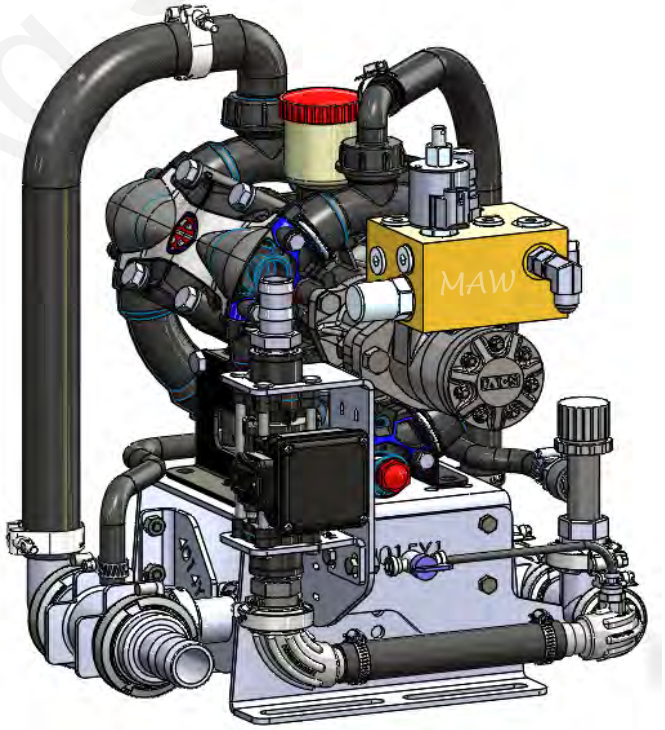
396-001460

PumpRight Fertilizer System and SureFire Commander II with PWM Control

SureFire Ag Systems

PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS



	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

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General Description

A
Introduction

You have purchased a SureFire fertilizer system for your equipment. This system will be controlled by your SureFire Commander II. The Commander II will adjust the speed of the SureFire PumpRight based on feedback from the flowmeter and vehicle speed.

The SureFire PumpRight Fertilizer system can be customized to meet the unique liquid application requirements of many producers. **Your system will not have every single component covered in this manual.**

Basic Installation Steps

1. Open the packages and familiarize yourself with the components. See the System Overview Example on the following page to see the big picture of how SureFire Fertilizer Systems are installed. Refer to manual sections B & D for component information.

2. Mount the PumpRight pump and make hydraulic connections. See section E for hydraulic plumbing information.

3. Plumb the tank to the PumpRight inlet. See section E for details.

4. 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.

5. Attach the flowmeter outlet to section valve or manifold inlet. Attach section valve outlets to flow indicator inlets.

6. Attach harnesses as shown in Section D.

7. Setup SureFire Commander II for PumpRight fertilizer system as shown in Section F.

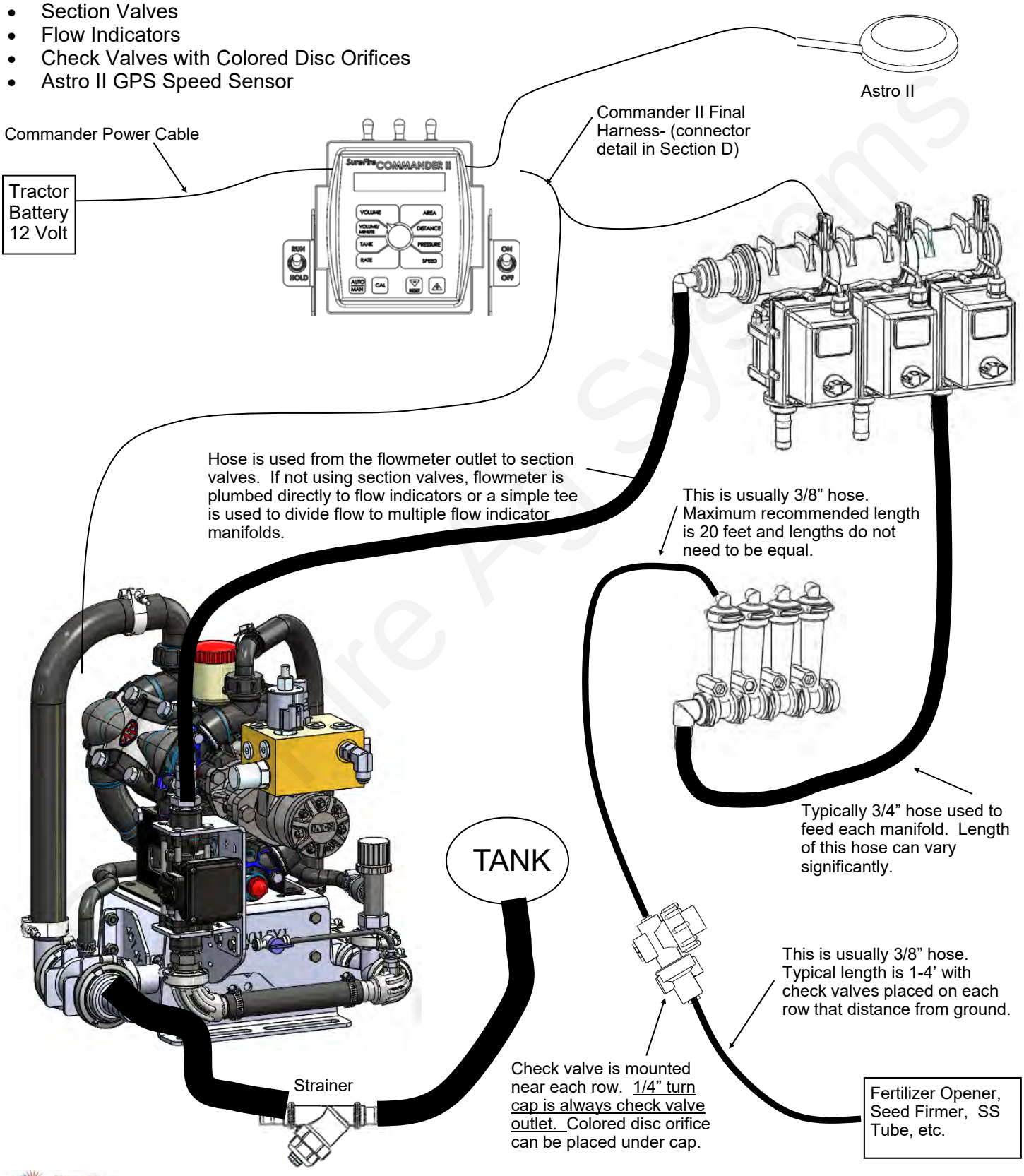
8. Fill system with water, conduct initial operation and tests per Section F.

9. Winterize system with RV Antifreeze if freezing temperatures are expected.

System Overview - Example 1

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

- Commander II
- PumpRight PR30
- Section Valves
- Flow Indicators
- Check Valves with Colored Disc Orifices
- Astro II GPS Speed Sensor



PR17 & PR30 Electromagnetic Flowmeter Kits

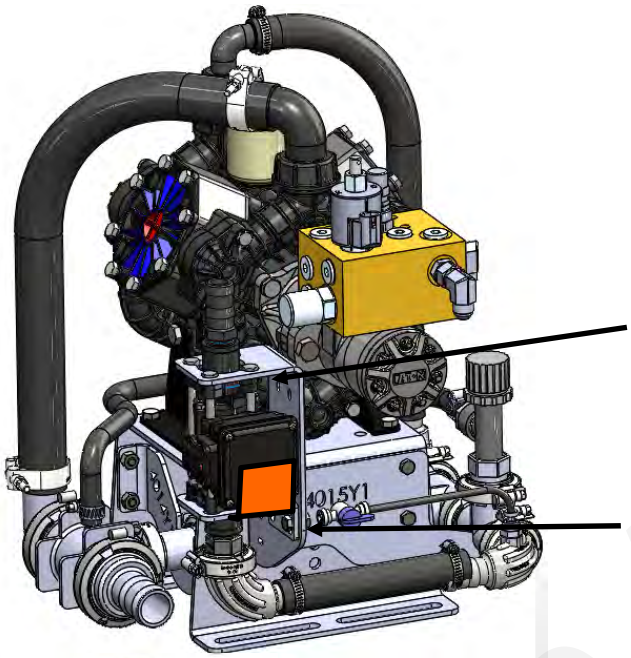
0.13 - 2.6 GPM Item Number 500-02-2082 (PR17)
0.3 - 5 GPM Item Number 500-02-2085 (PR17)
0.6 - 13 GPM Item Number 500-02-2090 (PR17 & PR30)
1.3 - 26 GPM Item Number 500-02-2095 (PR30)

B
Components
Liquid

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.

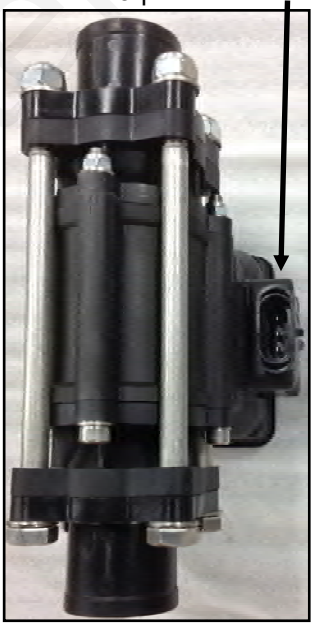
-Do not power wash the flowmeter. High pressure spray directed at the back edge of the face plate or at the wire connector may allow water into the flowmeter electronics.



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:

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**
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"

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.

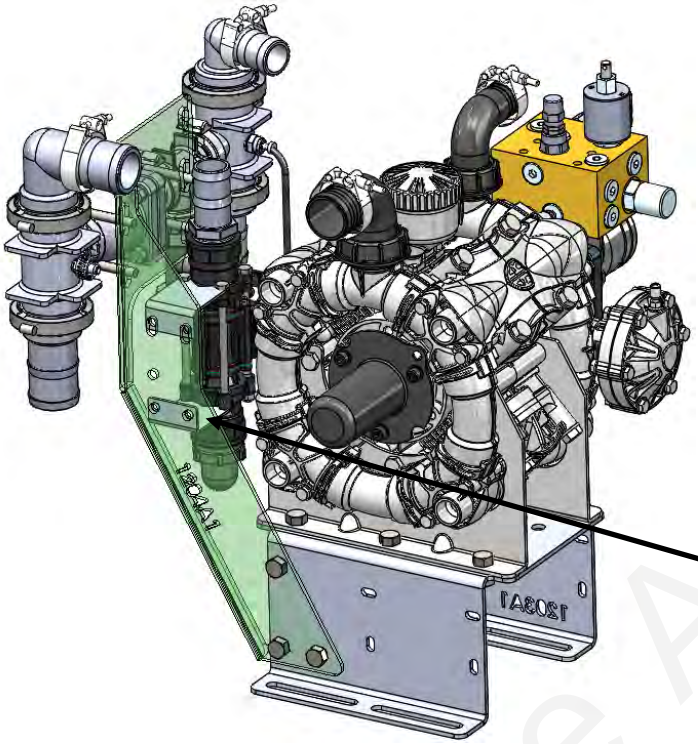
PR40 & D250 Electromagnetic Flowmeter Kit

2.6 - 53 GPM Item Number 500-02-2080

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

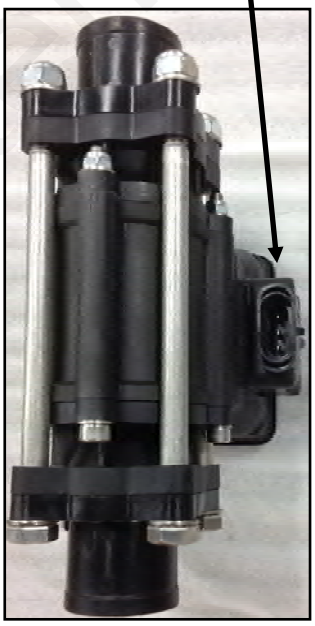
B
Components Liquid

-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



Troubleshooting Tip:

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

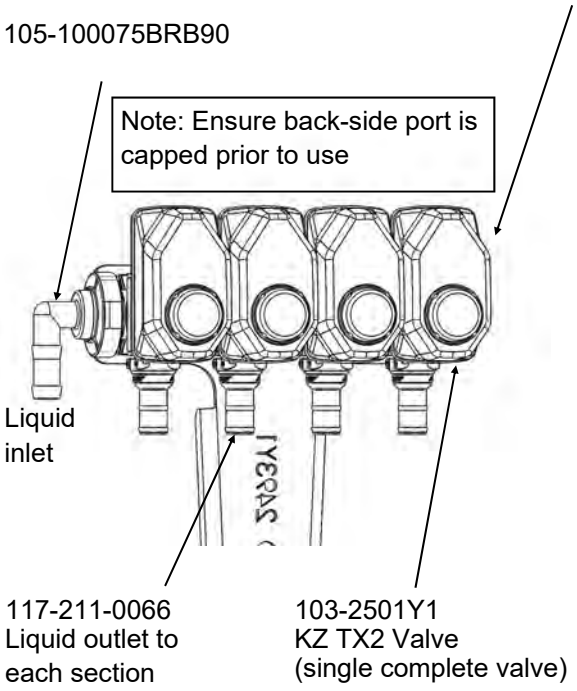
Flowmeter Model (black meter with orange label)	JDRC 2000 Flow Calibration	FPT Size	Hose Barb In kit
2.6—53 GPM	2000	1-1/4"	1-1/2"
1.3—26 GPM	2000	1"	1"

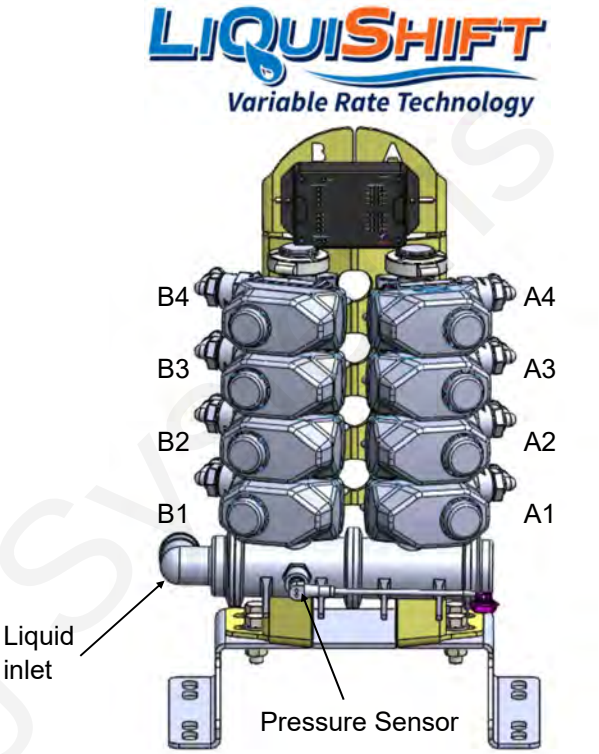
Earlier model flowmeters (meters with white labels with black text) have different calibration numbers. See the documentation for those meters to find the calibration numbers.

Section Valves and LiquiShift Valves

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

105-100075BRB90





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 section 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 variable rate between different fields. Each section has an A and B valve that are opened based on the section status, current rate and system pressure. Therefore, a 4– section LiquiShift (shown above) will have 8 total valves.

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

LiquiShift systems are available with systems from 1-8 sections.

On the JDRC 2000, LiquiShift systems connect to the JDRC 2000 Adapter Harness with a 14-pin round connector. Typically this connector would be for Sections 1-6 (product 1) or Sections 7-12 (product 2). Your system may vary so check the specific instructions with our JDRC 2000 adapter harness.

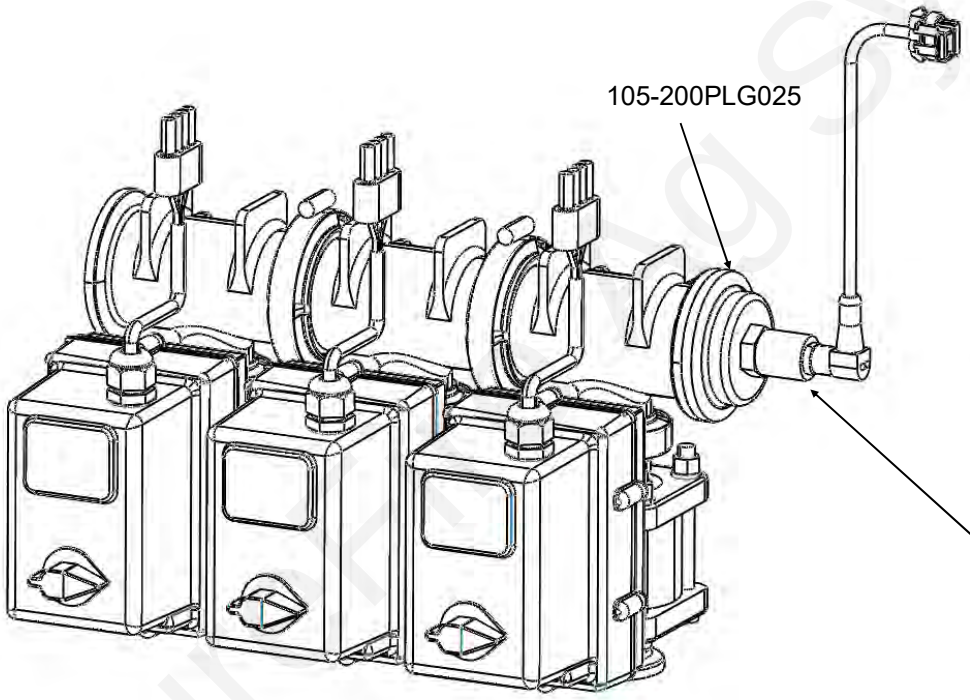
Pressure Sensor
2 Wire Sensor with 2” Manifold x 1/4” MPT Fitting
Item Number 520-00-055150

The Commander II has the ability to display fertilizer system pressure on the in-cab display. This sensor is most often mounted on electric section valves when used in PumpRight systems. The pressure sensor is a 2 wire type sensor for compatibility with the Commander II. The sensor has a 1/4” MPT fitting.

