



Flo-Pro™ Injection

Installation & Operating Guide HI Flow Vertical Systems



Underhill International Corporation

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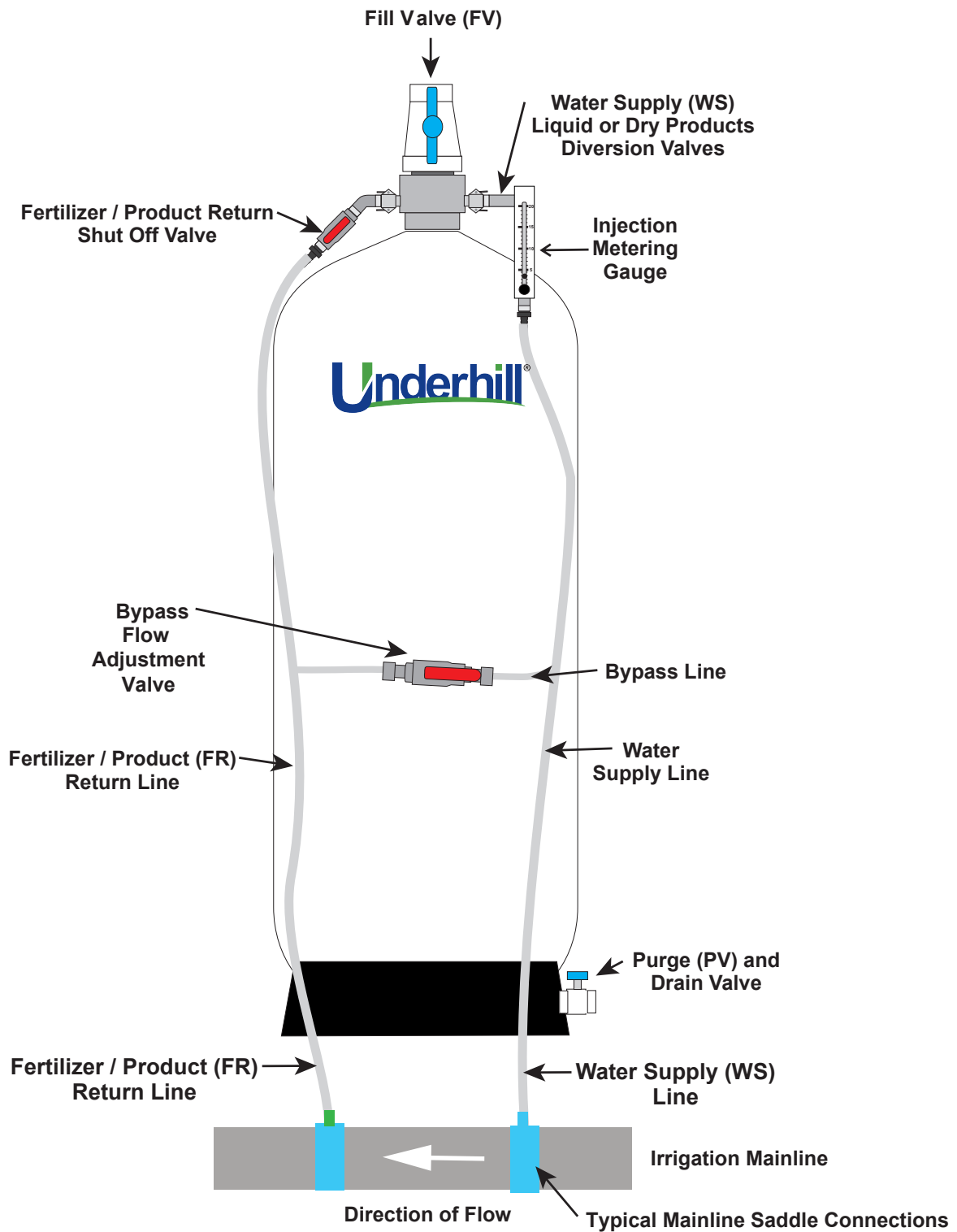
