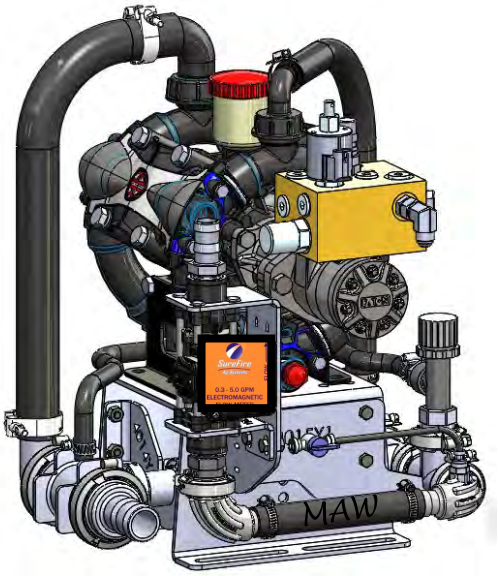
396-001230

PumpRight Fertilizer System for Trimble® Field-IQ™

(FmX® or FM-1000™ or TMX-2050 Displays

Trimble Field-IQ™ for PWM Control

PUMPRIGHT HYDRAULIC DRIVE DIAPHRAGM PUMPS



NOTICE

Operator should read this manual before operating the system.

Maximum Pump Flow and Application Rates

	Number of Diaphragms	Max Flow GPM	Max GPA on 40' at 6 MPH	Max GPA on 60' at 6 MPH
PR17	3	17	35	23.5
PR30	3	30	62	41
PR40	4	40	82	55
D250	6	55		75

Table Of Contents

Introduction

Components - Liquid

Components - Wiring & Electrical

Installation Overview

Setup & Operation

Troubleshooting

Maintenance & Parts

Safety

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 TMX-2050, FM-1000™, FmX®, CFX-750™ or FM-750 display and Field-IQ™ Rate and Section Control Module. The rate controller will adjust the speed of the SureFire PumpRight hydraulic pump based on feedback from the flowmeter and vehicle speed. The system is capable of section control to minimize overlap areas with optional section valves.

Note for TMX-2050 Users

The setup screens shown in this manual are from the FmX or FmX Plus display. Most of the setup for the TMX-2050 with the FmX Plus application and FmX or FM-1000 look the same.

A big difference from prior software versions is in the Drive Calibration. The TMX-2050 and most recent FmX software uses Proportional Gain instead of Integral Gain. Run the Auto-Tuning process to get the Drive Calibration. Set the Upper PWM Limit to 100 after running the Auto-Tuning. Auto-Tuning may set the Upper PWM Limit at a lower number which limits the top end of your system.

Basic Installation Steps

1. Install Trimble® display, harnesses, and Field-IQ™ Rate & Section Control Module.
2. Open the packages and familiarize yourself with the components. Refer to manual sections B, C & D for component information.
3. Mount the PumpRight pump and make hydraulic connections. See section E for hydraulic plumbing information.
4. Plumb the tank to the PumpRight inlet. See section E for details.
5. Install the plumbing kit including section valves, flow indicator columns / manifolds, check valves, plumbing to each row unit delivery point. See section B for information on these components.
6. Attach the flowmeter outlet to section valve or manifold inlet. Attach section valve outlets to flow indicator inlets.
7. Attach harnesses as shown in Section D.
8. Setup Controller for SureFire fertilizer system as shown in Section F.
9. Fill system with water, conduct initial operation and tests per Section F.
10. Winterize system with RV Antifreeze if freezing temperatures are expected.
11. Do preseason service and checks each year as described at the end of this manual.

Consult your Trimble Display User Guide for more information on the setup and operation of your Trimble system.

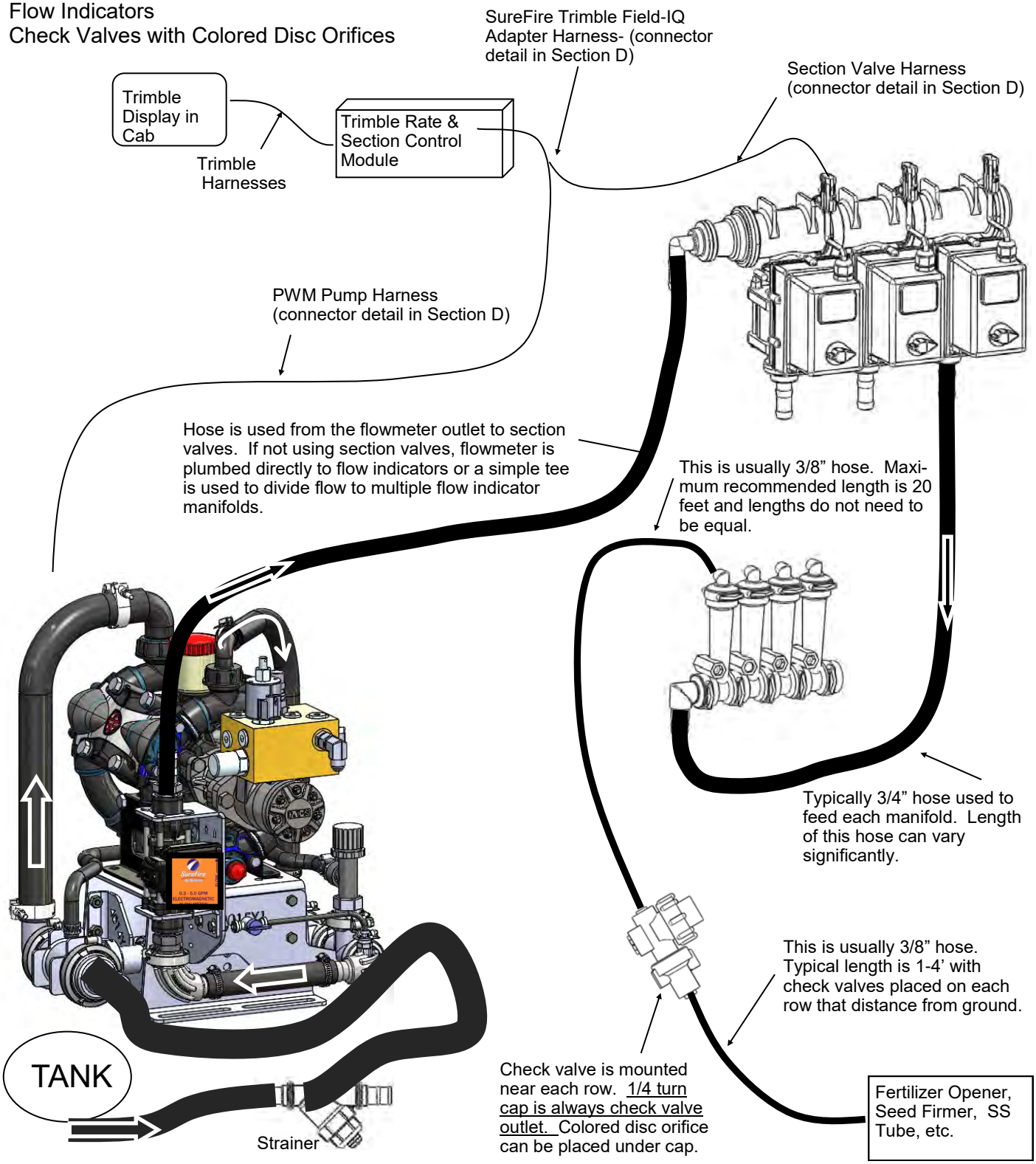
NOTICE

Operator must read this manual before operating the system.

System Overview Example

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

- Trimble® Display
- Trimble® Field-IQ Rate & Section Control Module
- PumpRight PR17
- Section Valves
- Flow Indicators
- Check Valves with Colored Disc Orifices

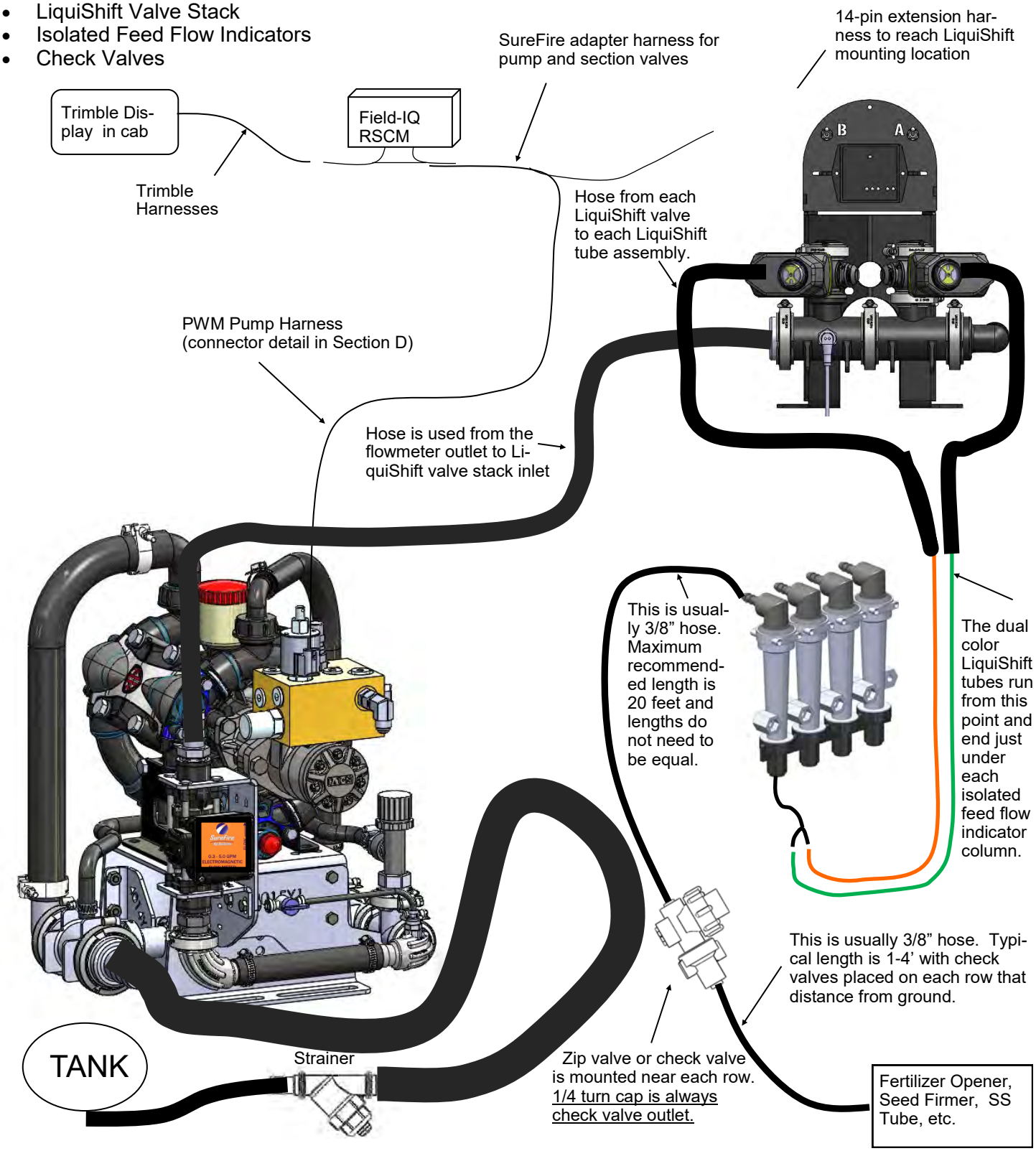


System Overview Example

A
Introduction

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

- Trimble Display
- Field-IQ Rate and Section Control Module (RSCM)
- PumpRight PR17
- LiquiShift Valve Stack
- Isolated Feed Flow Indicators
- Check Valves



PR17 & PR30 Electromagnetic Flowmeter Kits

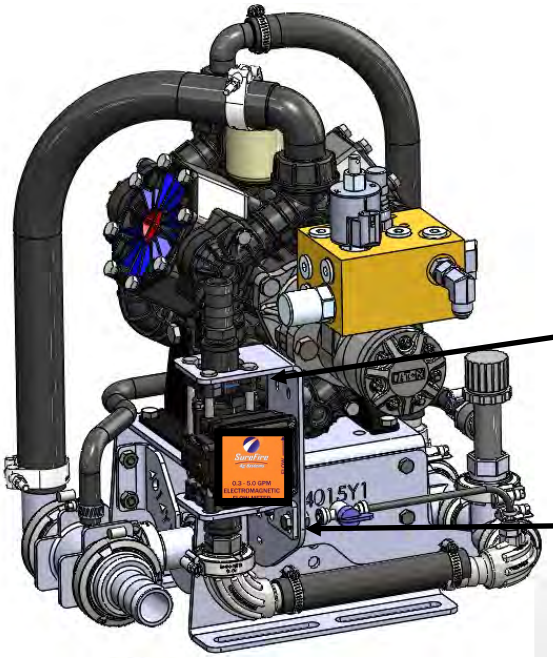
B
Components
Liquid

0.13 - 2.6 GPM Item Number 500-02-2082 (PR17)
0.3 - 5.0 GPM Item Number 500-02-2085 (PR17)
0.6 - 13 GPM Item Number 500-02-2090 (PR17 & PR30)
1.3 - 26 GPM Item Number 500-02-2095 (PR30)

Kits include flowmeter, adapter harness, 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.

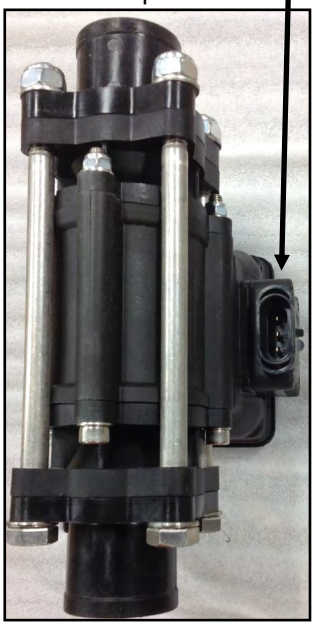
-Do not power wash the flowmeter. High pressure spray directed at the back edge of the face plate or at the wire connector may allow water into the flowmeter electronics.



Mounting Bracket, 410-4015Y1 (QTY 1) (not used for PR40 and D250 Pump)

Mounting Bracket, 400-3826Y1 (QTY 1) (not used for PR40 and D250 Pump)

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



Troubleshooting Tip:

1 2 3

Remove red guard to reach pins. Be careful so you don't break red side keepers.

3-pin MP Tower A- Signal B- 12V Power C- Ground *(See the next page for more flowmeter tips)*
3-pin AMP SuperSeal 1– Ground 2– 12V Power 3– Signal

Electromagnetic flowmeters are superior to traditional turbine flowmeters in two basic ways. First, they have no moving parts. There are 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 (black meter with orange label)	JD GRC Flow Calibration	FPT Size	Hose Barb In kit
0.13 - 2.6 GPM	3000	3/4"	1"
0.3 - 5 GPM	3000	3/4"	1"
0.6 - 13 GPM	2000	3/4"	1"
1.3 - 26 GPM	2000	1"	1"

The flowmeters will accurately read higher than the rated range.

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

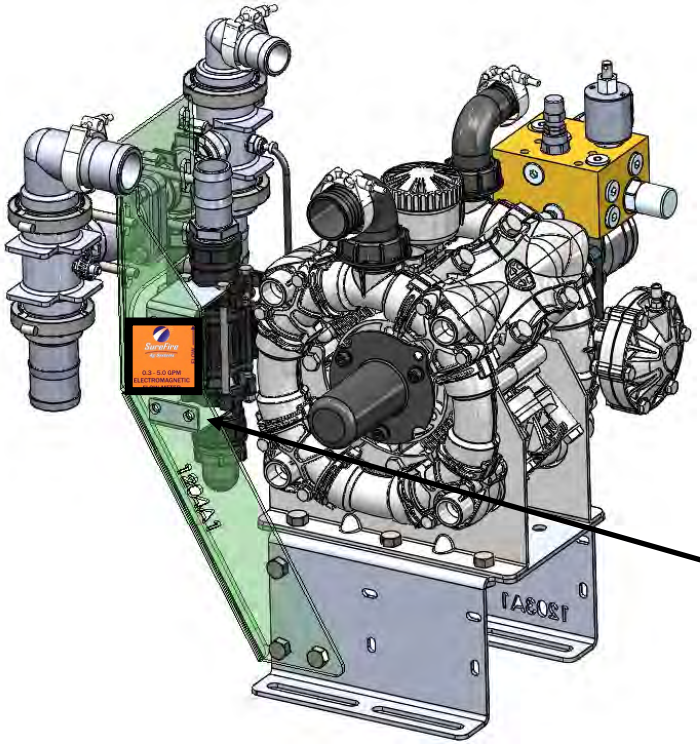
PR40 & D250 Electromagnetic Flowmeter Kit

2.6 - 53 GPM Item Number 500-02-2080

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

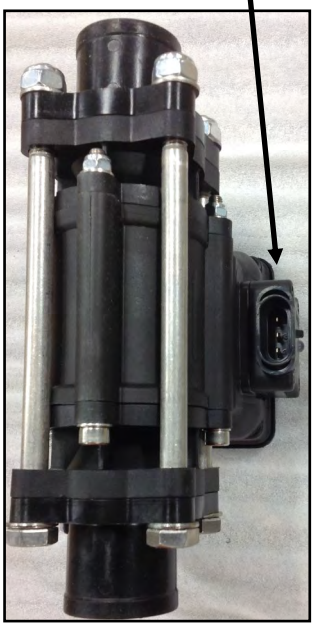
B
Components Liquid

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



Mounting Bracket, 400-3335Y1 (QTY 2) (used for PR40 and D250 Pump only)

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



1 2 3

Remove red guard to reach pins. Be careful so you don't break red side keepers.

Troubleshooting Tip:

3-pin AMP SuperSeal 1– Ground 2– 12V Power 3– Signal

Power to Ground should be 12 volts.
Signal to Ground should be 4.5 to 5 volts
Do Tap Test between Signal and Ground to test harnessing.

3-pin MP Tower A- Signal B- 12V Power C- Ground

Additional Tip:

If flowmeter is not reading and the harnessing has checked out OK with voltage readings and tap test, try cleaning the inside tube of flowmeter with warm soapy water and a soft brush. Sometimes, a film builds up on the electrodes.

Flowmeter Model (black meter with orange label)	JDRC 2000 Flow Calibration	FPT Size	Hose Barb In kit
2.6—53 GPM	2000	1-1/4"	1-1/2"
1.3—26 GPM	2000	1"	1"

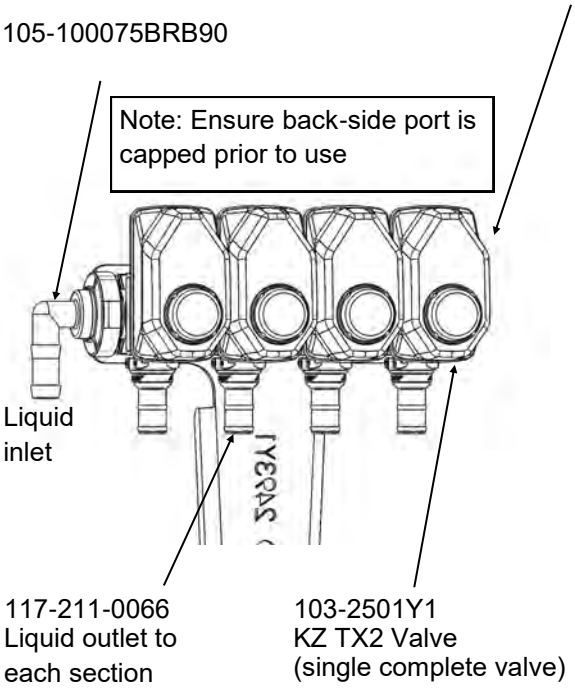
The flowmeters will accurately read higher than the rated range.

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

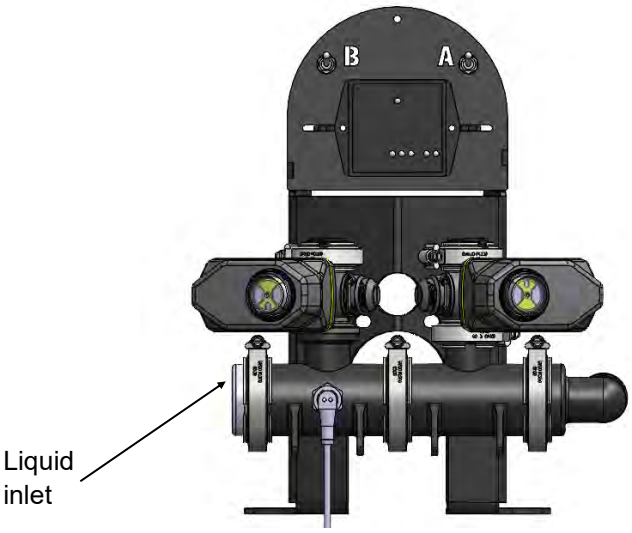
Section Valves and LiquiShift Valves

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

105-100075BRB90



LIQUISHIFT
Variable Rate Technology



Additional Parts:

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

How section valves work

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 wire. The power measured to ground should have 12 volts when the controller is on. The switched wire will have 12 volts to turn the valve on, and 0 volts to turn the valve off.

Wiring Connector:	**Mounting Hardware:**
Pin A—Red, 12 Volts + Pin B—Black, Ground - Pin C—White, Signal 12V=on ; 0V=off	2 Valve Bolt Kit 384-1100 Mounting Bracket 400-2493Y1

How LiquiShift Works

LiquiShift is a two-valve manifold specifically built and controlled to provide the operator a very wide flow range for variable rate application. It is valuable for variable rate prescription application or high-speed implements, or variable rate between different fields. LiquiShift has an A and B valve that are opened based on the system pressure.

The valves themselves are identical to a regular section valve (KZ TX2) and have a 3-pin weather pack electrical connector.

The A Valve is connected to a smaller metering tube. The B Valve is connected to a larger metering tube. The LiquiShift controller automatically turns on the A valve, or the B valve, or both valves depending on the flow required.

Gen3 LiquiShift systems connect to the Adapter Harness with a 14-pin round connector for the zip valves on the left side and another connector for the zip valves on the right side.

See also: Gen3 LiquiShift Manual (396-4608Y1)
Gen2 LiquiShift Manual (396-4063Y1)

Pressure Sensor
3 Wire Sensor with 2” Manifold x 1/4” MPT Fitting
Item Number 520-00-055100

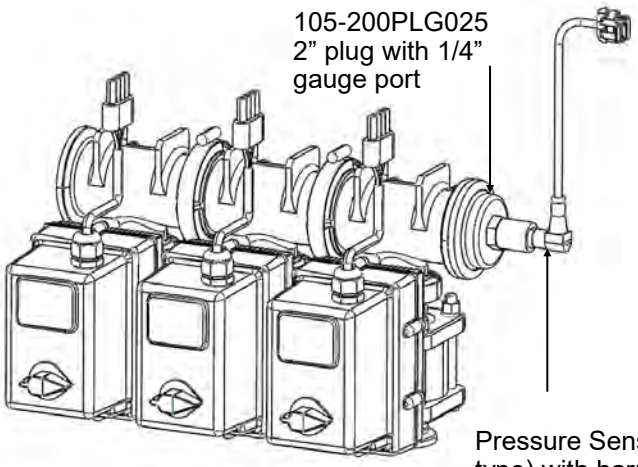
The Trimble display has the ability to show fertilizer system pressure from 2 sensors on the display. The pressure sensor is most often mounted on electric section valves when used in PumpRight systems. The SureFire harnesses for the Trimble system have a Pressure 1 connector on both the pump harness (207-4190Y1) and the section (1-6) harness (207-3463Y1). The section harness connected to Sections 7-12 has a Pressure 2 connector. The pressure sensor is a 0 to 5 volt, 100 psi, 3-wire type sensor for compatibility with the Trimble. The sensor has a 1/4” MPT fitting.

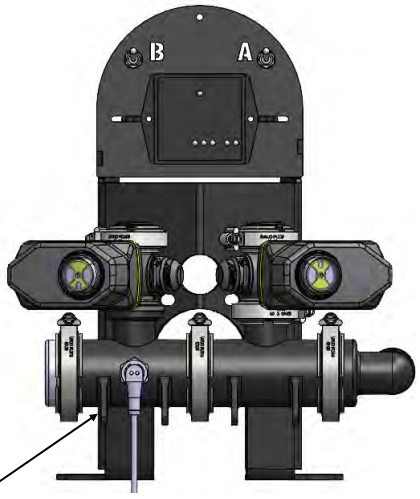
Trimble displays the system pressure on the in cab controller. **The pressure reading is only for informational purposes and is NOT used in the flow control process**. Flow control uses the flowmeter feedback only.

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

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

Trimble Pressure Calibration:
50 mv/psi





Pressure Sensor Hose Tap Kits

When electric section valves are **not** used in the fertilizer system, the best location to install the pressure sensor is in the hose after it leaves the flowmeter. To use these kits, order the correct kit for your hose size. Then also order the kit above that includes the 2” Manifold x 1/4” MPT fitting.

3/4” Hose Pressure Tap	520-00-055800
1” Hose Pressure Tap	520-00-055850
1 1/2” Hose Pressure Tap	520-00-055900

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.

Why use an air bleed valve:

Most fertilizer systems are equipped with a 4 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. PumpRight 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.

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

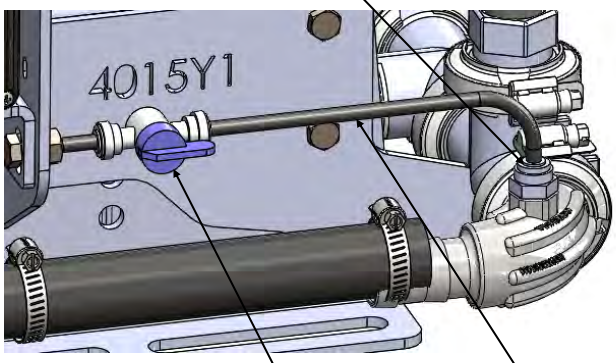
How to install the air bleed valve:

Remove the 1/4" plug from the quick connect fitting on the pump outlet side (see pictures below). 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 air to bleed.

PR17 & PR30

Attach 1/4" tubing to 1/4" QC on the 90 deg HB sweep gauge port



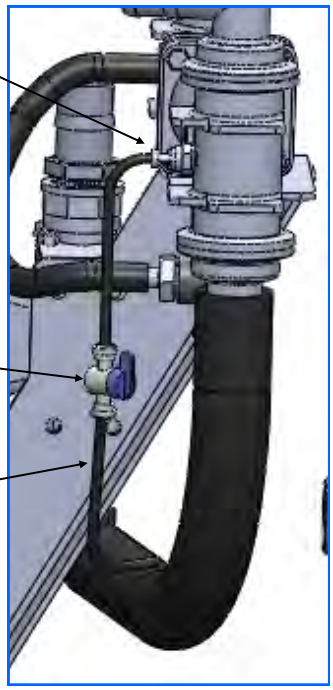
1/4" air bleed valve

1/4" Tubing

PR40 & D250

Attach 1/4" tubing to 1/4" QC on back side of 1" x 2" tee on outlet side of pump

1/4" air bleed valve



Recirculation & Agitation

A recirculation valve is standard on all 4 PumpRight models outlet plumbing assemblies.

B
Components
Liquid

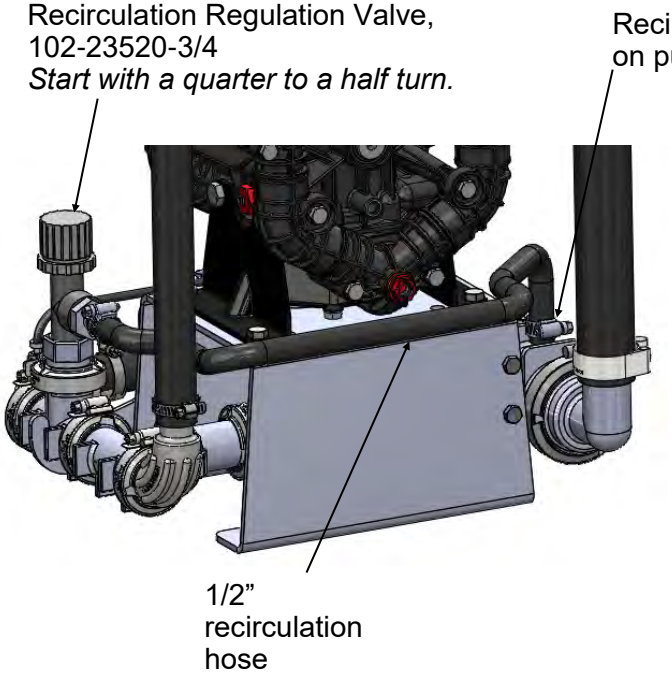
How Recirculation Works:

When running a PumpRight pump at less than 20% of it's maximum flow, it sometimes improves system stability to allow the pump to run faster. Opening the recirculation valve diverts some pump flow before the flowmeter, causing the pump to run faster. The application rate is still measured by the flowmeter and everything that passes through the flowmeter is applied to the ground. If the pump is surging at a low flow rate, open the recirculation regulation valve until the pump runs smoothly. *Start with a quarter to a half turn.* OPENING THE VALVE LOWERS THE MAXIMUM RATE THAT CAN BE APPLIED TO THE GROUND. Close the valve if a higher rate is required.

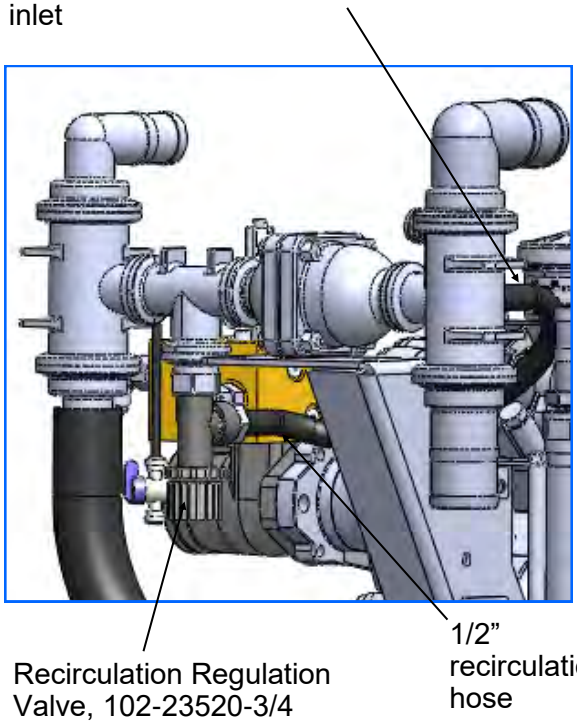
How to modify for tank agitation:

If tank agitation is required, the recirculation valve can be re-plumbed to divert flow to the tank. All that is required is to remove the 1/2" recirculation hose from the pump. Then replace the 3/8" MPT x 1/2" HB on the inlet side of the pump with a 3/8" plug which is included in your PumpRight accessories bag. Finally, install a longer 1/2" hose from the recirculation valve back to the tank.

