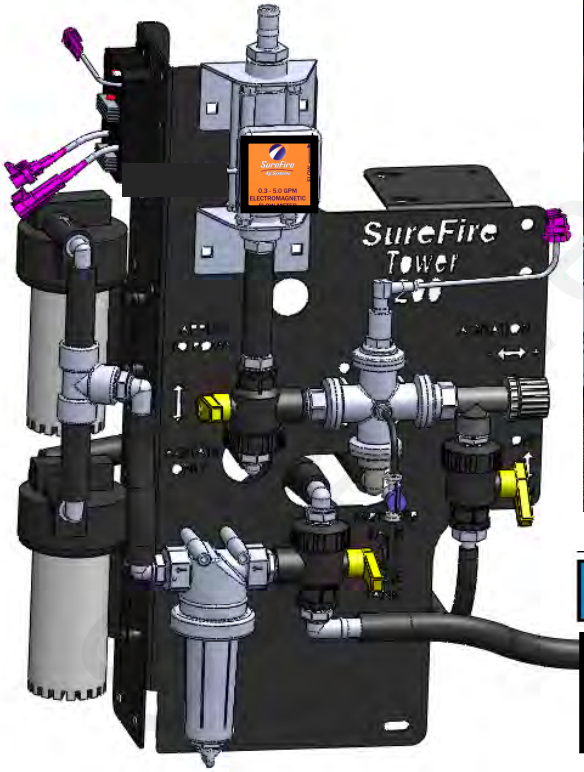
396-4954Y1

Tower Electric Pump
&

SureFire Sentinel Rate Control

With PWM Control

Sentinel Instructional Videos
Scan or click



NOTICE

Operator should read this manual before operating the system.

Maximum Application Rates with Two 5.3 GPM Electric Pumps

Maximum Application Rates in GPA on 30" Rows at 6 MPH (no agitation)				
Rows	8	12	16	24
Max GPA	20	12	9	5

See the Sentinel Manual, 396-4035Y1, for harness layouts, system setup, module addressing and more about operating the Sentinel Rate Control system.

Scan or click the QR Code to go to the Sentinel Instructional Videos Playlist on YouTube.

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Safety

A

TAKE NOTE! THIS SAFETY ALERT SYMBOL FOUND THROUGHOUT THIS MANUAL IS USED TO CALL YOUR ATTENTION TO INSTRUCTIONS INVOLVING YOUR PERSONAL SAFETY AND THE SAFETY OF OTHERS. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN INJURY OR DEATH.

THIS SYMBOL MEANS ATTENTION!

BECOME ALERT!

YOUR SAFETY IS INVOLVED!

Note the use of the signal words DANGER, WARNING and CAUTION with the safety messages. The appropriate signal word for each has been selected using the following guidelines:

DANGER: Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations typically for machine components which, for functional purposes, cannot be guarded.

WARNING: Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury, and includes hazards that are exposed when guards are removed. It may also be used to alert against unsafe practices.

CAUTION: Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE is used to address safety practices not related to personal safety.

Hydraulic Fluid and Equipment Safety

If your system uses hydraulic equipment with hydraulic fluid under extremely high pressure, please note:

Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin causing serious injury. Keep all hoses and connections in good serviceable condition. Failure to heed may result in serious personal injury or death. Avoid the hazard by relieving the pressure before disconnecting lines or performing work on the system.

Make sure hydraulic fluid connections are tight and all hydraulic hoses and lines are in good condition before applying pressure to the system. Use a piece of paper or cardboard, NOT BODY PARTS, to check for suspected leaks. Wear protective gloves and safety glasses or goggles when working with hydraulic systems. DO NOT DELAY!

Check hydraulic hoses and fittings frequently. Loose, broken, and missing hardware can cause equipment to not perform properly and can result in serious injury or death.
Hydraulic systems can be hot and cause burns. Before working on any system, wait until the fluid has cooled.

If an accident occurs, see a doctor familiar with this type of injury immediately. Any fluid injected into the skin or eyes must be treated within a few hours or gangrene may result.

A Word to the Operator

It is YOUR responsibility to read and understand the safety messages in this manual. YOU are the key to safety.
SAFETY IS YOUR RESPONSIBILITY.

This system may apply many different kinds of agricultural liquid products. Read and follow all label information and instructions related to the handling, storage, and application of the product you are using.

All electrical harnessing should be checked regularly and should be routed and secured so it will not be pinched, cut, or stretched.

General Description

A
Introduction

You have purchased a SureFire fertilizer system for your equipment. This system will be controlled by your SureFire Sentinel ECU Rate Controller via your ISO VT display. The Rate Controller will adjust the speed of the SureFire PumpRight hydraulic pump based on feedback from the flowmeter and vehicle speed. The system is capable of using section control or prescription rates in conjunction with Task Control on your display to minimize overlap areas with optional section valves or to do variable rate application.

See the Sentinel Manual, 396-4035Y1, for harness layouts, system setup, module addressing and more about operating the Sentinel Rate Control system.

Basic Installation Steps

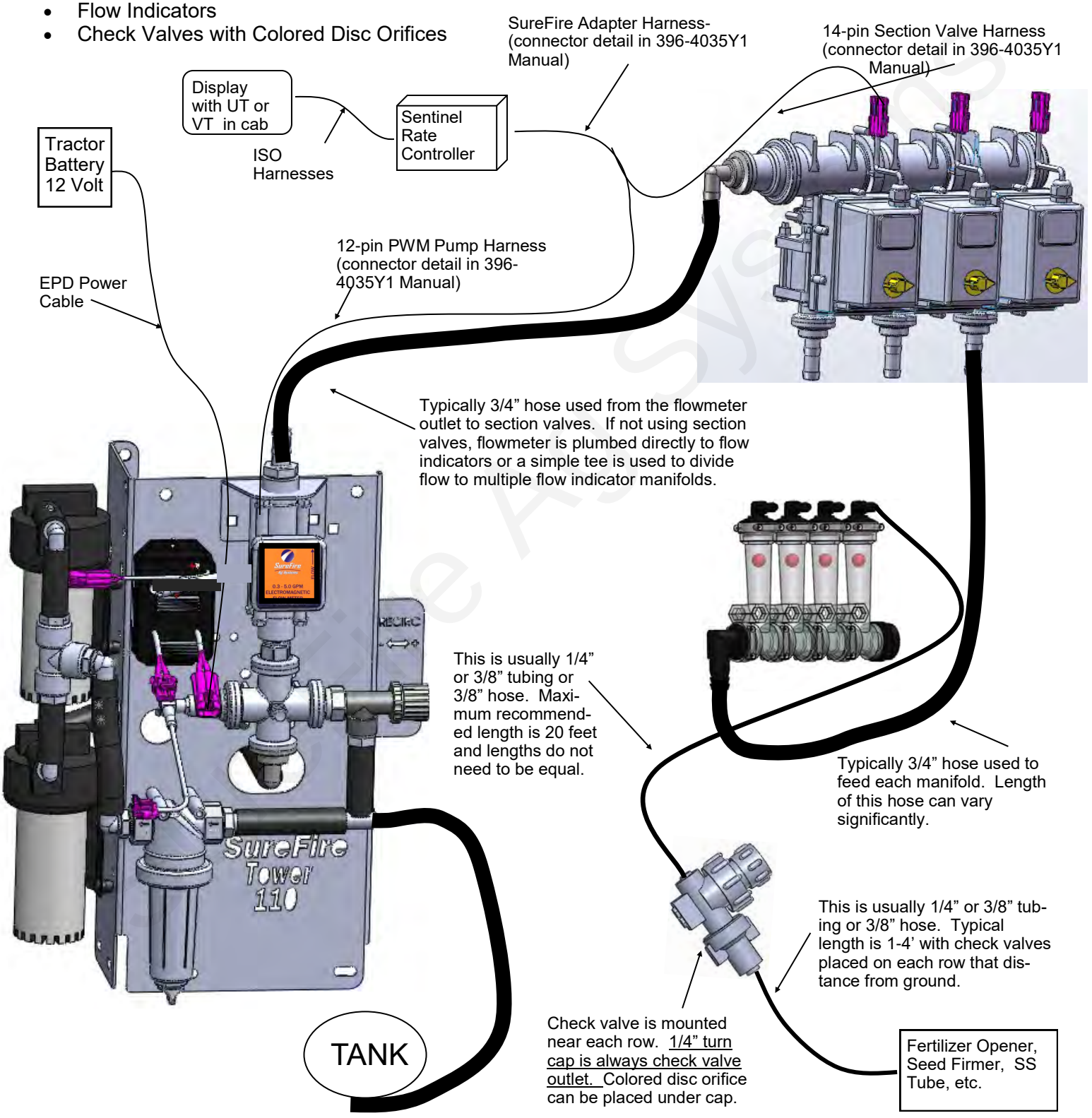
1. Mount the Sentinel ECU in a secure, convenient location.
2. Open the packages and familiarize yourself with the components. See the System Overview Examples on the following pages to see the big picture of how SureFire Fertilizer Systems are installed. Refer to manual sections B & D for component information.
3. Mount the Tower or Accelerator Tank on your equipment. Electric pumps should be located close to the tanks. They will push the product a long distance, but are not as good at pulling product a long distance.
4. Plumb the tank to the Tower inlet. See section E for details.
5. Install the plumbing kit including section valves, flow indicator columns / manifolds, check valves, plumbing to each row unit delivery point. See section B for information on these components.
6. Attach the flowmeter outlet to section valve or manifold inlet. Attach section valve outlets to flow indicator inlets.
7. Attach harnesses as shown in the Sentinel Manual, 396-4035Y1.
8. Set up Controller for SureFire fertilizer system as shown in the Sentinel Manual, 396-4035Y1.
9. Fill system with water, conduct initial operation and tests per the Sentinel Manual, 396-4035Y1.
10. Winterize system with RV Antifreeze if freezing temperatures are expected.
11. Do pre-season service each year as described on page 49.

System Overview - Example 1

A
Introduction

The following gives an example of a complete SureFire Fertilizer system with these components:

- Display with UT or VT and Task Control
- Sentinel ECU Module
- Tower 110
- Section Valves
- Flow Indicators
- Check Valves with Colored Disc Orifices

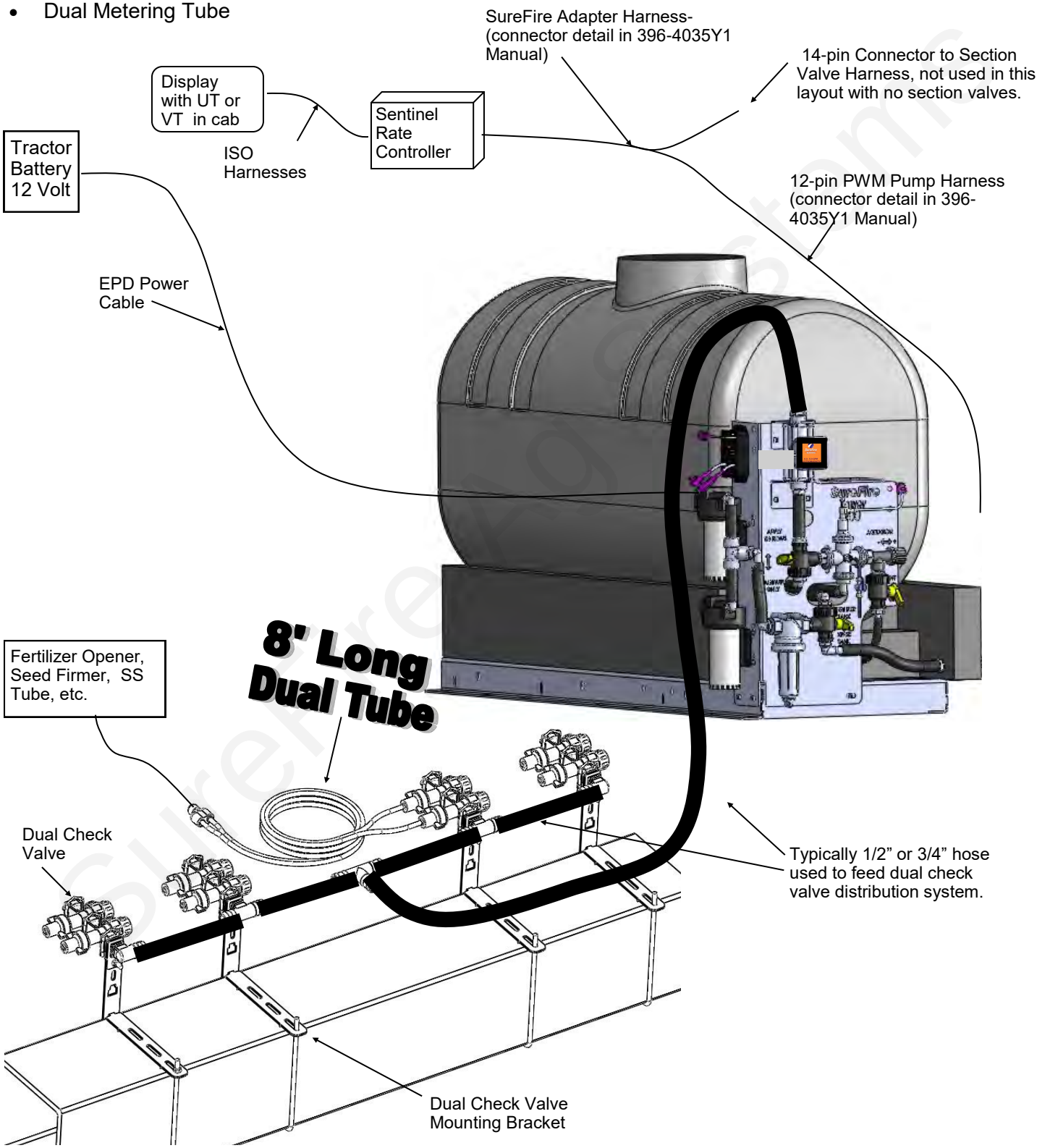


System Overview - Example 2

A
Introduction

The following gives an example of a complete SureFire Fertilizer system with these components:

- Display with UT or VT and Task Control
- Sentinel ECU Module
- Accelerator with Tower 200
- Dual Check Valve Distribution System
- Dual Metering Tube



Electromagnetic Flowmeter Kits

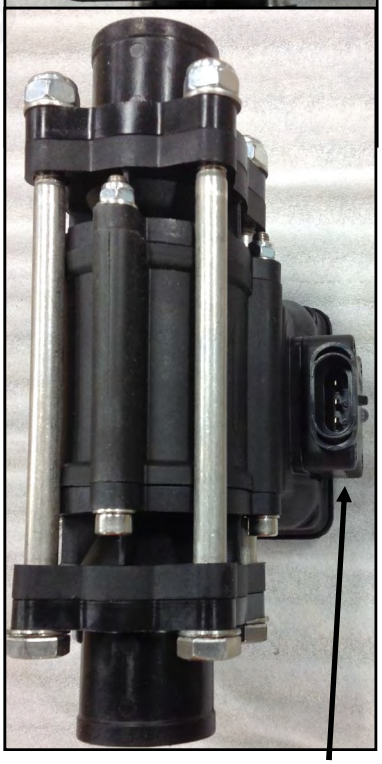
		Flowmeter Only
0.13 - 2.6 GPM	**Item Number 500-02-2040**	**204-01-46211CUF00**
0.3 - 5.0 GPM	**Item Number 500-02-2050**	**204-01-46211CUF01**
0.08 - 1.6 GPM	**—-**	**204-01-46211CUF05**

Kits include flowmeter, mounting bracket, hose barb fittings & hose clamps.

B
Components
Liquid

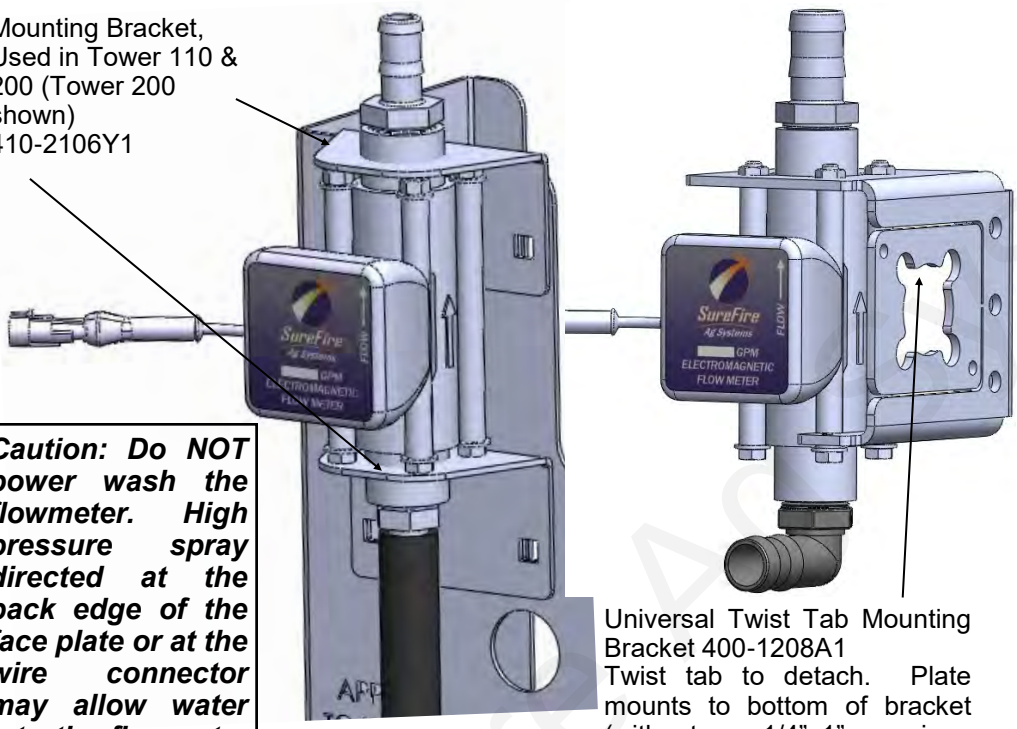
Before doing any arc welding on the implement, unplug the cable to the flowmeter, or damage to the flowmeter may result.

New Look in 2017—Black body with orange label. Same accurate, reliable electromagnetic technology.
3-pin Amp SuperSeal connector is sealed to flowmeter body for tighter, cleaner connection.



Amp SuperSeal 3-pin connector

Mounting Bracket,
Used in Tower 110 & 200 (Tower 200 shown)
410-2106Y1



Caution: Do NOT power wash the flowmeter. High pressure spray directed at the back edge of the face plate or at the wire connector may allow water into the flowmeter electronics.

Universal Twist Tab Mounting Bracket 400-1208A1
Twist tab to detach. Plate mounts to bottom of bracket (with two 1/4"x1" carriage bolts) to capture flowmeter.

Electromagnetic flowmeters are superior to traditional turbine flowmeters in two basic ways. First, they have no moving parts. This translates into no wear items or potential for contaminants to jam a spinning turbine.
Second, electromagnetic flowmeters detect the flow by electrically measuring the velocity of the liquid, which makes them independent of viscosity or density of the fluid measured. They are extremely accurate using the standard calibration number.
SureFire still recommends you perform a catch test to verify the system is properly installed and configured.

Flowmeter Model (orange label or blue label)	Pulses/Gal	FPT Size	Hose Barb In kit
0.13 - 2.6 GPM	3000	3/4"	3/4"
0.3 - 5.0 GPM	3000	3/4"	3/4"
0.08-1.6 GPM	22710	3/4"	3/4"

Use adapter 201-17842 to connect to 3-pin MP harness

Serial number label on side also shows pulses per gallon.

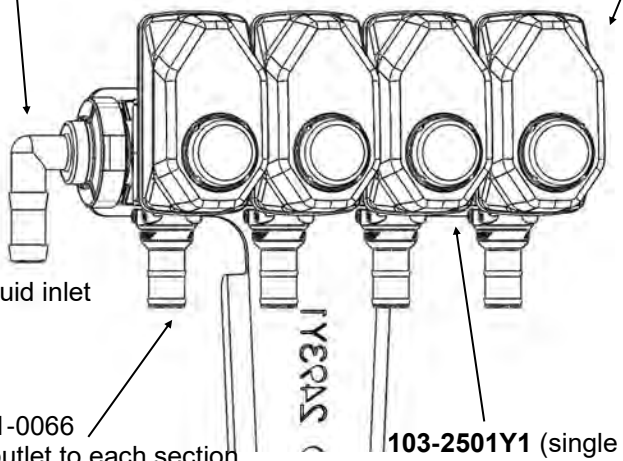
The flowmeters will accurately read higher than the rated range.
Earlier model flowmeters (meters with white labels with black text) have different calibration numbers. The flow cal number (pulses per gallon) is printed on the serial number sticker on the side of the flowmeter.