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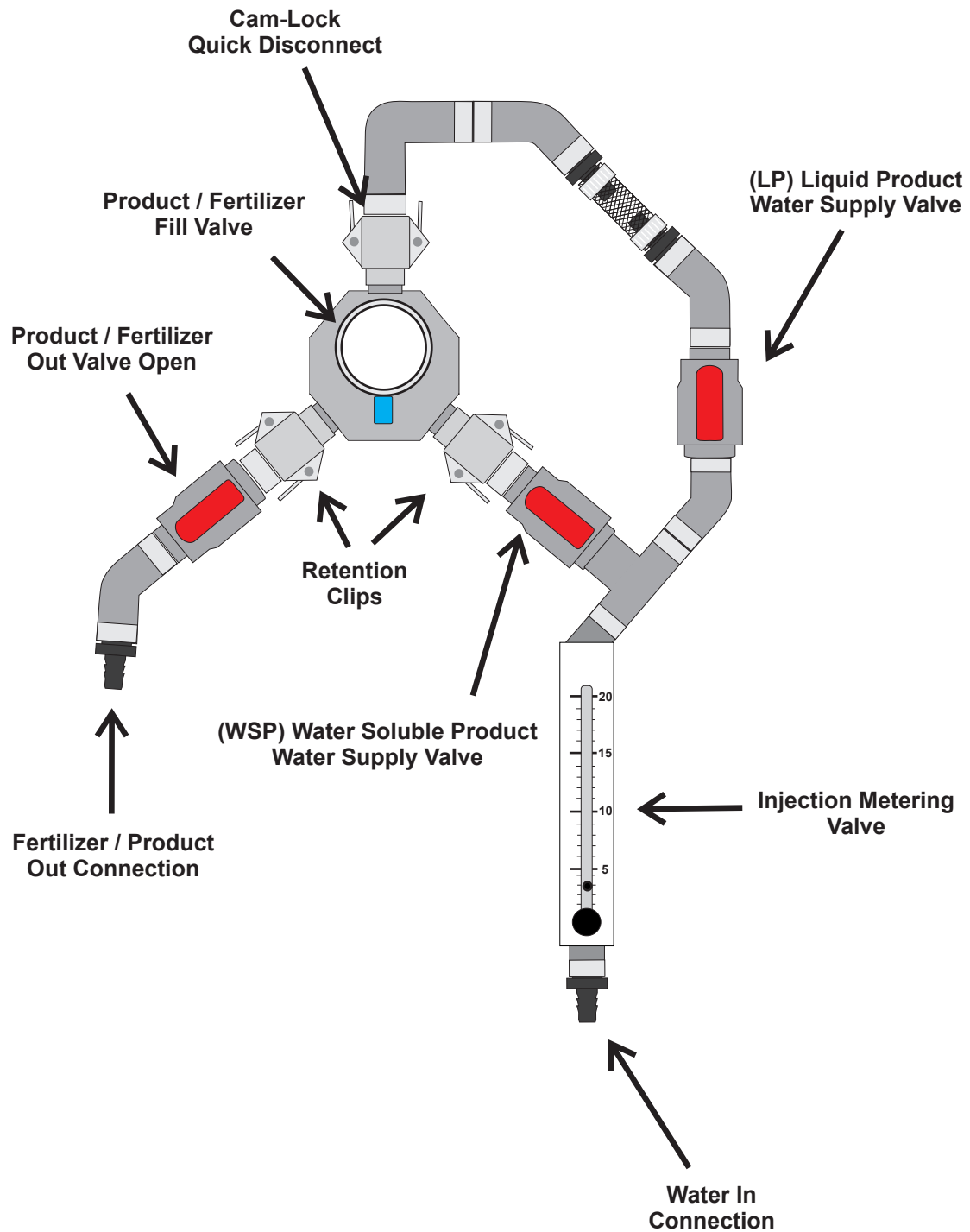
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System Configuration