PR17 & PR30



PR40 & D250



Product Distribution

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

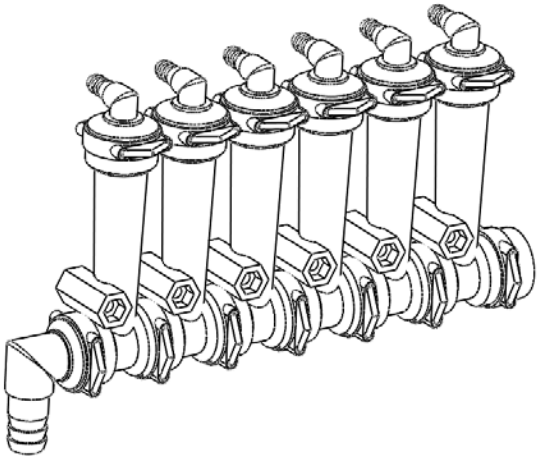
1. A metering orifice may be placed in the check valve cap in the line that leads to each row. (See photo on page 14)
2. A dual metering tube kit with dual check valves may be used. (See pages 18-21)
3. A LiquiShift valve stack may be used that automatically selects which metering tube to use based on system pressure.

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

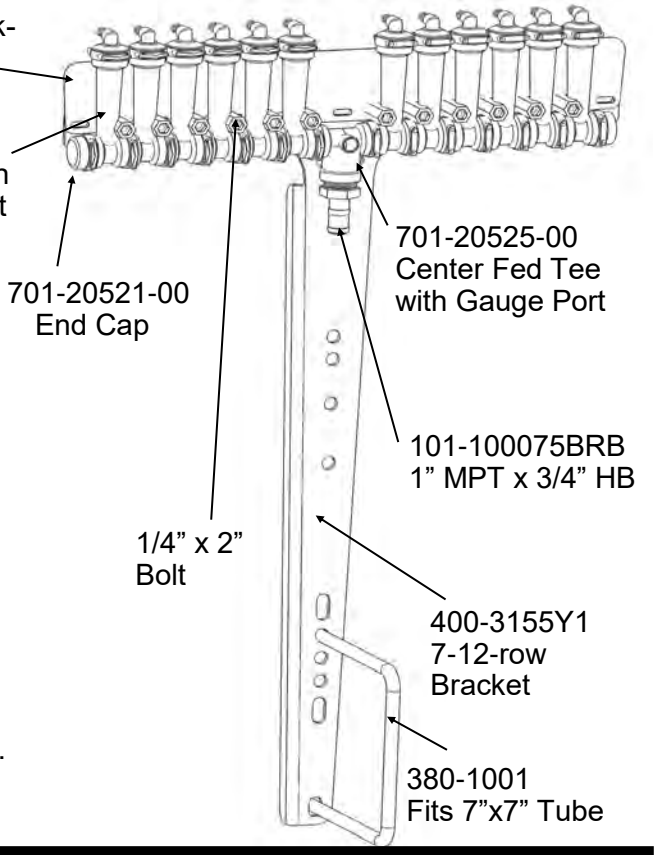
Brackets & U-Bolts

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")

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

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

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

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

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

Low Flow Indicators w/ 1/4" Push to Connect 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 (These orifices are not used very often.)

30” Spacing

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

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

PumpRight Pressure Recommendations (with 10 lb check valves):

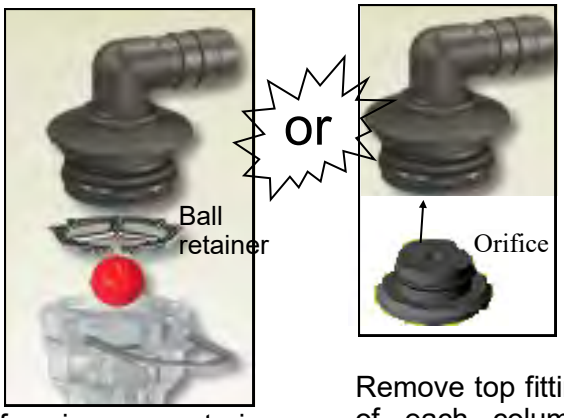
- Minimum 20 PSI
- Maximum 80 PSI

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

- Minimum 10 PSI
- Maximum 30 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.**



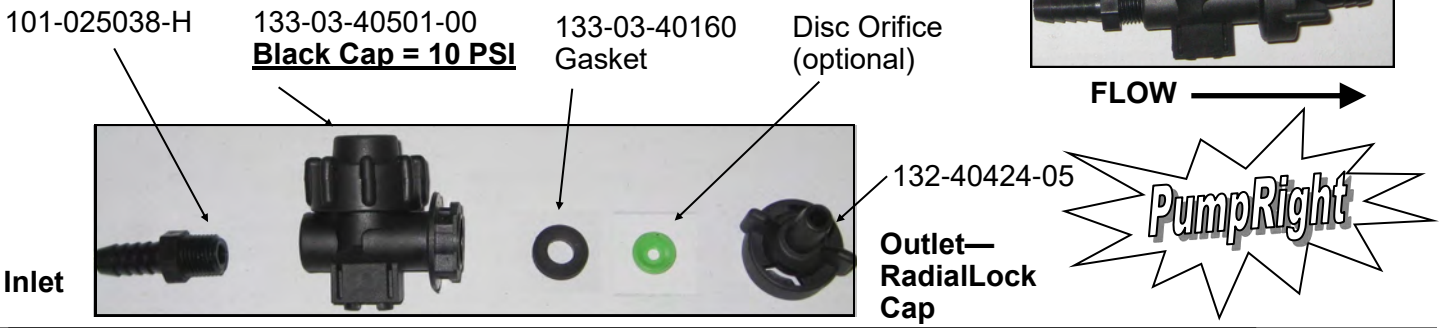
If using a metering orifice in the flow indicator, the orifice replaces the ball retainer. If not using an orifice here, the ball retainer must be in place.

Remove top fitting of each column. Then push the metering orifice into bottom of each outlet fitting.

Check Valves

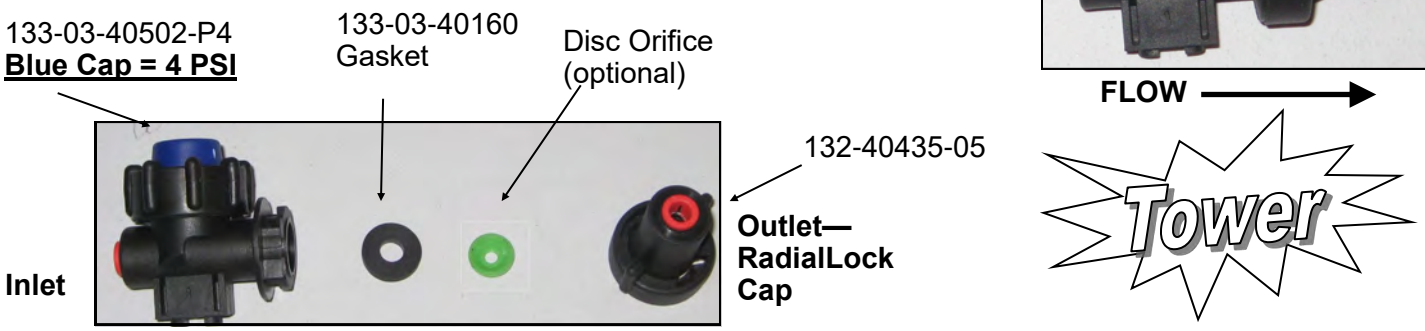
10 lb check valve with 3/8” hose barbs

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



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.



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

Download the SureFire Flow Calculator App for iPad

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

PumpRight Pressure Recommendations (with 10 lb check valves):

- Minimum 20 PSI
- Maximum 80 PSI

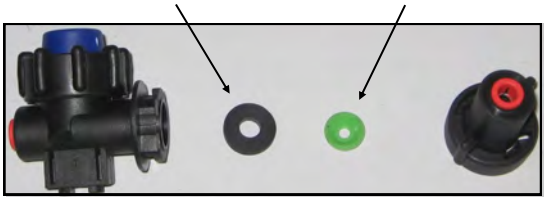
Tower Electric Pump Pressure Recommendations (with 4 lb check valves):

- Minimum 10 PSI
- Maximum 30 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.**

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



FLOW → 1/4 Turn Cap is Outlet

Colored Disc Orifice Chart
Common Grain Drill Row Spacings

7.5” Spacing

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

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

10” Spacing

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

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

Colored Disc Orifice Chart

15” Spacing

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

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

20” Spacing

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

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

Colored Disc Orifice Chart

22" Spacing

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

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

36" Spacing

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

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

Dual Metering Tube Plumbing Kits with Dual Check Valve

B
Components
Liquid

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

SureFire dual metering tube plumbing kits are a great way to apply 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).

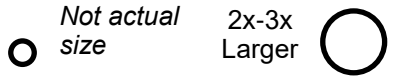
These instructions will show you where all the pieces go. It will provide guidance on how much metering tube to use. There are some optional fittings included in each plumbing kit. These instructions will show you where and why you'd want to use the optional pieces.

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 a fertilizer which has a highly variable viscosity based on temperature changes or when changing rates from field to field.

Dual Advantage of Dual Metering Tube

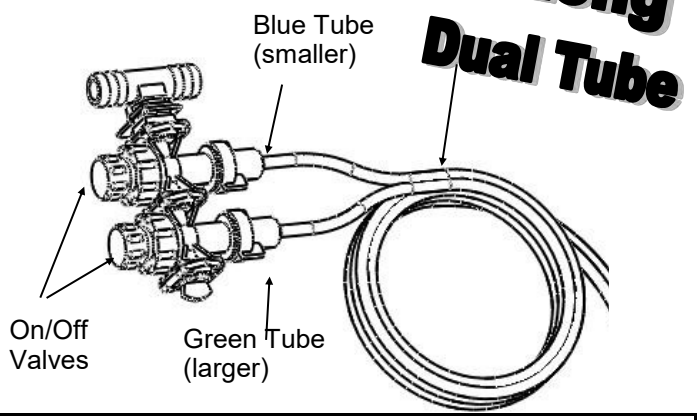
Metering tube provides a larger passage way diameter than a comparable orifice. For a 5 GPA rate on 30" rows, a size 0.046" orifice would be used. For the same rate a 0.110" meter tube that is 8' long would be used. This 8' tube with more than twice the diameter creates a fertilizer system resistant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

By using two metering tubes, the fertilizer system can handle a wider range of rates and provide the proper system pressure as the fertilizer properties change due to temperature, mixtures and other factors.



Standard Orifice Metering Tube

Field Operation of Dual Metering Tube - Dual Check Valve System



The dual metering tube allows for three application rate ranges. Some fertilizers 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 Nozzle Flow Check with fertilizer to determine your system pressure. If pressure is below 15 psi, some check valves may not open and row to row distribution will be uneven.

Start with larger tube ON, smaller tube OFF:

- **Pressure below 15 PSI: Turn larger tube OFF and smaller tube ON.**
- **Pressure over 50 PSI: Turn BOTH tubes ON.**

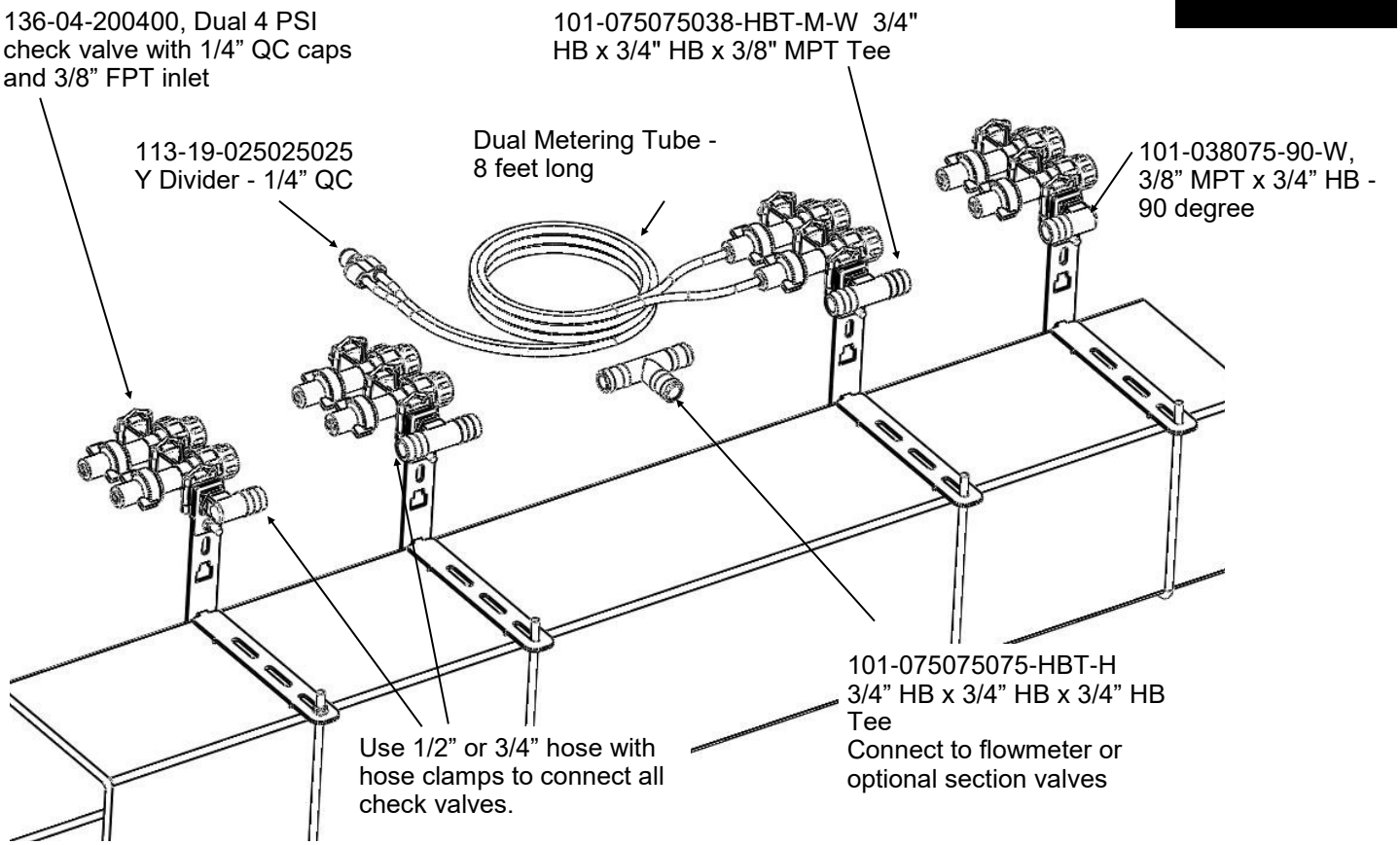
	GPA on 30" rows (approx, will vary)
Blue Tube	1.5 - 3
Green Tube	3 - 6
Blue & Green Tube	6 - 10
Minimum Recommended flow for Blue Tube (8 ft)	4 - 5 oz/min

Other 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 x MPH x spacing (inches)) ÷ 46.4

Dual Check Valve Plumbing Diagram

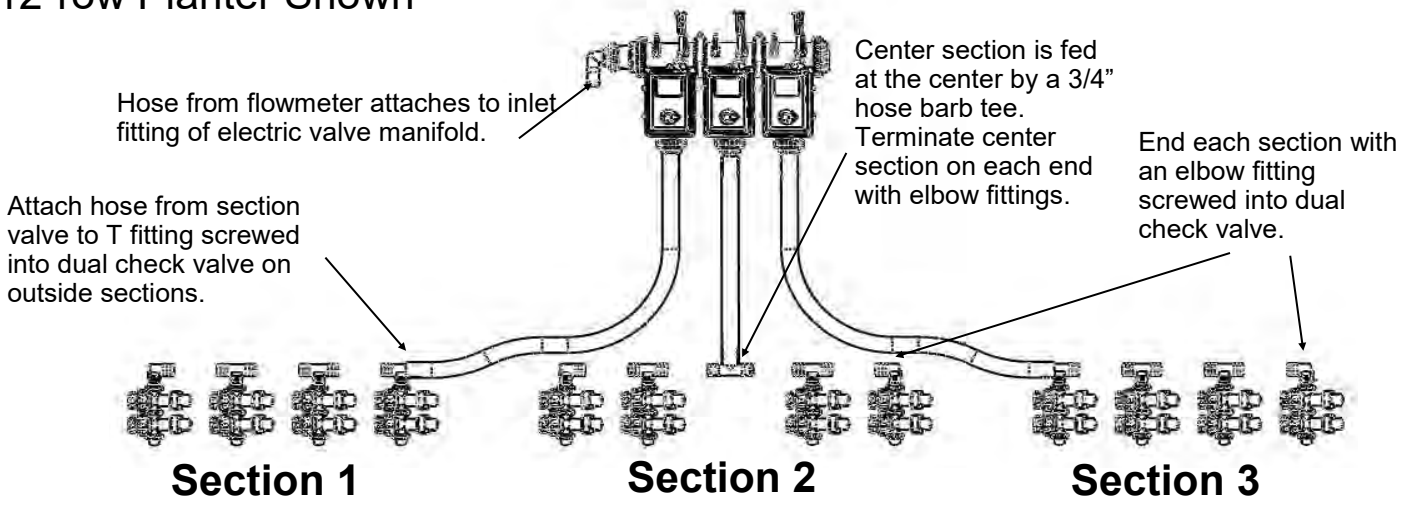
4 Row Planter Shown, add rows as necessary



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

Sectional Plumbing Diagram with Dual Check Valves

12-row Planter Shown

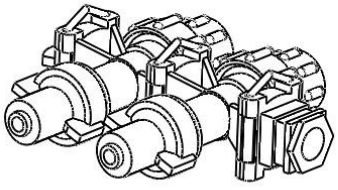


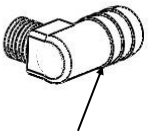
For a **2 section plumbing system**, omit the center section and plumb similar to the outside 2 sections.

Dual Check Valve Assembly Steps

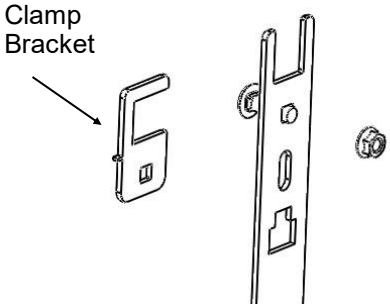
Follow these steps to mount each check valve to the steel bracket.

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

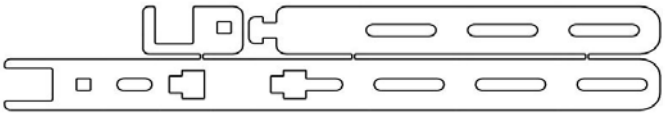




Elbow at end of section, Tee in mid-locations.



400-1966A1 Dual Check Valve Mount Bracket

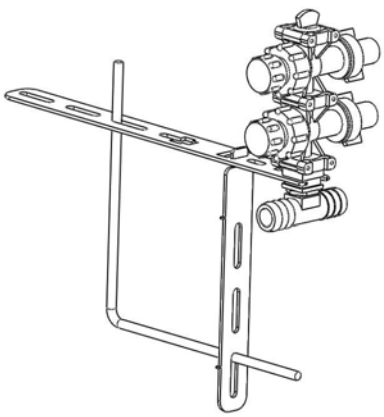


The long, short & clamp bracket come as one part connected by break-off tabs.

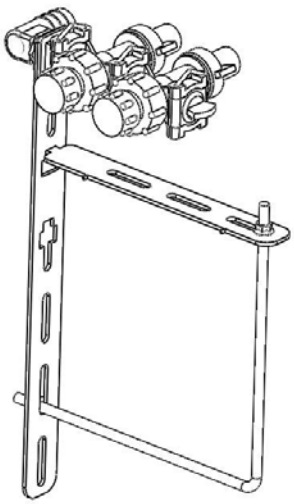
Check Valve Mounting Options

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

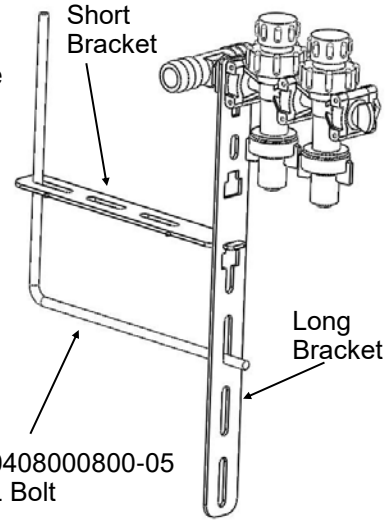
Example 1. Use the long bracket on the top of a bar. The check valve is mounted vertically. The liquid supply hose is ran directly on the front side of the bar. The U-bolt is placed in slots to clamp on a 4x6 inch tube.



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



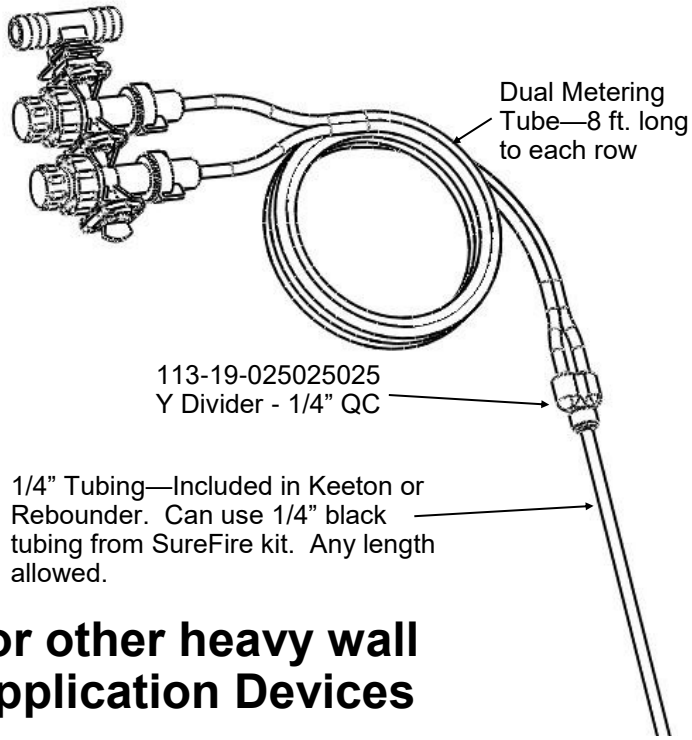
Example 3. Use the long bracket on the front of a 3x7 bar (vacuum tube on some planters). Mount the check valve hanging forward of the bar. The supply line will run directly over the bar. The excess bolt and bracket length can be cut off.



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

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

<u>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.</u>

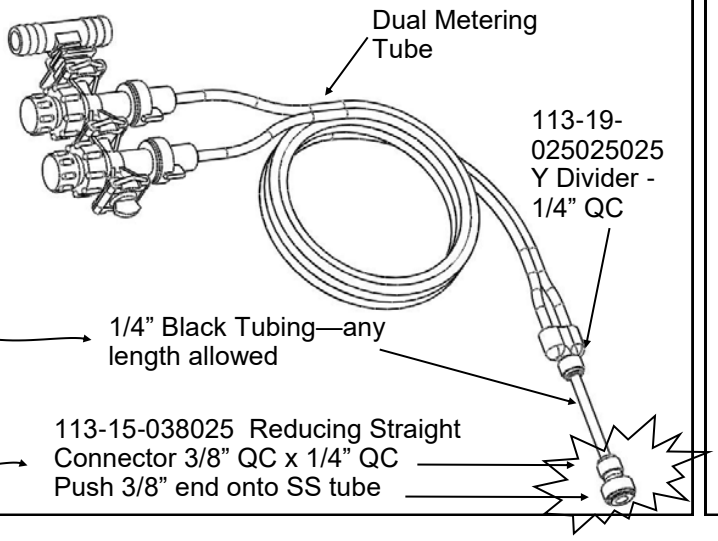


Connection to Totally Tubular or other heavy wall Stainless Steel Tube Ground Application Devices

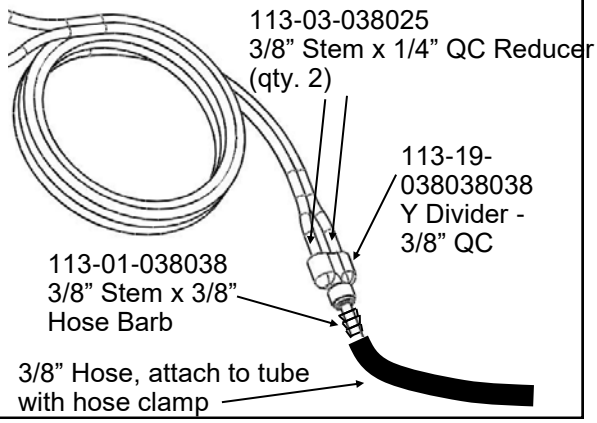
When using a 3/8” OD stainless steel tube to apply fertilizer to the ground, there are two options for the delivery tube plumbing. If the tube ID is less than 1/4” (tubing will not fit inside tube) this attachment method must be used. The description following is for Option 1. See bottom right picture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



396-4116Y1 Metering Tube (8'), LiquiShift, and Split Flow Tube Charts

Low Viscosity (28-0-0 approx 10.7 lb/gal)			
	oz/min	mL/min	gal/min
Tube Color	**Flow Range**	**Flow Range**	**Flow Range**
Gray	3.5-10	105-295	0.03 - 0.08
Purple	6-20	180-590	0.05 - 0.16
Brown	8-25	235-750	0.06 - 0.20
Blue	10-31	295-915	0.08 - 0.24
Green	18-55	530-1600	0.14 - 0.43
Tan	25-75	740-2220	0.19 - 0.59
Orange	44-126	1300-3725	0.34 - 0.98
Yellow	55-154	1625-4555	0.43 - 1.20
Black	72-205	2130-6060	0.56 - 1.60
5' Tan	33-100	975-2960	0.26 - 0.78
5'Orange	57-165	1685-4880	0.45 - 1.29
5' Yellow	70-200	2070-5915	0.55 - 1.56
5' Black	95-260	2810-7690	0.74 - 2.03

Medium-Low Viscosity (32-0-0 approx 11.0 lb/gal)			
	oz/min	mL/min	gal/min
Tube Color	**Flow Range**	**Flow Range**	**Flow Range**
Gray	2.5-7.5	74-222	0.02-0.06
Purple	4.1-15.7	121-464	0.03-0.12
Brown	5.7-20	170-590	0.04-0.16
Blue	7.5-25	220-740	0.06-0.20
Green	14-46	415-1360	0.11-0.36
Tan	20-64	590-1890	0.16-0.50
Orange	36-114	1065-3370	0.28-0.89
Yellow	44-137	1300-4050	0.34-1.07
Black	60-175	1775-5175	0.47-1.37
5' Tan	27-85	*800-2515*	0.21-.066
5'Orange	49-155	1450-4585	0.38-1.21
5' Yellow	59-185	1745-5470	0.46-1.45
5' Black	80-235	2365-6950	0.63-1.84

10-60 PSI 60°F

Medium Viscosity (Starter, N-P Blend, approx 11.2 lb/gal)			
	oz/min	mL/min	gal/min
Tube Color	**Flow Range**	**Flow Range**	**Flow Range**
Gray	1.5-5.0	45-150	0.01-0.04
Purple	2.2-11.5	65-340	0.02-0.09
Brown	3.5-15	105-445	0.03-0.12
Blue	5-19.5	150-575	0.04-0.15
Green	9.5-37	280-1095	0.07-0.29
Tan	14-53	415-1565	0.11-0.41
Orange	27-102	800-3015	0.21-0.80
Yellow	33-120	975-3550	0.26-0.94
Black	48-145	1420-4290	0.38-1.13
5' Tan	20-75	590-2220	0.16-0.59
5'Orange	38-140	1125-4140	0.30-1.09
5' Yellow	46-170	1360-5030	0.36-1.33
5' Black	67-200	1980-5915	0.52-1.56

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
Tube Color	**Flow Range**	**Flow Range**	**Flow Range**
Gray			
Purple	1-4	30-118	0.008-0.03
Brown	1.4-6	41-177	0.011-0.05
Blue	1.8-8	53-237	0.014-0.06
Green	2.6-14	77-414	0.02-0.11
Tan	4-22	120-650	0.03-0.17
Orange	9-44	265-1300	0.07-0.34
Yellow	13-61	385-1805	0.10-0.48
Black	18-80	530-2365	0.14-0.63
5' Tan	6-31	165-910	0.04-0.24
5'Orange	13-62	375-1820	0.10-0.48
5' Yellow	18-85	540-2525	0.14-0.67
5' Black	25-112	745-3310	0.20-0.88

10-60 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	2.5-7.5	75-220	0.02-0.06
Gray	5.8-15.5	170-460	0.045-0.12
Purple	10-26	295-770	0.08-0.20
Brown	12.5-34	370-1005	0.10-0.27
Blue	17.5-45	520-1330	0.14-0.35
Green	26-70	770-2070	0.20-0.55
Tan	34-93	1005-2750	0.27-0.73
Orange	60-159	1775-4700	0.47-1.24
Yellow	75-196	2220-5800	0.59-1.53

These charts are typical flow rates from 10 to 60 PSI.

Electric pumps typically won't operate at 60 psi. See charts on next page for 10 to 40 PSI for typical electric pump operating range.

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 Ag Systems

LiquiShift Dual Tube Combinations

Low Viscosity Product (28-0-0) (10.6 lb/gal)		
ML	OZ	20-70 PSI
Flow Range	**Flow Range**	**Tubes**
180-1475	6-50	Purple/Blue
240-2365	8-80	Brown/Green
295-2510	10-85	Blue/Green
295-3105	10-105	Blue/Tan
535-5025	18-170	Green/Orange
535-5765	*18-195*	*Green/Yellow*
740-6210	25-210	Tan/Yellow
740-7390	25-250	Tan/Black
1035-8870	35-300	5' Tan/Yellow
1300-9165	44-310	Orange/Black
1035-9610	35-325	5' Tan/Black
1625-10350	55-350	Yellow/Black
1685-11830	57-400	5' Orange/Black
2070-13600	70-460	5' Yellow/Black

Medium-Low Viscosity (32-0-0) (11.0 lb/gal)		
ML	OZ	20-70 PSI
Flow Range	**Flow Range**	**Tubes**
135-1180	4.5-40	Purple/Blue
165-1920	5.7-65	Brown/Green
220-2070	7.5-70	Blue/Green
220-2570	7.5-87	Blue/Tan
415-4495	14-152	Green/Orange
415-5175	*14-175*	*Green/Yellow*
590-5620	20-190	Tan/Yellow
590-6210	20-210	Tan/Black
830-7985	28-270	5' Tan/Yellow
1035-8030	35-275	Orange/Black
830-9020	28-305	5' Tan/Black
1300-9020	44-305	Yellow/Black
1420-10795	48-365	5' Orange/Black
1775-12125	60-410	5' Yellow/Black

To calculate Flow (oz/min/row): ***Speed (mph) X Rate (gpa) X Row Spacing (in) divided by 46.4***

Calculate Minimum flow using Minimum Speed and Minimum Rate.