Section Valves

105-100075BRB90

105-100PLG (alternate
105-100PLG025 includes 1/4" pipe thread for gauge)

Note: Ensure back-side port is capped prior to use



Liquid inlet

117-211-0066
Liquid outlet to each section

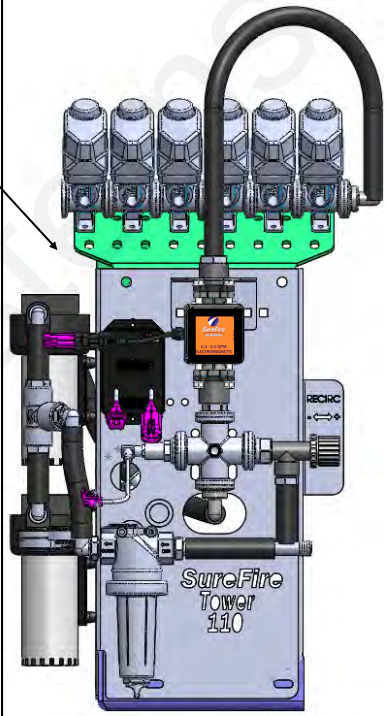
103-2501Y1 (single complete valve)
KZ Electric TX2 Series, 1 ball valve

Additional Parts:

1" Gasket	105-100G-H
1" Clamp	105-FC100

If valve indicator stays GREEN all the time or if valve indicator is not in full ON or full OFF position, replace actuator. Pull gray pin to remove actuator from valve.

Tower 110 Section Valve Bracket
Item Number 410-2110Y2



The Tower 110 can have up to 6 section valves mounted directly to the top of it with this bracket.

This is a 3-way valve. If product will not flow when valve is ON, either move the outlet hose to the other port, or remove actuator and rotate valve ball 180º, and replace actuator.

How it Works

Section valves can be assembled into groups with a common inlet to control flow to each section. Common assemblies use up to 5-6 valves, however, more can be used where practical. Many alternate fittings can be used to accommodate different hose sizes and configurations.

The valves have a 3-pin weather pack electrical connector. This has a power, ground, and switched signal wire. The power measured to ground should have 12 volts when the controller is on. The switched signal wire will have 12 volts to turn the valve on, and 0 volts to turn the valve off.

Wiring Connector:
Pin A—Red, 12 Volts +
Pin B—Black, Ground -
Pin C—White, Signal
12V=on ; 0V=off

Mounting Hardware:

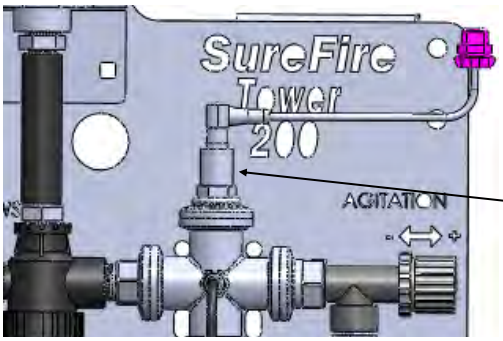
2 Valve Bolt Kit	384-1100
Mounting Bracket	400-2493Y1

Pressure Sensor

The Tower 110 and 200 come equipped with a 100 psi (0 to 5 volt) pressure sensor to work with the Sentinel controller. This sensor is a 3 wire type sensor. It has a 1/4" MPT fitting.

The display will show the system pressure on the screen. **The pressure reading is only for informational purposes and is NOT used in the flow control process, but it is very helpful to understanding system performance and in troubleshooting.** Flow control uses the flowmeter feedback only.

If the sensor, check for 12 v power at the connector. Look for a green LED light at the end of the sensor (can be hard to see in the light). Check harnessing by using a AA or AAA battery and connecting Pin A of the Pressure connector to the (+) end of the battery, and Pin C to the (-) end of the battery. It should show 30 PSI on the screen.

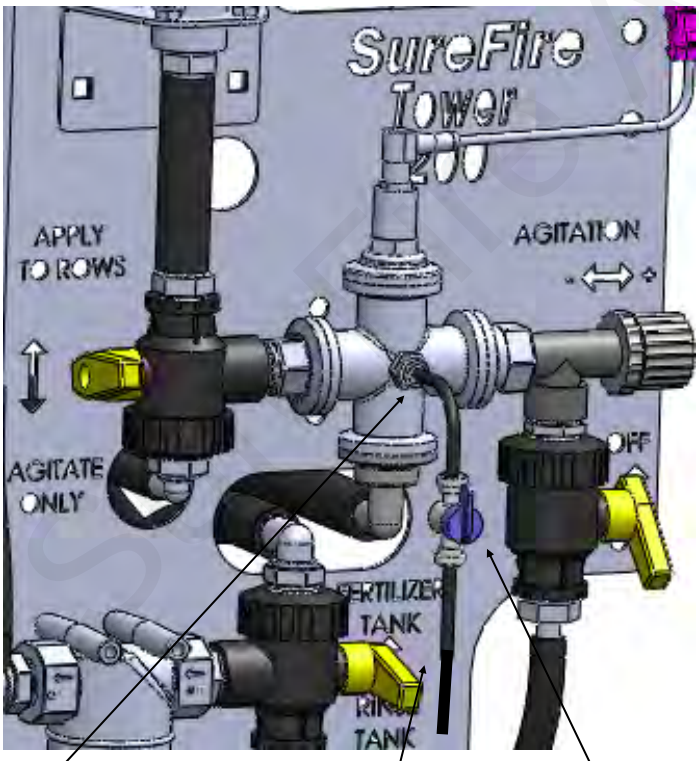


Pressure Sensor (3-wire type) with harness
521-05-050150

100 PSI - 0 to 5 volt
50 mv/psi

Pump Priming and Air Bleed Valve

An air bleed valve is included with each pump to aid in system priming. It is shipped in the pump accessories bag and *must be installed during system installation*.



Shipped from factory with plug installed.

1/4" Tubing

1/4" **air bleed valve**

Why use an air bleed valve:
Most fertilizer systems are equipped with a 4 lb. or 10 lb. check valve on the end of each hose delivering fertilizer to the ground. These valves do not let air escape from the system, unless it is pressurized. 12 volt liquid pumps are not good air compressors. Therefore, the pump can struggle to prime due to air trapped on the outlet side of the pump.

The air bleed valve is a small 1/4" valve that when opened lets air escape from the pump outlet at zero pressure. ***To prime the pump, open until liquid comes out and then close the valve.***

How to install the air bleed valve:
Remove the 1/4" plug from the quick connect fitting on the center cross on the Tower (see picture). Next, insert the 1/4" tubing in the quick connect fitting. Run the 1/4" tubing to an easily accessible spot on your equipment. Next, cut the tubing and push the 1/4" valve onto the tubing. Finally, run the tubing to a low location where any fertilizer that escapes will run on the ground.

Be sure the air bleed valve tube does not become plugged with dirt or it will not allow the air to bleed.

Product Distribution

B
Components
Liquid

<u>To assure proper and even distribution to each row, the product being applied must be metered to each individual row.</u> This metering is done by one of the 3 following methods which create back pressure so an equal amount of liquid is applied to each row.

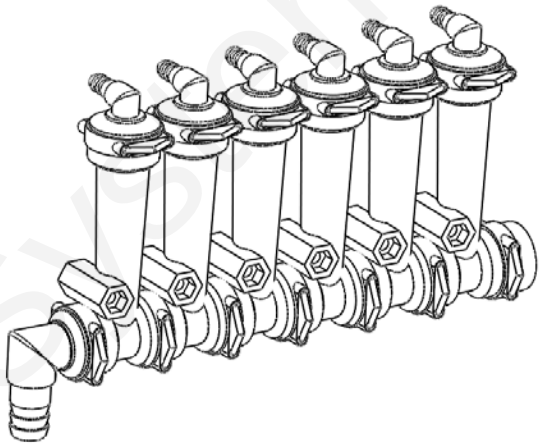
1. A metering orifice may be placed in the top cap of each floating ball flow indicator. (See photos on page 9—this is not used very often.)
2. A metering orifice may be placed in the check valve cap in the line that leads to each row. (See photo on page 11)
3. A dual metering tube kit with dual check valves may be used. (See pages 15-18)

Floating Ball Flow Indicator & Manifold System

Flow indicators give a clear visual signal that a fertilizer system is working. These indicators use an o-ring and wire clip connection to snap together in any configuration necessary.

SureFire has simple tee brackets and U-bolts that will mount these to a variety of bar sizes.

Two main types of flow indicators are used. On 30" row spacing, the low flow column with 1/4" or 3/8" push to connect outlet is recommended for rates under 10 GPA. For rates over 10 GPA the full flow column with 3/8" hose barb outlet is preferred.



Parts List

Complete Columns

701-20460-950	Single Full Flow Column with 3/8" HB - 90 Degree Outlet
701-20460-940	Single Full Flow Column with 3/8" QC - 90 Degree Outlet
701-20460-960	Single Full Flow Column with 1/2" HB - 90 Degree Outlet
701-20460-935	Single Low Flow Column with 3/8" QC - 90 Degree Outlet
701-20460-920	Single Low Flow Column with 1/4" QC - 90 Degree Outlet

Fittings

701-20503-00	ORS x 3/4" HB - Straight
701-20511-00	ORS x 3/8" HB - 90 Degree
701-20512-00	ORS x 1/2" HB - 90 Degree
701-20513-00	ORS x 3/4" HB - 90 Degree
701-20516-00	ORS x 1/4" QC - 90 Degree
701-20517-00	ORS x 3/8" QC - 90 Degree
701-20518-00	ORS x 1/4" FPT - 90 Degree
701-20519-00	ORS x 1/4" FPT - Straight
701-20520-00	ORS Male x ORS Female - 90 degree
701-20521-00	Wilger End Cap
701-20523-00	ORS Male x ORS Female x 3/8" FPT - Isolator
701-20525-00	ORS Male x ORS Male x 1" FPT - Tee

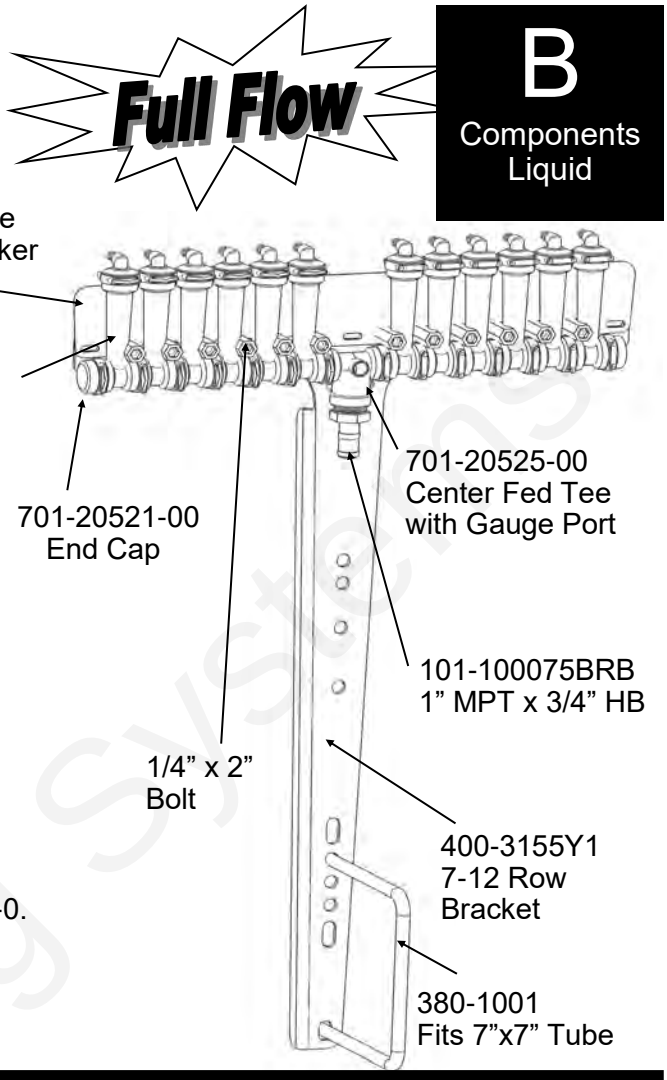
Service Parts Only

701-20460-02	Wilger Flow Indicator Ball Retainer
701-20460-03	FKM O-Ring for indicator body & fittings
701-20460-04	Wilger Lock U-clip
701-20460-05	Flow Indicator Ball - 1/2" SS Ball
701-20460-06	Flow Indicator Ball - Maroon Glass
701-20460-07	Flow Indicator Ball - Red Celcon
701-20460-08	Flow Indicator Ball - Green Poly
701-20460-09	Flow Indicator Ball - Black Poly
701-20460-15	Viton O-Ring for column & fittings
701-40225-05	Viton O-Ring for Orifice

Brackets & U-Bolts

400-1037A1	3-6 Row Bracket
400-3155Y1	7-12 Row Bracket
400-2011A1	White Backer Plate for 3-6 Row Bracket
400-2010A1	White Backer Plate for 7-12 Row Bracket
400-1315A2	Flow Indicator Bracket, 6-8 in wide hitch mount

Floating Ball Flow Indicators- Full Flow Column (mostly 3/8" HB)



The full flow column is typically used with rates over 10 GPA on 30" rows. For rates less than 10 GPA SureFire recommends the low flow columns with 1/4" or 3/8" push to connect (QC) outlet fittings.

The full flow columns are most often assembled with 3/8" hose barb outlets. See the low flow info below for the difference between full and low flow columns.

Full Flow Indicators w/ 3/8" Hose Barb Outlet

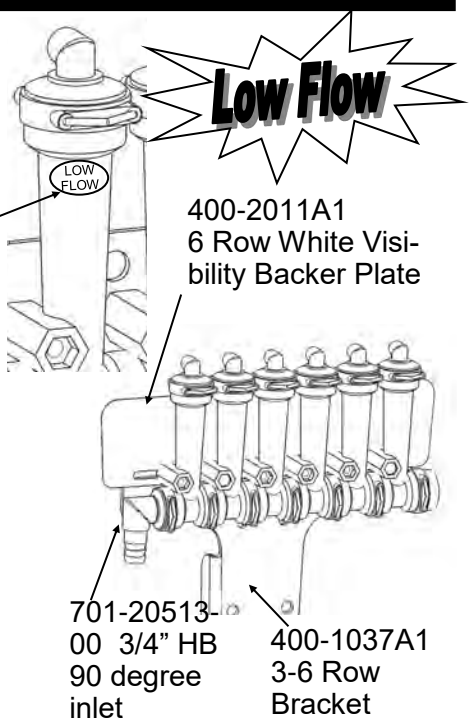
Column Flow (GPM): .05-2.70 GPM
Equivalent Application Rate
On 30" Rows at 6 MPH: 2-70 GPA

Ball Selection for 30" Rows

GPM	GPA	Ball
.05-.18	2-6	Green Plastic*
.09-.30	3-10	Red Plastic*
.31-.72	10-20	Maroon Glass
.40-2.1	13-70	Stainless Steel (1/2")

*Plastic balls may float on heavier fertilizers, such as 10-34-0. SureFire recommends using the low flow column for these flow rates.

Low Flow Column (mostly 1/4" QC or 3/8" QC)



The low flow column has a smaller internal diameter. This means a heavier ball can be used to monitor a smaller flow.

SureFire uses the low flow columns with 1/4" push to connect outlet fittings. The flow capability of 1/4" tubing and the low flow column are a great pair for rates on 30" rows under 10 GPA.

Externally, the low flow column can only be identified by "Low Flow" molded into one side of the column. All the same fittings work with low flow and full flow columns.

Low Flow Indicators w/ 1/4" Push to Connect (QC) Outlet

Column Flow (GPM): .03-.30 GPM
*** Low Flow Column with 3/8" hose barb .03 - .70 GPM
Equivalent Application Rate
On 30" Rows at 6 MPH (1/4" QC): 1-10 GPA

Ball Selection for 30" Rows

GPM	GPA	Ball
.03-.09	1-3	Green Plastic*
.05-.14	2-4	Red Plastic*
.10-.18	3-6	Maroon Glass
.15-.70	5-10	Stainless Steel (1/2")

*These balls may float on heavier fertilizers, such as 10-34-0. Use Maroon Glass in this case.

Floating Ball Flow Indicators– Metering Orifice Selection for 30” Rows

See www.surefireag.com for other row spacings

(This system is not used very often)

30” Spacing

Orifice	PSI	Gal/Min 28-0-0	MPH 4.0	4.5	5.0	5.5	6.0	6.5	7.0
28	10	0.043	2.15	1.91	1.72	1.56	1.43	1.32	1.23
	20	0.061	3.02	2.69	2.42	2.20	2.02	1.86	1.73
	30	0.075	3.72	3.31	2.98	2.71	2.48	2.29	2.13
	40	0.087	4.29	3.82	3.43	3.12	2.86	2.64	2.45
	50	0.097	4.82	4.28	3.85	3.50	3.21	2.97	2.75
	60	0.106	5.26	4.67	4.21	3.82	3.50	3.23	3.00
35	10	0.070	3.46	3.08	2.77	2.52	2.31	2.13	1.98
	20	0.098	4.86	4.32	3.89	3.54	3.24	2.99	2.78
	30	0.120	5.96	5.30	4.77	4.33	3.97	3.67	3.40
	40	0.139	6.88	6.11	5.50	5.00	4.58	4.23	3.93
	50	0.156	7.71	6.85	6.17	5.61	5.14	4.74	4.41
	60	0.170	8.41	7.48	6.73	6.12	5.61	5.18	4.81
40	10	0.090	4.47	3.97	3.57	3.25	2.98	2.75	2.55
	20	0.127	6.31	5.61	5.05	4.59	4.21	3.88	3.60
	30	0.157	7.75	6.89	6.20	5.64	5.17	4.77	4.43
	40	0.181	8.94	7.94	7.15	6.50	5.96	5.50	5.11
	50	0.202	9.99	8.88	7.99	7.26	6.66	6.15	5.71
	60	0.221	10.95	9.73	8.76	7.96	7.30	6.74	6.26
46	10	0.119	5.91	5.26	4.73	4.30	3.94	3.64	3.38
	20	0.169	8.37	7.44	6.69	6.08	5.58	5.15	4.78
	30	0.207	10.25	9.11	8.20	7.45	6.83	6.31	5.86
	40	0.239	11.83	10.51	9.46	8.60	7.88	7.28	6.76
	50	0.267	13.23	11.76	10.58	9.62	8.82	8.14	7.56
	60	0.293	14.50	12.89	11.60	10.55	9.67	8.92	8.29
52	10	0.149	7.36	6.54	5.89	5.35	4.91	4.53	4.21
	20	0.210	10.38	9.23	8.31	7.55	6.92	6.39	5.93
	30	0.257	12.70	11.29	10.16	9.24	8.47	7.82	7.26
	40	0.296	14.67	13.04	11.74	10.67	9.78	9.03	8.39
	50	0.332	16.43	14.60	13.14	11.95	10.95	10.11	9.39
	60	0.363	17.96	15.96	14.37	13.06	11.97	11.05	10.26
63	10	0.218	10.78	9.58	8.62	7.84	7.18	6.63	6.16
	20	0.307	15.20	13.51	12.16	11.05	10.13	9.35	8.69
	30	0.376	18.62	16.55	14.89	13.54	12.41	11.46	10.64
	40	0.435	21.51	19.12	17.21	15.64	14.34	13.24	12.29
	50	0.486	24.05	21.38	19.24	17.49	16.03	14.80	13.74
	60	0.532	26.33	23.40	21.06	19.15	17.55	16.20	15.04
78	10	0.341	16.87	14.99	13.49	12.27	11.24	10.38	9.64
	20	0.481	23.83	21.18	19.06	17.33	15.89	14.66	13.62
	30	0.590	29.22	25.97	23.37	21.25	19.48	17.98	16.70
	40	0.681	33.73	29.98	26.98	24.53	22.49	20.76	19.27
	50	0.762	37.72	33.53	30.17	27.43	25.14	23.21	21.55
	60	0.835	41.31	36.72	33.05	30.04	27.54	25.42	23.60
98	10	0.553	27.38	24.34	21.90	19.91	18.25	16.85	15.64
	20	0.782	38.72	34.42	30.98	28.16	25.82	23.83	22.13
	30	0.956	47.31	42.05	37.85	34.41	31.54	29.11	27.03
	40	1.106	54.76	48.67	43.81	39.82	36.50	33.70	31.29
	50	1.239	61.33	54.51	49.06	44.60	40.88	37.74	35.04
	60	1.354	67.02	59.58	53.62	48.74	44.68	41.24	38.30
107	10	0.649	32.11	28.54	25.69	23.35	21.41	19.76	18.35
	20	0.920	45.56	40.50	36.45	33.13	30.37	28.04	26.03
	30	1.124	55.63	49.45	44.51	40.46	37.09	34.24	31.79
	40	1.301	64.39	57.24	51.52	46.83	42.93	39.63	36.80
	50	1.451	71.84	63.86	57.47	52.25	47.89	44.21	41.05
	60	1.584	78.41	69.70	62.73	57.03	52.27	48.25	44.81
130	10	0.938	46.43	41.27	37.15	33.77	30.96	28.57	26.53
	20	1.319	65.27	58.02	52.22	47.47	43.51	40.17	37.30
	30	1.619	80.16	71.26	64.13	58.30	53.44	49.33	45.81
	40	1.867	92.43	82.16	73.94	67.22	61.62	56.88	52.82
	50	2.088	103.38	91.89	82.70	75.19	68.92	63.62	59.07
	60	2.292	113.46	100.85	90.76	82.51	75.64	69.82	64.83

All application rates (gallons/acres) are estimates based on 0-28-0 (10.65 lbs/gallon) at 70 degrees F.

