

# **NETAFIM**

# **DRIP IRRIGATION**

## **Choosing The System That Works Best**

### **Profitability**

There are many “kinds” of drip irrigation systems available to the American grower today. There are many that work, some that don't work very well, too many that don't work at all and a precious few that work the best. The purpose of this presentation is to inform the potential or practicing drip irrigator of what to look for when purchasing drip irrigation equipment. The goal is to buy the “best” system, meaning the best return on your investment.

A drip irrigation system should allow the farm manager to reliably apply water and fertilizer to the crop rootzone uniformly, in adequate quantities, at timely intervals, economically (both from a system purchase point of view, as well as management point of view) and without requiring a PhD or an IQ over 200. Drip irrigation systems should be user friendly and highly efficient. If they aren't, then the grower didn't get what he paid for. If the grower didn't pay enough, then he probably did get what he paid for. When considering the options, try to think of how much the system will make instead of how much it will cost.

### **Tips For Success**

Drip irrigating is an art and a science, just like farming. In order to ensure success, the grower must demand professional service and quality products from the irrigation dealer, and he must commit the time to learn how to operate a new piece of machinery. Anything less will end in disappointment for all involved.

It must be remembered that historically, the most common cause of drip system failure is plugging. To combat this problem, both the industry and growers have developed systems and management techniques to prevent emission devices from clogging, but it is not without effort. If any aspect of drip irrigation is overlooked, it should not be this one.

### **System Design & Installation**

The system must be designed, installed and managed properly. The design must be hydraulically sound and user friendly. In addition, quality products must be used which are backed by a reputable manufacturer. Ideally, the designer, dealer and manufacturer of the products have a close relationship and will stand as a team to support the grower's needs.

The system must be installed correctly. The best design and equipment may be seriously flawed if not put in the ground properly. A unique aspect of many drip systems is that the majority of the systems components are buried and inaccessible after the job is completed. It is best to question the quality of installation before it is too late. Make sure the installation is per the designer's specifications including pipe sizes and class, valve type and placement, filters and emission devices. Subsurface drip tubing must be accurately injected, especially if multi-crop usage is anticipated, and pipelines must be thoroughly flushed after assembly. Remember that money saving substitutions can be very costly in the long run.

### **System Management**

Last, but not least, the system must be managed properly to ensure success. If the grower is unfamiliar with the technology, help should be obtained for at least the first season or two. It is far different to manage the plant's rootzone using flood or furrow versus drip or microsprinklers. The grower must determine how much water and fertilizer to apply, and how often. To optimize the use of the new system, the intervals should be much shorter than other irrigation methods, and the rootzone will probably be smaller. This means higher production, but closer management. The system itself also needs maintenance like any other piece of equipment. Pipelines must be regularly flushed, and water treatment chemicals may need to be injected to keep bacterial and organic growth in check. Drip injected fertilizers and other chemicals should be closely scrutinized to prevent clogging from precipitation, and to prevent harm to humans, animals and equipment.





# Choosing a Drip



Dripperline

On-line Drippers

Filters

Valves

Manifolds

## The Most Important Feature

A typical drip system consists of several components. A pump will typically lift water from a well, reservoir or other water source and deliver it to a filter at a specified pressure. Filters will cleanse the water sufficiently to allow safe passage through the small flowpaths of drip emitters or micro-sprinklers. Valves will control the flow and pressure of the water to various parts, or blocks, of the system. Finally, pipelines, both mainline and submainline, will deliver water to the dripperlines with emitters or micro-sprinklers.

It is important to note that although all parts of the system are essential, the most important is the dripperline or micro-sprinklers. This is because ultimately, this is the part of the system that makes direct contact in delivering the water to the target plant. For this reason, it is imperative that the emission devices are of premium quality.

From an economic viewpoint, the emission device portion of the system is usually less than a third of the overall cost of the system. If the cost of developing the crop is included, which is what is at risk should the emission device fail, the portion of the cost may be insignificant. Considering the importance of the emission device in the system's success, it is clear that quality and performance should be weighed more heavily than price when selecting dripperlines, emitters or micro-sprinklers.

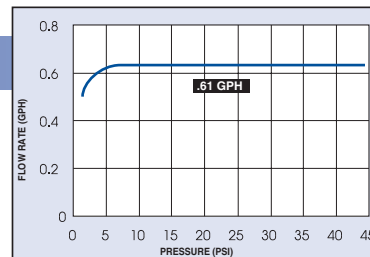
Emission devices of all different types may be readily evaluated according to objective engineering criteria. These criteria include the emission device's ability to deliver an equal amount of water and fertilizer from each outlet (emission uniformity), its ability to deliver water evenly within its wetting pattern (micro-sprinkler distribution uniformity), its filtration requirement based upon its minimum flowpath size, its ability to withstand specified operating and flushing pressure, its performance under hot water conditions and its propensity for leakage at fittings.

Emission devices may also be evaluated according to criteria which is not necessarily objective. This criteria includes how well the product is packaged, how reliably it is delivered, how well it is serviced and supported by both the dealer and the manufacturer, and how much it costs. These are all very important aspects of emission device selection, but of lesser importance if the emission devices don't perform well.