The Commander II 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 Commander II. No manual gauge is required.



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.

B
Components
Liquid

Why use an air bleed valve:

Most fertilizer systems are equipped with a 4 lb or 10 lb check valve on the end of each hose delivering fertilizer to the ground. These valves do not let air escape from the system, unless it is pressurized. 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.

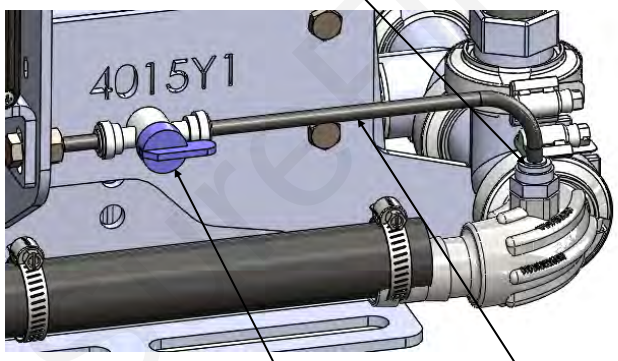
The air bleed valve is a small 1/4" valve that when opened lets air escape from the pump outlet at zero pressure. Open until liquid comes out and then close the valve.
Be sure the air bleed valve tube does not become plugged with dirt or it will not allow air to bleed.

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

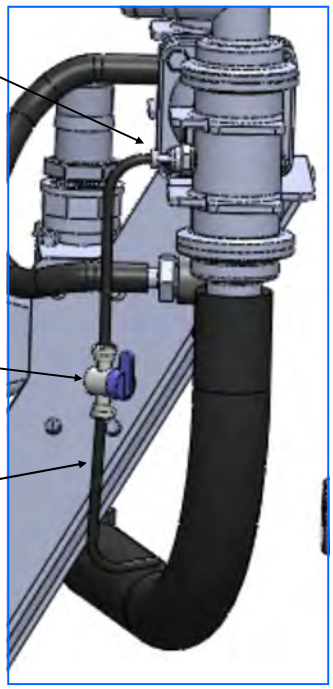


1/4" air bleed valve

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 assembly.

B
Components
Liquid

How Recirculation Works:

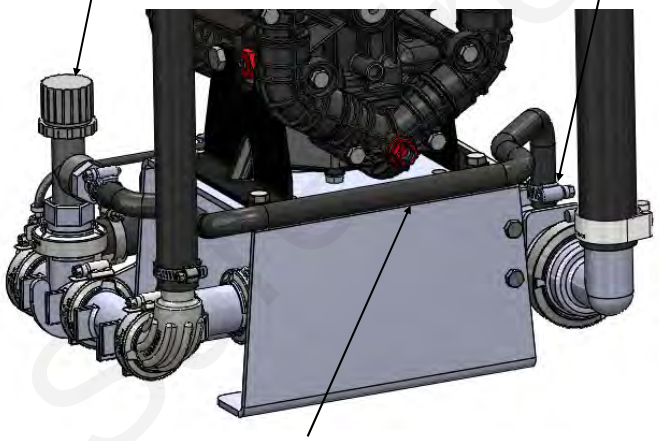
When running a PumpRight pump at less than 20% of it's maximum flow, it sometimes improves system stability to allow the pump to run faster. Opening the recirculation valve diverts some pump flow before the flowmeter, causing the pump to run faster. The application rate is still measured by the flowmeter 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 slowly until the pump runs smoothly. It may take only a 1/4 turn (or less). 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

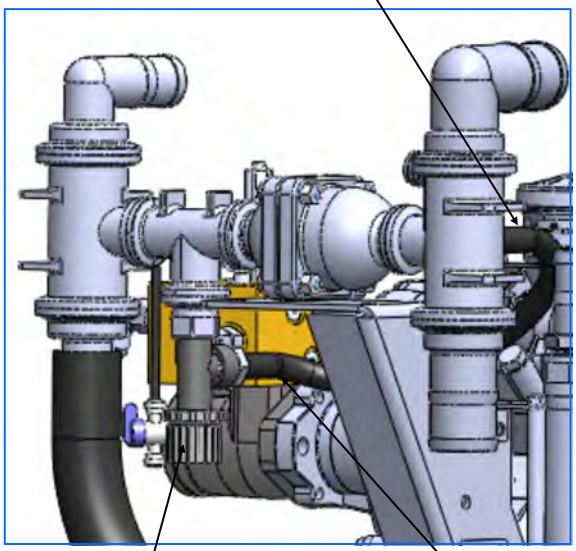
Recirculation Regulation Valve, 102-23520-3/4
Start with a quarter to a half turn.



1/2" recirculation hose

PR40 & D250

Recirculation hose attaches to back of 2" x 1" tee on pump inlet



Recirculation Regulation Valve, 102-23520-3/4

1/2" recirculation hose

Product Distribution

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

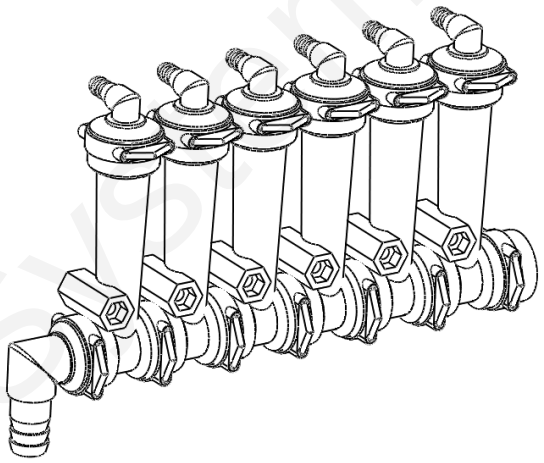
1. A metering orifice may be placed in the top cap of each floating ball flow indicator. (See photos on page 12.) This is not used very often.
2. A metering orifice may be placed in the check valve cap in the line that leads to each row. (See photo on page 14.)
3. A dual metering tube kit with dual check valves may be used. (See pages 18-21.)

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
701-20460-960	Single Full Flow Column with 1/4" FPT - 90 Degree Outlet
701-20460-970	Single Low Flow Column with 1/4" QC - 90 Degree Outlet
701-20460-980	Single Full Flow Column with 3/8" QC - 90 Degree Outlet
701-20460-990	Single Full Flow Column with 1/2" HB - 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

701-20460-00	Full Flow Column
701-20470-00	Low Flow Column
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

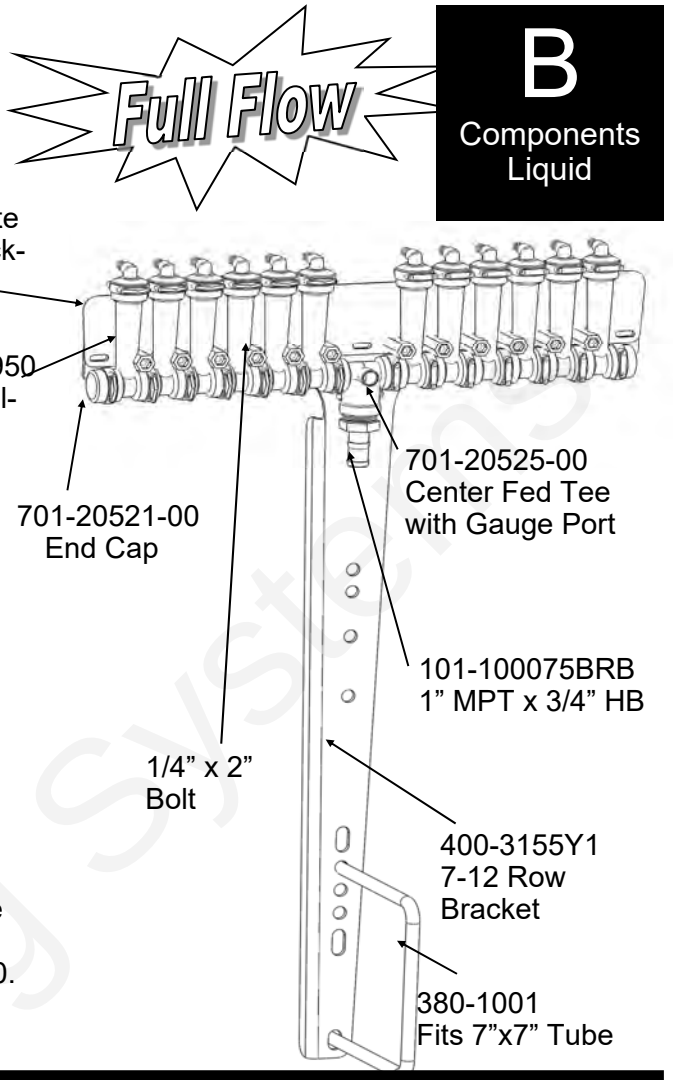
Brackets & U-Bolts

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”)

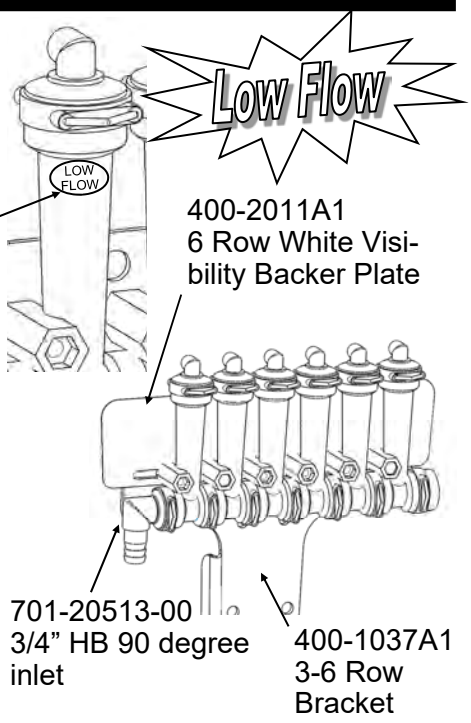
* SureFire recommends using the low flow column for these flow rates.
Plastic balls may float on heavier fertilizers, such as 10-34-0.

Low Flow Column (mostly 1/4” QC)

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

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

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



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

Column Flow (GPM): .03-.30 GPM
*** Low Flow Column with 3/8” hose barb .03 - .70 GPM

Equivalent Application Rate
On 30” Rows at 6 MPH (1/4” QC): 1-10 GPA

Ball Selection for 30” Rows

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

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

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

See www.surefireag.com for other row spacings

30” Spacing

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

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):

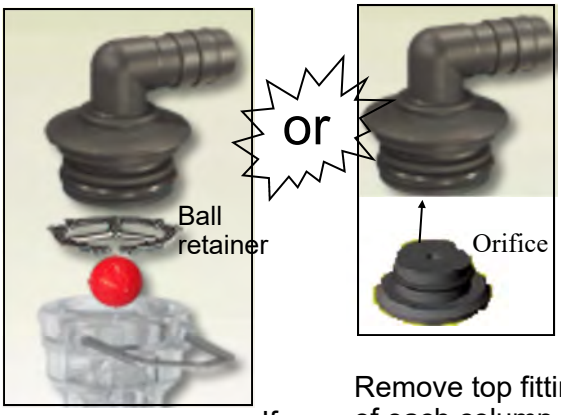
- Minimum 20 PSI
- Maximum 80 PSI

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.

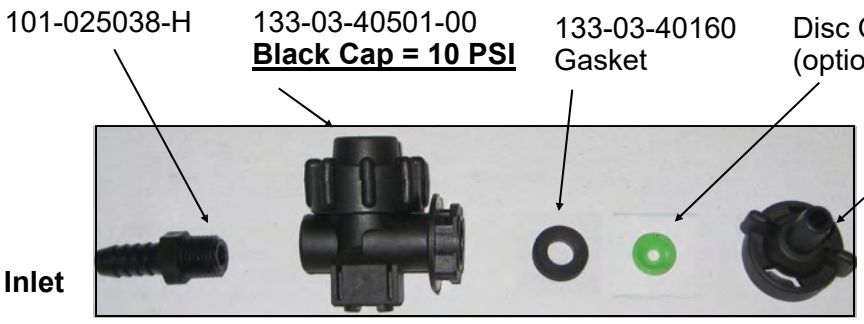
Remove top fitting of each column. Then push metering orifice into bottom of each outlet fitting.

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.

Complete Assembly
PN 136-10-06HB06HB



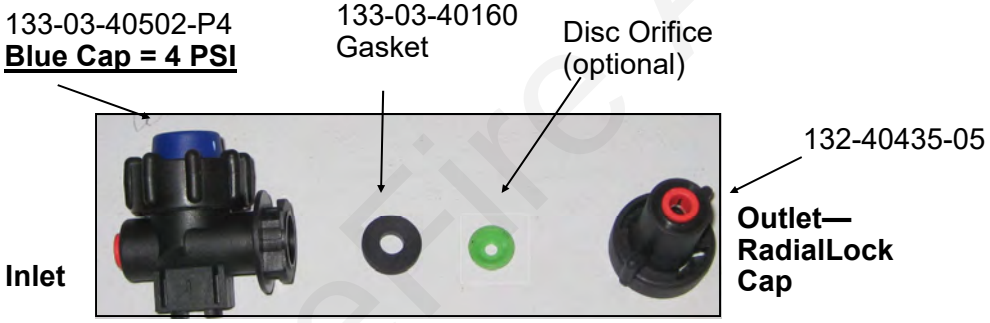
FLOW →

PumpRight

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.

Complete Assembly
PN 136-04-04QC04QC



FLOW →

Tower

Special Purpose Check Valve Assemblies

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

Colored Disc Orifice Chart for 30” rows

30” Spacing

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

PumpRight Pressure Recommendations (with 10 lb check valves):

- Minimum 20 PSI
- Maximum 80 PSI

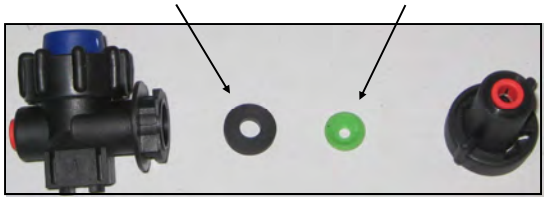
Tower Electric Pump Pressure Recommendations (with 4 lb check valves):

- 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	78	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, go to http://www.surefireag.com/cms/images/Metering-Tube-Maze_Reduced.pdf (Underscore before Reduced)

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).

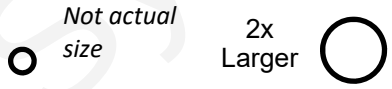
These instructions will show you where all the pieces go. It will provide guidance on how much metering tube to use. There are some optional fittings included in each plumbing kit. These instructions will show you where and why you'd want to use the optional pieces.

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.

