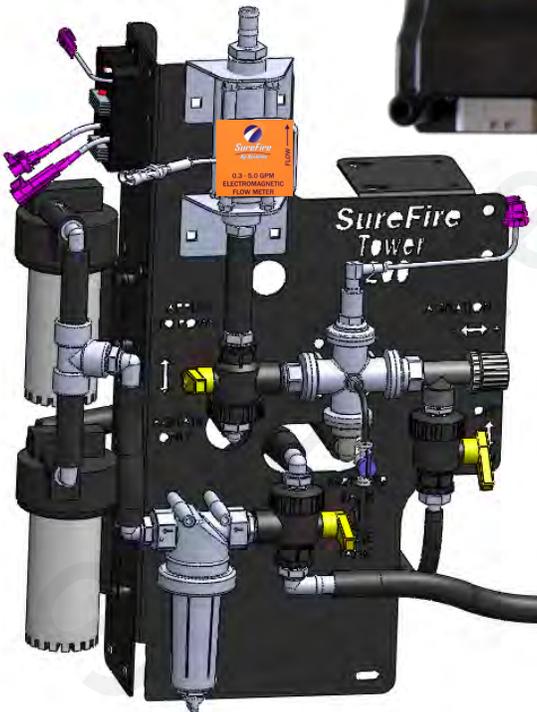


396-3814Y1



Tower Electric Pump Fertilizer System for Raven Rate Control Module (RCM)



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



SureFire Ag Systems



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396-3814Y1

SureFire Tower for Raven RCM—PWM Control

Revised 02/22/2022



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

This system uses hydraulic equipment with hydraulic fluid under extremely high pressure.

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

SAFETY IS YOUR RESPONSIBILITY.

YOU are the key to safety.

It is YOUR responsibility to read and understand the safety messages in this manual.

This system may be used to 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 in-cab display and Raven Rate Control Module (RCM). The RCM 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 optional section valves to minimize overlap. The RCM is capable of controlling up to 5 products depending on the exact situation. So, the same RCM that controls this PumpRight system could control additional liquid, dry or anhydrous ammonia products on your equipment.

You will need a SureFire RCM adapter harness to connect the RCM to the product harness(es). Setup instructions will be furnished with the adapter harness so all the products controlled with a single RCM controller will work properly.

You will use the Virtual Terminal (VT) or Universal Terminal (UT) software on your display to view the RCM on your screen.

Basic Installation Steps

1. Mount the Raven RCM and connect it to the Implement ISOBUS.
2. Open the packages and familiarize yourself with the components. See the System Overview Example on the following page 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 and make hydraulic connections. See section E for hydraulic plumbing information.
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, manifold inlet. Attach section valve outlets to flow indicator inlets.
7. Attach harnesses as shown in Section D.
8. Set up RCM for SureFire fertilizer system as shown in Section F or in the setup instructions sent with the RCM adapter harness.
9. Fill system with water, conduct initial operation and tests per Section F or in the QuickStart instructions.
10. Winterize system with RV Antifreeze if freezing temperatures are expected.
11. Do pre-season service each year as described at end of manual.

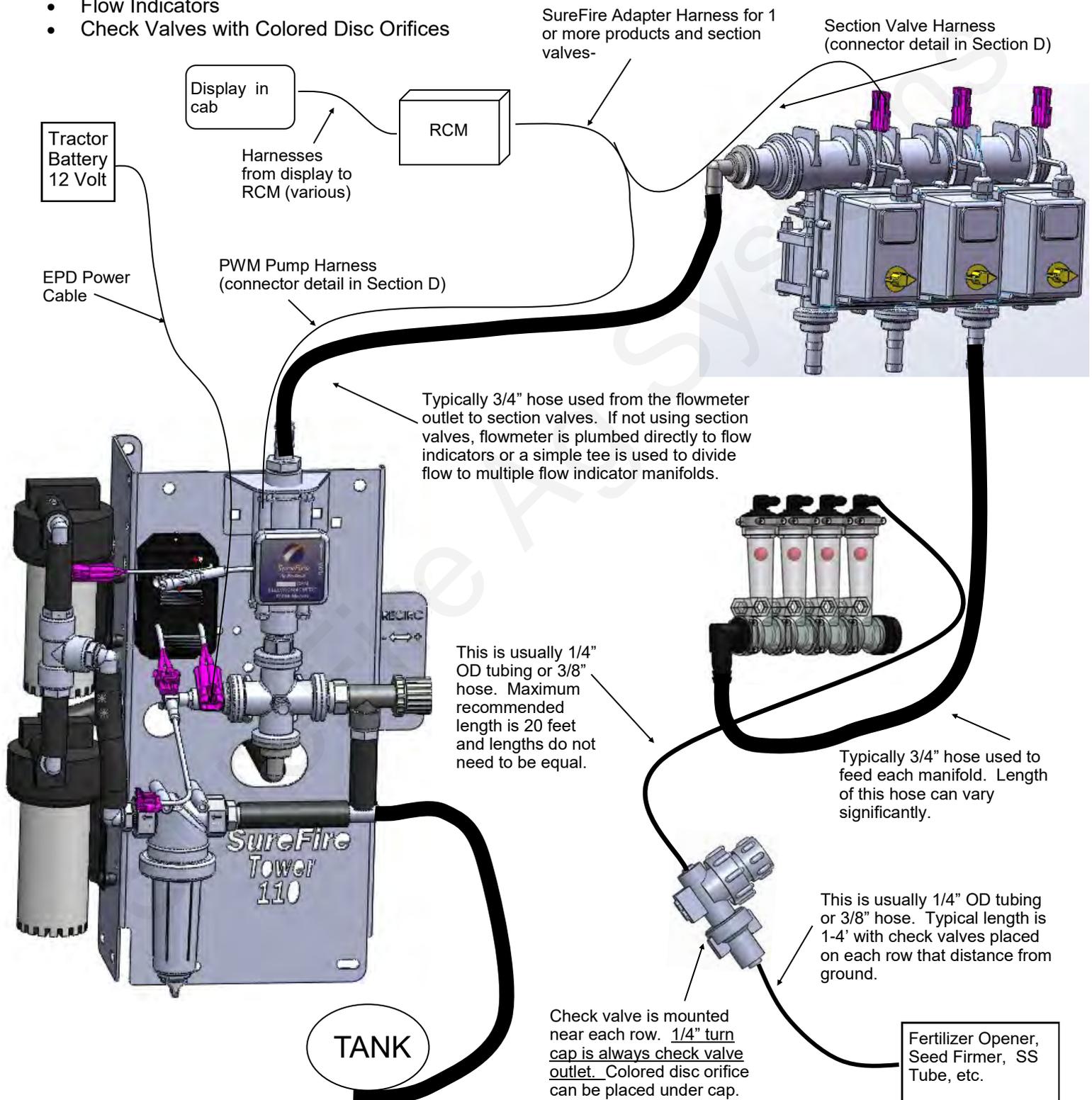
System Overview - Example 1

A

Introduction

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

- In-cab display
- Raven RCM
- Tower 110
- Section Valves
- Flow Indicators
- Check Valves with Colored Disc Orifices



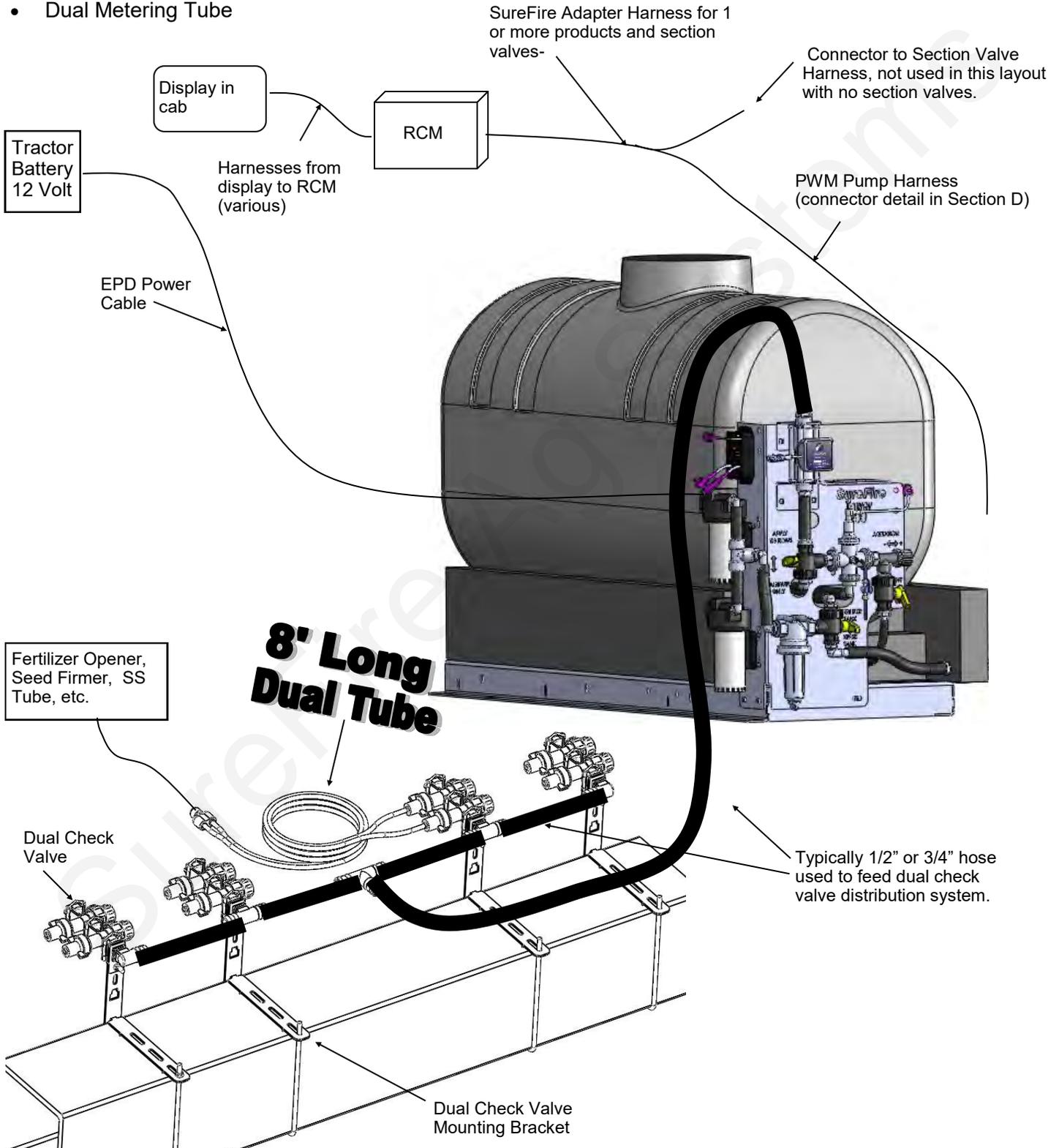
System Overview - Example 2

A

Introduction

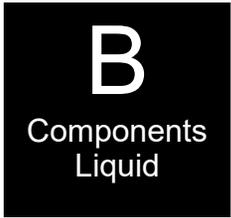
The following gives an example of a complete SureFire Fertilizer system with these components:

- In-cab display
- Raven RCM
- Accelerator with Tower 200
- Dual Check Valve Distribution System
- Dual Metering Tube



Electromagnetic Flowmeter Kits

0.13 - 2.6 GPM Kit Number 500-02-2040 FM 204-01-46211CUF00
 0.3 - 5.0 GPM Kit Number 500-02-2050 FM 204-01-46211CUF01
 0.08 - 1.6 GPM FM204-01-46211CUF05



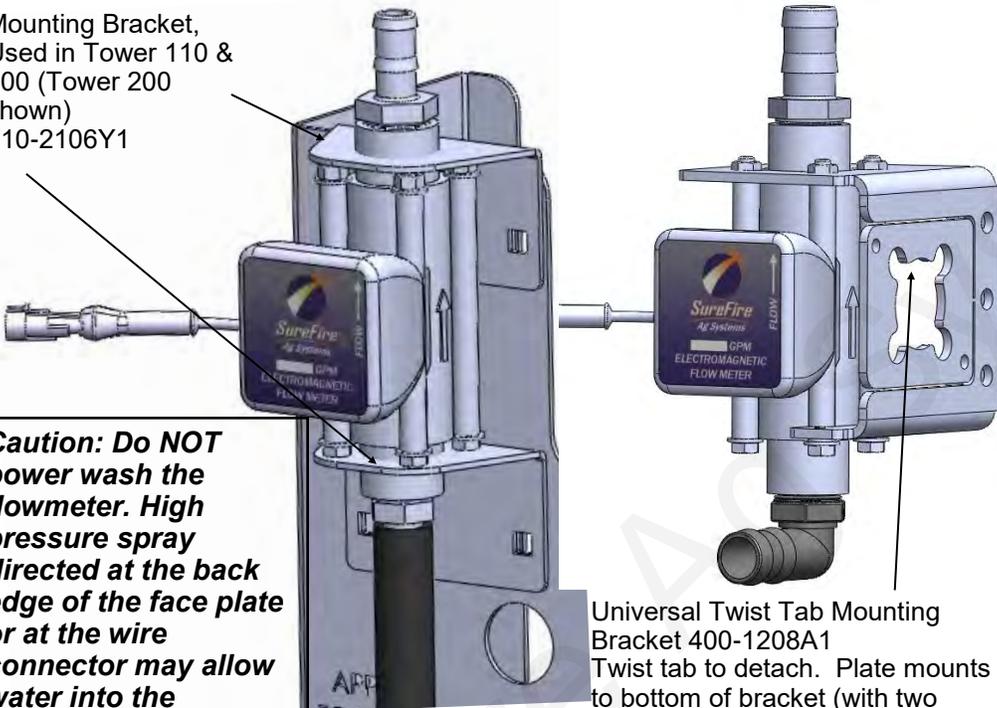
Kits include flowmeter, mounting bracket, hose barb fittings & hose clamps.

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.

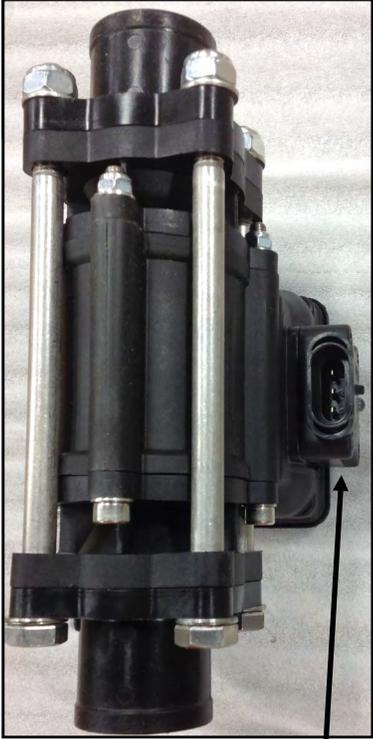


Mounting Bracket, Used in Tower 110 & 200 (Tower 200 shown) 410-2106Y1



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.



Amp SuperSeal 3-pin connector Use adapter 201-17842 to connect to 3-pin MP harness

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	22700	3/4"	3/4"



Serial number label on side also shows pulses per gallon.

If necessary, the flowmeter will read above it's rated range (and slightly below).

* Earlier model flowmeters (meters with white labels with black text) have different calibration numbers. See the documentation for those meters to find calibration numbers.)



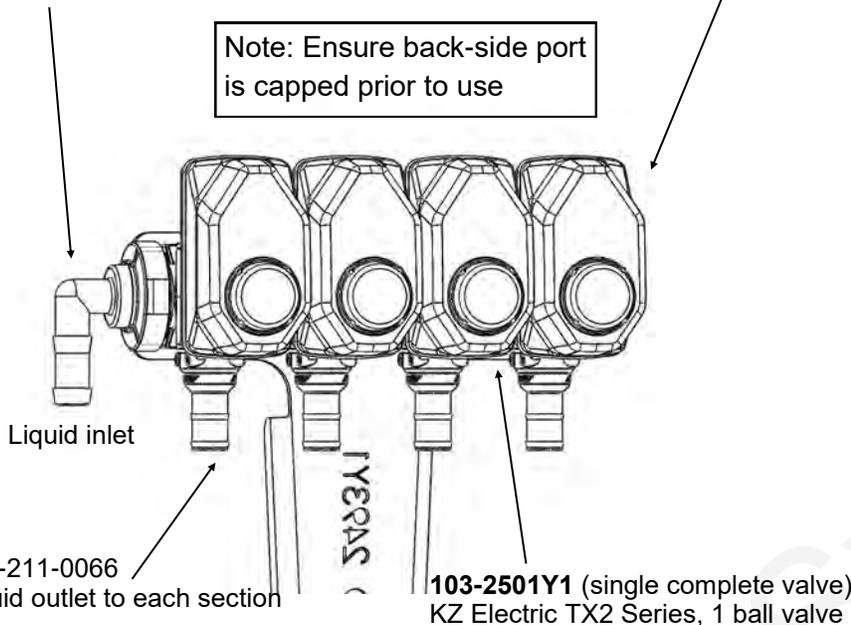
Section Valves

B
Components
Liquid

105-100075BRB90

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

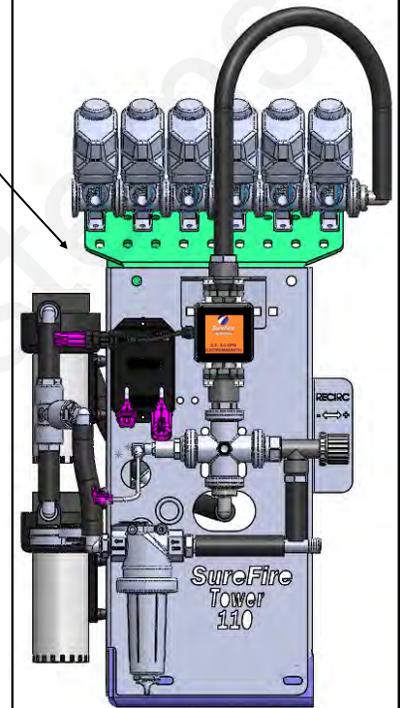
Note: Ensure back-side port
is capped prior to use



Additional Parts:

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

**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 180°, and replace actuator.



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.

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

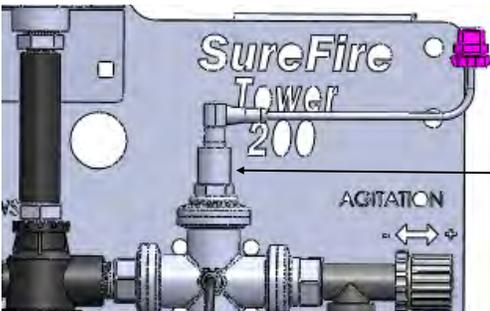
The Tower 110 and 200 come equipped with a 100 psi pressure sensor to work with the RCM. This sensor is a 3 wire type sensor for compatibility with the RCM. The sensor has a 1/4" MPT fitting.

Typical SureFire harnessing has one pressure sensor connector for each liquid product.

The display will show the system pressure on the in cab screen. **The pressure reading is only for informational purposes and is NOT used in the flow control process.** Flow control uses the flowmeter feedback only.

The pressure sensor is very helpful to optimize system performance and trouble shoot any issues.

The pressure transducer is factory calibrated and will display a very accurate pressure reading on the display. No manual gauge is required.

