


NETAFIM USA



SUBSURFACE DRIPLINE GUIDE

SELECTION, INSTALLATION & OPERATION GUIDELINES

A CULTURE OF CONSERVATION

In 1965, Netafim made history with the unique concept of drip irrigation that not only revolutionized traditional irrigation practices but gave us a way to beautify the environment without wasting precious resources. Today, together with over 50+ years of experience and ambitious, dedicated Research and Development, Netafim continues to take irrigation technology and performance, along with conservation to new heights.

Among its accomplishments, Netafim developed products that have been used successfully in turfgrass since the 1980's. They are a popular choice for a variety of residential and commercial, general and specialized-use turf areas, and have been used very successfully in sports turf as well as composition and grass tennis courts.

There are many myths surrounding the issue of dripline in subsurface, or below grade applications, especially in turf. That is the reason for this guide. It is time to realize that subsurface irrigation works and works very well. Landscape irrigation contractors are in the business of maximizing the beauty of a property, and drip and dripline does it better than overhead sprinklers. They do it faster, and they do it while saving water.

Many people imagine that there are no problems with overhead irrigation. To believe that, you must also believe:

- Nozzles are never pointed in the wrong direction
- Sprinkler heads don't break
- Hardscapes, plants and trees aren't battered, stained and ruined by spray
- Spray always reaches into the garden, and the coverage is always perfect.

Here are a few words and phrases that describe the advantages of drip irrigation and dripline. They appear in no particular order of importance and they help set the stage for what we are going to discuss in this guide:

- | | | |
|---|---|--|
| <ul style="list-style-type: none"> • Increases efficiency • Uses less water • Less likely to be banned during droughts • Lower water pressures needed • Reduces maintenance • Lower lifetime system cost • Smaller water tap or meter • Increases plant growth • Delivers outstanding uniformity • Increases water window • Less evaporative loss • Hardscapes remain undamaged | <ul style="list-style-type: none"> • Wind issues are eliminated • Plant obstruction issues removed • No water-stained buildings or windows • No damage to trees or fences • Out of sight, out of mind • Reduces plant disease • No sprinkler "donuts" • Dry streets and sidewalks increases safety • No nozzles to break, steal or misalign • Reduces liability | <ul style="list-style-type: none"> • Less water runs down the street and into the storm sewers • Conforms to any landscape shape • Reclaimed or recycled water can be used • Check valves in emitters • Works with fertigation • Larger zones are possible • Smaller station-count controllers • Fewer valves • Happier neighbors • Great on slopes • Curved areas easy to irrigate • Borders are easier to irrigate |
|---|---|--|

The following pictures illustrate common problems associated with overhead sprinklers.



Broken sprinkler floods street and hardscape causing damage



Sprinklers out of adjustment and wind drift

IMPORTANT DEFINITIONS

Capillary Action: The radial (outward and upward) movement of water through the soil that fills the spaces between particles with capillary moisture.

Capillary Moisture: The water held in pore spaces by the surface tension between the water and the soil particles. This is the primary source of water for plants and is also referred to as “available moisture.”

Gravitational Water: Free water in the soil which moves downward due to gravity. After a soil has been saturated, the gravitational water percolates downward, leaving the soil at field capacity.

Field Capacity: As much water as the soil can hold against the influence of gravity. If a soil is saturated by rainfall or irrigation and then allowed to drain freely for 24 hours, the soil is usually at field capacity.

NOT EVERY DRIPLINE IS CAPABLE OF PERFORMING SUBSURFACE

There are several products on the market that are either non-pressure compensating or are pressure compensating but cannot protect against root intrusion or soil infiltration. But because most rotors and sprays are assumed to be largely the same, companies decided that contractors and end-users probably wouldn't notice that not all driplines are created equal.

Conclusion: A non-pressure compensating dripline is fine for a garden where the run lengths aren't too long and it is being laid on-surface. To install dripline in a subsurface application, you are going to need a dripline that has PC emitters and the emitters must be designed with a permanent way to keep the roots from freely invading the emitter outlets. The dripline must also have an anti-siphon feature to keep soil from being sucked back into the emitter when the system turns off and a vacuum is created.

The Netafim Solution: Techline® CV Dripline. The emitters in this product were designed for use in rigorous agricultural applications, with the full knowledge that they could end up irrigating a field of crops where the only water source is ditch water, and where, if the system failed, the farmer might lose not only his crop, but his livelihood as well. So when these emitters are used in Techline CV, you know they were meant for a much harsher world than the emitters designed for a typical homeowner's garden. If Techline CV will work in agricultural applications, they will certainly work in Mr. and Mrs. Smith's yard.

Note: When other brands of products make their tubing the same color as Netafim, it's a marketing response, not an engineering or product quality response.