Dual Advantage of Dual Metering Tube

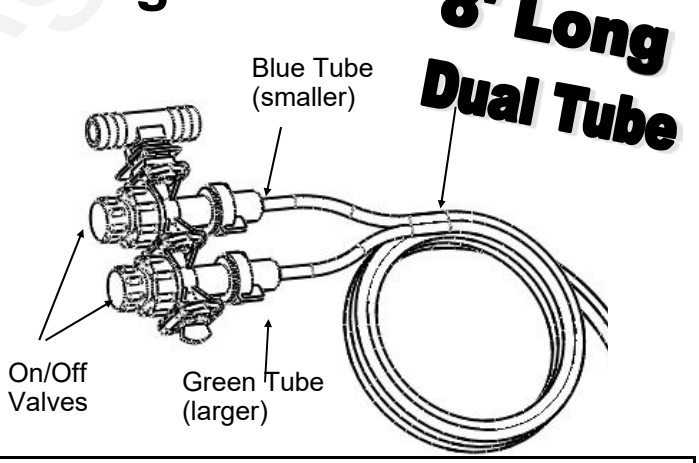
Metering tube provides a larger passage way diameter than a comparable orifice. For a 5 GPA rate on 30" rows, a size 0.046" orifice would be used. For the same rate a 0.110" meter tube that is 8' long would be used. This 8' tube with more than twice the diameter creates a fertilizer system resistant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

By using two metering tubes, the fertilizer system can handle Black Label ZN 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**

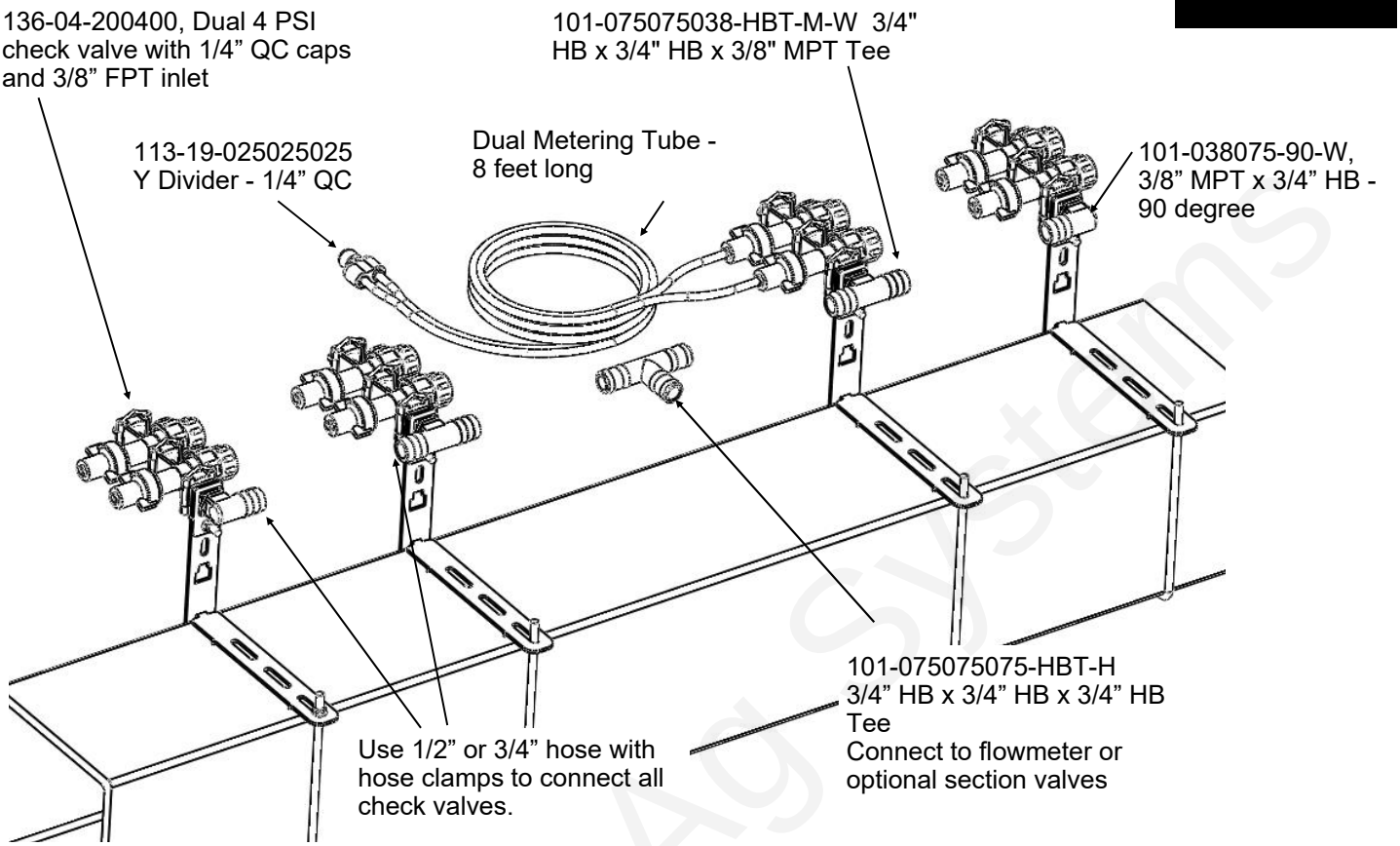
	GPA on 30" rows (approx, will vary)
Blue Tube	1.5 - 3
Green Tube	3 - 6
Blue & Green Tube	6 - 10
Minimum Recommended flow for Blue Tube (8 ft)	4 - 5 oz/min

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

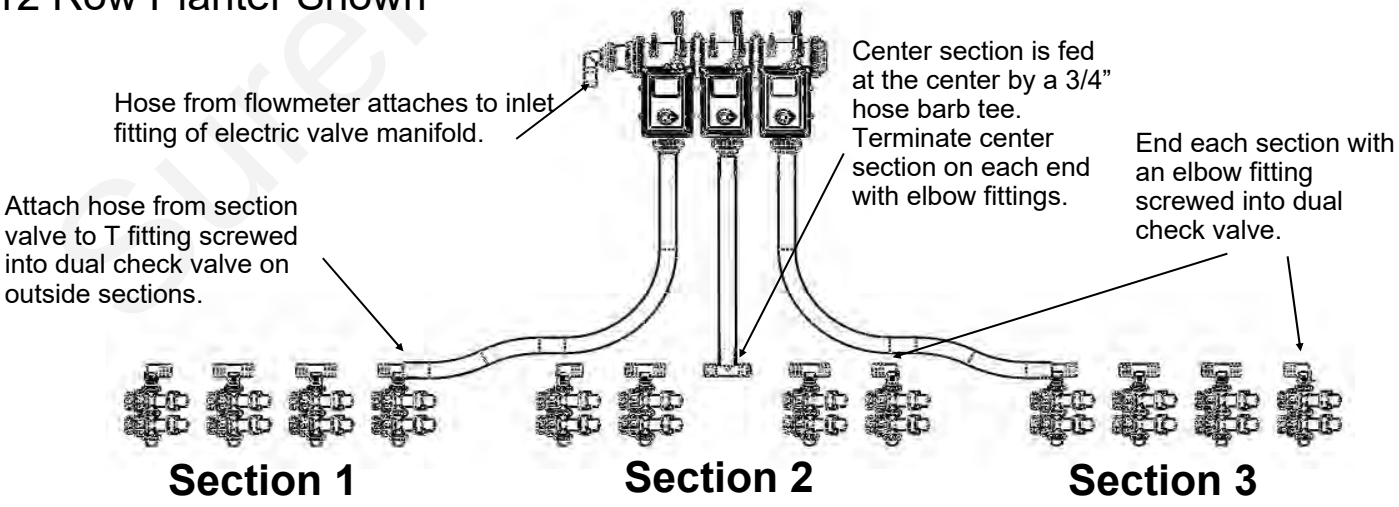
4 Row Planter Shown, add rows as necessary



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

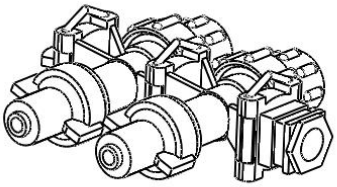


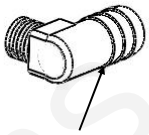
For a **2 section plumbing system**, omit the center section and plumb similar to the outside 2 sections.

Dual Check Valve Assembly Steps

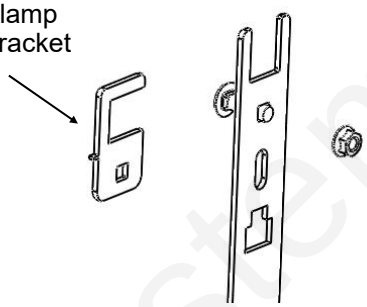
Follow these steps to mount each check valve to the steel bracket.

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.



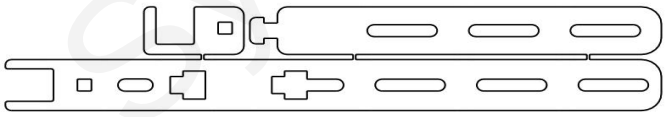


Clamp Bracket



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

400-1966A1 Dual Check Valve Mount Bracket

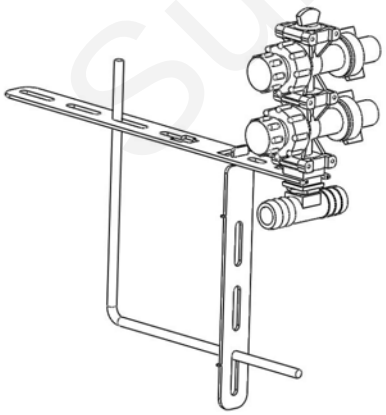


The long, short & clamp bracket come as one part connected by break-off tabs.

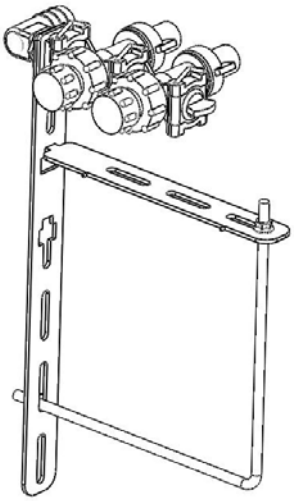
Check Valve Mounting Options

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

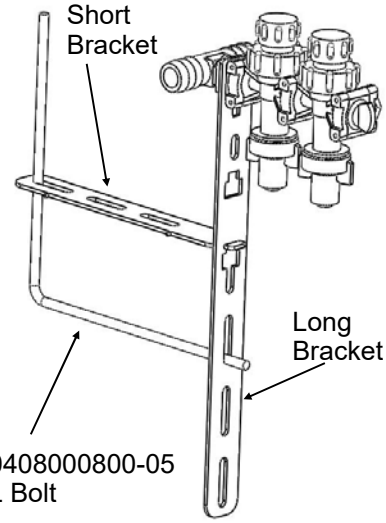
Example 1. Use the long bracket on the top of a bar. The check valve is mounted vertically. The liquid supply hose is ran directly on the front side of the bar. The U-bolt is placed in slots to clamp on a 4x6 inch tube.



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



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



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

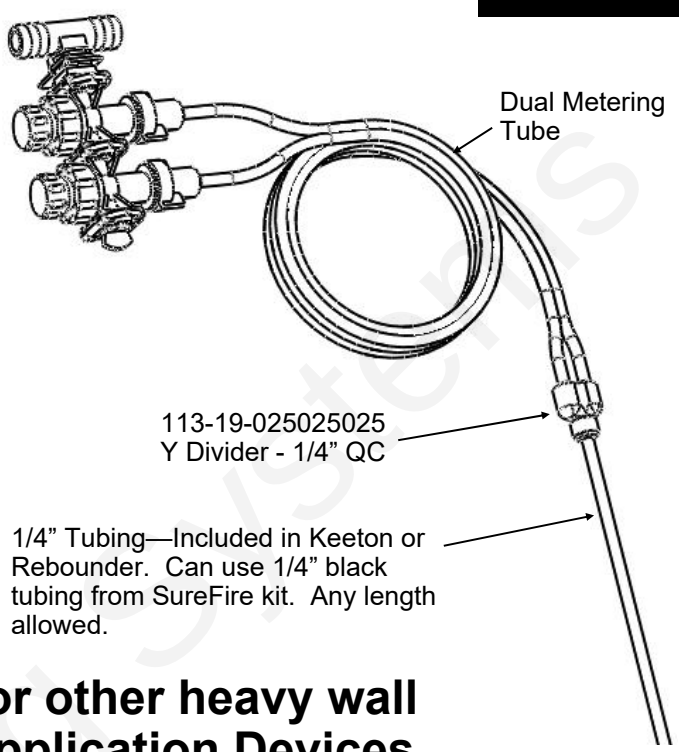
B
Components
Liquid

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>.

For more information on metering tube, go to

http://www.surefireag.com/cms/images/Metering-Tube-Maze_Reduced.pdf (underscore before Reduced)

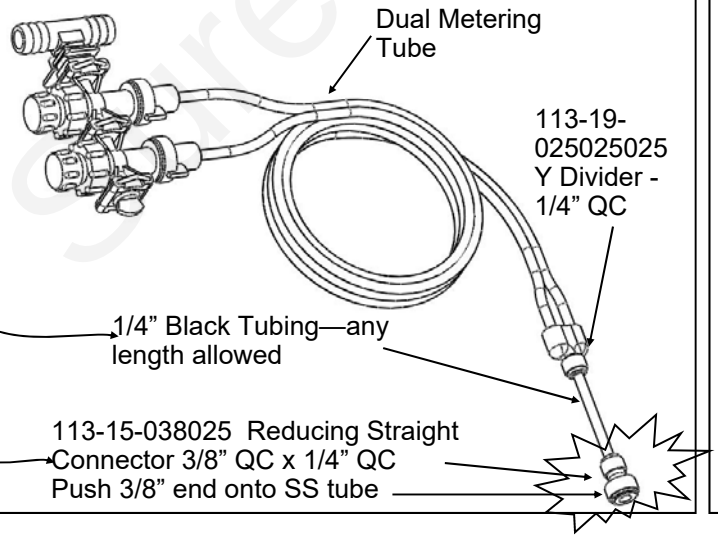


Connection to Totally Tubular or other heavy wall Stainless Steel Tube Ground Application Devices

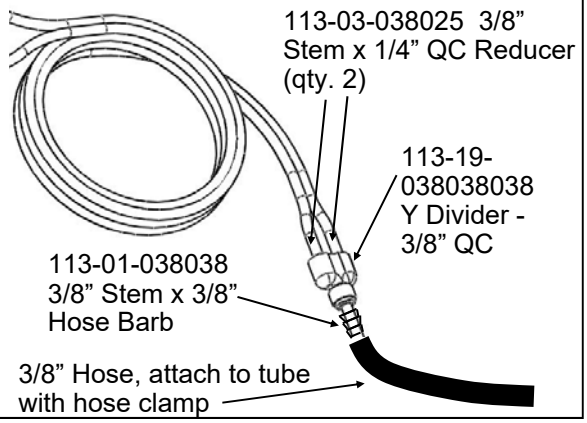
When using a 3/8” OD stainless steel tube to apply fertilizer to the ground, there are two options for the delivery tube plumbing. If the tube ID is less than 1/4” (tubing will not fit inside tube) this attachment method must be used. The description following is for Option 1. See bottom right picture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