Tower Electric Pump Pressure Recommendations (with 4 lb check valves):

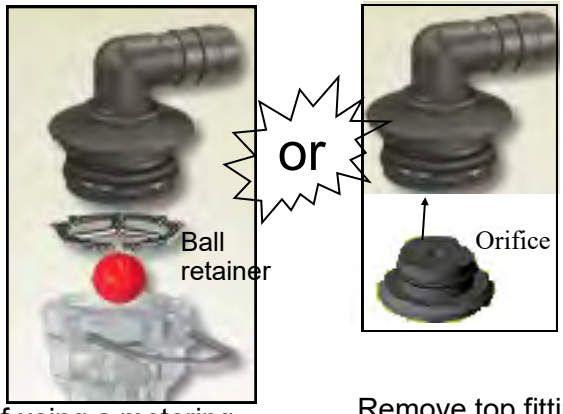
- Minimum 10 PSI
- Maximum 30 PSI *(pump can do 50 PSI or more if total output is not too great)*

PumpRight Hydraulic Pressure Recommendations (with 10 lb check valves):

- Minimum 20 PSI
- Maximum 80 PSI

Chart is for 28-0-0 Fertilizer @ 70°

- Heavier fertilizers (like 10-34-0) will have 5-15% less flow than chart indicates for a certain pressure
- Cold fertilizers will cause system pressure to increase at a given application rate.
- Tower Electric Pump Systems will have reduced flow and increased electrical current draw due to cold fertilizer increasing operating pressure. **Use the largest orifice possible for cold weather operation.**



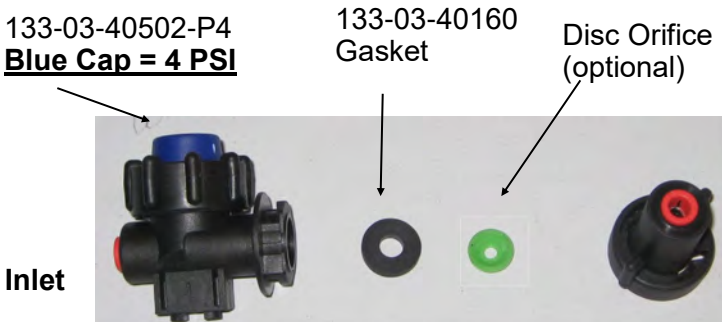
If using a metering orifice in the flow indicator, the orifice replaces the ball retainer. If not using an orifice here, the ball retainer must be in place.

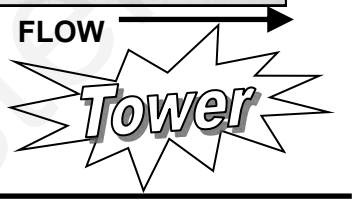
Remove top fitting of each column. Then push metering orifice into bottom of each outlet fitting. *(This is not used very often.)*

Check Valves

4 lb check valve with 1/4” quick connect fittings

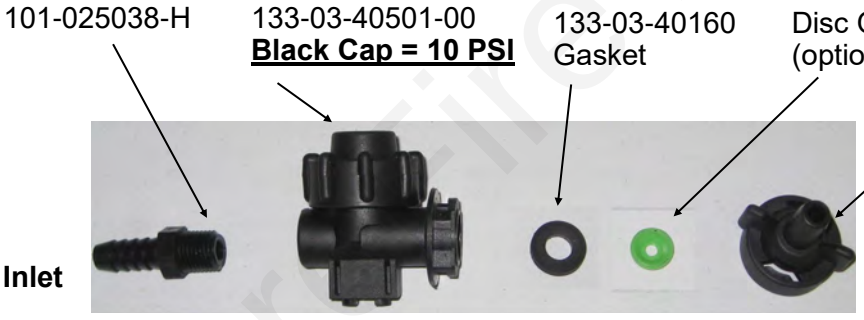
4 lb check valves are typically used with **electric pump systems**. SureFire recommends this valve for use with 1/4” tubing applying up to 10 GPA on 30” rows. The recommended minimum system operating pressure for this check is 10 psi, to ensure all checks open fully.

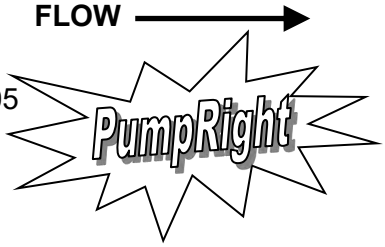




10 lb check valve with 3/8” hose barbs

The recommended check valve for most **PumpRight installations** is the 10 lb check with 3/8” hose barbs. This works with 3/8” rubber hose which SureFire recommends for most applications over 10 GPA on 30” rows. The recommended minimum system operating pressure for this check is 20 psi, to ensure all checks open fully.





Special Purpose Check Valve Assemblies

Assembly Part Number	Description	Suggested Uses (30” rows)
136-10-04QC04QC	1/4" QC x 1/4" QC 10 lb	< 10 GPA with **PumpRight** & 1/4” Tubing
136-10-06QC06QC	3/8" QC x 3/8" QC 10 lb	With 3/8” tubing plumbing
136-04-06HB06HB	3/8" HB x 3/8" HB 4 lb	> 10 GPA with **Electric Pumps**
136-04-08HB08HB	1/2" HB x 1/2" HB 4 lb	> 50 GPA with **PumpRight**
136-10-08HB08HB	1/2" HB x 1/2" HB 10 lb	> 50 GPA with **PumpRight**

Colored Disc Orifice Chart for 30” rows

30” Spacing

Orifice Color (Approx Size)	PSI	Gal/Min 28-0-0	MPH 4.0	4.5	5.0	5.5	6.0	6.5	7.0
Pink (24)	10	0.033	1.62	1.44	1.30	1.18	1.08	1.00	0.93
	20	0.046	2.28	2.02	1.82	1.66	1.52	1.40	1.30
	30	0.057	2.80	2.49	2.24	2.04	1.87	1.73	1.60
	40	0.065	3.24	2.88	2.59	2.36	2.16	1.99	1.85
	50	0.073	3.64	3.23	2.91	2.64	2.42	2.24	2.08
	60	0.081	3.99	3.54	3.19	2.90	2.66	2.45	2.28
Gray (30)	10	0.050	2.50	2.22	2.00	1.82	1.66	1.54	1.43
	20	0.072	3.55	3.15	2.84	2.58	2.37	2.18	2.03
	30	0.088	4.34	3.85	3.47	3.15	2.89	2.67	2.48
	40	0.101	4.99	4.44	4.00	3.63	3.33	3.07	2.85
	50	0.112	5.56	4.95	4.45	4.05	3.71	3.42	3.18
	60	0.124	6.13	5.45	4.91	4.46	4.09	3.77	3.50
Black (35)	10	0.070	3.46	3.08	2.77	2.52	2.31	2.13	1.98
	20	0.098	4.86	4.32	3.89	3.54	3.24	2.99	2.78
	30	0.120	5.96	5.30	4.77	4.33	3.97	3.67	3.40
	40	0.139	6.88	6.11	5.50	5.00	4.58	4.23	3.93
	50	0.156	7.71	6.85	6.17	5.61	5.14	4.74	4.41
	60	0.170	8.41	7.48	6.73	6.12	5.61	5.18	4.81
Brown (41)	10	0.094	4.64	4.13	3.71	3.38	3.10	2.86	2.65
	20	0.132	6.53	5.80	5.22	4.75	4.35	4.02	3.73
	30	0.162	8.02	7.13	6.41	5.83	5.34	4.93	4.58
	40	0.187	9.24	8.22	7.39	6.72	6.16	5.69	5.28
	50	0.209	10.34	9.19	8.27	7.52	6.89	6.36	5.91
	60	0.228	11.30	10.05	9.04	8.22	7.53	6.95	6.46
Orange (46)	10	0.119	5.91	5.26	4.73	4.30	3.94	3.64	3.38
	20	0.169	8.37	7.44	6.69	6.08	5.58	5.15	4.78
	30	0.207	10.25	9.11	8.20	7.45	6.83	6.31	5.86
	40	0.239	11.83	10.51	9.46	8.60	7.88	7.28	6.76
	50	0.267	13.23	11.76	10.58	9.62	8.82	8.14	7.56
	60	0.293	14.50	12.89	11.60	10.55	9.67	8.92	8.29
Maroon (52)	10	0.149	7.36	6.54	5.89	5.35	4.91	4.53	4.21
	20	0.210	10.38	9.23	8.31	7.55	6.92	6.39	5.93
	30	0.257	12.70	11.29	10.16	9.24	8.47	7.82	7.26
	40	0.296	14.67	13.04	11.74	10.67	9.78	9.03	8.39
	50	0.332	16.43	14.60	13.14	11.95	10.95	10.11	9.39
	60	0.363	17.96	15.96	14.37	13.06	11.97	11.05	10.26
Red (63)	10	0.218	10.78	9.58	8.62	7.84	7.18	6.63	6.16
	20	0.307	15.20	13.51	12.16	11.05	10.13	9.35	8.69
	30	0.376	18.62	16.55	14.89	13.54	12.41	11.46	10.64
	40	0.435	21.51	19.12	17.21	15.64	14.34	13.24	12.29
	50	0.486	24.05	21.38	19.24	17.49	16.03	14.80	13.74
	60	0.532	26.33	23.40	21.06	19.15	17.55	16.20	15.04
Blue (80)	10	0.351	17.39	15.46	13.91	12.65	11.59	10.70	9.94
	20	0.496	24.57	21.84	19.66	17.87	16.38	15.12	14.04
	30	0.608	30.09	26.75	24.08	21.89	20.06	18.52	17.20
	40	0.702	34.74	30.88	27.79	25.26	23.16	21.38	19.85
	50	0.785	38.86	34.54	31.08	28.26	25.90	23.91	22.20
	60	0.859	42.53	37.81	34.03	30.93	28.36	26.18	24.31
Yellow (95)	10	0.506	25.06	22.27	20.05	18.22	16.70	15.42	14.32
	20	0.715	35.39	31.46	28.32	25.74	23.60	21.78	20.23
	30	0.876	43.37	38.55	34.69	31.54	28.91	26.69	24.78
	40	1.009	49.94	44.39	39.95	36.32	33.29	30.73	28.54
	50	1.133	56.07	49.84	44.86	40.78	37.38	34.51	32.04
	60	1.239	61.33	54.51	49.06	44.60	40.88	37.74	35.04
Green (110)	10	0.686	33.95	30.18	27.16	24.69	22.63	20.89	19.40
	20	0.973	48.19	42.83	38.55	35.04	32.12	29.65	27.53
	30	1.186	58.70	52.18	46.96	42.69	39.13	36.12	33.54
	40	1.372	67.90	60.35	54.32	49.38	45.27	41.78	38.80
	50	1.531	75.78	67.36	60.63	55.12	50.52	46.64	43.30
	60	1.681	83.23	73.98	66.58	60.53	55.49	51.22	47.56

Tower Electric Pump Pressure Recommendations (with 4 lb check valves):

- Minimum 10 PSI
- Maximum 30 PSI *(pump can do 50 PSI or more if total output is not too great)*

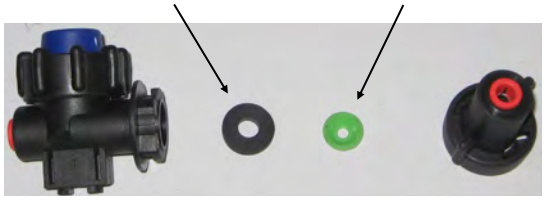
PumpRight Pressure Recommendations (with 10 lb check valves):

- Minimum 20 PSI
- Maximum 80 PSI

Chart is for 28-0-0 Fertilizer @ 70°

- Heavier fertilizers (like 10-34-0) will have 5-15% less flow than chart indicates for a certain pressure
- Cold fertilizers will cause system pressure to increase at a given application rate.
- Tower Electric Pump Systems will have reduced flow and increased electrical current draw due to cold fertilizer increasing operating pressure. **Use the largest orifice possible for cold weather operation. This is absolutely essential for 24-row systems using electric pumps.**

Colored Disc Orifice assembles under the check valve cap in most cases. (Drop the orifice with the hole down into the cap, then put the gasket on top of it.) The orifice can also be installed in a manifold (common on grain drills).



FLOW → 1/4 Turn Cap is Outlet

Colored Disc Orifice Chart
Common Grain Drill Row Spacings

7.5” Spacing

Orifice Color (Approx Size)	PSI	Gal/Min 28-0-0	MPH 4.0	4.5	5.0	5.5	6.0	6.5	7.0
Pink (24)	10	0.033	6.5	5.8	5.2	4.7	4.3	4.0	3.7
	20	0.046	9.1	8.1	7.3	6.6	6.1	5.6	5.2
	30	0.057	11.2	10.0	9.0	8.2	7.5	6.9	6.4
	40	0.065	13.0	11.5	10.4	9.4	8.6	8.0	7.4
	50	0.073	14.5	12.9	11.6	10.6	9.7	8.9	8.3
	60	0.081	15.9	14.2	12.8	11.6	10.6	9.8	9.1
Gray (30)	10	0.050	10.0	8.9	8.0	7.3	6.7	6.1	5.7
	20	0.072	14.2	12.6	11.4	10.3	9.5	8.7	8.1
	30	0.088	17.3	15.4	13.9	12.6	11.6	10.7	9.9
	40	0.101	20.0	17.8	16.0	14.5	13.3	12.3	11.4
	50	0.112	22.3	19.8	17.8	16.2	14.8	13.7	12.7
	60	0.124	24.5	21.8	19.6	17.8	16.4	15.1	14.0
Black (35)	10	0.070	13.8	12.3	11.1	10.1	9.2	8.5	7.9
	20	0.098	19.4	17.3	15.6	14.1	13.0	12.0	11.1
	30	0.120	23.8	21.2	19.1	17.3	15.9	14.7	13.6
	40	0.139	27.5	24.5	22.0	20.0	18.3	16.9	15.7
	50	0.156	30.8	27.4	24.7	22.4	20.6	19.0	17.6
	60	0.170	33.6	29.9	26.9	24.5	22.4	20.7	19.2
Brown (41)	10	0.094	19	17	15	14	12	11	11
	20	0.132	26	23	21	19	17	16	15
	30	0.162	32	29	26	23	21	20	18
	40	0.187	37	33	30	27	25	23	21
	50	0.209	41	37	33	30	28	25	24
	60	0.228	45	40	36	33	30	28	26
Orange (46)	10	0.119	24	21	19	17	16	15	14
	20	0.169	33	30	27	24	22	21	19
	30	0.207	41	36	33	30	27	25	23
	40	0.239	47	42	38	34	32	29	27
	50	0.267	53	47	42	38	35	33	30
	60	0.293	58	52	46	42	39	36	33
Maroon (52)	10	0.149	29	26	24	21	20	18	17
	20	0.210	42	37	33	30	28	26	24
	30	0.257	51	45	41	37	34	31	29
	40	0.296	59	52	47	43	39	36	34
	50	0.332	66	58	53	48	44	40	38
	60	0.363	72	64	57	52	48	44	41
Red (63)	10	0.218	43	38	34	31	29	27	25
	20	0.307	61	54	49	44	41	37	35
	30	0.376	74	66	60	54	50	46	43
	40	0.435	86	76	69	63	57	53	49
	50	0.486	96	86	77	70	64	59	55
	60	0.532	105	94	84	77	70	65	60
Blue (80)	10	0.351	70	62	56	51	46	43	40
	20	0.496	98	87	79	71	66	60	56
	30	0.608	120	107	96	88	80	74	69
	40	0.702	139	124	111	101	93	86	79
	50	0.785	155	138	124	113	104	96	89
	60	0.859	170	151	136	124	113	105	97
Yellow (95)	10	0.506	100	89	80	73	67	62	57
	20	0.715	142	126	113	103	94	87	81
	30	0.876	173	154	139	126	116	107	99
	40	1.009	200	178	160	145	133	123	114
	50	1.133	224	199	179	163	150	138	128
	60	1.239	245	218	196	178	164	151	140

All application rates (gallons/acres) are estimates based on 0-28-0 (10.65 lbs/gallon) at 70 degrees F

10” Spacing

Orifice Color (Approx Size)	PSI	Gal/Min 28-0-0	MPH 4.0	4.5	5.0	5.5	6.0	6.5	7.0
Pink (24)	10	0.033	4.9	4.3	3.9	3.5	3.2	3.0	2.8
	20	0.046	6.8	6.1	5.5	5.0	4.6	4.2	3.9
	30	0.057	8.4	7.5	6.7	6.1	5.6	5.2	4.8
	40	0.065	9.7	8.6	7.8	7.1	6.5	6.0	5.6
	50	0.073	10.9	9.7	8.7	7.9	7.3	6.7	6.2
	60	0.081	12.0	10.6	9.6	8.7	8.0	7.4	6.8
Gray (30)	10	0.050	7.5	6.7	6.0	5.4	5.0	4.6	4.3
	20	0.072	10.6	9.5	8.5	7.7	7.1	6.6	6.1
	30	0.088	13.0	11.6	10.4	9.5	8.7	8.0	7.4
	40	0.101	15.0	13.3	12.0	10.9	10.0	9.2	8.6
	50	0.112	16.7	14.8	13.4	12.1	11.1	10.3	9.5
	60	0.124	18.4	16.4	14.7	13.4	12.3	11.3	10.5
Black (35)	10	0.070	10.4	9.2	8.3	7.6	6.9	6.4	5.9
	20	0.098	14.6	13.0	11.7	10.6	9.7	9.0	8.3
	30	0.120	17.9	15.9	14.3	13.0	11.9	11.0	10.2
	40	0.139	20.6	18.3	16.5	15.0	13.8	12.7	11.8
	50	0.156	23.1	20.6	18.5	16.8	15.4	14.2	13.2
	60	0.170	25.2	22.4	20.2	18.4	16.8	15.5	14.4
Brown (41)	10	0.094	14	12	11	10	9	9	8
	20	0.132	20	17	16	14	13	12	11
	30	0.162	24	21	19	17	16	15	14
	40	0.187	28	25	22	20	18	17	16
	50	0.209	31	28	25	23	21	19	18
	60	0.228	34	30	27	25	23	21	19
Orange (46)	10	0.119	18	16	14	13	12	11	10
	20	0.169	25	22	20	18	17	15	14
	30	0.207	31	27	25	22	21	19	18
	40	0.239	35	32	28	26	24	22	20
	50	0.267	40	35	32	29	26	24	23
	60	0.293	43	39	35	32	29	27	25
Maroon (52)	10	0.149	22	20	18	16	15	14	13
	20	0.210	31	28	25	23	21	19	18
	30	0.257	38	34	30	28	25	23	22
	40	0.296	44	39	35	32	29	27	25
	50	0.332	49	44	39	36	33	30	28
	60	0.363	54	48	43	39	36	33	31
Red (63)	10	0.218	32	29	26	24	22	20	18
	20	0.307	46	41	36	33	30	28	26
	30	0.376	56	50	45	41	37	34	32
	40	0.435	65	57	52	47	43	40	37
	50	0.486	72	64	58	52	48	44	41
	60	0.532	79	70	63	57	53	49	45
Blue (80)	10	0.351	52	46	42	38	35	32	30
	20	0.496	74	66	59	54	49	45	42
	30	0.608	90	80	72	66	60	56	52
	40	0.702	104	93	83	76	69	64	60
	50	0.785	117	104	93	85	78	72	67
	60	0.859	128	113	102	93	85	79	73
Yellow (95)	10	0.506	75	67	60	55	50	46	43
	20	0.715	106	94	85	77	71	65	61
	30	0.876	130	116	104	95	87	80	74
	40	1.009	150	133	120	109	100	92	86
	50	1.133	168	150	135	122	112	104	96
	60	1.239	184	164	147	134	123	113	105

