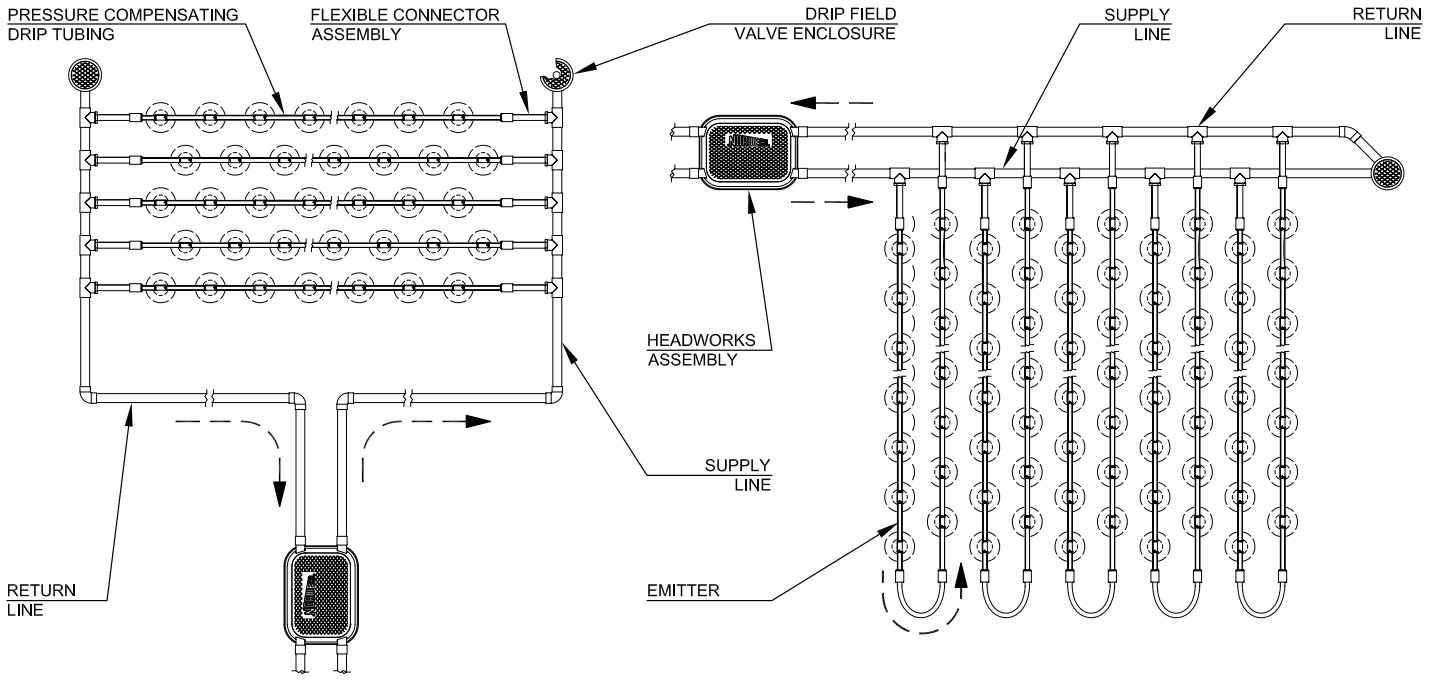
norweco® SINGULAIR®

## SUBSURFACE DRIP DISPOSAL SYSTEMS

# PRE-ENGINEERED DESIGNS

Subsurface drip disposal systems should be carefully planned for each site once a thorough evaluation of the available soil has been completed. A certified soil classifier or soil scientist must identify the class, type, texture, structure and soil absorption rate of the proposed disposal system area. The design and construction of any effluent drip disposal system must comply with state regulations, local codes, the information contained in this document and the Norweco Singulair Subsurface Drip Disposal Systems Design, Installation and Maintenance Guidelines.

The following pre-engineered applications of effluent drip disposal technology include pretreating domestic wastewater with a Singulair Bio-Kinetic treatment system. These designs cover a wide range of soil and site conditions and are based on a flow equalized, biologically treated and physically filtered effluent containing less than 10 mg/L $CBOD_5$ and 10 mg/L TSS. Following the design tables and calculations listed in this guidance document will result in an economical onsite treatment and subsurface effluent disposal system that will reliably serve the property owner.




**DUAL TRENCH INSTALLATION** **SINGLE TRENCH INSTALLATION**

The pre-engineered designs in this document set the size and number of disposal zones required, total emitter tubing length, lateral length, number of laterals per zone, filter size, supply and return line size, pump size, dosing rate, flushing rate, total flow rate, total dynamic head and the time required to pressurize the disposal field.

