

N E T A F I M U S A



SUCCESSFUL ROW CROP DRIP IRRIGATION SYSTEMS

PLANNING, INSTALLATION & MAINTENANCE CONSIDERATIONS

SUCCESSFUL DRIP IRRIGATION SYSTEMS

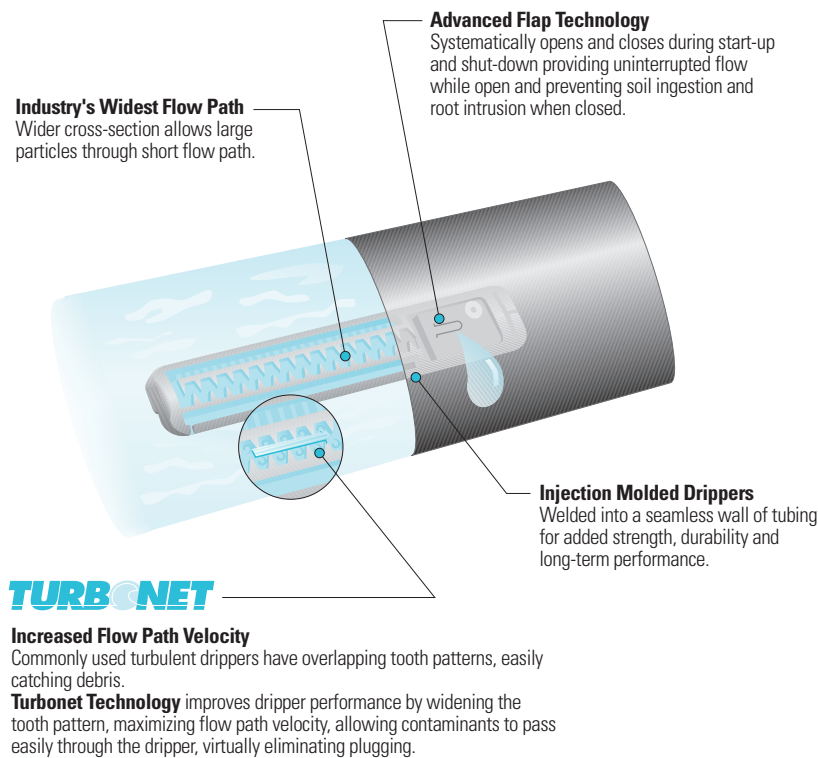
Over 3 billion feet of drip tubing was installed into row crop fields in the United States in 1995 alone. The success of drip irrigation has been attributed to many factors. The primary reason has been the evolution of equipment developed during the past 10 years, advanced equipment that allows a grower with little or no experience to succeed.

Netafim Irrigation, Inc. pioneered the use of drip irrigation over 45 years ago. Netafim USA continues to lead the world in technologically advanced, user friendly drip irrigation systems, offering a complete line of superior system components. Component compatibility combined with proper system design, installation and maintenance, ensures reliable easy to operate systems that provide the greatest efficiency and return on investment.

AT THE HEART OF THE SYSTEM - THE INTEGRAL DRIPPER

Netafim's integral drippers are injection molded using state-of-the-art precision machinery. This enables Netafim to produce drippers with the widest and shortest water passages on the market. Each integral dripper includes a precision molded filter. The position of the filter ensures that water is not drawn from the wall of the

lateral, where sediment is most likely to form. Both of these unique features - the size and shape of the water passage and the integral filter and the high turbulence of the special patented dripper teeth combine to make Netafim USA drippers highly resistant to clogging. Independent studies have shown that Netafim's integral drippers are by far the most clog resistant driplines available in the world.



PLANNING YOUR NETAFIM USA SYSTEM

A well planned project can greatly increase the success of your system. Proper project planning can help save time and money while limiting the potential for confusion or dissatisfaction with the final product. The information published in this document is intended to provide planning guidelines only.