Techline CV Dripline

THE FEAR OF ROOT INTRUSION NEED NOT CHASE YOU AWAY

Root intrusion can occur by burying a dripline that was only designed for on-surface application, doesn't have a physical root barrier or by not irrigating properly. One is easy to fix, one isn't.

Using an on-surface dripline in subsurface applications is asking for trouble. Because it isn't always easy to determine what can be used in a specific application, look at the manufacturer's printed product application data. The catalog is always the best place to start. If they do not specifically and clearly say that a product can be used in subsurface applications, or that it can be used in turf, it cannot. If used in a subsurface application, these poorly engineered emitters can and will allow roots to penetrate the emitter opening(s) and grow into the passageways of the emitters, eventually clogging the emitter.

FREQUENT, SHALLOW-ROOT WATERING CAN POTENTIALLY LEAD TO SHALLOW ROOTS

There is another reason why roots could become a problem. The system is being irrigated incorrectly. While it is true that you can promote shallow roots by irrigating daily with overhead sprinklers, you can't compare daily sprinkler watering to daily dripline watering.

Sprinklers throw water through the air. Depending on the water's velocity and the droplet size leaving the nozzle, the droplets will land somewhere out in the yard. Once there, the droplets sit on the surface, or slowly get absorbed into the soil. As more and more droplets hit the same area, a wetted area on the top of the soil is created. If you water too quickly, exceeding the basic intake rate of the soil much of the water will run off. If you don't lay enough water down, the effect is to create a very shallow area for roots to grow.

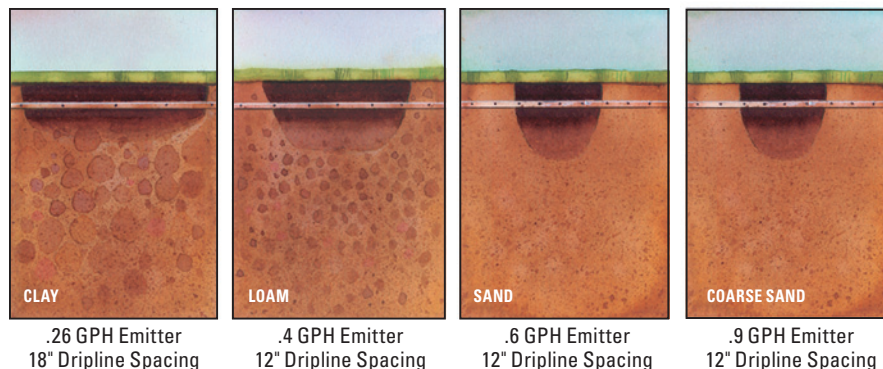
The infiltration rate is the rate at which water enters the soil. This rate varies greatly, and may impose a limitation upon the design of an irrigation system since water application rates in excess of the infiltration rate may result in runoff and erosion.

A dripline system should be run every day or every other day to establish and maintain a consistent moisture balance in the soil. It is this consistent moisture level that will allow the water to radiate as far outward, upward and downward as far as possible, and it is precisely because of this that you will achieve optimal plant growth. Should plant materials show signs of stress in an otherwise well-designed system, the culprit is typically improper scheduling.

SUBSURFACE DRIPLINE GUIDE

In contrast, subsurface dripline irrigation relies on the soil to hand off and absorb water molecules as you irrigate. Because the dripline is already below the surface, some of the water moves upward, (through capillary action) some radiates outward and some moves downward. How much is determined by the speed of application and the type of soil.

Relative movement of water based on soil type and recommended emitter flow and dripline spacing .



Always use the lowest flow rate emitter possible. The recommended emitter flow rates shown above not only allow you to maximize zone size, they apply the water at the proper rate for the soil to properly absorb and radiate it.

By irrigating on a daily basis, we develop a very large wetted area below the surface, and as such, two things happen:

- 1 The roots are allowed to reach deep into the soil because there is moisture available for them.
- 2 The water can reach out to its maximum radius when the soil stays moist. That's because it is easier for water molecules to move when they are in a consistently moist environment. (Capillary action)