Table I lists the standards for all Norweco pre-engineered drip systems. Table II lists the recommended loading rates and disposal field area requirements based on soil classification. Table III lists the number of zones required per the overall size of the disposal field. Table IV lists zone sizing guidelines and equipment specifications based on the size of each drip field zone. Table V provides a design calculator summarizing the steps to finalize system design.

Problems with subsurface drip disposal systems occur when soil texture is not properly interpreted. If in doubt about the soil type or the loading rate that should be used, choose the more restrictive soil type from Table II. Loading rates should be based on the most restrictive soil layer within two feet of the emitter line. Installing the emitter line with one foot of vertical separation from a limiting layer and six to ten inches below the surface of the soil has been proven successful when domestic wastewater is being treated by a Singulair Bio-Kinetic system.

# PRE-ENGINEERED DESIGNS (Page 2 of 6)

## TABLE I. DESIGN STANDARDS

| | |
|---|---|
| Maximum Disposal Field Slope | 20 Percent |
| Minimum Fall Through Supply & Return Lines to Pump Chamber | 1 Percent |
| Maximum Elevation (Pump to Drip Line) | See Table IV |
| Maximum Distance (Pump Chamber to Headworks) | 30 Feet |
| Maximum Supply Line Length (Headworks to Drip Line) | 200 Feet |
| Maximum Return Line Length (Drip Line to Headworks) | 200 Feet |
| Drip Line Spacing | 24 Inches |
| Drip Emitter Spacing | 24 Inches |
| Operating Pressure | 25 PSI |

If the design specifications listed in Table I cannot be met due to site conditions, a custom design of the effluent drip disposal system will be necessary. For design guidance, consult state and local codes and the Norweco Subsurface Drip Disposal System Design, Installation and Maintenance Guidelines.

## TABLE II. LOADING RATES AND AREA REQUIREMENTS

| Soil Class | Soil Type | Estimated Soil Percolation Rate (Minutes/Inch) | Hydraulic Conductivity (Inches/Hour) | Hydraulic Loading Rate (Gallons/Square Foot/Day) | Disposal Field Area Required (Square Feet/Gallon/Day) |
|---|---|---|---|---|---|
| I | Coarse Sand | <5 | >2.00 | 1.400 | 0.715 |
| I | Fine Sand | 5 - 10 | 1.50 - 2.00 | 1.200 | 0.833 |
| II | Sandy Loam | 10 - 20 | 1.00 - 1.50 | 1.000 | 1.000 |
| II | Loam | 20 - 30 | 0.75 - 1.00 | 0.700 | 1.430 |
| III | Clay Loam | 30 - 45 | 0.50 - 0.75 | 0.600 | 1.670 |
| III | Silt-Clay Loam | 45 - 60 | 0.30 - 0.50 | 0.400 | 2.500 |
| IV | Clay Non-Swell | 60 - 90 | 0.20 - 0.30 | 0.200 | 5.000 |
| IV | Clay-Swell | 90 - 120 | 0.10 - 0.20 | 0.100 | 10.000 |
| IV | Poor Clay | >120 | <0.10 | 0.075 | 13.340 |

**Table Source: "Subsurface Trickle Irrigation System for Onsite Wastewater Disposal and Reuse" by B.L. Carlile and A. Sanjines.**

Table II shows the recommended hydraulic loading rates for various soil conditions, using a safety factor of at least 12 with regard to the saturated hydraulic conductivity rate of the soil. These hydraulic loading rates assume a treated effluent with $CBOD_5$ $\leq$10 mg/L and TSS $\leq$10 mg/L. State and local codes may contain more conservative loading rates and should be consulted prior to finalizing disposal field design.

Once the number and size of zones required has been determined, use the design standards in Table I, the zone sizing guidelines in Table III, component specifications in Table IV and the system design calculator in Table V to finalize the subsurface drip disposal field design.