ESTABLISH EXPECTATIONS

- Increased ability to manage crop
- Uniform application of water
- Uniform application of nutrients
- Simplicity of operation and maintenance
- Quality durable components
- Limited exposure to risk of clogging
- Increase production
- Save money
- Increase profits

Traditional desired outcomes have been that a system deliver water to a crop. Today, successful growers verify that the system is capable of:

- Meeting the Et demands of the crop
- Capacity to fertigate and perform leaching
- Account for and compensate for inevitable inefficiencies while maintaining the ability to meet expectations

Proper irrigation design incorporates agronomic, financial and ergonomic considerations into a balanced system. Trying to cut too many corners can often result in a yearly labor cost that far exceeds the money that a better quality system would have cost and yields that are less than optimal.

Some growers hesitate using drip because of the apparent initial expense. Those growers that consider the whole financial picture however, often find that a well designed system quickly pays for

itself and adds to the bottom line. In most cases any increased profits have to be realized by achieving higher efficiencies of production. Technology like drip irrigation can allow growers to cut labor expenses per acre and more efficiently manage water and nutrient inputs. For those growers considering drip irrigation, it is essential that the proposed system be designed with proven, easy to use technology. Clogging is a major concern for users of drip irrigation. Proper attention to product selection and routine maintenance will greatly limit this risk. Progressive growers need to examine financial aspects of system performance. Growers may find that a system with 90% emission uniformity is actually not precise enough for their needs; for example, high value row crop or nursery crops with extensive fertility requirements.

DETERMINE FIELD LIMITATIONS

- Row length, width and possible variations
- Slope and drainage
- Possible crop variations
- Soil texture and chemistry variations
- Water quality and availability

Field limitations can have a major impact on the design of a successful system. The proposed drip system must not conflict with the growers desired cultural practices. Bed widths, access road locations and the need to change row configurations to accommodate different crops will all affect the system design. Soil texture and chemistry need to be considered in the initial design process. Failure to do so may result in less than ideal irrigation. Soil slope and drainage will play a major part in the initial system layout. Depending on run length, excessive slopes can result in unacceptable pressure variations throughout the field. An elevation change of 2.3 feet is approximately equal to 1 psi of pressure.

In most cases, water quality problems can be easily corrected, but only if a grower knows about it in advance. Periodic water tests are cheap insurance (about \$35) and protect not only the irrigation system but help detect potential plant toxicity problems. Growers should beware of 'economical' systems that force them to irrigate for unreasonable lengths of time or during peak power rate periods or that do not allow them to provide for the crop's needs during an unusual heat spell.

PLAN FOR THE FUTURE

- System flexibility
- Scheduling and record keeping
- Maintenance recommendations

Systems should be designed to accommodate likely changes the grower may wish to make during the life of the project. Common examples are changes in bed width, plant spacing or density. Training of operators and maintaining adequate records and schedules of routine practices can help to maintain higher efficiencies of operation. Keeping good records will enable growers to evaluate their system throughout it's life and assist in fine-tuning maintenance practices in the future. All systems should come with a recommended list of maintenance practices for that particular field. For example, be sure that the design includes provisions for flushing the dripline, especially on multi-season projects. Proper maintenance insures longevity of your system.

SYSTEM DESIGN

MANIFOLDS

- Because of the low pressure differentials allowable in drip system design, manifolds must be designed to produce minimal pressure drop due to friction.
- Manifolds can be buried or laid on the surface. Surface systems may be cheaper but are more subject to potential mechanical damage. Manifolds can be constructed of PVC, PE or fiber reinforced materials known as Layflat.
- Systems can be fed from one end, split in the middle or fed from both ends (looped). Dual feed systems are often designed with dual valves allowing the operator to use one end as a flush line during routine maintenance. Split systems may allow for better uniformity by shortening run lengths but can restrict cultivation practices that might damage the line, for example, ripping.