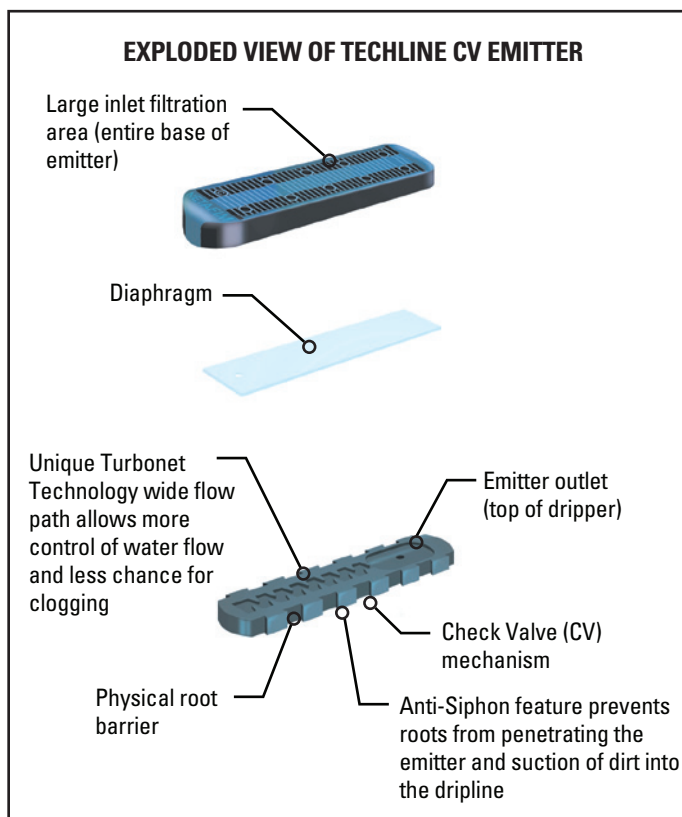
Note: The physics and hydraulics are not the same with subsurface dripline irrigation as they are with overhead sprinklers. As such - those who believe in infrequent deep-root watering practice for overhead sprinklers may continue to do so.

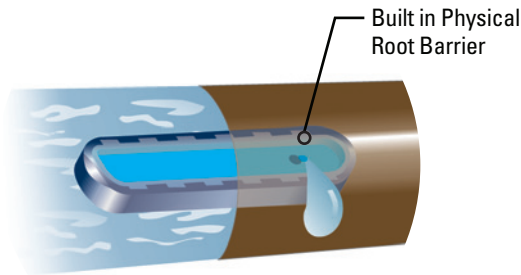
The rationale is simple. If you allow the soil to go through dry/wet cycles, the area nearest the emitter will be the area where most of the roots will congregate. It will also make it harder for the water molecules to reach outward as far as possible.

Note: Daily or every-other-day irrigation allows the area immediately around the emitter to be at or above field capacity. When the soil is in this 'super-saturated' state, roots won't grow into that area.

Moral: Root intrusion is not a problem if you choose the proper product and irrigate on a daily or every-other-day basis. You are simply maintaining a consistent and balanced level of moisture in the soil allowing the plants and turf to thrive without having to 'search' for water. As for the product to use, that is where you need to do your homework. But no method of water application will maintain an optimal mix of air and water in the soil profile better than subsurface drip irrigation.

The Netafim Solution: Use Techline CV Dripline. Here's why - the emitter uses a single hole outlet, but more importantly, the water leaves the emitter in one place and exits the emitter in another. We call this the 'physical root barrier'. Water exits Techline CV emitters into an air gap chamber area. When the emitter isn't running, the area is void of water. Also, Techline CV emitters are mounted to the inside wall of the tubing and have a raised lip surrounding the exit hole while the inlet area extends down into the center of the tubing where it captures the cleanest possible water. Techline CV Outside Diameter (O.D.) tubing is consistent with no increases in diameter where the emitter is located.





Transparent view of emitter inside tubing



Techline CV Dripline

THE FEAR OF STRIPES IN THE GRASS

The issue boils down to proper design, installation, and operation. Any irrigation system design that takes into account the type of soil, the plant material being watered, the available water source and all of the other external factors needed will translate into a good system. If down the road the plant material show signs of stress, there are two possible scenarios. Either the system was improperly designed or the system is improperly scheduled.

We'll talk later about the importance of the charts we use in helping you determine the type and amount of dripline based on the soil type and the plant materials being watered. For now, we need to introduce a concept called 'pulsing.'

Cycle and soak or pulsing is the frequent on-off cycling of a zone of dripline for the purpose of moving water as far outward, upward and downward as possible.

While some may think that increasing the watering time is the way to push the water farther out, it isn't. Neither is using an emitter with a flow rate above our recommendations. In fact, both go counter to what you should do.

Long run times allow the soil to become super-saturated with water. As such, the soil loses its ability to hold water against gravity, (field capacity) and the water becomes 'gravitational.'



Aerial view of sports field with severe 'donuts' caused by rotary sprinklers

IRRIGATION APPLICATION RATE EFFICIENCY

'Irrigation Application Rate Efficiency' is one of those topics where good contractors are often separated from other contractors. It refers to what percentage of water being applied actually gets into the active root zone. What that percentage is has been a hotly-debated topic.