**MANUFACTURED BY**

norweco®
Engineering the future of water and wastewater treatment

**NORWECO, INC.**
**NORWALK, OHIO**
**U.S.A. 44857**
**www.norweco.com**

# PRE-ENGINEERED DESIGNS (Page 3 of 6)

## TABLE III. DRIP DISPOSAL ZONES REQUIRED

| Total Square Feet Required | Zone Area Square Feet | Number of Zones | | Total Square Feet Required | Zone Area Square Feet | Number of Zones |
|---|---|---|---|---|---|---|
| 600 | 600 | 1 | | 4200 | 1400 | 3 |
| 800 | 800 | 1 | | 4800 | 1600 | 3 |
| 1000 | 1000 | 1 | | 5400 | 1800 | 3 |
| 1200 | 1200 | 1 | | 5600 | 1400 | 4 |
| 1400 | 1400 | 1 | | 6400 | 1600 | 4 |
| 1600 | 1600 | 1 | | 7200 | 1800 | 4 |
| 1800 | 1800 | 1 | | 8000 | 1600 | 5 |
| 2000 | 1000 | 2 | | 8400 | 1400 | 6 |
| 2400 | 1200 | 2 | | 9600 | 1600 | 6 |
| 2800 | 1400 | 2 | | 10000 | 2000 | 5 |
| 3200 | 1600 | 2 | | 10800 | 1800 | 6 |
| 3600 | 1800 | 2 | | 12000 | 2000 | 6 |

After determining the minimum zone size and number of zones required from Table III, use Table IV to determine the design details for each zone and the drip system component specifications.

## TABLE IV. DRIP DISPOSAL ZONE SIZING STANDARDS

| Zone Area - Square Feet | 600 | 800 | 1000 | 1200 | 1400 | 1600 | 1800 | 2000 |
|---|---|---|---|---|---|---|---|---|
| Maximum Pump to Drip Line Elevation - Feet | 30 | 30 | 30 | 30 | 30 | 30 | 25 | 19 |
| Total Tubing Length - Lineal Feet | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 |
| Lateral Length - Lineal Feet | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 |
| Laterals Per Zone | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Average Emitter Rate - GPH | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 |
| Filter Size - Inches | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Supply Line Size - Inches | 1 1/4 | 1 1/4 | 1 1/4 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 |
| Return Line Size - Inches | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Pump Size - HP | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| Dosing Rate - GPM | 2.55 | 3.40 | 4.25 | 5.10 | 5.95 | 6.80 | 7.65 | 8.50 |
| Flushing Rate - GPM | 7.40 | 7.40 | 7.40 | 7.40 | 7.40 | 7.40 | 7.40 | 7.40 |
| Minimum Total Flow +5% - GPM | 10.45 | 11.34 | 12.23 | 13.13 | 14.02 | 14.91 | 15.80 | 16.70 |
| Total Dynamic Head - Feet | 100.65 | 102.14 | 107.43 | 107.23 | 110.28 | 112.14 | 110.39 | 108.05 |
| Time to Pressurize - Minutes | 1.48 | 1.59 | 1.82 | 2.23 | 2.44 | 2.65 | 2.59 | 2.57 |

# PRE-ENGINEERED DESIGNS (Page 4 of 6)

## TABLE V. SYSTEM DESIGN CALCULATOR

| STEP | DESCRIPTION | VALUE |
|---|---|---|
| 1 | Determine Quantity of Effluent to be Dispersed Per Day (Refer to State and Local Regulations) | _____ GPD (A) |
| 2 | Establish Hydraulic Loading Rate (Refer to Soil Analysis and Table II) | _____Gallons/Square Foot/Day (B) |
| 3 | Determine Total Area Required for Effluent Dispersal (Divide Value (A) by (B)) | _____ Square Feet |
| 4 | Determine Zone Size (Refer to Table III) | _____ Square Feet Size of Each Zone |
| 5 | Determine Number of Zones (Refer to Table III) | _____ Zones Required |
| 6 | Drip Line Spacing | 24 Inches on Center |
| 7 | Drip Emitter Spacing | 24 Inches on Center |
| 8 | Determine Quantity of Drip Tubing Required (Refer to Table IV) | _____ Lineal Feet (C) |
| 9 | Calculate Total Number of Emitters Per Zone (Divide Value (C) by 2) | _____ Emitters/Zone |
| 10 | Drip Field Pressure | 25 PSI |
| 11 | Determine Minimum Pump Delivery (Refer to Table IV, Total Flow +5%) | _____ GPM |
| 12 | Determine Supply Line Size (Refer to Table IV) | _____ Inches |
| 13 | Determine Return Line Size | 1 Inch |
| 14 | Determine Total Dynamic Head (Refer to Table IV) | _____ Feet |

Completing steps one through fourteen in Table V will result in a hydraulically balanced effluent drip disposal system design. The calculated values and the values listed in the referenced tables establish zone sizing, pipe and lateral sizing and dosing volume. Following these design guidelines and established values will result in a subsurface effluent drip disposal system that will automatically flush all distribution lines at a velocity of two feet per second each time the dosing pump is activated. The combination of automatic field flushing and the effluent quality produced by the Singulair Bio-Kinetic treatment system eliminates the need to back flush the emitter tubing.