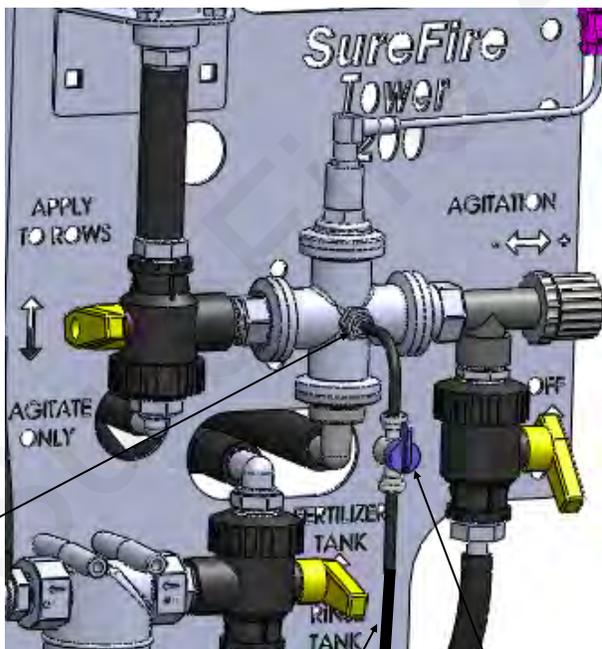


Pressure Sensor (3 wire type) with harness
521-05-050150

**Pressure Calibration:
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. Open until liquid comes out and then close the valve.

How to install the air bleed valve:

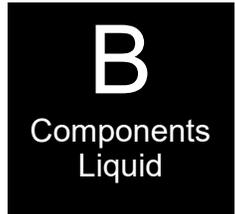
Remove the 1/4" plug from the quick connect fitting on the center cross on the Tower (see picture). Next, insert the 1/4" tubing in the quick connect fitting. Run the 1/4" tubing to an easily accessible spot on your equipment. Next, cut the tubing and push the 1/4" valve onto the tubing. Finally, run 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

To assure proper and even distribution to each row, the product being applied must be metered to each individual row. 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 10—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 12)
3. A dual metering tube kit with dual check valves may be used. (See pages 16-19)

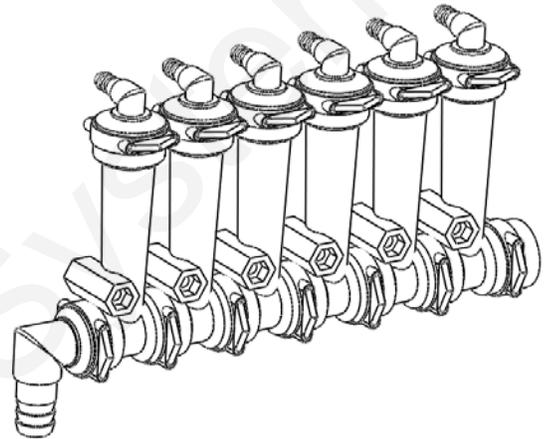


Floating Ball Flow Indicator & Manifold System

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" 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

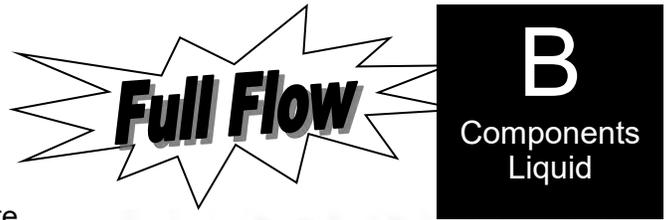
701-20460-02	Wilger Flow Indicator Ball Retainer
701-20460-03	FKM O-Ring for indicator body & fittings
701-20460-04	Wilger Lock U-clip
701-20460-05	Flow Indicator Ball - 1/2" SS Ball
701-20460-06	Flow Indicator Ball - Maroon Glass
701-20460-07	Flow Indicator Ball - Red Celcon
701-20460-08	Flow Indicator 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" push to connect 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.

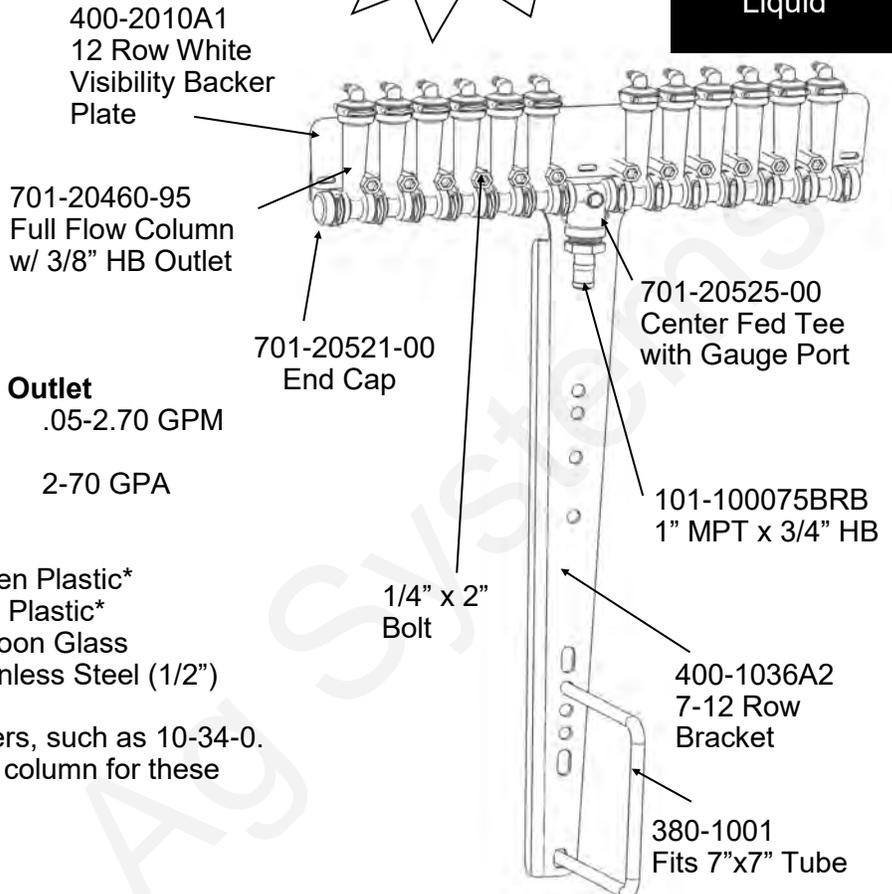
Full Flow Indicators w/ 3/8" Hose Barb Outlet

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)

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.

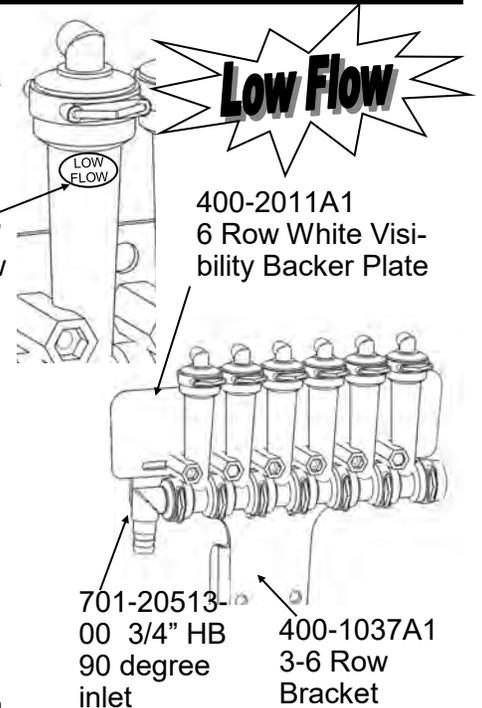
Low Flow Indicators w/ 1/4" Push to Connect Outlet

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

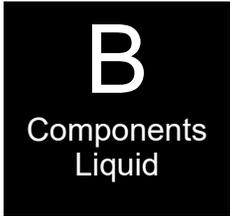
GPM	GPA	Ball
.03-.09	1-3	Green Plastic*
.05-.14	2-4	Red Plastic*
.10-.18	3-6	Maroon Glass
.15-.70	5-10	Stainless Steel (1/2")

*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



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

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

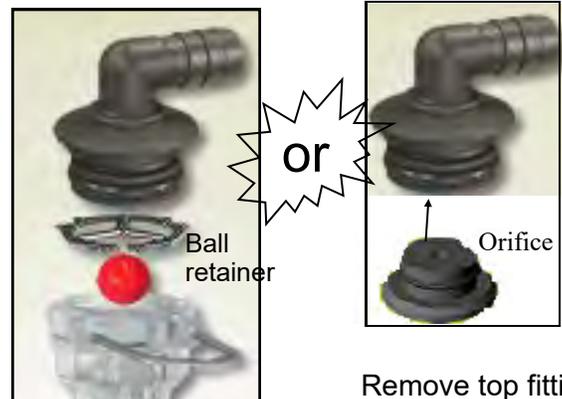
- Minimum 10 PSI
- Maximum 30 PSI

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.**



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 the metering orifice into the bottom of each outlet fitting. *(This is not used very often.)*

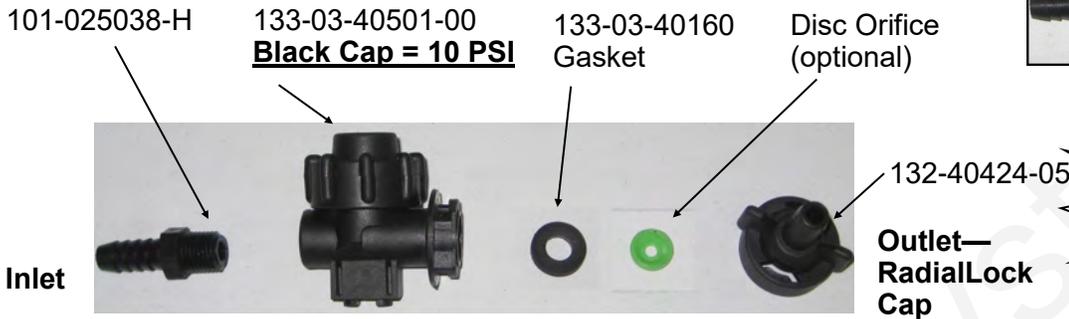
All application rates (gallons/acres) are estimates based on 0-28-0 (10.65 lbs/gallon) at 70 degrees F.

Check Valves

10 lb check valve with 3/8" hose barbs

B
Components
Liquid

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.



FLOW →



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.



FLOW →



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

B

Components
Liquid

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

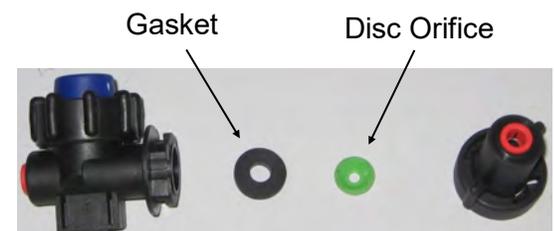
PumpRight Pressure Recommendations (with 10 lb check valves):

- 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 assemblies 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).



Colored Disc Orifice Chart Common Grain Drill Row Spacings

B
Components
Liquid

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

B

Components Liquid

22" Spacing

22" Spacing

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
			10	0.033	2.2	2.0	1.8	1.6	1.5
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

36" Spacing

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
			10	0.033	1.4	1.2	1.1	1.0	0.9
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

For more information on metering tube: www.surefireag.com/support > Distribution & Plumbing > *Metering Tube Advantages and Sizing Sheet*



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 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.



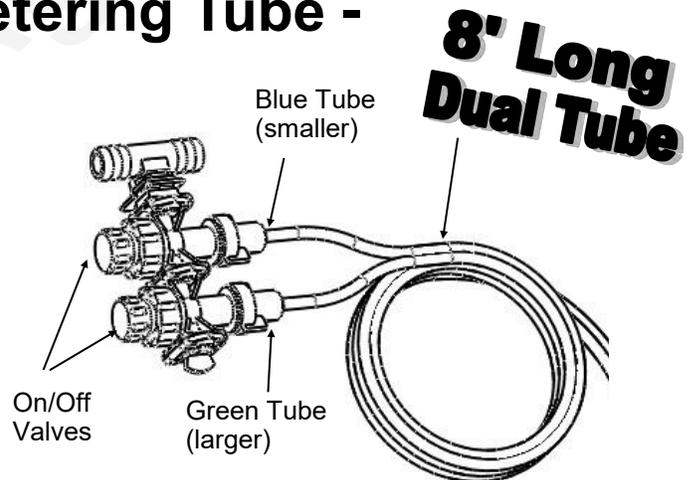
Field Operation of Dual Metering Tube - Dual Check Valve System

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

SureFire recommends you start with the larger tube ON only. This is the middle size 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 the system will operate less efficiently.

Start with larger tube ON, smaller tube OFF:

- **Pressure below 8 PSI: Turn larger tube OFF and smaller tube ON.**
- **Pressure over 30 PSI: Turn BOTH tubes ON.**



	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

Other size tubes are available if needed for different application rates.

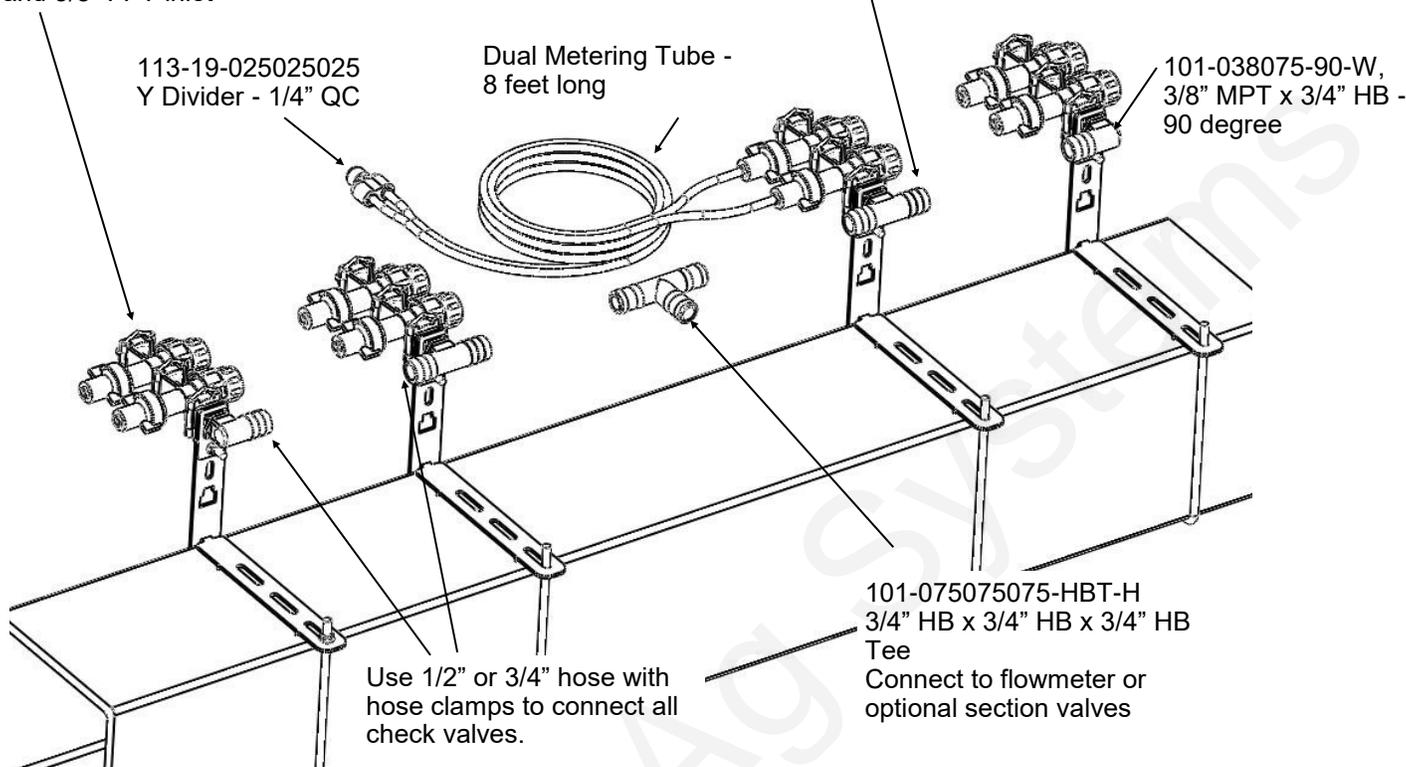
** Ultra Low Rate Application –For rates from 2-5 oz/min/row use a 12 foot length of metering tube. To calculate oz/min/row: $Oz/min/row = (GPA \times MPH \times spacing \text{ (inches)}) \div 46.4$

Dual Check Valve Plumbing Diagram

4 Row Planter Shown, add rows as necessary

136-04-200400, Dual 4 PSI check valve with 1/4" QC caps and 3/8" FPT inlet

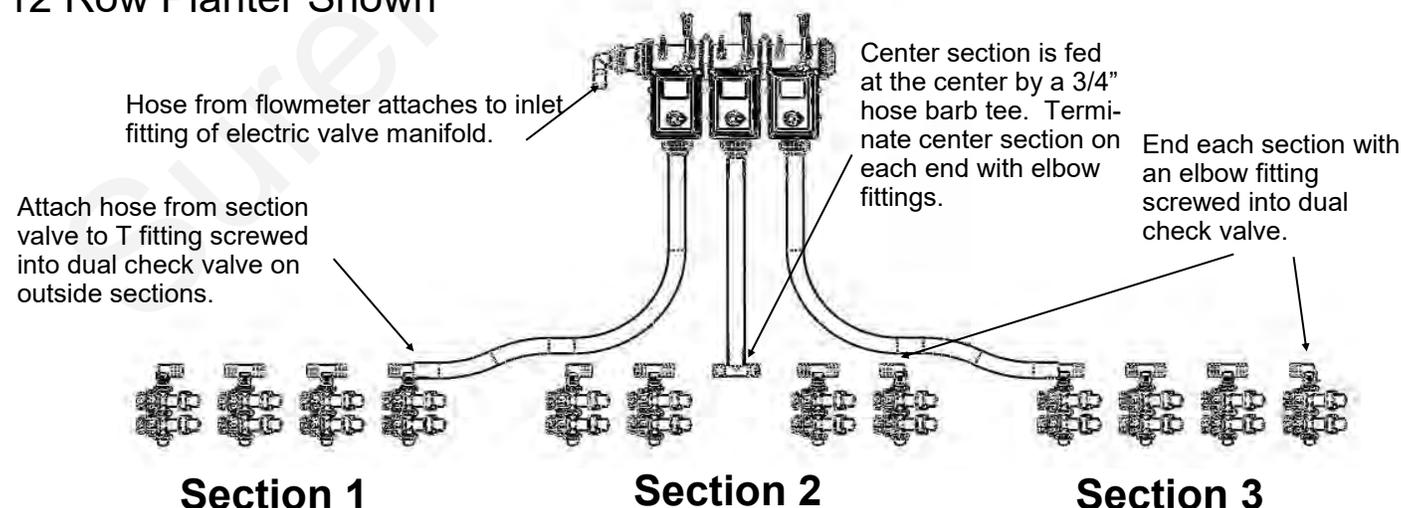
101-075075038-HBT-M-W 3/4" HB x 3/4" HB x 3/8" MPT Tee



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



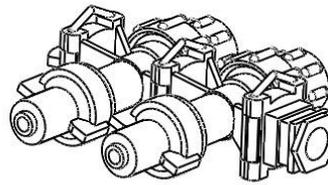
For a **2 section plumbing system**, omit the center section and plumb similar to the outside 2 sections.

Dual Check Valve Assembly Steps

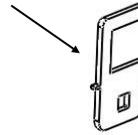
B
Components
Liquid

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

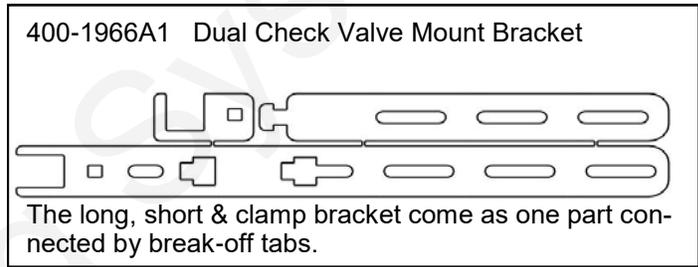
1. Screw the 3/8" MPT x 3/4" HB tee or elbow into the check valve using blue thread sealer. Orient the hose barb to run the 3/4" hose down the planter toolbar.
2. Insert the check valve into the "C" notch in the end of the bracket, according to how you want the check valve to be mounted on your planter. 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.