Metering Head Configuration



Getting Started

Take a few moments and observe the components that represent the Underhill Flo-Pro™ Injector system. Verify all of the components are complete and undamaged before stating the installation.

Review the attached Installation Instructions so you are familiar with the product, its components and operation before starting to install.



Note: When the Hi-Flo Metering Head is attached to the tank, the tank will be pressurized to the same pressure as the irrigation system. Before attaching a tank or another storage device to the irrigation system make sure the tank is capable of safely containing pressure of the irrigation system. Underhill cannot warrant or is responsible for failures of tanks that are not supplied by Underhill.

Recommended Tools

The following table identifies recommended tools needed to complete the Underhill Flo-Pro™ Injector installation.

No.	Description
1	2-3' Carpenter's level
2	Cordless or corded drill motor
3	1-1/4" diameter hole-saw or auger bit suitable for the mainline material
4	Utility knife (to cut tubing)
5	Sockets or open-end wrenches (to tighten saddle bolts)

Locating the Injector Tank

Select the location of where the injector tank is to be located. Selection criteria will depend on the application.

For golf application the injector could be located in the pump house (if sufficient room) or just outside the pump house but before the first sprinkler head.

Depending on the location, you may need to locate and excavate a hole where the mainline pipe can be accessed. You may also want to locate the Injector's saddle connections in a valve box for future access.

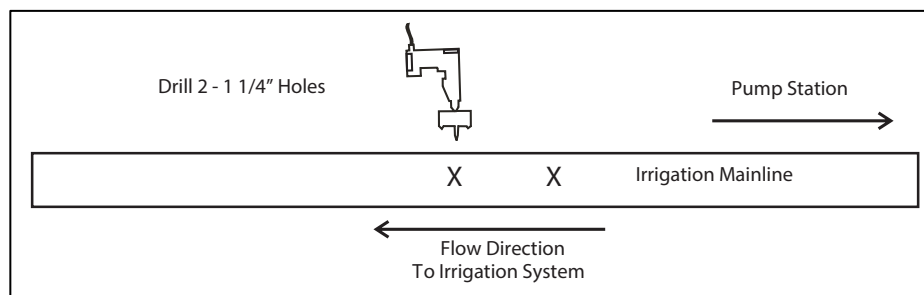


Note: Prior to installation, verify the mainline pipe is not pressurized and is drained. For below grade installations, excavate an area around the mainline to reduce dirt or debris from entering back into the injector connections until the saddles w/ venture probes and tubing have been installed.

Installing Saddle Venturi Connection

1. Once the injector tank is located and the mainline exposed, mark 2 (qty) locations at top dead center on the mainline pipe where the saddles for the Water Supply (**WS**) and Return Line (**LR**) connections will be installed.
2. Verify there is sufficient room for the saddles to attach snugly to the pipe **before** drilling the sidewall of the mainline pipe. Cast iron saddles w/ stainless steel ball valves are available in various sizes to match existing mainline size and material.

Drill 2 (qty), 1-1/4" diameter holes a minimum of 18" apart, in the irrigation mainline near the installation of the injector tank, (see Figure 6-1).



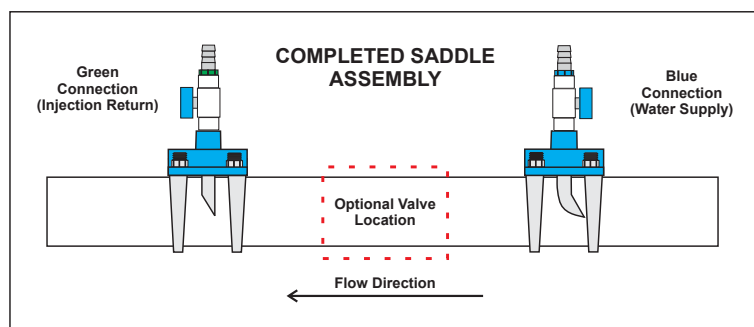
Locating the Injector Connections
Figure 6-1



Note: Drill slowly to prevent pipe fracture. A hole-saw or reaming bit is recommended.

2. Attach the saddle connections to mainline pipe. The blue saddle connection should be installed in the first drilled hole (see Figure 6-2), with the venturi probe opening facing into the water flow.