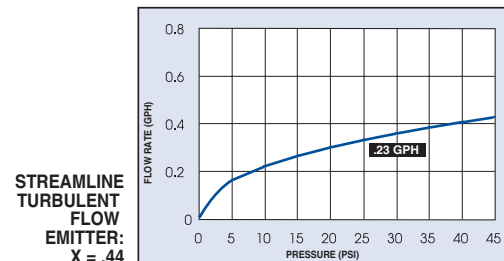
## Uniformity

Uniformity of water and fertilizer application is one of the most important evaluation criteria. Engineers can quantify uniformity with an equation (surprise?) which includes key elements describing how well the emission device is designed and how well it is manufactured. These two elements are known as the flow exponent " $x$ " and the coefficient of manufacturing variation, " $CV$ ".

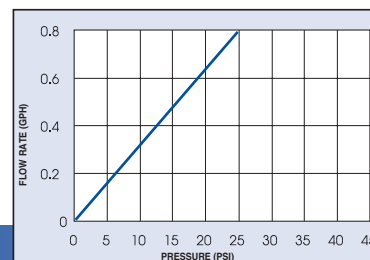
The flow exponent " $x$ " is extracted from the emission device's flow equation, or flow curve, which is unique for every type and flowrate of emission device made. This flow exponent describes how "pressure compensating" the emission device is, and normally measures between 0 and 1, the lower (closer to 0) the value, the better. Values close to 0 are considered pressure compensating, values of .5 turbulent flow and values of 1.0 laminar flow. For example, Netafim's Ram dripperline is pressure compensating with a "flat" flow curve and an exponent of 0. Netafim's Streamline dripperline is turbulent flow with an " $x$ " value of .44. Flow exponents may be lower for particular "windows" within the operating range where the curve is "flatter".



RAM  
PRESSURE  
COMPENSATING  
EMITTER:  
 $X = 0$



STREAMLINE  
TURBULENT  
FLOW  
EMITTER:  
 $X = .44$



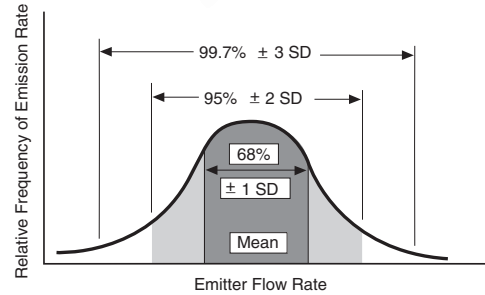
LAMINAR  
FLOW  
EMITTER:  
 $X = 1.0$

# Irrigation System



## Quality of Manufacturing

The CV is a statistical description of how uniformly each device is manufactured in relation to one another in terms of its flow rate. It is defined as the standard deviation divided by the average flow rate from a sample of emitters. The properties of the normal “bell shaped” curve (at right) illustrate that about 68% of all of the flow rate values will fall between plus or minus one standard deviation: It is desirable for Cv values to be as low, or as close to zero, as possible. Most product CV s measure between 1 and 20%, however, Netafim dripper and dripperline products normally maintain a CV of 3% or less.



Both the “x” and the “Cv” are integral parts of the Emission Uniformity equation which describes uniformity due to manufacturing design and variation. This equation does not consider the possible disuniformity that may occur from emitter plugging:

$$EU = \left( 1 - \frac{1.27 CV}{\sqrt{n}} \right) \times \frac{q_{min.}}{q_{ave.}}$$

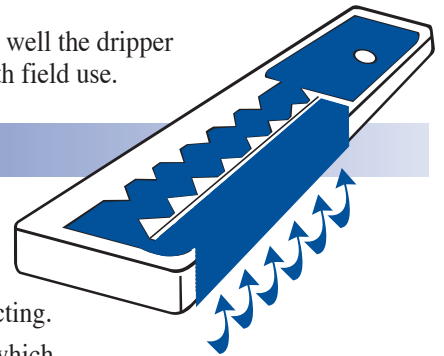
*n* = the number of emitters/plant  
*CV* = the coefficient of manufacturing variation of the emitters/sprayers  
*EU* = the design EU of the brand new system  
 $\frac{q_{min.}}{q_{ave.}}$  = the ratio of “minimum” to “average” flow rates within the system, due to pressure variations.

The “x” and “Cv” values may be obtained from the manufacturer of the emission device, the irrigation dealer or from actual testing performed by a laboratory such as Center for Irrigation Technology in Fresno. Realistic values will give the drip irrigator a good idea of the theoretical uniformity of the drip irrigation system.

Another factor that influences uniformity is field plugging of the emission devices. How well the dripper flow path is designed will largely dictate whether uniformity will eventually degrade with field use.

## Turbulent Flow Path Design

Flowpath design is a two-edged sword. The creator of the emission device must ensure that the flowpath achieves both a low hydraulic “x” (as pressure compensating as possible) and as large and short of a flowpath as possible (to prevent plugging and/or to reduce filtration requirements). Unfortunately for the engineer, these two goals are conflicting.