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.

Short Bracket

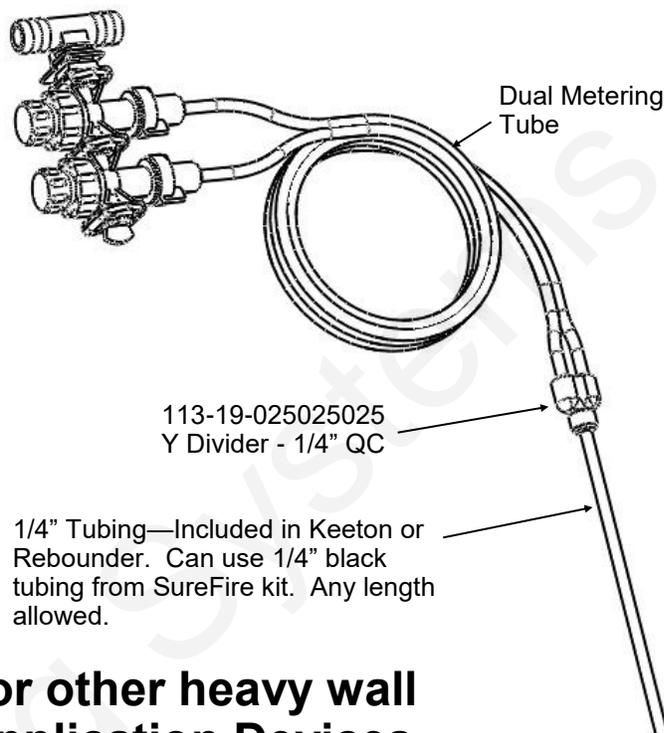
Long Bracket

311-0408000800-05
1/4" L Bolt

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.

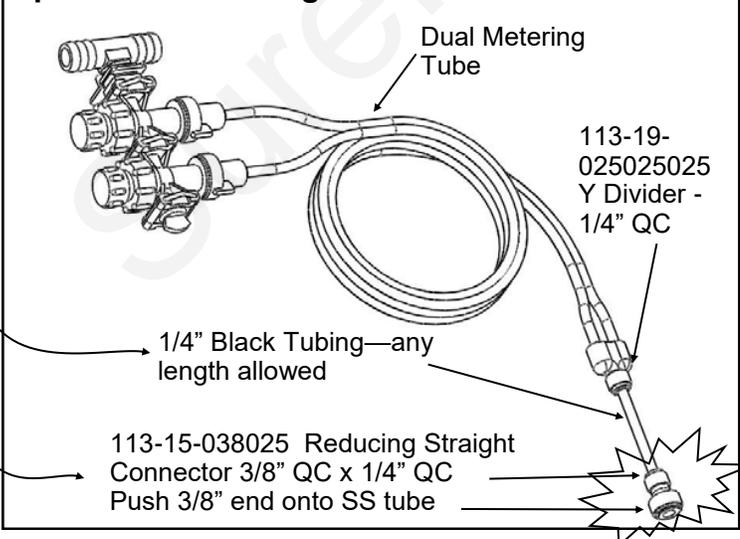


Connection to Totally Tubular or other heavy wall Stainless Steel Tube Ground Application Devices

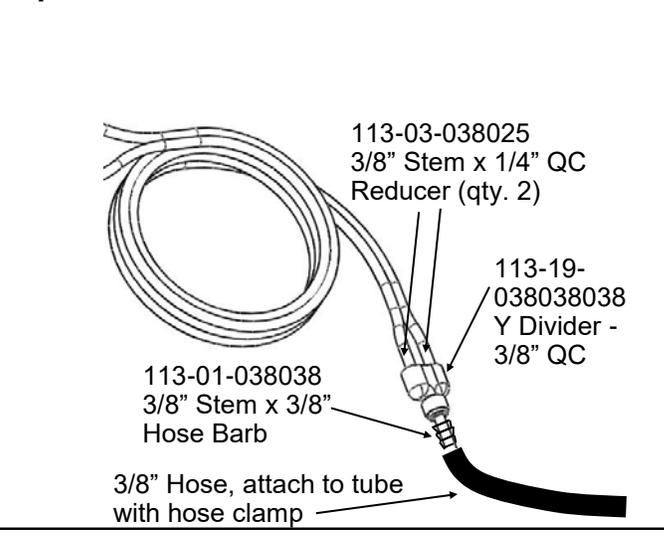
When using a 3/8" OD stainless steel tube to apply fertilizer to the ground, there are two options for the delivery tube plumbing. If the tube ID is less than 1/4" (tubing will not fit inside tube) this attachment method must be used. The description following is for Option 1. See bottom right picture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



Electric Pump (Tower) Systems--10-40 PSI (Tubes 8' unless noted)

Low Viscosity (28-0-0 approx 10.7 lb/gal)				Medium-Low Viscosity (32-0-0 approx 11.0 lb/gal)			
	oz/min	mL/min	gal/min		oz/min	mL/min	gal/min
Tube Color	Flow Range	Flow Range	Flow Range	Tube Color	Flow Range	Flow Range	Flow Range
Gray	3.5-7.4	105-220	0.03 - 0.06	Gray	2.5-5.5	74-163	0.02-0.04
Purple	6-14.4	175-415	0.05 - 0.11	Purple	4.1-11.1	121-328	0.03-0.09
Brown	8-18.2	235-540	0.06 - 0.14	Brown	5.7-14.3	170-425	0.04-0.11
Blue	10-22.6	295-670	0.08 - 0.18	Blue	7.5-18	220-530	0.06-0.14
Green	18-40.2	530-1190	0.14 - 0.31	Green	14-33.2	415-980	0.11-0.26
Tan	25-55	740-1625	0.19 - 0.43	Tan	20-46.4	590-1370	0.16-0.36
Orange	44-93.6	1300-2770	0.34 - 0.73	Orange	36-83	1065-2455	0.28-0.65
Yellow	55-114.4	1625-3380	0.43 - 0.89	Yellow	44-100	1300-2955	0.34-0.78
Black	72-152	2130-4495	0.56 - 1.19	Black	60-129	1775-3815	0.47-1.01
5' Tan	33-73	975-2160	0.26 - 0.57	5' Tan	27-63	800-1865	0.21-0.49
5' Orange	57-121	1685-3580	0.45 - 0.95	5' Orange	49-113	1450-3340	0.38-0.88
5' Yellow	70-145	2070-4290	0.55 - 1.13	5' Yellow	59-134	1745-3965	0.46-1.05
5' Black	95-200	2810-5915	0.74 - 1.56	5' Black	80-172	2365-5085	0.63-1.34

10-40 PSI 60°F

Medium Viscosity (Starter, N-P Blend, approx 11.2 lb/gal)				High Viscosity (10-34-0 approx 11.6 lb/gal) For 11-37-0, find the flow range here, and use next larger tube.			
	oz/min	mL/min	gal/min		oz/min	mL/min	gal/min
Tube Color	Flow Range	Flow Range	Flow Range	Tube Color	Flow Range	Flow Range	Flow Range
Gray	1.5-3.7	45-110	0.01-0.03	Gray			
Purple	2.2-7.8	65-230	0.02-0.06	Purple	1.0-2.8	30-83	0.008-0.02
Brown	3.5-10.4	105-310	0.03-0.08	Brown	1.4-4.2	41-124	0.011-0.03
Blue	5-13.7	150-405	0.04-0.11	Blue	1.8-5.5	53-163	0.014-0.04
Green	9.5-26	280-770	0.07-0.20	Green	2.6-9.4	77-280	0.02-0.07
Tan	14-37.4	415-1105	0.11-0.29	Tan	4-14.8	120-440	0.03-0.12
Orange	27-72	800-2130	0.21-0.56	Orange	9-30	265-885	0.07-0.23
Yellow	33-85	975-2515	0.26-0.66	Yellow	13-42	385-1240	0.10-0.33
Black	48-106	1420-3135	0.38-0.83	Black	18-55	530-1625	0.14-0.43
5' Tan	20-53	590-1565	0.16-0.41	5' Tan	6-22.2	165-655	0.04-0.17
5' Orange	38-101	1125-2985	0.30-0.79	5' Orange	13-43	380-1270	0.10-0.34
5' Yellow	46-118	1360-3490	0.36-0.92	5' Yellow	18-58	540-1715	0.14-0.45
5' Black	67-148	1980-4375	0.52-1.16	5' Black	25-76	740-2250	0.20-0.59

10-40 PSI 60°F--For 10-34-0 select a tube with additional capacity for cold weather.

Water (8.34 lb/gal)			
	oz/min	mL/min	gal/min
Tube Color	Flow Range	Flow Range	Flow Range
White	2.5-5.5	75-165	0.02-0.04
Gray	5.8-11.6	170-340	0.045-0.09
Purple	10-20	295-590	0.08-0.16
Brown	12.5-25	370-740	0.10-0.20
Blue	17.5-35	520-1040	0.14-0.28
Green	26-52	770-1540	0.20-0.40
Tan	34-68	1005-2010	0.27-0.54
Orange	60-120	1775-3550	0.47-0.94
Yellow	75-150	2220-44400	0.59-1.18

These charts are typical flow rates from 10 to 40 PSI.

The capacity of electric pumps declines as the pressure increases. If total pump output is low enough, they can operate at 50 psi or more.

These charts are designed for typical N-P fertilizers. Suspension, granular, and/or clay/based products may not follow these charts.

These charts are for product at 60° F. Products will be thicker and pressure will be higher at lower temperatures (esp 10-34-0). MAW



SureFire Harness Layout for RAVEN RCM



SureFire recommends buying a Raven RCM Adapter Harness from SureFire that will connect directly to the three connectors on the Raven RCM Controller.

Footswitch & ISO Extensions (Purchase from SureFire)

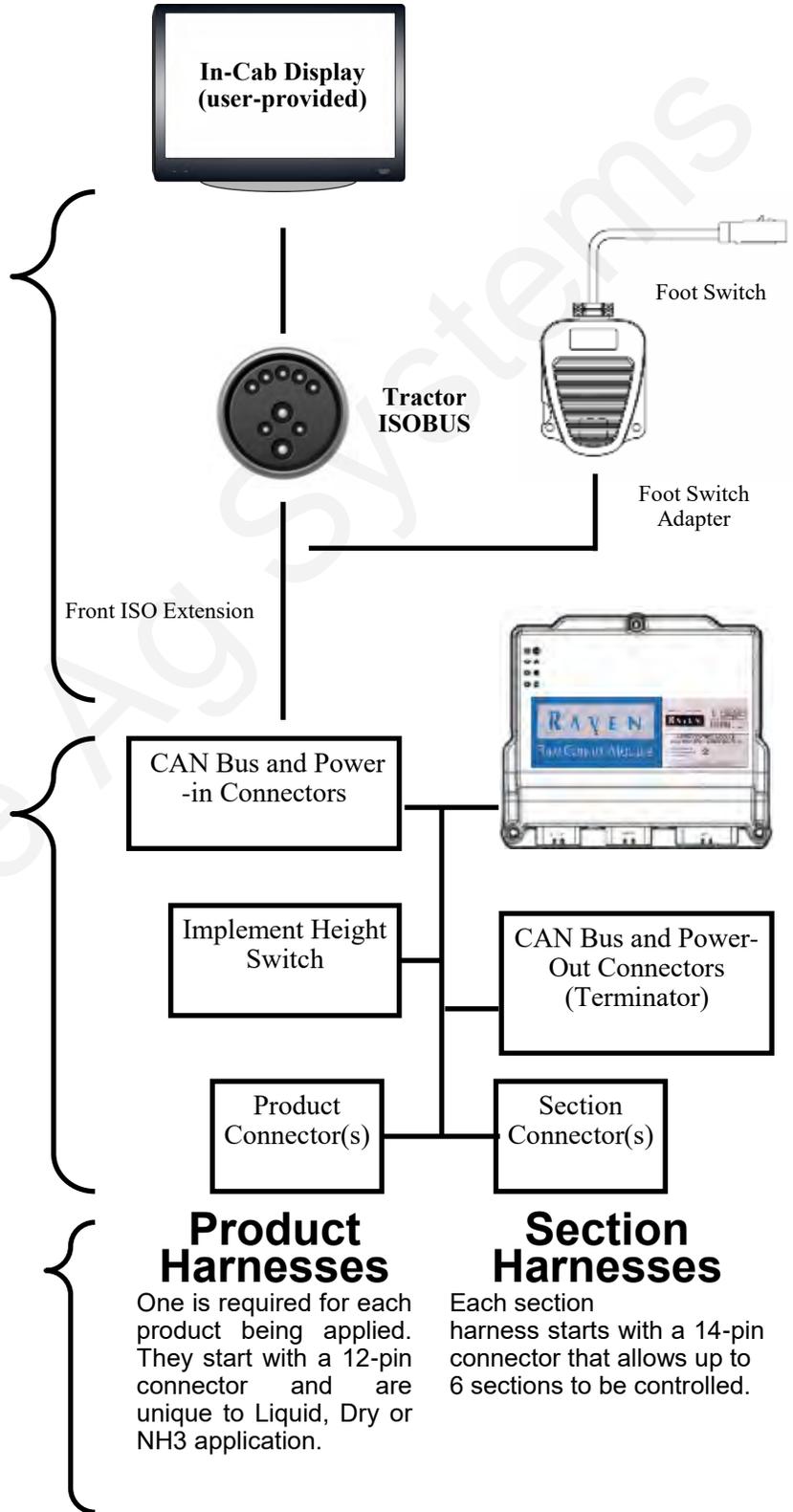
Designed to integrate with many ISOBUS virtual terminals, The Raven RCM's connection starts at the tractor's ISOBUS connection. Power and information is relayed to the Raven RCM using a SureFire Front ISO Extension which includes a foot switch and CAN bus connections. Already using the tractor ISOBUS? No Problem. SureFire has an ISOBUS Y harness that can be used in that instance.

Raven RCM & Adapter Harness (purchase from SureFire)

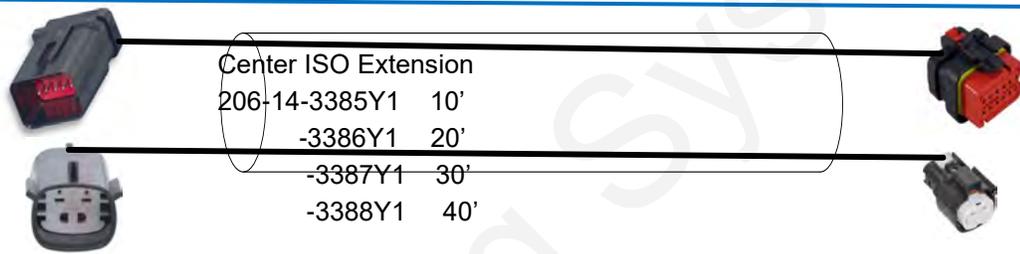
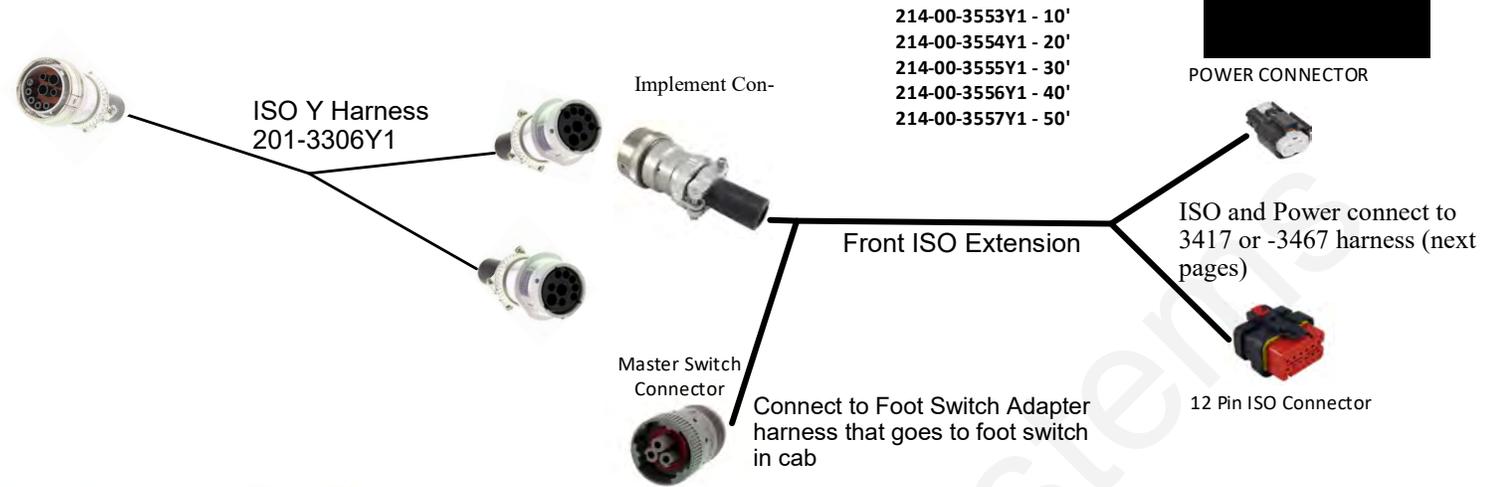
These harnesses connect the CAN bus to the Raven RCM. Each harness will go directly to 12-pin product connectors and 14-pin section connectors. SureFire offers many different Raven RCM Adapter Harnesses built for a specific single-product or multi-product systems.

Final Harnesses (purchase from SureFire)

Final Harnesses connect the Raven RCM Adapter Harness to pump drivers, flowmeters, hydraulic motors, speed sensors, pressure sensors, valves and any other components in a liquid, dry or NH3 application system.

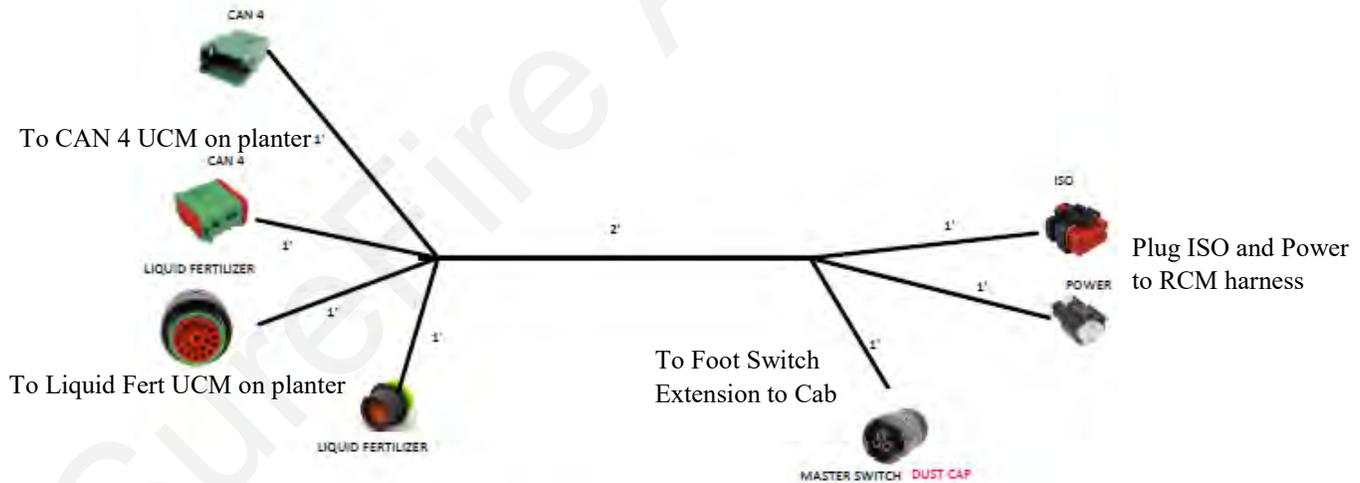


Harness Layout Below and on the next page are the harnesses in a typical setup. Your layout may vary. A layout could begin with a Center ISO Extension if there is a connection for that on the implement.