The green saddle connection should be installed in the second drilled hole in the irrigation mainline with the venturi probe opening facing away from the water flow.



Completed Saddle Assembly
Figure 6-2



Note: Saddle connections can be ordered to mainline pipe sizes 3-4" and 6-16" diameters. Verify the mainline size and appropriate saddle connections **before** drilling.

3. A butterfly valve can be installed for low-flow applications to allow for throttling. This maybe applicable in non-golf applications to increase the differential pressure necessary to operate the system.

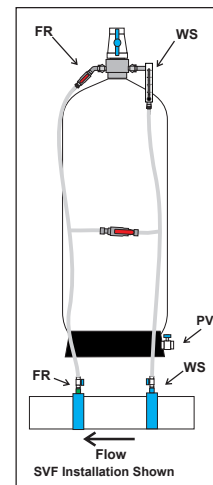
Connecting the Injector to the Irrigation Mainline

1. Connect the tubing between the injector tank and irrigation mainline. Connect the Water Supply (**WS**) tubing to the Water Supply blue connector on the irrigation mainline. Connect the injector Return Line (**RL**) tubing to the green connector on the irrigation mainline pipe. See Figure 7-1.

The connections are color-coded or labeled for easy reference. Secure all tubing connections using the provided tubing clamps. Do not over tighten clamps or stress barbed ends.

Fill the tank from the top fill valve.

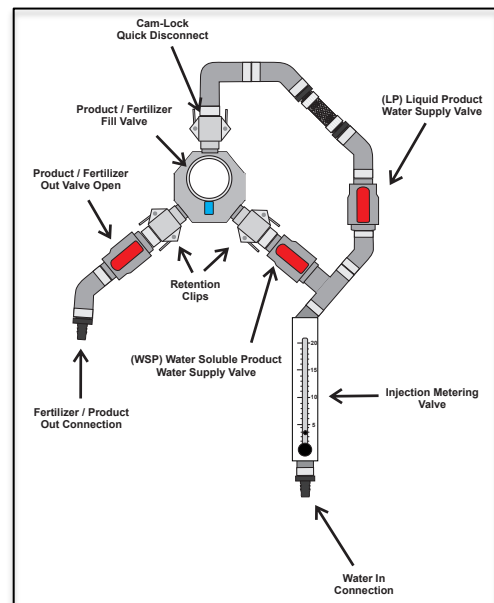
Once the tank is full, turn the ball valve (**RL**) and (**WS**) tubing to the "Closed" position and pressurize the irrigation mainline. Look for any leaks in the connector saddles and/or tubing up to the ball valves and correct as needed.



**Connect System To
Irrigation Mainline
Figure 7-1**

2. There are 2 (qty) water supply options on the metering head, (see Figure 7-2), one is for liquid products and other is for dry, water-soluble powder products. See Step 4 for more detail.

Connect the water supply line based on the type of product you will be injecting. No matter the type of product being injected, the Water Supply (**WS**) always enters through the bottom of the injection metering gauge assembly as shown in Figure 8-2.



**Metering Head
Figure 7-2**

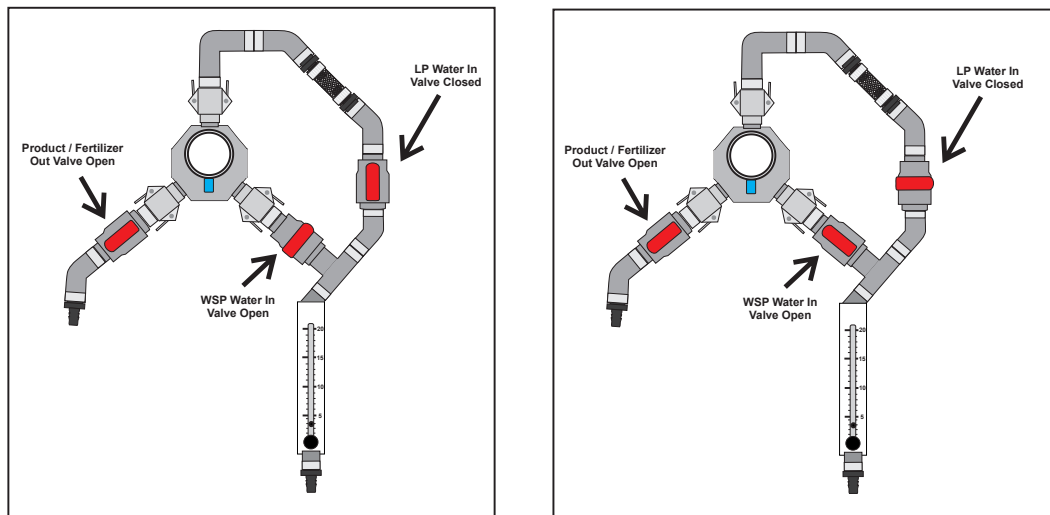
Configuring the Metering Gauge Assembly for Liquid or Dry, Water-Soluble Products