Calculate Maximum flow using Maximum Speed and Maximum Rate.

Find the Tube Combination that best covers the Flow Range needed.

10-34-0 gets thicker and harder to push when cold. ***Use a larger tube combination when possible for 10-34-0*** *so it will flow OK when it is cold.*

Medium Viscosity (N-P-K Blend, ProGerm-11.2 lb/gal)		
ML	OZ	20-70 PSI
Flow Range	**Flow Range**	**Tubes**
75-885	2.5-30	Purple/Blue
105-1475	3.5-50	Brown/Green
150-1625	5-55	Blue/Green
150-2070	5-70	Blue/Tan
295-3990	10-135	Green/Orange
295-4435	*10-150*	*Green/Yellow*
415-5025	14-170	Tan/Yellow
415-5765	14-195	Tan/Black
590-7245	20-245	5' Tan/Yellow
800-7100	27-240	Orange/Black
590-7985	20-270	5' Tan/Black
975-7690	33-260	Yellow/Black
1125-9760	38-330	5' Orange/Black
1360-10795	46-365	5' Yellow/Black

High Viscosity (10-34-0 at 60 deg) (11.65 lb/gal)		
ML	OZ	20-70 PSI
Flow Range	**Flow Range**	**Tubes**
30-325	1-11	Purple/Blue
44-530	1.5-18	Brown/Green
53-590	1.8-20	Blue/Green
53-830	1.8-28	Blue/Tan
75-1480	2.6-50	Green/Orange
75-1920	*2.6-65*	*Green/Yellow*
118-2220	4-75	Tan/Yellow
118-2960	4-100	Tan/Black
180-3400	6-115	5' Tan/Yellow
265-3400	9-115	Orange/Black
180-4230	6-143	5' Tan/Black
385-3850	13-130	Yellow/Black
415-4730	14-160	5' Orange/Black
530-5765	18-195	5' Yellow/Black

Tubes may need to be adjusted for best operation with a particular product.

If necessary, system can be operated at 70-90 PSI to achieve high flow rates.

Green/Yellow combination should only be used when maximum range is needed.

LiquiShift Mode Selection should be set at 20-80 PSI for Green/Yellow tubes.

7/14/2020

Metering Tubes to use to split the flow to both sides of the row:

*(Numbers indicate the **flow range through each tube** in oz/min with a pressure drop from 4 to 15 psi)*

LOW VISC	2’	32”	4’
Purple	7-20	6-15	5-11
Blue	12-32	11-25	9-20
Green	24-55	20-47	18-36
Tan	31-73	27-64	24-48
Orange	56-125	47-110	41-83
Yellow	71-153	60-135	53-104
Black	91-205	76-175	68-133

MID VISC	2’	32”	4’
Purple	4-11	3-9	2-6
Blue	7-20	5-15	4-11
Green	14-36	10-30	8-23
Tan	20-55	15-44	12-31
Orange	37-100	30-84	26-62
Yellow	46-120	36-102	30-75
Black	65-145	52-130	45-100

HIGH VISC	2’	32’	4’
Purple	1-4	0.9-3	0.6-2
Blue	2-8	1.8-6	1.6-4
Green	4-14	3-11	2.5-9
Tan	6-22	4.5-17	3.8-11.5
Orange	14-44	10.5-36	8-25
Yellow	19-61	15-49	12-34
Black	27-80	21-65	16-49

WATER	2’	32’	4’
White	3.5-7.5	3-5.8	2.5-5
Gray	7-15	6-13	5-11
Purple	13-26	11-23	9-18
Blue	22-40	19-39	16-31
Green	33-70	28-60	25-48
Tan	43-93	37-80	32-64

(32” tube is an 8’ tube cut into 3 pieces)

VISC	EX	LB/ GAL	SP GR
LOW	28-0-0	10.7	1.29
MID	9-24-3	11.2	1.34
HIGH	10-34-0	11.6	1.39

As with all metering tube recommendations, these charts should provide a starting point, but adjustments may need to be made in the field.

When doing a split at the row, we are trying to provide paths of equal resistance (and equal flow) to each side of the row, while keeping the pressure drop in this step as small as possible.

In general, use as large a tube (and / or as short a tube) as possible to minimize the pressure drop caused by splitting the flow. In other words, if possible, use the tube that matches up best at the low end of the range on the chart, rather than at the high end.

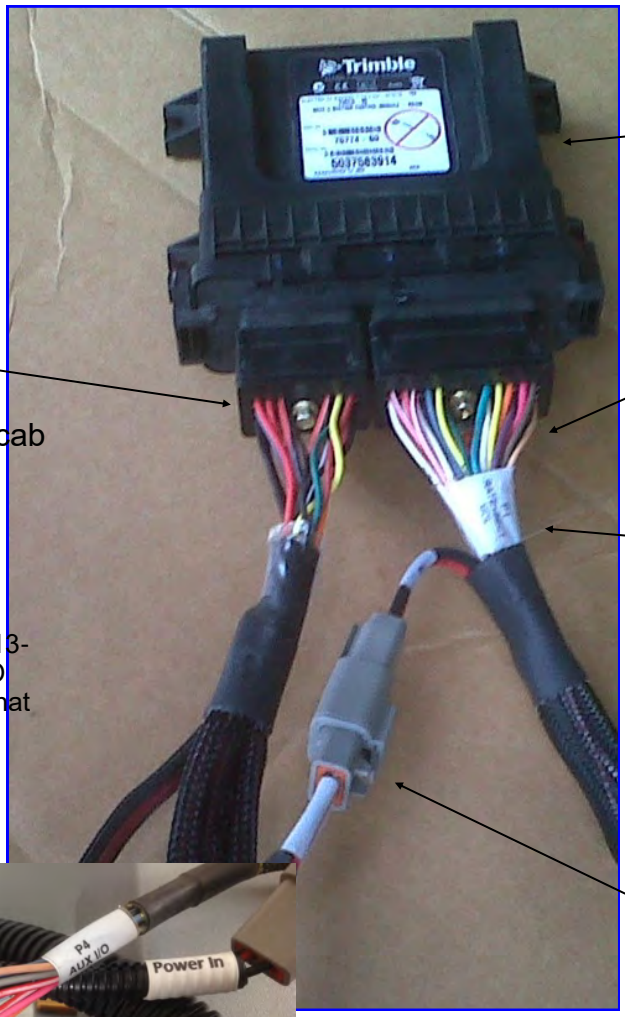
A compromise may need to be made in LiquiShift systems that have a wide flow range that extends beyond a selection on the chart.

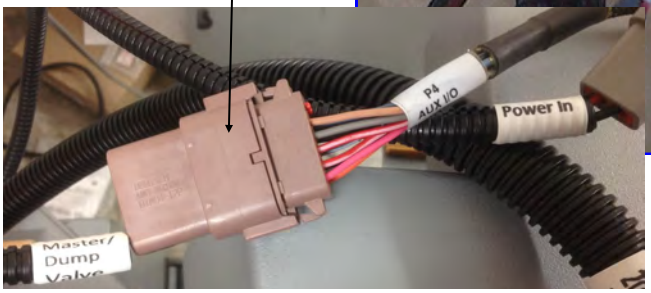
Trimble® Field-IQ™
Rate and Section Control Module

SureFire Fertilizer Systems begin at the Trimble Field-IQ Rate and Section Control Module. The picture below shows this control module. You will need to purchase this module from your Trimble dealer. You will also need to purchase an unlock code for your Trimble display to enable rate control functions.

The rate controller has two harness connections. The first is the connection to the Trimble wiring harness (18-pin) that connects to the in-cab display. The second (30-pin) is where the SureFire Fertilizer System harnesses begin. The following pages show system diagrams for single section, 2-6 section and 7-10 section configurations. Detailed harness drawings follow for information and troubleshooting.

Instructions for setting up the Field-IQ on the in cab display are in Section F. Detailed screen shots of the TMX-2050, FmX & FM-1000 and displays are included showing exactly what settings are required and recommended for SureFire Fertilizer Systems.





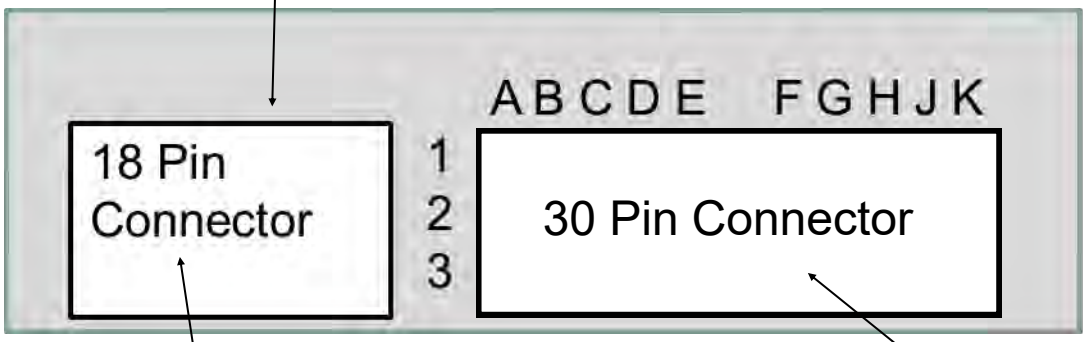
Trimble® Field-IQ™
Rate and Section Control Module

D
Wiring & Elec

This chart shows you the output functions by pin location on the Trimble Field-IQ Rate and Section Control Module. Use this information to verify if the Trimble system is providing the correct output. If the module is not providing the correct output, contact your Trimble dealer to repair the problem. Also review any applicable settings on the display to verify the system is properly set up.

Check with your Trimble dealer or online for the current software and firmware for your display and Field-IQ module.

Trimble Field-IQ Rate and Section Control Module



18-Pin Connector-
Connect to Trimble Harness
back to in-cab display

30-Pin Connector-
Connect to SureFire
Harness 213-02-3764Y2

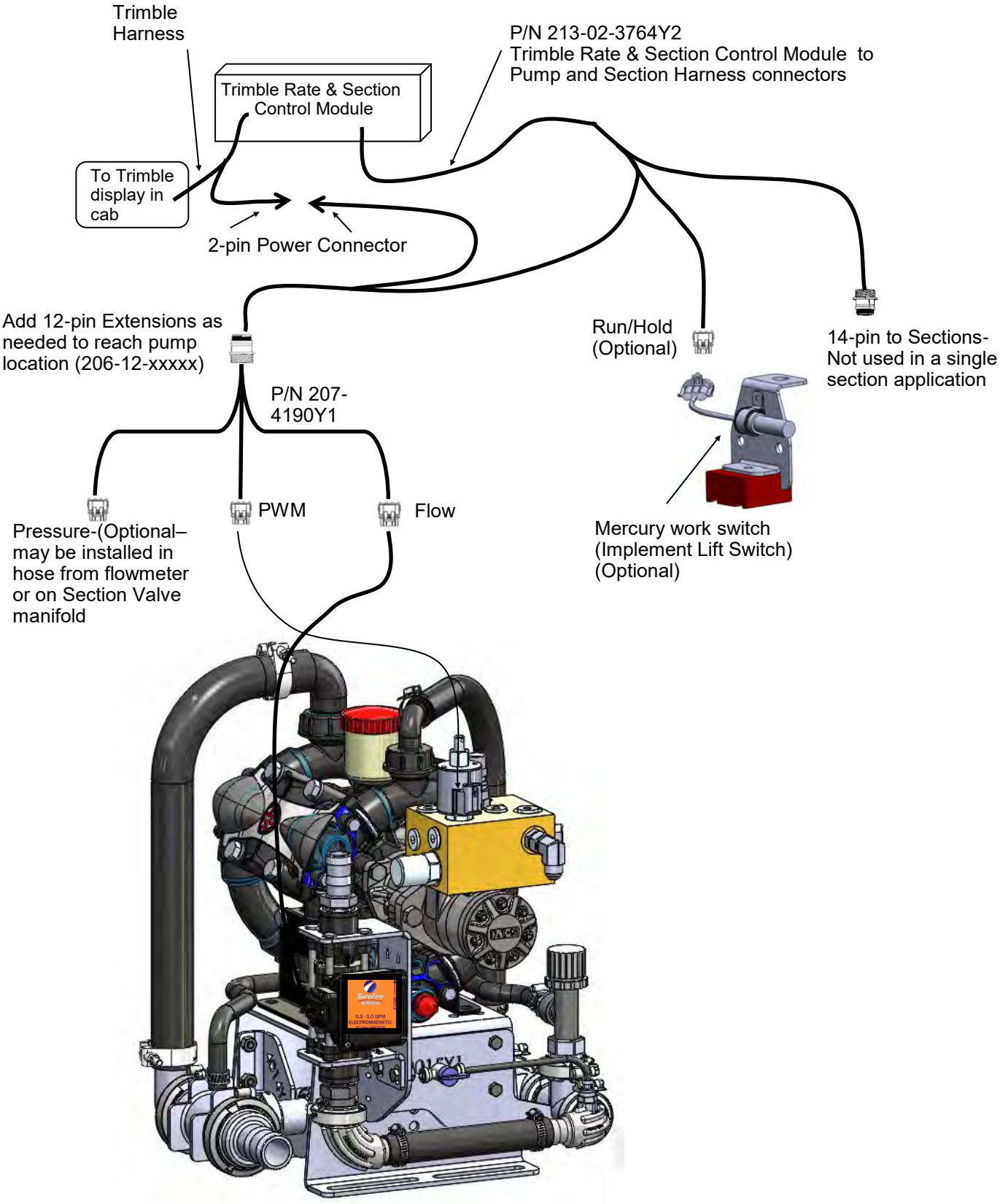
Common Troubleshooting:

PWM Signal to Pump: Pins E1 to E2 should have 0-12 volts to turn pump on. Use manual mode to increase signal. Should get up to 12 volts after holding increase button.

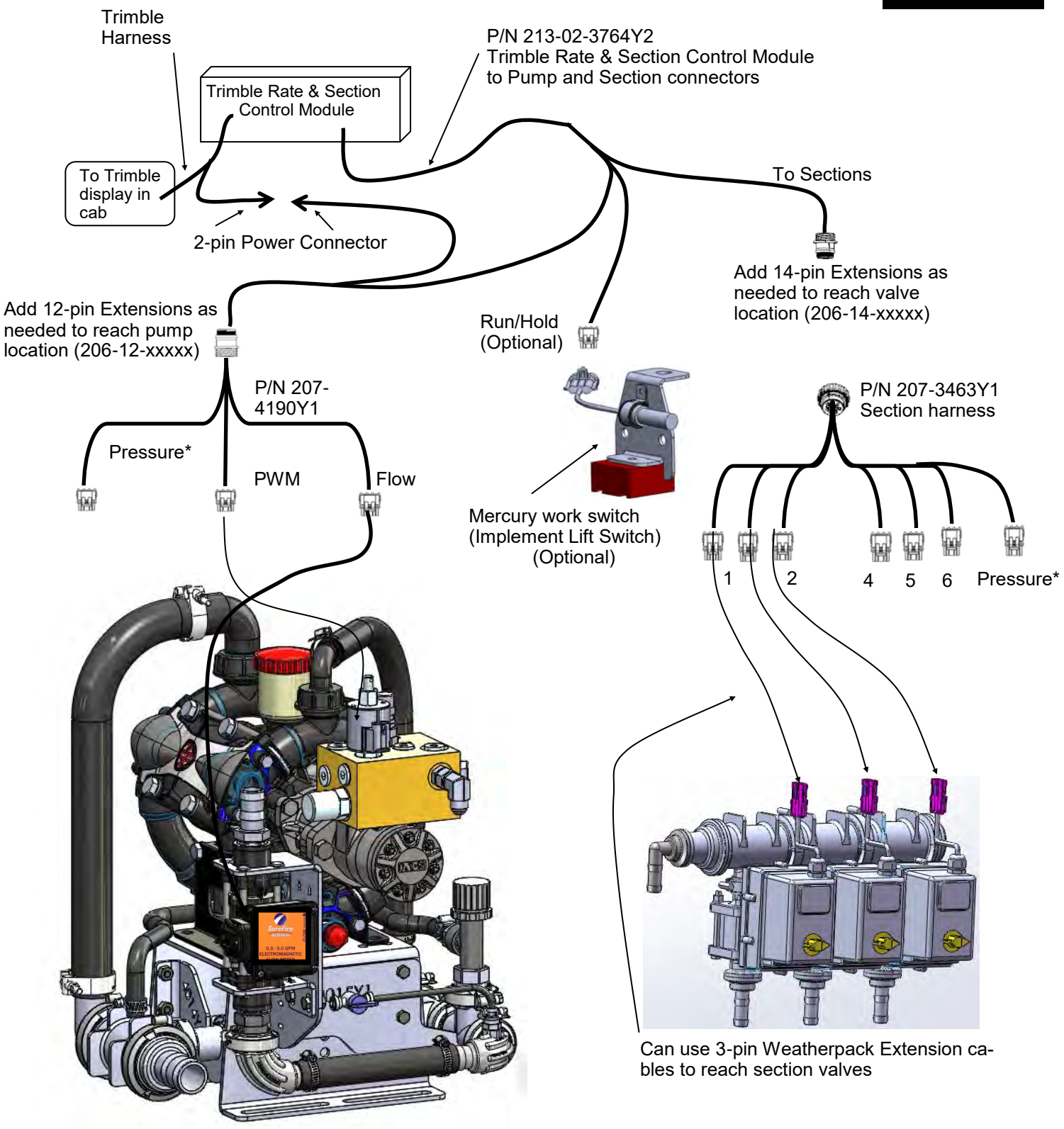
Flowmeter Tap Test: Pins C2 and C3 are Flow Ground and Signal. If no flow is registering on the display, you can tap between these two pins with a short wire. This produces a pulse. The display should indicate a flow when this is done rapidly. *(Note: To help register flow for the tap test, change the flowmeter calibration to 1 pulse/gal, so it will show a flow with fewer taps. Be sure to reset the flow cal to the proper number after the test.)*

See the drawing of harness 213-02-3764Y2 for all pin locations on the 30-pin connector.

Trimble® Field-IQ™ PWM Wiring Schematic Single Section for PumpRight Hydraulic Pump Liquid Application



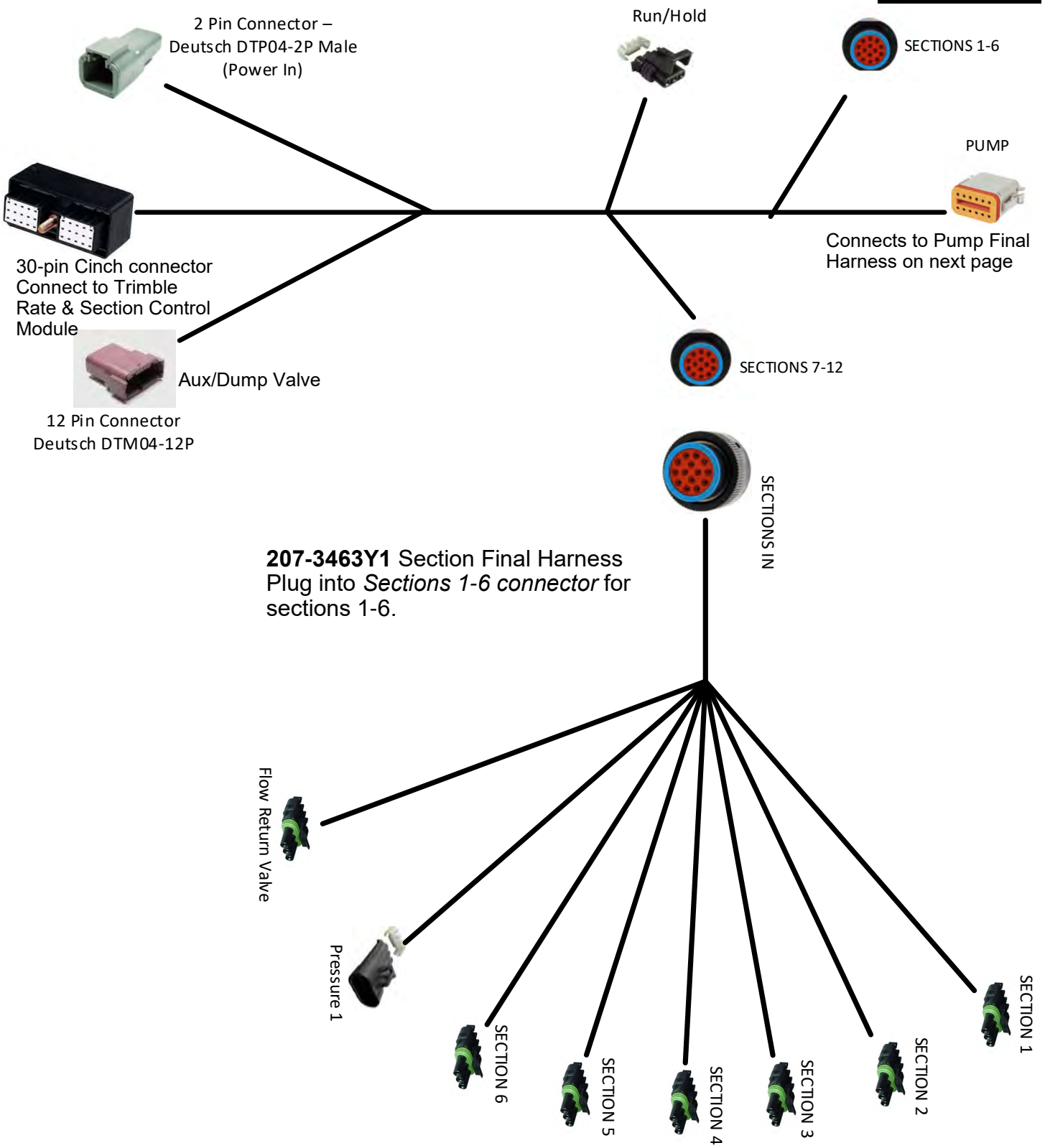
Trimble® Field-IQ™ PWM Wiring Schematic 2-6 (or 7-10) Sections for PumpRight Hydraulic Pump Liquid Application



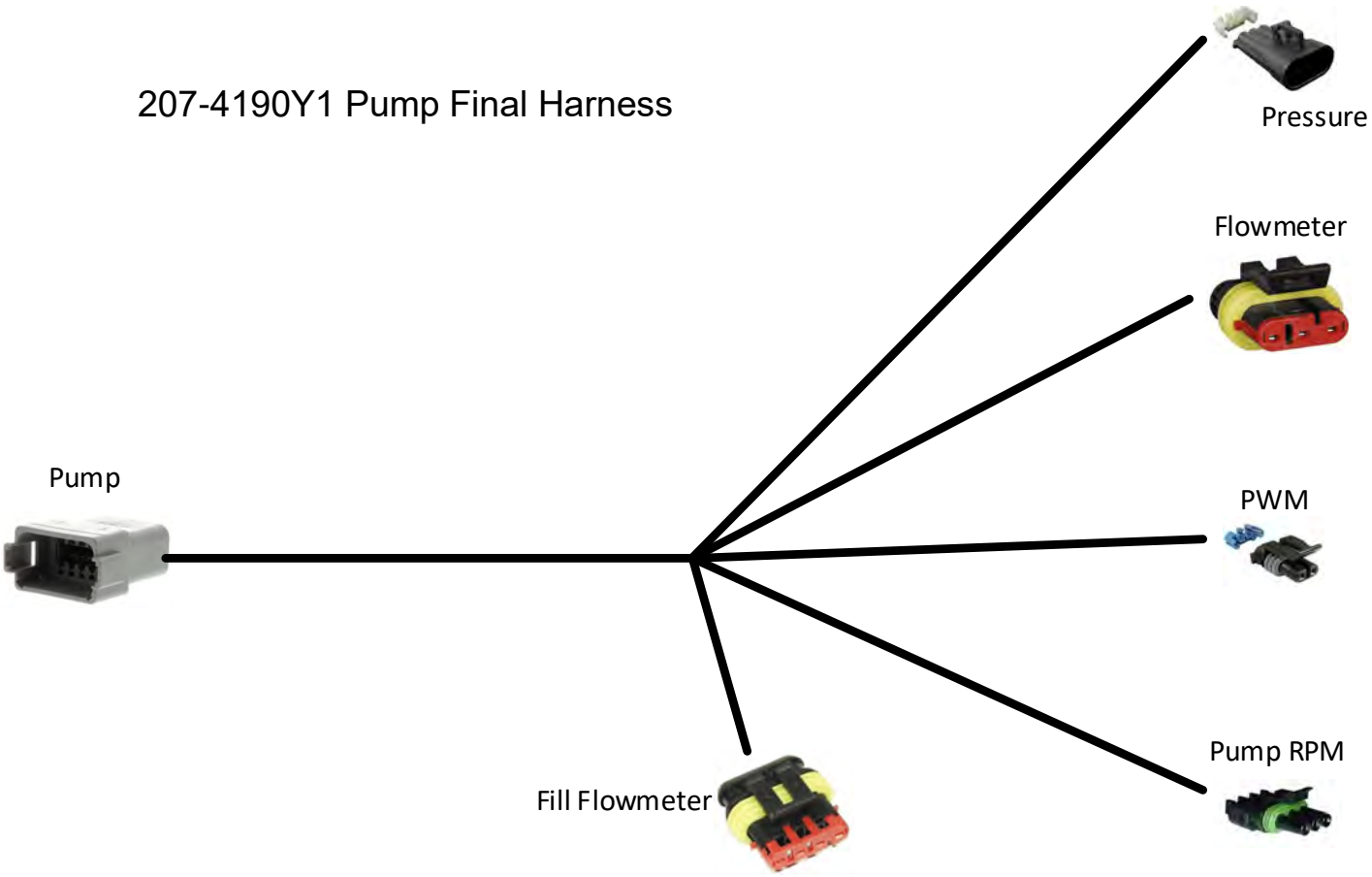
* The PUMP final harness has a Pressure 1 connector. Section 1-6 has a Pressure 1 connector. Section 7-12 has a Pressure 2 connector.

Adapter Harness, Pump Harness, and Section Harness Layout

Adapter Harness 213-02-3764Y2



207-4190Y1 Pump Final Harness



Note: On the Trimble Field-IQ module, the Pump Final harness MUST have a Yellow and a ***Green*** *wire on the PWM connector.*
207-3461Y2 or 207-3462Y2 will NOT work.

Implement Lift Switch for Field-IQ™ (Mercury Run/Hold Switch)

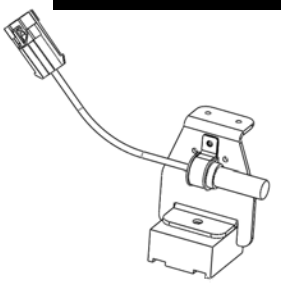
The Mercury Run/Hold Switch turns liquid application on and off automatically when the implement is raised or lowered. The switch is mounted on a component that rotates when the implement is raised and lowered. The switch is attached to a magnetic base for easy mounting to any metal part of your tractor hitch or implement.

For mounted 3-point equipment:

- Mount the switch on the tractor 3 point arms.
- See the pictures below for switch orientation in run and hold positions.
- Connect the switch to the Run/Hold Switch connector on Harness 213-02-3764Y2.

For hitch drawn implements:

- Mount the switch on a wheel frame that rotates as it lifts the wheels up and down to raise and lower the implement.
- See the pictures below for switch orientation in run and hold positions.
- Connect the switch to the Run/Hold Switch connector on Harness 213-02-3764Y2.



See the User Guide for your FM-750 or Fm X Display to set up the Implement Lift Switch.

Calibrating the implement lift switch **Fm X or FM-1000**
1. From the **Field-IQ Calibration screen,** select the **Implement Lift option**.
2. Raise the implement and then tap Next.
3. Lower the implement and then tap Next.
4. Tap OK to return to the Field-IQ Calibration screen.

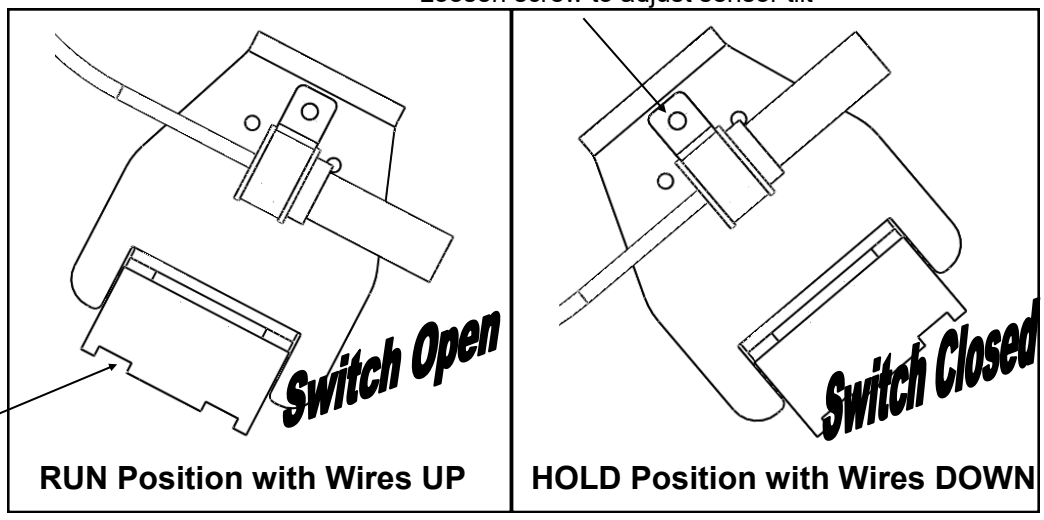
Run/Hold Switch Logic

How to Adjust:

If your controller is turning off product application before or after you want, tilt the switch. If it turns off after you want when lifting the implement, tip more to the HOLD position. If product application should begin sooner when you lower the implement, tip more to the RUN position.
You can adjust the switch by moving the magnet or by loosening the screw and rotating the mercury switch.

Loosen screw to adjust sensor tilt

Magnet to attach to metal surface.



How to Test:

To test the run / hold mercury switch you will need a volt meter. Set the meter to test continuity (or ohms). With the wires down, you should have continuity between the two pins in the connector. With the wires up, the switch should be open (no continuity).

Trimble Field-IQ Wiring Schematics

Your Field-IQ system may have one of the following two sets of harnesses. The first set is being introduced during the 2018 season. The second set is the legacy set that has been used for several years.

