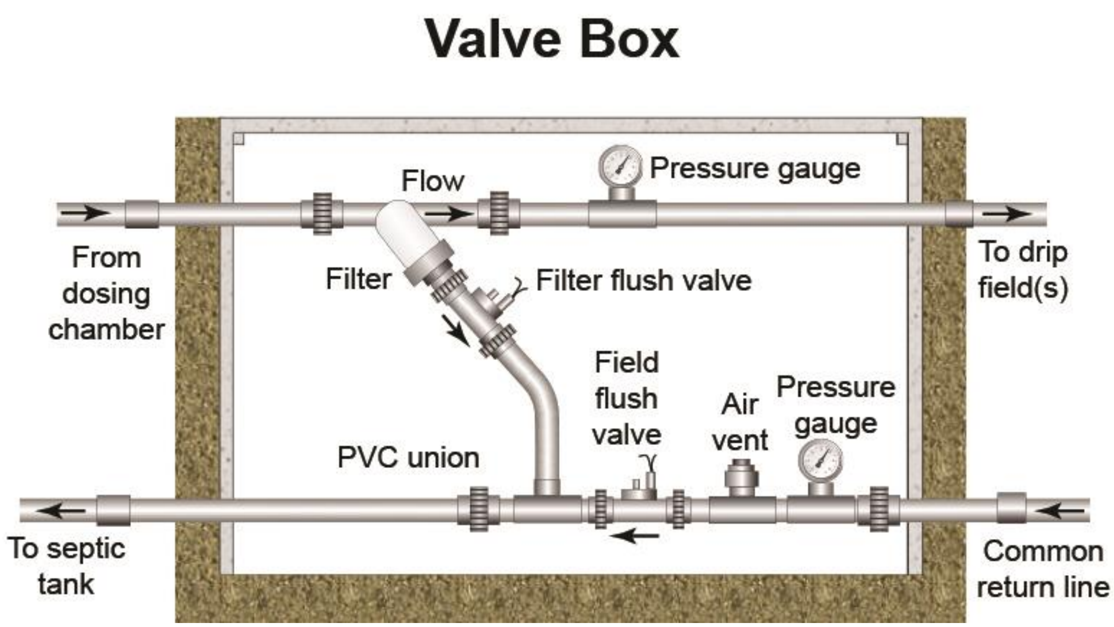

Figure 4-9. Cross-sectional view of typical filter, valve, and meter assembly for a noncontinuous flush system.

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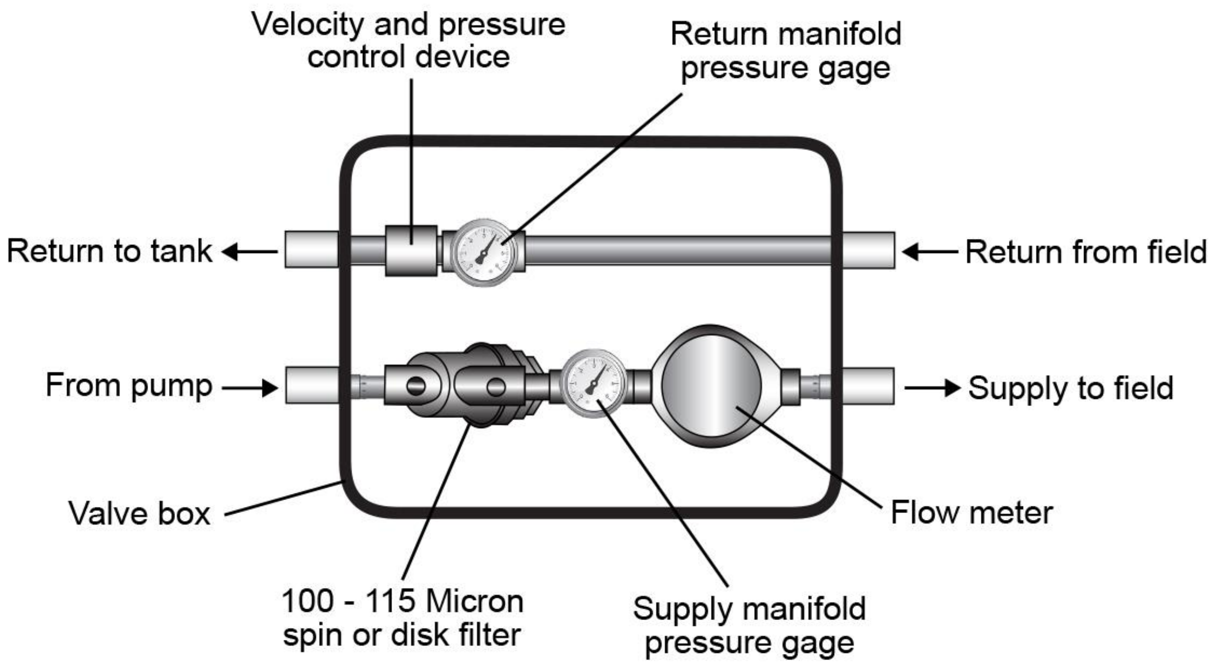

Figure 4-10. Overhead view of continuous flush system filter and meter assembly.

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