All application rates (gallons/acres) are estimates based on 0-28-0 (10.65 lbs/gallon) at 70 degrees F

Colored Disc Orifice Chart

15" Spacing

Orifice Color (Approx Size)	PSI	Gal/Min 28-0-0	MPH 4.0	4.5	5.0	5.5	6.0	6.5	7.0
Pink (24)	10	0.033	3.2	2.9	2.6	2.4	2.2	2.0	1.9
	20	0.046	4.6	4.0	3.6	3.3	3.0	2.8	2.6
	30	0.057	5.6	5.0	4.5	4.1	3.7	3.5	3.2
	40	0.065	6.5	5.8	5.2	4.7	4.3	4.0	3.7
	50	0.073	7.3	6.5	5.8	5.3	4.8	4.5	4.2
	60	0.081	8.0	7.1	6.4	5.8	5.3	4.9	4.6
Gray (30)	10	0.050	5.0	4.4	4.0	3.6	3.3	3.1	2.9
	20	0.072	7.1	6.3	5.7	5.2	4.7	4.4	4.1
	30	0.088	8.7	7.7	6.9	6.3	5.8	5.3	5.0
	40	0.101	10.0	8.9	8.0	7.3	6.7	6.1	5.7
	50	0.112	11.1	9.9	8.9	8.1	7.4	6.8	6.4
	60	0.124	12.3	10.9	9.8	8.9	8.2	7.5	7.0
Black (35)	10	0.070	6.9	6.2	5.5	5.0	4.6	4.3	4.0
	20	0.098	9.7	8.6	7.8	7.1	6.5	6.0	5.6
	30	0.120	11.9	10.6	9.5	8.7	7.9	7.3	6.8
	40	0.139	13.8	12.2	11.0	10.0	9.2	8.5	7.9
	50	0.156	15.4	13.7	12.3	11.2	10.3	9.5	8.8
	60	0.170	16.8	15.0	13.5	12.2	11.2	10.4	9.6
Brown (41)	10	0.094	9.3	8.3	7.4	6.8	6.2	5.7	5.3
	20	0.132	13.1	11.6	10.4	9.5	8.7	8.0	7.5
	30	0.162	16.0	14.3	12.8	11.7	10.7	9.9	9.2
	40	0.187	18.5	16.4	14.8	13.4	12.3	11.4	10.6
	50	0.209	20.7	18.4	16.5	15.0	13.8	12.7	11.8
	60	0.228	22.6	20.1	18.1	16.4	15.1	13.9	12.9
Orange (46)	10	0.119	11.8	10.5	9.5	8.6	7.9	7.3	6.8
	20	0.169	16.7	14.9	13.4	12.2	11.2	10.3	9.6
	30	0.207	20.5	18.2	16.4	14.9	13.7	12.6	11.7
	40	0.239	23.7	21.0	18.9	17.2	15.8	14.6	13.5
	50	0.267	26.5	23.5	21.2	19.2	17.6	16.3	15.1
	60	0.293	29.0	25.8	23.2	21.1	19.3	17.8	16.6
Maroon (52)	10	0.149	15	13	12	11	10	9	8
	20	0.210	21	18	17	15	14	13	12
	30	0.257	25	23	20	18	17	16	15
	40	0.296	29	26	23	21	20	18	17
	50	0.332	33	29	26	24	22	20	19
	60	0.363	36	32	29	26	24	22	21
Red (63)	10	0.218	22	19	17	16	14	13	12
	20	0.307	30	27	24	22	20	19	17
	30	0.376	37	33	30	27	25	23	21
	40	0.435	43	38	34	31	29	26	25
	50	0.486	48	43	38	35	32	30	27
	60	0.532	53	47	42	38	35	32	30
Blue (80)	10	0.351	35	31	28	25	23	21	20
	20	0.496	49	44	39	36	33	30	28
	30	0.608	60	54	48	44	40	37	34
	40	0.702	69	62	56	51	46	43	40
	50	0.785	78	69	62	57	52	48	44
	60	0.859	85	76	68	62	57	52	49
Yellow (95)	10	0.506	50	45	40	36	33	31	29
	20	0.715	71	63	57	51	47	44	40
	30	0.876	87	77	69	63	58	53	50
	40	1.009	100	89	80	73	67	61	57
	50	1.133	112	100	90	82	75	69	64
	60	1.239	123	109	98	89	82	75	70
Green (110)	10	0.686	68	60	54	49	45	42	39
	20	0.973	96	86	77	70	64	59	55
	30	1.186	117	104	94	85	78	72	67
	40	1.372	136	121	109	99	91	84	78
	50	1.531	152	135	121	110	101	93	87
	60	1.681	166	148	133	121	111	102	95
White (125)	10	0.867	86	76	69	62	57	53	49
	20	1.230	122	108	97	89	81	75	70
	30	1.504	149	132	119	108	99	92	85
	40	1.735	172	153	137	125	114	106	98
	50	1.938	192	171	153	140	128	118	110
	60	2.124	210	187	168	153	140	129	120
Lime Green (156)	10	1.372	136	121	109	99	91	84	78
	20	1.947	193	171	154	140	128	119	110
	30	2.381	236	209	189	171	157	145	135
	40	2.752	272	242	218	198	182	168	156
	50	3.071	304	270	243	221	203	187	174
	60	3.363	333	296	266	242	222	205	190

All application rates (gallons/acres) are estimates based on 0-28-0 (10.65 lbs/gallon) at 70 degrees F.

20" Spacing

Orifice Color (Approx Size)	PSI	Gal/Min 28-0-0	MPH 4.0	4.5	5.0	5.5	6.0	6.5	7.0
Pink (24)	10	0.033	2.4	2.2	1.9	1.8	1.6	1.5	1.4
	20	0.046	3.4	3.0	2.7	2.5	2.3	2.1	2.0
	30	0.057	4.2	3.7	3.4	3.1	2.8	2.6	2.4
	40	0.065	4.9	4.3	3.9	3.5	3.2	3.0	2.8
	50	0.073	5.5	4.8	4.4	4.0	3.6	3.4	3.1
	60	0.081	6.0	5.3	4.8	4.3	4.0	3.7	3.4
Gray (30)	10	0.050	3.7	3.3	3.0	2.7	2.5	2.3	2.1
	20	0.072	5.3	4.7	4.3	3.9	3.5	3.3	3.0
	30	0.088	6.5	5.8	5.2	4.7	4.3	4.0	3.7
	40	0.101	7.5	6.7	6.0	5.4	5.0	4.6	4.3
	50	0.112	8.3	7.4	6.7	6.1	5.6	5.1	4.8
	60	0.124	9.2	8.2	7.4	6.7	6.1	5.7	5.3
Black (35)	10	0.070	5.2	4.6	4.2	3.8	3.5	3.2	3.0
	20	0.098	7.3	6.5	5.8	5.3	4.9	4.5	4.2
	30	0.120	8.9	7.9	7.1	6.5	6.0	5.5	5.1
	40	0.139	10.3	9.2	8.3	7.5	6.9	6.3	5.9
	50	0.156	11.6	10.3	9.3	8.4	7.7	7.1	6.6
	60	0.170	12.6	11.2	10.1	9.2	8.4	7.8	7.2
Brown (41)	10	0.094	7.0	6.2	5.6	5.1	4.6	4.3	4.0
	20	0.132	9.8	8.7	7.8	7.1	6.5	6.0	5.6
	30	0.162	12.0	10.7	9.6	8.7	8.0	7.4	6.9
	40	0.187	13.9	12.3	11.1	10.1	9.2	8.5	7.9
	50	0.209	15.5	13.8	12.4	11.3	10.3	9.5	8.9
	60	0.228	17.0	15.1	13.6	12.3	11.3	10.4	9.7
Orange (46)	10	0.119	8.9	7.9	7.1	6.5	5.9	5.5	5.1
	20	0.169	12.6	11.2	10.0	9.1	8.4	7.7	7.2
	30	0.207	15.4	13.7	12.3	11.2	10.3	9.5	8.8
	40	0.239	17.7	15.8	14.2	12.9	11.8	10.9	10.1
	50	0.267	19.8	17.6	15.9	14.4	13.2	12.2	11.3
	60	0.293	21.7	19.3	17.4	15.8	14.5	13.4	12.4
Maroon (52)	10	0.149	11	10	9	8	7	7	6
	20	0.210	16	14	12	11	10	10	9
	30	0.257	19	17	15	14	13	12	11
	40	0.296	22	20	18	16	15	14	13
	50	0.332	25	22	20	18	16	15	14
	60	0.363	27	24	22	20	18	17	15
Red (63)	10	0.218	16	14	13	12	11	10	9
	20	0.307	23	20	18	17	15	14	13
	30	0.376	28	25	22	20	19	17	16
	40	0.435	32	29	26	23	22	20	18
	50	0.486	36	32	29	26	24	22	21
	60	0.532	39	35	32	29	26	24	23
Blue (80)	10	0.351	26	23	21	19	17	16	15
	20	0.496	37	33	29	27	25	23	21
	30	0.608	45	40	36	33	30	28	26
	40	0.702	52	46	42	38	35	32	30
	50	0.785	58	52	47	42	39	36	33
	60	0.859	64	57	51	46	43	39	36
Yellow (95)	10	0.506	38	33	30	27	25	23	21
	20	0.715	53	47	42	39	35	33	30
	30	0.876	65	58	52	47	43	40	37
	40	1.009	75	67	60	54	50	46	43
	50	1.133	84	75	67	61	56	52	48
	60	1.239	92	82	74	67	61	57	53
Green (110)	10	0.686	51	45	41	37	34	31	29
	20	0.973	72	64	58	53	48	44	41
	30	1.186	88	78	70	64	59	54	50
	40	1.372	102	91	81	74	68	63	58
	50	1.531	114	101	91	83	76	70	65
	60	1.681	125	111	100	91	83	77	71
White (125)	10	0.867	64	57	52	47	43	40	37
	20	1.230	91	81	73	66	61	56	52
	30	1.504	112	99	89	81	74	69	64
	40	1.735	129	114	103	94	86	79	74
	50	1.938	144	128	115	105	96	89	82
	60	2.124	158	140	126	115	105	97	90
Lime Green (156)	10	1.372	102	91	81	74	68	63	58
	20	1.947	145	128	116	105	96	89	83
	30	2.381	177	157	141	129	118	109	101
	40	2.752	204	182	163	149	136	126	117
	50	3.071	228	203	182	166	152	140	130
	60	3.363	250	222	200	182	166	154	143

All application rates (gallons/acres) are estimates based on 0-28-0 (10.65 lbs/gallon) at 70 degrees F.

Colored Disc Orifice Chart

22" Spacing

Orifice Color (Approx Size)	PSI	Gal/Min 28-0-0	MPH 4.0	4.5	5.0	5.5	6.0	6.5	7.0
Pink (24)	10	0.033	2.2	2.0	1.8	1.6	1.5	1.4	1.3
	20	0.046	3.1	2.8	2.5	2.3	2.1	1.9	1.8
	30	0.057	3.8	3.4	3.1	2.8	2.5	2.4	2.2
	40	0.065	4.4	3.9	3.5	3.2	2.9	2.7	2.5
	50	0.073	5.0	4.4	4.0	3.6	3.3	3.1	2.8
	60	0.081	5.4	4.8	4.3	4.0	3.6	3.3	3.1
Gray (30)	10	0.050	3.4	3.0	2.7	2.5	2.3	2.1	1.9
	20	0.072	4.8	4.3	3.9	3.5	3.2	3.0	2.8
	30	0.088	5.9	5.3	4.7	4.3	3.9	3.6	3.4
	40	0.101	6.8	6.1	5.4	5.0	4.5	4.2	3.9
	50	0.112	7.6	6.7	6.1	5.5	5.1	4.7	4.3
	60	0.124	8.4	7.4	6.7	6.1	5.6	5.1	4.8
Black (35)	10	0.070	4.7	4.2	3.8	3.4	3.1	2.9	2.7
	20	0.098	6.6	5.9	5.3	4.8	4.4	4.1	3.8
	30	0.120	8.1	7.2	6.5	5.9	5.4	5.0	4.6
	40	0.139	9.4	8.3	7.5	6.8	6.3	5.8	5.4
	50	0.156	10.5	9.3	8.4	7.6	7.0	6.5	6.0
	60	0.170	11.5	10.2	9.2	8.3	7.6	7.1	6.6
Brown (41)	10	0.094	6.3	5.6	5.1	4.6	4.2	3.9	3.6
	20	0.132	8.9	7.9	7.1	6.5	5.9	5.5	5.1
	30	0.162	10.9	9.7	8.7	8.0	7.3	6.7	6.2
	40	0.187	12.6	11.2	10.1	9.2	8.4	7.8	7.2
	50	0.209	14.1	12.5	11.3	10.3	9.4	8.7	8.1
	60	0.228	15.4	13.7	12.3	11.2	10.3	9.5	8.8
Orange (46)	10	0.119	8.1	7.2	6.5	5.9	5.4	5.0	4.6
	20	0.169	11.4	10.1	9.1	8.3	7.6	7.0	6.5
	30	0.207	14.0	12.4	11.2	10.2	9.3	8.6	8.0
	40	0.239	16.1	14.3	12.9	11.7	10.8	9.9	9.2
	50	0.267	18.0	16.0	14.4	13.1	12.0	11.1	10.3
	60	0.293	19.8	17.6	15.8	14.4	13.2	12.2	11.3
Maroon (52)	10	0.149	10	9	8	7	7	6	6
	20	0.210	14	13	11	10	9	9	8
	30	0.257	17	15	14	13	12	11	10
	40	0.296	20	18	16	15	13	12	11
	50	0.332	22	20	18	16	15	14	13
	60	0.363	24	22	20	18	16	15	14
Red (63)	10	0.218	15	13	12	11	10	9	8
	20	0.307	21	18	17	15	14	13	12
	30	0.376	25	23	20	18	17	16	15
	40	0.435	29	26	23	21	20	18	17
	50	0.486	33	29	26	24	22	20	19
	60	0.532	36	32	29	26	24	22	21
Blue (80)	10	0.351	24	21	19	17	16	15	14
	20	0.496	34	30	27	24	22	21	19
	30	0.608	41	36	33	30	27	25	23
	40	0.702	47	42	38	34	32	29	27
	50	0.785	53	47	42	39	35	33	30
	60	0.859	58	52	46	42	39	36	33
Yellow (95)	10	0.506	34	30	27	25	23	21	20
	20	0.715	48	43	39	35	32	30	28
	30	0.876	59	53	47	43	39	36	34
	40	1.009	68	61	54	50	45	42	39
	50	1.133	76	68	61	56	51	47	44
	60	1.239	84	74	67	61	56	51	48
Green (110)	10	0.686	46	41	37	34	31	28	26
	20	0.973	66	58	53	48	44	40	38
	30	1.186	80	71	64	58	53	49	46
	40	1.372	93	82	74	67	62	57	53
	50	1.531	103	92	83	75	69	64	59
	60	1.681	113	101	91	83	76	70	65
White (125)	10	0.867	59	52	47	43	39	36	33
	20	1.230	83	74	66	60	55	51	47
	30	1.504	102	90	81	74	68	62	58
	40	1.735	117	104	94	85	78	72	67
	50	1.938	131	116	105	95	87	81	75
	60	2.124	143	127	115	104	96	88	82
Lime Green (156)	10	1.372	93	82	74	67	62	57	53
	20	1.947	131	117	105	96	88	81	75
	30	2.381	161	143	129	117	107	99	92
	40	2.752	186	165	149	135	124	114	106
	50	3.071	207	184	166	151	138	128	118
	60	3.363	227	202	182	165	151	140	130

All application rates (gallons/acres) are estimates based on 0-28-0 (10.65 lbs/gallon) at 70 degrees F.

36" Spacing

Orifice Color (Approx Size)	PSI	Gal/Min 28-0-0	MPH 4.0	4.5	5.0	5.5	6.0	6.5	7.0
Pink (24)	10	0.033	1.4	1.2	1.1	1.0	0.9	0.8	0.8
	20	0.046	1.9	1.7	1.5	1.4	1.3	1.2	1.1
	30	0.057	2.3	2.1	1.9	1.7	1.6	1.4	1.3
	40	0.065	2.7	2.4	2.2	2.0	1.8	1.7	1.5
	50	0.073	3.0	2.7	2.4	2.2	2.0	1.9	1.7
	60	0.081	3.3	3.0	2.7	2.4	2.2	2.0	1.9
Gray (30)	10	0.050	2.1	1.8	1.7	1.5	1.4	1.3	1.2
	20	0.072	3.0	2.6	2.4	2.2	2.0	1.8	1.7
	30	0.088	3.6	3.2	2.9	2.6	2.4	2.2	2.1
	40	0.101	4.2	3.7	3.3	3.0	2.8	2.6	2.4
	50	0.112	4.6	4.1	3.7	3.4	3.1	2.9	2.6
	60	0.124	5.1	4.5	4.1	3.7	3.4	3.1	2.9
Black (35)	10	0.070	2.9	2.6	2.3	2.1	1.9	1.8	1.6
	20	0.098	4.1	3.6	3.2	2.9	2.7	2.5	2.3
	30	0.120	5.0	4.4	4.0	3.6	3.3	3.1	2.8
	40	0.139	5.7	5.1	4.6	4.2	3.8	3.5	3.3
	50	0.156	6.4	5.7	5.1	4.7	4.3	4.0	3.7
	60	0.170	7.0	6.2	5.6	5.1	4.7	4.3	4.0
Brown (41)	10	0.094	3.9	3.4	3.1	2.8	2.6	2.4	2.2
	20	0.132	5.4	4.8	4.4	4.0	3.6	3.3	3.1
	30	0.162	6.7	5.9	5.3	4.9	4.5	4.1	3.8
	40	0.187	7.7	6.8	6.2	5.6	5.1	4.7	4.4
	50	0.209	8.6	7.7	6.9	6.3	5.7	5.3	4.9
	60	0.228	9.4	8.4	7.5	6.8	6.3	5.8	5.4
Orange (46)	10	0.119	4.9	4.4	3.9	3.6	3.3	3.0	2.8
	20	0.169	7.0	6.2	5.6	5.1	4.6	4.3	4.0
	30	0.207	8.5	7.6	6.8	6.2	5.7	5.3	4.9
	40	0.239	9.9	8.8	7.9	7.2	6.6	6.1	5.6
	50	0.267	11.0	9.8	8.8	8.0	7.3	6.8	6.3
	60	0.293	12.1	10.7	9.7	8.8	8.1	7.4	6.9
Maroon (52)	10	0.149	6	5	5	4	4	4	4
	20	0.210	9	8	7	6	6	5	5
	30	0.257	11	9	8	8	7	7	6
	40	0.296	12	11	10	9	8	8	7
	50	0.332	14	12	11	10	9	8	8
	60	0.363	15	13	12	11	10	9	9
Red (63)	10	0.218	9	8	7	7	6	6	5
	20	0.307	13	11	10	9	8	8	7
	30	0.376	16	14	12	11	10	10	9
	40	0.435	18	16	14	13	12	11	10
	50	0.486	20	18	16	15	13	12	11
	60	0.532	22	20	18	16	15	14	13
Blue (80)	10	0.351	14	13	12	11	10	9	8
	20	0.496	20	18	16	15	14	13	12
	30	0.608	25	22	20	18	17	15	14
	40	0.702	29	26	23	21	19	18	17
	50	0.785	32	29	26	24	22	20	19
	60	0.859	35	32	28	26	24	22	20
Yellow (95)	10	0.506	21	19	17	15	14	13	12
	20	0.715	29	26	24	21	20	18	17
	30	0.876	36	32	29	26	24	22	21
	40	1.009	42	37	33	30	28	26	24
	50	1.133	47	42	37	34	31	29	27
	60	1.239	51	45	41	37	34	31	29
Green (110)	10	0.686	28	25	23	21	19	17	16
	20	0.973	40	36	32	29	27	25	23
	30	1.186	49	43	39	36	33	30	28
	40	1.372	57	50	45	41	38	35	32
	50	1.531	63	56	51	46	42	39	36
	60	1.681	69	62	55	50	46	43	40
White (125)	10	0.867	36	32	29	26	24	22	20
	20	1.230	51	45	41	37	34	31	29
	30	1.504	62	55	50	45	41	38	35
	40	1.735	72	64	57	52	48	44	41
	50	1.938	80	71	64	58	53	49	46
	60	2.124	88	78	70	64	58	54	50
Lime Green (156)	10	1.372	57	50	45	41	38	35	32
	20	1.947	80	71	64	58	54	49	46
	30	2.381	98	87	79	71	65	60	56
	40	2.752	114	101	91	83	76	70	65
	50	3.071	127	113	101	92	84	78	72
	60	3.363	139	123	111	101	92	85	79

All application rates (gallons/acres) are estimates based on 0-28-0 (10.65 lbs/gallon) at 70 degrees F.