FILTRATION STATIONS

- A properly designed system includes provisions for correct filtration. This is the main difference between having an easy to use system and one requiring constant monitoring.
- Filtration should be based on several factors: water quality throughout the growing season, dripper flow path area, nature of contamination and the likelihood for fluctuations, etc. Industry recommendations vary between 1/5 and 1/10 of the smallest dripper cross-sectional dimension.
- Filter pads take up valuable space. Compact size is a major consideration.
- The backflush process is critical to proper filter station operation. Processes involving large amounts of water and long periods of time can cause adverse hydraulic fluctuations in the system.
- The filter station will be the single most expensive component in the list of materials tempting some growers to cut corners on this item. A less than adequate filter can cost far more than it originally saved in chemical treatments, field labor and extraordinary maintenance to fix clogging problems.

FERTILIZER INJECTION

- Good chemigation capabilities will help the system pay for itself faster than any other component. Growers often neglect to utilize this feature to its full potential due to perceived complexity, uncertainty over what to inject, etc.
- Injection systems should meet expected demands for all chemicals, be easy to operate and calibrate and have provisions to prevent unwanted precipitates.
- A schedule of proper flushing procedures will reduce the chances of unwanted clogging due to precipitation or other unwanted chemical interactions.

AIR/VACUUM RELEASE

- The use of air and vacuum relief vents can mean the difference between a successful system and one with vacuum-induced plugging problems.
- Vacuum placement is critical and is topography dependent. Depending on field layout, venting may have to be provided at the top, bottom or both ends of the field.

VALVES

- Due to thinwall dripline burst pressure limitations, proper use of pressure regulating valves is essential.

CROP MANAGEMENT TECHNOLOGIES

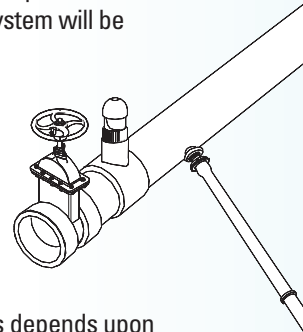
- Automation can greatly enhance manageability of an irrigation system.

WATER METERS

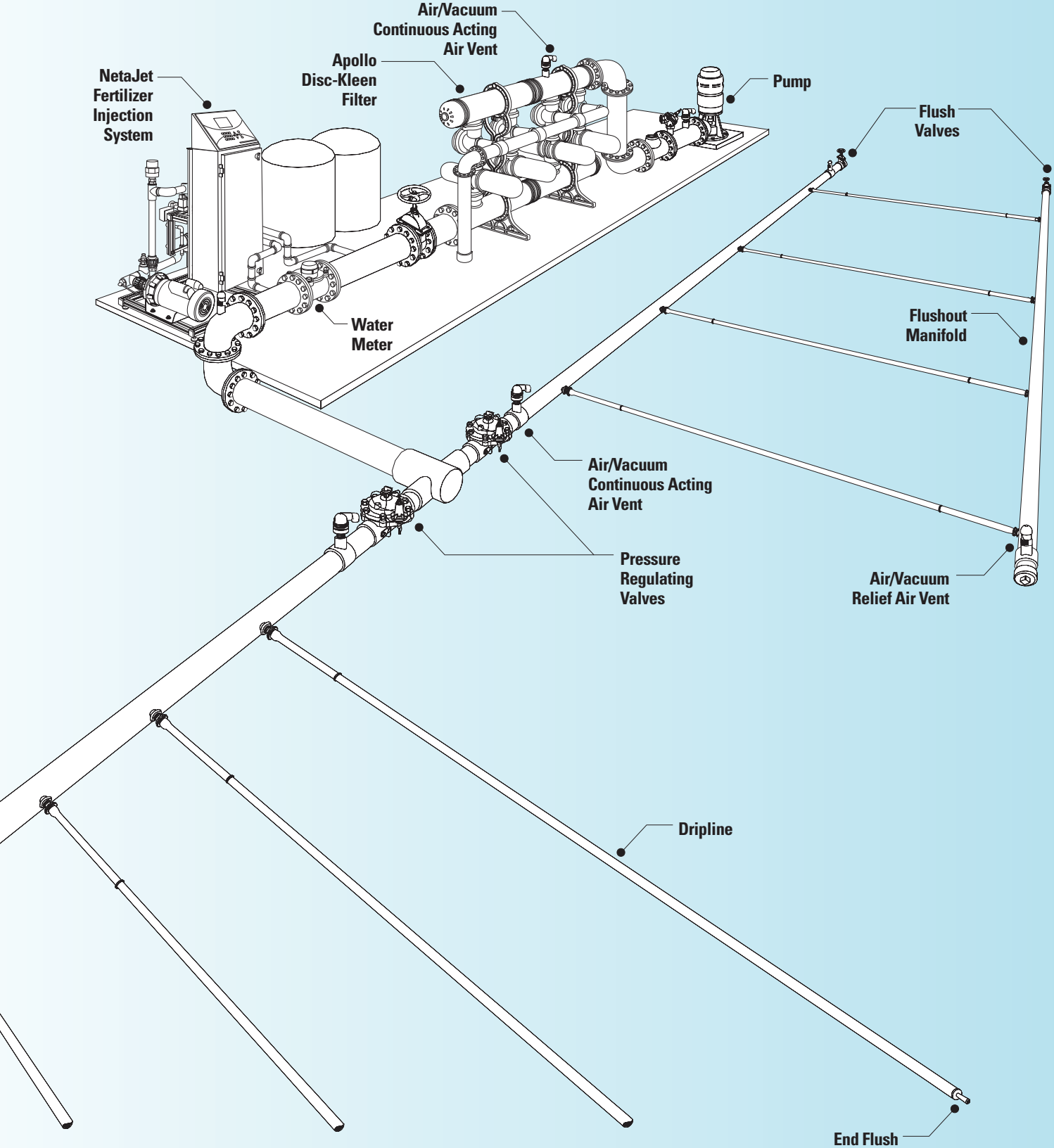
- Measuring irrigation water with a water meter is a more accurate way to deliver water to a crop.
- Water meters monitor system performance and record total water applied.