Dripline uses less water (because it reduces waste) and grows healthier plants than sprinklers. If it didn't, most of the vineyards in California and around the world would use sprinklers, and most of the greenhouses would just use sprinklers. But they don't, because they know they can use less water (higher application rate efficiency) with drip and dripline than with sprinklers. The amount varies from area to area. On a hot, windy day in southern Arizona, maybe 30% of the water from a sprinkler gets useably into the root zone. In New England, maybe it's 70%. Where does the other water go? Everywhere but where it should.

Some places where sprinkler water goes (that it shouldn't):

- Evaporation due to low humidity
- Evaporation due to nozzles that are atomizing the water because the pressure is too high
- Wind drift
- Onto the blades of grass or petals and leaves and evaporated
- Down the sidewalk or driveway
- On your car
- On cars driving by or pedestrians walking by
- Into the storm sewer
- Into the trees
- Into the neighbor's lawn
- Onto your house, or the neighbor's house

In short, sprinklers are inefficient. They use too much water and waste much of it.

ANTI-SIPHON FEATURE

This unique feature prevents soil and debris from being sucked back into the emitter when the system turns off and a vacuum is created.

SELF-FLUSHING VS. CONTINUOUS FLUSHING EMITTERS

Netafim Techline CV and Techline DL driplines have a 'Continuous Self-Flushing' feature that sets them apart from other products. The operative word is 'continuous'. Any time debris gets into the emitter, the same diaphragm that creates the pressure compensating feature, momentarily shifts position and flushes the debris out of the emitter. After that split-second of purging is complete, the emitter goes back to its normal operation. In comparison, other emitters on the market tout a self-flushing feature but all that means is that at the moment the dripline turns on, or just after it shuts off, debris may be released. What isn't being said is that during operation, if an emitter becomes clogged, it stays clogged.

EMITTER FLOW RATES AND SPACINGS

Different companies have different flow rates for their emitters. Virtually all emitters used in subsurface landscape applications use a flow rate of less than 1.0 gallon per hour (GPH). Netafim Techline CV and Techline DL are offered in a broad range of flow rates in order to match the flow rate to the soil's ability to absorb the water.

In deciding the proper emitter to use, it is based primarily on the soil (and slope):

- Sandy soil, use an emitter that emits either 0.6 or 0.9 GPH
- Loam soil, use a 0.4 or 0.6 GPH flow rate
- Tight soils like clay, either a 0.26 or 0.4 GPH flow rate emitter

The Maximum Precipitation Rates Chart from the U.S. Department of Agriculture shows the ability of various soils to absorb water. This information is important because it is the best way to show how different soils manage water. In the case of Coarse Sandy Soil on a 0 to 5% Slope, it can absorb 2.00" of water if covered with vegetation. Conversely, a heavy clay/clay loam soil can only accept about 0.20". This means that sandy soil does not hold water as well as tighter soils. It also means that sandy soil will not radiate the water as far laterally and upward as a tighter soil. As such, care needs to be taken when deciding what emitter flow rate to use and how far apart the emitters can be from each other. And as the slope increases, this takes on even greater importance.

Once the proper emitter flow rate is selected (based on soil and slope), the proper emitter spacing inside the tubing needs to be determined. Netafim uses emitter intervals of either 12" or 18," regardless of emitter flow rate. We also offer a 24" spacing for specialty applications. The last determinate is how far apart the rows will go.

MAXIMUM PRECIPITATION RATES (inches per hour)								
Soil Texture	0% to 5% Slope		5% to 8% Slope		8% to 12% Slope		12% to 20% Slope	
	Covered	Bare	Covered	Bare	Covered	Bare	Covered	Bare
Coarse Sandy Soil	2.00	2.00	2.00	1.50	1.50	1.00	1.00	1.00
Coarse Sandy Soil Over Compact Sub Soil	1.75	1.50	1.25	1.00	1.00	0.75	0.75	0.40
Light Sandy Loam	1.75	1.00	1.25	0.80	1.00	0.60	0.75	0.40
Light Sandy Loam Over Compact Sub Soil	1.25	0.75	1.00	0.50	0.75	0.40	0.50	0.30
Uniform Silt Loam	1.00	0.50	0.80	0.40	0.60	0.30	0.40	0.20
Silt Loam Over Compact Sub Soil	0.60	0.30	0.50	0.25	0.40	0.15	0.30	0.10
Heavy Clay / Clay Loam	0.20	0.15	0.15	0.10	0.12	0.08	0.10	0.06

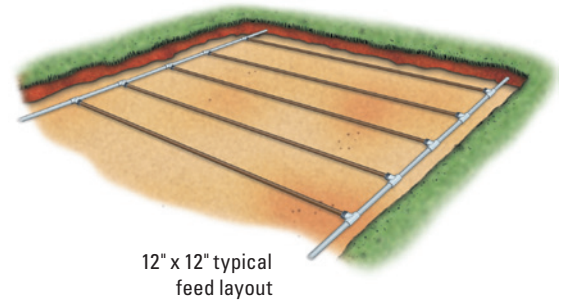
Note: The above average values are for reference purposes. Data may vary with respect to actual soil and site conditions. Data from USDA.