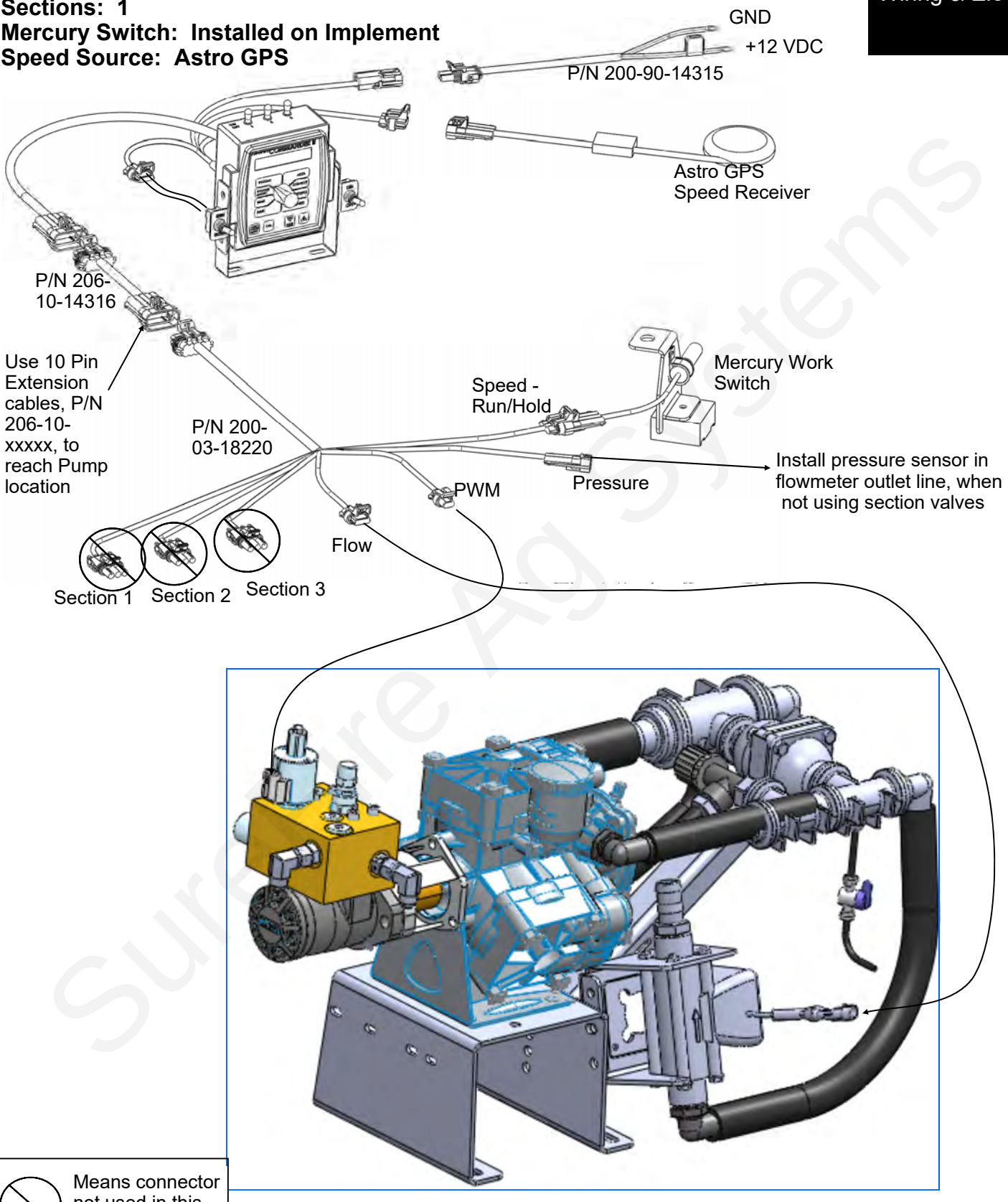


Option 2: 3/8” Hose attaches to SS Tube



PumpRight & Commander II Layout #1 - Basic Single Section

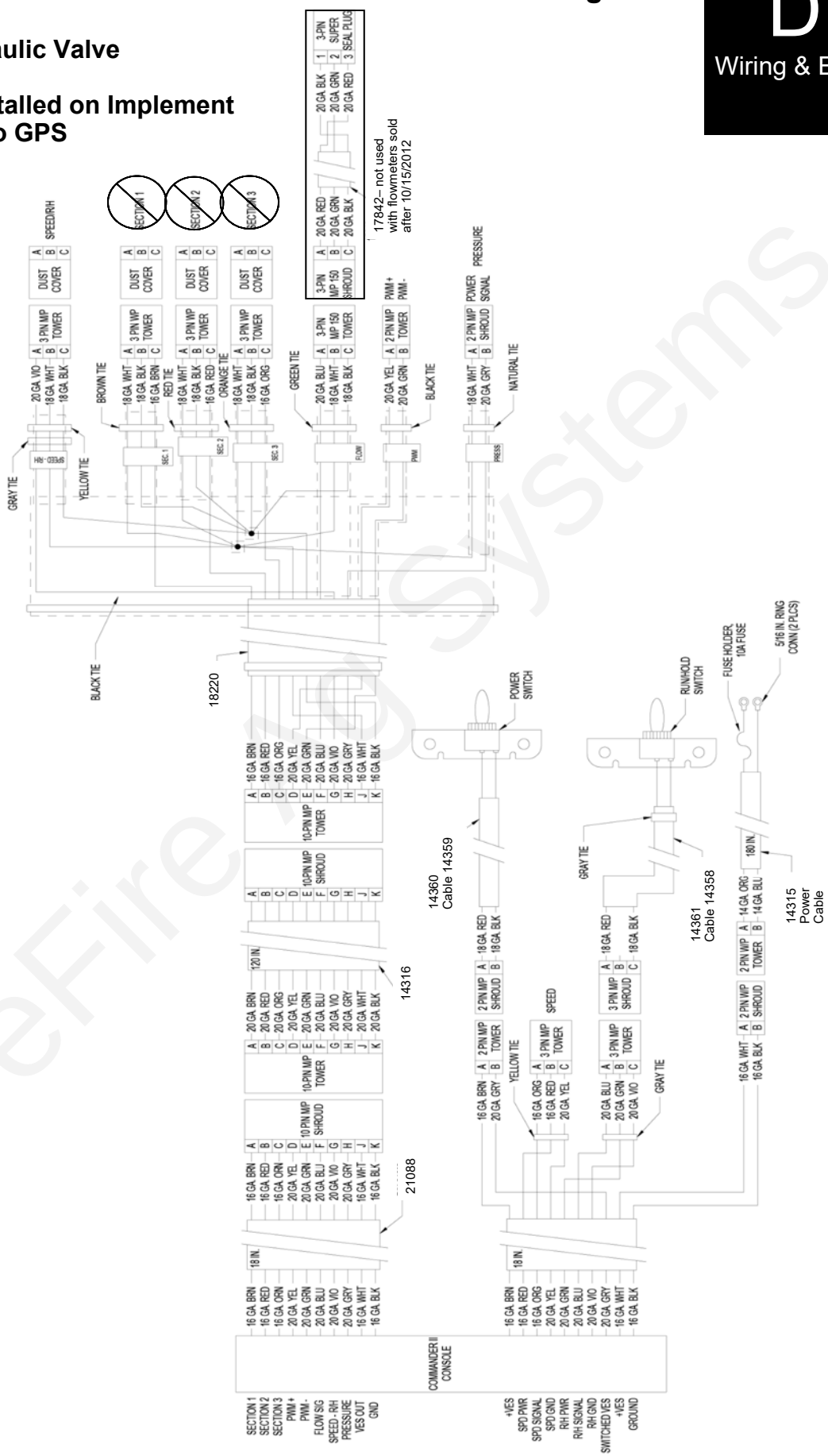
Control: PWM Hydraulic Valve
Sections: 1
Mercury Switch: Installed on Implement
Speed Source: Astro GPS



Means connector not used in this configuration.

PumpRight & Commander II Schematic #1 - Basic Single Section

Control: PWM Hydraulic Valve
Sections: 1
Mercury Switch: Installed on Implement
Speed Source: Astro GPS

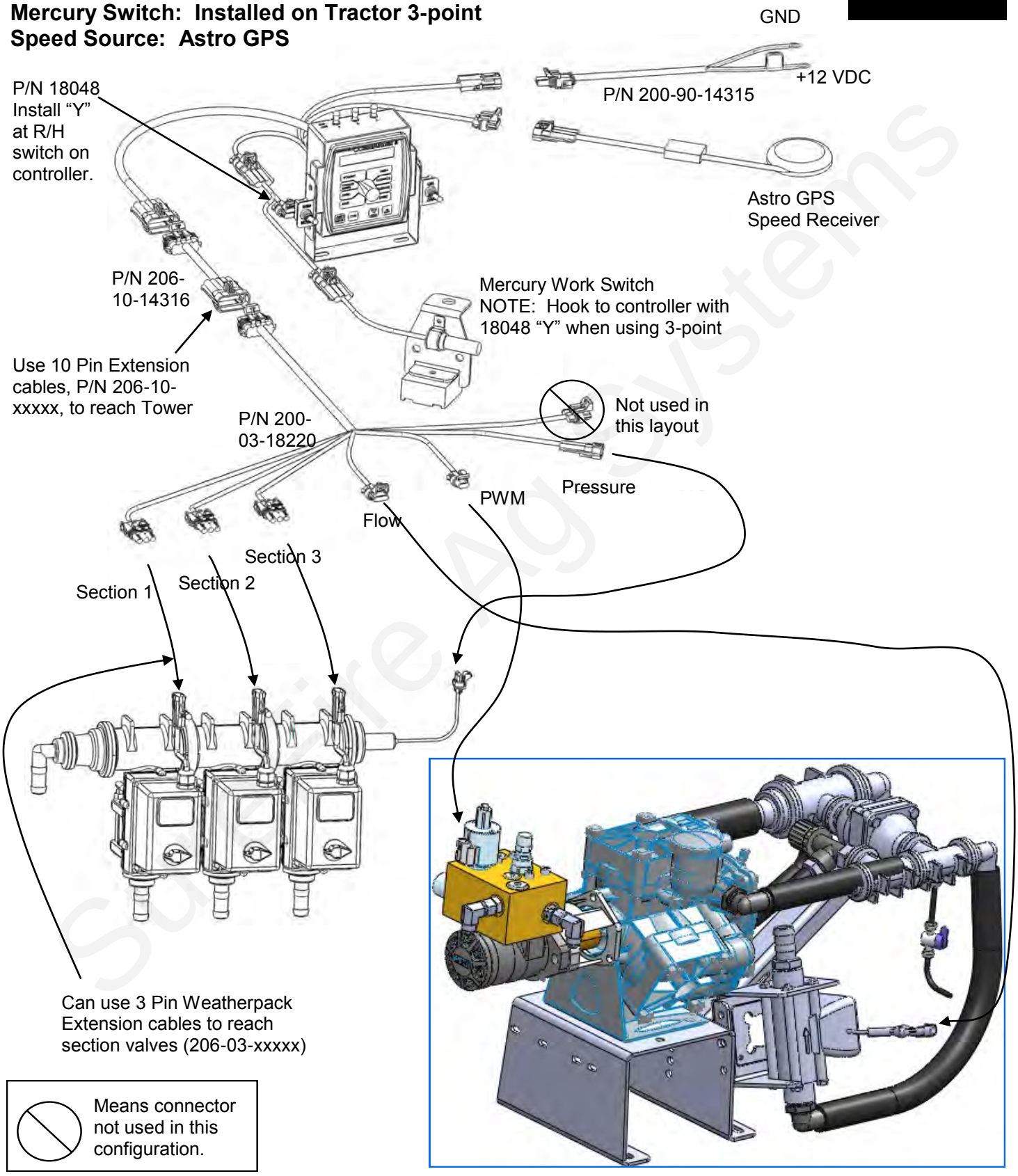


Means connector not used in this configuration.

PumpRight & Commander II Layout #2 - With Section Valves

Control: PWM Hydraulic Valve
Sections: 3
Mercury Switch: Installed on Tractor 3-point
Speed Source: Astro GPS

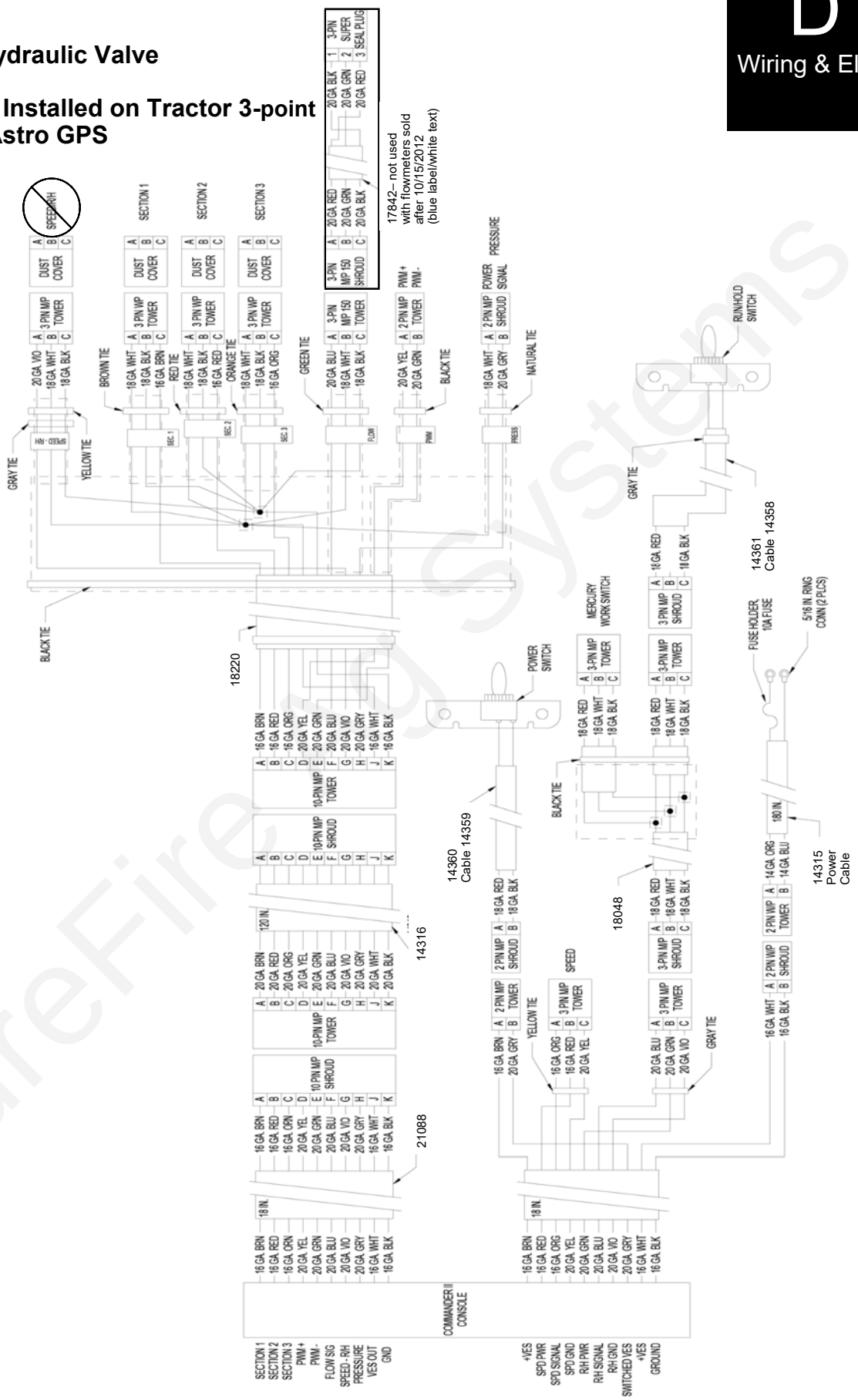
D
Wiring & Elec.



Means connector not used in this configuration.

PumpRight & Commander II Schematic #2 - With Section Valves

Control: PWM Hydraulic Valve
Sections: 3
Mercury Switch: Installed on Tractor 3-point
Speed Source: Astro GPS

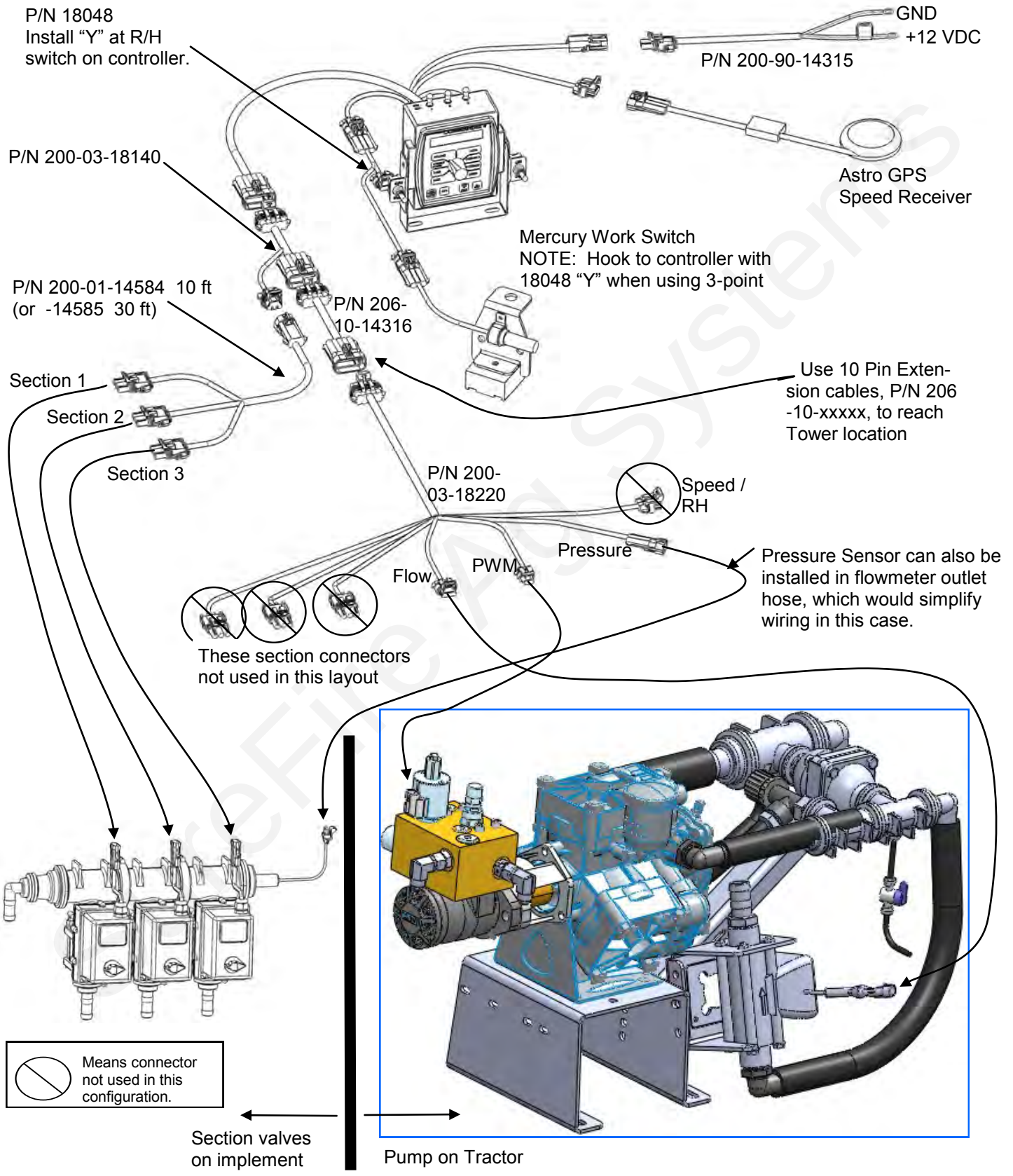


Means connector not used in this configuration.

PumpRight & Commander II Layout #3 - Pump on Tractor

Control: PWM Hydraulic Valve
Sections: 3 - Mounted on Implement (long distance from PumpRight)
Mercury Switch: Installed on Tractor 3-point
Speed Source: Astro GPS

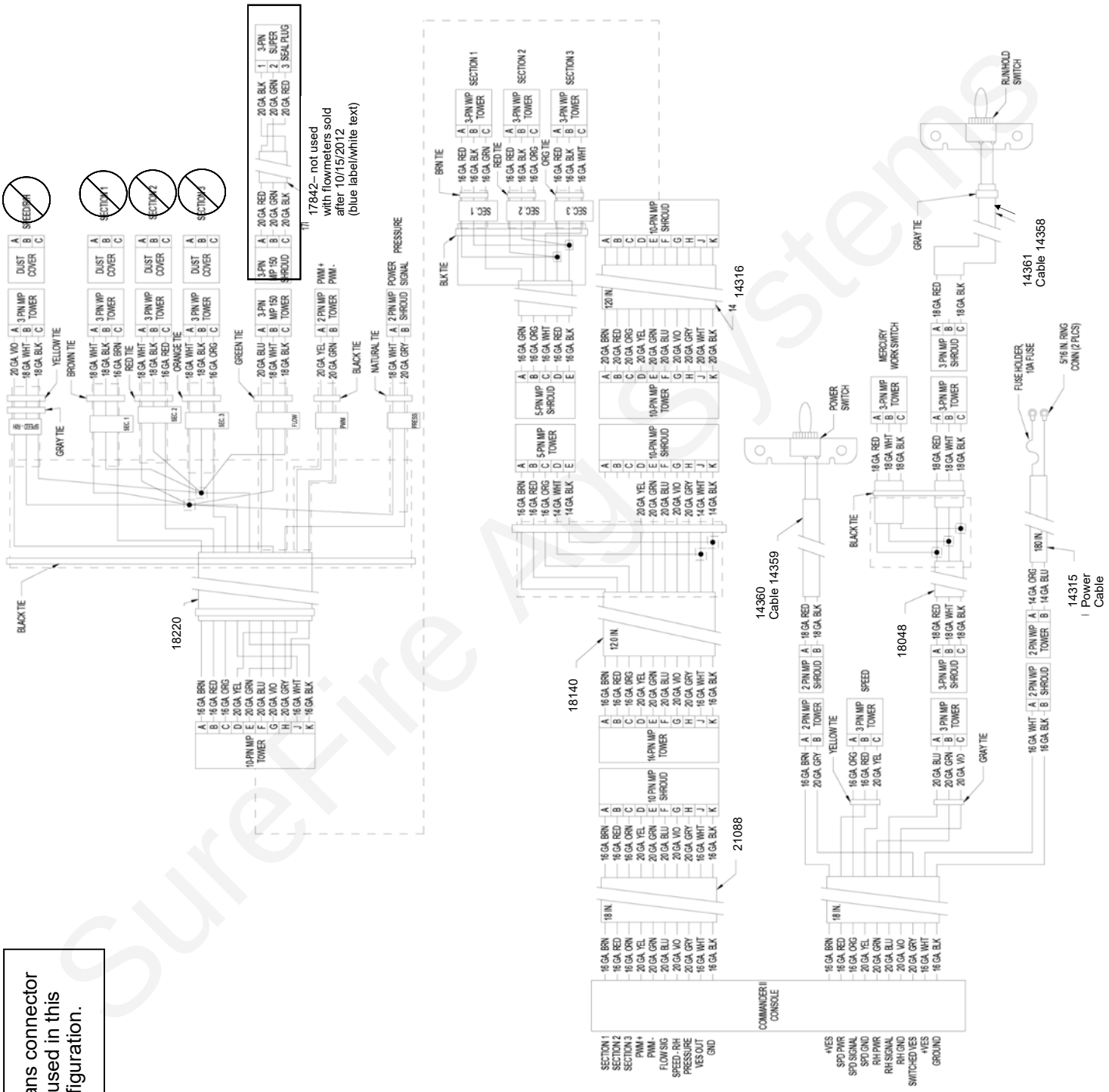
D
Wiring & Elec.