Dual Metering Tube Plumbing Kits with Dual Check Valve

B
Components
Liquid

For more information, read Navigating the Metering Tube Maze or Metering Tube / LiquiShiftTube Charts.

SureFire dual metering tube plumbing kits are a great way to plumb a planter to apply starter fertilizer. They'll also work on other implements when applying low rates or high rates of fertilizer.

These plumbing kits will contain everything you need to distribute fertilizer from the flowmeter outlet down to the ground application device of your choice (not included).

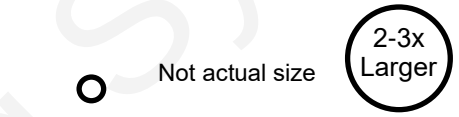
These instructions will show you where all the pieces go. It will provide guidance on how much metering tube to use. There are some optional fittings included in each plumbing kit. These instructions will show you where and why you'd want to use the optional pieces.

The dual check valve assembly is a key piece in the dual metering tube design. In addition to a check valve to stop fertilizer from draining when the system is shut off, **each check valve has an on/off valve on top of it. These on / off valves allow the operator to turn on only tube 1, only tube 2, or both tube 1 and 2.** *This provides for three different application ranges*, which is especially helpful when using Black Label Zn fertilizer (or any other liquid) which has a highly variable viscosity based on temperature changes.

Dual Advantage of Dual Metering Tube

Metering tube provides a larger passage-way diameter than a comparable orifice. For a 5 GPA rate on 30" rows, a size 0.046" orifice would be used. For the same rate a 0.110" meter tube that is 8' long would be used. This 8' tube with more than twice the diameter creates a fertilizer system resistant to plugging while providing excellent row to row distribution.

By using two metering tubes, the fertilizer system can handle Black Label ZN (or most other liquid solutions) and provide the proper system pressure as the fertilizer properties change due to temperature, mixtures and other factors.



Field Operation of Dual Metering Tube - Dual Check Valve System

The dual metering tube allows for three application rate ranges. Some fertilizers can have a widely variable viscosity range. Therefore, based on temperature, tank mixing and fertilizer batch, the best tube to use will change.

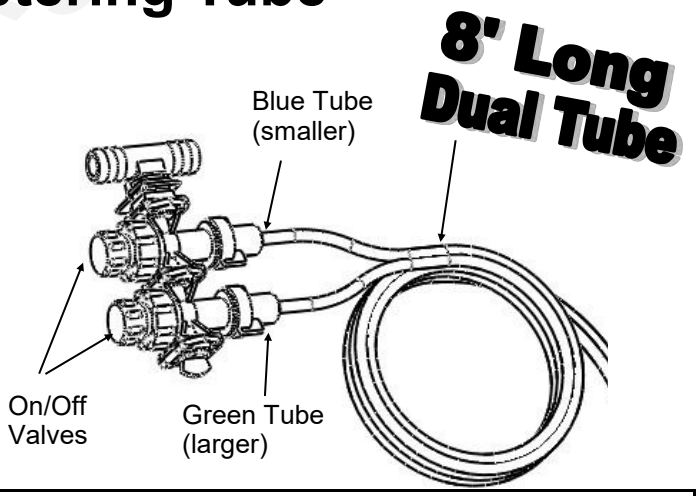
SureFire recommends you start with the Green (or larger) tube ON only. This is the middle application range and is a good starting point. Conduct a test using the test speed mode to determine your system pressure. Recommended pressure is between 8 - 30 PSI. If pressure is below 8 psi, some check valves may not open and row to row distribution will be uneven. If pressure is too high , pump output will decrease and you may not reach the target rate.

Start with green (or larger) tube ON, blue tube OFF:

- **Pressure below 10 PSI: Turn green tube OFF and blue tube ON.**

Pressure over 30 PSI: Turn BOTH tubes ON.

(Other color tubes are available for different application rates.)

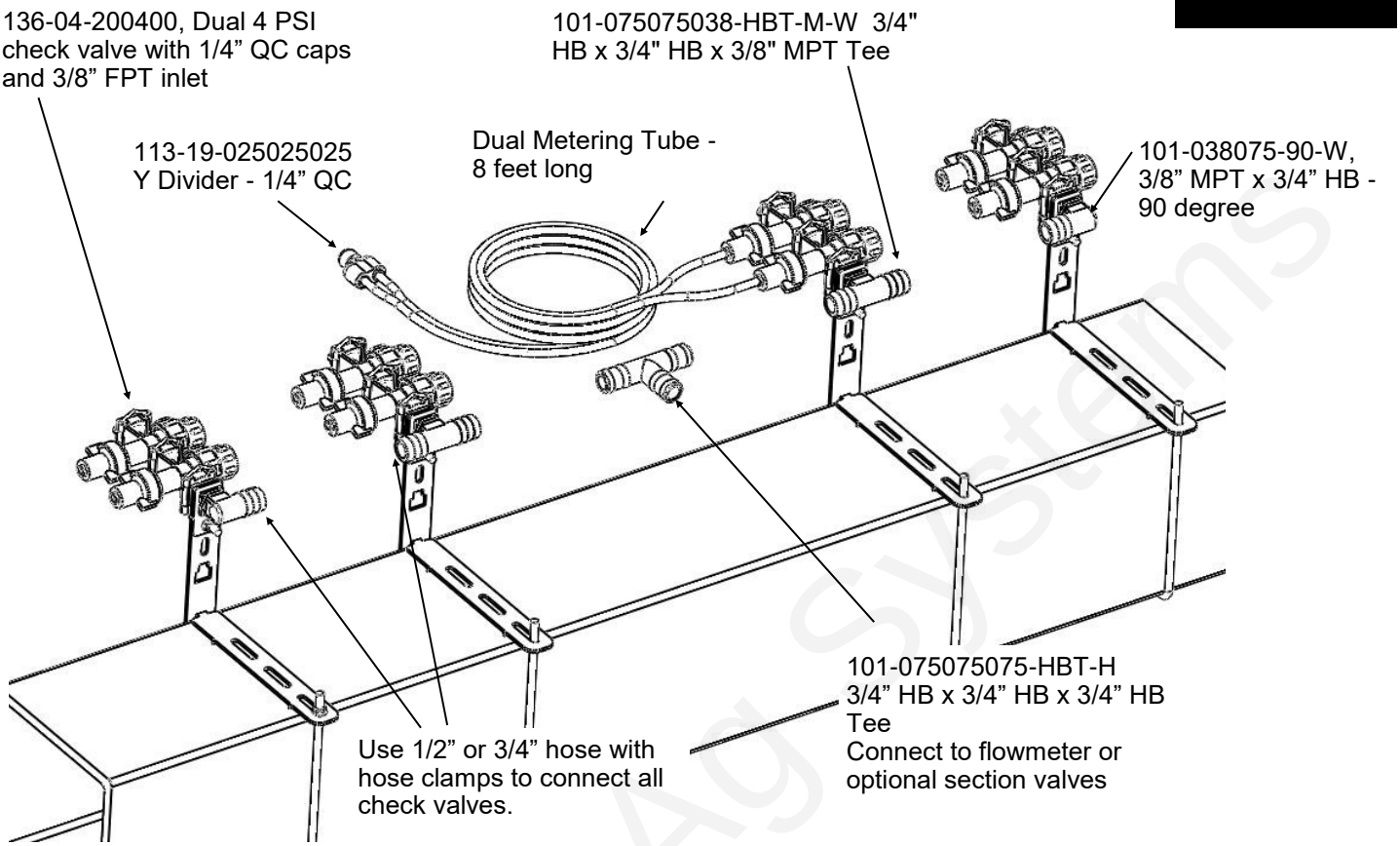


	GPA on 30" rows (approx, will vary)
Blue Tube	1.5 - 3
Green Tube	3 - 6
Blue & Green Tube	6 - 10
Minimum Recommended flow for Blue Tube (8 ft)	4 - 5 oz/min

** Ultra Low Rate Application –For rates from 2-5 oz/min/row use a 12 foot length of metering tube.
To calculate oz/min/row: Oz/min/row = (GPA x MPH x spacing (inches)) ÷ 46.4

Dual Check Valve Plumbing Diagram

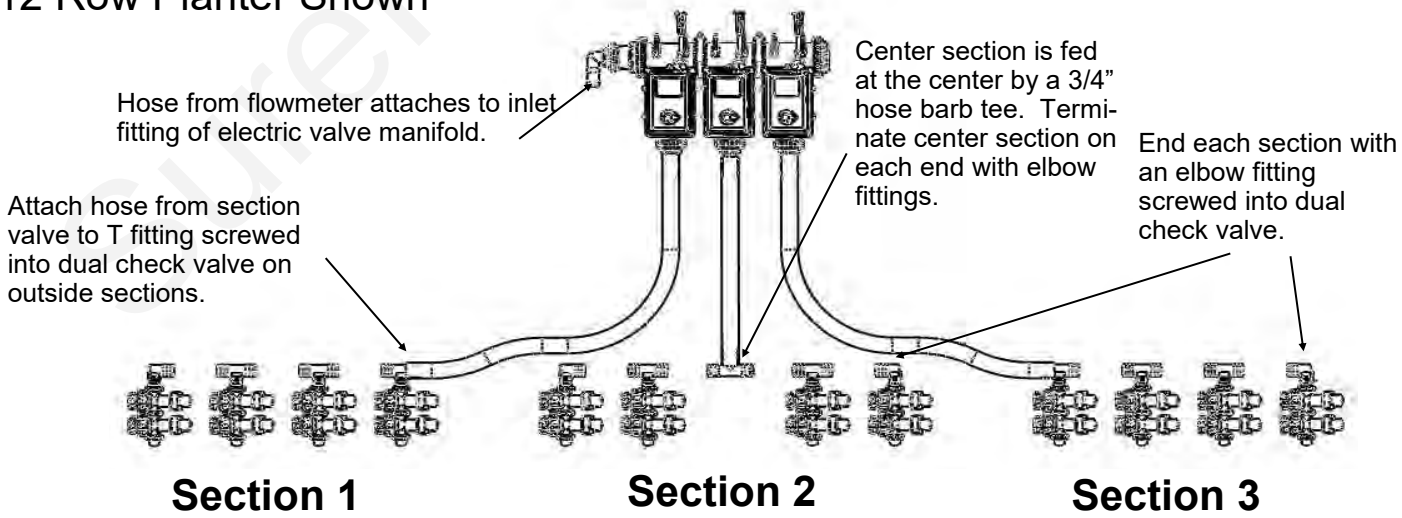
4 Row Planter Shown, add rows as necessary



This is a general diagram showing the dual check valve assembly mounted on a planter toolbar. The check valve and bracket are very flexible in their mounting. The check valve can mount behind, directly over, or in front of the toolbar. The check valve can be put in the bracket facing up & down or sideways (shown). In addition the steel bracket could be rotated 90 degrees and clamp around the bar. The multiple slots in the bracket are used to mount to any tube 7x7 inches or smaller.

Sectional Plumbing Diagram with Dual Check Valves

12 Row Planter Shown

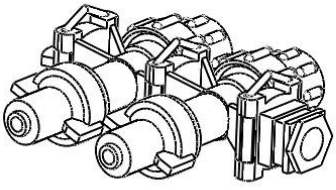


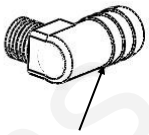
For a **2 section plumbing system**, omit the center section and plumb similar to the outside 2 sections.

Dual Check Valve Assembly Steps

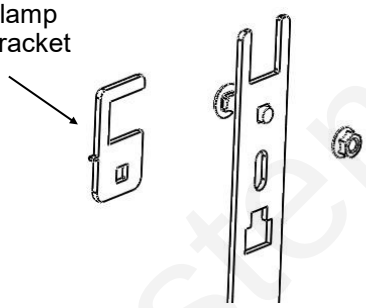
Follow these steps to mount each check valve to the steel bracket.

1. Screw the 3/8” MPT x 3/4” HB tee or elbow into the check valve using blue thread sealer. Orient the hose barb to run the 3/4” hose down the planter toolbar.
2. Insert the check valve into the “C” notch in the end of the bracket, according to how you want the check valve to be mounted on your planter. Orient the wire clips up or to the side for easiest access.
3. Slide the small “C” clamp bracket around the check valve to lock it in place.
4. Install the 1/4” carriage bolt and flange nut to secure the “C” clamp plate around the check valve.
5. Now, mount the check valve on the bar. Hold the check valve and long bracket assembly on the toolbar. Slide the tab on the front of the short bracket into the upper or lower notch on the long bracket.
6. Slide the L bolt into the appropriate slots on the brackets for your tube size. Tighten the 1/4” flange nuts to hold the bracket in place.



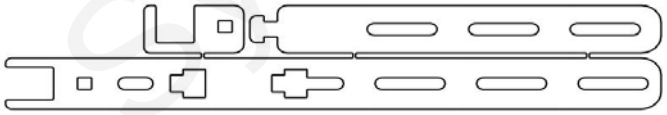


Clamp Bracket



Elbow at end of section, Tee in mid-locations.

400-1966A1 Dual Check Valve Mount Bracket

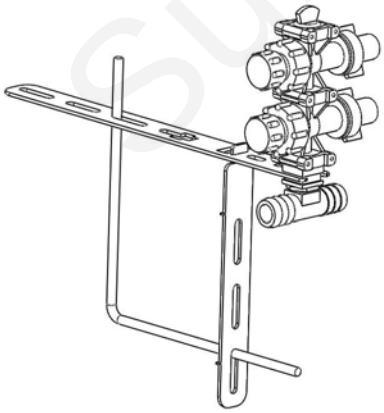


The long, short & clamp bracket come as one part connected by break-off tabs.

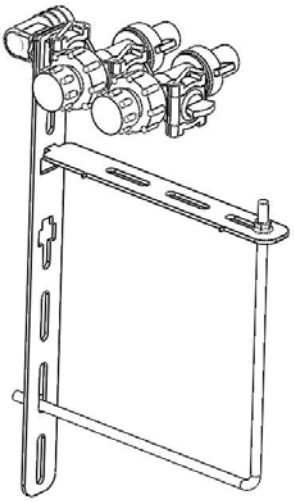
Check Valve Mounting Options

The dual check valve mounting bracket is very flexible to fit many different planter configurations. Three options are shown here to illustrate some of the possibilities.

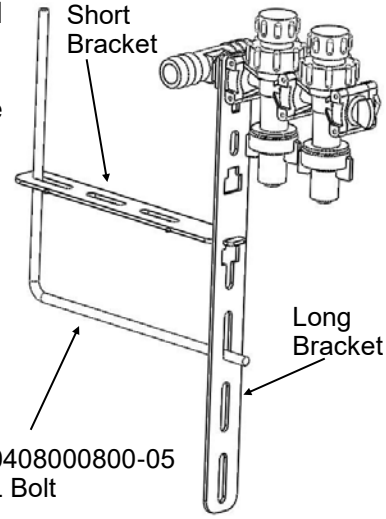
Example 1. Use the long bracket on the top of a bar. The check valve is mounted vertically. The liquid supply hose is ran directly on the front side of the bar. The U-bolt is placed in slots to clamp on a 4x6 inch tube.



Example 2. Use the long bracket on the rear of a bar. The check valve is mounted over the top of the bar. The supply line would run above and behind the bar. The short bracket is placed in the notch to mount the check valve closer to the bar.



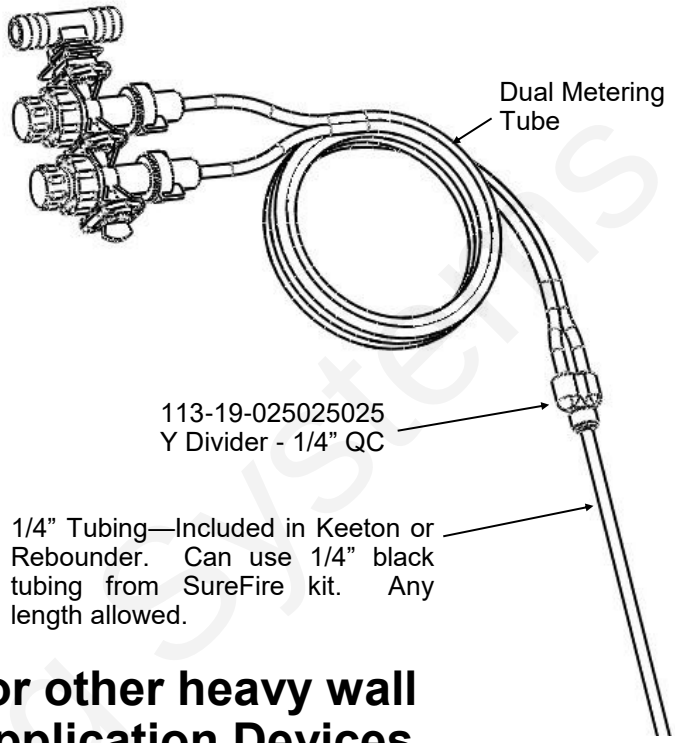
Example 3. Use the long bracket on the front of a 3x7 bar (vacuum tube on some planters). Mount the check valve hanging forward of the bar. The supply line will run directly over the bar. The excess bolt and bracket length can be cut off.



Connection to Keeton Seed Firmer, Rebounder Seed Covers or through thin wall stainless steel tubes

1. Mount the Keeton Seed Firmer or Rebounder Seed Cover.
2. Route the tube included in the above kit as instructed.
3. Attach the 1/4” tube to the 1/4” QC Y divider fitting.
4. Zip all tubing to the planter and row unit in as many locations as possible.

For thin wall stainless steel tubes, you can push the 1/4” black tubing all the way through the stainless steel tube so fertilizer will run directly from the tubing onto the ground.