THE BOTTOM LINE ON APPLICATION RATES

Low volume does not mean low application rate or low precipitation rate. If an average rotor system is applying 0.4 inches per hour, that does not mean it is delivering 0.40" of water useably to the root zone. In fact, it is probably only delivering about half that amount.

Conversely, Netafim Techline CV and Techline, using a 0.9 GPH flow rate on a 12" x 12" grid are applying 1.44 inches per hour, and anywhere from 85% to 95% of the water is usable.

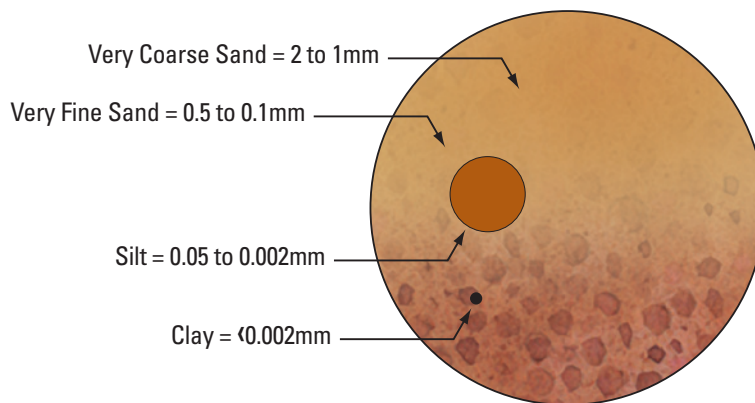
Using something that puts down more water than the soil can handle is bad water management.



12" x 12" typical feed layout

DETERMINING SOIL TYPE

Knowing the soil type is important to picking the proper flow rate for the emitter. It is equally important to know the type of soil because it will drive what emitter interval you use (12" or 18") as well as how far apart you space the rows.



Sizes of various soil particles. The relative proportions of sand, silt and clay particles in a mass of soil (material less than 2mm in size).

Most contractors can easily determine soil type from these three choices, but what if your professional opinion is that it is clay-loam, or a sandy-loam?

As you review our General Guidelines Chart (below) you will see that as the soil selection changes from clay to sand, we move from a lower flow rate emitter to a higher flow rate emitter and our emitter interval and row spacings get closer.

Bottom Line: If you are in doubt between clay and loam, choose loam. If the decision is between loam or sand, choose sand. Why? The rows and emitter intervals will be closer, and yes, the emitter's flow rate could increase as well. The result will be that you have not overextended the spacings. Remember too that the information in the Maximum Precipitation Rates Chart from the U.S. Department of Agriculture regarding the soil's ability to absorb water is based on type, cover and slope.

Note: When amending a soil, do not add more than 15% to 20% organic compound to it. Adding too much organic compound can cause the water to be absorbed and reduce the effective wetted area.

SELECTING THE PROPER DRIPLINE

This will be remarkably easy because Netafim USA has developed a series of charts that answer virtually all product selection, flow rate, spacing and run length questions.

TECHLINE CV® General Guidelines																								
	TURF																							
	Clay Soil			Loam Soil			Sandy Soil			Coarse Soil														
Emitter Flow	0.26 GPH			0.4 GPH			0.6 GPH			0.9 GPH														
Emitter Interval	18"			12"			12"			12"														
Lateral (Row) Spacing	18"	20"	22"	18"	20"	22"	12"	14"	16"	12"	14"	16"	18"	21"	24"	18"	21"	24"	16"	18"	20"	16"	18"	20"
Burial Depth	Bury evenly throughout the zone from 4" to 6"									On-surface or bury evenly throughout the zone to a maximum of 6"														
Application Rate (inch/hour)	0.19	0.17	0.15	0.30	0.27	0.25	0.98	0.84	0.73	1.48	1.27	1.11	0.19	0.16	0.14	0.30	0.26	0.23	0.73	0.65	0.59	1.11	0.99	0.89
Time to Apply ¼" of Water (minutes)	80	89	97	50	55	61	15	18	20	10	12	13	80	93	106	50	58	66	20	23	26	13	15	17

Following these maximum spacing guidelines, emitter flow selection can be increased if desired by the designer. 0.9 GPH flow rate available for areas requiring higher infiltration rates, such as coarse sandy soils.
 Note: 0.4, 0.6, and 0.9 GPH are nominal flow rates. Actual flow rates used in the calculations are 0.42, 0.61, and 0.92 GPH.