PumpRight & Commander II Schematic #3 - Pump on Tractor

Control: PWM Hydraulic Valve
Sections: 3 - Mounted on Implement (long distance from Pump)
Mercury Switch: Installed on Tractor 3-point
Speed Source: Astro GPS

D
Wiring & Elec.

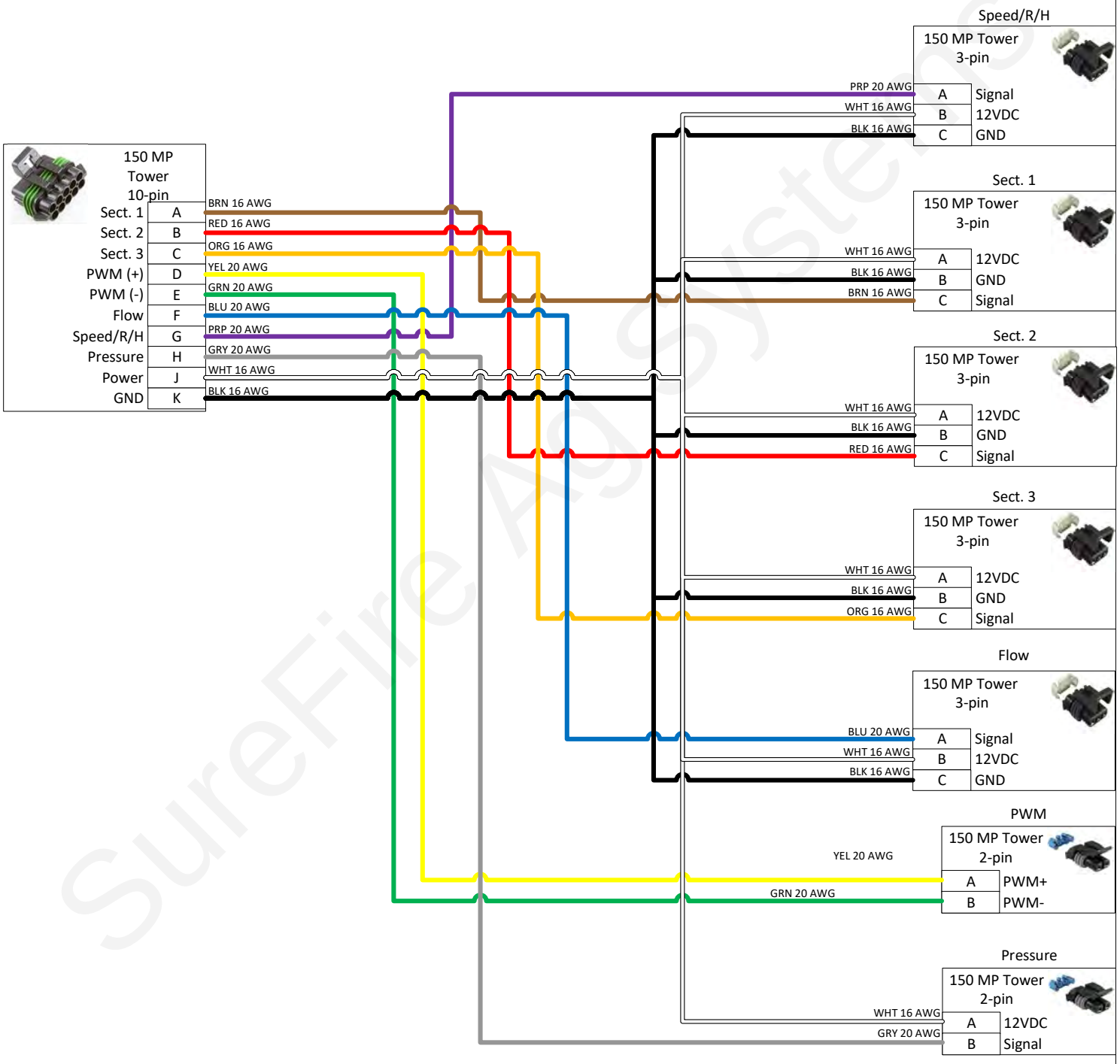


Means connector not used in this configuration.

18220

Commander II Harness

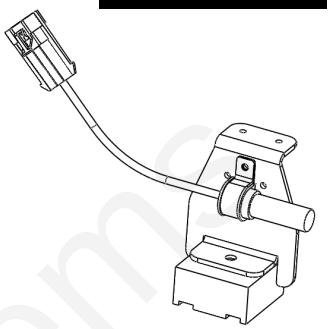
Wire 18AWG unless otherwise specified



SureFire Ag Systems	Part No:	18220	Drawn By:	Matthew Fritz	
	Description:	Commander II Harness	Last Edit Date:	5/26/2020	Revision A-01
			Page of Pages	1 of 1	

Mercury Run/Hold Switch for Commander II

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.
- Use the 18048 “Y’ Run/Hold adapter (included in box with Commander II controller) to plug the switch in at the back of the Commander II controller. See Layout #2 or #3 showing this wiring connection.

For hitch drawn implements:

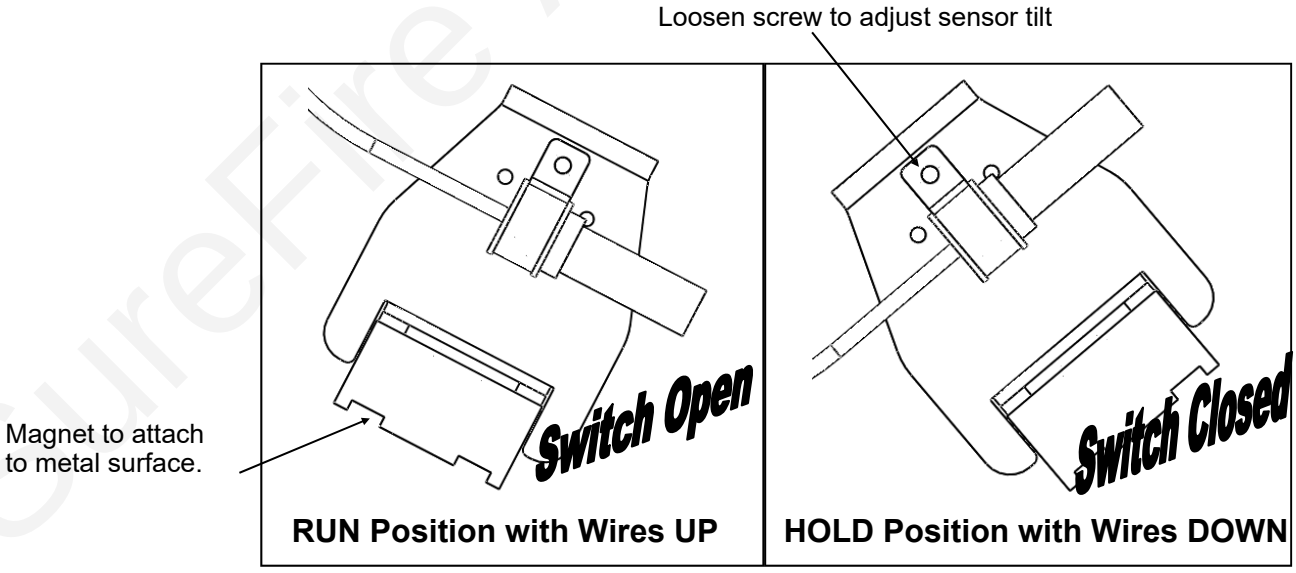
- Mount the switch on a wheel frame that rotates as it lifts the wheels up and down to raise and lower the implement.
- See the pictures below for switch orientation in run and hold positions.
- Connect the switch to the Commander II Final Harness (200-03-18220). See Layout #1 showing this wiring connection.

Commander II Run/Hold Switch Logic

How to Adjust:

<u>If your controller is turning off product application before or after you want, tilt the switch</u>. 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 loosing the screw and rotating the mercury switch.



How to Test:

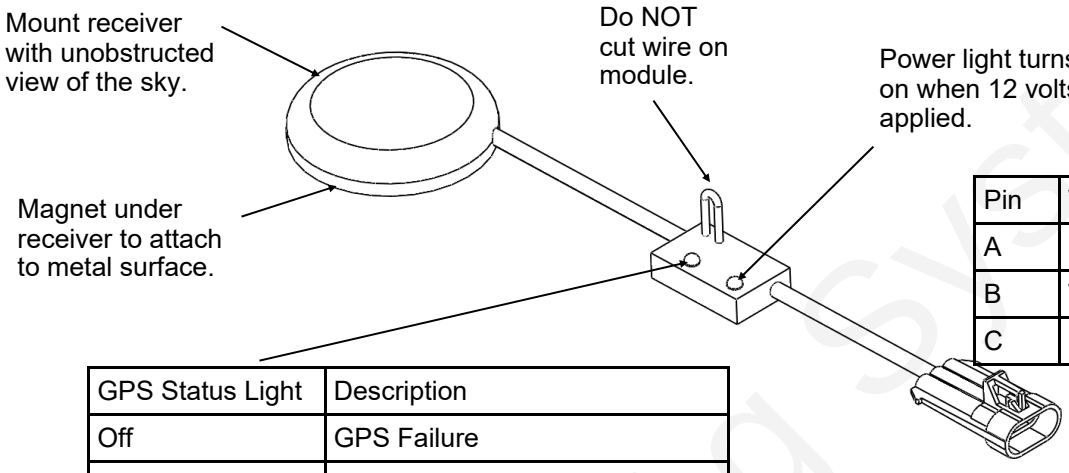
To test the run / hold mercury switch you will need a volt meter. Set the meter to test continuity (or ohms). With the wires down, you should have continuity between the two pins in the connector. With the wires up, the switch should be open (no continuity).

Astro GPS Speed Sensor

The Astro GPS Speed Sensor is the simplest speed sensor to use with the SureFire Commander II Controller. The GPS receiver uses the GPS satellites to track only speed. The output from Astro is a pulse to communicate speed to the Commander II.

PN 203-01-01410 Astro 2, 2 Hz GPS Receiver (most common with Commander II)
PN 203-01-01425 Astro 5, 5 Hz GPS Reciever

Speed Calibration for Commander II: 0.189
Astro Minimum Operating Speed: 1.0 MPH



Pin	Wire Color	Function
A	Red	Signal
B	White	+ 12 V Constant
C	Black	Ground

GPS Status Light	Description
Off	GPS Failure
Blinking	Acquiring GPS satellites
On	GPS signal acquired

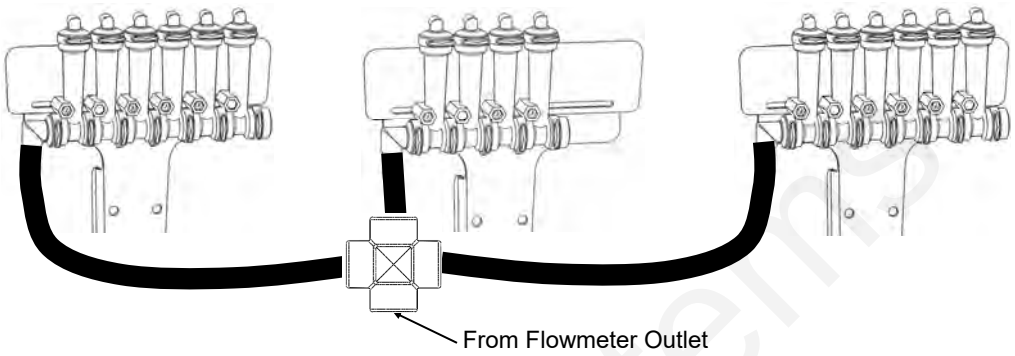
Floating Ball Flow Indicators

E
Installation Overview

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

16 Row
Split 6 - 4 - 6

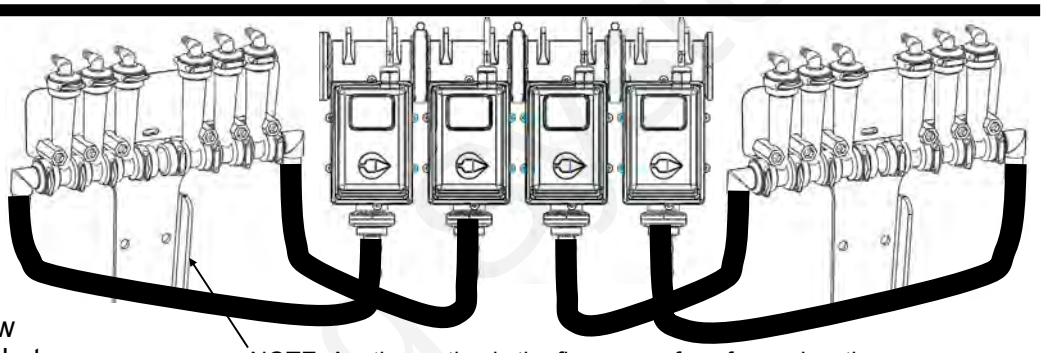
This configuration works well on a 16 row front fold planter. Each flow indicator manifold is shown fed by a cross in a single section installation. Each manifold could be fed by a section valve if desired.



12 Row
Split 3 - 3 - 3 - 3

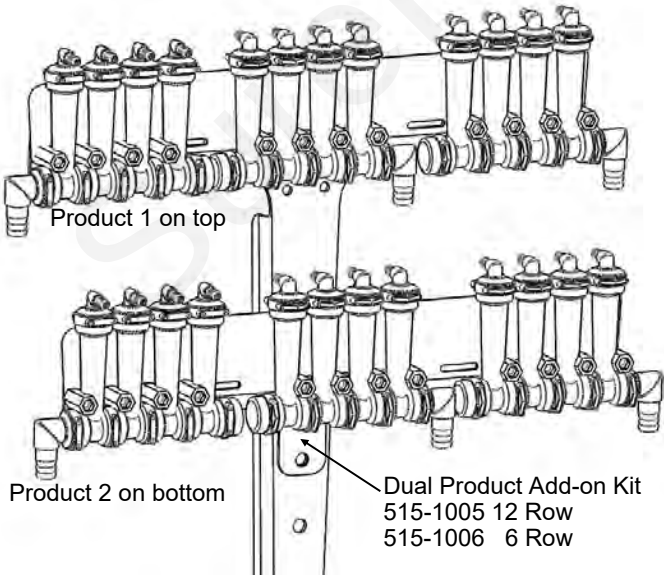
Shown here is a 12 row with four 3 row sections controlled by four section valves. Note each 6 row T-Bracket can hold two separate 3 row manifolds.