New Trimble Field-IQ harnesses for the 2018 season:

Adapter Harness

213-01-3764Y2 Field-IQ Adapter harness with 12-pin Product and 14-pin Section connectors

Pump Harness

207-4189Y1 12-pin Final Cable for Tower with 1 or 2 Section Valves (PWM, Flow, Pressure, Sect 1 and 2)

Or

207-4190Y1 12-pin Final Cable for SureFire PumpRight Liquid System (PWM, Flow, Pressure)

(Note: 207-3461Y2 and 207-3462Y2 will NOT work on the Trimble system. 207-3461Y2 and 207-3462Y2 have Yellow and Black on the PWM connector. 207-4190Y1 and 207-4189Y1 have Yellow and Green.)

Section Harness (if needed)

207-3463Y1 14-pin 6-section Final Cable

Trimble Field-IQ Legacy Harnesses

Adapter Harness

201-215464Y4 Trimble Field-IQ Rate & Section Control Module to twin 16-pin AMP connectors

Pump Harness

207-215223Y2 PWM Pump Cable

Section Harness

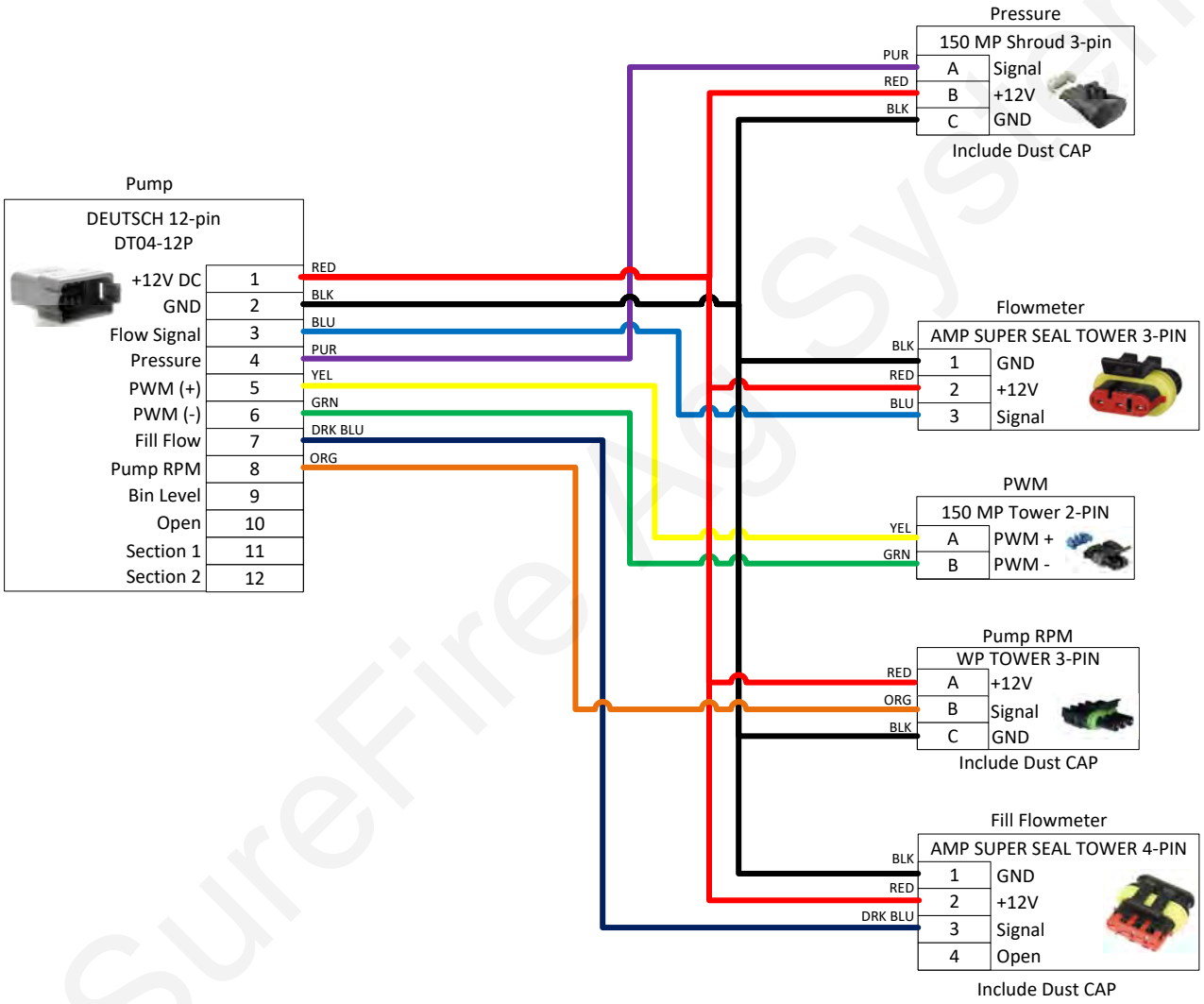
207-215466Y2 16-pin 6-Section Harness

207-215467Y2 16-pin 12-Section Harness

207-4190Y1

12-pin Deutsch Final Cable-same as 3462Y1

Wire 18AWG unless otherwise specified



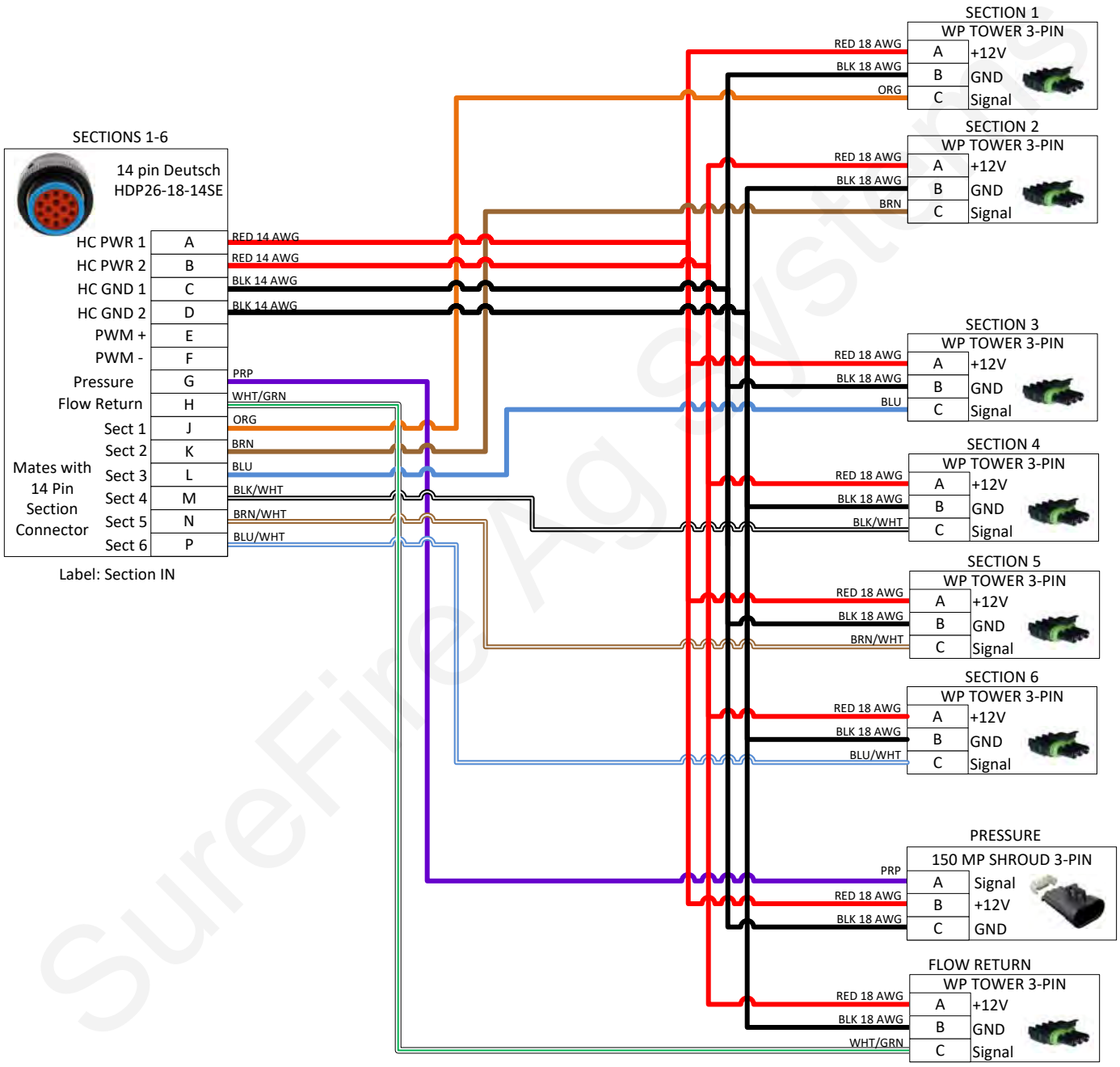
SureFire Ag Systems	Part No:	207-4190Y1	Drawn By:	Brandon Cavenee	
	Description:	12-pin Deutsch Final Cable-same as 3462Y1(pwm, flow, pres., pump rpm, fill flow)	Last Edit Date:	10/31/2016	Revision A-02
			33		1 of 2

207-3463Y1

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

Wire 18AWG unless otherwise specified

Provide dust caps for WP and MP connectors



SureFire Ag Systems	Part No:	207-3463Y1	Drawn By:	Brandon Cavenee	
	Description:	14-Pin 6-Section Final Cable (6 sections, flow return, pressure)	Last Edit Date:	11/2/2016	Revision A-01
			34		1 of 2

213-02-3764Y2

Trimble Field IQ Adapter Cable 30-pin to 12-pin Product and 14-pin Sections

Wire 18AWG unless otherwise specified

30-pin Cinch Connector

+12V	A1	
+12V	B1	
+ 5V	C1	
Impl Switch 5V	D1	RED
Servo +/PWM	E1	YEL
Section 5	F1	BRN/WHT
Section 4	G1	BLK/WHT
Section 3	H1	BLU
Section 2	J1	BRN
Section 1	K1	BLK
Pressure 1 Signal	A2	PUR
Pressure 2 Signal	B2	PUR/WHT
Flow Signal	C2	BLU
Impl Switch Signal	D2	RED
Servo -/PWM	E2	GRN
Section 10	F2	PNK
Section 9	G2	WHT/BLU
Section 8	H2	WHT/BRN
Section 7	J2	WHT/BLK
Section 6	K2	BLU/WHT
GND	A3	
GND	B3	
Flow GND	C3	
	D3	
	E3	
	F3	
GND	G3	
POWER	H3	
Section 12	J3	WHT/GRN
Section 11	K3	WHT/YEL

SECTIONS 1-6

14-pin Deutsch HDP24-18-14PE

RED 14 AWG	A	HC PWR 1
RED 14 AWG	B	HC PWR 2
BLK 14 AWG	C	HC GND 1
BLK 14 AWG	D	HC GND 2
YEL	E	PWM 1 (+)
GRN	F	PWM 1 (-)
PUR	G	Pressure 1
PNK	H	AUX/Dump Valve
BLK	J	Sect 1
BRN	K	Sect 2
BLU	L	Sect 3
BLK/WHT	M	Sect 4
BRN/WHT	N	Sect 5
BLU/WHT	P	Sect 6

PUMP

12-Pin Deutsch Female DT06-12SA

RED	1	+12V DC
BLK	2	GND
BLU	3	Flow Signal 1
PUR	4	Pressure 1
YEL	5	PWM (+)
GRN	6	PWM (-)
	7	
	8	
	9	
	10	
BLK	11	Section 1
BRN	12	Section 2

SECTIONS 7-12

14-pin Deutsch HDP24-18-14PE

RED 14 AWG	A	HC PWR 1
RED 14 AWG	B	HC PWR 2
BLK 14 AWG	C	HC GND 1
BLK 14 AWG	D	HC GND 2
	E	PWM 1 (+)
	F	PWM 1 (-)
PUR/WHT	G	Pressure 2
PNK	H	AUX/Dump Valve
WHT/BLK	J	Sect 7
WHT/BRN	K	Sect 8
WHT/BLU	L	Sect 9
PNK	M	Sect 10
WHT/YEL	N	Sect 11
WHT/GRN	P	Sect 12

POWER IN

2 Pin Connector – Deutsch DTP04-2P Male

GND	1	14 AWG BLK
+12VDC	2	14 AWG RED

Aux/Dump Valve Signal

12 Pin Connector Deutsch DTM04-12P

1	PNK

Run/Hold

150 MP TOWER 3-PIN

	A	Imp Sw Signal
	B	
	C	Imp Sw 5V

RED

RED

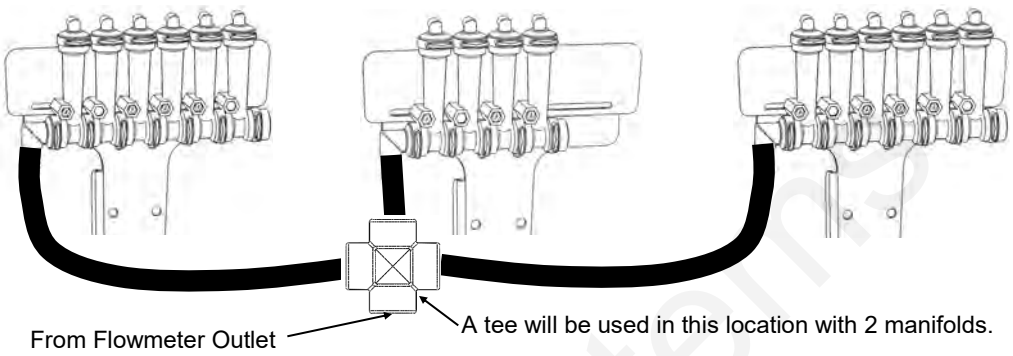
Dust Cap

SureFire Ag Systems	Part No:	213-02-3764Y2	Drawn By:	Mark Wolters	
	Description:	Trimble Field IQ Adapter Cable 30-pin to 12-pin Product and 14-pin Sections	Last Edit Date:	10/12/2018	Revision A-02
			35		1 of 2

Floating Ball Flow Indicators

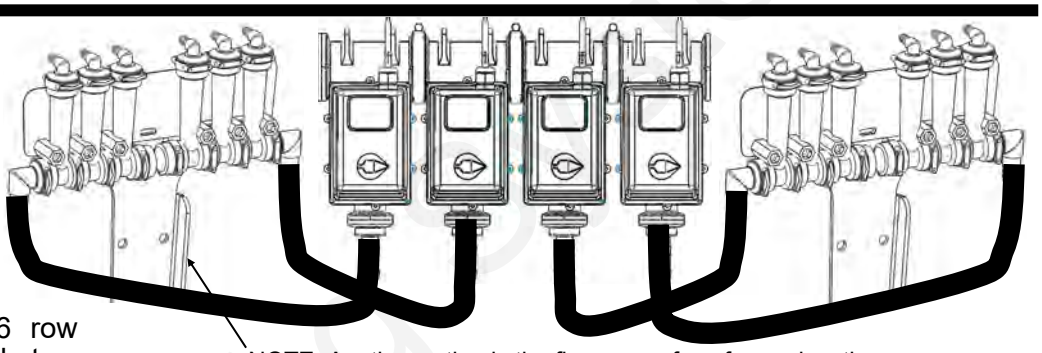
Flow Indicators are extremely flexible and can be mounted in hundreds of different configurations on various types of liquid application equipment. This page is to give you some ideas and let you customize the installation for what works best on your equipment.

16-row
Split 6 - 4 - 6
This configuration works well on a 16-row front fold planter. Each flow indicator manifold is shown fed by a cross in a single section installation. Each manifold could be fed by a section valve if desired.

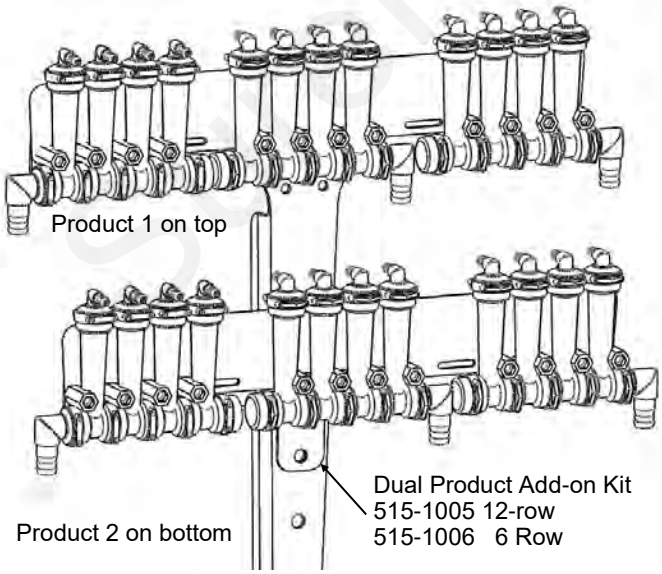


12-row
Split 3 - 3 - 3 - 3
Shown here is a 12-row with four 3 row sections controlled by four section valves. Note each 6 row T-Bracket can hold two separate 3 row manifolds.

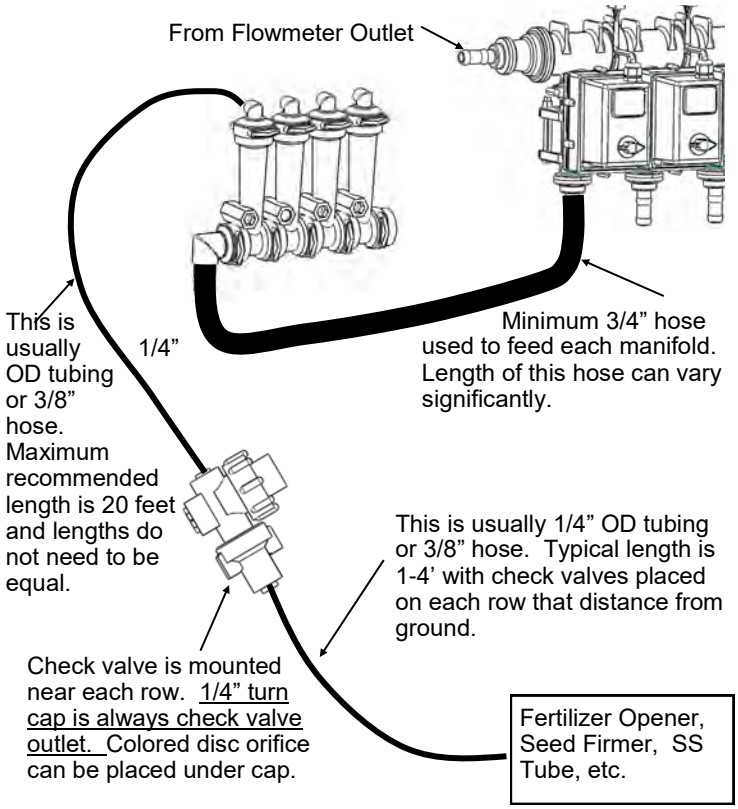
A 4 section 24 row could be similar with four 6 row manifolds on two large T-Brackets.



12-row Dual Product
Product 1 Split 4 - 4 - 4 / Product 2 Split 4 - 4 - 4
In this case each manifold would be fed by a section valve. There would be 6 total section valves (3 sections X 2 products). Most often one set (top) of flow indicators would be Full Flow for high rate fertilizer and 2nd set (bottom) would be Low Flow for starter.



General Plumbing Guidelines

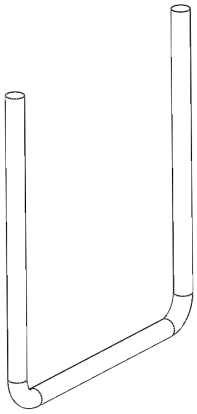


PumpRight Pump Installation

E
Installation Overview

Mounting

1. Mount pump in your preferred location. The PumpRight pump has excellent suction and priming ability, so it can be mounted away from or above fertilizer tanks.
2. SureFire has U-Bolts available to mount the pump directly to multiple bar sizes shown below. Each U-bolt kit includes 1 bolt and 2 flange nuts.
3. If the U-Bolts will not work, order the universal backer plate kit, number 515-203000 which will clamp to any size tube from 4” - 8” wide.



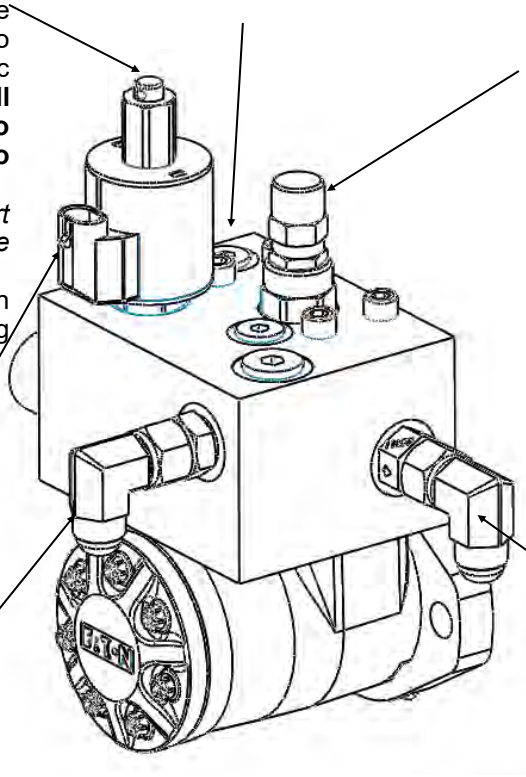
Mounting Bar Size	Item Number	Item Description
3” x 3”	380-1022	1/2" U-bolt Kit - 1/2", fits 3" x 3" tube - (3" opening)
4" x 4"	380-1023	1/2" U-bolt Kit - 1/2", fits 4" x 4" tube - (4" opening)
4" x 6"	380-1015	1/2" U-bolt Kit - 1/2", fits 4" x 6" tube - (4" opening)
	380-1017	1/2" U-bolt Kit - 1/2", fits 6" x 4" tube - (6" opening)
5" x 7"	380-1014	1/2" U-bolt Kit - 1/2", fits 5" x 7" tube - (5" opening)
	380-1016	1/2" U-bolt Kit - 1/2", fits 7" x 5" tube - (7" opening)
6” x 7”	380-1018	1/2" U-bolt Kit - 1/2", fits 7" x 6" tube - (7" opening)
7" x 7"	380-1001	1/2" U-bolt Kit - 1/2", fits 7" x 7" tube - (7" opening)
6” x 10”	380-1021	1/2" U-bolt Kit - 1/2", fits 6" x 10" tube - (6" opening)
8" x 12"	380-1019	1/2" U-bolt Kit - 1/2", fits 8" x 12" tube - (8" opening)
8" x 16"	380-1020	1/2" U-bolt Kit - 1/2", fits 8" x 16" tube - (8" opening)

A Safety Tip from the Kansas Farm Bureau Safety Poster Program

PumpRight Hydraulic Connections
PWM Valve

Load Sense Port—For power beyond hydraulic use only.

Manual Override - Push down and turn 1/2 turn CCW to lift the valve for manual override to check for proper hydraulic operation. **Override will completely open valve, so limit tractor hydraulic flow to valve.**
(May need to clean packed dirt to allow movement of override knob.)
Push down and turn 1/2 turn CW to return to operating position.



Bypass Valve—Remove the cap to access a bypass needle valve. This valve is shipped from the factory closed. **The only case when valve should be open is when running in series with other hydraulic motors.**

Depending on your tractor and exact hydraulic plumbing scenario your pump may turn very slowly when it should stop. To stop the pump completely, open the bypass valve slightly.

To adjust the Bypass Needle Valve, first loosen the lock nut. Do not overtighten the needle valve.

PWM Valve Connector -2 Pin MP Shroud
Troubleshooting Tip:
To check coil, an ohmmeter placed on the two pins should show 7-9 ohms.

Return oil to Tank - Check valve included on return port

Pressure line from Tractor

⚠ DANGER

Hydraulic oil under extremely high pressure. Do not use hand or any other skin to check for or to stop hydraulic leaks. Be sure pressure is relieved before loosening hydraulic fittings. Replace worn hoses immediately. Seek medical care immediately if hydraulic oil is shot into the eye or the skin.

Pump Rotation Check Valve

A check valve is included on the outlet port of the hydraulic valve. This prevents the pump from running in the wrong direction. If ran in the wrong direction, liquid will be pumped, however the hydraulic valve will not be able to control the flow. The check valve can be identified by the Part Number 1108R stamped on it and a flow direction arrow.

How it Works with Power Beyond Hydraulics

This valve is designed to work with power beyond hydraulics. This configuration will not require a standard tractor remote hydraulic valve. The load sense port and hose described next will typically not be needed if other hydraulic ports are in use. If the load sense is needed, do this: First, remove the load sense plug and install a #6 male boss x #6 JIC adapter fitting, SureFire PN 161-01-6MB-6MJ. Then run a 3/8” or 1/4” hydraulic hose back to the tractor. This hose will connect to the load sense port on the tractor. The load sense line will signal the tractor hydraulic system to supply the flow needed by the pump to meet your application rate. The SureFire valve has an internal load sense check valve, which is required for power beyond hydraulics.. The bypass valve (see above) must be closed to use power beyond hydraulics or else an unlimited amount of oil will be continuously circulated.

PumpRight Hydraulic Connections

Hydraulic Hose

SureFire recommends 1/2” hydraulic hose for both pump inlet and outlet. The hoses will need #8 JIC female swivel fittings.

Where do I get hydraulic flow for my PumpRight?

This question is often asked as many implements use up all the hydraulic connections on a tractor. SureFire has some recommendations as to what works best.

Best Option - Dedicated PumpRight Circuit

Preferred

If you have a tractor remote available, attach the tractor remote valve directly to the PumpRight pressure and return ports. DO NOT try to avoid this method simply to save another set of hydraulic hoses running to the tractor. Operating the PumpRight on it’s own circuit is the simplest for installation and operation. It guarantees the PumpRight won’t negatively affect any other hydraulic components on your equipment.

Alternate Option - In Series with John Deere CCS Fan or Bulk Fill Seed Fan

If you do not have a tractor remote valve available, this may be your best method. You can plumb the PumpRight after the seed distribution fan in series. If using this method, the SureFire PWM bypass valve must be open (see previous page for instruction & picture). If bypass is left closed, the SureFire valve will limit the speed of the seed distribution fan.

For example, the John Deere CCS fan uses around 7 GPM of oil. This will limit the PumpRight maximum flow (9 GPM oil necessary for maximum flow). See the charts on the next page for adjusted maximum pump flow. See section G for flow charts to determine your necessary flow rate.

DO NOT plumb the PumpRight in series with a vacuum fan. The vacuum fan uses just a few GPM of oil. Also, problems will be caused by excessive pressure at the vacuum fan motor

Two PumpRights

The preferred method is to plumb the two pumps in series. DO NOT plumb two pumps after the CCS fan. Excessive pressures may damage the CCS fan motor. Run the pressure line from tractor to first pump inlet. Plumb from the outlet of Pump 1 to the Inlet of Pump 2, then from Pump 2 outlet back to the tractor. Open the bypass needle valve on both pumps so each valve controls motor speed independently. Run the flow setting procedure on the next page to minimize the hydraulic flow based on the pump that requires more hydraulic motor flow.

Hydraulic oil under extremely high pressure. Do not use hand or any other skin to check for or to stop hydraulic leaks. Be sure pressure is relieved before loosening hydraulic fittings. Replace worn hoses immediately. Seek medical care immediately if hydraulic oil is shot into the eye or the skin.

PumpRight Hydraulic Oil Flow Requirements

(Requirements for 4.0 CID Motor—standard SureFire motor beginning in 2016—Earlier motor was 4.9 CID which uses 20% more oil)

Setting Tractor Hydraulic Remote Speed

PumpRight pumps require a constant hydraulic oil flow from the tractor. The amount of oil needed varies with pump size and speed. The chart at right shows the necessary oil flow for each pump model at varying fertilizer flows.

Use this procedure to determine the correct setting on your tractor hydraulic flow.

1. Run the fertilizer system in the field at the maximum rate and ground speed.
2. Turn down the hydraulic flow slowly while watching the pump flow (Volume / Minute).
3. Observe when the Volume / Minute begins to drop.
4. Turn the hydraulic flow back up slightly.

This setting will provide the Pump Right pump just enough oil for your application rate.

If running with the bypass open (only recommended when 2 motors are operated in series) this process will minimize the oil circulated in the bypass loop, leaving more oil flow for other hydraulic functions.

NOTICE

The pump is rated at a maximum of 550 RPM. Spinning the pump over 550 RPM may cause pump failure.

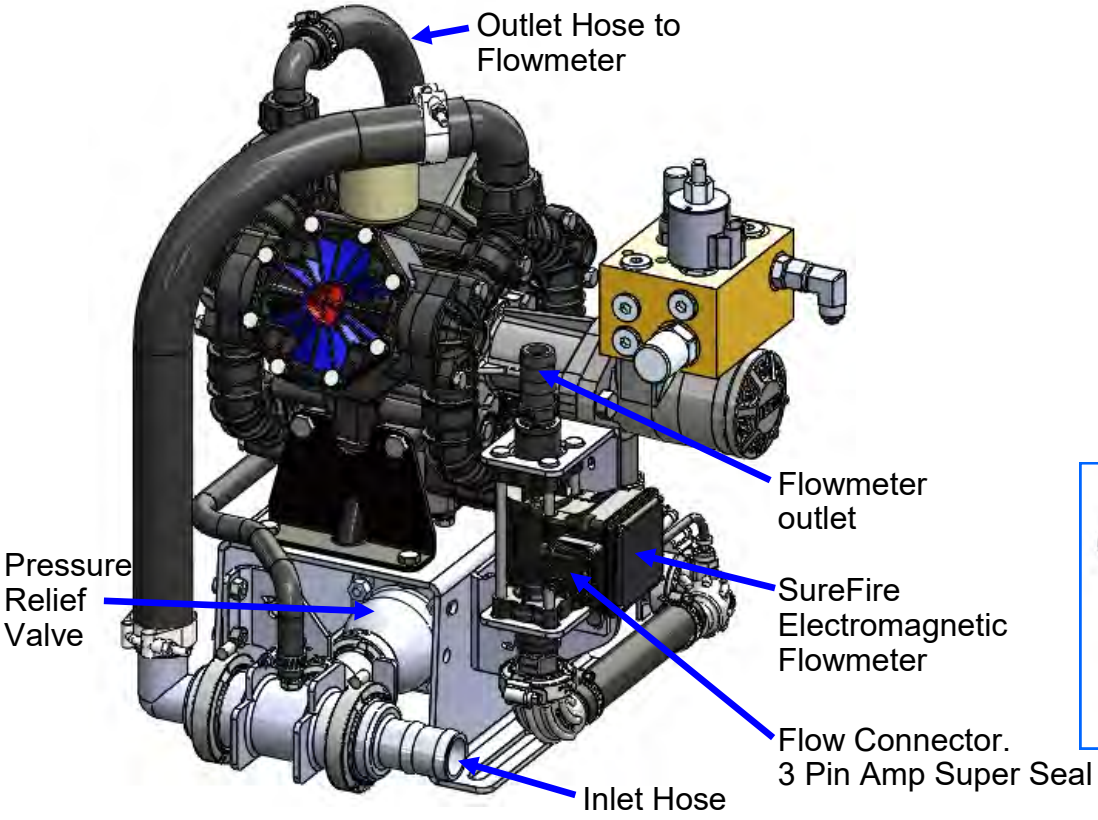
The system will spin the pump faster than that if precautions are not taken to limit the speed. This could happen if the strainer becomes plugged or blocked and the controller attempts to speed the pump up to achieve the desired Rate. It could also happen if a high pressure situation occurs that opens the Pressure Relief Valve (PRV) and the pump speeds up to try to achieve the Rate.