The Flo-Pro™ Injection system provides the option to inject liquid products (LP) or water-soluble powder (WSP) or a combination of both. To change between LP and WSP products different valves should be opened. Figure 8-1 indicates which valves are to be opened depending on the material to be injected.

Disconnect the Injection Metering Gauge Assembly from the Metering Head by removing the assembly at the quick connect closest to the Metering Head and reconnecting it to the desired port.



Note: Orient the metering connections to the blue valve handle for the fill valve, (see Figure 8-1).



Liquid vs. Water-Soluble Metering Head Setup
Figure 8-1

Setting the Injection Rate



Note: Prior to injecting any material particularly for the first time, set the feed rate by filling the tank with water only and some colored food dye so product can be visually confirmed leaving the return line into the irrigation system.



Note: When initially filling the tank, it will stretch and expand for the first few minutes. When the tank has fully expanded, the tank pressure will equalize with the line pressure and the feed rate can be set.

To set the injection rate, start by collecting the following information:

- Amount of irrigated area in acres to be applied with product,
- Length of nightly watering window (6-8 hours),
- The size of the tank being used,
- Recommended application rate of the product to be dispensed in gallons
- The number of gallons that will be dispensed within a watering window.
- Know the capacity of the tank being used;
 - 45-gallon tank – 45 gallons (liquid product), 450 pounds (water soluble product)
 - 86-gallon tank – 86 gallons (liquid product), 860 pounds (water soluble product)



Note: Normally injection rates are set once to dispense product over three to five days. Longer dispensing times improve coverage rates and nutrient uptake.

Liquid Products – Note: Any amount of liquid product can be added to the system up to the total amount of the tank's capacity. If adding less than the full tank capacity, mix the solution with water. If filling a 45 gallon tank completely, then 45-gallon mix that will be injected at the rate shown on the metering gauge.

For example: If the irrigation schedule is for 6 hours per day, the desired dispensing time is 3 days and the system has a 45-gallon capacity, set the meter to 2.5 gallons per hour. At this rate 45 gallons of product will dispense in 18 hours. **45 gallons ÷ 18 hours of injection time = 2.5 gallons per hour.**

Dry water-soluble products- Note: Approximately two pounds of water-soluble product is delivered in each gallon of the injected mix and the system will hold up to 10 pounds of dry product for every gallon of capacity.

For example: If the irrigation schedule is 6 hours per day, the desired dispensing time is 3 days, with a system having a 45-gallon capacity and 450 pounds of dry product has been added to the tank, set the meter to 12.5 gallons per hour. At this rate 450 pounds of dry product will dispense in 18 hours. **450 pounds ÷ 2 pounds per gallon = 225 gallons to be injected ÷ 18 hours of injection time = 12.5 gallons per hour.**

If you have the same conditions but only want to put 100 pounds of dry products in the system, set the meter to 2.75 gallons per hour. **100 pounds ÷ 2 pounds per gallon = 50 gallons to be injected ÷ 18 hours of irrigation time = 2.75 gallons per hour.**

Once the injection rate has been properly set and visually confirmed it is feeding into the irrigation system, the tank can be filled with injectable material.