The General Guidelines Chart above tells you what type of Techline CV to use. The specific dripline chosen is based on the answers you provide and what is being irrigated and its soil type.

For instance, if you are irrigating turf and with clay soil, the chart tells you to use:

- Emitters with 0.26 GPH flow rates
- Emitters spaced 18" apart in the dripline
- Rows spaced anywhere from 18" - 22" apart

The type of plant and its soil are two questions that need to be answered regardless of what type of irrigation system you are designing. The important thing is, even if you have never used dripline before, you have just been steered to the proper product. In this case, you would ask your Netafim Landscape & Turf Distributor for 0.26/18" (0.26 GPH flow rate per emitter with emitters spaced every 18") Techline CV dripline.

As we continue down the column there is more information available for us. The chart indicates that you can bury the dripline down to 6", as well as what the application rate is in inches per hour. Going one step further, we have translated application rates into how long it will take to apply ¼ inch of water.

Now that we know what flow rate and emitter interval to use, (0.26 GPH and 18" emitter interval in this example) we can move to the Maximum Length of a Single Lateral Chart below. Here we'll learn how far a single dripline lateral can run.

Note: We are often asked how many feet of dripline you can put in a zone. We normally answer the question by asking, "How many rotors or sprays can you put on a line?" The answer to that question comes fast. "It all depends on how much water you have, and the pressure." It's no different with dripline. The amount of dripline you can put on a zone is a function of the pressure and the amount of water available.

TECHLINE CV® Maximum Length of a Single Lateral (feet)												
Emitter Spacing		12"				18"				24"		
Emitter Flow Rate (GPH)		0.26	0.4	0.6	0.9	0.26	0.4	0.6	0.9	0.6	0.9	
Inlet Pressure (psi)	20	331	242	190	144	468	344	270	204	342	260	
	25	413	302	238	180	584	429	338	257	430	326	
	30	471	345	272	206	668	491	387	293	492	374	
	35	518	380	299	227	737	540	426	323	542	412	
	40	559	410	223	244	794	584	459	348	584	444	
	45	594	436	343	260	845	620	489	371	622	472	
	50	626	459	361	274	890	654	515	390	656	498	
	55	655	480	378	287	932	684	539	410	686	522	
	60	681	500	393	298	969	713	561	426	716	544	

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The Techline CV Maximum Length of a Single Lateral chart takes the information we learned from the General Guidelines Chart and expands on it. In our example, we are using 0.26/18" Techline CV for our turfgrass in clay zone. This chart tells us that if we have 45 psi available at the beginning of the dripline lateral, we could run a single lateral 845 feet. If the pressure is 35 psi, the length of a single lateral could be 737 feet.

The science behind this number is simple. We have taken the friction loss over distance and the amount of water it can flow at velocities at or below 5 feet per second and determined for you the point that the dripline would no longer work properly. In short, this is a friction loss chart with all the heavy lifting done.

As to the number of rows needed, each of them extending as far as 845 feet, that is a function of how much water you have. Just like the number of rotors you have depends on available water, pressure, and piping, so does dripline.

TECHLINE CV® Flow per 100 Feet								
Emitter Spacing	0.26 GPH Emitter		0.4 GPH Emitter		0.6 GPH Emitter		0.9 GPH Emitter	
	GPH	GPM	GPH	GPM	GPH	GPM	GPH	GPM
12"	26.4	0.44	42.3	0.71	60.8	1.01	92.5	1.54
18"	17.6	0.29	28.2	0.47	40.5	0.68	61.6	1.03
24"	13.2	0.22	21.2	0.35	30.4	0.51	46.2	0.77

PIPE SIZING		
Pipe Size	PVC	Flow (GPM)
1/2"	Sch 40	5
3/4"	Sch 40	8
1"	Sch 40	13

CL/200

The last of the three charts designed to speed the selection process is the Techline CV Flow per 100' chart. This chart simply translates the gallons per hour world of low volume into gallons per minute. Because Techline CV and Techline DL driplines are pressure compensating, we can accurately determine the flow. In the case of 0.26/18" Techline CV, every 100 feet would use 17.6 gallons per hour, or 0.29 GPM. For example, a lateral that is 800 feet long would use 2.32 GPM (8 x 0.29).