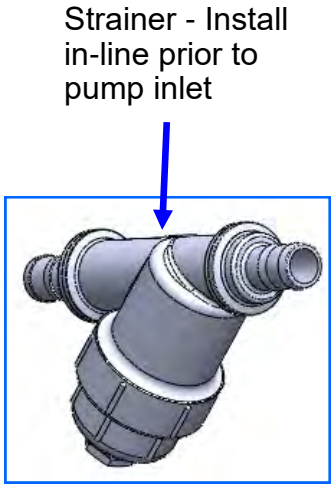
A way to limit the maximum pump speed is to set the High PWM Limit just above what is needed for regular operation. If the pump tries to speed up above that, check for blocked strainer or other issue.

Model PR17 - 3 Diaphragms		
Fertilizer Flow (GPM)	Pump Speed (RPM)	Hydraulic Oil Flow (GPM)
5	137	2.4
10	275	4.8
15	412	7.1
17	467	8.1
Model PR30 - 3 Diaphragms		
Fertilizer Flow (GPM)	Pump Speed (RPM)	Hydraulic Oil Flow (GPM)
5	85	1.5
10	170	2.9
15	255	4.4
20	340	5.9
25	425	7.4
30	510	8.8
Model PR40 - 4 Diaphragms		
Fertilizer Flow (GPM)	Pump Speed (RPM)	Hydraulic Oil Flow (GPM)
10	115	2.0
20	229	4.0
30	344	6.0
40	458	7.9
Model D250 - 6 Diaphragms		
Fertilizer Flow (GPM)	Pump Speed (RPM)	Hydraulic Oil Flow (GPM)
10	86	1.6
20	172	3.2
30	258	4.8
40	343	6.4
50	429	8.0
55	472	8.6

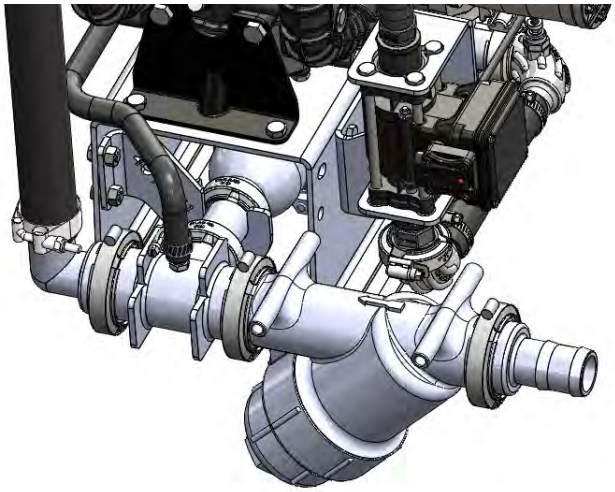
PUMPRIGHT HYDRAULIC DRIVE DIAPHRAGM PUMPS

PR17 & PR30 Liquid Plumbing Connections





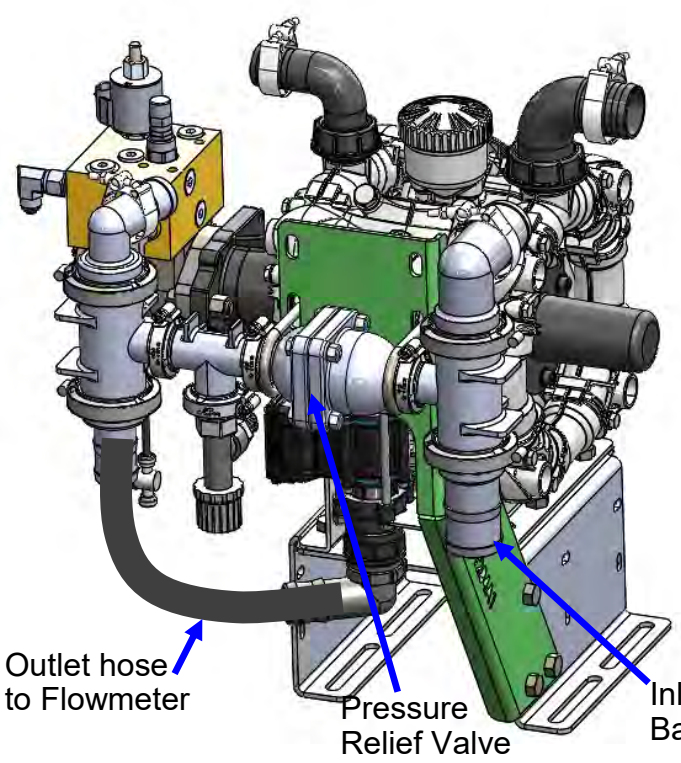
Inlet: The PR17 and PR30 PumpRight are shipped with a 1 1/2" inlet hose barb. Attach this to the hose from your supply tank and strainer . A 1 1/2" 90 degree hose barb is included and can be substituted.
Inlet Strainer: A 20 mesh strainer is included in the pump kit. The manifold strainer includes two hose barbs so it can be mounted anywhere in the inlet line. If space allows, the strainer can be mounted directly to the inlet plumbing assembly as shown below.
Outlet: The outlet is plumbed directly to the flowmeter with 1" hose. As shown above, the flowmeter may be mounted directly to the PumpRight pump. The flowmeter outlet is a 1" hose barb. The outlet hose should be a minimum of 24" long with a gentle curve prior to any fittings for optimum flowmeter performance. The flowmeter outlet will attach to your manifold(s) or section valves. A 3/4" hose barb is included in the bag of parts and can be substituted on the flowmeter outlet.
Pressure Relief Valve (PRV): The PRV is a 100 psi relief. If there is a restriction that creates over 100 psi in the system, the PRV will open allowing the excess flow to pass back to the inlet side of the pump. This protects the pump and fertilizer system from damage.

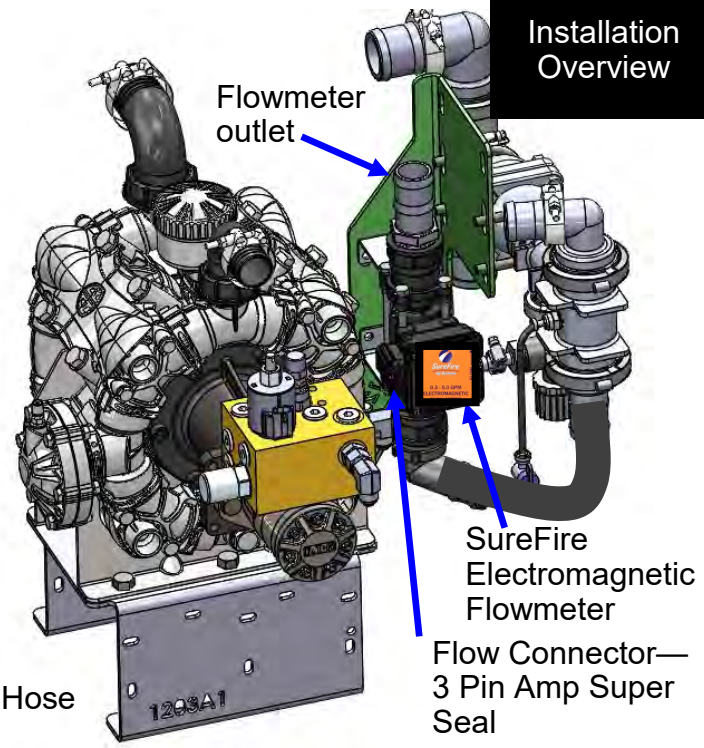


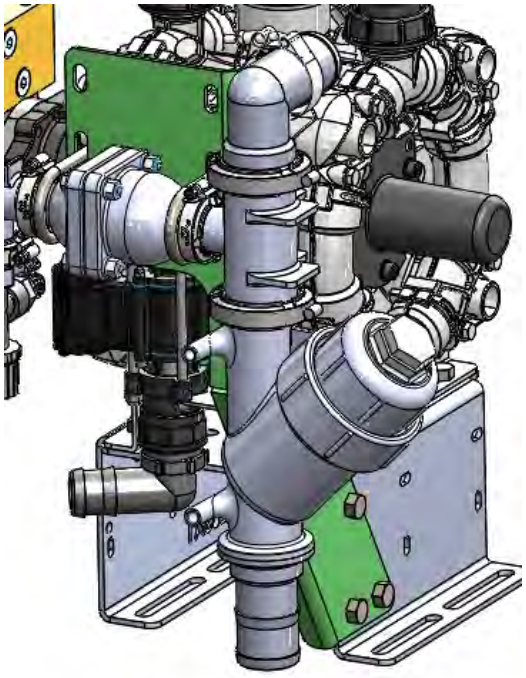
CAUTION

These pumps can deliver liquid at high pressure (290 PSI). Be sure the 100 PSI Pressure Relief Valve (PRV) is installed and functioning so system pressure will be kept under 100 PSI. Check hoses, hose clamps, and liquid fittings regularly and repair or replace loose connections.

PR40 & D250 Liquid Plumbing Connections







Inlet: The PR40 and D250 PumpRight are shipped with a 2" inlet hose barb. Attach this to the hose from your supply tank and strainer . A 2" 90 degree hose barb is included and can be substituted.

Inlet Strainer: A 20 mesh strainer is included in the pump kit. The manifold strainer includes two hose barbs so it can be mounted anywhere in the inlet line. If space allows, the strainer can be mounted directly to the inlet plumbing assembly as shown in image to the left.

Outlet: The outlet is plumbed directly to the flowmeter with 1 1/2" hose. As shown above, the flowmeter may be mounted directly to the PumpRight pump. The flowmeter outlet is a 1 1/2" hose barb. The outlet hose should be a minimum of 24" long with a gentle curve prior to any fittings for optimum flowmeter performance. The flowmeter outlet will attach to your manifold(s) or section valves.

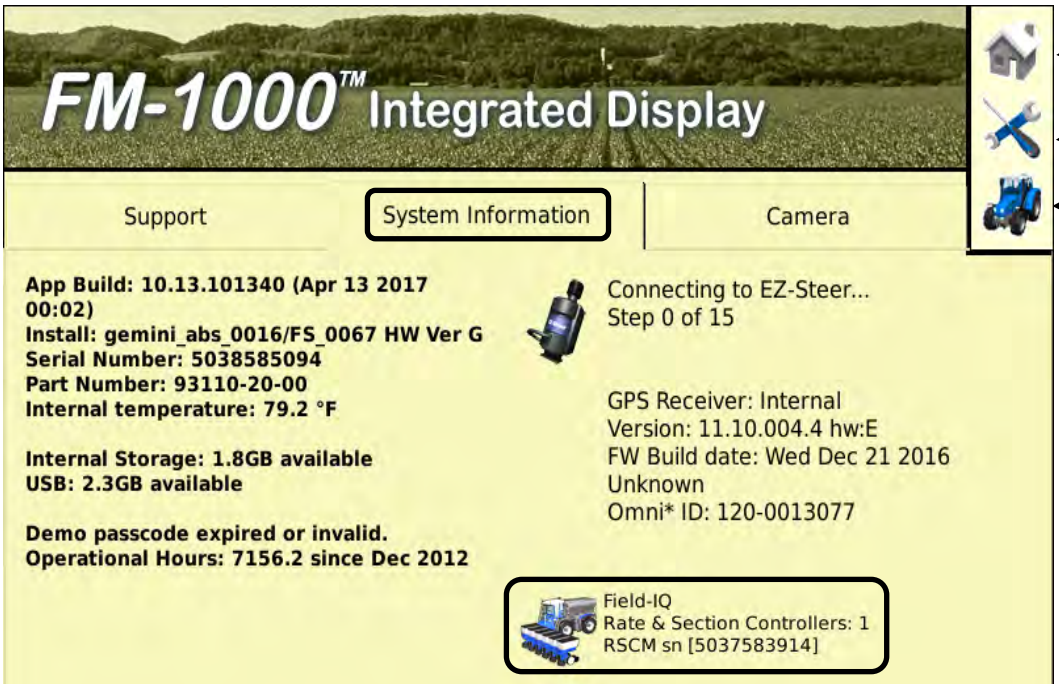
Pressure Relief Valve (PRV): The PRV is a 100 psi relief. If there is a restriction that creates over 100 psi in the system, the PRV will open allowing the excess flow to pass back to the inlet side of the pump. This protects the pump and fertilizer system from damage.

⚠ CAUTION

These pumps can deliver liquid at high pressure (290 PSI). Be sure the 100 PSI Pressure Relief Valve (PRV) is installed and functioning so system pressure will be kept under 100 PSI. Check hoses, hose clamps, and liquid fittings regularly and repair or replace loose connections.

Trimble® Field-IQ™ Setup for TMX-2050, FmX® or FM-1000™

Home Screen > System Information



Home

Configuration Setup - Diagnostics

Run Screen

Check with your Trimble dealer for the latest software/firmware updates.

System Information

From the HOME screen, you can select 3 tabs; Support, System Information or Camera. The **System Information** tab is shown above. This will show what Trimble components are properly connected to your display. **If your fertilizer system quits functioning, first check that the Field-IQ Rate & Section Control Module is still recognized on the display.** If not, inspect the Trimble wiring harness connections or consult your Trimble dealer.

CFX-750 and FM750 Users

The SureFire Tower system will also work with Field-IQ on the 750 displays. All the information in this manual is applicable to the 750 except for screen shots shown in Section F, Setup & Operation. The calibration and setup values in section F DO apply to the 750. However, the 750 has a completely different screen layout and menu structure that is not shown in this manual. Use your Trimble manual to navigate, then enter the appropriate numbers from the SureFire manual.

Use your Trimble FmX® Integrated Display USER GUIDE (Chapter 10 Field-IQ Plugin) or CFX-750™ Display USER GUIDE (Chapter 5– Field IQ System) for further configuration instructions.

TMX-2050 Users

The SureFire system works well with the TMX-2050 running the FMX Plus Application. Some screens look a little different, but setup is similar to the Field-IQ setup for the regular FmX.

The TMX-2050 and latest versions of the FmX software use the Proportional Gain setting instead of the Integral Gain. Using the AutoTuning procedure should give values that work. The screenshots on the following pages show what a typical setup might look like. Your setup may vary from what is shown.

The *TMX-2050 User Guide* has complete information on the setup and operation of this display.
Chapter 6 > Implements > see *Application control*
Chapter 10 > Operations > Field-IQ system operations *Chapter 11 > Diagnostics / Troubleshooting*

FmX & FM-1000 Home Screen > Support

FM-1000™ Integrated Display

Support | System Information | Camera

To upgrade (or change) the software version on the Field-IQ Rate and Section Control, go to Home Screen > Support > Upgrade > Field-IQ and select the FIQ_Rate_Section_Module version that you want to use.

3.20 has been a good version.

There have been issues with 4.09 or 4.11.

4.13 and above should be OK. 3.20 has worked almost all the time.

To identify which version is being used, Field-IQ > Diagnostics > Hardware (see below).

Data Files

Upgrade

Unlocks

Firmware Upgrade

Hardware

Display

Field-IQ

Firmware

FIQ_Rate_Section_Module_3_20

~~FIQ_Rate_Section_Module_4_09~~

~~FIQ_Rate_Section_Module_4_11~~

FIQ_Rate_Section_Module_4_13

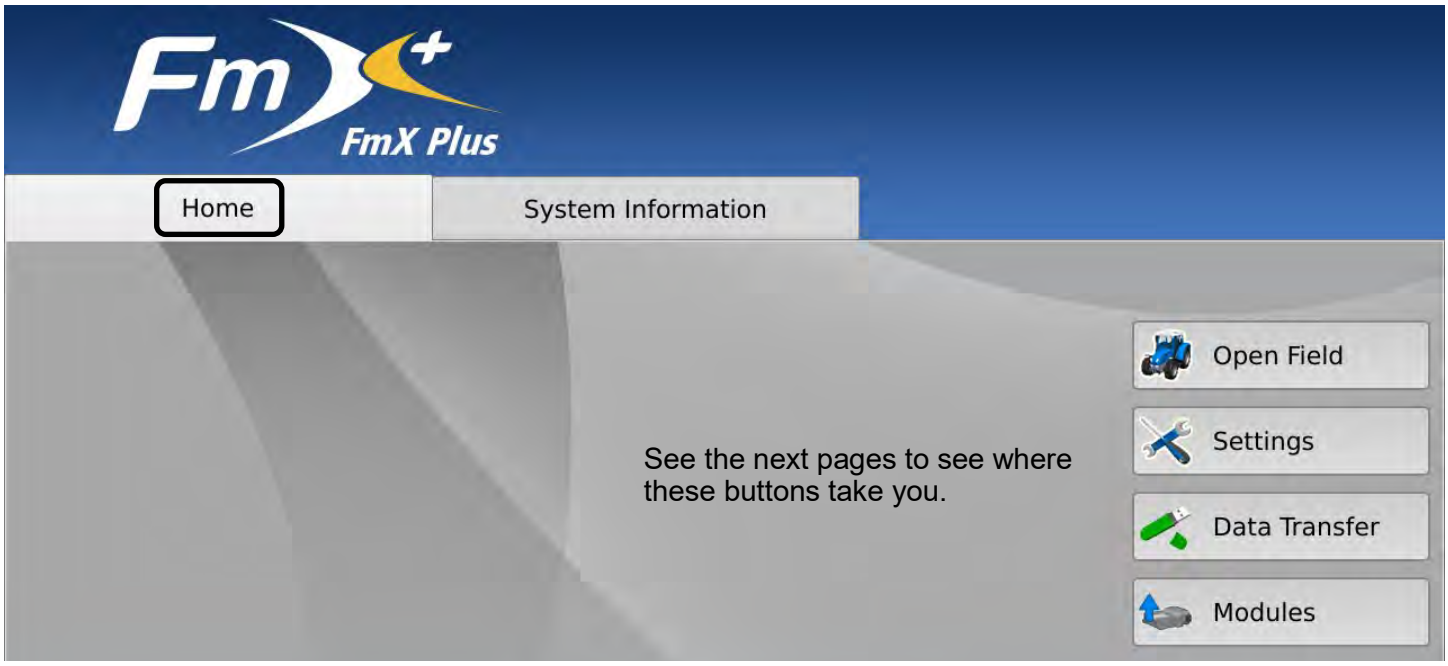
Field-IQ Diagnostics

Operations | Hardware | Sensor | Row Monitor

Controller	S/N	Position	Version	Status	Details	Auth	Tx/Rx	Errors (C
Rate and Section Control Module	5607501428	n/a	4.13	Master is off		Yes	98 / 99	
Rate and Section Control Module	5315512570	n/a		Not detected		No	0 / 0	
Master Switch Box	5537500244	n/a	3.06	Connected		Yes	98 / 99	

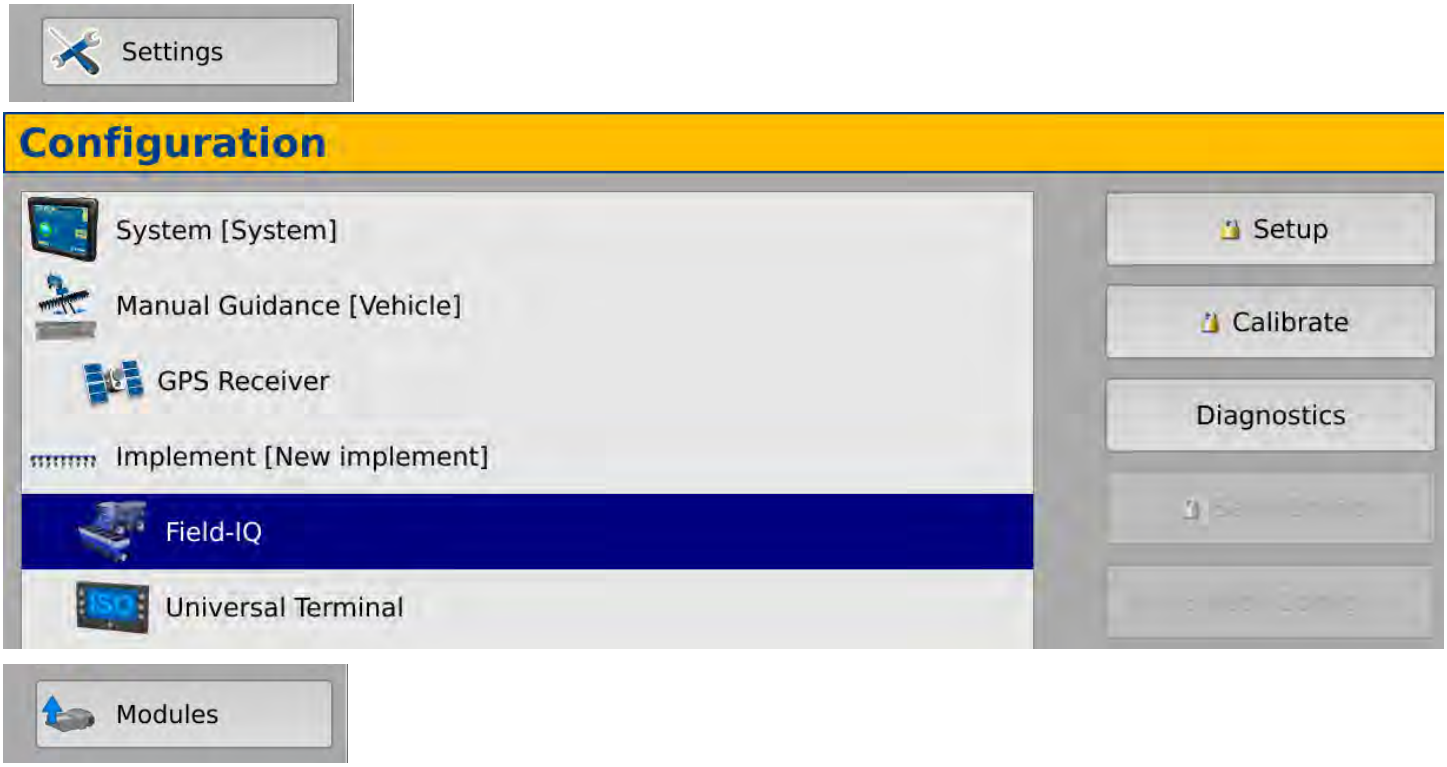
TMX-2050 with FmX Plus > Home Screen > System Information

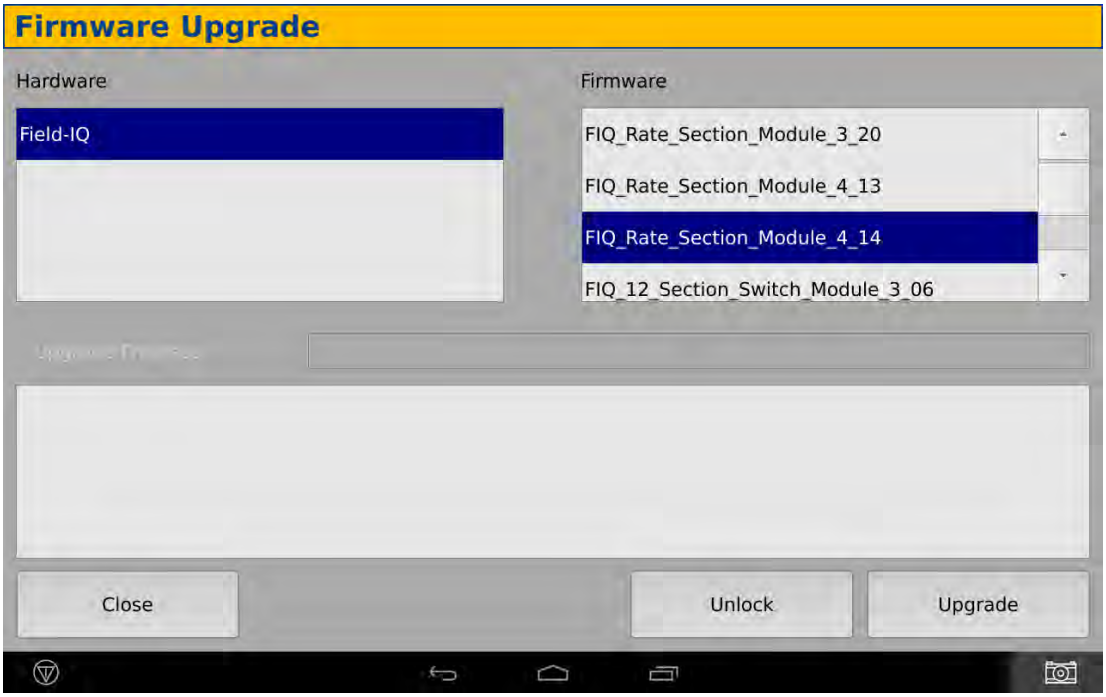
On the TMX-2050 Startup screen, press the FmX Plus icon to start the FmX Plus app.




Open Field
Configuration Selection
Display
System
Language: English
Units: Feet and Inches
Keyboard: QWERTY
Switch
Edit
Vehicle
Vehicle
Switch
Edit
Implement
New implement
20' 0" swath width
20' 0" application width
2 sections
8 rows
Switch
Edit
OK
Field Selection
Client
SFA
New
Farm
SFA
New
Field
North 40
New
Event
t2
New
Event Attributes
Selected Implement
New implement
20' 0" swath width
20' 0" application width
2 sections
8 rows
OK
n/a
N
Tank: Starter
Target 4.00 gal/a
Actual 0.00 gal/a
Tank Level 186.5 gal
Hitch: 28
Target n/a
Actual 0.00 gal/a
Tank Level 400.0 gal

TMX-2050 with FmX Plus > Home Screen >





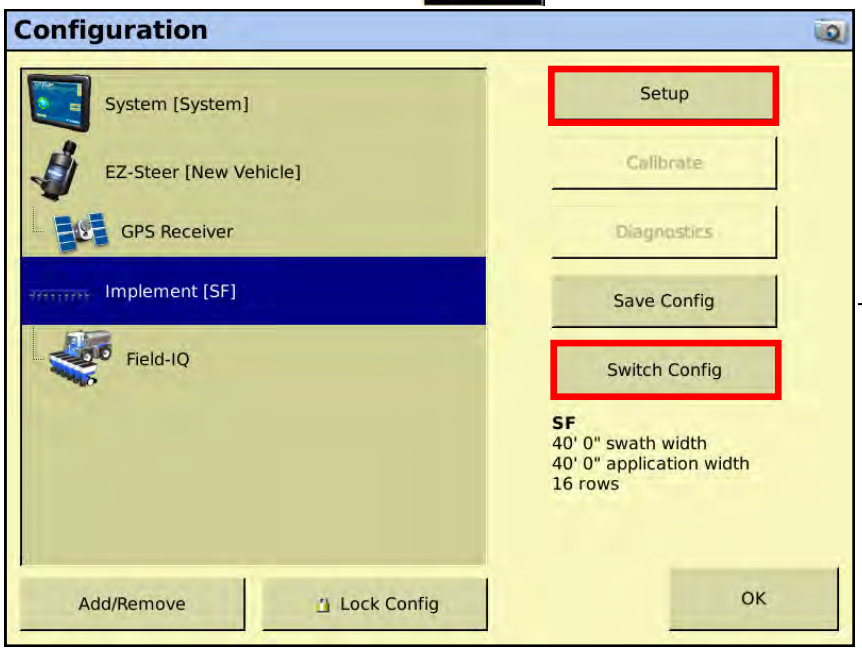
3.20 has been a good version. If you have problems with another version, try 3.20.

⚠ WARNING

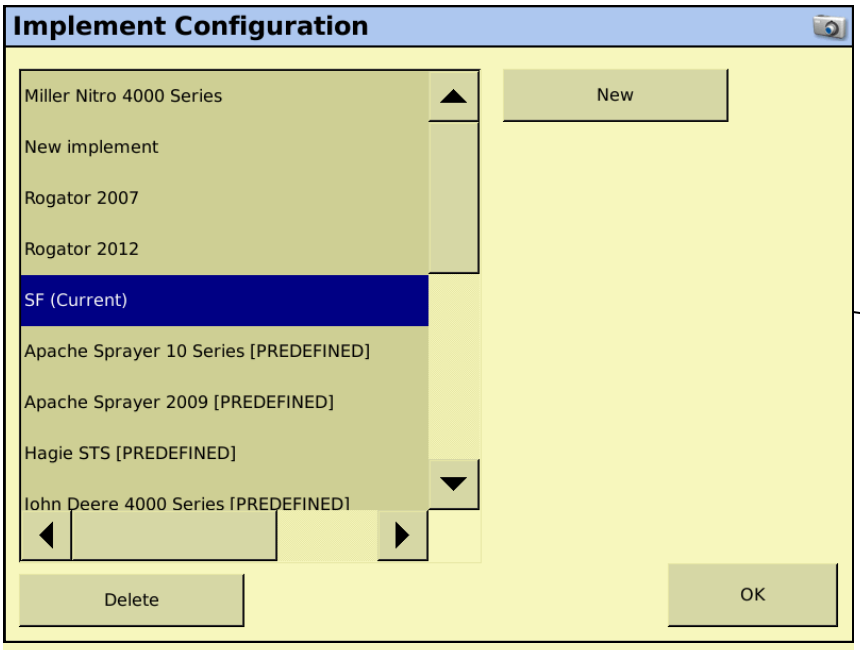
The operator is responsible for knowing and understanding the safe operation of this equipment. Systems with hydraulic equipment require additional safety precautions to prevent serious injury and/or death.

Implement Setup

Implement Setup is where you set the information for the implement you are using. Some of these settings affect the guidance control. However, if using auto section shutoff, these settings will determine when each section valve shuts off.
Measure your implement carefully and consult your Trimble dealer or the Trimble FmX Integrated Display User Guide (Chapter 10) for additional assistance with the Implement Setup section.