Note: If the metering float fails to return to the set feed rate and steadily drops, then see page 14 for calibration using the Bypass Flow Adjustment Valve.

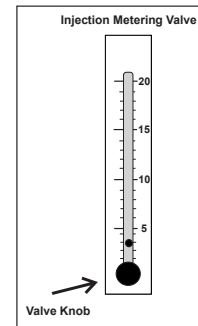
Confirm the following steps prior to setting the injection rate;

1. Insure the mainline is pressurized
2. Open all appropriate incoming and outgoing valves

3. Slowly open the injector metering valve by turning the knob to the left (counter-clockwise). The gauge will register the amount of water entering the tank until its completely pressurized. Water for the meter to drop to zero before setting the metering rate
4. Turn on the irrigation system and operate a head or series of heads that will represent the average flow rate.
5. Rotate the knob on the metering head to the left (counter-clockwise) until the desired gallons per hour or gallons per minute is achieved.



Note: If the gauge will not reach the desired injection rate you may need to calibrate your connection using the By-pass valve.



Turn Knob to Select Injection Rate
Figure 11-1

Filling the Tank with Product

The injector tank can be filled with any liquid or water-soluble product in concentrated form. Pre-mixing or pre-dilution is not required. For dry, water-soluble products it may be easier to pour by adding water to create a slurry mixture.

Before filling, close and open the valves in the following order:

1. Close the Return Line (**RL**) and Water Supply (**WS**) valves (see figure 10-1).
2. Open the Air Vent Valve (**AVV**) to exhaust pressure.

For re-filling,

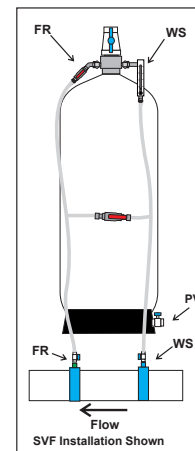
1. Open the Drain Valve (**DV**) to drain water from the system.
2. When the tank is completely drained, close the Drain Valve (**DV**).
3. Open Fill Valve (**FV**).

To fill with dry, water-soluble products:

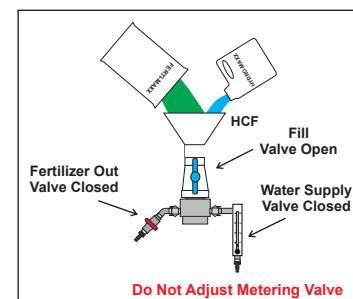
Pre-mixing is not required. For convenience, water can be added to the product to create an easy-to-pour slurry mixture.



Note: Make sure the system is set-up to inject dry, water-soluble product before starting. To do this, connect the Water Supply Gauge Assembly to the water in the dry products connection. Refer to Figure 8-1.



Fill Injector Tank
Figure 10-1



Water Soluble & Liquid Materials
Figure 10-2



Note: Consider adding anti-foaming material when injecting wetting agents.

1. Connect the High Capacity Funnel (**HCF**) to the Fill Valve (**FV**), (see Figure 10-2).
2. Pour the product directly into the High Capacity Funnel (**HCF**).
3. Fill the remainder of the tank with water.

To fill with liquid products:

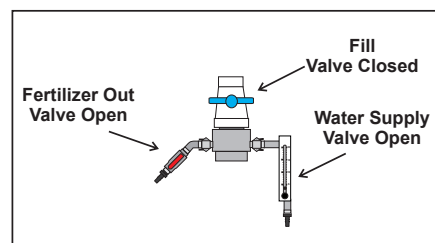


Note: Make sure the system is setup to inject liquid products. To do this, see Step 4, Figure 7-1.

1. Attach the High Capacity Funnel (**HCF**) or fill hose from the product storage tank to Fill Valve (**FV**).
2. Fill the remainder of the tank with water.

After Filling The Tank

1. To get system ready to inject material, open and close the ball valves in this order:
 - Close Fill Valve (**FV**).
 - Open the Return Line (**RL**) and Water Supply (**WS**) valves.