Fortunately for the grower, Netafim has patented flow path and emission device designs which uniquely achieve both of these goals. Netafim dripperline products consistently “outsize” competitor s flow path cross sectional areas, and are the shortest in length as well (which also helps prevent plugging). In fact, there is not a single Netafim product produced, including Streamline dripperline, which requires more than 140 mesh filtration. This is in contrast to many competitors which require over 200 mesh. In addition, the raised inlet to Netafim s drippers prevents plugging from settled debris in dripperline products.

To determine the filtration requirement for any given product, standard engineering practice suggests that the minimum flow path dimension be divided by at least 5 (if not 7 or 10 to be conservative). That number, in inches, is then converted to filtration mesh, or micron. For example, Netafim s Typhoon .40 gph dripper has a flowpath dimension of .028"x.028". If .028" is divided by 5, then .006" is the level of filtration required, which is 100 mesh. The Filtration Equivalents chart on the following page can be used to calculate filtration requirements for emission devices. Obviously, the higher the filtration requirement, the more attention that must be paid to filtration by the farm manager. This attention often costs time and money.



## Filtration

Filtration is a topic of its own which won't be completely covered in this discussion. However, it should be noted that the selection of the filter is dependent on the quality of the incoming water source, and the desired quality of the outgoing water. Once these parameters are known, then the type and size of filter may be selected.

Many types of filters are successfully used in the marketplace today including screens, centrifugal separators, disks and media. They all have their relative advantages and disadvantages including filtration efficiency (which is dependent on the contaminant), pressure loss, required operating pressure, operating flow range, quantity of backflush water generated, size, weight, material of construction, serviceability, maintenance requirements and price, to name a few. Sand media filtration has traditionally been considered the standard for systems using devices with very small flowpaths, such as "tape" products, because of the level of filtration achieved and the ability to automate the backflush. It should be noted, however, that automatically backflushing "Disc-Kleen" disc filters have also been successfully used in "tape" applications with distinct advantages including smaller size, lower weight, easier serviceability, less backflush water generated, wider operating flow range and plastic construction. A minimum of 45 psi is required to achieve optimum backflushing, so a pressure sustaining valve is often used downstream of the filter station in lower pressure applications. These filters should be closely considered, especially if a portable filtration station is desired.

### FILTRATION EQUIVALENTS

Screen Size			
Mesh	Inches	mm	micron
20	.0280	.711	711
40	.0165	.420	420
80	.0071	.180	180
100	.0060	.152	152
120	.0049	.125	125
140	.0042	.105	105
180	.0035	.089	89
200	.0030	.074	74
270	.0021	.053	53
325	.0017	.044	44
600	.0010	.025	25

## Other Important Criteria

Pressure rating is also an important feature, especially in relation to the mil thickness of the dripperline. Many growers intend to use thin mil dripperline, or "tape", for multiple crops. In this application, it is critical that the dripperline is regularly flushed to maintain uniformity over the desired lifespan of the product. If the dripperline lengths of run are long (over 600 feet), higher than operational inlet pressures may be required to achieve adequate flushing velocities (between 1.25 and 2.0 feet per second (fps) is usually adequate). The manufacturer's maximum operating pressure must be evaluated compared to the inlet pressure required for flushing. It may also be interesting to evaluate the product's burst pressure in comparison to the operating pressure. In general, it is desirable that burst pressures be 3 times as high as the operating pressure. For example, Netafim's Streamline 8 mil dripperline is rated at 12 psi, and has a burst pressure of 45 psi, whereas a competitor's 8 mil product is rated at 12 psi and bursts at 15 psi. Clearly, this is not desirable, especially when considering raising the pressure for flushing purposes.

In many areas, dripperline applications are operated with hot water due to the temperature of the water source, or heating of the water for surface laid dripperline. It is important to evaluate a dripper's performance under these conditions if they are likely to occur. In general, Netafim's dripperlines are not influenced by water temperature because their drippers are constructed from injection molded polyethylene resins. This is in contrast to many of the competitor's products which increase in flow as temperatures increase.

Drip irrigation systems incorporate many fittings to connect the various components together. It is essential that these connections are reliable and leak free. In dripperline applications, it is especially bothersome when seamed "tapes" leak at the fitting, which often occurs due to the non-regular shape of the inner and outer diameter. Leaks lead to increased weed and pest growth, and may develop into fitting failure under some conditions. All Netafim dripperline products are of seamless, extruded construction. The smooth inner and outer diameter lends itself well to leak tight fittings, improves the product's tensile strength, and prevents roots from traveling along a seam and intruding.

## Summary

In conclusion, there are many things to consider when evaluating drip irrigation equipment. It is hoped that the preceding discussion will serve as a guideline when comparing products and systems. There are many choices.

Remember, the uniformity of any system is highly influenced by how well the emission device is made ("x" and "Cv") and how well it resists plugging (flow path size and length). EUs of over 90% should be expected of new drip irrigation systems.



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