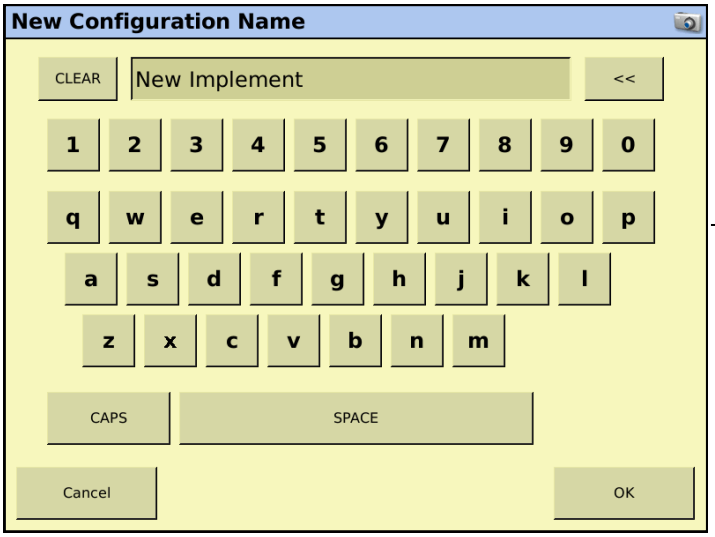


1. From the Home Screen select the wrenches to go the Configuration screen.
2. The Configuration screen below will appear. Choose **Implement**. If the Setup button is locked, shown by a padlock next to it, Push **Setup** (to edit the Implement that is shown) or **Switch Configuration** (to set up a new Implement or to switch to an Implement previously entered), then enter "**2009**".
3. You will be ready to edit the Implement Setup or to enter a New Implement Setup.

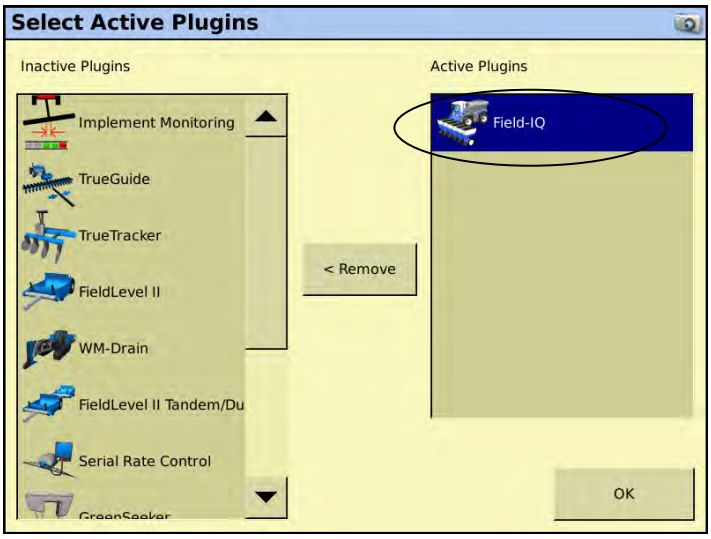


From this screen, either select a previously entered Implement or select **New** to set up a new implement.

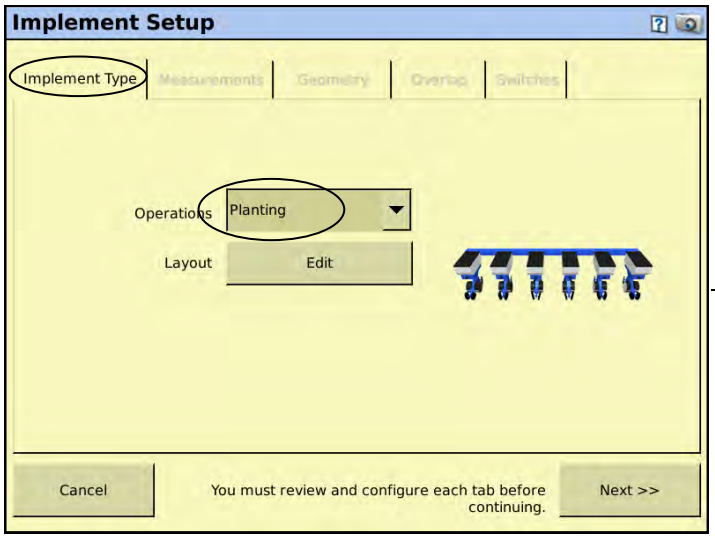
Implement Setup (continued)



If entering a New Implement, type in a name for the Implement, and then press OK.

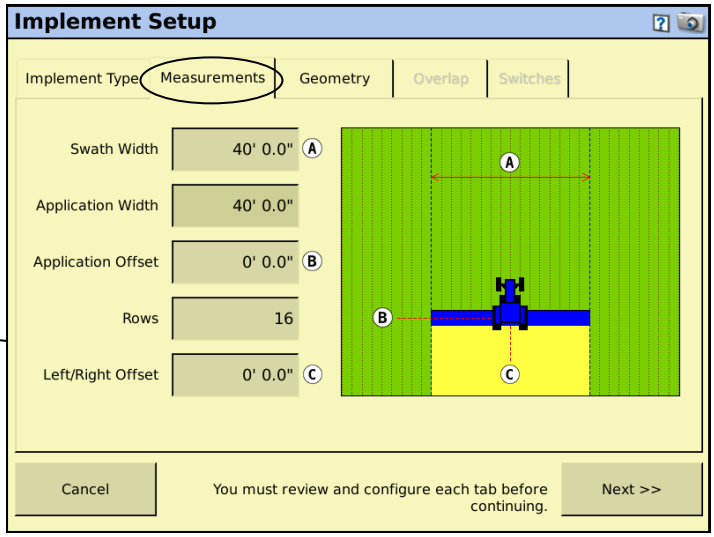


Select **Field-IQ** as the Active Plugin.



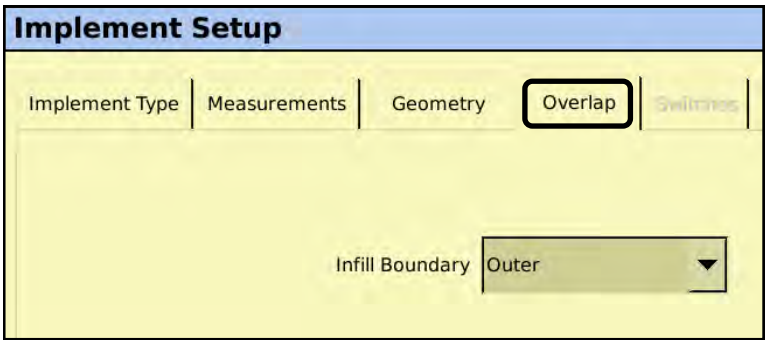
For Implement Type, select **Planting** (if setting up a planter) or the appropriate Implement Type.

Edit the Layout of the Planter (or other Implement) as needed.



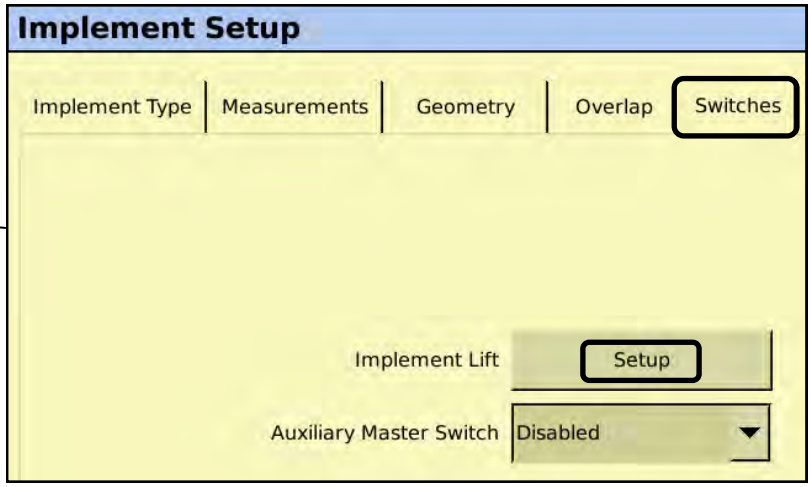
Enter the appropriate measurements for the Implement.
On the Next screen, enter the Geometry measurements requested.

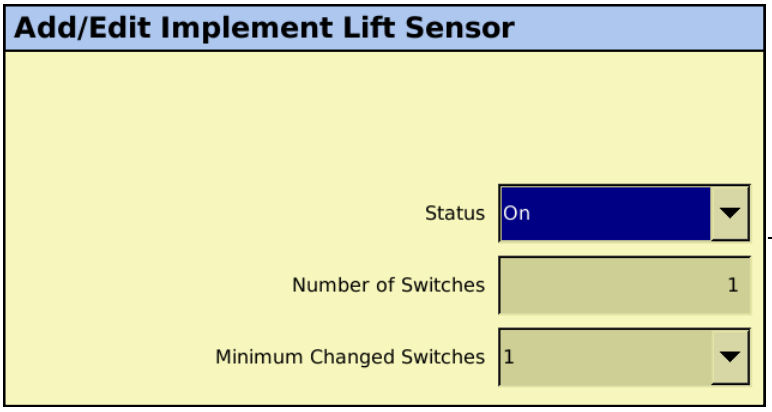
Implement Setup (continued)



Select either "**Outer**" or "**Inner**" for the Infill Boundary on the Overlap Tab.
Outer uses the field boundary as the infill boundary. **Inner**: When running a Headland setting, this moves the boundary to the inside of the last headland pass.

If you are not using an Implement Lift Switch (also known as a Mercury Run/Hold Switch), just press **OK.**
If you will be using an Implement Lift Switch, press **Setup.**

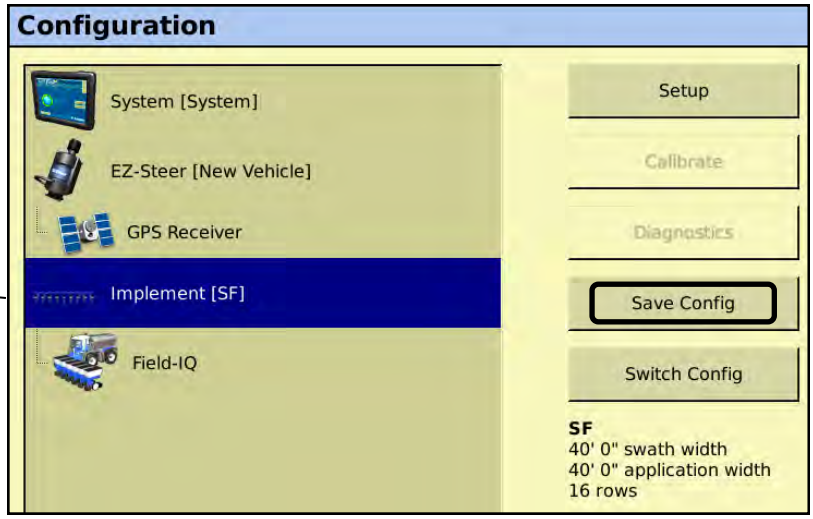




If using an Implement Lift Switch, change the Status to **On**. Enter the number of switches and the minimum number of switches that need to change.
You will need to Calibrate the Implement Lift Switch later on by going to Field IQ - Configuration - Implement Lift Switch (see page 28 and page 59.)

When you return to the beginning screen, select **Save Configuration**.

The Implement should be set up.

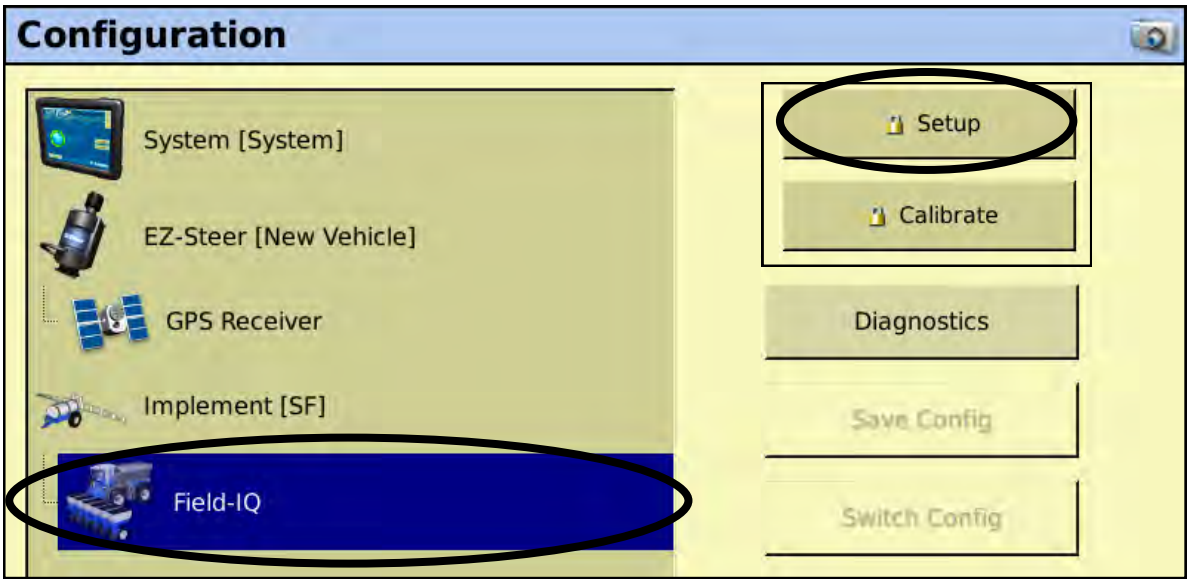


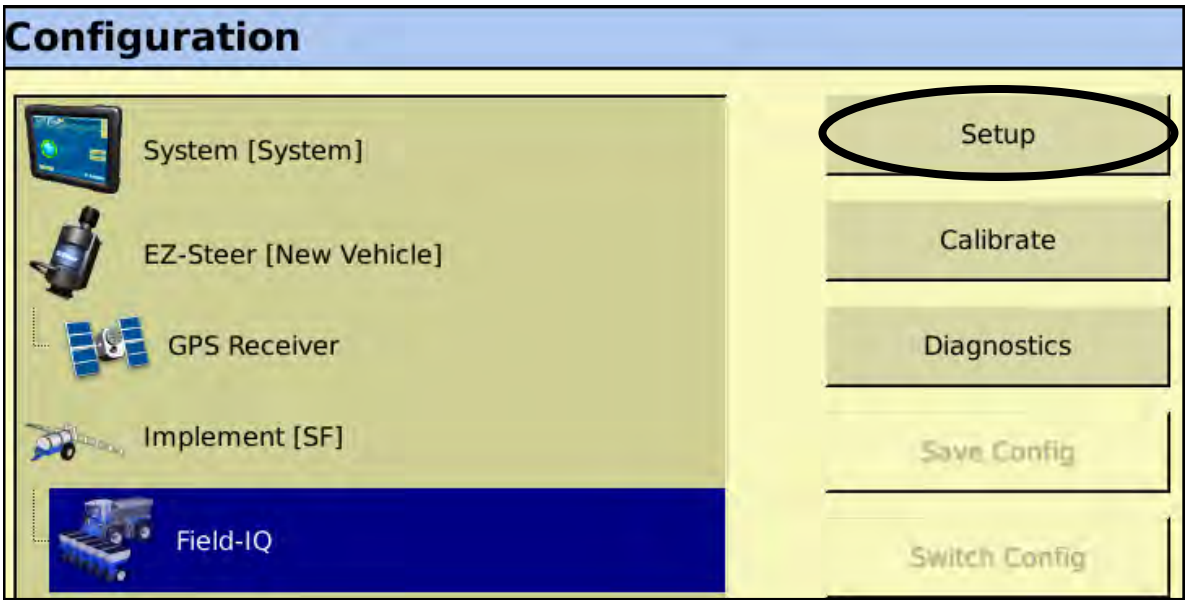
Configuration - Field-IQ™ Setup

In the Setup & Calibrate menus you will set the Trimble Field-IQ to work properly with the SureFire Fertilizer System. Carefully follow these steps to first make the proper settings. Then, run the tests shown to verify your fertilizer system is ready to go to the field.

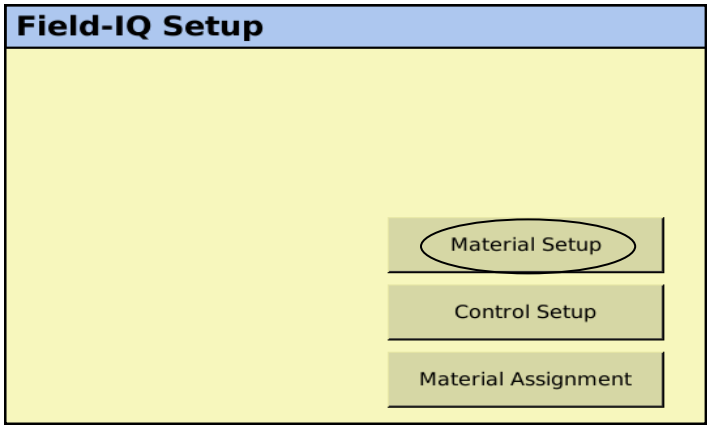
1. From the Home Screen access the Configuration screen (wrenches).
2. The Configuration screen below will appear. Choose **Field-IQ**. If the Setup & Calibrate buttons are locked, shown by a padlock next to them, Push **Setup**, then enter "**2009**".
3. After entering the code, the locks will disappear. Push Setup to proceed to the next steps.

(If the Calibrate and Diagnostics buttons are grayed out, you probably need to close a Field.)

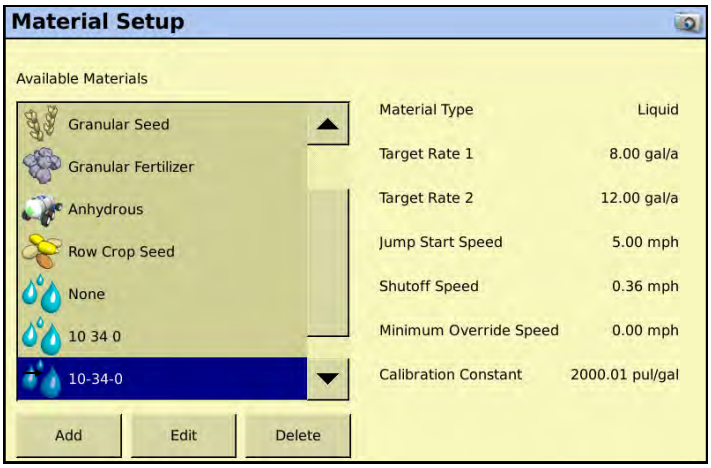




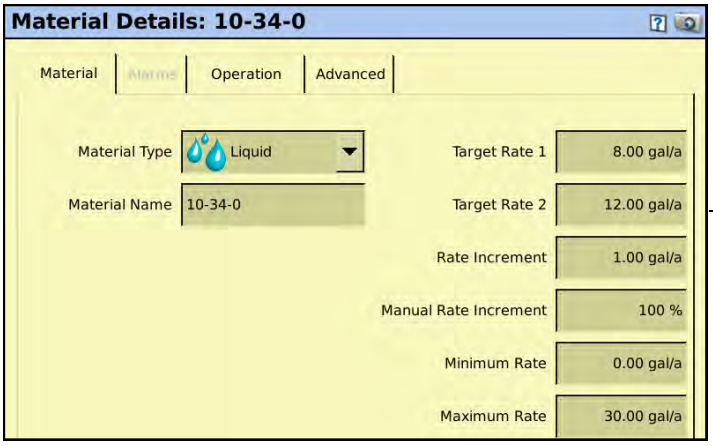
Material Setup



To set up the Material, press **Material Setup**.



Select one of the Available Materials or press **Add** to add a new material. Press **Edit** to change any of the parameters of the Material.

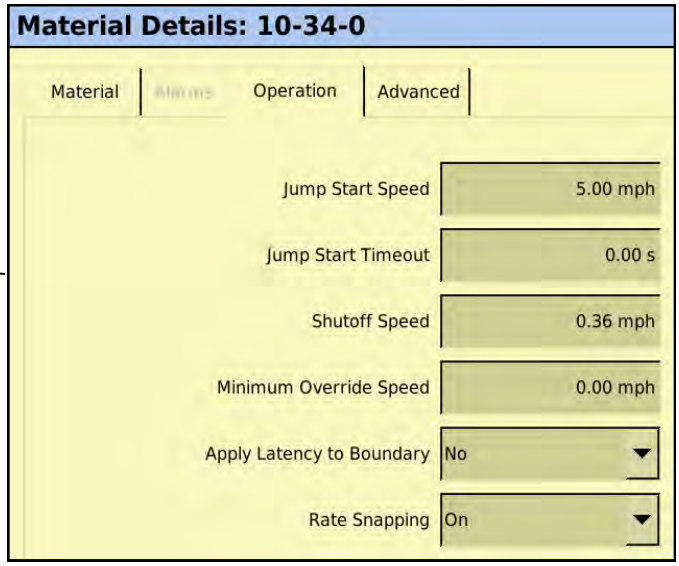


Set **Target Rate 1 & Target Rate 2** as desired.
Rate Increment increases or decreases Rate 1 or Rate 2 by this amount each time you press the Rate Adjustment Switch on the Master Switch Box.
Manual Rate Increment works when the Rate Switch is in the Manual Position. This number controls the speed at which the valve increases or decreases when you press the Rate Adjustment Switch on the Master Switch Box.
Minimum Rate is typically set at 0.
Maximum Rate is set at or above the maximum rate that will be applied.

These parameters may be adjusted as desired.

Jump Start Speed is the speed the system will ramp up to when the operator pushes the Jump Start button on the Master Switch Box. 3.0-5.0 mph is a good setting for this.
Jump Start Timeout allows the Jump Start Speed to run for a specified amount of time.
Apply Latency to Boundary: Set as needed so the system begins applying when needed.

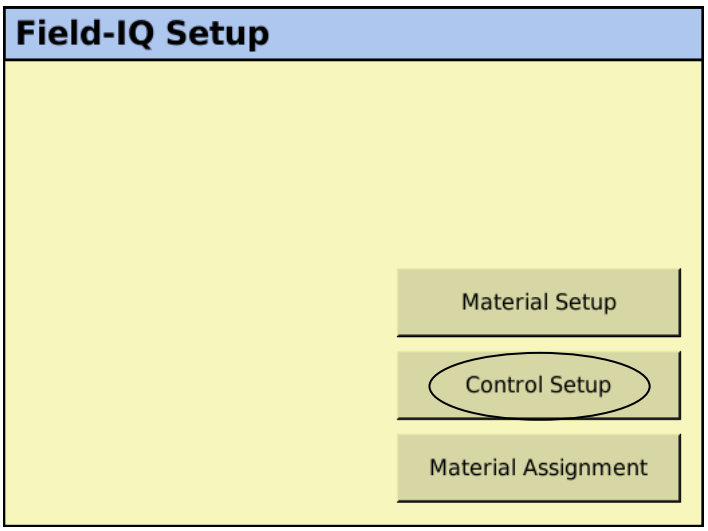
SureFire recommends setting the **Rate Snapping** to **On.** This will smooth out the rate fluctuation seen on the screen. If you are within the rate smoothing range, the applied rate will just show your target rate, and not small deviations from the target rate.

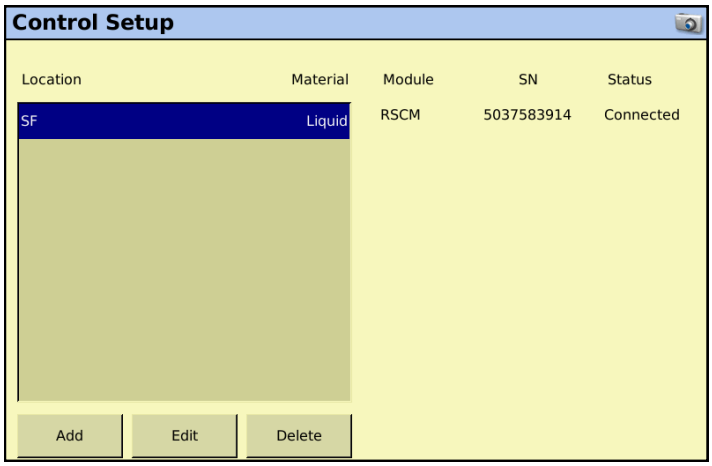


Trimble® Field-IQ™ Setup for FmX® or FM-1000™ (continued)

Control Setup

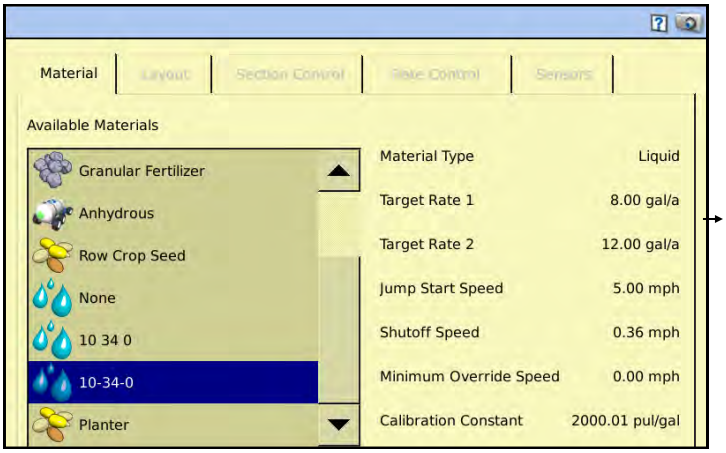
See the FmX Integrated Display User Guide, beginning on page 10-22, for more information.



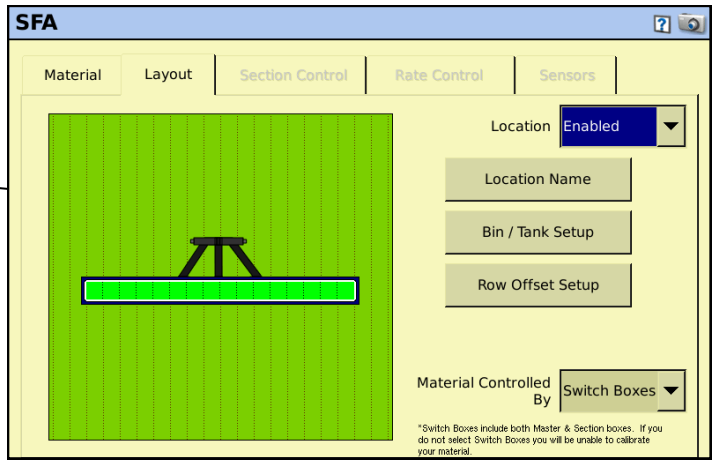


If this is the first time to do Control Setup, there will be no Locations entered. In that case, press **Add** and enter the information for a location.

If there is a location and material set up, you can select and/or edit it.

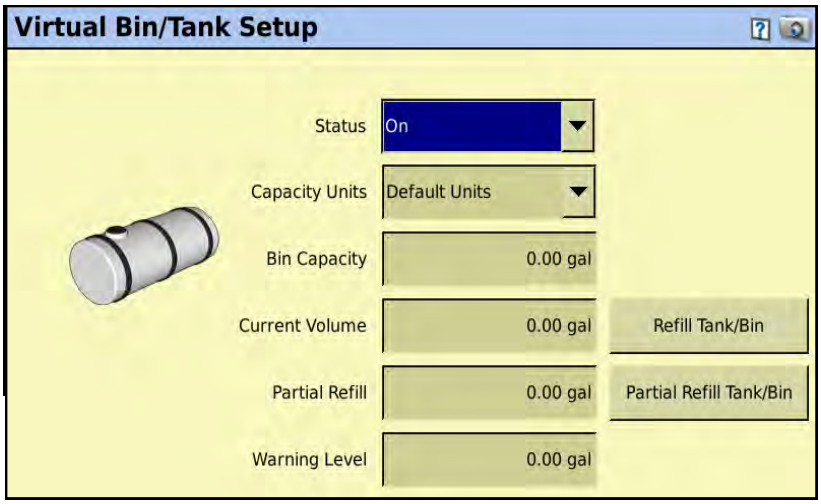


Select an Available Material.



From this screen, you can add a **Location Name** such as Front Tank, Rear Tank, etc..
If desired, you can set up the **Bin/Tank Setup** to allow the system to track how much material is left in the tank. (See screenshot on next page)

Trimble® Field-IQ™ Setup for FmX® or FM-1000™

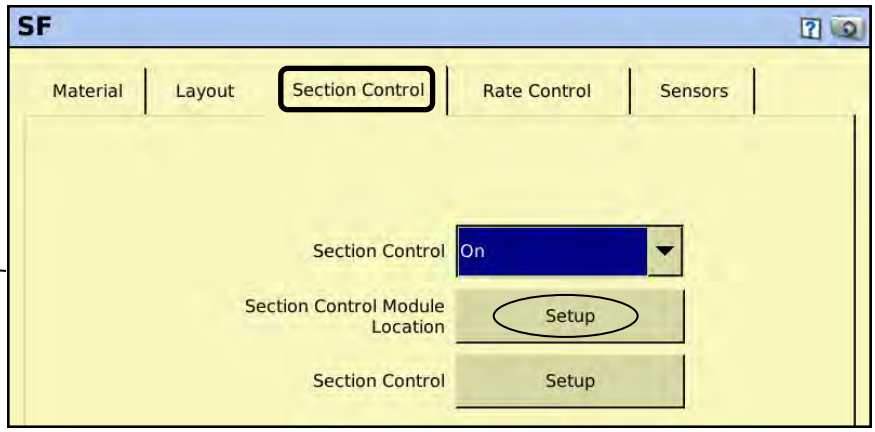


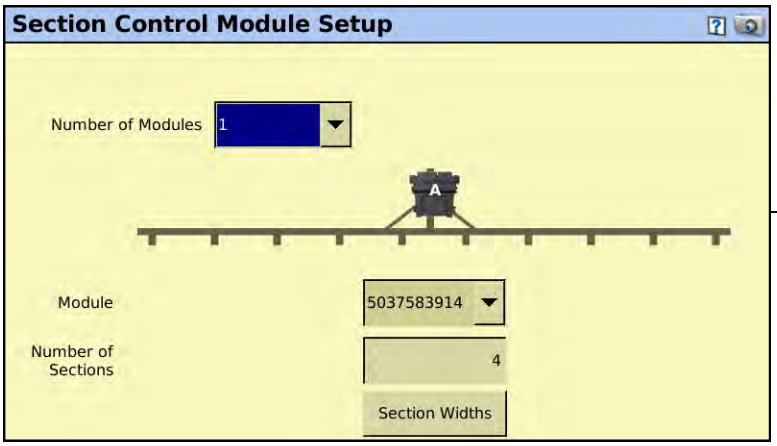
Optional. If desired, enter the information here to let the controller monitor how much material is left.

Section Control

See the FmX Integrated Display User Guide, beginning on page 10-25, for more information.