Harness Option for Case 2000 Series Planter to Raven RCM

213-05-3873Y3



Plugging in the Raven RCM:

1. Plug the 35-pin and 23-pin connectors from the SureFire adapter harness (213-00-3467Y2) into the RCM.
2. Plug the 12-pin ISO and 2-pin Power connector on the long leads of the 213-00-3467Y2 harness into the ISO and Power connectors shown above. Plug in an ISO terminator to the short ISO lead, or connect next ISO module.
3. The RCM must have a foot switch in the cab. Make the necessary connections to connect the foot switch.
4. Plug in the Implement Height Switch if it is being used.
5. Plug in the final Product and Section harnesses.

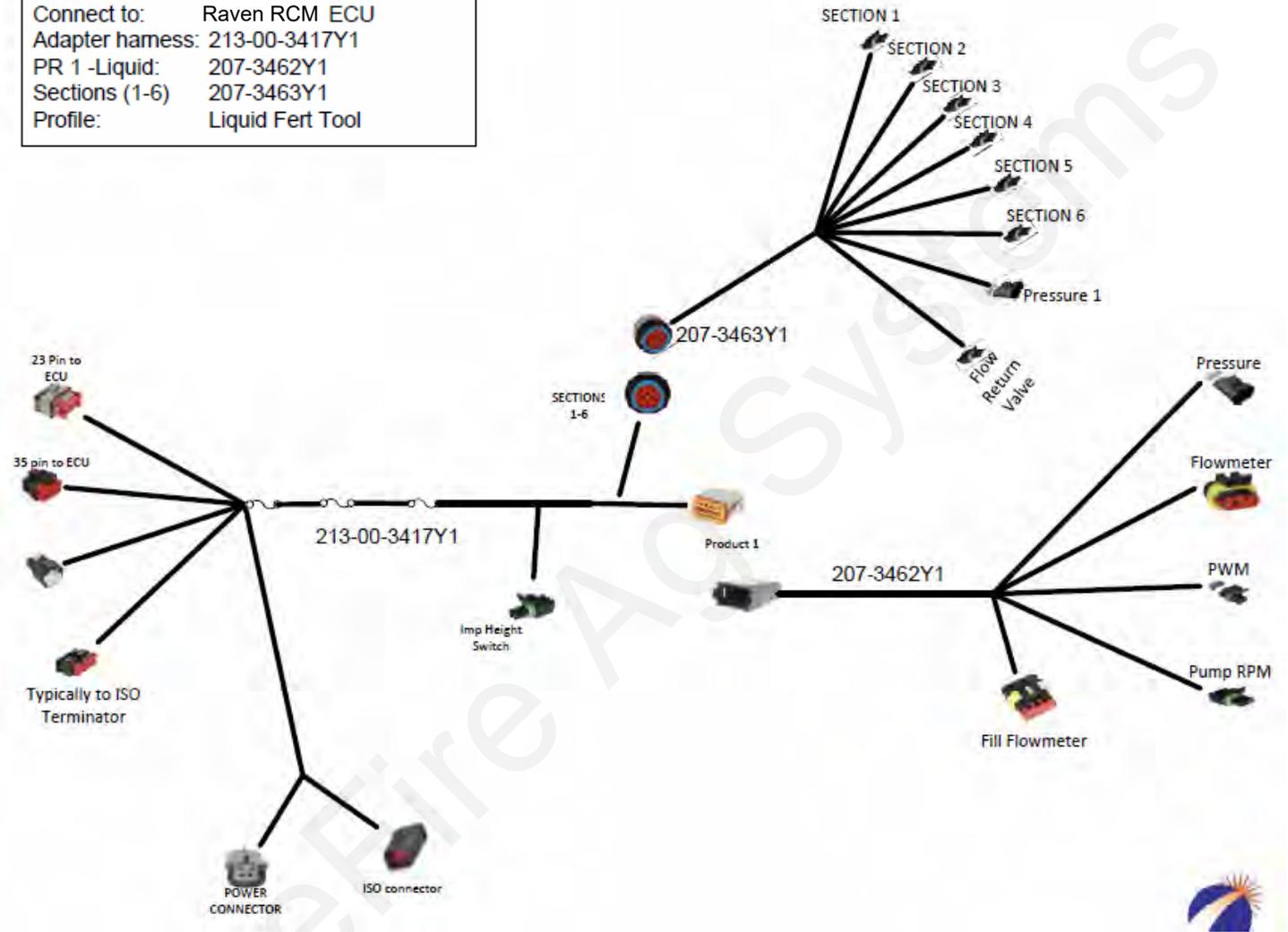
Example PumpRight & RCM Layout



The harnessing shown below would be used to connect a SureFire PumpRight system with up to 6 section valves to the Raven RCM.

Using SureFire Direct to RCM ECU

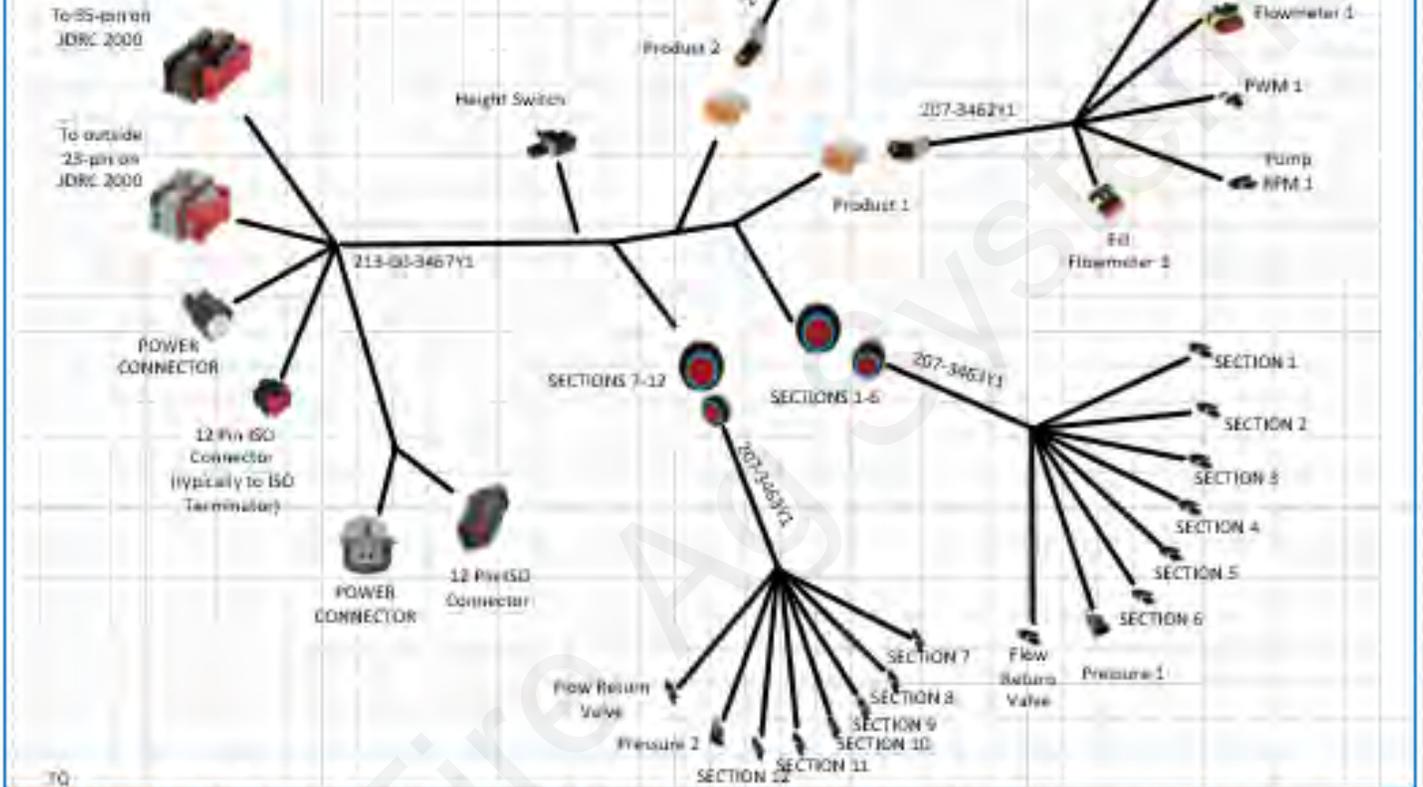
Product:	1 Liquid (up to 6 Sections)
Connect to:	Raven RCM ECU
Adapter harness:	213-00-3417Y1
PR 1 -Liquid:	207-3462Y1
Sections (1-6)	207-3463Y1
Profile:	Liquid Fert Tool



SureFire Ag Systems and Raven RCM Harnessing

D
Wiring

Product:	2 Liquids
Connect to:	Raven RCM
Adapter harness:	213-00-3467Y1
PR 1 -Liquid:	207-3462Y1
Sections (1-6):	207-3463Y1
PR 2 Liquid:	207-3462Y2
Sections (7-12):	207-3463Y1
Profile:	Generic



40 Amp PWM EPD

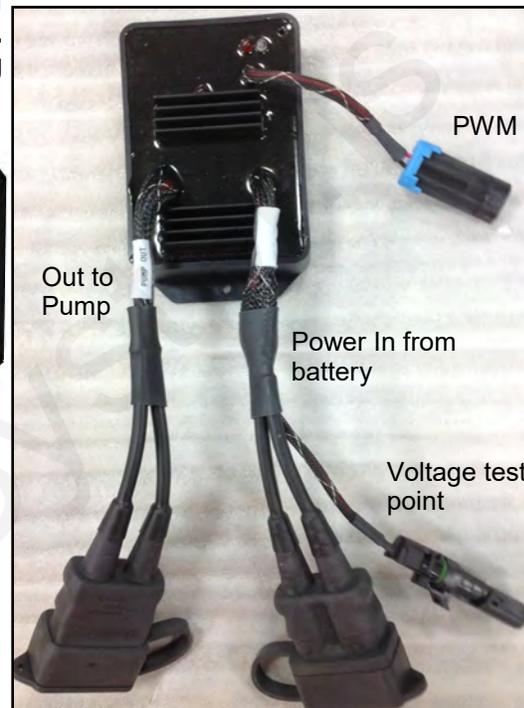
(Pulse Width Modulated Electric Pump Driver)

Item Number: 205-19024 with Anderson connectors
(replaces 205-18385 with 480 MP connectors)



The Electric Pump Driver powers 1 or 2 electric pumps by providing a pulse width modulated signal to control pump speed. It needs to have a power connection and wiring capable of carrying up to 40 amps of current. **It must be connected directly to the tractor battery.** SureFire recommends 8 gauge wire (or heavier) if extending harnesses in the field.

205-19024



PWM Connection on pump harness

Beginning in late 2015, these four connectors are Anderson connectors

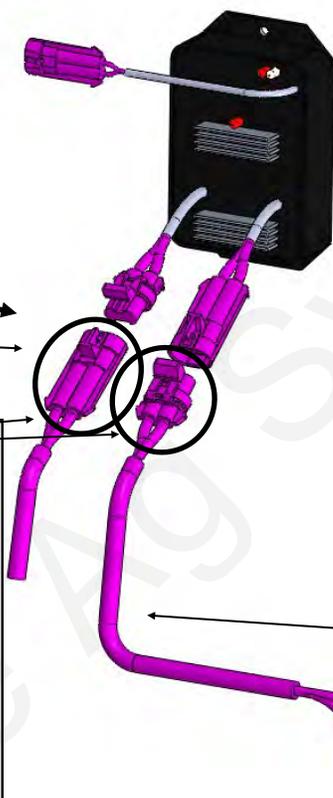
Plug in 1 pump directly OR plug in 2 pumps with "Y" cable PN 205-3116Y1.

Troubleshooting Tip:

If the pumps won't run, connect the power and pump connector directly together to give pumps full 12 volts directly from battery. This will tell you if the pumps are the problem or if something else is wrong. The pumps will be running at full speed, so don't leave them connected this way for long.

Use the test connector on the line from the battery to test the voltage under load.

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.



EPD Power Harness PN 205-3118Y1 (20 feet) - **connect to tractor battery.** This is 6 AWG wire.

40 Amp in-line fuse

Use EPD **Power Harness Extensions** as needed (These have Anderson Connectors)

Part Number	Description	Wire Size
206-02-3120Y1	1' Extension	10 gauge
206-02-3121Y1	5' Extension	10 gauge
206-02-3122Y1	10' Extension	8 gauge
206-02-3123Y1	20' Extension	8 gauge
206-02-3124Y1	30' Extension	30' and longer—6 gauge
206-02-3125Y1	40' Extension	
206-02-3126Y1	50' Extension	
206-02-3127Y1	60' Extension	
206-02-3128Y1	2' Anderson Ext w/ Power Switch-8 AWG	

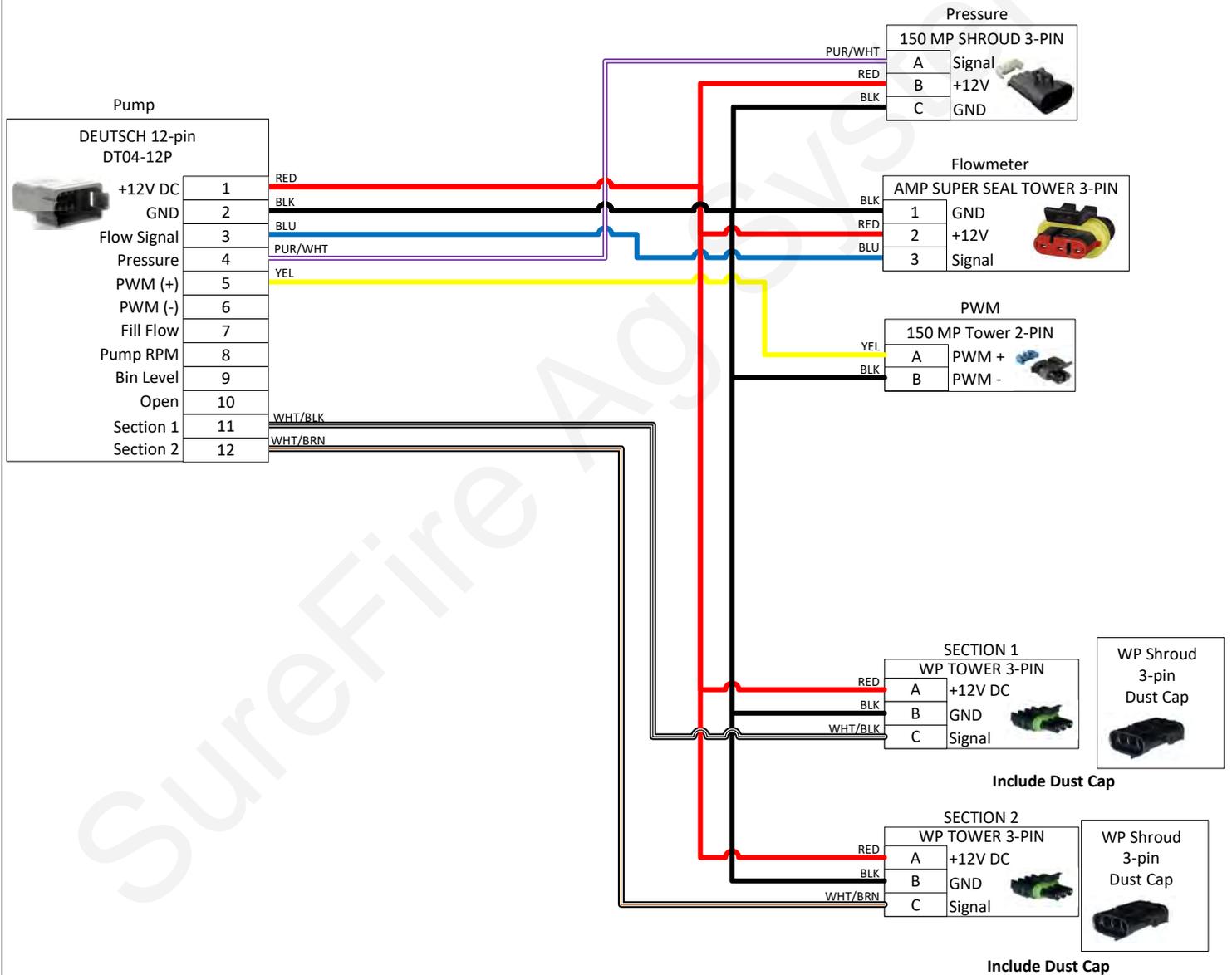
SureFire recommends a single long extension harness as multiple connectors will reduce voltage, increase current and hurt performance of your electric pump system.



207-3461Y2

Final Cable for Tower With 1-2 Section Valves (pwm, flow, pres., sec 1, sec 2)

**Wire 18AWG
unless otherwise
specified**

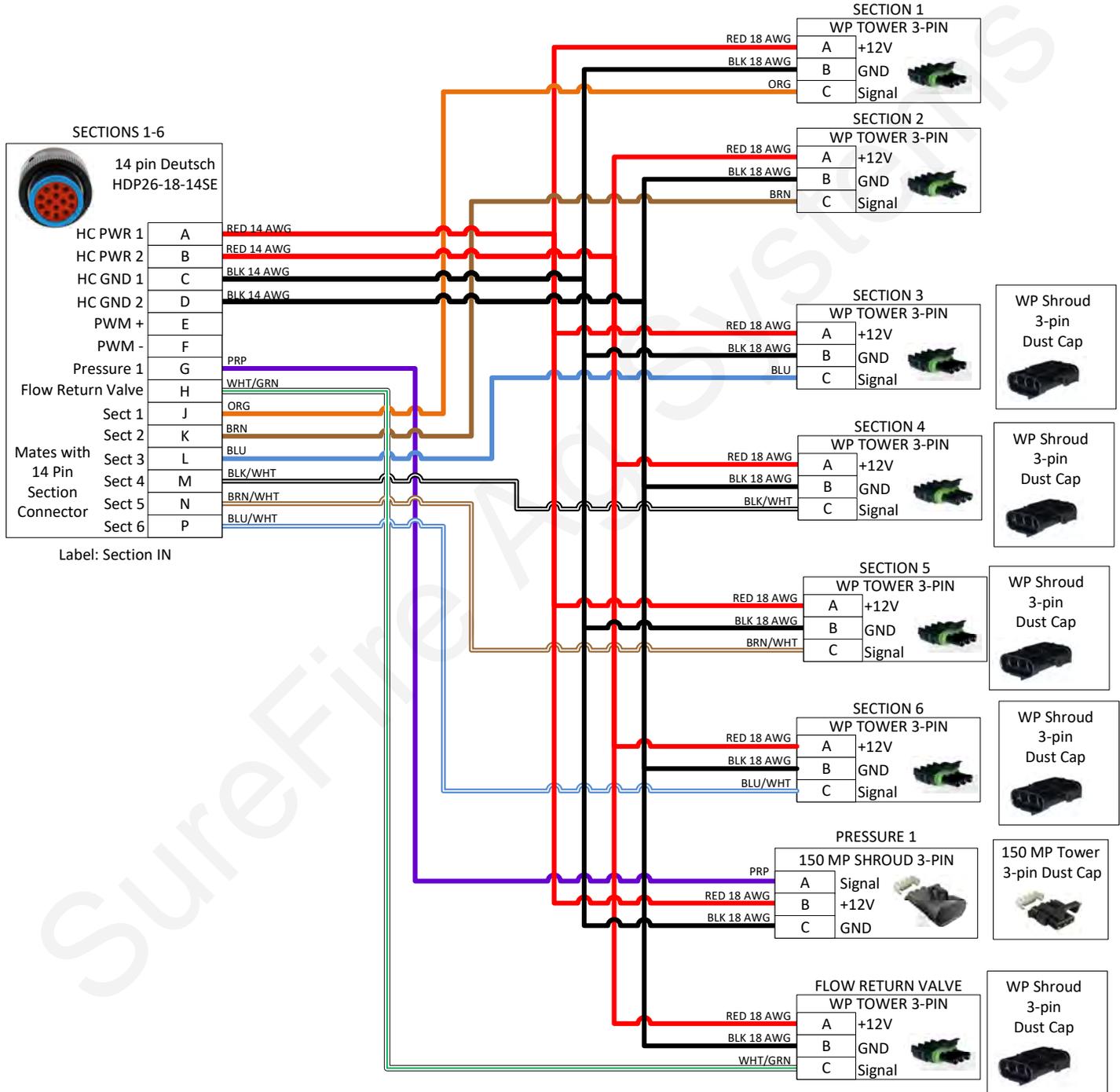


	Part No:	207-3461Y2	Drawn By:	Brandon Cavenee		
	Description:	Final Cable for Tower With 1-2 Section Valves (pwm, flow, pres., sec 1, sec 2)	Last Edit Date:	6/4/2021	Revision	A-04
	Copyright 2018 SureFire Ag Systems, Reproduction or other use of drawing without express written permission from SureFire Ag Systems is forbidden			26		