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

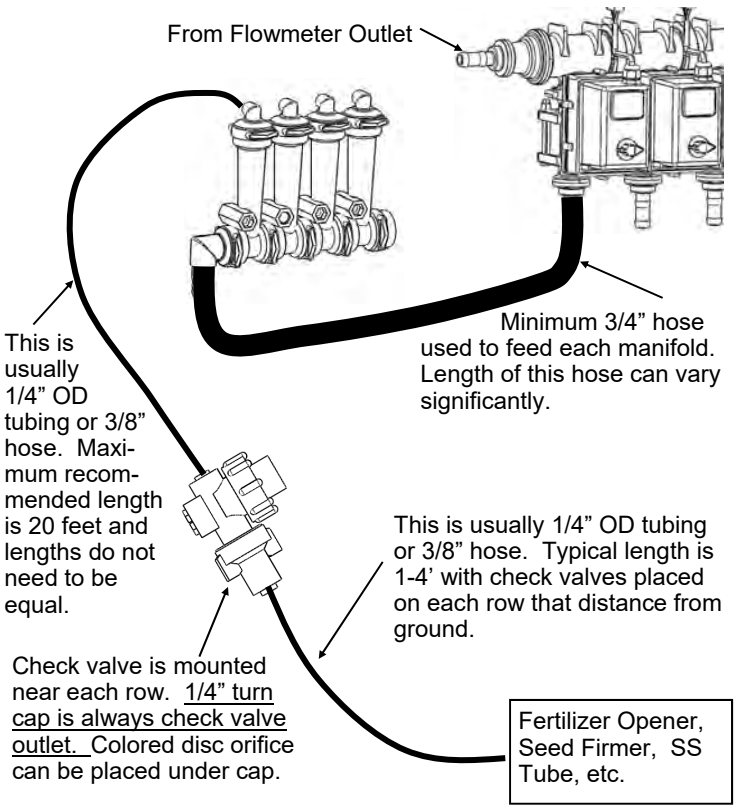


12 Row Dual Product
Product 1 Split 4 - 4 - 4 / Product 2 Split 4 - 4 - 4

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



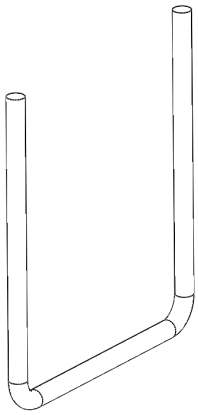
General Plumbing Guidelines



PumpRight Pump Installation

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.



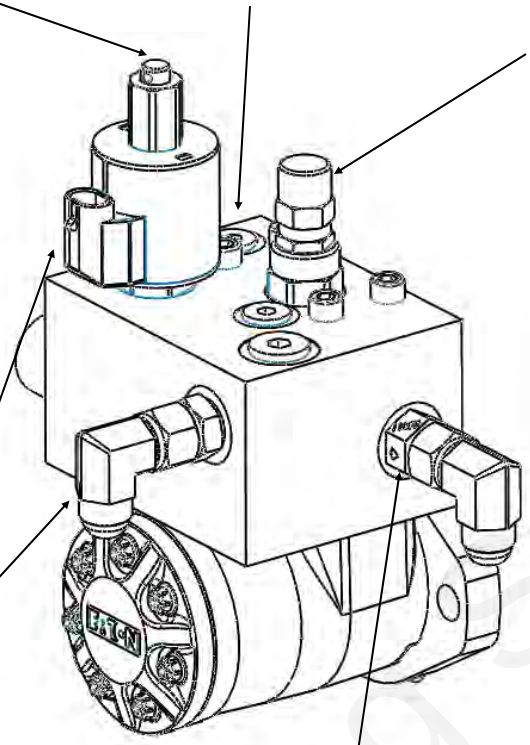
Mounting Bar Size	Item Number	Item Description
3” x 3”	380-1022	1/2" U-bolt Kit - 1/2", fits 3" x 3" tube - (3" opening)
4" x 4"	380-1023	1/2" U-bolt Kit - 1/2", fits 4" x 4" tube - (4" opening)
4" x 6"	380-1015	1/2" U-bolt Kit - 1/2", fits 4" x 6" tube - (4" opening)
	380-1017	1/2" U-bolt Kit - 1/2", 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)

PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

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 connections. 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. *(Always loosen the lock nut before adjusting the needle valve. Do not overtighten needle valve.)*

PWM Valve Connector -2 Pin MP Shroud

Pressure from Tractor

Return oil to Tank - Check valve included on return port

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. 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 bypass valve must be closed to use power beyond hydraulics.** 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.

PumpRight Hydraulic Connections

E
Installation Overview

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
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.

Preferred

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. **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 (10 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. If you absolutely need the maximum flow in this case, SureFire has an alternate motor (smaller displacement) to increase pump speed at 7 GPM oil flow.

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.

PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

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.

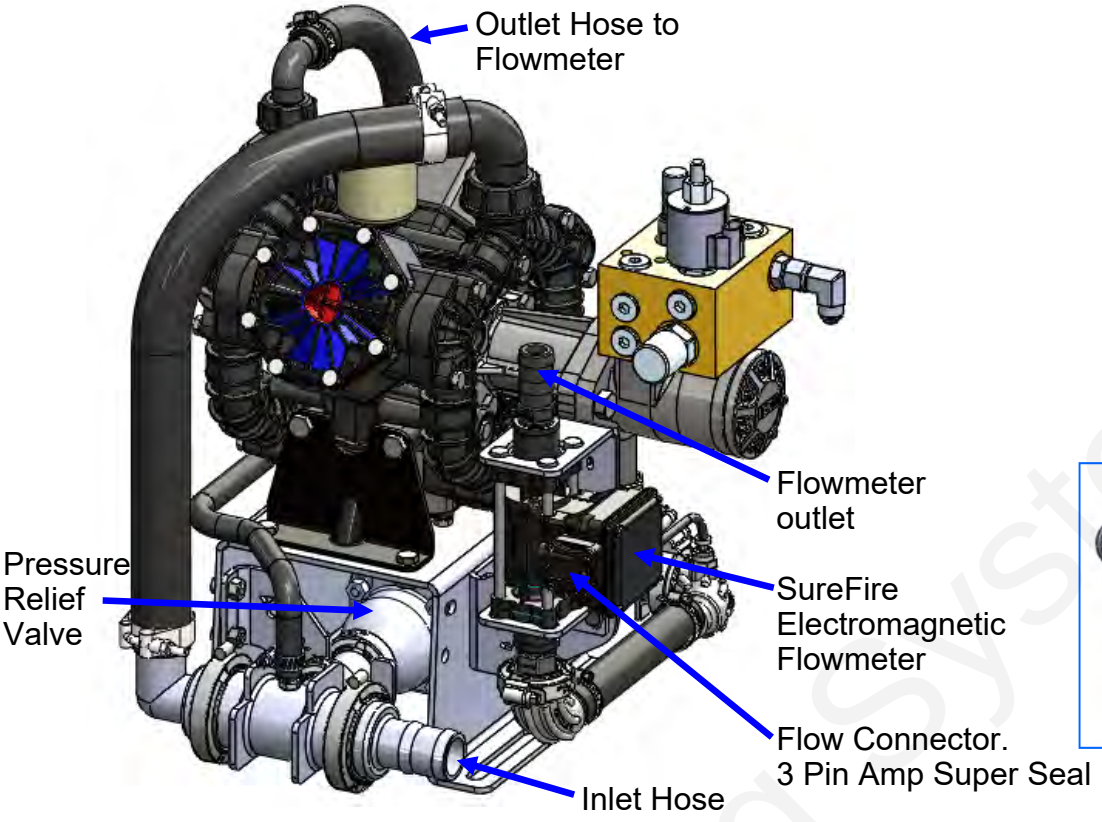
This setting will provide the Pump Right pump just enough oil for your application rate.

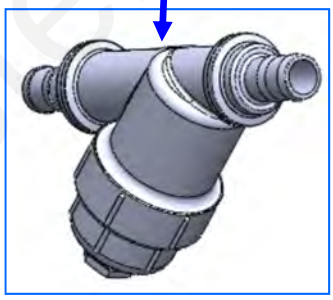
If running with the bypass open (only recommended when 2 motors are operated in series) this process will minimize the oil circulated in the bypass loop, leaving more oil flow for other hydraulic functions.

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

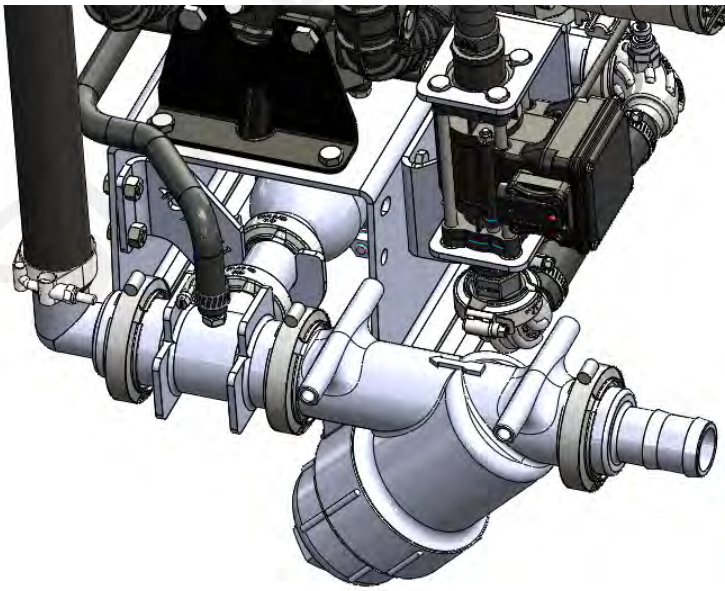




Inlet: The PR17 and PR30 PumpRight are shipped with a 1 1/2" inlet hose barb. Attach this to the hose from your supply tank and strainer . A 1 1/2" 90 degree hose barb is included and can be substituted.

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.

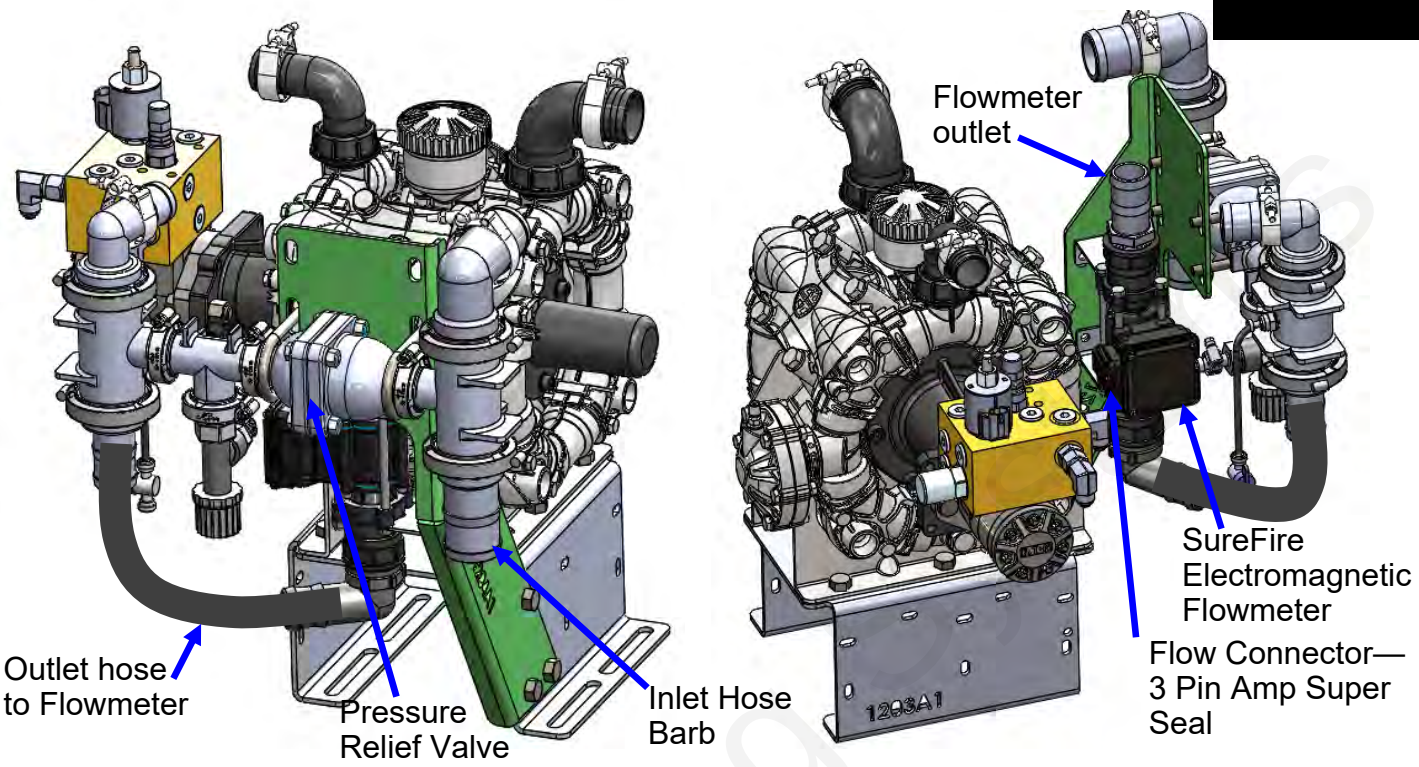
Outlet: The outlet is plumbed directly to the flowmeter with 1" hose. As shown above, the flowmeter may be mounted directly to the PumpRight pump. The flowmeter outlet is a 1" hose barb. The outlet hose should be a minimum of 24" long with a gentle curve prior to any fittings for optimum flowmeter performance. 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.



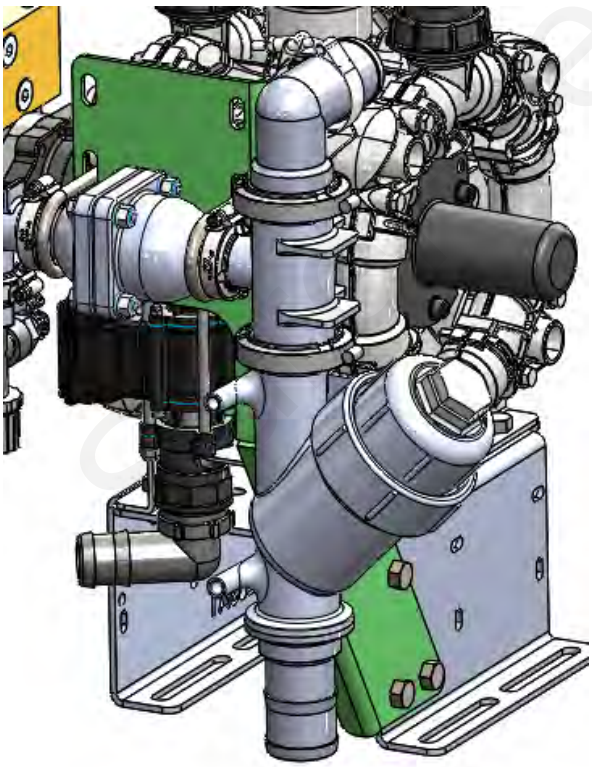
Pressure Relief Valve (PRV): The PRV is a 100 psi relief. If there is a restriction that creates over 100 psi in the system, the PRV will open allowing the excess flow to pass back to the inlet side of the pump. This protects the pump and fertilizer system from damage.

PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

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.

Commander II Console Functions

The Commander II is a very robust rate controller with manual section control for 3 sections. It will operate in either PWM or servo mode. Typical operation is PWM control.

In Field Operating Instructions

VOLUME: Displays total gallons (liters) of liquid applied. Can be reset to 0 by holding the reset button.

3 SECTION SWITCHES: Turns application on or for each section. If not dividing implement into sections, use Section 1 switch only.

AREA: Displays the area of coverage by the equipment in acres (hectares). May be reset.

DISTANCE: Displays the distance traveled in feet (meters). May be reset.

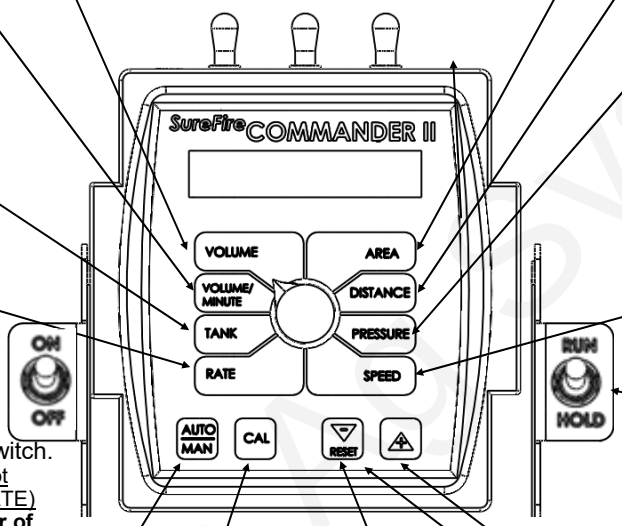
VOLUME/MINUTE: Displays gallons (liters) of liquid applied per minute. Use this to read instant flow in GPM.

PRESSURE: Displays the liquid pressure at the location of the optional pressure sensor. In addition to displaying Pressure the console will warn the operator with HiPSI (High Pressure) message when the input pressure exceeds the limit pressure (set in Special Cal)

TANK: Displays gallons (liters) of liquid remaining

RATE: Displays application rate GPA(LPH)

SPEED: Displays ground speed in miles per hour (Kilometers per hour).



RUN/HOLD: Turns liquid application on (RUN) or off (HOLD)

ON/OFF: Commander II power switch. When the console is turned on (except when starting in "SPECIAL" CALIBRATE) the data display will show the **Number of Hours** it has operated for one second, followed by the **Software Part Number (45124)** and the **Software Revision (rP X)** for 1.5 seconds each. Then it will display the **Control Mode (P-FLO or S-FLO)** for 1.5 seconds.

AUTO/MAN: Key which changes operation from automatic control to manual.

CAL: This key is used to enter & exit calibration mode.

RESET/ - : When not in CAL, clears the selected counter when held for two seconds.

+ & - : Plus & Minus keys are used to increase and decrease values

Five Steps for Commander II Setup for PumpRight Systems

1. **Commander II Special Cal Quick Setup** (Factory defaults are for Tower Electric Pump Systems so **this step must be completed** for PumpRight Hydraulic systems)
2. **Standard Calibration**
3. **Initial Operation in Manual Mode**
4. **Test Speed Operation in Automatic Mode**
5. **Speed Signal Verification & Field Operation**

See the following pages for further instructions.