INSTALLING TECHLINE CV OR TECHLINE DL DRIPLINE IN A NEWLY SODDED LAWN, FOLLOW THESE GENERAL GUIDELINES:

- 1** Bury Techline CV or Techline DL dripline:

 - Approximately 4" to 6" below final grade
 - We do not recommend laying the sod directly on top of the dripline
 - In areas where mechanical aeration may be used, bury the dripline 6" below final grade and ensure that aeration does not exceed 4"
- 2** When installing the sod:

 - It is important that the final grade is smooth, ensuring that the sod makes complete contact with the soil
 - Compaction of the soil is key too even distribution of water
 - Turn the system on before laying sod. Visually look at the wetting pattern and evenness of distribution
 - Roll the sod to ensure good contact with the soil
 - Properly 'knit' the edges of the soil together
 - Thoroughly wet the sod from above after installation
 - Depending on weather conditions, supplemental overhead sprinklers may be necessary during establishment, however good results have been achieved without supplemental overhead irrigation
- 3** If the irrigation system is automatic:

 - Set the zone to run several times daily, the object is to maintain a very moist soil condition until the roots establish themselves
 - You may wish to rope off the area to keep traffic away
 - Once you cannot pull the edges of the sod up, discontinue any overhead watering
 - Irrigate on a daily or every-other-day basis
- 4** Protection against root intrusion - following any of these recommendations will help. Following all of them will ensure a lifetime of protection:

 - Use Netafim Techline CV or Techline DL dripline since they are the only subsurface irrigation products designed with a physical root barrier proven most resistant to root intrusion in tests conducted by the renowned Center for Irrigation Technology (CIT)
 - Apply some water every day. Running your Netafim dripline system for even several minutes a day (more may be required depending on your local climate) will help keep soil moisture consistent so the roots do not seek additional water
 - For 100% warranty protection against root intrusion use the Netafim Techfilter, with replaceable cartridges

INSTALLING TECHLINE CV OR TECHLINE DL DRIPLINE IN A NEWLY SEEDED LAWN, FOLLOW THESE GENERAL GUIDELINES:

- 1 Bury the Techline CV or Techline DL dripline:
 - At any depth down to 6" below final grade
 - In areas where mechanical aeration may be used, bury the dripline 6" below final grade and ensure that aeration does not exceed 4"
 - Compaction of the soil is key to even distribution of water
- 2 After the seeding or hydro-seeding is complete:
 - The object will be to create a soil condition that is held near field capacity so that adequate moisture moves upward to establish the seed
 - You may wish to rope off the area to keep traffic off while the seed is being established and the soil is wet
 - Supplemental overhead sprinklers may be necessary, however good results have been achieved without
- 3 If the irrigation system is automatic:
 - Set the zone to run several times daily-the object is to maintain a very moist soil condition until the roots establish themselves
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 - For 100% warranty protection against root intrusion use the Netafim Techfilter, with replaceable cartridges

MAINTAINING A SUBSURFACE SYSTEM

When designed and installed properly, a Netafim Techline CV or Techline DL subsurface system offers the designer, contractor and system owner very high quality equipment, unparalleled performance, system reliability and low maintenance.

As we discussed earlier, training, repair and maintenance considerations are actually less with a subsurface system than with a sprinkler system.

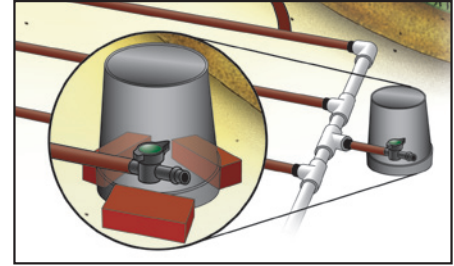
As with any irrigation system, it is important that it be designed according to the manufacturer's specifications and installed according to the designer's specifications. Note that on the following chart, the major elements relating to a dripline system vs. a sprinkler system are the same.

MAINTENANCE COMPARISON Sprinklers vs. Dripline		
	Sprinklers	Dripline
Calculate or determine from water meter and record zone flow for future reference	✓	✓
Clean filters or screens in sprinklers	✓	✓
Visually inspect all irrigated areas	✓	✓
Check for leaks	✓	✓
Test pressure and flow	✓	✓
Reset heads that are too high or low	✓	
Adjust nozzles, arcs and radius	✓	
Replace nozzles due to wear	✓	

LINE FLUSHING VALVES

If manual flush valves or flush ports have been installed, they should be opened and the system flushed at least three times each irrigation season until the flowing water is visibly clean. The zone may need to be flushed more frequently depending on the water source.

Flushing is also recommended anytime that the system has been repaired.



Manual flush valve mounted on an exhaust header used with Techline CV dripline

CONCLUSION

It has been our goal to explain the concept of subsurface dripline using Techline CV and Techline DL in a simple, informative way. Subsurface dripline is an irrigation technology that contractors around the world have been using for years with excellent success. We hope that you agree that because much is known about it, using it is both a logical and safe decision. To view the full version (45 pages) of the Netafim USA Subsurface Dripline Guide, visit the Netafim USA website at www.netafimusa.com/landscape.