After Filling
Figure 10-2

2. Set System Feed Rate. With the irrigation system operating:
 - Open fill valve at the top of the tank so air can vent.
 - Open the Meter Valve (**MV**) to allow water to flow into the tank. The metering float will register maximum flow of water and tank pressure is equal to line pressure.



Note: On the initial fill, the tank will stretch and expand for the first few minutes. When the tank has fully expanded the tank pressure will equalize with the line pressure and the feed rate can be set.

3. The meter registers gallons per hour being injected. This reading will change as the flow rate of the irrigation system changes. To accurately set the feed rate, set it when the irrigation system is running at its normal operating GPM.

How to Apply Underhill's Hydro-Wet® Injectable Wetting Agent - Example

The following table and calculations represent a sample of how one would apply Underhill's Hydro-Wet® Injectable Wetting Agent using a Flo-Pro Tank Injection system.

To set the Metering Head, confirm the following information:

No.	Req' Info	Description
1	Verify	Confirm the Flo-Pro's metering head is configured for "liquid" product application. See Step 4, Figure 7-1
2	24 Oz per acre	Determine Hydro-Wet's Injectable application rate from product label. Rate varies, based on your need.
3	100 acres	Determine the amount of irrigated area in acres to be injected (this is an example)
4	8 hours	What is the length of a typical watering window for the entire course during one night's scheduled irrigation (this is an example)
5	2 nights	Determine how many nights product is to be injected. (Typically over a 2-3 night period is considered to be more effective, again this is an example)
6	45 Gal	What size Flo-Pro tank is being used?



Calculations:

1. What is the recommended application rate of Hydro-Wet Injectable wetting agent in gallons?

Hydro-Wet Injectable Wetting Agent is to be applied at 24 oz. per acre as an example. $24 \text{ ounces} \times 100 \text{ acres} = 2400 \text{ ounces}$. There are 128 ounces per gallon. $2400 \div 128 = 18.75$ or roughly 19 gallons of Hydro-Wet Injectable is the recommended application rate for 100 acres.

2. How many gallons of product will be dispensed within a watering window?

The Flo-Pro tank being used is a 45 gallons \div 8 hours of scheduled irrigation per night = 5.625 gallons dispensed per hour. Round this number to 6 gallons per hour. In this example product is being applied over a 2-night period. $6 \text{ gallons per hour} \div 2 \text{ nights}$ is 3 gallons per hour. The feed rate on the Flo-Pro tank should be set to 3 gallons per hour.

Typical Questions

- 1) *Can I fill the tank with 19 gallons of Hydro-Wet Injectable Wetting Agent knowing it will dispense this product over the next two nights if the feed rate is set to 3 gallons per hour?*

Yes, the product will be dispensed at the feed rate calculated and set. Any remaining product will simply be injected during the next night's scheduled irrigation.

- 2) *If I only need to apply 19 gallons of product but I have a 45-gallon tank what should I do?*

Fill the remainder of the tank with water.

- 3) *Does setting a lower metering rate dilute the effectiveness of the application?*

If you calculated feeding the entire course in one night, at a rate of 6 gallons per hour, but then decide to inject over two nights, at 3 gallons per hour, the feed rate is simply slower and not diluted more. As a matter of fact, applying over a 2-3-night period is more effective.

- 4) *What if I only want to apply Hydro-Wet Injectable to the tees and greens?*

Then calculate the amount of irrigated area for both tees and greens in square feet and then convert to acres. For example if you have 10,000 square feet of tees and greens then divide this by 43,560 which is the number of square feet per acre. $43,560 \text{ square feet per acre} \div 10,000 \text{ square feet} = 4.36 \text{ acres}$. Then schedule the controller programming for that night's irrigation to only irrigate tees and greens. Set the feed rate based on the number of nights of application. This may require the Water Supply (**WS**) to be shut-off one night if fairways and roughs are to be irrigated the following night.

- 5) *How does the venturi system work?*

The reduction of fluid pressure when water flows through a restricted area, for example through the Water Supply (**WS**) injector, it pulls water into the Flo-Pro tank. The pressure differential then pulls the material in the tank back into the irrigation system. This process does not require any moving parts or a pump for this to occur.