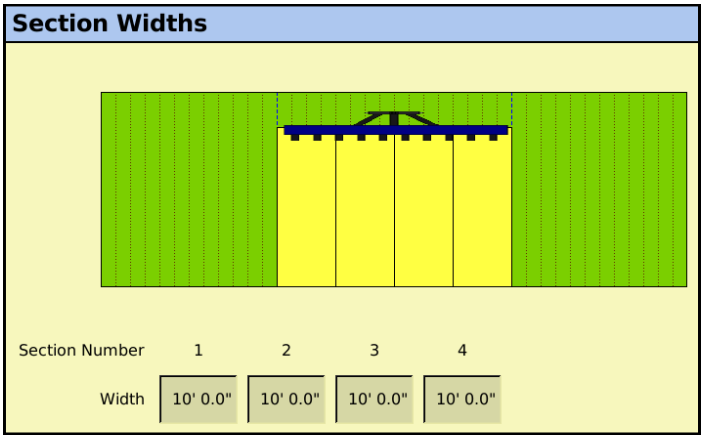
Press **Setup** next to **Section Control Module Location**.



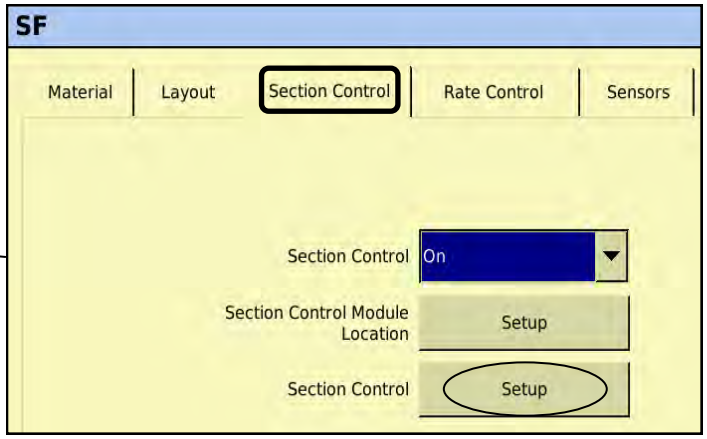


1. Set the Number of Modules in your system.
2. Select the Module Serial Number.
3. Set the number of Sections for your system.
4. Press **Section Widths.**

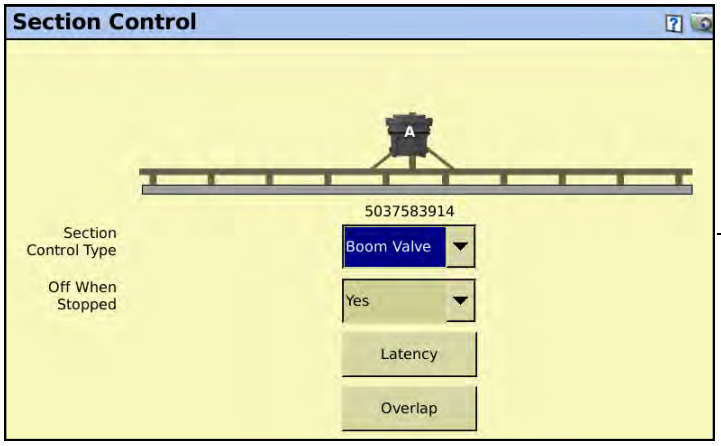
Section Control Setup (cont.)



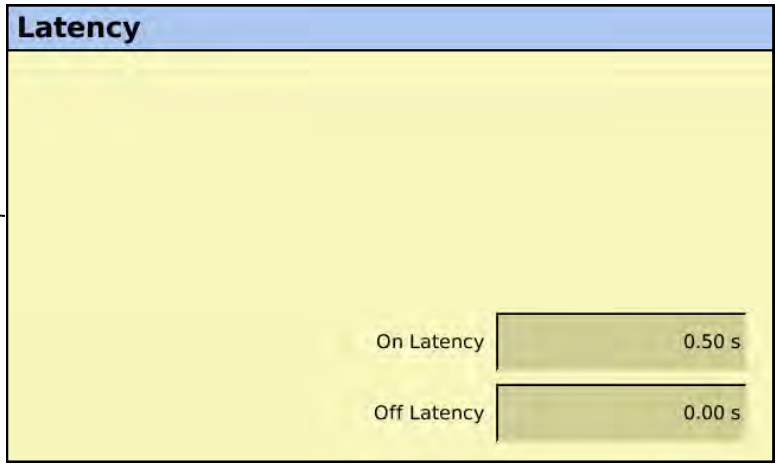
→ Set the width of your sections.



Press **Setup** next to **Section Control**.



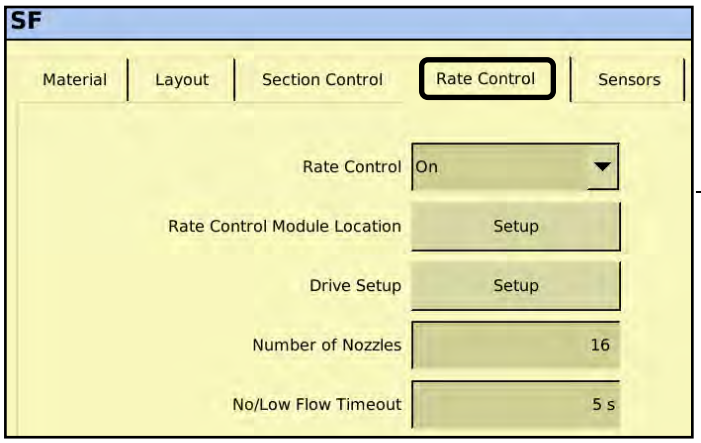
1. Set **Section Control Type** to **Boom Valve.**
2. Set **Off When Stopped** to **Yes**.
3. Press **Latency.**



1. Set **On Latency** to 0.50 seconds.
2. Set **Off Latency** to 0.

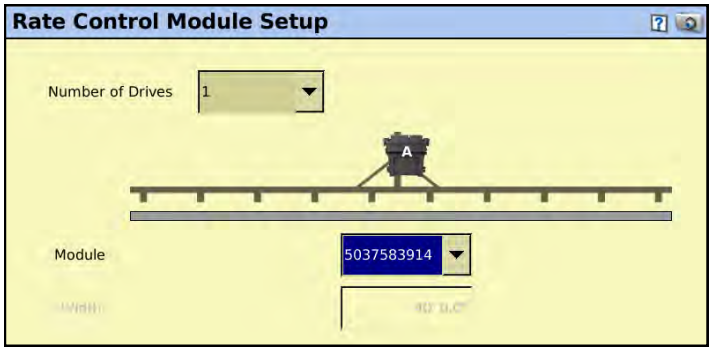
These numbers pertain to how long it takes for your system to actually begin applying or stop applying after the controller sends the signal to start or stop when controlling automatically. To start the system sooner, increase the On Latency number.
Adjust as necessary in the field.

Rate Control Setup

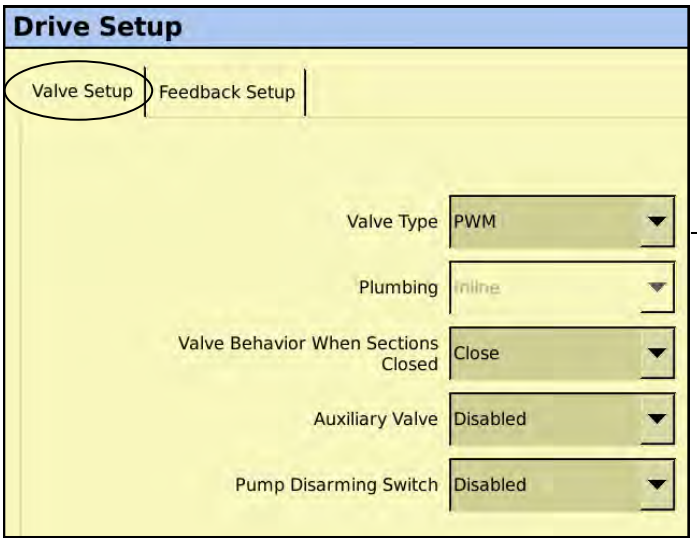


See the FmX Integrated Display User Guide, beginning on page 10 -32, for more information.

1. Select the **Rate Control** tab at the top.
2. Set **Rate** Control to **On.**
3. Set **Number of Nozzles** number or rows).
4. Set **No/Low Flow Timeout** to 45 s for troubleshooting so the system does not shut off too quickly.
5. Press **Setup** next to **Rate Control Module Location.**



1. Set the correct information on this screen.
2. Press **OK.**
3. The next screen should look like the screen above. On **Drive Setup**, press **Setup**.

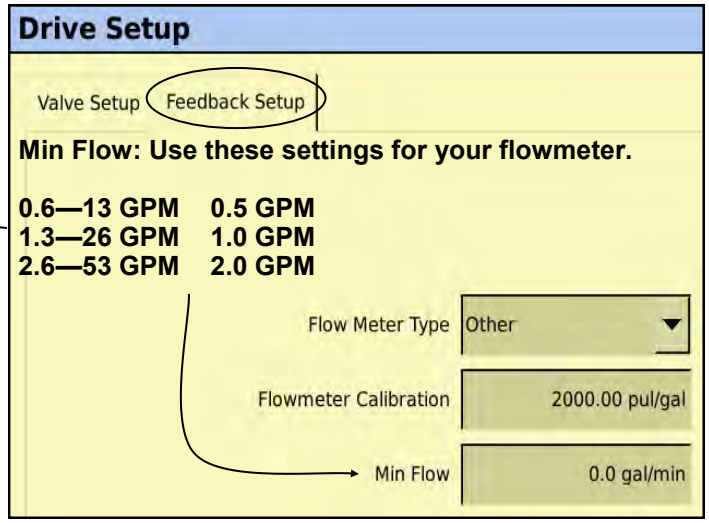


Set the Valve Setup as shown.
ValveType: PWM
Valve Behavior When Sections Closed: Close
Auxiliary Valve: Disabled
Pump Disarming Switch: Disabled

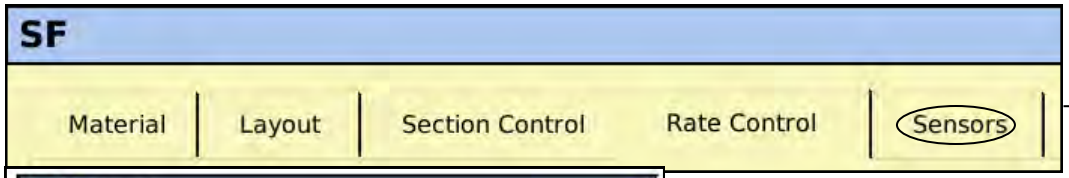
*(Optional: If using an **Aux/Dump valve** to keep the pump running when application stops so the system will resume applying at the Target Rate immediately upon restart, set **Auxiliary Valve** to **Dump**, then set **Valve Behavior When Sections Closed** to either **Lock in Last Position** or **Lock at Minimum**. This setup requires section valves with an additional dump valve plumbed to return flow to the tank when application stops.)*

Set the Feedback Setup screen as shown.
Flowmeter Calibration = 2000.

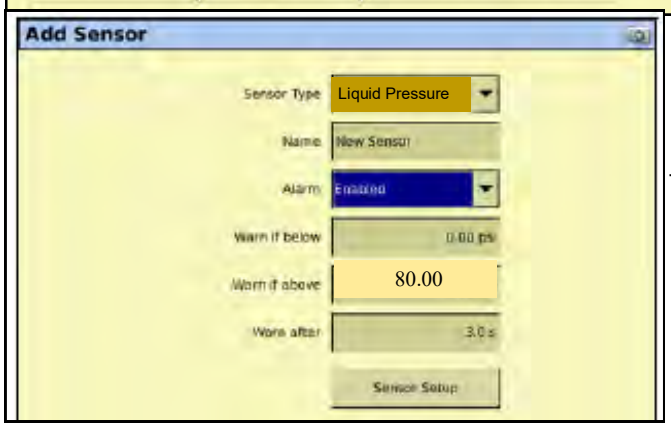
This flowmeter calibration will work with the flowmeter that has the blue label or orange label on the PumpRight System.
Earlier flowmeters have a white label with black text and have different calibration numbers.



Pressure Sensor Setup



→ Select the **Sensor** tab.



→

Sensor Type : Liquid Pressure

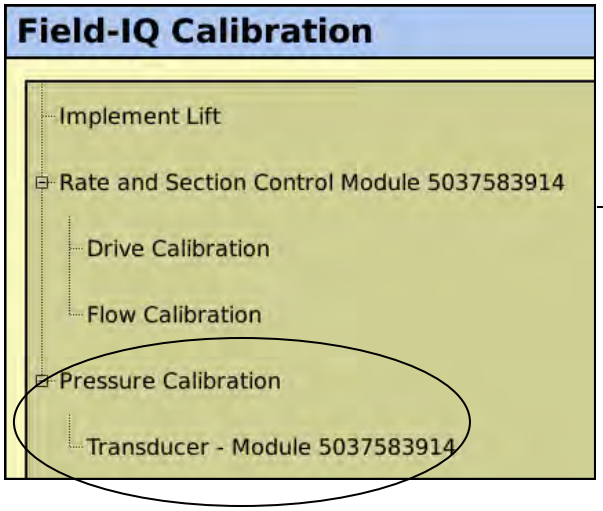
Name: Transducer (or other name)

Alarm: As desired. You may want to leave Warn if Below set to 0, and Warn if Above to 80 PSI for hydraulic pump systems.

Sensor Setup will take you to a screen where you can select the Field-IQ Module that is controlling this sensor.

Two pressure sensors can be connected when using SureFire harnesses with Pressure 1 and Pressure 2 connectors.

Reminder: The pressure sensor is for informational purposes only and does not control the system in any way. The SureFire system can have up to two pressure sensors.



→

To finish the Pressure Sensor setup, it will be necessary to go to Field-IQ Calibration and select Pressure Calibration and the name of the Pressure sensor you set up.

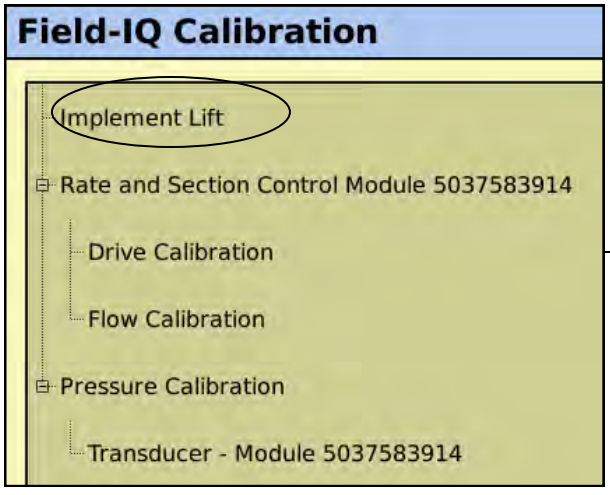
Calibrate Type: Point/Slope

The calibration setting (slope) is **50 mv/PSI.**

Be sure there is no pressure on the sensor when you calibrate. You can unplug the sensor to be sure.

You do not need to “Run Calibration”. You *do not* need to hook up a manual gauge to calibrate the sensor.

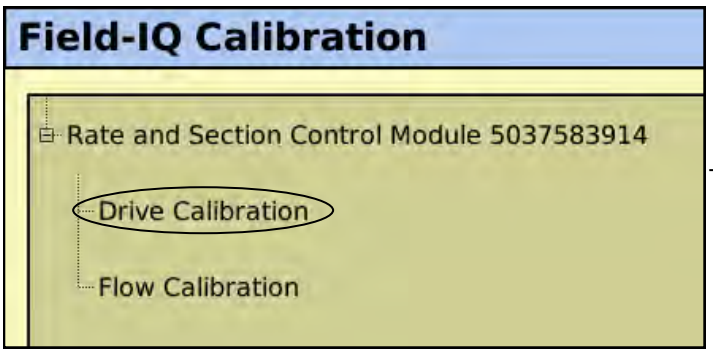
Implement Lift Switch Calibration



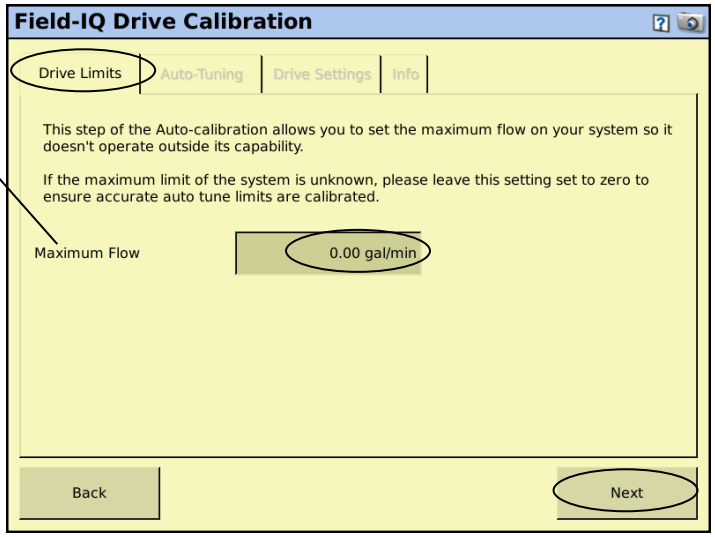
→

1. From the **Field-IQ Calibration screen,** select the **Implement Lift option**.
2. Raise the implement and then tap Next.
3. Lower the implement and then tap Next.
4. Tap OK to return to the Field-IQ Calibration screen.

Trimble® Field-IQ™ Setup for FmX® or FM-1000™

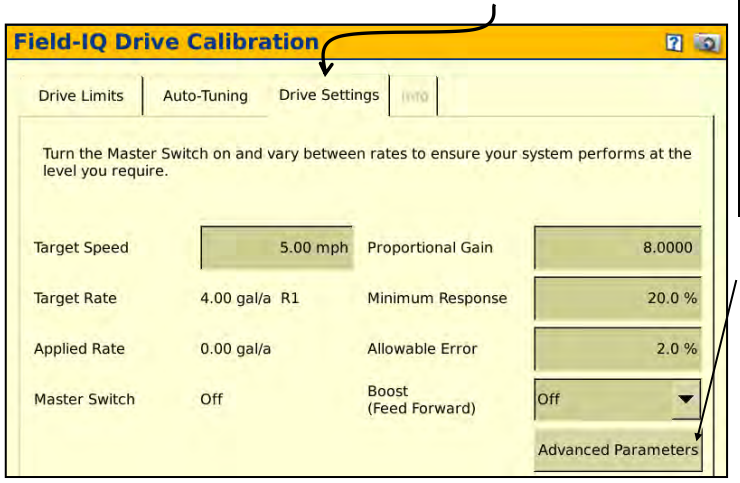


Select **Field-IQ - Calibrate** on the Calibration screen.
This brings up the screen on the left.
Select **Drive Calibration.**



You can leave Maximum Flow set at 0 or enter the **Maximum Flow** rate of your pump in Gal/Min. Then press **Next.**

Follow the screen instructions to run the Auto Tuning procedure.
You can press **Next** at the bottom of the Auto-Tuning screen to go to the **Drive Settings** screen.



Select the **Advanced Parameters** button to bring up the **Advanced Flow** screen (shown below). Here you will enter the numbers for the system.

Target Speed: Enter a typical operating speed.

Upper PWM Limit: *Make sure this is set to 100. If Auto-Tuning has been used, the Trimble control will set it at a lower number that will limit the upper range of your pump.*

Lower PWM Limit: 0.

Boost (Feed Forward)-Turn ON to help get to Rate faster

Recommended Settings for PumpRight system:

Proportional Gain: 7-10. If the gain is set too high, the system will fluctuate above and below the desired rate. Lower the gain to achieve steady pump operation. If the gain is too low, the system takes too long to respond to rate and speed changes.

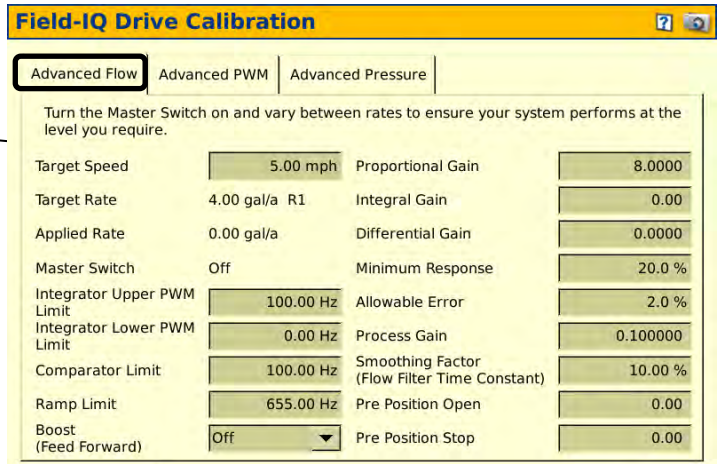
Minimum Response: 20-30 This is where the pump will start. Raise it to get to Target Rate faster when starting. Lower it if system overshoots Target Rate when starting.

Allowable Error: Start at 2%

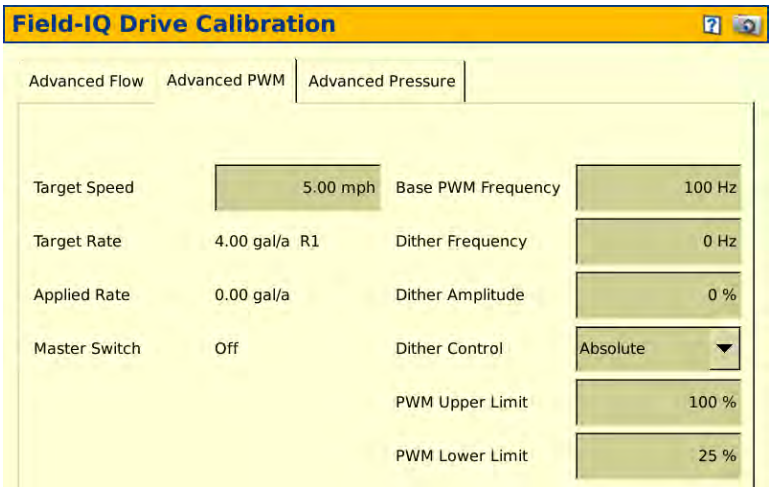
Process Gain: 0.10

Smoothing Factor: 10

Older software versions use Integral Gain instead of Proportional Gain. In that case, use the Proportional Gain numbers shown above for the Integral Gain.

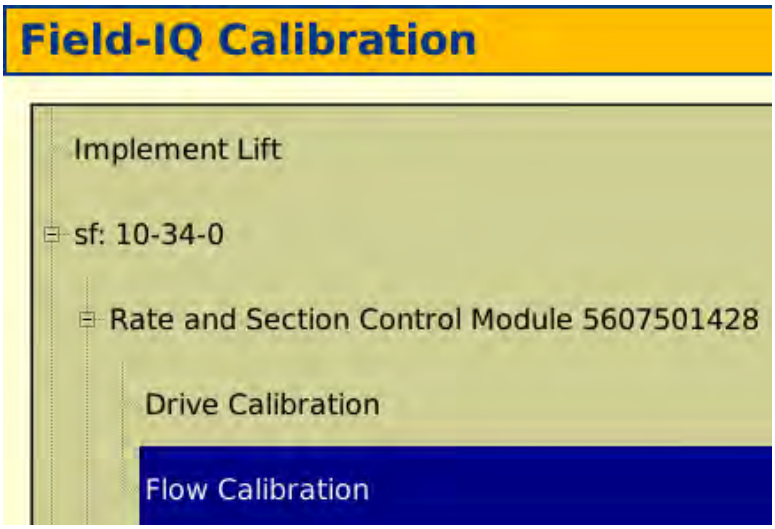


Field-IQ Drive Calibration: Advanced PWM



Advanced PWM Tab

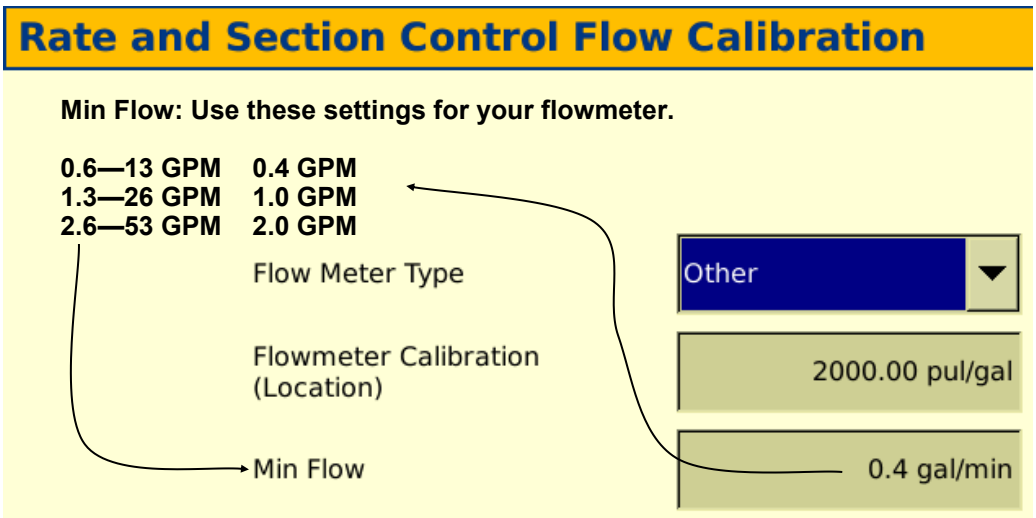
Base PWM Frequency: 100
Dither Frequency: 0
Dither Amplitude: 0
→ **Dither Control: Absolute**
PWM Upper Limit: 100%
PWM Lower Limit: 25%



Flow Calibration

Select **Field-IQ - Calibrate** on the Calibration screen.
This brings up the screen on the left.
Select **Flow Calibration.**

The Flow Calibration numbers may have already been set in the Drive Setup. You can verify or update the settings here.

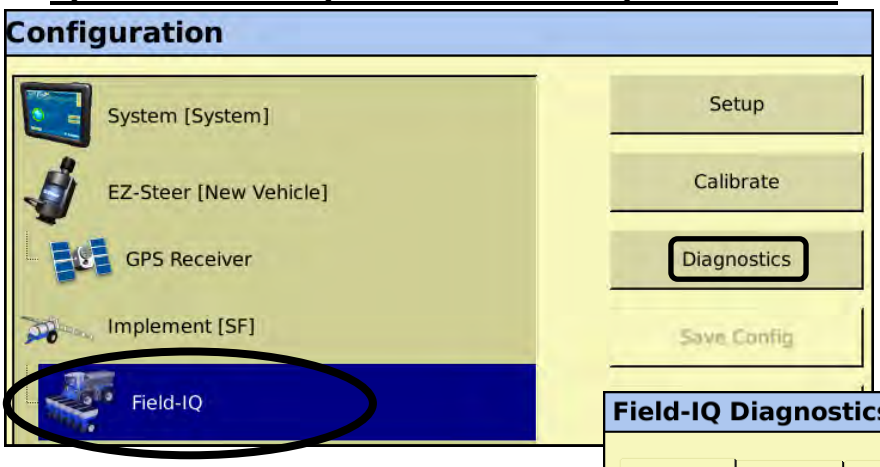


Flowmeter Model (blue label or orange label)	Pulses/Gal	FPT Size	Hose Barb In kit
0.13 - 2.6 GPM	3000	3/4”	3/4”
0.3 - 5.0 GPM	3000	3/4”	3/4”
0.6 - 13 GPM	**2000**	3/4”	1”
1.3 - 26 GPM	**2000**	1”	1”
2.6 - 53 GPM	**2000**	1 1/4”	1 1/2”

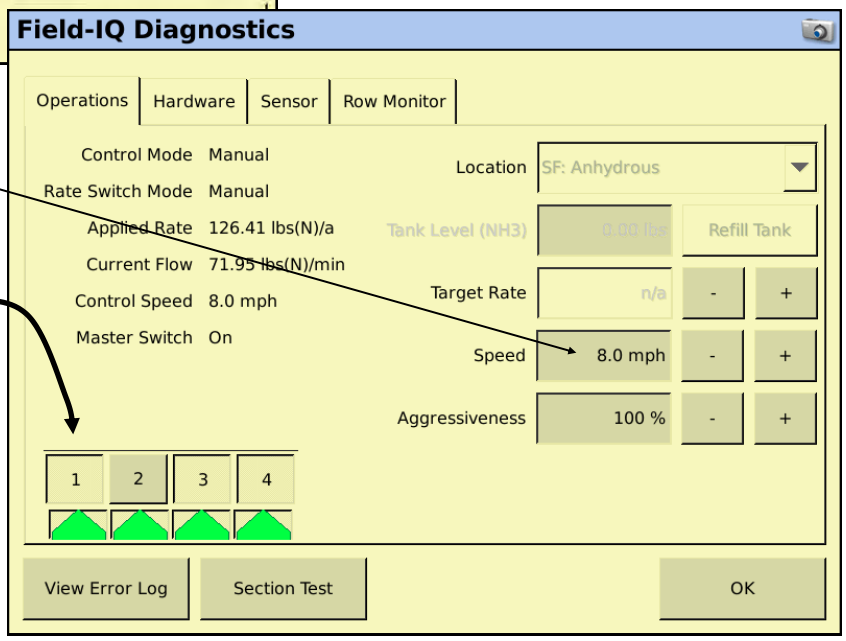
The flowmeter calibration number (pulses/gal) is printed on the serial number sticker on the side of the flowmeter.
Earlier model flowmeters (meters with white labels with black text) have different calibration numbers. See the documentation for those meters to find the calibration numbers or check on the serial number sticker.

Initial Operation Instructions

SureFire recommends you perform these exact steps with water to verify system is correctly installed and ready for field use.



From the Configuration Screen, select **Field-IQ**, then **Diagnostics.** (*If the Diagnostics tab is grayed out, you probably need to close a Field.)*



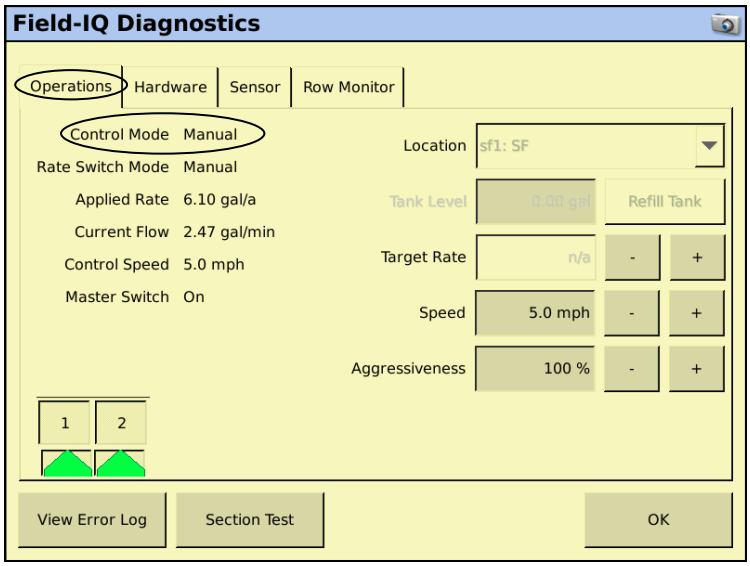
1. Turn on the hydraulic flow to the pump.
2. Press the + next to Speed to simulate a Speed signal.
3. Turn the Field-IQ master switch (#5) on.
4. Push each section valve button and verify each valve is working.
5. Turn Switch #2 to Manual and open the section valves. Use switch #1 to increase flow. Does "Current Flow" display a flow rate? Is it stable after the system is primed? Do increase & decrease buttons increase & decrease flow?
6. Move switch #2 to Rate 1 and set speed to your typical field speed.
7. The system should begin to pump liquid now in automatic control mode. Is the flow in GPM stable? Is it applying at the correct rate? (applied rate = target rate?)
8. Change rate using screen buttons or switch #1 to increase/decrease rate or switch #2 to go to Rate 2. Does applied rate change to equal target?
9. Close 1 section valve, does flow decrease? Does applied rate still equal target rate?