For specific product and design recommendations, we encourage you to review the following materials which are located on our website:

- Netafim USA Landscape & Turf Division Catalog
- Techline CV Design Guide
- Techline DL Design Guide

Each of these resources will provide you with even more specifics regarding the proper choice and application of products.



Techline CV dripline turfgrass subsurface installation



Wetting pattern of Techline CV dripline prior to turfgrass subsurface installation



BEFORE

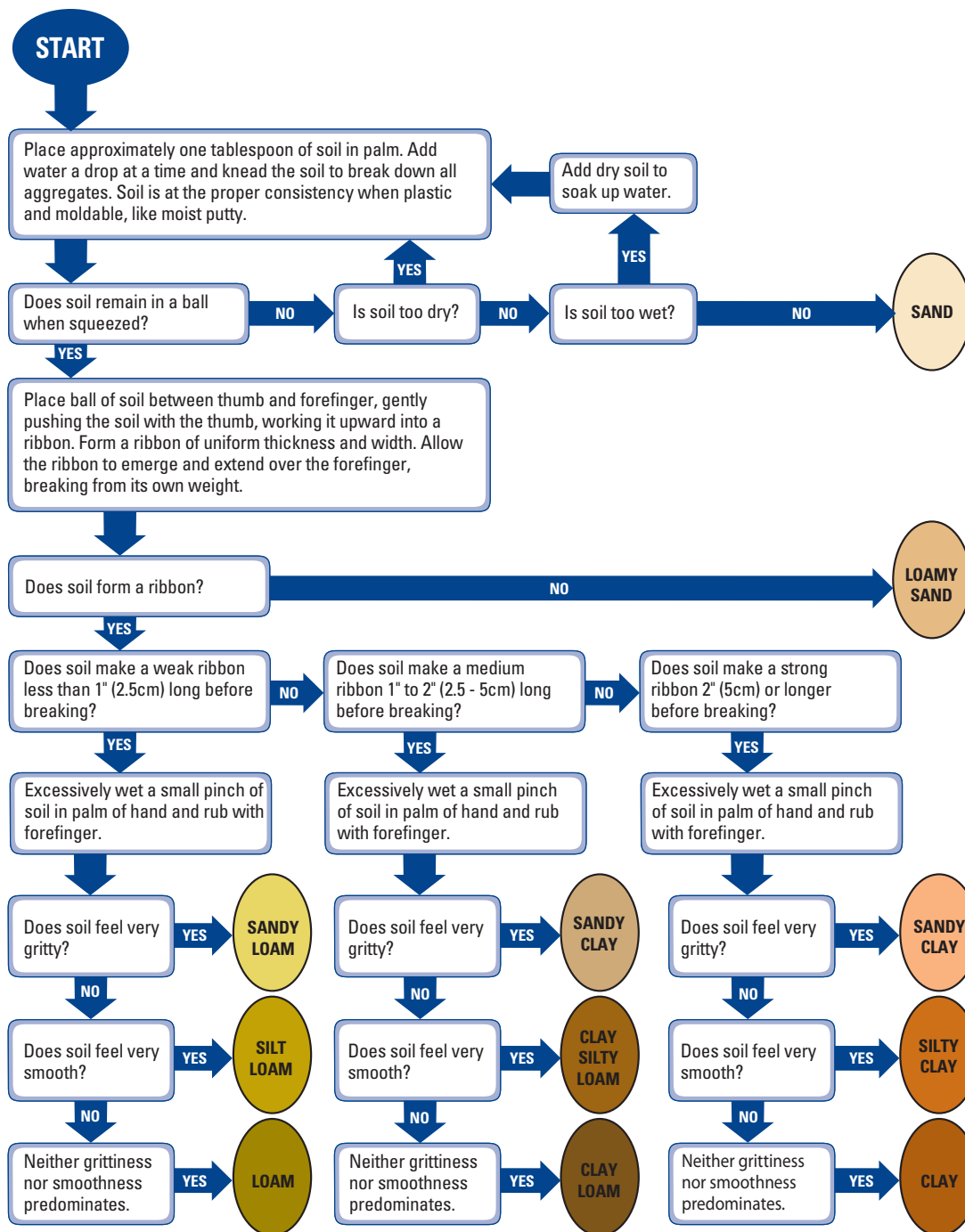


AFTER

Techline CV dripline turfgrass subsurface installation

SUBSURFACE DRIPLINE GUIDE

DETERMINING SOIL TEXTURE BY THE 'FEEL' METHOD



Modified from: Thien, Steve J.; Kansas State University, 1979 Jour. Agronomy Education.