The final steps in system design are pump chamber sizing and pump timer settings. Pump chamber design is critical to system operation, as an inappropriate soil loading schedule will cause disposal field failure. To verify the design specifications of the pump chamber, refer to state or local regulations for minimum pump chamber capacity. Pump chamber capacity requirements are normally established based on daily design flow and being able to retain the daily flow within the pump chamber for a 24 to 36 hour period. Pump chamber size and materials of construction vary per Norweco distributor.

Pump timer settings are based on the amount of time necessary to pressurize the disposal zone (see Table IV), the amount of the dose being sent to the disposal zone and 24 dosing events per day.

**MANUFACTURED BY**

norweco®
Engineering the future of water and wastewater treatment

**NORWECO, INC.**
**NORWALK, OHIO**
**U.S.A. 44857**
**www.norweco.com**

# PRE-ENGINEERED DESIGNS (Page 5 of 6)

## TABLE VI. DOSING PUMP OPERATIONS

| Zone Area - Square Feet | 600 | 800 | 1000 | 1200 | 1400 | 1600 | 1800 | 2000 |
|---|---|---|---|---|---|---|---|---|
| **500 GPD** | | | | | | | | |
| Pumped Doses Per Day | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| "On" Time Per Dose - Minutes | 9.75 | 7.75 | 6.75 | 6.50 | 6.25 | 6.00 | 5.50 | 5.25 |
| "Off" Time Between Doses - Minutes | 50.25 | 52.25 | 53.25 | 53.50 | 53.75 | 54.00 | 54.50 | 54.75 |
| **600 GPD** | | | | | | | | |
| Pumped Doses Per Day | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| "On" Time Per Dose - Minutes | 11.50 | 9.00 | 7.75 | 7.25 | 6.75 | 6.50 | 6.00 | 5.75 |
| "Off" Time Between Doses - Minutes | 48.50 | 51.00 | 52.25 | 52.75 | 53.25 | 53.50 | 54.00 | 54.25 |
| **750 GPD** | | | | | | | | |
| Pumped Doses Per Day | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| "On" Time Per Dose - Minutes | 13.75 | 11.00 | 9.25 | 8.50 | 8.00 | 7.50 | 6.75 | 6.50 |
| "Off" Time Between Doses - Minutes | 46.25 | 49.00 | 50.75 | 51.50 | 52.00 | 52.50 | 53.25 | 53.50 |
| **800 GPD** | | | | | | | | |
| Pumped Doses Per Day | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| "On" Time Per Dose - Minutes | 14.75 | 11.50 | 9.75 | 9.00 | 8.25 | 7.75 | 7.00 | 6.75 |
| "Off" Time Between Doses - Minutes | 45.25 | 48.50 | 50.25 | 51.00 | 51.75 | 52.25 | 53.00 | 53.25 |
| **1000 GPD** | | | | | | | | |
| Pumped Doses Per Day | | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| "On" Time Per Dose - Minutes | | 14.00 | 11.75 | 10.50 | 9.75 | 9.00 | 8.25 | 7.75 |
| "Off" Time Between Doses - Minutes | | 46.00 | 48.25 | 49.50 | 50.25 | 51.00 | 51.75 | 52.25 |
| **1250 GPD** | | | | | | | | |
| Pumped Doses Per Day | | | 24 | 24 | 24 | 24 | 24 | 24 |
| "On" Time Per Dose - Minutes | | | 14.25 | 12.50 | 11.50 | 10.50 | 9.50 | 9.00 |
| "Off" Time Between Doses - Minutes | | | 45.75 | 47.50 | 48.50 | 49.50 | 50.50 | 51.00 |
| **1500 GPD** | | | | | | | | |
| Pumped Doses Per Day | | | | 24 | 24 | 24 | 24 | 24 |
| "On" Time Per Dose - Minutes | | | | 14.50 | 13.25 | 12.00 | 11.00 | 10 |
| "Off" Time Between Doses - Minutes | | | | 45.50 | 46.75 | 48.00 | 49.00 | 50 |

### TIMER SETTING INSTRUCTIONS

Refer to the values in Table VI prior to setting the pump timer. The electronic timer needs to be set for the desired pump “on” time per dose and the desired pump “off” time between doses. Once established, the “on” and “off” cycles will repeat whenever there is a sufficient quantity of effluent in the pump chamber.