Commander II Special Cal Quick Setup

Step 1

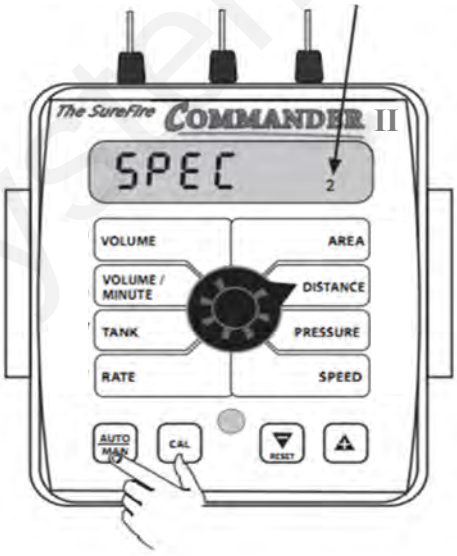
F
Setup & Operation

The Commander II has a quick setup feature to load the necessary defaults for a SureFire Tower or PumpRight system. **Follow the steps below BEFORE performing standard calibration on next page.**

To change defaults:

1. Power off Commander II.
2. Enter Special Cal by holding both the AUTO/MAN and the CAL button down while turning on the power switch.
3. You should see "SPEC" on the screen, if not, repeat steps one and two.
4. Ensure "1" displays to indicate Page 1 in Special Cal. Press CAL to change if necessary.
5. Turn dial to point at AREA.
6. Select desired defaults from chart below. (Press the UP or DOWN arrows in bottom right corner to change selection.)
   - Select "EP-E" for Tower Electric Pumps.
   - Select "**HP-E**" **for PumpRight** or other Hydraulic Pumps. (-E is for English units, -M for metric units)
7. Save changes by holding CAL until red light goes out (about 3 seconds).

This number tells you which special CAL screen you are on. Pressing the CAL button will change this number.



NOTE: **The above procedure will load all default values in the Commander II. It must be done before standard calibration.** For example, if you entered your implement width, then did the quick setup above, the Commander II would default back to 240 inches.

Complete Table of System Defaults (for Software Revision rP F. Earlier Revisions will have different default Flow Cal numbers. Software Revision information displays briefly on console startup.)

The following table shows the unique values that are loaded in the above procedure. The first letter, **E or H** stands for **electric or hydraulic** pumps. The second letter, **P or S**, stands for the type of control used, **PWM or Servo**. Finally, the last letter, **–E or -M** , is for **English or metric** units. Turf utilizes 1,000 square feet for the area measurement.

The Commander II is typically sold with new PWM controlled application systems. However, it is compatible with Servo controlled systems. **A special wiring harness is needed for the servo controlled systems.**

Load Defaults Selection	PWM Electric Pumps EP-E, EP-M, TURF	PWM Hydraulic Pumps HP-E, HP-M	Servo Electric Pumps ES-E, ES-M	Servo Hydraulic Pumps HS-E, HS-M
Control Rate	-2	-2	-1	-2
Min PWM	0	15	----	----
Max PWM	100	80	----	----
Start Time	Off	1	Off	Off
PWM Start %	----	50	----	----
Flow Cal	**6000**	**4000**	**6000**	**4000**
Control Mode	P-FLO	P-FLO	S-FLO	S-FLO
Max Pressure	50	80	50	80

Standard Calibration Procedure:

Step 2

F
Setup & Operation

1. Press CAL key for one (1) second to enter calibration mode.
2. Red light will be on steady and CAL will be displayed in CAL mode.
3. Turn the dial to the items listed below and set as instructed.
4. When complete, press CAL for one (1) second to exit CAL mode. Red light should go out and CAL will not be displayed. **You MUST exit Calibration mode to save your settings.**

FLOW CAL: Enter the calibration number for your **flowmeter** here. On electromagnetic flowmeters the calibration number is from the chart below. **(These numbers are for flowmeters sold after 10/15/2012. These meters have a blue label with white text. Earlier flowmeters (white label with black text) use different FLOW CAL numbers.)** On turbine flowmeters, the calibration number is on a metal tag attached to the flowmeter.
Quick Tip: To quickly change the flow cal, press the AUTO/MAN button to allow you to directly change the 2 left digits (thousands). Then press the UP or DOWN arrow to change the number. Press AUTO/MAN again to change the right 3 digits.

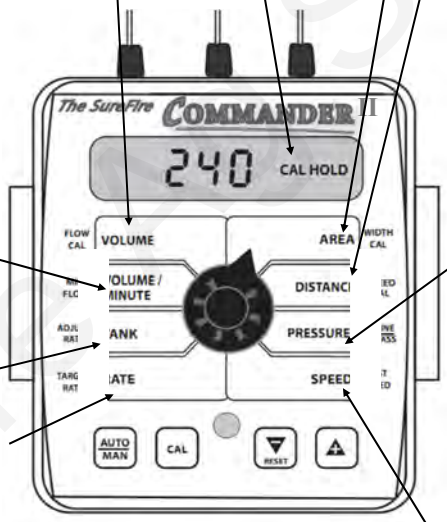
Flow Range (GPM)	Pulses/ Gallon	Commander II Flow CAL
0.13 - 2.6	3000	**6000**
0.3 - 5	3000	**6000**
0.6 - 13	2000	**4000**
1.3 - 26	2000	**4000**
2.6 - 53	2000	**4000**

P/F Ratio: Not used at this time.

ADJUST RATE: Sets amount of rate change by pressing "+" or "-" button once. Usually set to 1.0. This allows you to change from 8 GPA to 9 GPA to 10 GPA etc.

TARGET RATE: Set to your intended target rate in Gallons per Acre.

NOTE: This indicates you are in CAL mode.



WIDTH CAL: Enter the width of each fertilizer or chemical section of your implement. For a single section system, set Section One to the full implement width in inches. For example, for an 8 row 30" implement, set Section One to 240 inches. To set the section widths the Run/Hold Switch has to be in Run and the Section Switch must be ON. If using a single section implement, set Section 2 and 3 to ZERO.

SPEED CAL: Used in calibration mode to enter the speed calibration number in inches (cm) per pulse. Default is 0.189 for SureFire Astro GPS speed sensor.

When using the shaft speed sensor on grain drills, this will need calibrated. SureFire recommends you enter a value of 1.0 as a starting point. See section G for that calibration procedure under "Ground Speed Displayed is not correct".

CONTROL SPEED: Typically **-2 for PumpRight Hydraulic Pumps**.

Allows adjustment of response to "tune" the system for use with fast or slow valves. For example, if response is too slow, use the "+" button to adjust the valve response number to 1, 2 or 3. The range of adjustment is -4 to +3.

TEST SPEED: Use this mode to verify controller automatic operation only AFTER initial operation in MANUAL mode.

Standard CAL Factory Defaults: (for Software Revision rP F)

Software Revision identification displays briefly when Commander II is started.

Electric Pumps: 6000 Hydraulic Pumps: 4000	**FLOW CAL**	VOLUME / AREA	**WIDTH**	Boom 1: 240 Inches Boom 2: 0 Inches Boom 3: 0 Inches
Off	**P/F RATIO**	VOLUME/ MINUTE / DISTANCE	**SPEED CAL**	0.189
1.0 GPA	**ADJUST RATE**	TANK / PRESSURE	**CONTROL SPEED**	PWM Electric: -2 **PWM Hydraulic: -2** Servo Electric: -1 Servo Hydraulic: -2
10.0 GPA	**TARGET RATE**	RATE / SPEED	**TEST SPEED**	Off

Initial Operation Instructions

SureFire highly recommends you perform these exact steps with water to verify system is correctly installed and ready for field use.
Note: When testing with water, the system will develop much less pressure than it will have with fertilizer.

Test the system in **MANUAL mode**. *DO THIS !*

1. Push the AUTO/MAN button until **MAN** is displayed on the Commander II. You are now in Manual mode.
2. Put the system in **RUN**. Turn the console switch to RUN or lower the implement if using a mercury Run/ Hold Switch. When HOLD Is not displayed on the screen the system is in RUN.
3. Turn **Section 1 switch ON**.
4. Open the Air Bleed valve on the PumpRight. Be prepared to close the valve when water comes out.
5. Turn dial to **VOLUME/MINUTE** position. Is a number displayed? If so push the "+" button. Does the flow increase? Push the "-" button. Does the flow decrease?
6. If no reading in VOLUME/MINUTE is the pump turning and is there water present at the pump inlet?
   NOTE: **Feel if pump is vibrating to tell if it is running.**
7. You must determine if the pump is turning to determine if you have an electric or a hydraulic issue. See Section G Troubleshooting “Pump Will Not Turn” to isolate electric vs. hydraulic issues.
8. If water is being pumped, but no reading on the Commander VOLUME/MINUTE, check the flowmeter connections and the Flow Cal value.

Proceed to Step 4, ONLY when you can increase and decrease the VOLUME/MINUTE reading using the "+" and "-" keys on the Commander II.

Now, we will operate the Commander II in **Test Speed mode**. *DO THIS !*

1. Enter Calibration by pushing and holding the **CAL** button until CAL is displayed on the Commander II and the red light is on.
2. Push the AUTO/MAN button until **AUTO** is displayed, indicating you are in automatic mode.
3. Turn the dial to **Test Speed** in the bottom right corner. Use the + key to adjust to your field operating speed.
4. Turn Run/Hold switch on Commander II to **RUN**.
5. Turn Run/Hold **mercury switch to RUN** by lowering the implement, unplugging it, or manually tilting the switch.
6. Turn at least **Section 1 switch on**.
7. You should now be dispensing liquid as if you were traveling through the field at the test speed you entered.

NOTE: When testing with water, the system will develop much less pressure than it will have with fertilizer. This is normal and to be expected.

Proceed to the next step when liquid application is verified in AUTO mode with Test Speed operation.

Finally, we will verify the Commander II Speed is correct.
Turn the dial to **SPEED**. Drive the tractor. Does the speed reading seem reasonable and correct? The ASTRO II will be a more accurate speed than an un-calibrated tractor speedometer.

Proceed to the next step when your Commander II Ground Speed is correct.
You are now ready to verify regular field application.

Special Calibration Procedure - Page 1

Special Cal Parameters should not need changed in most cases. Consult with your SureFire dealer or representative before adjusting.

To enter Special Cal:

1. Power off Commander II.
2. Enter Special Cal by holding both the AUTO/MAN and the CAL button down while turning on the power switch.
3. You should see “SPEC” on the screen, if not, repeat steps one and two.
4. Save changes by holding CAL until red light goes out (about 3 seconds).

This number tells you which special CAL screen you are on. Pressing the CAL button will change this number.

FILL TANK SIZE: If using the Tank feature, this setting can be used to enter the volume of the tank. Use the “+” and “-” buttons to choose OFF or any value from 1-65,535. Then when the tank is filled, the tank counter can be reset to full by simply turning the rotary switch to the TANK position and pressing the “+” button.

SET DEFAULTS / COMMANDER II SPECIAL CAL QUICK SETUP: See page titled COMMANDER II SPECIAL CAL QUICK SETUP.

TANK ALARM SET POINT: Use the “+” and “-” buttons to set the level where the Warning LED starts flashing and the word “FILL” flashes on the display. Range is OFF or 1-65,535. When the tank value drops below the set point, the alarms will notify the user that the tank level is low.

FLOW CAL DEC: Sets the number of decimals available when entering the Flow CAL number in standard calibration mode. Defaults to 1. (Flow cal sets to whole number.)

CONTROL MODE: Allows the selection of either Servo mode or PWM mode. The selection is made based upon your specific equipment. On power up, the mode is displayed briefly as “S Flo” for servo mode and “P Flo” for PWM mode.

AUTO SHUTOFF ON/OFF: When Auto Shutoff is enabled (ON) the servo will run toward minimum flow for 4 seconds any time the system is put in HOLD or all booms are turned off, or if in AUTO mode and speed goes to zero. This feature is normally used only in Dry Application systems where the HOLD condition must stop a hydraulic auger or conveyor belt.

AUTO DELAY TIME: Typically used when using relatively slow ball valves for boom shut-off, this feature delays adjustment of the servo valve until the boom valves are open. Use “+” and “-” buttons to set from zero (OFF) to 4 seconds.

VALVE POLARITY: For establishing servo polarity. If pushing increase button causes flow to decrease and vice versa, switch this setting between Inline and Bypass.

Special CAL 1 Settings

FILL TANK SIZE	VOLUME	AREA	SET DEFAULTS	
TANK SETPOINT	VOLUME/ MINUTE	DISTANCE	FLOW CAL DEC	
AUTO SHUTOFF	TANK	PRESSURE	CONTROL MODE	
AUTO DELAY	RATE	SPEED	VALVE POLARITY	

Special CAL Page 1 Factory Defaults: Set for EP-E at factory

Set this to HP-E for PumpRight Hydraulic pump

Special CAL 1 Settings

FILL TANK SIZE	VOLUME	AREA	SET DEFAULTS	EP-E
TANK SETPOINT	VOLUME/ MINUTE	DISTANCE	FLOW CAL DEC	1
AUTO SHUTOFF	TANK	PRESSURE	CONTROL MODE	P-Flo
AUTO DELAY	RATE	SPEED	VALVE POLARITY	— — — — —

Off

Off

— — — — —

1

Special Calibration Procedure - Page 2

Special Cal Parameters should not need changed in most cases. Consult with your SureFire dealer or representative before adjusting.

This number tells you which special CAL screen you are on. Pressing the CAL button will change this number.

MIN PRESSURE: Sets the value of the minimum pressure alarm. When the pressure drops below this setting, an alarm will occur. PRESS ALM MIN SPEED can be used to disable alarm when speed drops below MIN SPEED.

MIN PRESSURE ALARM MINIMUM SPEED: This setting is used in conjunction with the MIN PRESSURE setting. It is disabled when MIN PRESSURE is off and sets the MIN SPEED at which the MIN PRESSURE alarm can occur when a setting is present in the MIN PRESSURE location. If MIN PRESSURE is set to 5 PSI and PRESS ALM MIN SPEED is set to 2MPH, then the alarm will only occur if you are moving faster than 2MPH, otherwise it will be disabled.

MAX PRESSURE: The system alarms if the pressure gets above this setting. This cannot be set higher than the pressure full scale setting.

Special CAL 2 Settings

MIN PRESSURE	VOLUME	AREA	**MAX PRESSURE**
PRESS ALM MIN SPEED	VOLUME/ MINUTE	DISTANCE	**MIN PRESS FREQ**
MIN FLOW	TANK	PRESSURE	**MAX PRESS FREQ**
REMOTE RUN/HOLD	RATE	SPEED	**PRESS FULL SCALE**

MIN PRESSURE FREQ: Set at the factory. Do not change.

MAX PRESSURE FREQ: Set at the factory. Do not change.

MIN FLOW: The purpose of this calibration value is to prevent the system from applying below the recommended minimum rate for spray nozzles.

For non spraying applications, nearly always leave this at ZERO.

To use, enter the minimum flow rate in gallons per minute for the entire boom on the sprayer. DO NOT enter the actual flow of your spray application. For example: If the minimum flow rate for the nozzle you are using is .22 GPM at their minimum recommended pressure and your boom has 20 nozzles, enter 4.4 as the MIN FLOW value (.22 x 20 = 4.4). The system WILL NOT apply at a rate lower than this value when spraying in AUTO.

REMOTE RUN/HOLD: Set to **rHold** to use a remote hold switch such as the SureFire mercury work switch. Set to **rSpeed** for using a remote speed signal such as a wheel speed sensor on a drill. When set to rSpeed, the normal speed connector on the Commander II will be disabled and only the remote speed connection on the implement will be active.

PRESSURE FULL SCALE: Set this to the maximum reading of the pressure transducer. For all SureFire Systems this is set to **100**.

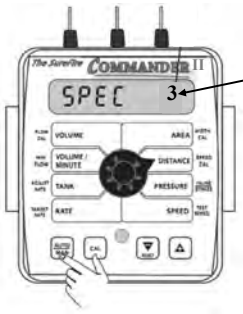
Special CAL Page 2 Factory Defaults: Set for EP-E at factory

Special CAL 2 Settings

Off	**MIN PRESSURE**	VOLUME / AREA	**MAX PRESSURE**	Electric: 50 **Hydraulic: 80**
_____	**PRESSURE ALARM**	VOLUME/ MINUTE / DISTANCE	**MIN PRESS FREQ**	approx. 200—do not change
0.0	**MIN FLOW**	TANK / PRESSURE	**MAX PRESS FREQ**	approx. 1000—do not change
rHold	**REMOTE RUN/HOLD**	RATE / SPEED	**PRESS FULL SCALE**	100

Special Calibration Procedure - Page 3

Special Cal Parameters should not need changed in most cases. Consult with your SureFire dealer or representative before adjusting.



This number tells you which special CAL screen you are on. Pressing the CAL button will change this number.

START TIME & VALVE START %: These settings set how far open the valve will open and how long it will stay at that setting on startup. These settings are only available in PWM mode. If the START TIME parameter is Off, then the VALVE START % will be unavailable. These settings will allow the system to get up and operating at a predetermined speed for a predetermined amount of time. Once the START TIME has been reached, the auto control takes over from that point. This is a very good method of smoothing out startup (switching from hold to run).

Special CAL 3 Settings

START TIME	VOLUME	AREA	PWM MIN
VALVE START%	VOLUME/ MINUTE	DISTANCE	PWM MAX
————	TANK	PRESSURE	PWM FREQ
RATE SMOOTH	RATE	SPEED	————

PWM MIN %: This setting affects how low the PWM signal can go. If set to 10, then the PWM signal can go down to 10%. If set to 20, then the PWM signal can go down to 20%. Most valves have a bottom end where they no longer change any flow. This is the point where the PWM MIN should be set. If this is set too high, it will keep the system from getting to your lowest rates.