207-3463Y1

14-Pin 6 Section Final Cable (6 sections, flow return, pressure)

**Wire 18AWG
unless otherwise
specified**



	Part No:	207-3463Y1	Drawn By:	Brandon Cavenee		
	Description:	14-Pin 6 Section Final Cable (6 sections, flow return, pressure)	Last Edit Date:	6/4/2021	Revision	A-02
	Copyright 2016 SureFire Ag Systems, Reproduction or other use of drawing without express written permission from SureFire Ag Systems is forbidden			27		

Floating Ball Flow Indicators

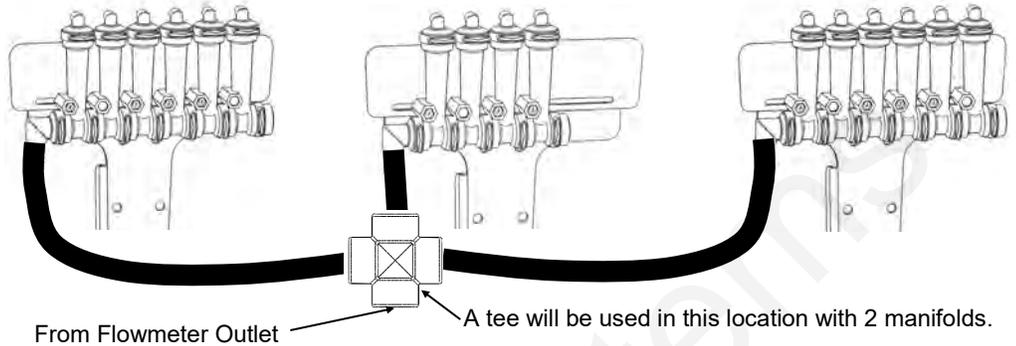
Flow Indicators are extremely flexible and can be mounted in hundreds of different configurations on various types of liquid application equipment. This page is to give you some ideas and let you customize the installation for what works best on your equipment.

E Installation Overview

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.

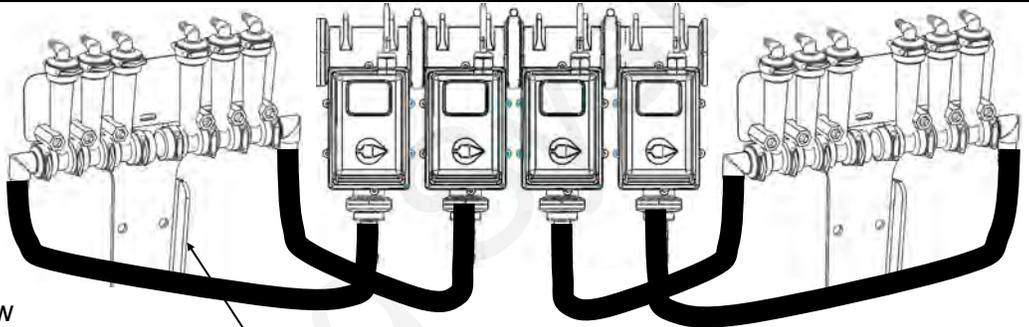


12 Row

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.

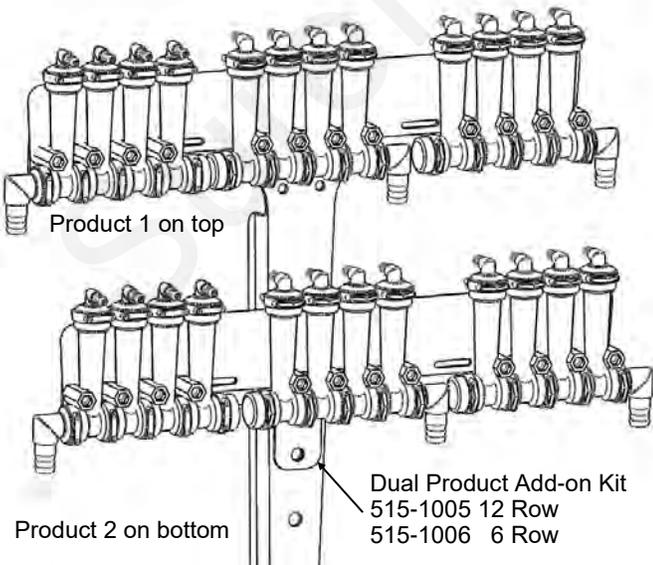


NOTE: Another option is the flange can face forward so the T-Bracket could be mounted on the front side of a bar.

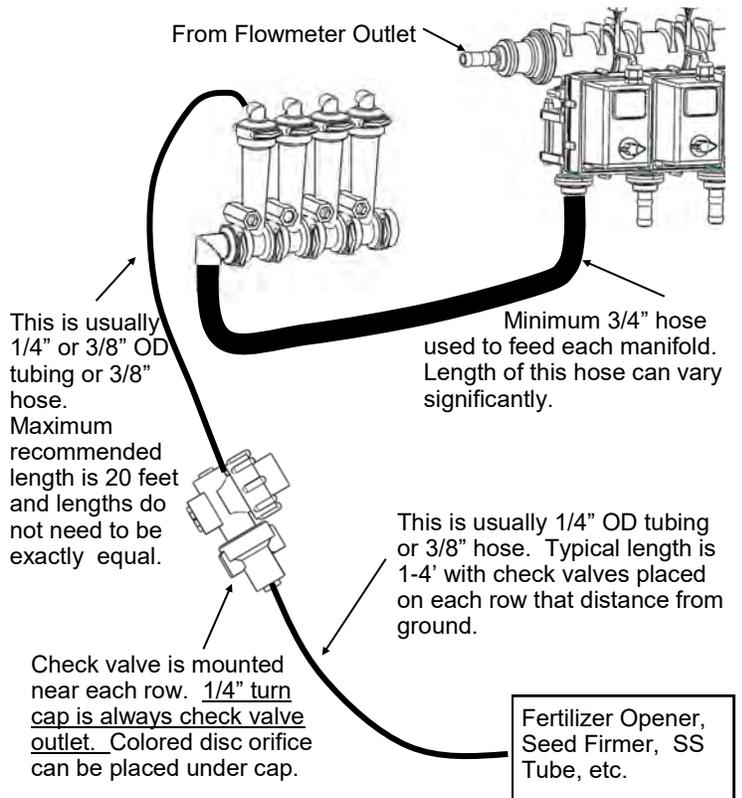
12 Row Dual Product

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

E

Installation Overview

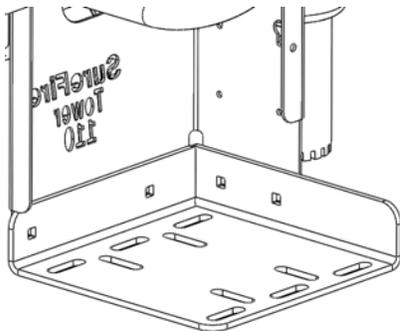
Tower Basic Mounting Bracket

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.

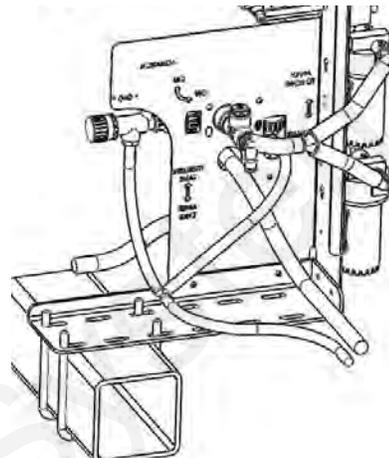


Tower Offset Mounting Bracket

Item Number **511-1010**

The Tower is available as a stand alone item.

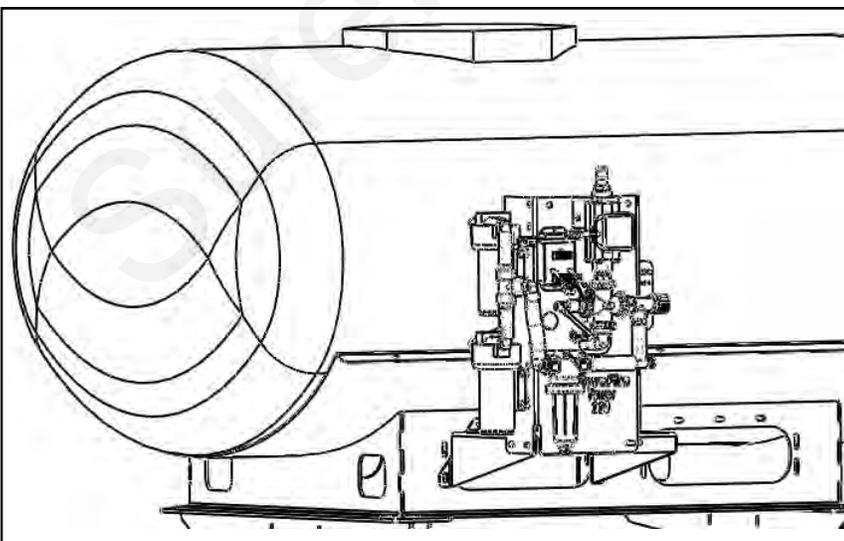
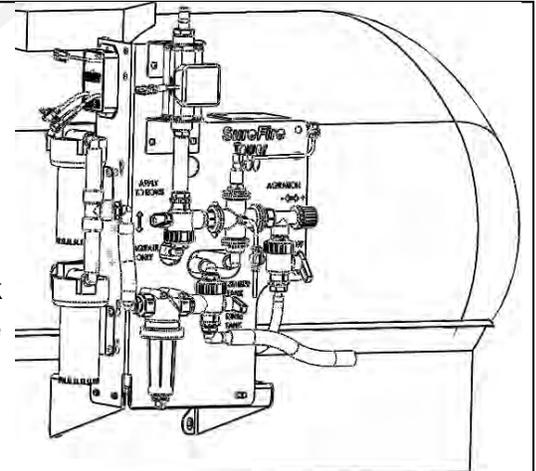
This kit includes a bracket to mount to the top side of a bar and hold the Tower. U-bolts are NOT INCLUDED. They must be ordered separately based on mounting bar size. Multiple slots allow the Tower to be mounted away from or directly over the bar.



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.

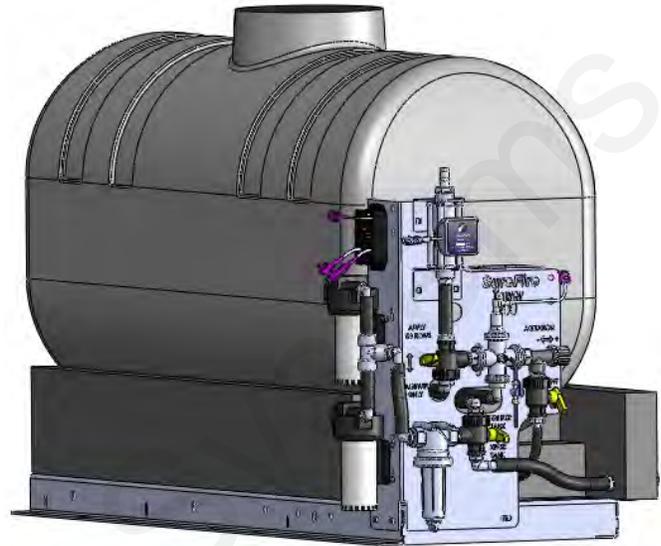
Accelerator with Tower 200 Pump Panel



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.

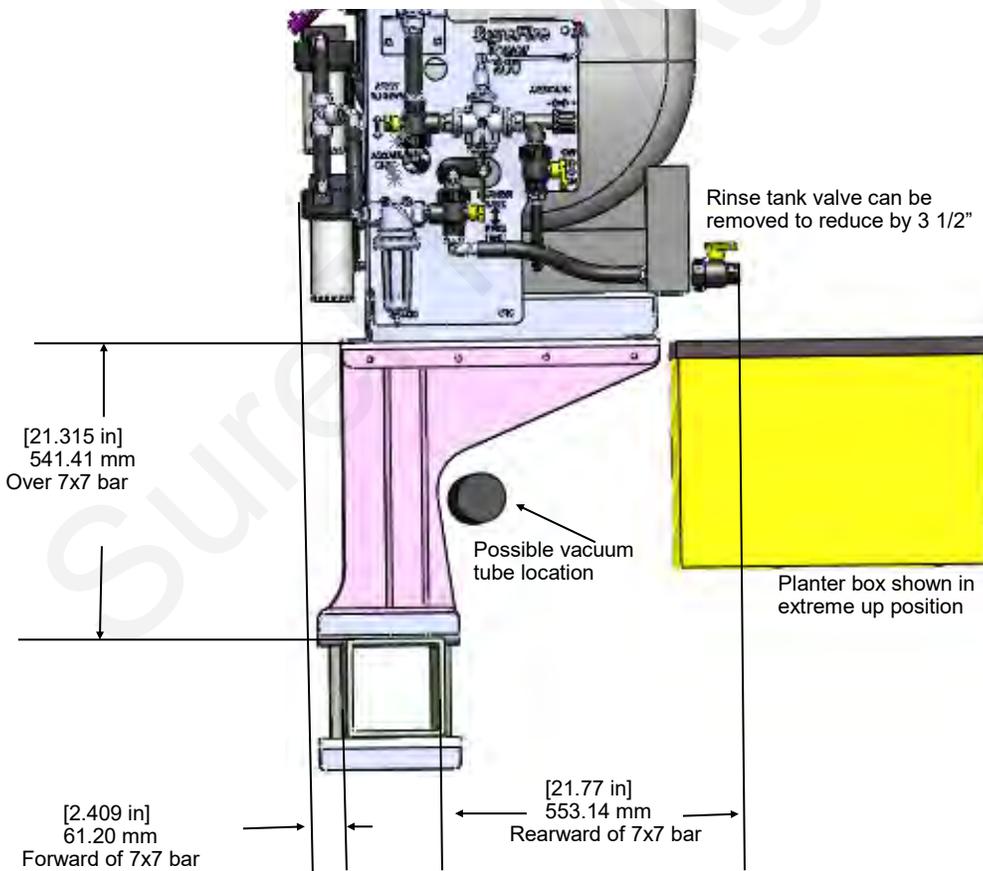
Dimensions:

- 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**

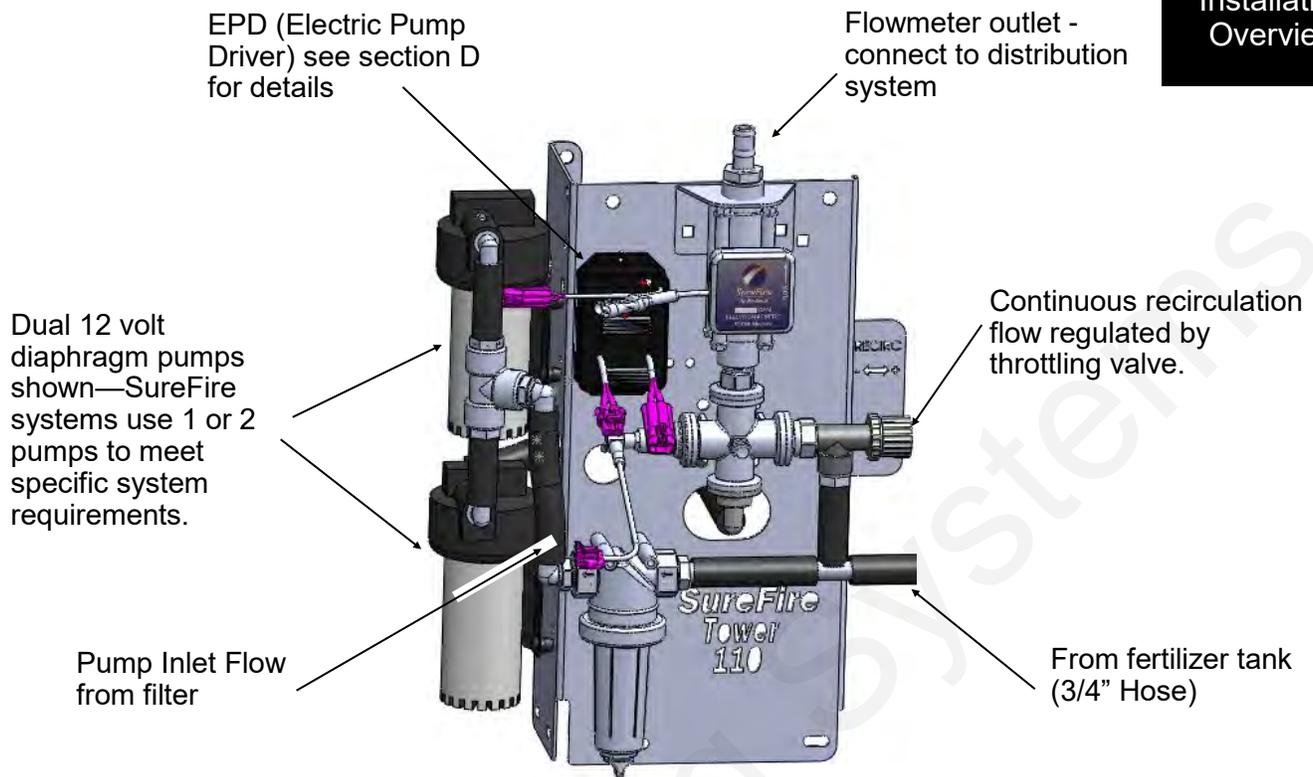
This mount kit includes two welded brackets to mount any of the 3 sizes of accelerator tanks above and offset from the 7x7 planter toolbar as shown.



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 go to **Tests** and choose **Nozzle Flow Check**. 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 agitate adjust valve slowly 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.
4. Set the valve to somewhere in the middle based on visual observation of agitation flow needed.
5. On your display, verify the system has locked on to application rate at your agitation valve setting.