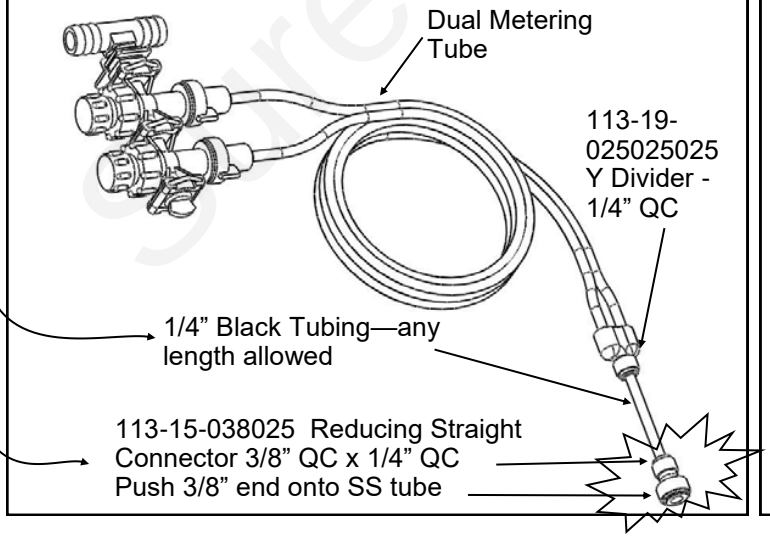


Connection to Totally Tubular or other heavy wall Stainless Steel Tube Ground Application Devices

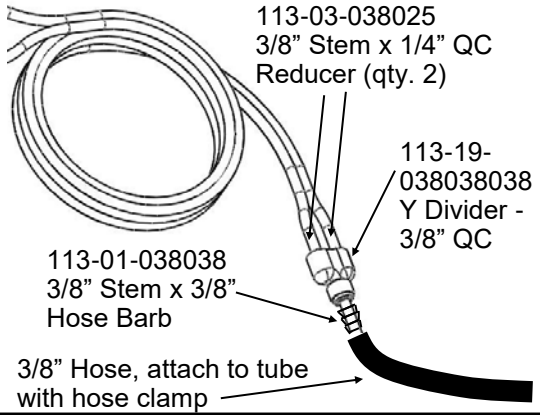
When using a 3/8” OD stainless steel tube to apply fertilizer to the ground, there are two options for the delivery tube plumbing. If the tube ID is less than 1/4” (tubing will not fit inside tube) this attachment method must be used. The description following is for Option 1. See bottom right picture for Option 2.

1. Use the 1/4” x 3/8” QC fitting shown. Push the 3/8” end onto the stainless steel tube. (Hint: if the fitting slips off the stainless steel tube, use sandpaper or a file to roughen the end of the tube slightly)
2. Use a short piece of 1/4” black tubing to connect the Y fitting to the reducer fitting on the stainless steel tube.
3. Zip all tubing to the planter and row unit in as many locations as possible.

Option 1: QC Fitting attaches to SS Tube



Option 2: 3/8” Hose attaches to SS Tube



See the Sentinel Manual, 396-4035Y1, for harness layouts, system setup, module addressing and more about operating the Sentinel Rate Control system.

Scan or click the QR Code to go to the Sentinel Instructional Videos Playlist on YouTube.

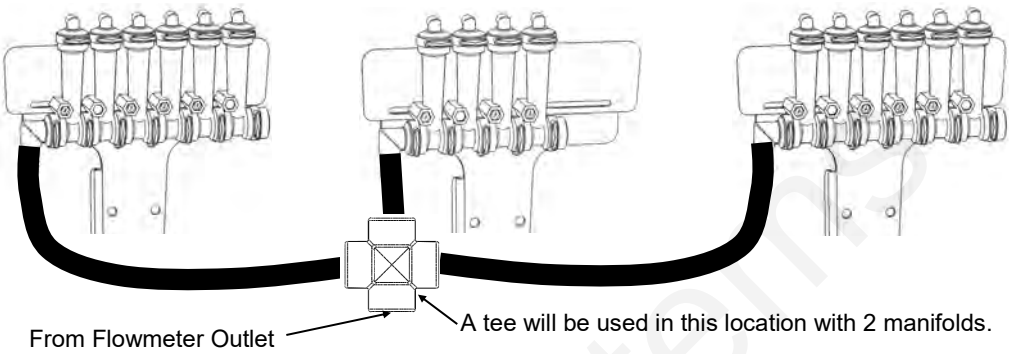
Floating Ball Flow Indicators

E
Installation Overview

Flow Indicators are extremely flexible and can be mounted in hundreds of different configurations on various types of liquid application equipment. This page is to give you some ideas and let you customize the installation for what works best on your equipment.

16 Row
Split 6 - 4 - 6

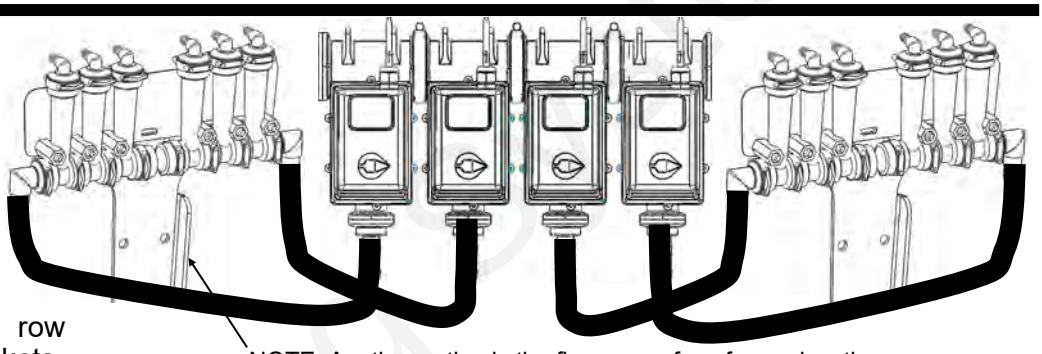
This configuration works well on a 16 row front fold planter. Each flow indicator manifold is shown fed by a cross in a single section installation. Each manifold could be fed by a section valve if desired.



12 Row
Split 3 - 3 - 3 - 3

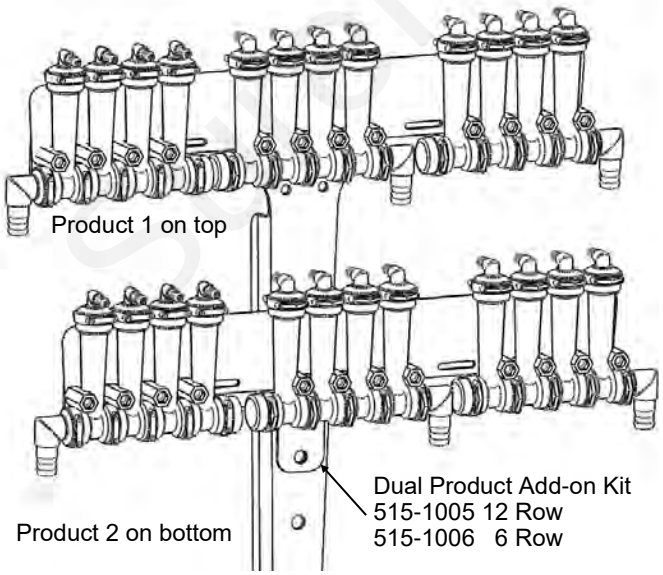
Shown here is a 12 row with four 3 row sections controlled by four section valves. Note each 6 row T-Bracket can hold two separate 3 row manifolds.

A 4 section 24 row could be similar with four 6 row manifolds on two large T-Brackets.

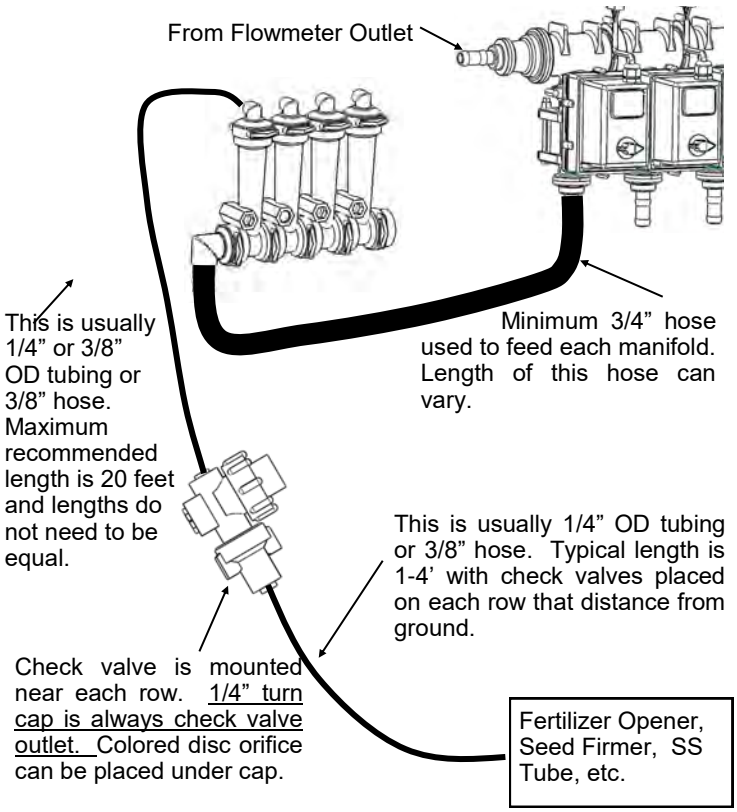


12 Row Dual Product
Product 1 Split 4 - 4 - 4 / Product 2 Split 4 - 4 - 4

In this case each manifold would be fed by a section valve. There would be 6 total section valves (3 sections X 2 products). Most often one set (top) of flow indicators would be Full Flow for high rate fertilizer and 2nd set (bottom) would be Low Flow for starter.



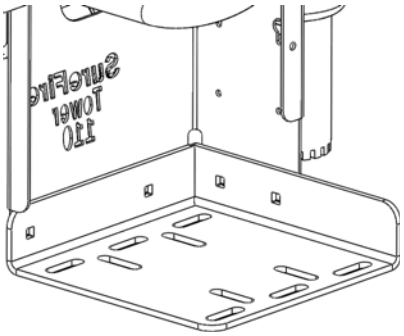
General Plumbing Guidelines



Tower 110 & 200 Mounting Options

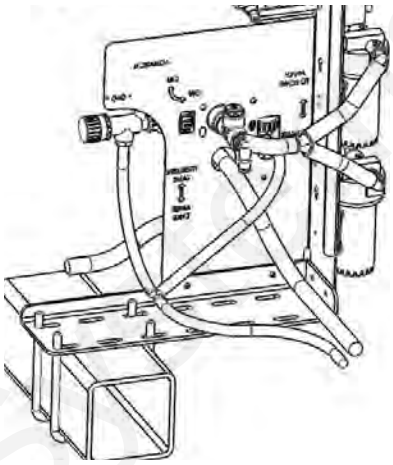
Tower Basic Mounting Bracket
Item Number:
511-1007 (8x16 hitch)
511-1008 (8x12 hitch)

This kit includes a bracket to mount to the top side of a bar or hitch and mount the tower directly over that bar. It is often used on front fold planter hitches. U-bolts to mount to two common hitch sizes are included in the kits as labeled above.



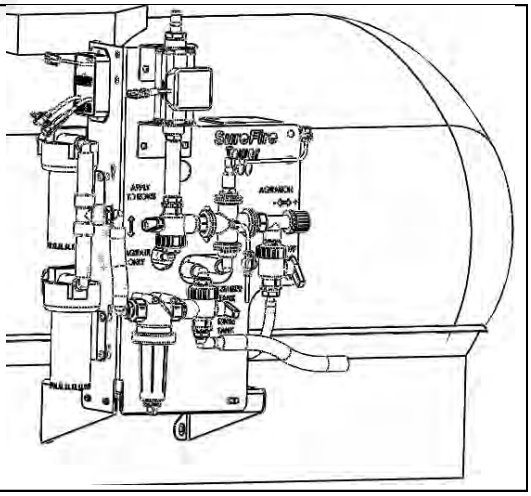
Tower Offset Mounting Bracket
Item Number 511-1010

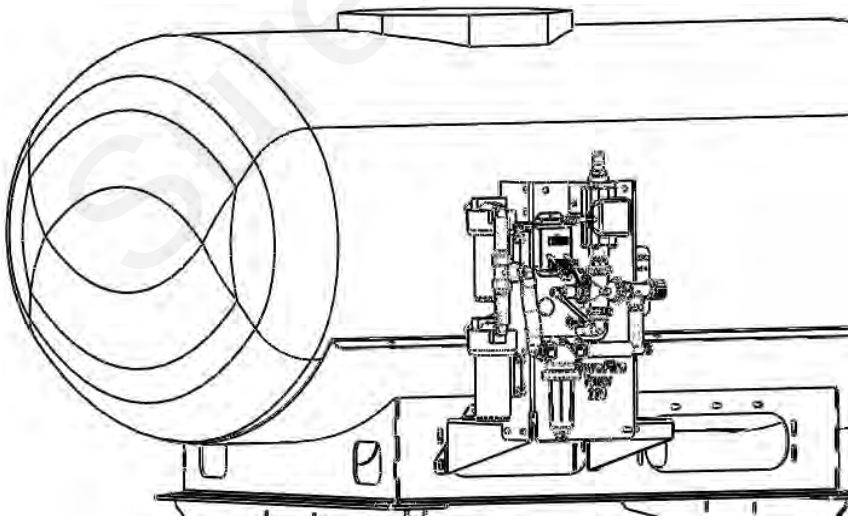
The Tower is available as a stand alone item. This kit includes a bracket to mount to the top side of a bar and hold the Tower . U-bolts are NOT INCLUDED. They must be ordered separately based on mounting bar size. Multiple slots allow the Tower to be mounted away from or directly over the bar.



Tractor Front Mount Elliptical Cradle Tower Mounting Bracket
Item Number 511-1009

Mounts a Tower directly to the front of tractor front mount 200 & 300 gallon elliptical tank cradles. This bracket will mount the back of the tower just over 4 1/2" forward of the flat bracket mounting face. When using a tractor mounted tank, SureFire recommends mounting the Tower near the tank, not back on the implement. Electric pumps work better to push the liquid than to suck the liquid a long distance into the pump inlet.





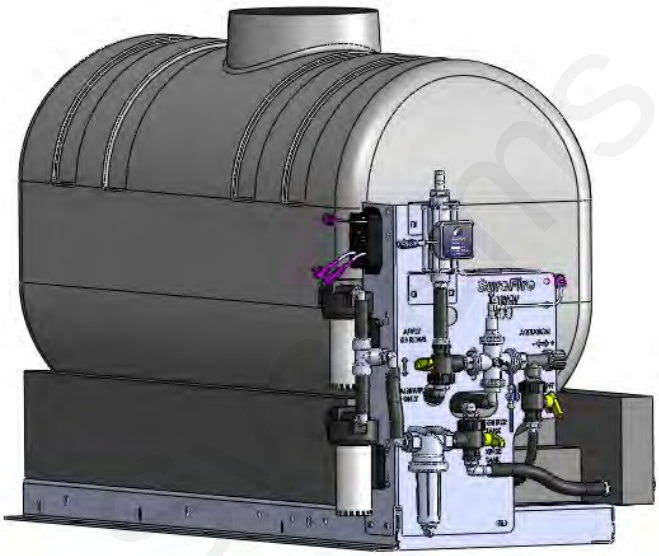
500 Gallon Elliptical Cradle Tower Mounting Bracket
Item Number 526-10-200500

Mounts a Tower directly to the side of the SureFire 500 gallon elliptical tank cradle. This bracket will mount the back of the tower just over 9" forward of the flat bracket mounting face.

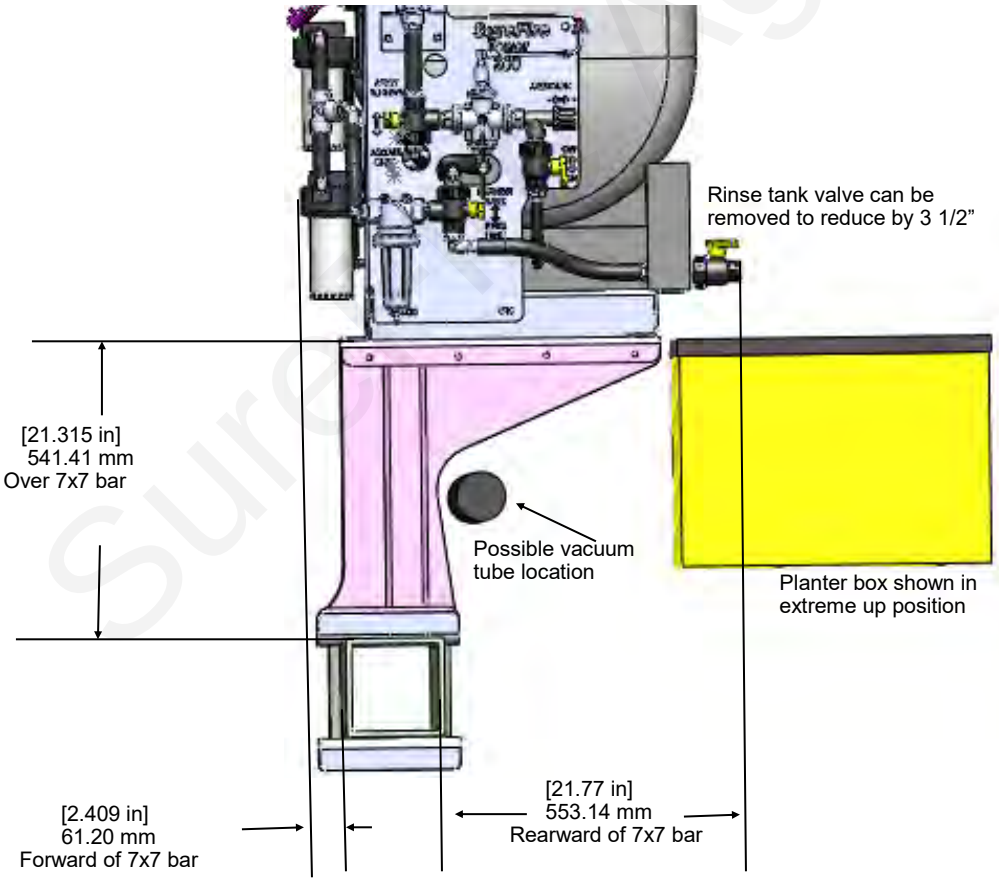
Accelerator with Tower 200 Pump Panel

The Accelerator is a completely assembled and tested fertilizer system. It has a 55, 110, or 155 gallon tank resting in a custom molded tank base that doubles as a rinse water tank. This bolts to a steel frame with eighteen 5/8" mounting slots for flexible mounting to fit many situations. The Tower 200 is often used with the accelerator to work with the rinse tank base.

Dimensions:
55 Gallon: 27" W x 54" L x 36" T
110 Gallon: 28" W x 72" L x 36" T
155 Gallon: 28" W x 72" L x 46" T



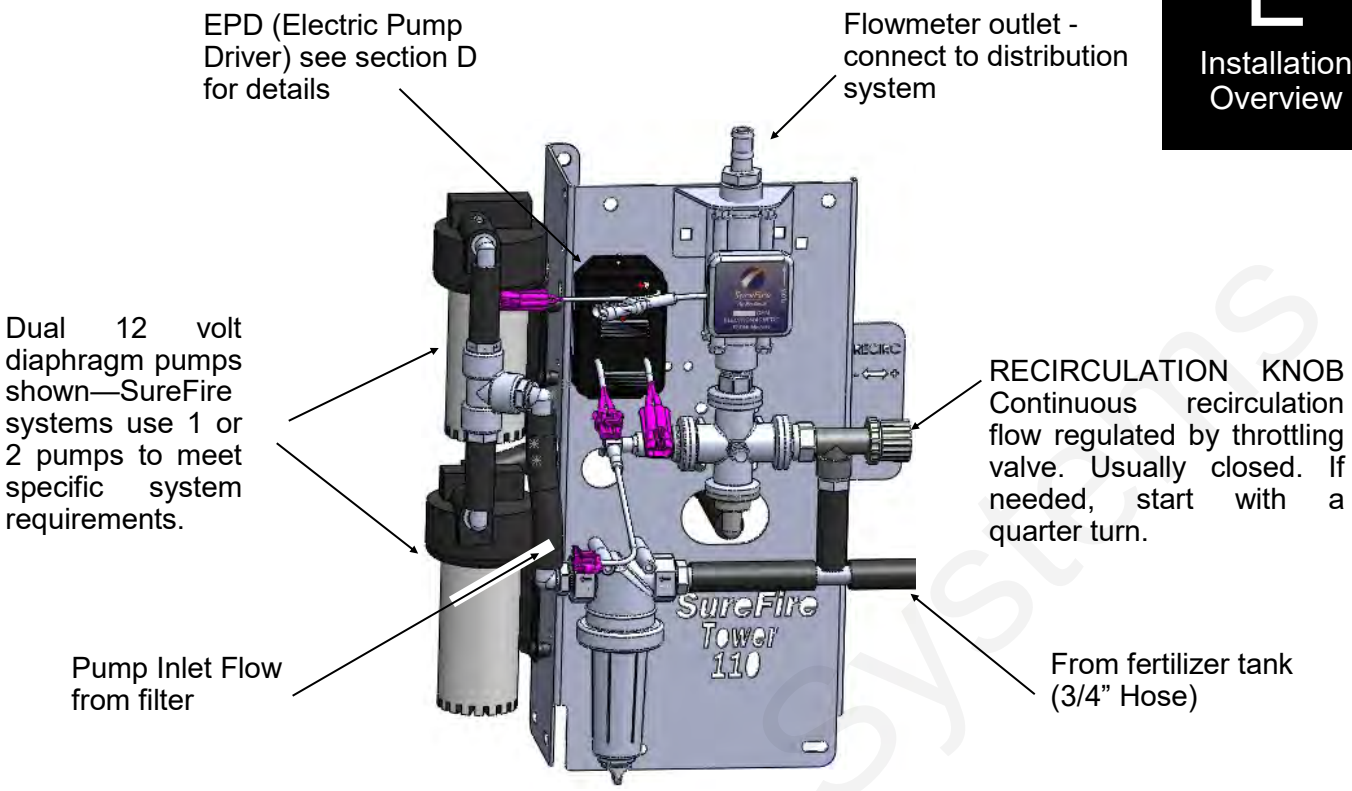
Accelerator Z Mount Kit (fits 5" to 7" wide bars, included bolts fit 7" tall bar)
Item Number 526-01-100300



This mount kit includes two welded brackets to mount any of the 3 sizes of accelerator tanks above and offset from the 7x7 planter toolbar as shown.