DRIPLINE LATERALS

- Outlet spacing and flow rates relate directly to the soils ability to take in the water and move it across the bed. The rate of application (inches/hour) will also be affected by these variables.
- Although burial is not necessary for success with drip, it can help protect the tape from mechanical damage, displacement by wind and adverse affects of expansion and contraction due to heat and cold. Typical burial depths vary from between 2 to 12 inches. Burial depth will be determined by cultural practices, plant rooting depth and soil properties. In mulched beds, tape burial may not be necessary.
- Dripline wall thickness will be dependent on the expected life of the dripline network and whether or not the system will be retrieved for re-use.
- Vacuum protection is critical for the prevention of vacuum plugging especially in a buried product.
- Part of successfully managing a drip irrigation system is insuring that the lines remain clean. This is best accomplished through a regular program of flushing. Successfully flushing debris depends upon the speed at which the water moves through the tubing during flushing (called the scouring velocity). The minimum scouring velocity should be between 1 and 1 ½ feet per second.



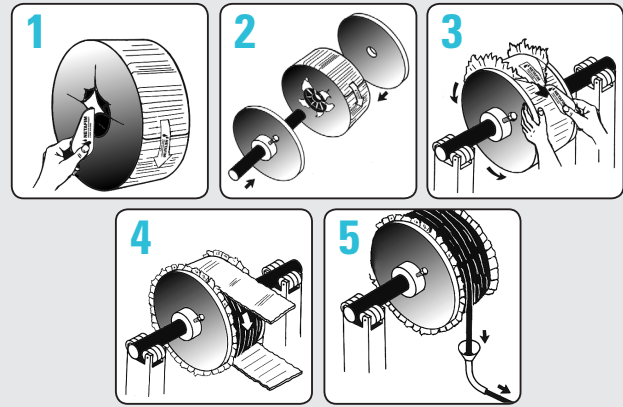
NETAFIM USA DRIP IRRIGATION SYSTEM LAYOUT



INSTALLATION TIPS

GETTING STARTED

Netafim USA driplines are specially packaged, protecting them against moisture and mechanical damage. The driplines should be left on the packing reels until they are mounted for installation. Prior to injection, follow the step-by-step instructions (illustrated to the right). These instructions ensure that the cardboard core and sidewalls of the reel remain dry until injection, particularly if you are operating in wet weather. If you have to stop the procedure due to rain, be sure to cover the open reels to prevent the cardboard from becoming wet.