# PRE-ENGINEERED DESIGNS (Page 6 of 6)

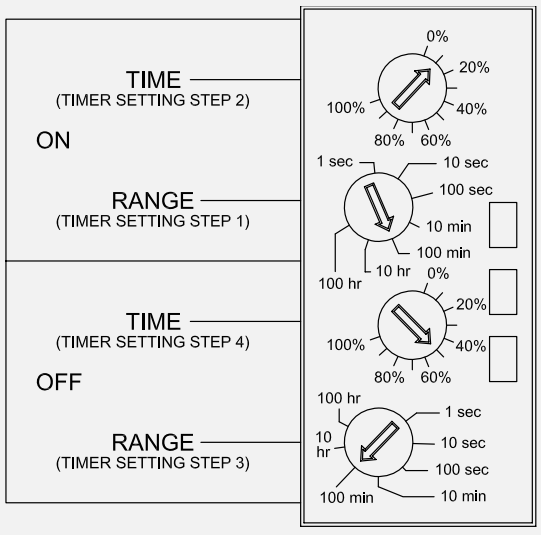
**STEP 1:** Setting the "on" cycle is a two step process. The first step is to set the "ON-RANGE" indicator, the second dial from the top. Select the next larger range than the desired pump "on" time. For example, if the desired pump "on" time is 10 minutes, the next larger range would be 100 minutes. See example.

**STEP 2:** The second step is to set the "ON-TIME" indicator, the top dial. The desired pump "on" time is set as a percentage of the range established in Step 1. For example, if the desired pump "on" time is 10 minutes, and the range established in Step 1 is 100 minutes, the "ON-TIME" indicator would be set for 10% (10 minutes/100 minutes = 10%). See example.

**STEP 3:** Setting the desired pump "off" time between "on" cycles requires two more steps. The first step is to set the "OFF-RANGE" indicator, the bottom dial. Select the next larger range than the desired pump "off" time. For example, if the desired pump "off" time between pump "on" cycles is 50 minutes, the next larger range would be 100 minutes. See example.

**STEP 4:** The last step is to set the "OFF-TIME" indicator, the third dial from the top. The desired pump "off" time is set as a percentage of the range established in Step 3. For example, if the desired pump "off" time is 50 minutes, and the range established in Step 3 is 100 minutes, the "OFF-TIME" indicator would be set for 50% (50 minutes/100 minutes = 50%). See example.

**TIMER SETTING EXAMPLE**




## DESIGN AND INSTALLATION SUMMARY

The pre-engineered designs established in this guidance document are based upon information available from academic, regulatory and industry sources. Because drip emitter tubing is the core component of subsurface effluent drip disposal technology, the design and installation recommendations contained herein are primarily those of the drip emitter tubing manufacturer. **NOTE:** Designers must be aware that state and local regulations take precedence over the designs and values listed. In most cases, the final design of the disposal system is developed from a combination of several criteria including the experience of the soil classifier, designer and installing contractor.

The most critical design and installation requirement of drip disposal technology is matching the soil's capacity to absorb water with the amount of treated effluent to be returned to the environment. It is recommended that two to three soil core samples be taken from each disposal zone with the core sample extending a minimum of two to three feet below the proposed location of the drip tubing. Soil samples must be analyzed for texture, presence of groundwater, seasonal high water table and restrictive layers. The direction water moves through the soil profile and the hydraulic loading rates for system design are determined by the most restrictive soil layer within the profile.

Areas subject to surface water ponding should not be considered for installation of a drip disposal system. Overcoming ponding, poor soil, slopes of 20% or greater and other difficult site conditions are possible with drip disposal, but are beyond the scope of this document. When conditions beyond the pre-engineered guidelines listed are encountered, a designer, experienced in overcoming limiting site conditions, must be consulted. There should always be a vertical separation of at least 12" between the bottom of the disposal field and any seasonal groundwater table, rock or impervious soil strata. Greater vertical separation may be necessary if a site is hydraulically limited, as determined by the soil analysis. If rock or tight clays are encountered three to four feet below the proposed location of the drip tubing, the size of the disposal field must be increased to protect against system failure.

If site or soil conditions dictate the need for a system design by a professional designer, the local Norweco distributor can provide calculations and a design spreadsheet. The equipment and techniques employed when installing the effluent drip disposal system are critical to the long-term operation of the system. For a listing of installing contractors who have developed an expertise in drip disposal system installation, contact the local Norweco distributor.