Troubleshooting:

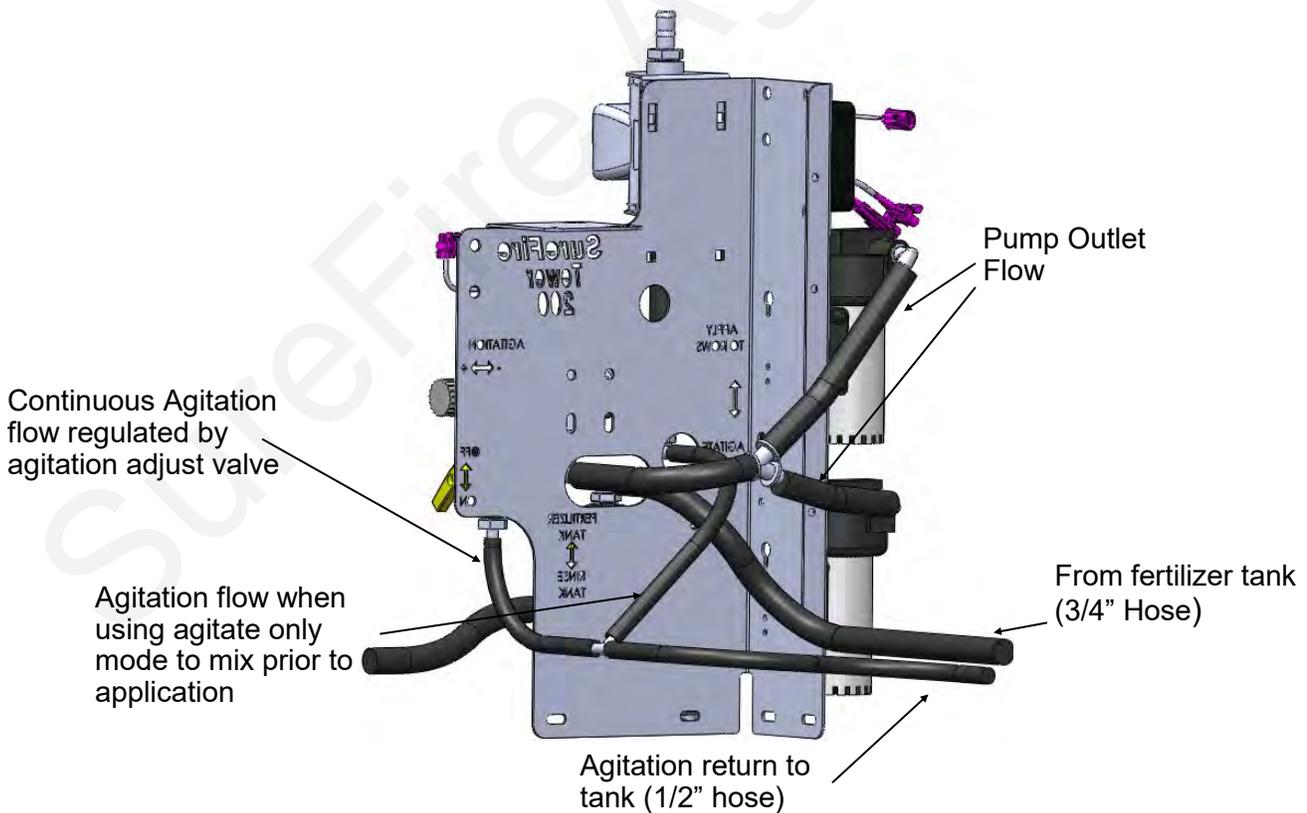
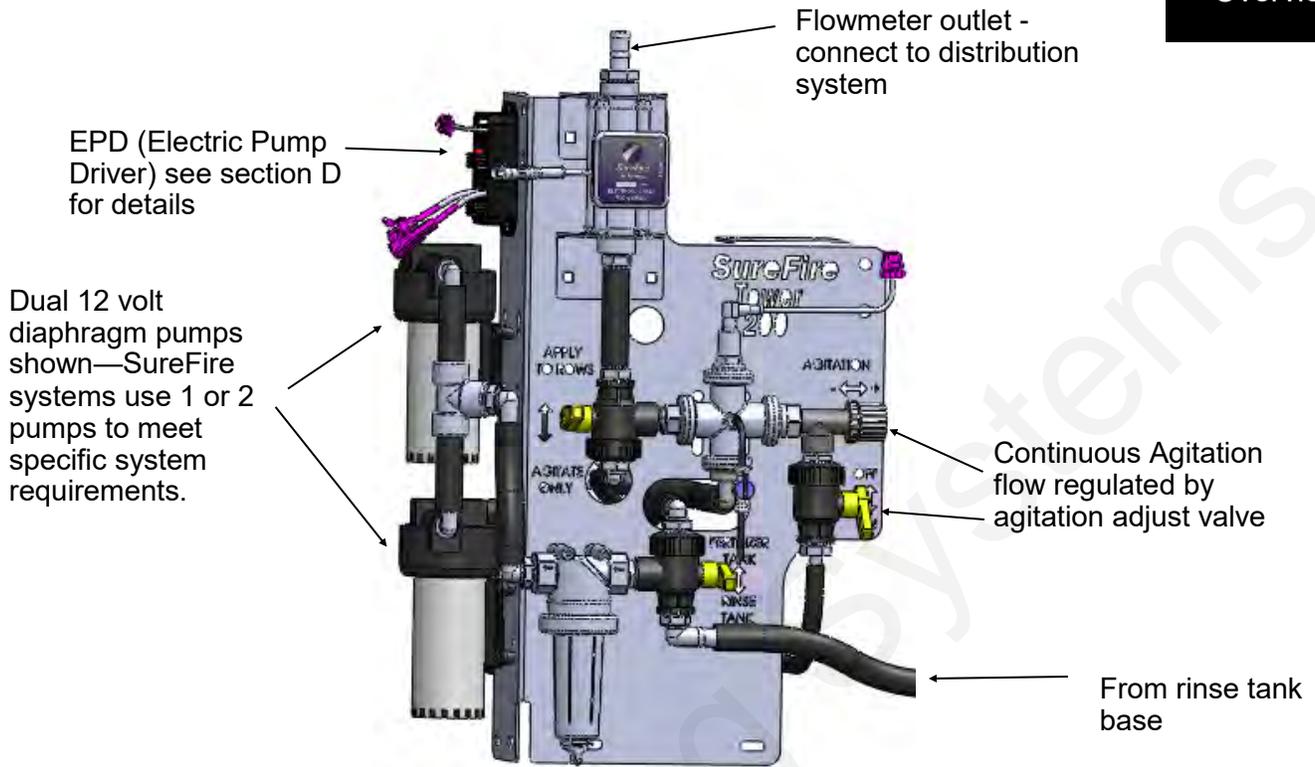
- If the system is applying a rate lower than your target, you need to close the agitation adjust valve some.
- If the system is applying a rate higher than you want and will not lock on rate, you need to open the agitation adjust valve some.
- If the rate is still fluctuating around your target and 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. 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

E Installation Overview



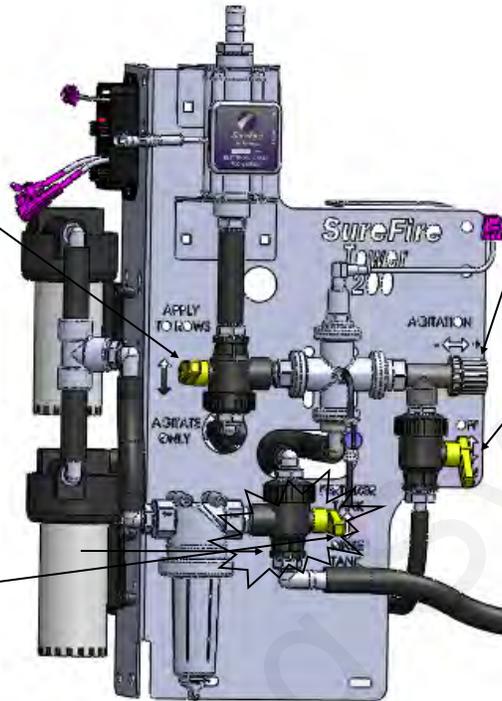
Tower 200 Valve Operation

E

Installation
Overview

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: This valve adjusts how much flow returns to the tank while working in the field.

Agitation On/Off Valve: This valve will shut off agitation flow without the need to move the agitation adjust valve. **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.**

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.

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

1. On the display go to **Tests** and choose **Nozzle Flow Check**. 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 agitate adjust valve slowly 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.
6. On your display, verify the system has locked on to application rate at your agitation valve setting.

Troubleshooting:

- If the system is applying a rate lower than 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.
- 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.**

Rate Control Module (RCM) Setup

Following are screen shots typical of a Raven RCM setup. Your setup and screens may vary since the RCM is capable of running many different application scenarios.

To access the RCM, push this button. If this button is not present the rate controller is not communicating with the display.

This button will take you to the Main Run Screen below.



Main Run Screen

Actual Rate (gal/ac): 5.0
Target Rate (gal/ac): 5.0
Tractor Speed (mph): 5.0

Navigation Buttons:
 Raven RCM Run Screen (Home icon)
 Setup (Gears icon)
 Totals (1 2 3 icon)
 Diagnostics (Waveform icon)

Estimated Volume Remaining / Tank Refill Button (press to refill tank): 487 (gal)

Implement Height Switch Indicator: Arrow will point up or down to indicate implement position if height switch is used.



Menu Structure



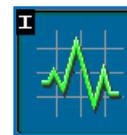
Setup

- **Applicator Setup** > Profile > Height Switch > Test Speed
- **System Settings** > Control Valve Setup
 - Rate Sensor Setup
 - Tank Fill Settings
 - Display Setup Menu
 - Pressure Sensor Setup
 - Auxiliary Functions Setup (Advanced Tuning)
- **Alarm Settings**
- **Rates Setup**/ Display Smoothing / Decimal Shift



Totals

- Current
- Job Summaries
- Lifetime Totals



Diagnostics

- System Information Menu
- Tests
- System Summary
- Product Summary

See the [Raven RCM Operation Manual](#) for safety information and additional setup/operating information.

Rate Control Module (RCM) Setup

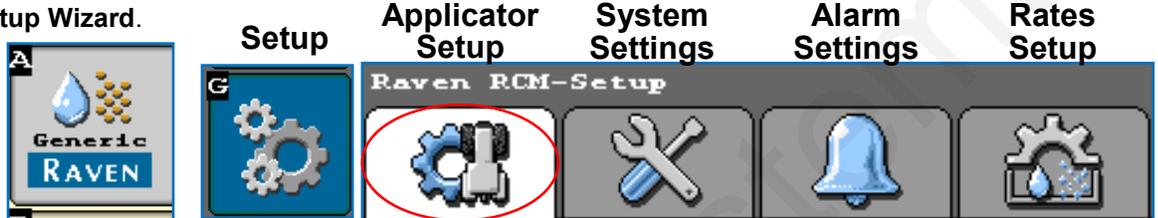
Following are screen shots typical of a Raven RCM 2-product setup. Your setup and screens may vary since the RCM is capable of running many different application scenarios.

To access the RCM, push this button. If this button is not present the rate controller is not communicating with the display.

This button will take you to the Main Run Screen below.

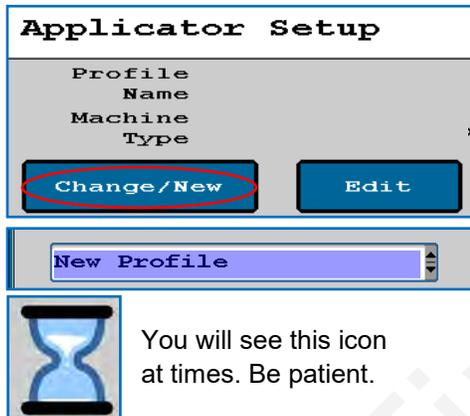


1. Navigate to the **Setup Wizard**.



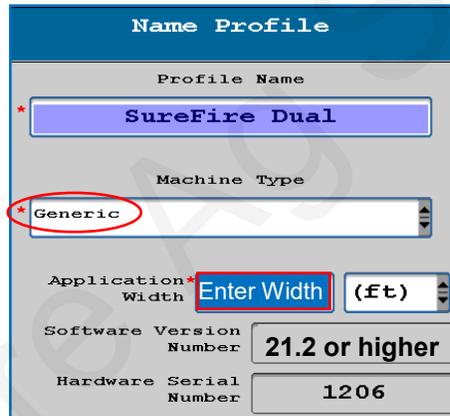
For the initial setup, start a new profile. The Raven RCM allows you to store 8 profiles. Be prepared to wait during this phase of the setup process.

2. Start a **New Profile**.

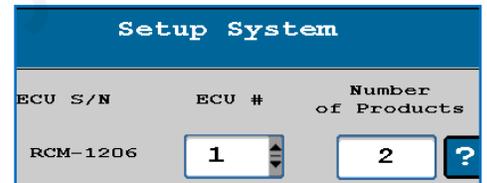


You will see this icon at times. Be patient.

3. Enter a **Profile Name**. Machine Type > **Generic**

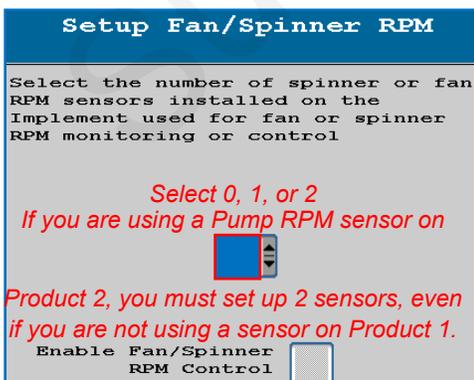


4. Number of Products = **2**



Many setup screens have this "?". This will take you to a Help Screen with valuable information.

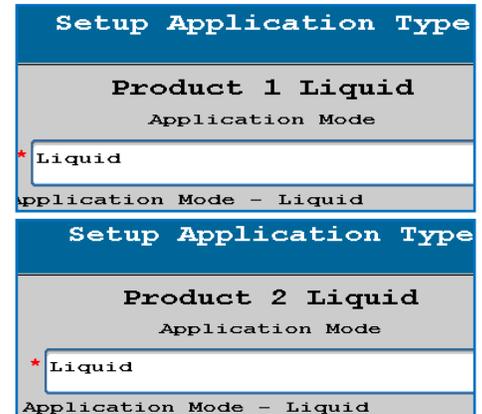
5. Fan/Spinner RPM– Will NOT be used for electric pump system. Use for pump RPM sensor on hydraulic pump. Product 2 uses RPM Sensor # 2 on the SureFire harness.



6. Select **Application Type & Mode**



If you are applying a Dry product, one or both products could be set up as Granular Fertilizer, with an appropriate Application Mode for that setup.



See the [Raven RCM Operation Manual](#) for safety information and additional setup/operating information.

Setup instructions for Raven RCM and SureFire: 2 Liquid Products



7. Section Group Setup—Typical setup—Product 1 is Sections 1-6. Product 2 is Sections 7-12. Many other setups are possible. For a typical dual product setup, you will say NO to sharing section drivers. However, **when using a Spartan injection pump** that is going into a mixing chamber, say YES to sharing section drivers with the main product.

Setup Section Groups

Are section drivers shared between all products in product harness? ?

Yes No

Product 1 Sections: 15.00 15.00 15.00 15.00 (1-4)

Product 2 Sections: 15.00 15.00 15.00 15.00 (1-4)

Product 1 Sections: 15.00 15.00 15.00 15.00 (1-4)

Product 2 Sections: 30.00 30.00 (7-8)

See note above on YES or NO

No

Setup Section Harnessing

Section Group	*Starting* Section Number	*Number* Of Sections	Equal Section Widths
1	1	4	<input checked="" type="checkbox"/>
2	7	4	<input checked="" type="checkbox"/>

Setup Section Width

Enter the width of the sections

1*	10.000 (ft.)	7*	10.000 (ft.)
2*	10.000 (ft.)	8*	10.000 (ft.)
3*	10.000 (ft.)	9*	10.000 (ft.)
4*	10.000 (ft.)	10*	10.000 (ft.)
5*	0.000 (ft.)		
6*	0.000 (ft.)		

Setup Section Group Assignment

Product	Section Groups
1	Section Group 1
2	Section Group 2

Typical setup shown. Many different section setup combinations are possible. The SureFire harness has Sections 1-6 on one connector and Sections 7-12 on another connector. You could set up each product with 12 sections and share section drivers. You do NOT have to have the same number of sections on each product.

Setup Section Groups

Number of Section Groups: 2

8. SureFire Pressure Sensors will be CUSTOM.

Setup Pressure Sensors

Pressure Sensor 1: Custom

Pressure Sensor 2: Custom

Setup Pressure Assignment

Pressure Sensor 1

Product 1:

Product 2:

Pressure Sensor 2

Product 1:

Product 2:

Setup Pressure Alarms

	Min	Max	Alarm?
Pressure 1 (PSI)	0	0	<input type="checkbox"/>
Pressure 2 (PSI)	0	0	<input type="checkbox"/>

For most systems, do not set any pressure alarms. Checking the Alarm box sets a control limit and the pressure will not go beyond that.

9. Pump RPM setup-NOT for electric pump systems. For hydraulic pumps with RPM sensors

Setup Fan/Spinner RPM Calibration

RPM 1 Calibration (Pulse/Revolution): 15 Alarm?

RPM 1 Low Limit (RPM): 0

RPM 1 High Limit (RPM): 0

RPM 2 Calibration (Pulse/Revolution): 15 Alarm?

RPM 2 Low Limit (RPM): 0

RPM 2 High Limit (RPM): 0

RPM Calibration for SureFire Pump RPM sensor is 15 pulses/rev. Set up as needed for your system. Product 2 will be RPM Sensor 2 on the SureFire harness. If using a Pump RPM sensor, you will set up a *Display Setting* on the Run Screen with the Pump RPM readout (described later).

Setup RPM Sensor Assignment

RPM Sensor 1

Product 1:

Product 2:

Go to support.surefireag.com to see the latest QuickStart Setup Guides for the RCM.

RPM Sensor 2

Product 1:

Product 2:

- 396-3786Y1 RCM & 1 Product
- 396-3787Y1 RCM & 2 Products
- 396-3788Y1 RCM & 3 Products
- 396-3789Y1 RCM & 4 Products

Read the [Raven RCM Operation Manual](#) for safety information and additional setup/operating information.



Setup instructions for Raven RCM and SureFire: 2 Liquid Products

10. Control Valve Setup (start with the numbers indicated for your system)

Valve Response Rate: (Adjust as needed)

PumpRight (hydraulic)	1-2
Tower (electric)	20
Catalyst and Spartan	1-5

Control Deadband: Start at 2

If pump is slow responding to rate or speed changes, increase **Valve Response Rate** 10 at a time. If product oscillates around rate going across the field, reduce **Valve Response Rate**.

Setup PWM

Product 1 Liquid

Coil Frequency (Hz)

PWM High Limit (%)

PWM Low Limit (%)

PWM Startup (%)

Setup Control Valve

Product 1 Liquid

Control Valve Type

Valve Response Rate (1-100)

Control Deadband (%)

Low Limit (Adjust in field as needed)

PumpRight (hydraulic)	25-30
Tower (electric)	8-15
Catalyst and Spartan	5-10

PWM Startup (Adjust in field as needed)

PumpRight (hydraulic)	35-40
Tower (electric)	15-25
Catalyst and Spartan	5-15

Fine-tune PWM Low Limit at Diagnostics > Tests > Calibrate PWM Limits

11. Enter appropriate Flowmeter Cal.

Setup Rate Sensor

Product 1 Liquid

Flowmeter Calibration

Flowmeter Pulse/Units

Flowmeter Size (GPM)	Pulses/Gal	Spartan model #	Puls/fl oz
0.08-1.6	22710		
0.13-2.6	3000		
0.3-5.0	3000	115	1700
0.6-13	2000	125	890
1.3-26	2000	135	450
2.6-53	2000	145	220

SureFire Electromagnetic Flowmeters. Verify pls/gal on Serial Number label.

13. Set Rates as desired.

You must enter at least one rate.

Check **Display Smoothing**

Set the **Decimal Shift** box at 1.

Set **Decimal Shift** at 2 for rates such as 0.25 gal/ac.

12(a). Tank and Fill Flowmeter setup

Setup Tank/Bin

Product 1 Liquid

Tank Capacity (gal)

Current Tank Level (gal)

OPTIONAL: Use as desired

Low Tank Level (gal) Alarm?

Tank Fill Monitor

Check **Tank Fill Monitor** box if using a fill flowmeter.

12(b). Fill Flowmeter Cal setup

Setup Tank Fill

Product 1 Liquid

Tank Fill Flowmeter* Calibration

Tank Fill Flowmeter Pulse/Units

Then enter **Tank Fill Flowmeter Calibration**

SFA 3" Fill Flowmeter	130
SFA 2" Fill Flowmeter	300

(Units are 10 gal on SureFire Tank Fill flowmeters.)