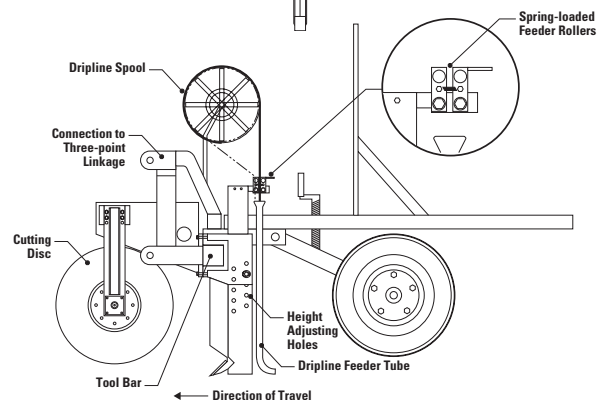
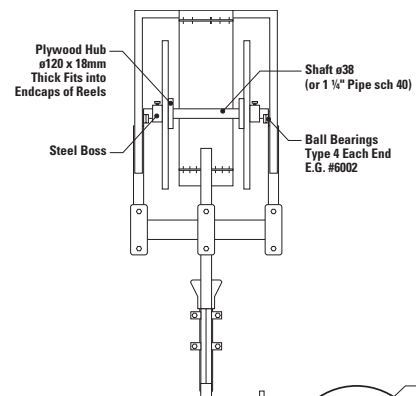
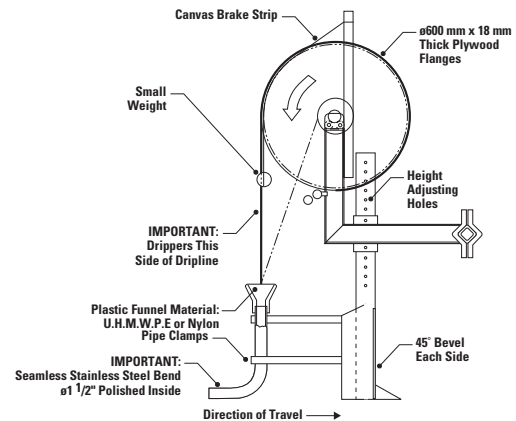
1. Expose the core by cutting away the protective film.
2. Place the roll on the injection machine.
3. Remove the protective film.
4. Remove the cardboard from the spool.
5. Feed the tape into the injection tube.
6. Emitter outlet should be facing upward.

DRIPLINE INJECTION EQUIPMENT

Well designed and properly maintained equipment will ensure trouble-free injection and efficient operation of driplines. It is important to inspect each component of the injection equipment, in particular those parts which come into direct contact with the driplines.

Injection Tube - This curved tube guides the unwinding lateral downward and into the soil. It should be made from seamless stainless steel with no internal nicks or burrs. Some designs incorporate a steel tube with a smooth plastic sleeve. The internal diameter of the injection tube should be $1\frac{1}{2}$ ". The top of the tube should be high enough above the surface of the soil so that there is no chance of earth, stones, or other debris falling into it, as this would cause serious damage to the dripline. A plastic funnel should be fitted to the top of the injection tube. The funnel should be made from durable ultrahigh molecular weight polyethylene or nylon. Both the injection tube and the plastic funnel should be inspected regularly for signs of wear and damage. Stainless steel injection tubes should be polished inside using an electric drill with a flexible hone or circular brushes.