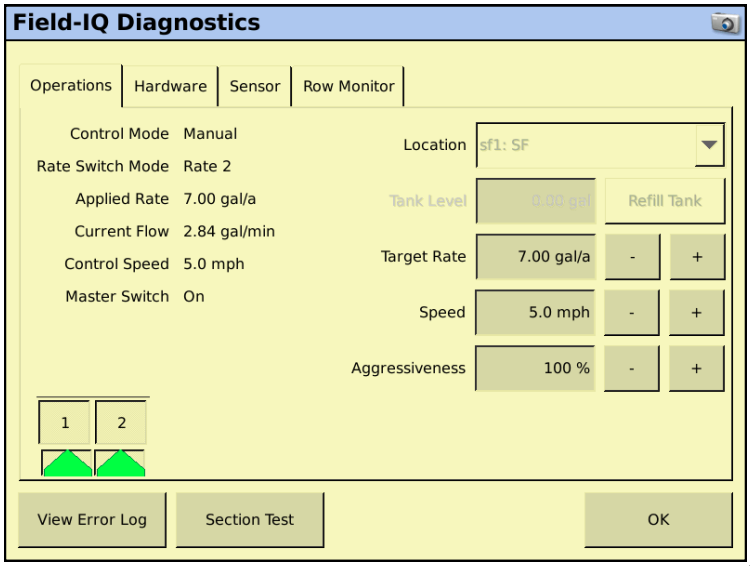
10. Change speed and target rate to minimum and maximum values. Does system perform at these values? Does the system pressure seem reasonable (remember fertilizer will increase pressure over water)? Use "Sensor" tab at the top of page to read the pressure sensor value (if equipped).
11. Press the **Sensor** tab to see **PWM Percent** while the system is running. Typical operating ranges for PumpRight systems will be between 30% and 60%. With the control switch in Manual mode, pressing switch #1 towards (+) on the switch box should increase the PWM Percent

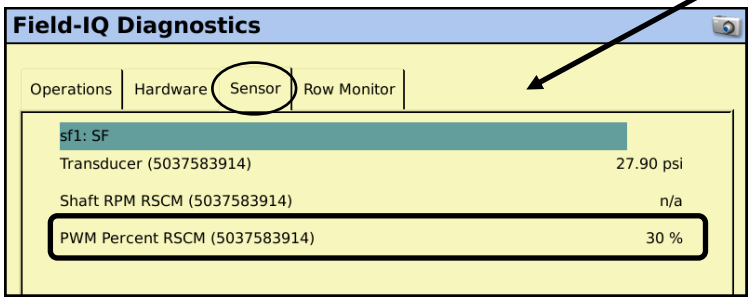
Running the system with water will create much lower pressure than with fertilizer. If the pressure is too low, all the check valves will not open, and some of the rows will have no flow. Increase the flow to build enough pressure to open all the check valves.

Field-IQ Diagnostics

From the **Configuration Screen,** select **Field-IQ** and then **Diagnostics.** You can test-run the system from this screen. *(If the Diagnostics tab is grayed out, you probably need to close a Field.)*







To enable the sections, tap the numbered section tabs above each of the section icons.

The **Operations** tab displays the current status of:
Control Mode (Auto or Manual)
Rate Switch Mode (Manual, Rate 1, or Rate 2)
Master Switch (Off, On, or Jump Start)

This screen also allows you to manually enter values for *Tank Level, Target Rate,* and/or *Speed.*

Operate the system, and check the value shown for *Applied Rate* at various *Speeds* and *Target or Manual Rates.*

In **Manual** mode, press the + or - button beside Target Rate to increase or decrease the rate.

You can change the Rate and/or Speed while the system is running by pressing the corresponding + or - buttons.

Sensor tab: Go here while the system is running to see the PWM Percent. In manual mode, the PWM Percent should increase and decrease while the (+) and (-) button is held down on the switch box.
In AUTO Mode, the PWM Percent should hold steady while the system is locked on to a rate.

The **Sensor** tab provides information on the Pressure Sensor and Pump Speed (PWM Percent). It is good to know the **PWM Percent** required for normal operation.
To enable the pump to get to the Target Rate faster when starting, set the **Minimum Response** (see Drive Calibration on page 60) close to what the PWM Percent is running at normal speed and application rate.

Troubleshooting

Pump Will Not Turn

Be sure the Implement Lift Switch is oriented correctly.

Turn hydraulics off, go to the SureFire PWM valve and use the manual override (red knob) on top of the electric coil to manually open the valve (Manual Override UP = valve fully open). (You may have to clean dirt out to move the manual override knob.) Start a Manual test to open the section valves. Turn hydraulics on **at a low flow only** as the valve is 100% open. If the pump does not turn, try hydraulic lever in opposite direction. Gradually increase the hydraulic flow. Does the pump turn? If it turns, your problem is electric / electronic. If the pump still does not turn, you have a hydraulic problem. .

Electric / Electronic Problem

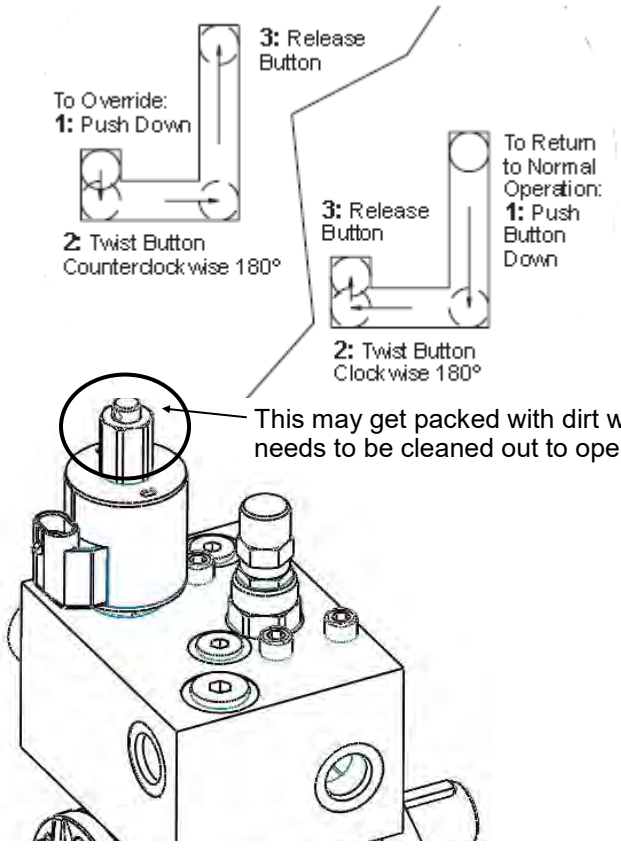
1. Close manual override (lock down).
2. Go to Diagnostics to investigate this issue.
3. Verify hydraulics are on.
4. Turn rate switch on Field-IQ switchbox to Manual. Turn master switch on. Open section valves with on-screen buttons.
5. Use Field-IQ increase/decrease to increase rate 25 times.
6. Take a metal object and hold it next to the coil. If the coil is working, you will feel the magnetic pull. The coil should also show 7 to 9 ohms between the two pins on the electrical connector to the coil.
7. If no magnetic force is felt, disconnect the PWM valve connector and check voltage. You will need 6-12 volts to get hydraulic valve to open. Go to Diagnostics > Sensors > PWM Percent to verify that a PWM signal is being sent from the controller. This should be more than 30% for system to run. Hold switch on switchbox to (+) to increase PWM %.
8. If 6-12 volts is not present, check harnesses and review control valve type setup.
9. Go back to the 30-pin connector at the Trimble Rate and Section Control Module. Check voltage between pins E1 & E2, should be between 6-12 volts while in section test after holding increase button.
10. If you cannot get voltage at pins E1 & E2, contact your Trimble dealer for further assistance.

Hydraulics Problem

1. Leave the manual override open on the SureFire valve.
2. Check the hose routings. The “P” port on the SureFire valve should hook to pressure. The “T” port is the return that should flow back to the tractor.
3. Try hoses in a different hydraulic remote. Inspect hydraulic connectors for damage or restrictions.

Hydraulic Manual Override

Down - Normal Operation
Up - Override, valve 100% open



Troubleshooting

Section Valve(s) will not move

1. Go to Diagnostics, to investigate this issue.
2. In Diagnostics, check and uncheck the section valve on-screen buttons. Indicator should turn green when section is activated.
3. Do you have a problem with 1 valve or all valves? Even-numbered sections have a different power source than the odd-numbered sections.
4. If working with the 7-12 section harness, identify if section 1-6 or section 7-12 as a group are not working.

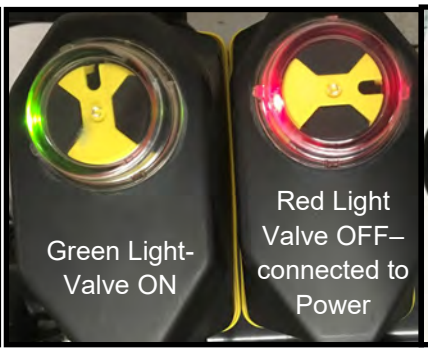
If Valve doesn't work:

1. Check the harness connection to that valve. It is a 3-pin Weather Pack connector.
2. Switch a valve or connector with one that is working to help diagnose where the problem is.
3. Check voltage pin A to Pin B. Must be 12 volts, if not, go back to 14-pin & 30- pin connector and check voltage. See Section D for wiring diagrams.

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

4. 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.
5. If signal voltage is not present to open valve, use diagrams to check at the 14-pin , then the 30-pin for voltage.
6. If no signal voltage on 30-pin connector from Trimble Control Module, contact your Trimble dealer for assistance.
7. If constant voltage (Pins A&B) and switched voltage (Pins C&B) are present, inspect, repair or replace the valve.

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



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

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

⚠ CAUTION

These pumps can deliver liquid at high pressure (290 PSI). Be sure the 100 PSI Pressure Relief Valve (PRV) is installed and functioning so system pressure will be kept under 100 PSI. Check hoses, hose clamps, and liquid fittings regularly and repair or replace loose connections.

Troubleshooting

G
Trouble-shooting

Application Rate Fluctuates

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.

You need to determine if the fluctuation is caused by the controller sending fluctuating signals to the valve.

OR

1. Go to the Diagnostics screen.
2. Turn the system on in Manual mode and 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 12-16 GPM is a problem. If only a small normal fluctuation is seen, skip steps 4-8 and proceed to "Application Rate Fluctuates in Field …….. " below.
4. If there is a large fluctuation, observe the system flow. Is the discharge a steady stream; are the flow indicator balls floating steady?
5. If visually the flow is steady, but the display reports a fluctuation in GPM, inspect the flowmeter. See section B for flowmeter information.
6. If visually the flow is unsteady, the flowmeter is working correctly reporting a flow problem. Is the pump turning steady or surging? If the pump is surging reduce the PWM gain in controller settings.
7. Look for any type of obstruction in the pump inlet. Clean the strainer. If continually plugging the strainer investigate fertilizer quality and necessary strainer size.

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

This problem indicates the PWM gain needs changed. The system is surging because the Control Module is "hunting" for the correct flow.

1. Go to Field-IQ > Calibration > Drive Calibration.
2. Change the settings by reducing the Proportional gain. (Older software may use Integral Gain)

Application Rate is slow to get to the Target Rate

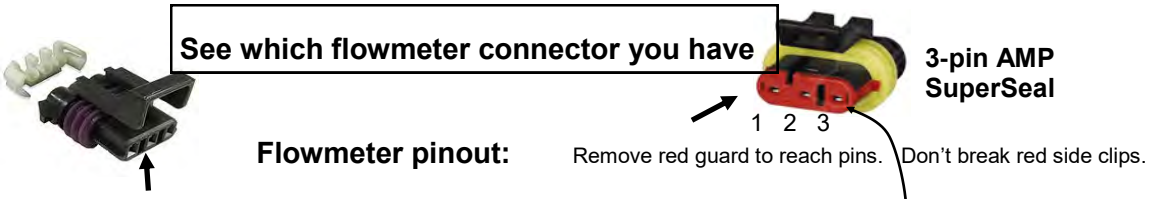
1. You may need to increase the valve calibration. Go to Field-IQ > Calibration > Drive Calibration.
2. Change the settings by increasing the Proportional gain. (Older software may use Integral Gain)
3. At Field-IQ, Diagnostics, make sure the Aggressiveness is at 100% or more.
4. If system is slow getting to Target Rate on startup after doing the steps above, set the **Minimum Response** to a higher number (see page 60) and turn **Boost (Feed Forward) ON.** Another option to get to Target Rate quicker on startup on a system with section valves is to add an additional Aux Dump valve that is plumbed to return flow to the tank and setting the PWM valve to Lock in Last Position (see Drive Setup on page 60).

No Flow shown on display but liquid is being pumped

1. Unplug flowmeter. With voltmeter, check for 12 volts between pins 1&2 of flowmeter connector. If 12 volts not present, inspect wiring harness and troubleshoot all connections per schematic (see Section D).
2. If 12 volts is present, then conduct a tap test. Go to setup and change the flow cal to 1. Have a second person watch GPM on the display while other person taps (use a short piece of wire or a paper clip) between pins 1&3 of flowmeter connector . A flow value should show up indicating the wiring is not damaged.
3. If flow display responded to the tap test, your wiring to that point is good. If still not fixed, inspect adapter harness and test continuity per schematic (see Section D).
4. Sometimes, running a soft brush through the inner tube of the flowmeter will clean the electrodes.
5. Replace flowmeter.

No Flow shown on display, but liquid is being pumped

Flowmeter Tap Test



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.
2. If 12 volts is present, then conduct a **tap test**. Have a second person watch Flow on the Liquid Diagnostics > screen (see next page) while other person taps repeatedly (use a short piece of wire or a paper clip) between signal and ground pins of flowmeter connector. The tapping should show a small number on the Flow Meter Signal Frequency and the Flow Meter Pulse count should increase indicating the wiring is OK.
3. If the display responded to 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. SureFire has a Speed/Flow Simulator (PN 219-01462) or a Tap Tester (212-03-3912Y1) that can be used to confirm if the wiring is good between the flowmeter and controller.

Field Verification of Flowmeter Calibration

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

In general:

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

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

Formula to Adjust Flow Cal Number

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

Example: Display shows 727 gallons was applied. Weigh ticket shows 749 gallons was actually applied. Flow cal number in display was 3000. *(We applied too much, so we will decrease the flow cal.)*

727 / 749 X 3000 = 2912 (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 doing any welding on the implement.

Recommended Care and Maintenance

H
Maintenance & Parts

Air Bladder

PumpRight pumps have an air bladder to smooth the pump output flow. It is recommended to run this bladder at 20% of working pressure. So if your system operates at 50 psi, charge the air bladder to 10 psi. Due to the small size of the air bladder, **very little air is needed**. SureFire recommends charging a portable air tank to the correct pressure, then attach to the bladder valve to charge the air bladder to the same pressure as your air tank.

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.

Change Pump Oil Annually

PumpRight pumps use an internal oil lubricated crankshaft and connecting rod design. The oil is held in an external reservoir with level indicators. Hypro oil is recommended for the pump. This is a non-detergent SAE30 weight oil. If not available, hydraulic jack oils are a similar non-detergent formulation. Annual oil changes are recommended.

To fill or drain the pump completely, the pump shaft must be turned slowly by hand. The hydraulic motor will have to be removed to do this.

On some pump models, the pump will have to be removed from the mounting bracket and lifted slightly to allow access to the oil plug.

When refilling the pump with oil, the shaft will again have to be rotated to fill the pump to its required oil volume.

CRANKCASE OIL CAPACITIES				
Model	Capacity		Model	Capacity
PR17	13 oz		PR40	56 oz
PR30	28 0z		D250	98 oz

Diaphragm & Valve Replacement

PumpRight pumps are designed to allow very simple replacement of the two main pumping components; the diaphragms and the inlet & outlet valves. It is a good practice to replace these every 3 or 4 years, depending on usage. It is a small job that helps ensure reliable operation during the busy season.

Pre-season Service for PumpRight (Hydraulic Pump) Systems

(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. 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 all power cables / connectors beginning at the battery. Verify voltage at LPCM and to SureFire Adapter harness (3764).
4. Check the flow indicators for cracks and clarity. They can become weathered and difficult to see through.
5. Change the pump oil annually. Use SAE 30 Non-Detergent Oil. SureFire has Hypro Oil specifically for these pumps.
6. On the display, recheck all setup screens (see Section F of the manual) 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. ***Clean out the dirt that may be packed into the manual override knob on the hydraulic valve block.*** May need to use a spray like WD-40 or compressed air to get the dirt out. You should be able to push down and rotate the knob a half turn counterclockwise, and have it pop up (to open the manual override) and then be able to push it down and turn it a half turn clockwise to lock it in operating position. If the stem is packed full of dirt, forcing the knob to turn with a pliers can break the stem. When the knob has been pushed down and rotated counterclockwise, there should be about ¼" movement in the stem with heavy spring tension.
9. If necessary, run pump in manual override mode to check hydraulic setup. This involves turning the hydraulic flow to 1, popping up the manual override knob, starting a Manual Test to open the section valves, and then turning on the hydraulic flow. The pump will be controlled by adjusting the hydraulic flow.
10. Fill system with water and run in Manual mode to verify components and system are in working order. (May need to open air bleed valve to prime pump the first time. Be sure 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 Low Limit that generally work for nearly all systems. It is possible to fine-tune those settings. The Zero Flow Offset 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 Zero Flow Offset can be increased. This is particularly helpful 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 it is too high, there could be over-application at those times that lower output is needed (such as with only one section on). Some operators 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.

a. This is a good time to check out the Diagnostics > Sensors screen. This is a screen that every tech and every user should regularly check.

b. On the Liquid Diagnostics screen, check out the flowmeter operation at Current Flow.

c. Check out the PWM Duty Cycle. On an Auto Test or while operating in the field at a steady speed, this should also be steady (±2). If this is bouncing around more, lower the PWM Proportional Gain. 8 is our starting point on the Proportional Gain for a hydraulic pump.

11. 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.
12. 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.
13. 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.
14. Remove and clean the strainer. Be sure strainer is tightened securely so it will not suck air. Check the housing for cracks.
15. Run system with a simulated speed and rate to be used in the field.
16. 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.)
17. While the test is running, go to Diagnostics > Sensors screen and look at Pressure and PWM Duty Cycle.
18. Verify that all sections open and close (and in the correct order) with the switches in a Manual test.
19. LiquiShift valves will not open until there is a PWM signal. This can be done with a Manual test or Auto Test.
20. 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.

Techs and end users should be familiar with the SureFire Ag website where manuals and documentation are available for download.

http:/www.surefireag.com/support

PumpRight Valves & Diaphragms for D– pumps

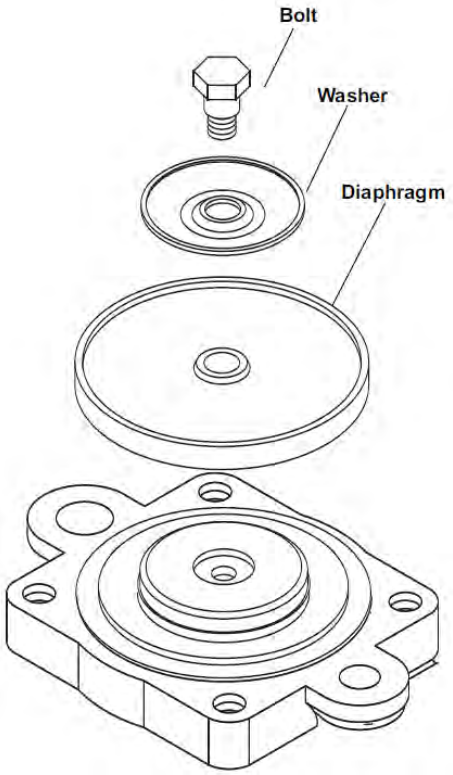
All PumpRight D-models use the same diaphragm and valve parts.

Diaphragm Pump Service Kit Item Number 291-02-100500

1 Kit contains 1 diaphragm and 2 valves to service a single pumping diaphragm. Order multiple kits to service all the diaphragms in your pump per chart at right.

Qty in Kit	Part Number (all begin 291-02-9910-xxxxxx)	Description
1	550085	Diaphragm (Desmopan)
2	320030	O-Ring
2	759051	Valve Assembly

	Number of Diaphragms
D70	2
D115	3
D160	4
D250	6

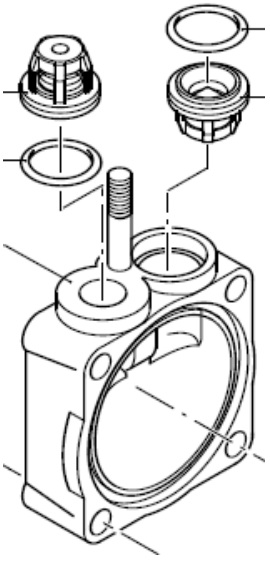


Diaphragm & Valve Service Steps:

1. Remove inlet and outlet plumbing connections by unscrewing ring nut on inlet and outlet fitting.
2. Use extreme caution when removing and replacing drain plug, so that threads are not stripped and o-ring is not damaged. Remove drain plug from bottom of pump to drain oil from pump. Rotate pump shaft to remove all oil. Replace drain plug making sure o-ring is in place. Tighten plug to 171.4 In.Lbs.
3. Remove pump manifold(s) using a 17mm or 13 mm wrench.

D70	1 manifold	2 x 17 mm nuts (on top)
D115	1 manifold	3 x 17 mm nuts (on side)
D160	2 manifolds	Each manifold has 4 sets of 2 x 13 mm nuts
D 250	2 manifolds	Each manifold has 6 sets of 2 x 13 mm nuts

4. Remove and replace complete valve assembly.
5. Remove the pump head.
6. Remove the diaphragm bolt, support washer and diaphragm. Turn the pump shaft to up stroke to replace diaphragm.
7. Install new diaphragm (LIQUID side up), then replace washer and bolt.
8. Turn pump to downstroke to seat new diaphragm into the sleeve groove.
9. Replace pump head and manifold(s).
10. Refill crankcase with SAE30 non detergent oil (PumpRight Oil or hydraulic jack oil). Turn pump shaft and top off sight glass with oil.



D70 - D115 Valves are on same side of head. Valves should pop out with slight screwdriver pressure.

D160 - D250 Valves (not shown) are arranged on opposite sides of head.

Other Service Parts D70, D115, D160, D250

Part Number (all begin 291-02-9910-xxxxxx)	Description
550080	Diaphragm (Buna, Optional)
550190	Accumulator Diaphragm

PumpRight Valves & Diaphragms

Diaphragm Pump Service Kits

1 Kit contains 1 diaphragm and 2 valves to service a single pumping diaphragm.

Order multiple kits to service all the diaphragms in your specific pump per chart below...

Visit www.surefireag.com or www.support.surefireag.com for PumpRight Diaphragm Pump Repair and Maintenance Video

QTY in Kit	Part Number	Description
PR17 Pump Service Kit - 3 Diaphragm		
KIT #: 291-13-100100 (pump requires 3 kits)		
1	291-13-1040083	BlueFlex Diaphragm (PR17)
2	291-13-2429051	Valve
2	291-13-3460380	Gasket/O-ring

PR30 Pump Service Kit - 3 Diaphragm		
KIT #: 291-13-100150 (pump requires 3 kits)		
1	291-13-550081	BlueFlex Diaphragm
2	291-13-2429051	Valve
2	291-13-3460380	Gasket/O-ring

PR40 Pump Service Kit - 4 Diaphragm		
KIT #: 291-13-100150 (pump requires 4 kits)		
1	291-13-550081	BlueFlex Diaphragm
2	291-13-2429051	Valve
2	291-13-3460380	Gasket/O-ring

D250 Pump Service Kit - 6 Diaphragm		
KIT #: 291-13-100200 (pump requires 6 kits)		
1	291-13-550081	BlueFlex Diaphragm
2	291-02-9910-759051	Valve
2	291-02-680070	Gasket/O-ring

For other service parts, see individual Pump Part Breakout Diagrams in 396-4034Y1, the PumpRight manual that came with your pump.

Also see the manual and individual pump parts breakouts online here. (store.surefireag.com)

PumpRight Valves & Diaphragms

Diaphragm Pump Service Kit Replacement Instructions for PR Pumps

Visit www.surefireag.com for PumpRight Diaphragm Pump Repair and Maintenance Video or support.surefireag.com

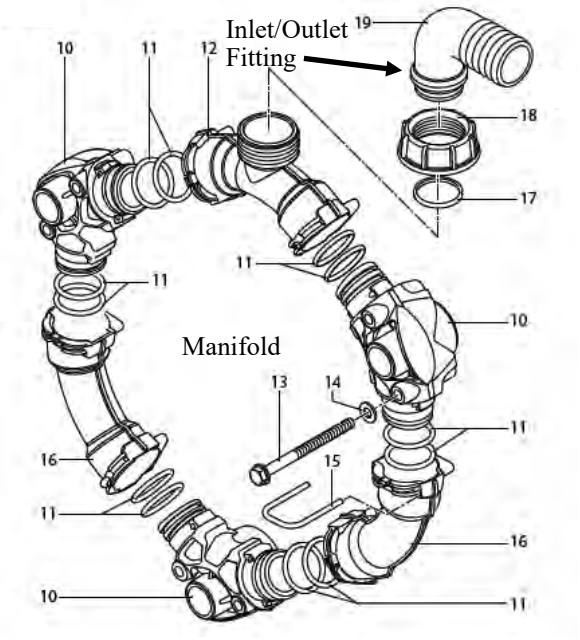
	Number of Diaphragms
PR17	3
PR30	3
PR40	4
D250	6

Diaphragm & Valve Service Steps:

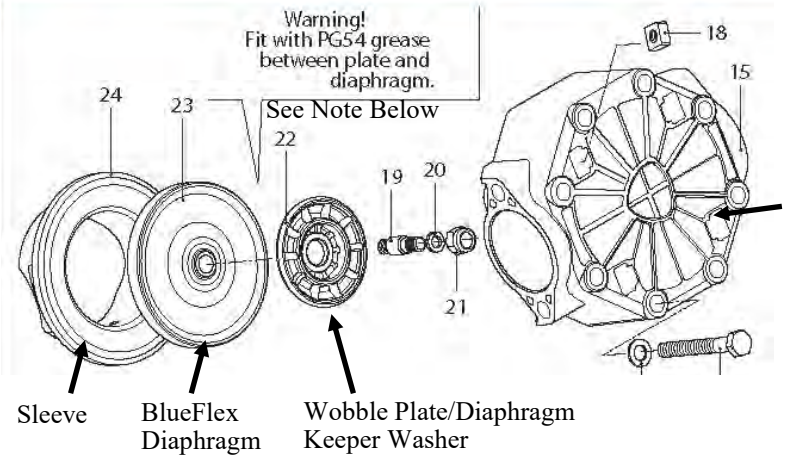
1. Remove inlet and outlet plumbing connections by unscrewing ring nut on inlet and outlet fitting.
2. Use extreme caution when removing and replacing drain plug, so that threads are not stripped and o-ring is not damaged. Remove drain plug from bottom of pump to drain oil from pump. Rotate pump shaft to remove all oil. Replace drain plug making sure o-ring is in place. Tighten plug to 180 In.Lbs.
3. Remove pump manifold(s) using a 13 mm wrench.
4. Remove and replace complete valve assembly.
5. Remove the pump head.
6. Remove the diaphragm bolt, support washer and diaphragm. Turn the pump shaft to up stroke to replace diaphragm.
7. Install new diaphragm (LIQUID side up), then replace washer and bolt.
8. Turn pump to downstroke to seat new diaphragm into the sleeve groove.
9. Replace pump head and manifold(s).
10. Refill crankcase with SAE30 non detergent oil (PumpRight Oil or hydraulic jack oil). Turn the pump shaft and top off sight glass.

NOTE: See individual Part Breakout Charts for Bolt/Nut Torque Specs.

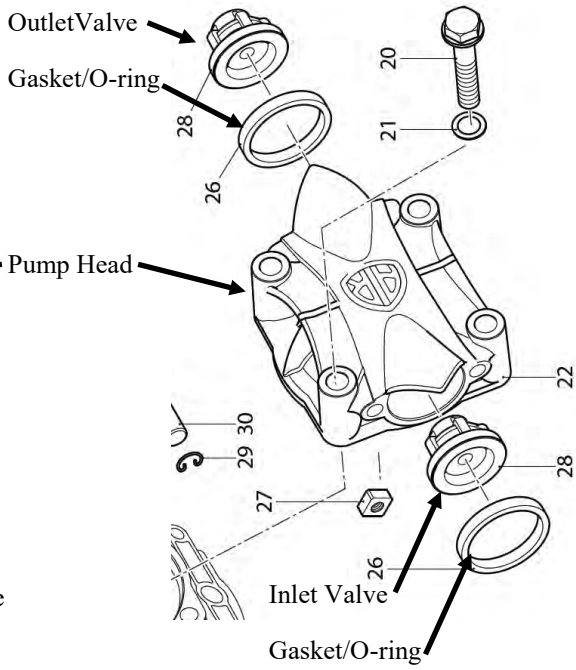
Typical Manifold—2 per pump—inlet and outlet



Typical Diaphragm Assembly



Typical Valve Assembly



NOTE: A multipurpose grease is fine to use for applying in between the Diaphragm and Wobble Plate/Washer

For other pump service parts, see individual Pump Part Breakout Diagrams in 396-4034Y1, the PumpRight manual that came with your pump.

Also see the manual and individual pump parts breakouts online here. (store.surefireag.com)

Go to support.surefireag.com for pump information and parts breakdowns.

Hydraulic oil under extremely high pressure. Do not use hand or any other skin to check for or to stop hydraulic leaks. Be sure pressure is relieved before loosening hydraulic fittings. Replace worn hoses immediately. Seek medical care immediately if hydraulic oil is shot into the eye or the skin.

PWM Valve and Motor Parts

164-FTA0994 4.0 CID motor (this is the standard motor beginning in 2016)

164-FTA1609 Same as 164-FTA0994, but with RPM Speed Sensor--
Field-IQ does not support a Pump RPM sensor.