Setup Rates

Product 1 Liquid

Preset Rate* Values (gal/ac)

Rate Bump (gal/ac)

Rate Selection

Display Smoothing

Decimal Shift

14. Set Off-Rate Alarm as desired.

Setup Alarms

Product 1 Liquid

Off Rate Alarm (% off target rate) Alarm?

If Pressure Sensor 1 has a minimum pressure alarm enabled the system will not drop below that pressure to maintain spray pattern.

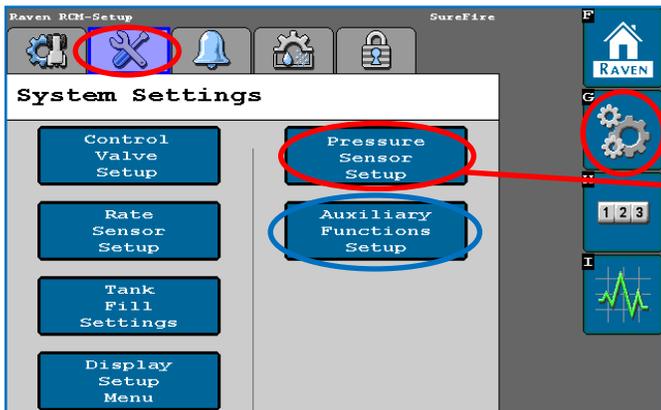
Set up Product 2 in a similar fashion to the Product 1 setup.

Read the [Raven RCM Operation Manual](#) for safety information and additional setup/operating information.

Setup instructions for Raven RCM and SureFire: 2 Liquid Products

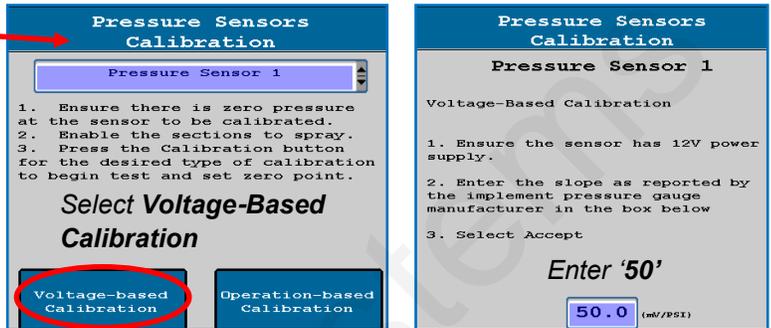


15. **Pressure Sensors** must be calibrated. See the boxes below for the procedure. Enter **50.0 mv/PSI** for SureFire 0-100 PSI sensor. *If you have 2 sensors, both must be calibrated. Be sure there is no pressure against the sensor when calibrating. Unplug the sensor during the calibration process.*

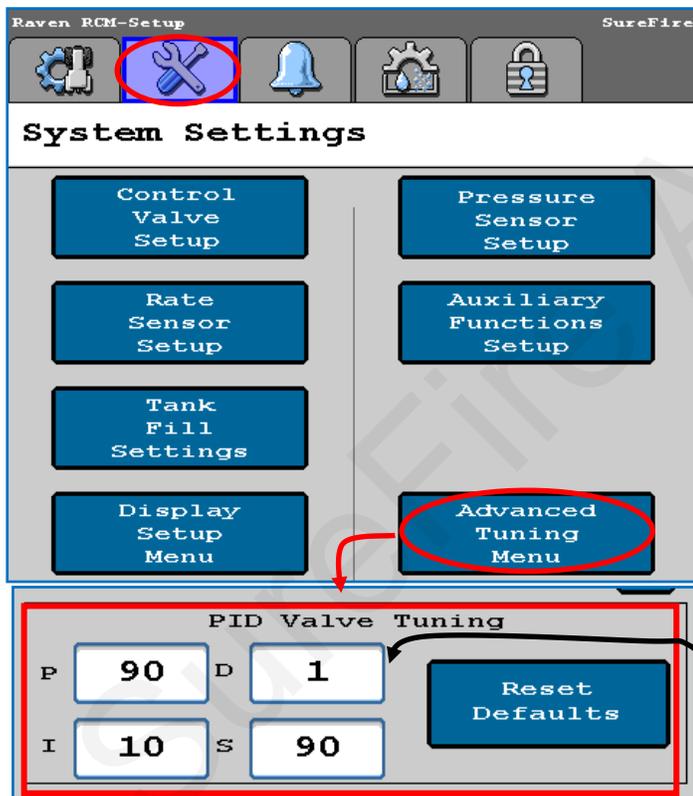


SureFire recommends putting the Pressure Sensor reading in your **Display Settings** on the Run Screen (see next page).

For complete information on how the sensor is operating, go to **Diagnostics > System Information > Pressure Sensors**.



Do this for SureFire electric pump systems - only with Software prior to 1.4



DO THIS for SureFire electric pump systems

16. Advanced Tuning

On SureFire **electric pump systems**, it will be necessary to use the **Advanced Tuning** feature in addition to the regular Control Valve Calibration. To activate **Advanced Tuning**, **press and hold the Settings tab**  for about 8 seconds.

On **electric pump** systems, set the PID Valve Tuning parameters as shown (below left). Press the "?" for an explanation of what each of these values does.

Fine-tuning of the system may require some adjustment of these numbers along with the Valve Response Rate on the Control Valve Setup.

(For quickest response of the Tower 110 system, set P = 100 and S = 100.)

For SureFire hydraulic pumps start with the Default values for the PID Valve Tuning.

Start with these settings for SureFire electric pumps.

- Only with software prior to 1.4. -

These instructions do not cover every possible setup. Your setup may be different. See the [Raven RCM Operation Manual](#) for safety information and complete setup and operating instructions.

SureFire harnesses for the Raven RCM are designed for specific operating setups. Pinouts on the Raven RCM change depending on the Profile Setup and the number of products. See the wiring harness diagram for your harness.

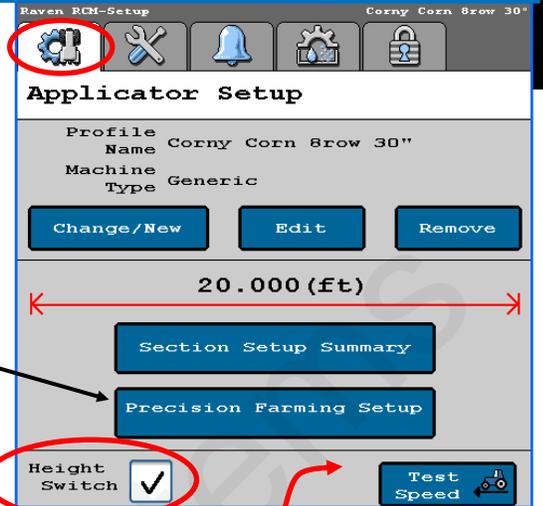
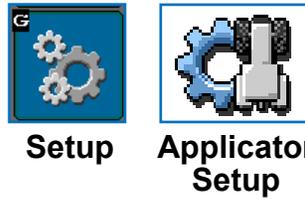
More information is available at support.surefireag.com.



Setup instructions for Raven RCM and SureFire: 2 Liquid Products



Implement Height Indicator Setup

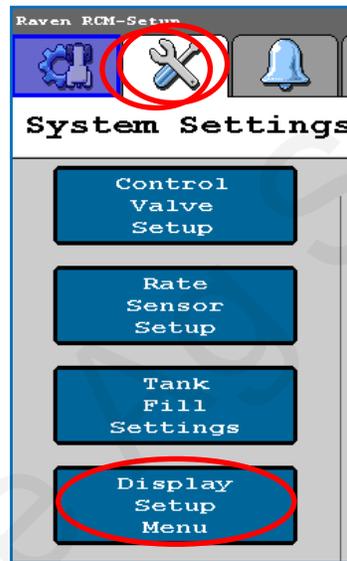
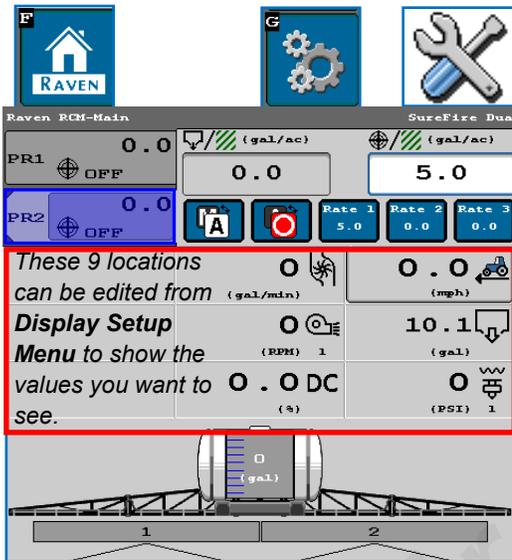


Precision Farming Setup

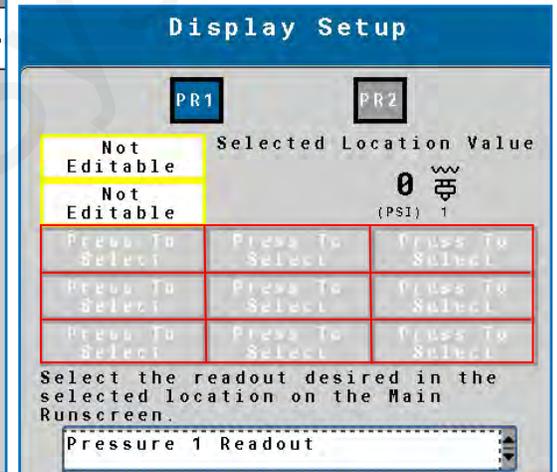
This wizard will allow implement width to be changed as well as section offsets and on/off look aheads to be set. This works in conjunction with the Task Controller software in the display.

Check the **Height Switch** box if you are using a Mercury Switch or Finger Style Switch for Implement Height Indication.

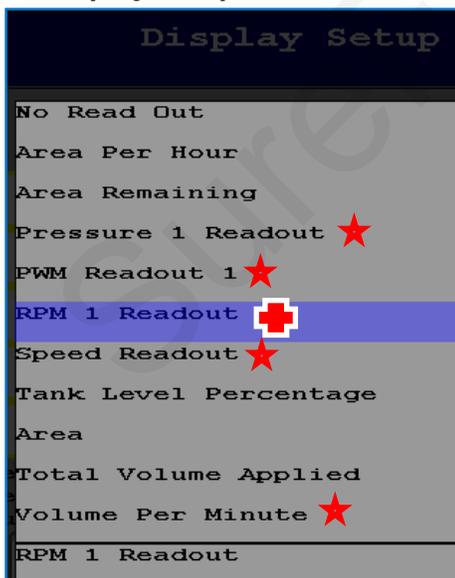
Run Screen



Test Speed will be used later when testing the system.



Display Setup Menu



Control Valve Setup Menu

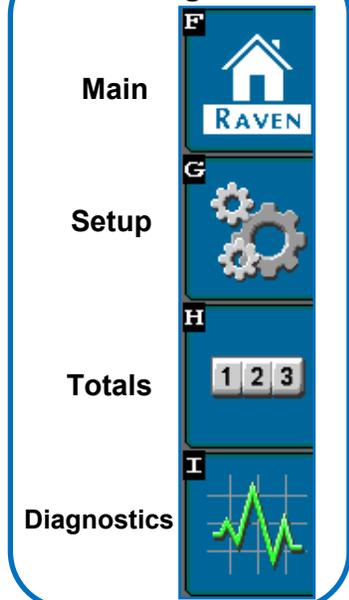
- Valve Response Rate
- Control Deadband
- PWM Setup (Coil Frequency, High Limit, Low Limit, PWM Standby)

Auxiliary Features Setup Menu

- RPM Calibration Pulse/Rev
- RPM Low Limit
- RPM High Limit
- RPM Sensor Assignment

- ★ Recommended for all systems
- ✚ Recommended for hydraulic pump systems with Pump RPM sensor

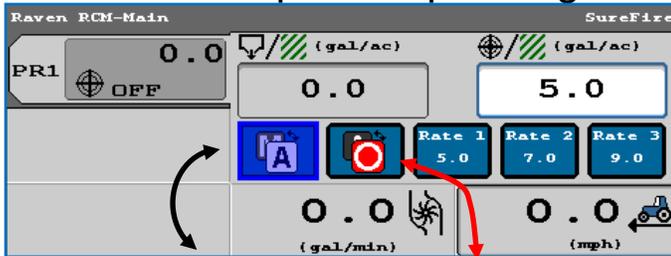
Navigation



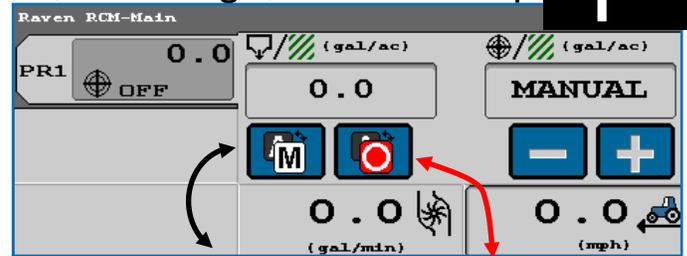
Read the [Raven RCM Operation Manual](#) for safety information and additional setup/operating information.



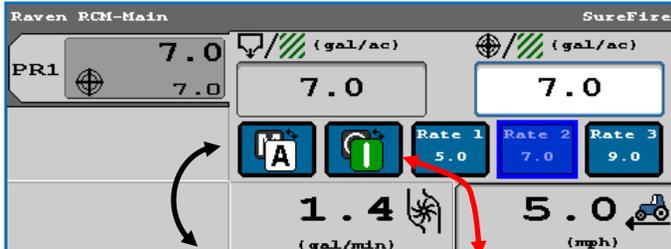
Advanced Setup and Operating Information, Run Page, Initial Startup



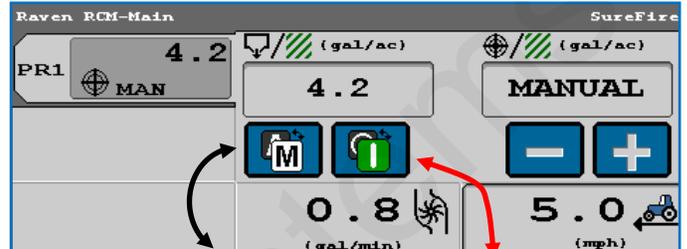
AUTO MODE / DISABLED



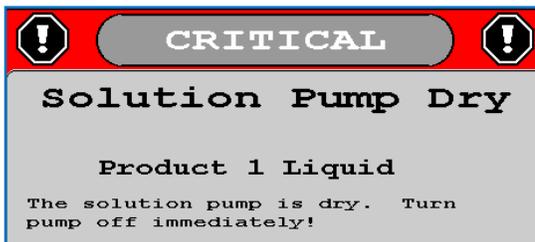
MANUAL MODE / DISABLED



AUTO MODE / ENABLED



MANUAL MODE / ENABLED



If flow or pressure is not immediately detected, the **Solution Pump Dry** warning will come up and the system will shut down. **Solution Pump Dry** is NOT a problem for SureFire electric pumps or for SureFire PumpRight hydraulic diaphragm pumps. These pumps will not be hurt by running dry. It is a problem for centrifugal pumps.

Initial Operation in MANUAL mode: (See Optional Manual Pump Operation below)

1. Fill the system with water. For first time startup, open air bleed valve until a steady stream comes out.
2. Enter a **Test Speed** by pressing on the **Speed (mph)** window or at **Setup > Applicator Setup**.
3. Navigate to **MANUAL MODE** as shown above (toggle between Auto and Manual with the Auto/Manual button).
4. **ENABLE** system (toggle between Enable / Disable with the Enable / Disable button).
5. Height switch must be **DOWN** (or uncheck Height Switch box).
6. Turn on **Master Switch**. Press and hold + to increase flow.
7. Monitor Flow (gal/min), PSI, DC.
8. Go to **Switch Box**. Turn Sections OFF and ON.
9. Turn Master Switch OFF.



OPTIONAL MANUAL PUMP OPERATION:

Go to **Diagnostics > Tests > Calibrate PWM LIMITS**. Here you can manually run the pump without the system shutting down if it doesn't read flow immediately. Turn on Master Switch, Start the test, hold + button to increase pump speed.

Initial Operation in AUTO mode: (Could also do Nozzle Flow Check).

1. Enter a **Test Speed** by pressing on the **Speed (mph)** window or at **Setup > Applicator Setup**.
2. Toggle system to **AUTO / ENABLED**. Select a Rate.
3. Height switch must be **DOWN** (or uncheck Height Switch box).
4. Turn on **Master Switch**.
5. Monitor Actual Rate (gal/ac), Flow (gal/min), PSI, DC, Pump RPM.
6. Go to **Switch Box** (above). Turn Sections OFF and ON.
7. Turn Master Switch OFF. (NOTE: Pressure will be much less with water than with heavier, thicker fertilizer.)

Read the [Raven RCM Operator's Manual](#) for safety information and additional setup/operating information.



Main Screen / Run Page

Frequently Used System Information Screens

Diagnostics



Diagnostics > System Information Menu

Diagnostics > Tests Menu

- Hardware / Software
- Switchbox
- Delivery System
- Section Status
- System Voltages
- Working Parameters
- Switches / Status
- Pressure Sensors
- Bin Level Sensors
- RPM Sensors
- Tank Fill Monitor

- Nozzle Flow Check
- Rinse Cycle
- Control / Section Test
- Calibrate PWM Limits

Pressure Sensor Information

Delivery System Information

Set PWM Limits

Tests > Calibrate PWM Limits

1. Turn Master Switch ON.
2. Press the Start button.
3. Adjust setting until minimum acceptable flow/pressure is achieved, and press Set Low Limit.
4. Adjust setting until maximum acceptable flow/pressure is achieved, and press Set High Limit.

Note: Turn the Master Switch off to stop product application.

These tests can be run at initial system startup or for troubleshooting. Similar tests can also be run from the Run Page using Manual and Auto Mode with a Test Speed.

Section Test

Tests > Control / Section Test

1. Select the section outputs to be activated.
2. Turn the Master Switch on.
3. Press the Start Button.
4. Toggle Sections using the buttons.

Note: Turn the Master Switch off to stop product application.

Press and hold the - or + button to operate the control valve.

When testing with water, the system pressure will be much less than it will be with a fertilizer product. There may not be enough pressure to open all the check valves, so some rows may not flow.

Nozzle Flow Check

Tests > Nozzle Flow Check

1. Enter test speed and rate.
2. Turn Master Switch ON.
3. Press the Start button.

Note: Turn the Master Switch off to stop product application.

Read the [Raven RCM Operator's Manual](#) for safety information and additional setup/operating information.



TROUBLESHOOTING TIPS:

1. Pump Won't Run—Start the Calibrate PWM Limits Test. Press (+) to run the PWM Duty Cycle (DC) to 100%. With a voltmeter check voltage at the 2-pin PWM connector at the EPD or hydraulic valve solenoid. You should have 12-13 volts. If there is voltage here, but the pump won't run, check the pump using the following tests:

Electric Pump—Start Calibrate PWM Limits Test to open Section Valves. Unplug the two big connectors that plug into the black EPD module on the pump tower. Plug these together. This will take power from the battery directly to the pump(s). The pump(s) should run full speed.

Hydraulic Pump—On the hydraulic valve block, pop up the Manual Override button (red knob on top of solenoid). If unit has been in the field, you may need to loosen the dirt to move the knob. In cab, turn hydraulic flow to very low. Start Calibrate PWM Limits Test to open Section Valves. Engage hydraulics. Pump should begin turning. Slowly increase hydraulic flow to speed up pump.

2. Pump runs and liquid flows, but display is not reading flow. Unplug the flowmeter. With a voltmeter, check for 12 volts between pins 1 (black) and 2 (red) of the connector that plugs into the flowmeter. (You may have to remove the red keeper to get access to the pins with your voltmeter. Be careful not to break the sides of the red keeper.) You should also have 4-5 volts between pins 1 (black) and 3 (red).