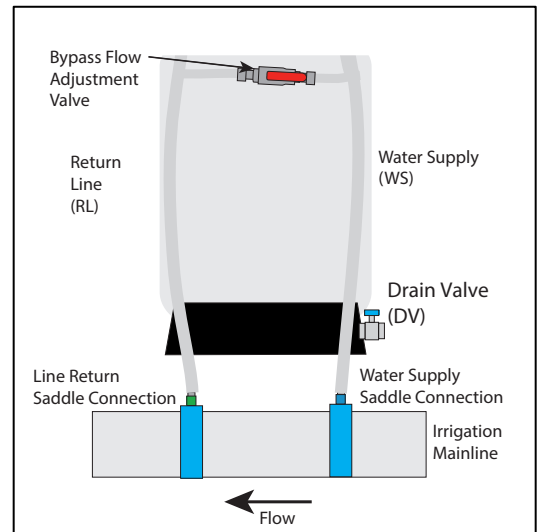
HI-FLO Bypass Operation (Adjustment)

Typically the HI-FLO systems will operate perfectly fine without the use of the bypass/ venturi Bypass Flow Adjustment Valve, but if injecting into flow streams above 120 GPM, valve adjustment may be required. To properly calibrate and adjust:



Note: This calibration is to be accomplished with the Bypass Flow Adjustment Valve and not the feed rate setting.

1. Make sure the tank is completely filled so no air is present.
 - a. Allow an excess in the tank to vent by opening the Air Vent Vacuum Valve (**AVV**).
2. Start with the Bypass Flow Adjustment Valve in the “Closed” position, (see Figure 12-1).
 - a. Allow the irrigation system to reach maximum flow by scheduling a typical irrigation program. This should represent the largest number of sprinklers operating at one time.
 - b. The key is to calibrate the bypass valve at the maximum flow rate (maximum number of heads operating at one time), so the appropriate amount of bypass is attained. If there is insufficient bypass, the system has the potential to stop injecting at higher flow rates. If there is too much bypass, the system may not be able to inject enough product at the required feed rate.
3. Once the mainline is operating at full flow, set the flow meter to the desired feed rate
 - a. **Do not** adjust the Bypass Flow Adjustment Valve yet, as it should remain in the “Closed” position.
4. Observe the metering float and its ability to maintain the set level for a period of 2-3 minutes.
 - a. The metering float will bounce due to fluctuations in pressure but will quickly recover to the selected setting. This is normal operation.
 - b. Continue to monitor and verify the metering float is returning to the appropriate feed rate level and not steadily dropping.
5. If the metering float continues to return to the appropriate level and the irrigation system is operating at full flow, no adjustment needs to be made to the Bypass Flow Adjustment Valve.
6. While monitoring, if the metering float fails to return to the appropriate feed rate level and steadily drops to lower levels, the bypass valve will need to be opened.
 - a. When the metering float steadily drops, increase the observation time to 5 minutes to insure it does not recover.
7. To adjust the Bypass Flow Adjustment Valve, simply open to the full position



Bypass Valve
Figure 12-1

- a. This will instantly relieve any turbulence and the metering float will go past the desired feed rate.
8. Once in the full position, slowly close the Bypass Flow Adjustment Valve until the float begins to fall again.
 - a. Once the metering float falls, adjust the Bypass Flow Adjustment Valve slightly towards the open position until the metering float maintains its set level.
9. After the metering float is stabilized, observe operation for 3-5 minutes and insure the Bypass Flow Adjustment valve is appropriately set.
10. Now the metering float may be set to the desired feed rate.

The bypass valve is now calibrated and it is recommended the handle be removed and set aside to avoid any future tampering. If the bypass valve is ever accidentally adjusted, the above steps must be repeated.



Special Notation – If the bypass valve is too far open, the system will lose its ability to inject at higher rates at the desired feed rate. Depending on the desired level of injection, this may not be an issue. When the bypass valve is too far closed, the injection may suddenly stop.