Reel Mounts - Reel mounts should be able to move freely so that the dripline enters the injection tube smoothly. Stretching or pulling can scratch or cut the dripline, causing sand to enter the dripper outlets resulting in start-up clogging. The reel mount should have a breaking mechanism to avoid over-spooling when the tractor stops. If a mechanized lateral feeder is used, it is important that the feeder rollers be made from wear resistant rubber (polyurethane) and that the feeder shafts be spring-loaded. The dripline should not be dragged over sharp corners or rough surfaces as it is fed into the injection tube since this can cause damage. Special care must be taken not to reverse or roll backwards when stopping and starting the tractor. This could cause the dripline to be severed or kinked.



INSTALLING DRIPLINES

The driplines are generally placed under the row of plants. If two rows or more of crops are to be grown the driplines are generally placed between the two rows of plants.

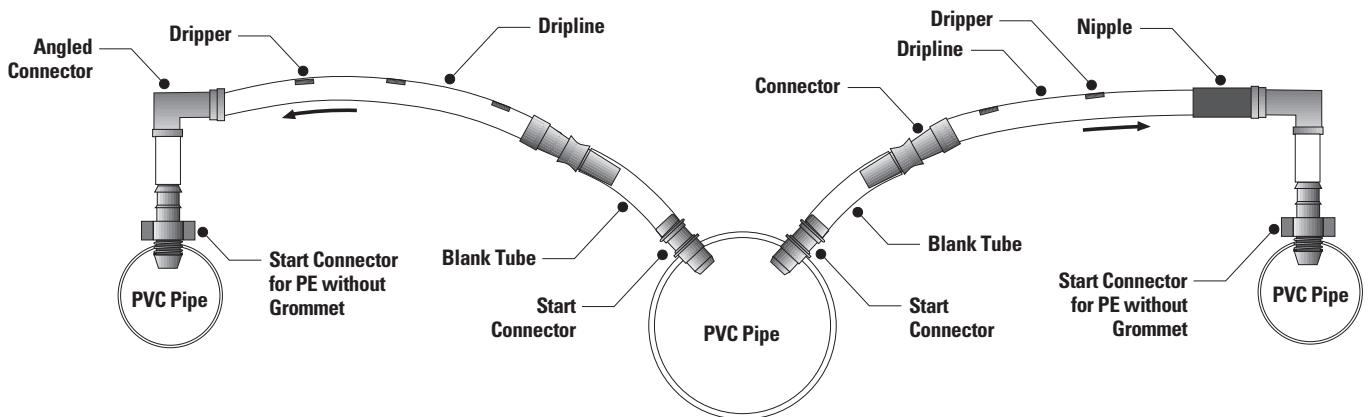
- Drippers should be facing up.
- Adjust the speed of injection to the condition of the field.
- Cancel the load control of the tractor and use depth wheels on the injection feeder in order to maintain a constant depth.

After the dripline is installed, use a trencher to dig in locations where the manifolds and flushouts will be located. Sub-mains and collectors can be laid deeper than driplines to allow for retrieval of tape without disturbing the submains. Vacuum protection is especially critical in these types of applications. After connecting the driplines to the distribution pipes, check that the soil around the

connection point is evenly distributed. Make sure that the air and vacuum outlets are in place and the flushing taps in the collector pipes are open. Water can then be gradually introduced into the system.

Note: Flush only with water which has been through a filtering system. After flushing the driplines and the collectors, the trenches can be covered. This should be done while the system is operating, to prevent distributor pipes from collapsing.

Note: Use recommended Netafim connection fittings. Skimping will save very little money overall and lead to mud puddles, wheel ruts and excessive weed growth near connection points.



SYSTEM START-UP

1. Check and backflush the filter. If you are using a media filter, backflushing is advisable even if it has just been filled with new sand, gravel, etc., since new media tends to be dusty and can cause blockages.
2. If you are using an automatic backflush system, make sure there is sufficient pressure and that the duration of flushing is sufficient for adequate cleaning.
3. Do initial backwashing manually, making sure duration and pressure meet design requirements before running the system automatically.
4. Check the pressure reducing valves, making sure they are adjusted to suit your laterals' recommended working pressure. One common method involves adjusting the valve to the maximum regulating position and then gradually adjusting the pressure up to the desired operating point.
5. For system start-up, fill the system gradually, one sub-main at a time. Open the main and sub-main end points and flush before connecting the driplines.
6. Connect the dripline to the sub-main with the far end of the driplines open. Flush before connection to collector pipes or flushing valves.
7. Once the system is in full operation, check all pressure and flow rates, paying particular attention to the farthest points of the system. Make sure operating specifications are met.
8. Walk through the field checking for damage, leaks or blockages.
9. Set the controller, fertilization pump, etc., and test their operation.