Tower 110 Plumbing Overview & Valve Operation

E
Installation Overview



Do I need recirculation flow?

Recirculation flow allows the pump(s) to run faster than if the total pump flow was applied to the ground. This is helpful when operating at very low flow rates. On a Tower 110 equipped with two 5.3 GPM pumps, you likely will NOT open the recirculation valve if applying over 1.5 GPM to the ground.

How to use the Recirculation Adjust Valve:

Follow these steps to set the agitation adjust valve after your system is primed and tested:

1.On the display run an Auto Rate test. Enter your field operating speed and rate. Turn your master switch on. The system will now operate at your Target Rate and Test Speed.

2.Start with the recirculation adjust valve completely closed and note the slow pump speed (by pump noise).

3.Open the recirculation adjust valve slowly and note the increased pump speed and noise. Start with a half turn of the knob. The system is applying the same amount to the ground, the pumps are now running faster due to more recirculation flow.

4.Set the valve to somewhere in the middle based on visual observation of agitation flow needed. (A quarter to a half turn is often sufficient recirculation to speed the pump up slightly.)

5.On your Deere display, verify the system has locked on to application rate at your agitation valve setting.

Troubleshooting:

•If the system can not reach your target, you need to close the agitation adjust valve some.

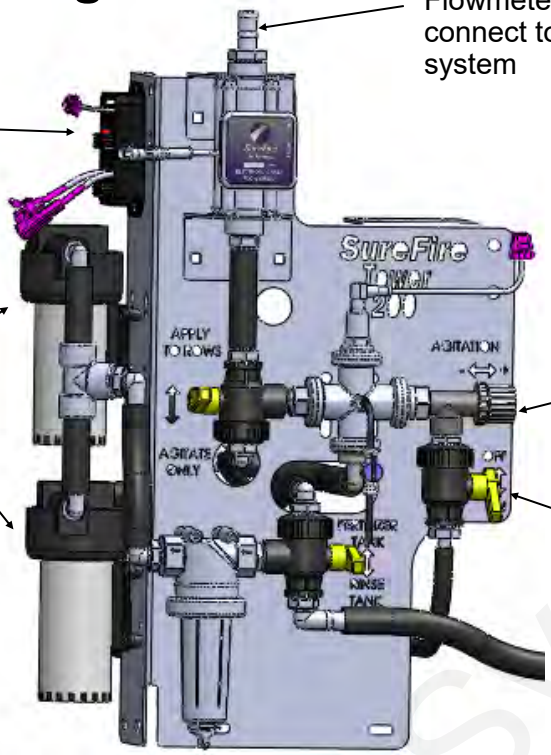
•If the system is applying a rate higher than you want and will not lock on rate, you need to open the agitation adjust valve some. Also check for Low PWM Limit.

•If the rate is still fluctuating around your target and you have a two pump system, unplug one pump. At low flows, one pump may deliver the needed rate and produce a more stable flow.

What if my product needs agitation?

- Tower Electric Pump systems can provide minimal agitation. If more agitation is needed, a separate pump may be needed or the system may need a hydraulic pump. On the Tower 110, simply remove the tee located below the recirculation valve. Connect the main hose from product tank to the filter and connect the tank agitation hose to the recirculation valve. Agitation will reduce the amount the pump can deliver to the rows.

Tower 200 Plumbing Overview



Flowmeter outlet - connect to distribution system

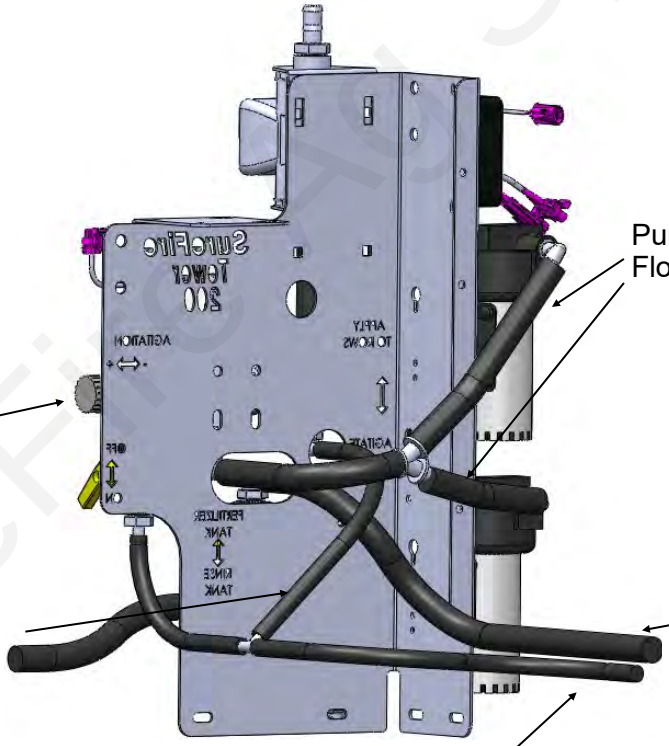
EPD (Electric Pump Driver) see section D for details

Dual 12 volt diaphragm pumps shown—SureFire systems use 1 or 2 pumps to meet specific system requirements.

RECIRCULATION KNOB Continuous recirculation flow regulated by throttling valve. Usually closed. If needed, start with a quarter turn.

Agitation ON/OFF valve

From rinse tank base



Pump Outlet Flow

Continuous Agitation flow regulated by agitation adjust valve

From fertilizer tank (3/4” Hose)

Agitation flow when using agitate only mode to mix prior to application

Agitation return to tank (1/2” hose)

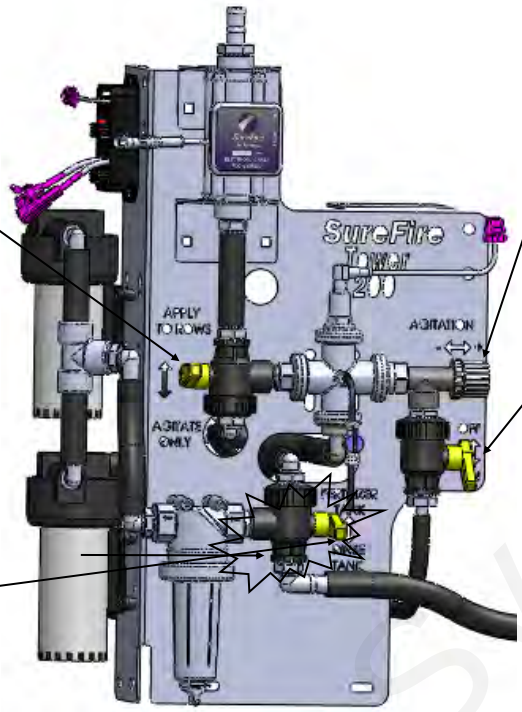
What if my product needs agitation?

- Tower Electric Pump systems can provide minimal agitation. If more agitation is needed, a separate pump may be needed or the system may need a hydraulic pump. Agitation will reduce the amount the pump can deliver to the rows.

Tower 200 Valve Operation

System Mode Valve: This valve selects if you will apply to the rows. Valve must be in the **up position for field operation**. Move down to Agitate Only for tank mixing prior to field operations.

Tank Selection Valve: This valve selects if product is pulled from the fertilizer tank or rinse tank. **For field operation the valve must be up**. Move down to Rinse Tank to flush fertilizer system.



Agitation Adjust Valve: RECIRCULATION KNOB This valve adjusts how much flow returns to the tank while working in the field. Normally closed. If needed, start with a quarter turn.

Agitation On/Off Valve: This valve will shut off agitation flow without the need to move the agitation adjust valve**. <u>This valve must be closed when rinsing the system with product still in the fertilizer tank. If not closed, the rinse water will be injected into the fertilizer tank through the agitation line.</u>**

How to use the Agitation Adjust Valve:

Agitation or recirculation flow serves two purposes. First, it mixes products that will separate. Second, it allows the pump(s) to run faster than if the total pump flow was applied to the ground. The pump(s) will become difficult to control if they are operated at the slowest speed possible. By circulating product back to tank, the pump(s) will run faster, producing a more stable flow at low application rates.

Follow these steps to set the agitation adjust valve after your system is primed and tested:

1. On the display run an Auto Rate test. Enter your field operating speed and rate. Turn your master switch on. The system will now operate at your Target Rate and Test Speed.
2. Open the Agitation On/Off valve.
3. Start with the recirculation adjust valve completely closed and note the slow pump speed (by pump noise).
4. Open the recirculation adjust valve slowly (start with a quarter turn) and note the increased pump speed and noise. The system is applying the same amount to the ground; the pumps are now running faster due to more recirculation flow.
5. Set the valve to somewhere in the middle based on visual observation of agitation flow needed. (A quarter to a half turn is often sufficient recirculation to speed the pump up slightly.)
6. On your display, verify the system has locked on to application rate at your agitation valve setting.

Troubleshooting:

- If the system cannot reach your target, you need to close the agitation adjust valve some.
- If the system is applying a rate higher than you want and will not lock on rate, you need to open the agitation adjust valve some. Be sure there is not a Low PWM Limit.
- If the rate is still fluctuating around your target and you have a two pump system, unplug one pump. **At low flows, one pump may deliver the needed rate and produce a more stable flow.**

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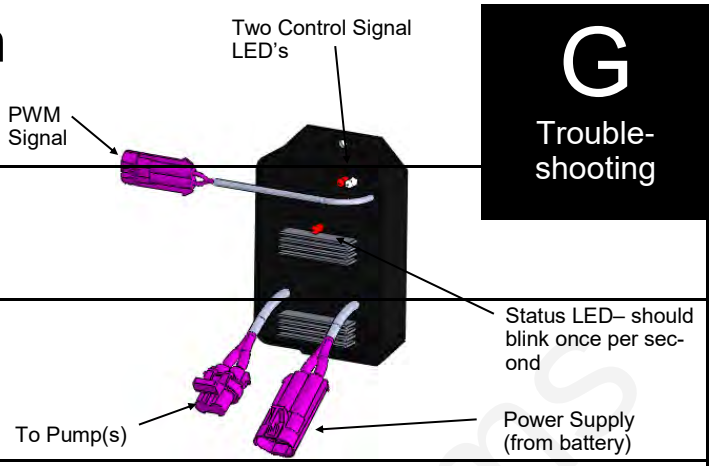
SCAN ME

Electric Pumps Won't Run

EPD Status Lights



Status LED	Status Description	Troubleshooting Steps
On Steady	Power input is good and PWM input Signal is detected	**No Problem, Typical operating condition.**
Steady Blink (1 hz— 1 blink/sec)	Power input is good and PWM signal is not detected.	**Typical 'Off' Condition.** If pumps should be on: 1. Inspect wiring and connectors 2. Check voltage at PWM connector to EPD, should be 1-12 volts to turn on. 3. Check voltage on PWM wires at 37 pin connector, pins 15&16.
Blink once, pause, blink once, pause	Open circuit between motor output and motor.	Check harness and connectors to motor. If using two motors, plug each in separately directly to EPD (bypassing Y-harness)
Blink twice, pause, blink twice, pause	Output short circuit detected.	• Check motor wiring
Three blinks, pause, three blinks, pause	Overcurrent condition	• Check total load • Clean cooling fins on EPD
Four blinks, pause, four blinks, pause	***Input power fault. Low voltage condition in power to EPD.***	***Unplug battery power from EPD to reset. Check power cables and connections for quality.*** ***Be certain that power cable connects directly to battery and has a solid, clean connection.*** • Test the voltage under load coming into the EPD. (See picture on page 21 for voltage test point.) Voltage may appear adequate when system is not on, but bad connectors or wiring may not carry the current needed under load.) • You may be able to reduce power draw by lowering the system pressure. Typically, though, this is an indication of a cable or connector issue.
Five blinks, pause	Input frequency out of range.	Check PWM Settings on Rate Controller.
Control Signal LEDs (top corner)		
Light intensity varies	Off - No PWM Signal 100% brightness - Maximum PWM input signal	Red light in top corner should be on when PWM signal is received (system is applying product)

The most common issue with the EPD *will be a low voltage condition (under load) delivered to the EPD from the battery. Voltage drop occurs anytime current is moved through a wire. A low-voltage (12 v) system with long runs (60-80 feet) may have unacceptable voltage drops if any part of the system is weak or the load is high. This could be bad (corroded, weak, loose or burnt) connectors (at the battery, at the hitch, and at the EPD), too small of wire used (smaller wire equals more voltage drop), low source voltage, and heavy load. Any or all of these may contribute to a low voltage condition under load that may shut down the processor in the EPD module. This will be indicated by 4 quick flashes of the red light, followed by a short pause. Unplug the power-in connector to reset the EPD. Check and correct any wiring deficiencies.*

Troubleshooting / Service Guide for SureFire PWM Liquid Application Systems and *JD GRC*

Always verify the controller settings. See the screenshots in Section F of the system manual and on the QuickStart setup sheet.

The pump won't run.

Electric Pump System

EPD flashing 4 times

1. Find the EPD module (electric pump driver—black module on Tower). Should have a steady blinking light (one blink per second) in the middle when pumps should be off. In Run mode, the center light should be steady red, the upper right should be steady red (indicates it is receiving a PWM signal). If Status LED (center light) is *flashing 4 times, then pausing*, EPD has tripped due to low voltage condition. Unplug the Power Supply to the EPD to reset. If condition persists, check Power Supply cables from battery to EPD to insure solid connections and good electrical path. Check connections at battery. Check connectors at the hitch and at the EPD. (*There should be 11.5-13 volts at the point where the EPD connects to the battery power harness, when **tested under load**. This voltage may show up when there is no load, but the harnessing may not be good enough to deliver 11.5-13 volts under load.)*

No Lights on EPD

1. There should be a steady blinking light in the middle of the EPD. If no light is ON, check the 40-amp fuse in the EPD harness near the battery. Use a voltmeter to verify that there is 12-13 volts at the Power Supply connector that plugs into the EPD. *If there is good voltage here, but no light on the EPD, replace the EPD module.*

Will pumps run?

1. Connect the two large connectors that are plugged into the bottom of the EPD to each other (bypass the module and supply 12 volts directly to pumps).
2. Do the pumps run? If not, check the 40 amp fuse in the EPD harness near the tractor battery. Inspect harnesses and connections. If 2 pump system, plug pumps in by themselves to check individually. If pump won't run, connect it to pickup battery with jumper cables.

Pumps run, but won't pump anything—

1. Are valves from tank to pump open? Is strainer clean? Close recirculation. Open air bleed valve.
2. Tap on pump with rubber mallet. Pour water (hot, if available) in inlet of pump. Remove outlet hose from pump.

Electric pumps only run with 12 volts direct from battery

Check to see if a PWM signal is getting to the EPD:

1. Connect pumps and power harness back to EPD.
2. Go to **Manual Operation Mode** to investigate this issue.
3. In Manual Operation Mode (DUTY CYCLE = MAN), enter a Speed and Rate, set the PWM Duty Cycle to 100%. Turn Section Control to MAN. Turn Master ON.
4. Remove PWM valve connector at EPD and check voltage. (PWM Duty Cycle at 100 should be 12+ volts on PWM signal)
5. If 12 volts is not present, check harnesses and review control valve type setup.
6. Go back to the 12-pin Deutsch pump connector, check PWM voltage between Pins 5 & 6 (check pins 5 & 2 if wires on PWM connector are Yellow and BLACK).

Application Rate & Flow Troubleshooting

G
Trouble-shooting

Application Rate Fluctuates

First, you need to determine if the fluctuation is caused by the controller sending fluctuating signals to the valve.

1. **Inspect & clean pump inlet strainer.** Strange flow rate fluctuations are very often due to an obstruction to the pump inlet. Inspect plumbing from tank to pump.

OR

1. Run the system in Manual Mode (try various PWM Duty Cycle %s).
2. Turn the system on and watch the flow in GPM.
3. Is the flow steady within a very small range? For example a fluctuation from 2.3 to 2.5 GPM would be considered normal. A fluctuation from 2-4 GPM is a problem. If only a small normal fluctuation is seen, skip steps 4-8 and proceed to "Application Rate Fluctuates in Field …….. " below.
4. If there is a large fluctuation, observe the system flow. Is the discharge a steady stream? Are the flow indicator balls floating steady?
5. If visually the flow is steady, but the display reports a fluctuation in GPM, inspect the flowmeter. See section B for flowmeter information.
6. If visually the flow is unsteady, the flowmeter is working correctly reporting a flow problem. Is the pump turning steady or surging?
7. Look for any type of obstruction in the pump inlet. Clean the strainer. If continually plugging the strainer, investigate fertilizer quality and necessary strainer size.

Application Rate fluctuates in field, but flow in Section Test mode is stable.

This problem indicates the valve calibration needs changed. The system is surging because the Rate Controller is moving the pump driver too much.

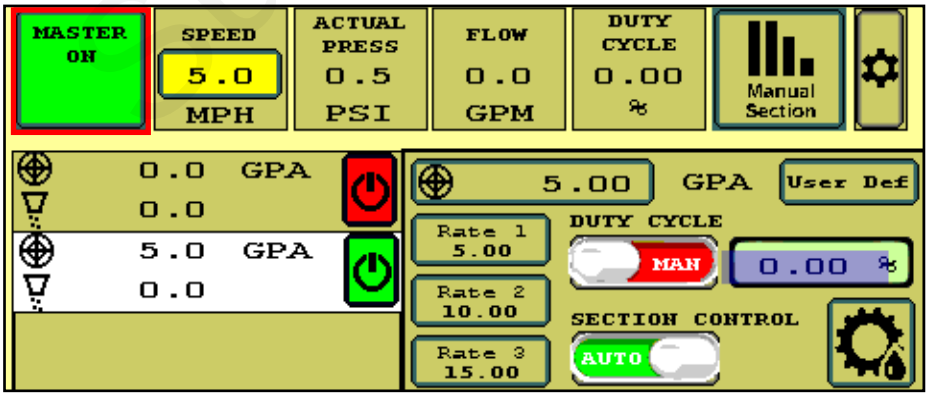
1. Go to **Setup - Control Speed**.
2. Change the Control Speed **Valve Calibration** by reducing the valve speed . Try reducing it 500 at a time. If this number is too low, the system will be slow to respond to speed or rate changes.

Application Rate is slow to get to the Target Rate

1. Check the Recirculation knob. If this is open, it will take the pump longer to get the system to Target Rate. Normally, the recirculation should be closed.
2. You may need to increase the **Control Speed**. Go to **Rate Control > Setup Tab**.
3. Change the **Control Speed** by increasing the valve speed (increase 500 at a time).
4. If system is too slow to get to the Target Rate when starting, increase the Start Boost.