If the voltage is OK, conduct a tap test. Have one person on the display go to Diagnostics > System Information > Delivery System, watching Flow Meter (Hz). The second person will tap repeatedly between pins 1 and 3 on the flowmeter connector with a bent paper clip or short piece of wire. As the person taps, the display should show some numbers on Flow Meter (Hz).

If the voltages are good, and the tap test shows on the display, but the system does not read flow when liquid is flowing, the flowmeter is not working.

3. PWM Startup—For best startup performance, set the PWM Startup at or slightly above the DC% that the system will be running at in the field.

Using the Quick Start button:



Use the Quick Start button to get the system primed and ready to apply when entering a field or starting in a field corner. Turn on the Master Switch, push Quick Start, the system will begin applying as if the Speed is 3 mph. Start driving. The Auto Rate Control will take over when the speed reaches the Minimum Application speed. Quick Start runs for 15 seconds. For additional time, push Quick Start again.

Virtual Terminal (VT), Universal Terminal (UT), and Task Controller (TC)

VT or UT software allows the display to show the ISOBUS Implement (the Raven RCM) on the display screen. This usually comes with the display, but be sure the software is installed if the display has not previously been used as a Virtual Terminal.

Task Controller software is necessary to do Section Control, Variable Rate Application using prescriptions, and/or As-Applied Mapping. Task Controller is typically purchased from the display manufacturer as an Unlock.

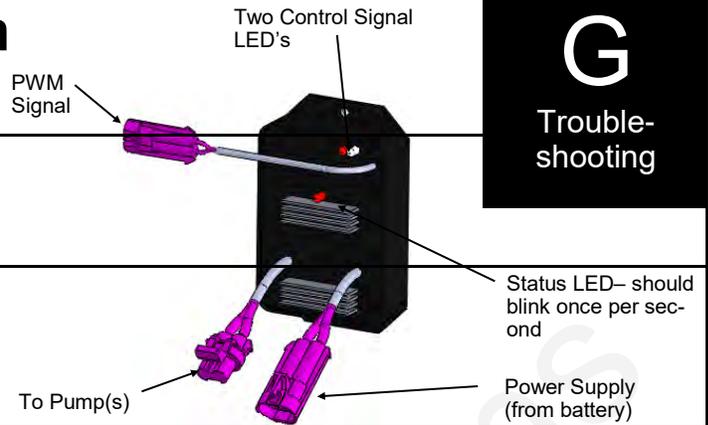
See the Task Controller documentation from your display manufacturer for more information on setup and operation.

For more information, see the SureFire Manual for your Raven RCM system at support.surefireag.com.

Read the [Raven RCM Operator's Manual](#) for safety information and additional setup/operating information.

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) This light will go off after 5 minutes of inactivity	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 12-pin connector, pins 2&5.
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.	<ul style="list-style-type: none"> Check motor wiring
Three blinks, pause, three blinks, pause	Overcurrent condition	<ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> Test the voltage under load coming into the EPD. (See picture on page 22 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

Raven RCM

G

Troubleshooting

Always verify the controller settings. See the screenshots in Section F of the system manual and on the QuickStart setup sheet that came with the adapter harness.

The pump won't run. Electric Pump System

EPD flashing 4 times

1. Find the EPD (electric pump driver) shown above. Should have a steady blinking light in the middle when pumps should be off. If Status LED 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. *(There should be 12 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 11-12 volts under load.)*

No Lights on EPD

1. The center blinking light will go off after 5 minutes of inactivity.
2. There should be a steady blinking light in the middle of the EPD. If no light is ON, unplug the connector that comes from the battery to reset the EPD. 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. Check this under load. It may show adequate voltage with nothing on, but bad wiring or connectors may not support the current needed with a load.

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 both.

Electric pumps only run with 12 volts direct from battery

1. Connect pumps and power harness back to EPD.
2. Go to **Diagnostics, Calibrate PWM Limits Test** to investigate this issue (this is a place where you can run the pump).
3. Start the test. Hold down "+" button for a few seconds. A single tap of this button produces a very small change in signal to the valve, so you must hold it.
4. Remove PWM valve connector at EPD and check voltage. You will need 4-12 volts to turn pumps on.
5. If 4-12 volts is not present, check harnesses and review control valve type setup.
6. Go back to the 12-pin connector that plugs into the Pump harness. Check voltage between pins 5 & 6.
7. On 35-pin connector on RCM, PR 1 PWM is pins 23 & 35. PR 2 PWM is pins 13 & 24 when set up In a Generic profile for 2 liquids.

For more complete system information see the manual for your system. Manuals can be seen and downloaded at support.surefireag.com. The manuals also contain wiring harness diagrams.

Application Rate Fluctuates

First, you need to determine if the fluctuation is caused by the controller sending fluctuating signals to the valve or because of something else.



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 with a Test Speed.
2. Turn the system on. Watch the flow in GPM.
3. Is the flow steady within a very small range? For example, a fluctuation from 12.3 to 12.6 GPM would be considered normal. A fluctuation from 10-14 GPM is a problem. If only a small normal fluctuation is seen in section test, 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 of manual for flowmeter information. Check connections between tank and pump. A loose connection may not show up as a leak, but it can be a place where air can be sucked in. Air in the system will cause erratic flowmeter operation.
6. If visually the flow is unsteady, the flowmeter is working correctly reporting a flow problem. Is the pump turning steady or surging?
7. If the pump is turning steady, the hydraulic circuit is functioning correctly. 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.
8. If the pump speed is surging, there is a hydraulic problem.

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 hydraulic valve too much.

1. Go to **Setup - System Settings - Control Valve Setup**.
2. Lower the Valve Response Rate by 5 or 10. You can do this on the go and see how the change affects the rate.
3. In extreme cases, it may be necessary to go to Advanced Tuning and adjust some other parameters.

Application Rate is slow to get to the Target Rate

1. To get system to Target Rate faster on startup, go to **Setup - System Settings - Control Valve Setup > PWM Setup > PWM Startup**. Set PWM Startup (%) so that pump starts up at or slightly above the normal PWM Duty Cycle.
2. If system is slow responding to rate or speed changes, you may need to increase the Valve Response Rate. Go to **Setup - System Settings - Control Valve Setup**. Increase Valve Response Rate 10 at a time. You can do this while going across the field and observe the effects of each change. If Valve Response Rate is at 100 and system is still slow getting to Target, go to Advanced Tuning and increase P and S.

Helpful Operating and Troubleshooting Information on the RCM

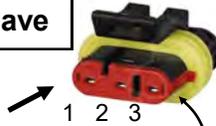
1. **Flow (gal/min), Pressure (PSI), PWM Duty Cycle (DC%)** are important indicators of system performance. It is good to know what these values are in normal field operation. They provide good troubleshooting information if there is a problem.
2. These items can be placed on the Run Screen with **Display Settings**.

1.4 (gal/min)	5.1 (mph)
73 (RPM) 1	11.8 (gal)
40.0 DC (%)	26 (PSI) 1

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 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 **Setup > System** and change the flow cal to 1. Have a second person watch GPM on the 1,2,3 screen 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 (gpm) should show up indicating the wiring is not damaged. (If alone, note or reset a volume counter to 0, and start Calibrate PWM Limits Test. Check for increased volume after tapping.)
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

$(\text{Volume shown on display}) / (\text{Volume actually applied}) \times \text{flow cal number in display} = \text{new flow cal}$

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.*)

$$727 / 750 \times 3000 = 2908 \text{ (new flow cal number to set in display)}$$

(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 **Diagnostics > Tests > Section Test** to investigate this issue. If system shuts off with Solution Pump Dry warning, use the Calibrate PWM Limits Test.
2. Start Section Test. Check and uncheck the boxes. With the box checked the valve should turn on. The valve should be off with the box not checked.
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)

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

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.
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.



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 180°, 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. Be sure the Pressure Sensor that is displayed on your screen is the same sensor that is plugged into your harness for that product.
2. Make sure the pins where the harness screws on to the end of the sensor have not been bent.
3. Be sure Pressure Sensor is set up and calibrated in the display. Unplug the pressure harness before doing this.

Setup > Settings > Pressure Sensor Setup. Select the sensor you want. > Calibrate Pressure Sensor > Voltage-based Calibration > 50 mv/PSI.

4. There should be a green LED light on the end of the pressure sensor. (may be difficult to see in daylight). The sensor needs 12 v. Check between pins B&C on the Pressure connector on the harness that connects to the pressure sensor. If there is no voltage here, check the voltage between pins 1 & 2 on the 12-pin connector labeled PUMP.
5. **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. You can check this at *Diagnostics > Readings > Sensors/Status* (0 PSI should be 0.0v, 90 PSI should be 4.5 v)

Other issues

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Trouble-
shooting

1. “My rate won’t go low enough. I want 8 gpa, but it won’t put down less than 11 gpa.”

A. Check **Setup > System Settings > Rates > Minimum Flow Rate**. This can be set at 0.0 or at the low range of your flowmeter. This is **gal / min** not **gal / acre**.

B. Check **Setup > System Settings > Control Valve Setup > PWM Settings > Low Limit**. Default setting is 10 for electric pumps and 25-30 for hydraulic pumps. If set too high, the pump cannot slow down enough when your speed drops or when sections close.

C. On a hydraulic pump, be sure the red manual override knob is down and locked on the hydraulic valve.

2. “I can’t get up to my rate. I want 12 gpa, and I can’t get more than 10 gpa.”

A. How many GPM are required to hit your rate? Is this within the pump’s specifications? On an electric pump, the output of the pump decreases as the pressure increases. Keep the pressure under 40 PSI (or lower) on an electric system. Is a recirculation valve open, allowing too much liquid to recirculate?

B. On a dual electric pump system, check each pump individually to see that each one is working at capacity.

C. Is the strainer plugged? If too small of a mesh strainer is being used, the fluid can gel up around the screen as the fluid is pulled through.

D. Does the pump have enough hydraulic oil to hit the desired rate? If the pump is in series behind another pump or motor, the hydraulic oil to this pump may be limited.

E. Check **Setup > System Settings > Control Valve Setup > PWM Setup > PWM Settings > High Limit**. This should be 100.

F. Check the PWM DC % (Duty Cycle). This can be placed on the Run Screen.

G. Check the Pump RPM. Maximum RPM should be 500-550 RPM.

H. Run the pump with a Test Speed in Manual Mode. Press the + button to increase flow. Observe flow (GPM), PWM DC%, PSI, and Pump RPM (if equipped).

I. Run a Nozzle Flow Check. See gal/ac, PSI, gal/min, and PWM Duty Cycle.

J. Is the flow cal correct? Is the width of the implement set correctly?

3. “It’s pretty close to the rate, but it won’t ever lock in to the rate.”

Go to **Setup > System Settings > Rates > Display Smoothing**. Check the box for Display Smoothing.

Without Display Smoothing it is normal for the system to show the rate constantly changing small amounts as you go across the field. With Display Smoothing, if the Applied Rate is close to the Target Rate, the display does not show all the small changes.

4. “When I start up, I get a screen that says “Solution Pump Dry”.

This is not unusual on the RCM. If the flowmeter does not show flow immediately when you start, this screen pops up. It is made to protect centrifugal pumps that can be harmed quickly if they are dry. This is not a problem for SureFire diaphragm pumps. To get to Target Rate quicker on startup, set the PWM Startup % so the pump starts at or near where it will be running.

5. “My pressure is too high / too low.”

The pressure will be what it is depending on how hard it has to push to get the amount of liquid you are moving from the pressure sensor to where it leaves the system. This pressure will depend on the product itself, the volume (gal/min) you are moving and how much restriction there is to that flow. The orifice or metering tube will be the primary restriction, but it is possible that other parts of the system may add to the total pressure. The pressure a system develops will be less (possibly much less) with water than it will be with a fertilizer product.

What pressure is “too low”?

You need enough pressure to open the check valves. If the pressure is too low, some check valves will open before others, so that some rows may be flowing while others are not. **With 4 lb check valves, we like at least 8 PSI. With 10 lb check valves, we like 15-20 PSI.**

What pressure is “too high”?

There are a few products that may have flow characteristics that are better at lower rather than higher pressures. With most products that is not a concern.

The plumbing components of a SureFire system are rated at 100 PSI or above. On an electric pump system, the pump capacity decreases as the pressure increases. Our standard Tower pump has an internal 70 PSI bypass. **With an electric pump, we like to see pressures from 10 to 30 PSI.** If the pump has the capacity to hit the rate at higher pressures, there is not a problem with doing that, but for long-term operation it would be best to switch to a larger orifice or metering tube.

The SureFire PumpRight hydraulic pump has the ability to pump up to 290 PSI. SureFire plumbs these with a 100 PSI pressure relief valve (PRV) so that plumbing components will not be damaged if high pressure develops. **Typical operating pressures with hydraulic pumps will be 20-60 PSI**, but the pump will work fine at 80-90 PSI if that is needed. If continually running in that high range, consider a larger orifice or metering tube.

Lower pressure will not necessarily reduce the **velocity of the output stream** at the row. Conversely, higher pressure will not necessarily increase the velocity of the output stream at the row. The velocity of the output stream is determined by the volume of the flow and the size of the opening at the output. Changing the pressure by changing an orifice or metering tube upstream from the outlet will not affect the velocity of the output stream if the flow volume remains the same.

Options if pressure is too high with orifices: Use a bigger orifice. Slow down. If pressure is too low, use a smaller orifice.

With metering tube: Options if pressure is too high: Use a larger diameter tube. Shorten the tubes that are on now. Slow down. (*The pressure in a metering tube is related to the viscosity of the product. Many products change viscosity as the temperature changes. A product will have a higher viscosity (and therefore higher pressure) on a cold morning that it will on a hot afternoon.*)

With metering tube: Options if pressure is too low: Switch to a smaller diameter tube. Use a longer tube.

See SureFire publication “396-3269Y1 Navigating the Metering Tube Maze” for more information on how metering tube works.

See SureFire publication “396-3229Y1 Liquid System Components Overview” for a description of all the system components and additional troubleshooting/service information.

See the system manual for your system for more complete information. Manuals and publications are available for download at support.surefireag.com.

Read the [Raven RCM Operator’s Manual](#) for safety information and additional setup/operating information.

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.

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 more than 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.
2. On the display, recheck all setup screens (see Section F) to verify correct setup.
3. Fill system with water and run in Manual mode (Section Test) to verify components and system are in working order. (May need to open air bleed valve to prime pump the first time.)
4. Unplug one pump at a time to verify that each pump is operating as it should.
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 tubes at all Quick-Connect fittings so they are seated tightly. Tubes that are not fully seated are not always obvious, but may allow air in, which can cause check valves to leak.
7. Remove the 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.)
10. Run the Nozzle Flow Check to verify that system will lock on to a Target Rate. Pressure will be much lower when testing with water than it will be with fertilizer.

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Pre-season Service for Tower (Electric pump) Systems

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

H

Maintenance
& Parts

1. Visually check entire system (hoses, fittings, harnesses, etc.) for any signs of wear or trouble. If connectors, harnesses, or parts have been soaked in fertilizer, check these very carefully.
2. Particularly check all 37- and 16-pin connectors on systems that have been in use. Be sure pins are clean, not corroded, and are making good contact. Corroded pins need to be replaced. Cleaning will not restore good electrical contact. If the pin has corroded, a lot of time the corrosion extends to the first part of the wire. If there is much corrosion, consider replacing the cable. Newer style cables have Deutsch connectors that seal better than the round AMP connectors.
3. Check the 12-pin ISO Connector and 2-pin Molex power connector.
4. Check the Power Cable connection at the battery and at the hitch. If these have 480 MP connectors, consider upgrading the connectors to the Anderson connectors and possibly upgrading the full power harness and extension to the new heavier duty cables. The biggest problem with electric pump systems is when we get low voltage at the EPD because of the length of the cable necessary to get there. The heavier duty cables (6AWG wire) with the robust Anderson connectors helps to reduce the voltage drop. On EPDs with the Anderson connectors there is a Voltage Test connector. Test the voltage here when the pumps are running.
5. Check the flow indicators for cracks and clarity. They can become weathered and difficult to see through.
6. On the display, recheck all setup screens (see Section F of the manual or the QuickStart Setup Guide) to verify correct setup.
7. Raise and lower the implement to verify that the height switch (if being used) arrow is indicating correctly on the Run Screen by the Master Switch indicator.
8. Fill system with water and run in Manual mode (Section Test or Calibrate PWM Limits) to verify components and system are in working order. (May need to open air bleed valve to prime pump the first time. Be sure the air bleed valve and tube are not plugged. Be sure recirculation knob is closed.) In these two tests, you should be able to speed the pump up and slow it down with the (+) and (-) button. SureFire gives recommendations for setting the PWM High Limit and Low Limit that generally work for nearly all systems. It is possible to fine-tune those settings with the Calibrate PWM Limits Test. The PWM Low Limit should be a setting at which the pump will run enough to register steady flow on the flowmeter. If the pump will be operating at a higher level (even when running with only one section on) the Low Limit can be increased. This is particularly helpful on the GRC to get quicker startup at the beginning of a pass. Understand that the pump will not slow down below the PWM Low Limit so if the Low Limit is too high, there could be over-application at those times that lower output is needed (such as with only one section on). Some users of the GRC may be willing to live with a little over-application on the small areas that will be covered with only one section on to get a faster startup on every pass by setting the PWM Low Limit higher.
9. This is a good time to check out the Readings > Delivery System screen. This is a screen that every tech and every user should regularly check.
10. On the Delivery System screen, check out the flowmeter operation at Flowmeter (Hz) to see the pulses (per second) that are being generated by the flowmeter. With the pump running at a steady speed this should be stable (± 2 Hz variation).
11. Check out the PWM Duty Cycle. On a Nozzle Flow Check or while operating in the field at a steady speed, this should also be steady (± 2). If this is bouncing around more, lower the Valve Response Rate (RC2000) or lower the first 2 digits of the Valve Calibration number (GRC). 9911 is our starting point on the GRC Valve Cal for an electric pump (and usually stays there).
12. Check the voltage at the EPD (on the Voltage Test connector) while the pumps are running hard. If the

voltage drops to 11 v or less there could be problems with the EPD.

H

Maintenance
& Parts

13. Check the operation of each pump individually. Run the Calibrate PWM Limits Test with one pump at a time and verify the flow output (GPM) of each pump.
14. 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.
15. Push in all QuickConnect (QC) fittings to be sure the tubes are tightly seated. Unseated QC fittings may not leak but they can cause check valves to leak because they allow air to be drawn into the system when application stops.
16. Remove the blue or 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. These check valve fairprene diaphragms (133-03-40155-07) and the O-ring (133-03-40160) in the check valve should be replaced every year or two for best performance.
17. Remove and clean the strainer. Be sure strainer is tightened securely so it will not suck air. Check the housing for cracks.
18. Run system with a Nozzle Flow Check with speed and rate to be used in the field.
19. 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.)
20. While the test is running, go to Diagnostics > Readings > and look at Delivery System (Flow and PWM Duty Cycle), System Voltages, and Sensors/Status (Pressure Sensors on RCM). Verify the Calibration Points (0 PSI = 0 v) and Slope (50).
21. Verify that all sections open and close (and in the correct order) with the Section Test.
22. It is good to run a catch test to verify flowmeter operation. This can be done using the Diagnostics > Tests > Calibrate Flowmeter or can be run using a Nozzle Flow Check. If the amount caught is close to what it should be, do not change the Flowmeter calibration number unless you have repeatedly done accurate tests that indicate a change should be made. The flowmeters are generally very accurate with the factory flow calibration number and should not be changed unless very accurate data indicates it should.
23. Check the placement devices for wear and alignment. Check tension on Keeton seed firmers.

Use Flow Simulator (219-01462) or Tap Tester tool (212-03-3912Y1) to verify harnessing.

Use Pressure Simulator (212-03-3910Y1) to verify harnessing and setup and to change LiquiShift valves.

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