GENERAL MAINTENANCE

Routine maintenance will help extend the life of the system and limit problems. Maintenance should follow a regular schedule and be recorded for later reference.

PUMP AND FILTER STATION INSPECTION

Routinely check flow meter readings. This will reveal many in-field problems as well as provide a cross check of total irrigation applied during a season. Verify correct pressures up and downstream of the filter. Recording pressure differentials across the filter station can help detect any gradual degradation of filter performance. Regular checks of system pressure will help detect problems in the field. Periodically verify correct flows and pressures for each block. Verify that there are no problems with the main filter or precipitate formation downstream by attaching a small filter to a single lateral in the field and checking periodically. Perform any routine maintenance recommended for the filter station.

INJECTION SYSTEM MAINTENANCE

Conduct routine calibration checks. Record the drop in tank levels to verify that the injector is performing correctly. Pay careful attention to maintaining injection components with moving parts. Routinely open and inspect bulk and batch tanks for precipitates and evidence of contamination. Periodically flush tanks with clean water.

DISTRIBUTION SYSTEM INSPECTION AND MAINTENANCE

Perform flushing at the start and end of each irrigation season. Flush mains and manifolds periodically during the season. Flush driplines as needed. Routinely check pressures at field valves in addition to those at the filter station. Routinely dig into random beds after irrigation to verify proper wetting pattern dispersion and to check for potential root intrusion into the dripper outlets. Conduct periodic soil and water sampling to detect chemicals or conditions potentially harmful to crop or system.

CHEMICAL TREATMENTS

Acid Warning! Acids are dangerous. Read all manufacturer's instructions before use and carefully follow all recommended safety instructions.

Acid is used to dissolve scale deposits (carbonates, hydroxides, phosphates, etc.) in the drip system. The use of acid is dependent on water quality and pH levels. Consult an agricultural lab for assistance. Acids are very corrosive to steel, cement and aluminum. Pipes made of polyethylene and PVC are corrosion resistant. Acids such as hydrochloric, sulfuric, nitric and phosphoric are used and available in a range of concentrations. Prior to treatment, thoroughly flush the entire system. Calibrate injection pump before use. Be sure that the injection unit is resistant to acid. Acids are typically injected into the system for a period of 10 to 12 minutes. Following this, continue irrigating with clean water for one hour.

Chlorine Warning! Active chlorine is a dangerous substance. Carefully follow all recommended precautions. Direct contact of chlorine and fertilizer can create an explosive reaction. Extreme caution is required.

Active chlorine is a strong oxidizer, useful for prevention of clogging and sedimentation of organic substances; destroying decomposing sulfur, iron bacteria and bacterial slime; improving filtration efficiency and saving backflush water. Note: Chlorine has no effect on scale deposits. Required chlorine concentrations are dependent on the level of organic activity in the water. A simple pool test kit can be used to detect residual chlorine levels. Several sources for active chlorine exist on the market: liquid chlorine, gaseous chlorine and solid chlorine. Recommended concentrations of active chlorine are injected into the irrigation system during regular operation. The same equipment used for introduction of fertilizers can be used with liquid chlorine (to the extent that the equipment is chlorine tolerant.) Methods of application can be either continuous (low dosage in water) or intermittent (higher dosage in water). The injection point should be as close as possible to the treatment system, since residual chlorine concentration decreases with time and distance from the injection point. The presence of ammonium or urea in the irrigation water reduces chlorinating efficiency and should be prevented as much as possible. Check regulations prior to injecting chemicals. Contact your supplier for assistance.



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