See the Sentinel Manual, 396-4035Y1, for harness layouts, system setup, module addressing and more about operating the Sentinel Rate Control system.

Scan or click the QR code to see Sentinel Instructional Videos:



Manual Operation Mode:

1. Speed
2. Rate
3. Duty Cycle - MAN - enter 30+%
4. May need Section Control - MAN
5. Master ON

No Flow shown on display, but liquid is being pumped

Flowmeter Tap Test

See which flowmeter connector you have

Remove red guard to reach pins. Don't break red side clips.

Flowmeter pinout:

3-pin MP Tower	**A- Signal**	**B- 12V Power**	**C- Ground**
3-pin AMP SuperSeal	**1– Ground**	**2– 12V Power**	**3– Signal**

1. Unplug the flowmeter. With voltmeter, check for **12 volts between Power & Ground** of flowmeter connector. Should have **4-5 volts (might be 9v) between signal and ground**. If voltage is not present, inspect wiring harness and check for voltage at harness connection(s) nearer the Rate Controller (at 12-pin Deutsch connector, Power is 1, Ground is 2, Flow Signal is 3).
2. If 12 volts is present, then conduct a **tap test**. Go to the **Setup** Tab and change the flow cal to 1. Have a second person watch GPA on the Diagnostics tab while other person taps repeatedly (use a short piece of wire or a paper clip) between signal and ground pins of flowmeter connector. A flow value (GPA) should show up indicating the wiring is not damaged.
3. If the flow showed on the display during the tap test, your wiring to that point is good. If tap test did not work, go back to the next harness connection and do a tap test there between signal and ground.
4. If the tap test registers flow on the display, replace flowmeter. (*Sometimes, cleaning the inside tube of the flowmeter with soapy water and a soft brush will remove a film covering the electrodes.)*
5. Change Flow Cal back to appropriate Flow Cal when finished with Tap Test.
6. SureFire has a Speed/Flow Simulator (PN 219-01462) or a Tap Tester (212-03-3912Y1) that can be used to confirm if the wiring is good between the flowmeter and controller.

Field Verification of Flowmeter Calibration

Always verify the flow cal setting by comparing the amount actually applied in the field (from weigh tickets) with the amount shown on the display. Adjust the flow cal as needed to get less than 1% difference between the actual amount applied and the amount shown on the display.

In general:

Increase the Flow Cal number if not enough product is actually being applied. *(If you want more, increase the number)*

Decrease the Flow Cal number if too much product is being applied. (*If you want less, decrease the number)*

Formula to Adjust Flow Cal Number

(Volume shown on display) / (Volume actually applied) X flow cal number in display = new flow cal

Example: Display shows 727 gallons was applied. Weigh ticket shows 750 gallons was actually applied. Flow cal number in display was 3000. *(We applied too much, so we will decrease the flow cal.)*

727 / 750 X 3000 = 2908 (new flow cal number to set in display)

(*Any adjustments to the flow cal number will only be as accurate as the measurements used in figuring it.)*

Do not power wash the flowmeter.

Unplug the flowmeter before welding on the implement.

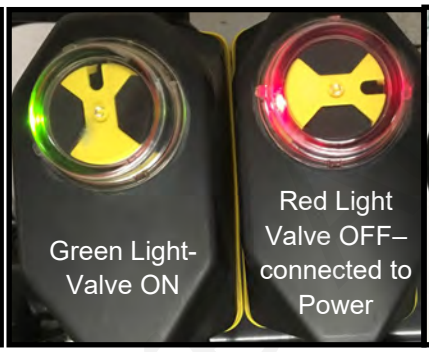
Section Valve(s) will not move

1. Go to **Manual Operation Mode.** May need to turn Auto Section Control to Manual.
2. Go to Manual Valve Operation. Turn each valve on and off.
3. If none of the valves are working, or if half of the valves are working, it may be a Power (or Ground) issue. The odd-numbered sections have one power source, the even-numbered sections have another power source. (See harness diagrams)
4. If a valve does not open, switch the connector that is plugged into that valve with a connector that is plugged into a working valve. Also, plug in the connector to the non-working valve to a valve that is working.

Pin	Function
A	+ 12 V Constant
B	Ground
C	+ 12 V Signal

5. Check the harness connection to the non-working valve. It is a 3-Pin Weather Pack connector. Check voltage pin A to Pin B. Must be 12 volts, if not, go back to the next harness connection and check the voltage there. (See harness diagrams for pins)
6. If voltage is present on pins A&B of 3 pin connection to valve, then check Pin C to Pin B. This should be 12 volts when the valve is commanded on or open. This should be zero volts when valve is off or closed.
7. If signal voltage is not present to open valve, use diagrams to check at the 14-pin connector, then the 47-pin for voltage on the proper pin for that section.
8. If harnesses and voltages are good, but valve still will not open, remove the actuator from the valve and see if the actuator will work when it is not connected to the valve. Use a wrench to turn the valve to be sure it is moving freely. Be sure actuator and valve are oriented correctly when you put them back together.
9. If constant voltage (Pins A&B) and switched voltage (Pins C&B) are present, inspect, repair or replace the valve.

If valve indicator stays GREEN all the time or if valve indicator is not in full ON or full OFF position, replace actuator. Pull gray pin to remove actuator from valve.



Replacement Valve Actuator—**104-KZ1169**—KZ Electric TX2 Series Actuator

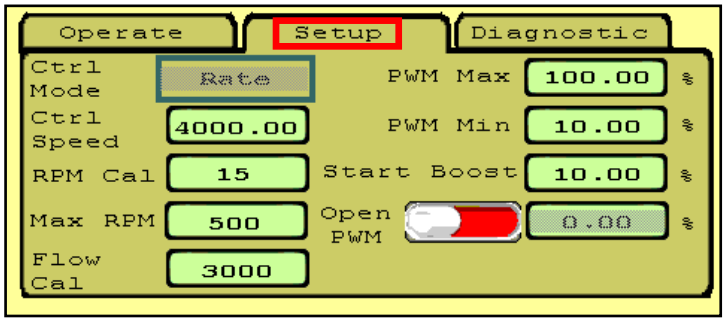
This is a 3-way valve. If product will not flow when valve is ON, either move the outlet hose to the other outlet port, or remove actuator and rotate valve ball 180º, and replace actuator. Product should flow through the port closest to the Indicator light when the valve is open (green).

Pressure Sensor is not reading

1. Make sure the pins where the harness screws on to the end of the sensor have not been bent.
2. There should be a green LED light on the end of the pressure sensor. This may be difficult to see in daylight. The sensor needs 12 v. Check between pins B&C on the Pressure 1 connector on the harness. If there is no voltage here, check the voltage between pins 1 (power) and 2 (ground) if you have a 12-pin pump connector. (Check pins 11 (ground) & 16 (power) on the 16-pin connector labeled PUMP on the legacy harnessing.)
3. **Testing Pressure Sensor Harnessing:** If the pressure sensor is not reading, you can use a AA or AAA battery to test the harnessing. Connect the (-) end of the battery to pin C and the (+) end to pin A of the pressure connector. The 1.5 v should show up as 30 psi on the screen.

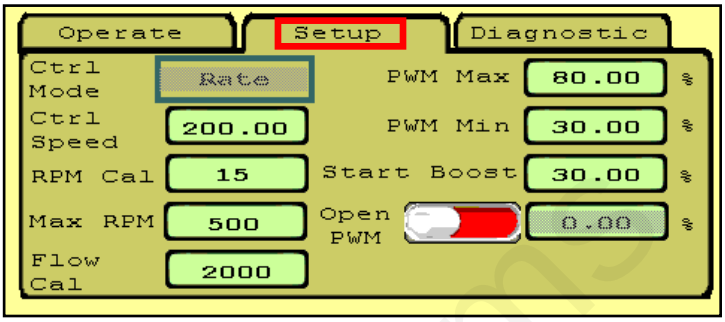
Sentinel HOME Screen for Rate Control -- Setup and Diagnostic Tabs

Setup values are shown for typical **electric** pump system. These can be adjusted as necessary for best operation.



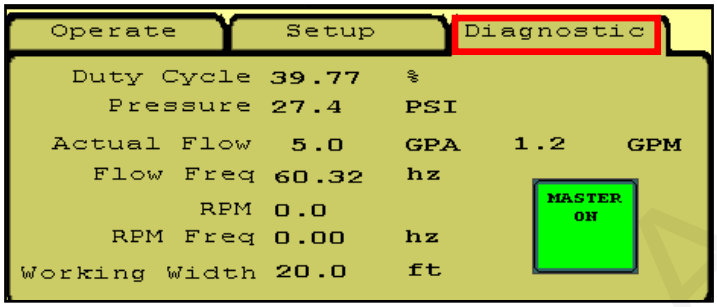
Ctrl Speed: Decrease if pump surges or oscillates back and forth above and below the rate. Increase if pump is slow to adjust.
RPM is not used with electric pumps.

Setup values are shown for typical **hydraulic** pump system. These can be adjusted as necessary for best operation.



Flow Cal can be adjusted slightly if an accurate catch test or field verification indicates it should. Increase Flow Cal if more product is needed. Decrease flow cal if less product is needed.
Decrease **PWM Min** if pump will not slow down enough for low speed/rate/width.

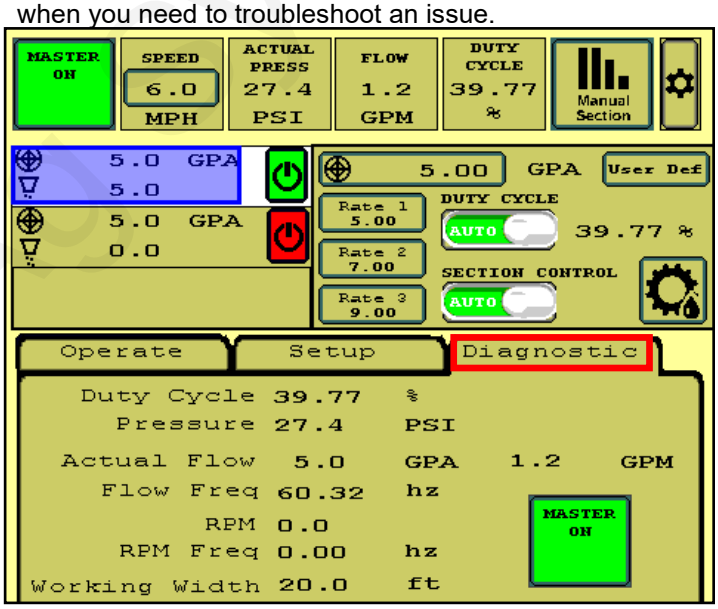
Diagnostic is a screen that can be seen while operating in the field or while testing. The important system parameters can be seen here.



Diagnostic Tip: Note the relationship between Duty Cycle (%), Pressure, Flow (GPM), and RPM (hydraulic pump). If Duty Cycle and RPM increase above what Is normal for a given flow, there could be a restriction on the inlet side of the pump. This could be a plugged strainer or a strainer that gets gelled over, especially with cold fertilizer.

Increased Duty Cycle with no increase in RPM could mean the pump is not getting enough hydraulic flow to spin the pump faster.

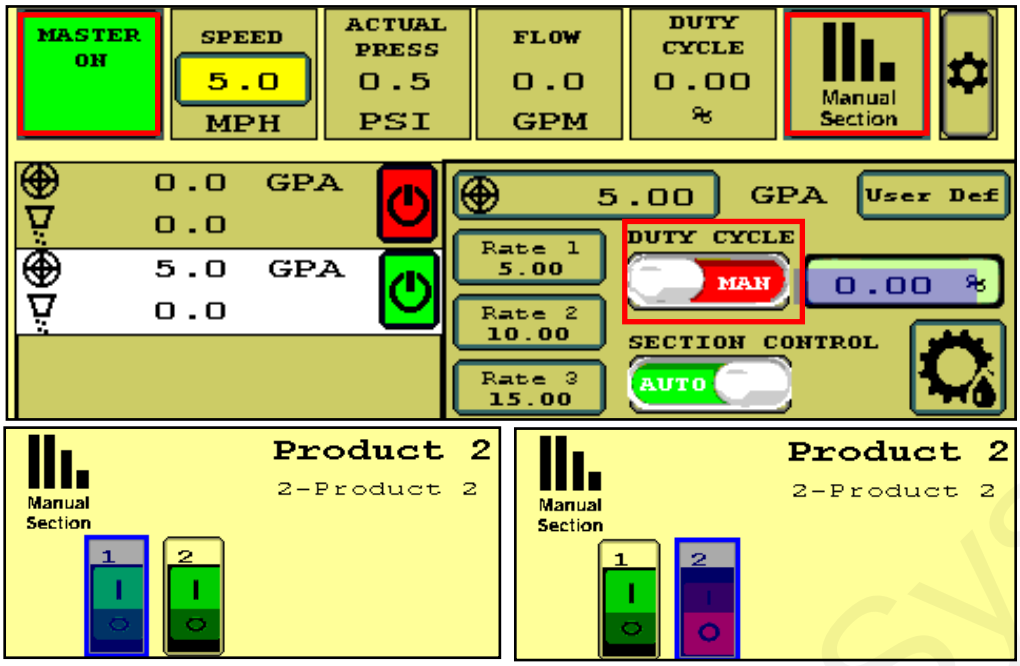
Check the **Diagnostic** screen regularly so you have an idea what “normal” operating numbers are. This can help when you need to troubleshoot an issue.



Diagnostic: (PWM) **Duty Cycle** shows the PWM signal sent from the controller to control the pump. On a hydraulic system, this needs to be around 30% before the pump will run. 40%- 50% is a typical operating range. On a normal pass this should be fairly stable (± 2%). The Duty Cycle will adjust for speed, rate changes or width changes (sections going on and off).
Actual Flow shows the GPA being applied based on the Speed and the Machine Width.
Flow is the GPM measured by the flowmeter.
Flow Freq shows the number of pulses per second (hz) being received from the flowmeter. This should be fairly stable (± 2). When diagnosing flowmeter issues, watch this number during a tap test to see if the signal gets from the flowmeter harness connector to the display.
RPM shows the pump RPM on a hydraulic pump equipped with an RPM sensor. This should be less than 500. Can be set at 550 if maximum pump output is required. **RPM Freq** shows the signals received from the RPM sensor. This can also be used during a tap test.
Watch these values regularly during operation so you know what “normal” looks like. For example, a plugged strainer could mean the pump has to run faster than normal to get enough product. This will show up in an increased Duty Cycle and RPM.
Working Width will change as sections turn on and off. It should show the application width at any time.

Sentinel Rate Control Troubleshooting

Section Test or Manual Section Valve Operation and Manual Pump Operation

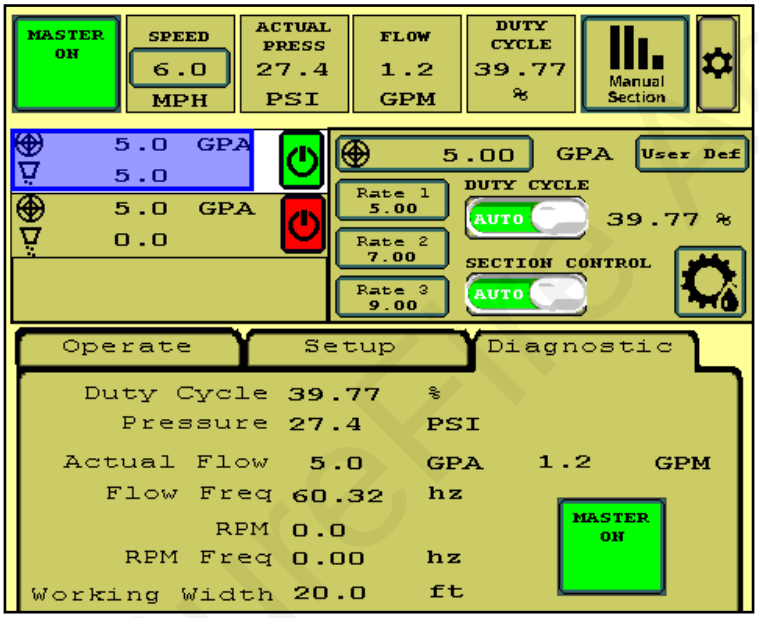


To operate the Section Valves manually, press **Manual Section**, then press any section button to turn the valve off/on.

To test the valves sitting still, put **DUTY CYCLE to MAN, MASTER** must be ON, and there must be a **SPEED** entered to actually open the valve.

To run the pump while doing this, enter a number for the Duty Cycle %. The Flow (GPM) and Pressure should be steady. Adjust DC%.

AUTO Test Operation



1. Enter a **SPEED** (tap the box and enter).
2. Select a **RATE.**
3. **Master ON.** May need to turn Auto Section Control off.
4. Adjust SPEED and RATE to test range.
5. Observe Flow (GPM), Pressure, and Duty Cycle %. On hydraulic pump observe RPM.
6. When testing with water, the pressure will be much less than it will be with a heavier fertilizer. You may have to increase the rate significantly to open all the check valves so all rows will flow.
7. You can go to Manual Section (on the top row) and close some sections to see system response.
8. If Duty Cycle / Rate / Flow oscillate and won't lock in, decrease the Control Speed on the Setup Tab (adjust electric pump by 500, hydraulic by 50). Adjust Control Speed as needed for best field performance.

System Won't Run

1. Is MASTER ON? Is there a SPEED? Is there a RATE? Switch Section Control from AUTO to MANUAL.
2. On **Hardware** screen, uncheck TASK CONTROL. If you have TASK CONTROL checked on the Sentinel, Task Control must be activated and turned ON on the display software.
3. Verify settings for Master Switch and Implement Switch. If these boxes are checked, these items must be plugged into the Sentinel harnessing, not into harnessing for another control module. If using an IMPLEMENT SWITCH for Sentinel, is the orientation correct (check arrow on MASTER ON button)?
4. If there is a DC% showing, but the pump is not running, check the hydraulics or the EPD on an electric pump system. Verify there is voltage on the 2-pin PWM Connector.

Recommended Care and Maintenance

H
Maintenance & Parts

Winterization

SureFire recommends flushing your fertilizer pump and complete system with adequate amounts of water first. Next, use RV antifreeze to winterize your system by pumping an adequate amount through all components. At the beginning of the next season, begin with water to verify the system is in working order with no leaks.

Clean all harness connections.

Inspect Electric Pumps

The electric pump and motor is a completely sealed component. Over time the electric motor will lose efficiency. The entire pump and motor will need replaced when it won't efficiently produce the flow required.

Each individual pump should be able to produce 4 gpm of water flow with an open outlet (zero pressure). If pump falls short of this specification, replace to ensure a trouble-free fertilizing operation.

You can test the operation of each pump individually by unplugging one pump and running one pump at a time. Compare the output of each pump to each other and to the standard above.

Pre-season Service

(A little time spent here may prevent some downtime when you want to be rolling.)

1. Visually check entire system (hoses, fittings, harnesses, etc.) for any signs of wear or trouble. Be sure pins are clean, not corroded, and are making good contact.
2. On the display, recheck all setup screens to verify correct setup.
3. Fill system with water and run in Manual mode to verify components and system are in working order. (May need to open air bleed valve to prime pump the first time. Be sure recirculation knob is closed.)
4. Unplug one pump at a time to verify that each pump is operating as it should. Check GPM output of each pump.
5. Tighten all clamps. Loose clamps may be evident by leaks on the output side of the system. Loose clamps from the tank to the pump are not always apparent, but can be sources of air getting into the system which can create issues.
6. Push in all QuickConnect (QC) fittings to be sure the tubes are tightly seated. QC fittings that are not sealed can cause check valves to leak.
7. Remove the black cap from the top of each check valve. Check the diaphragm to be sure it is intact and not gummed up with residue. Look under the diaphragm for debris. Compress the spring in the cap to be sure it moves freely. Carefully replace diaphragm and tighten cap.
8. Remove and clean the strainer. Be sure strainer is tightened securely so it will not suck air.
9. Be sure all rows are flowing and that all metering tubes/orifices are open. (Note: It will take a higher flow rate with water to create enough pressure to open all the check valves so that each row will flow.)
10. Run system with an Auto Rate Test with speed and rate to be used in the field.

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