RATE SMOOTHING: This value is used to help the system lock on to the target if all system parameters seem to be functioning appropriately.

PWM FREQ: Set this to match your PWM valve frequency or set it to the PWM frequency expected by the device you are connecting to.

PWM MAX %: This setting affects how high the PWM signal can reach. If set to 100, then the PWM signal can reach 100%. If set to 80, then the PWM signal can reach 80%. If a valve is being used that does not have any control after it gets to a certain point, then that point should be your PWM MAX % setting. If this is set too low, it will keep the system from reaching maximum rate.

Special CAL Page 3 Factory Defaults: Set for EP-E at factory.

Special CAL 3 Settings

START TIME	Off-electric	1-hydraulic	PWM MIN	0-electric	15-hydraulic
VALVE START%	Off-electric	50-hydraulic	PWM MAX	100-electric	80-hydraulic
————			PWM FREQ	100	
RATE SMOOTH	10		————	————	

Pump Will Not Turn

Turn hydraulics off, go to the SureFire PWM valve and use the manual override on top of the electric coil to manually open the valve (Manual Override UP = valve fully open). Turn hydraulics on **at a low flow only** as the valve is 100% open. Try hydraulic lever in opposite direction. 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

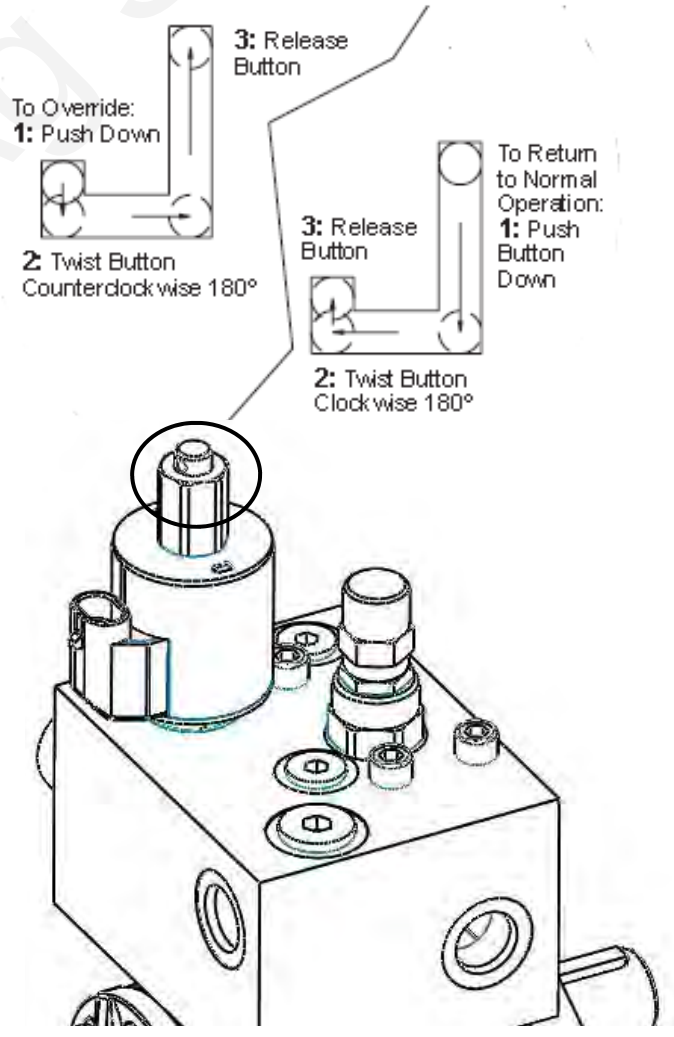
1. Close manual override (lock down)
2. Push the AUTO/MAN button until MAN is displayed on the Commander II. You are now in Manual mode.
3. Put the system in RUN. Turn the console switch to RUN or lower the implement if using a mercury Run/Hold Switch. When HOLD Is not displayed on the screen the system is in RUN.
4. Turn Section 1 switch ON.
5. Verify hydraulics are on.
6. Turn Dial to VOLUME/MINUTE position.
7. Press the "+" button for a few seconds.
8. Take a metal object and hold it next to the coil. If the coil is working, you will feel the magnetic pull.
9. 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.
10. If 6-12 volts is not present, check harnesses and connectors.

Test the electromagnetic solenoid coil:
Set your meter to work as an ohmmeter--
Put your probes on the 2 pins on the connector on the side of the solenoid. Ohmmeter should read between 7 and 9 ohms.

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

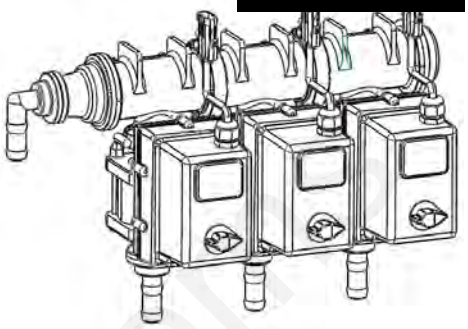


Section Valve(s) will not move

1. Check the harness connection to that valve. It is a 3 Pin Weather Pack connector. See Section D for wiring diagrams.

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

2. Check voltage pin A to Pin B. Must be 12 volts, if not, go back to 10 pin on Commander II and check voltage (pins J & K, white and black wire).
3. 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.
4. If signal voltage is not present to open valve, use diagrams to check at the 10 pin connector on back of Commander II.
5. If constant voltage (Pins A&B) and switched voltage (Pins C&B) are present, inspect, repair or replace the valve.



Console is Erratic in Operation

- If you have a **two-way radio**, it may be mounted too close to the console. Keep all cables away from the radio, its antenna and power cable.
- **Ignition wires** may be causing the console to malfunction. Keep cables away from ignition wires or install ignition suppressor.
- Reroute all cables away from **electric solenoids, air conditioning clutches** and similar equipment.

Console Appears Dead

- Using your voltmeter, check for 12 volts at Commander power connector. Check for damaged power cable or reversed terminals. Check fuse in power cable and any other fuses or circuit breakers in path. Inspect connections to Commander II power switch.

Commander II Error Messages

Message	Description
Lo P	Low Power to Commander II, check all power and ground connections
no SPEEd	Will flash in display if dial is in RATE position and there is no speed signal regardless of all other conditions. Check speed sensor and connections. (When vehicle is not moving, this is a normal condition)
no FLo	Will flash in display if rotary switch is in Rate position and should have flow (In Run, some sections on, speed greater than zero) but no flow is detected. Check flowmeter and flow harness connections.
no FLo StoP	Pumps will stop and this message will be displayed if no FLo condition continues for 60 seconds. Console Power must be cycled to reset this condition. Check flowmeter and connections. Use Manual mode for priming and plumbing troubleshooting to avoid this error.
no boom	Will flash in display if dial is in Width position in Cal mode and no sections are turned on.
FILL	Will flash in display if tank level is equal to or less than tank set point. Adjust these settings in Special Calibration.
SPEC	Appears when entering Special Calibration mode
CLEAr	Alerts user that the currently selected counter will be reset to zero if RESET button is held for 2 seconds.
OFL	Displayed when a DISTANCE, AREA or VOLUME counter has overflowed their maximum value. Hold RESET button for 2 seconds to reset the counter.

Application Rate & Flow Troubleshooting

G
Trouble-shooting

Application Rate Fluctuates

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

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

OR

1. Go to Manual Mode and turn system on.
2. Turn dial to VOLUME/MINUTE position. Use the +/- buttons to get to a flow similar to field operation.
3. If there is a large fluctuation in flow on the Commander II, visually observe the liquid flow. Is the discharge a steady stream? Are the flow indicator balls floating steady?
4. If visually the flow is steady, but the display reports a fluctuation in GPM, inspect the flowmeter. See section B for flowmeter information.
5. If visually the flow is unsteady, the flowmeter is working correctly reporting a flow problem. Is the pump turning steady or surging?
6. 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.
7. Look for air bubbles in the flow. These can be seen in the flow indicators. Air bubbles indicate an air leak on the pump inlet allowing the pump inlet to suck some air.

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

1. Turn dial to SPEED. Look for any wild fluctuations in speed indicating a sensor problem.
2. Change the Valve Control Speed in Cal Mode by reducing or increasing the value (range is –4 to +3).

Application Rate is slow to get to the Target Rate

1. You may need to increase the Control Speed in Cal mode (range is –4 to +3) if system is slow in returning to Target Rate when speed changes.
2. Increase the Valve Start %, see Special Cal page 3.
3. If slow getting to Target Rate when starting, increase PWM minimum on Special Cal page 3.

No Flow shown on Commander II but liquid is being pumped

1. Unplug flowmeter. With voltmeter, check for 12 volts between pins B&C of flowmeter connector (on main harness PN 18220). 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. Enter CAL mode and change the flow cal to 10. Have a second person watch VOLUME/MINUTE while other person taps (use a short piece of wire or a paper clip) between pins A&C of flowmeter connector (on 18220 harness). A flow value should show up indicating the wiring is not damaged.
    - If working alone, you can set dial to VOLUME and reset a counter to zero. Then tap approximately 20 times and see if the Commander II volume counter has changed.
3. If Commander II 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. Reset flow cal if you changed it.
5. Replace flowmeter.

Flowmeter is inaccurate

This procedure is used to verify and fine-tune the flowmeter calibration. With Electromagnetic flowmeters, it should not be necessary to change the Flow Cal. However, **SureFire recommends always running a catch test to verify accuracy and that Commander II is setup correctly.**

PROCEDURE

1. Put enough water in the tank to perform this test. **(The larger the volume of water used, the more accurate the calibration will be).**
2. Start pump and turn on sections. Run enough water to purge all air from lines. Turn off pump.
3. Turn console rotary selector to the VOLUME position. Select the counter (1-3) that you want to use. Press and hold the RESET button until the display reads 0 **(About 2 seconds).**
4. Turn on all sections, and run a known amount of water.
5. Turn off all sections. Compare the console's VOLUME reading with the known amount of water run. If the two amounts are within one or two percent, no fine tuning is required. If the two amounts are more than two or three percent different, continue with the next step.
6. With the console still in the VOLUME position, enter calibration **(Boom switches OFF, hold the CAL button until red warning light comes on; about one second).** The display will show the flowmeter calibration value and the CAL icon.
7. Momentarily press the CAL button. The CAL icon will begin to flash and the total volume will be displayed.
8. When the TOTAL FLOW value is displayed, use the "+" or "-" button to adjust the value to match the amount of water run.
9. Momentarily press the CAL button. The word CAL and the flowmeter calibration number will be displayed. You will notice that the flowmeter calibration value has changed. Write down the new flowmeter calibration value. This is your "fine tuned" calibration value, keep it for future reference.
10. Exit calibration by holding the "CAL" button until the red warning light goes out (about one second).

NOTE: **The most accurate method to measure the volume of water run is to place a container under every nozzle** and add together the amount from each nozzle. This assures that 100 percent of the water is collected and that all rows are equal. At a minimum collect water from 4 - 6 rows. **NEVER base a calibration on a single row catch. It is important to perform this procedure at a flow rate similar to that which will be used in the field.**

Speed is inaccurate

This procedure is used to drive a known distance and find the Speed Cal for your setup. The Astro GPS Speed Sensor Cal should be 0.189 and should not need to be changed.

1. With the console turned ON, place the Run/Hold switch in the HOLD position. The HOLD icon will be displayed. Turn the rotary dial to the "DISTANCE" position. Be sure the display shows 0. If not, reset the distance counter by pressing and holding "RESET" until the display returns to 0 (approximately one second).
2. Place the Run/Hold switch in RUN when the vehicle passes the starting flag to activate the distance counting function. The console display numbers will increase, adding to the distance total as you drive. Drive the pre-measured course and place the Run/Hold switch in HOLD, when the vehicle passes the ending flag, to stop the distance counting function. The console display should read "HOLD". **Stop the vehicle in a level and safe area** and continue with this procedure.
3. With the rotary dial still at DISTANCE (SPEED CAL), press and hold the "CAL" key for one second. Once the console is in "CAL," CAL and the speed calibration value will be displayed. Momentarily press CAL and the word CAL will begin to flash and the distance travelled will be displayed.
4. When the display shows distance ("CAL" is flashing), verify whether the number displayed is the exact distance you drove (within +/- 1 - 2 %). If not, press the "+" or "-" key to adjust the figure to match the distance you actually drove. If the display reads too high, use the "-" key to lower the displayed value. If the display reads too low, use the "+" key to raise the displayed value.
5. When the number shown on the display matches (as closely as possible) the actual distance driven, you have arrived at the correct Speed Cal. You may check the calibration number by momentarily pressing CAL. The word CAL and the SPEED CAL number will appear. Exit "CAL" by pressing "CAL" for one second.

I want to match Commander II speed to Tractor Speed

Use the equation below to calculate a new Speed Cal to enter in Cal mode. The Astro GPS Speed Sensor Cal should be 0.189 and should not need to be changed.

Hint: If you change the Commander II Speed Cal to 1.0 first, it makes the math very easy.

New Speed Cal = Old Speed Cal x Tractor Speed ÷ Commander II Speed

Notes

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.

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

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, perhaps more often with heavy use. It is a small job that helps ensure reliable operation during the busy season.

Recommended Care and Maintenance
Hypro Recommendations

Maintenance Schedule

REGULAR SERVICE PERIOD Performed at every indicated month or operating hour interval, whichever comes first. Item		First Use	Each Use	First month or 40 hours	Every 3 months or 500 hours	Every 6 months or 1000 hours
Crankcase Oil	Check Level	X	X			
	Replace			X	X	
Gearbox Oil	Check Level	X	X			
	Replace			X	X	
Pulsation Dampener Pressure (in models with dampeners)	Set to 20% of working PSI	X				
	Check			X	X	
Diaphragms	Replace				X	
Valves	Check				X	
	Replace					X
O-rings	Check				X	
	Replace					X

Pre-season Service

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

1. Visually check entire system (hoses, fittings, harnesses, etc.) for any signs of wear or trouble.
2. On the display, recheck all setup screens (see Section F) to verify correct setup.
3. Fill system with water and run in Manual mode to verify components and system are in working order. (May need to open air bleed valve to prime pump the first time. Be sure air bleed tube is not plugged.)
4. ***Clean out the dirt that may be packed in to the manual override knob on the hydraulic valve block.***
5. If necessary run pump in manual override mode to check hydraulic setup (see page 39).
6. 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.
7. Push in tubes at all Quick-Connect fittings so they are seated tightly. Tubes that are not fully seated are not always obvious, but may allow air in, which can cause check valves to leak.
8. Remove the black cap from the top of each check valve. Check the diaphragm to be sure it is intact and not gummed up with residue. Look under the diaphragm for debris. Compress the spring in the cap to be sure it moves freely. Carefully replace diaphragm and tighten cap.
9. Remove and clean the strainer. Be sure strainer is tightened securely so it will not suck air.
10. 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.)*
11. Run the system in Auto Test Mode to verify that system will lock on to a Target Rate.

PumpRight Valves & Diaphragms for D pumps

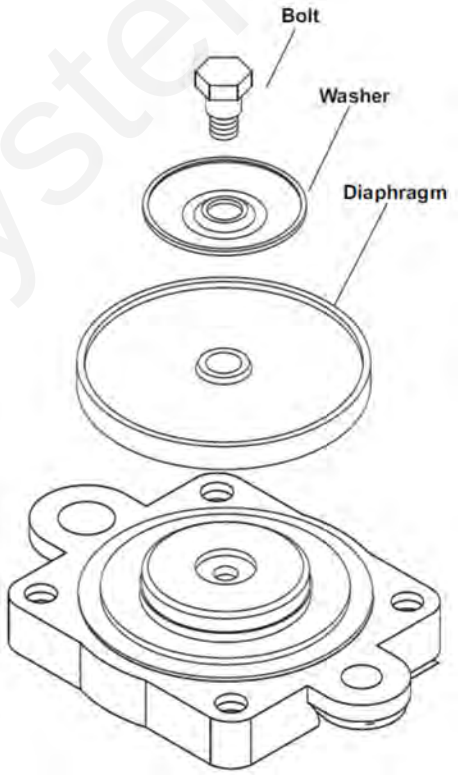
All PumpRight D-models use the same diaphragm and valve parts.

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

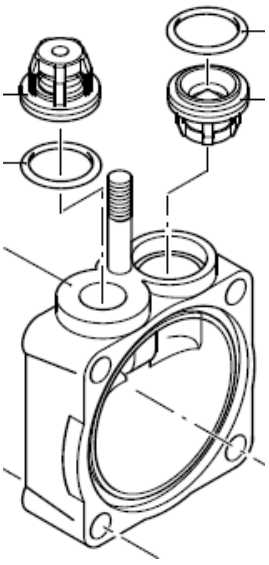


Diaphragm & Valve Service Steps:

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).



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 for PR pumps

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...

QTY in Kit	Part Number (All parts begin with 291-13-9910-XXXXXX)	Description
PR17 Pump Service Kit - 3 Diaphragm		
KIT #: 291-13-100100		
1	1040083	BlueFlex Diaphragm
2	2429051	Valve
2	3460380	Gasket/O-ring

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

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

D250 Pump Service Kit - 6 Diaphragm		
KIT #: 291-13-100200		
1	550081	BlueFlex Diaphragm
2	759051	Valve
2	680070	Gasket/O-ring

See SureFire Manual for PumpRight pumps—396-4034Y1 for more information and parts breakout—also at www.surefireag.com

There is a pump repair video there showing how to change diaphragms and valves.

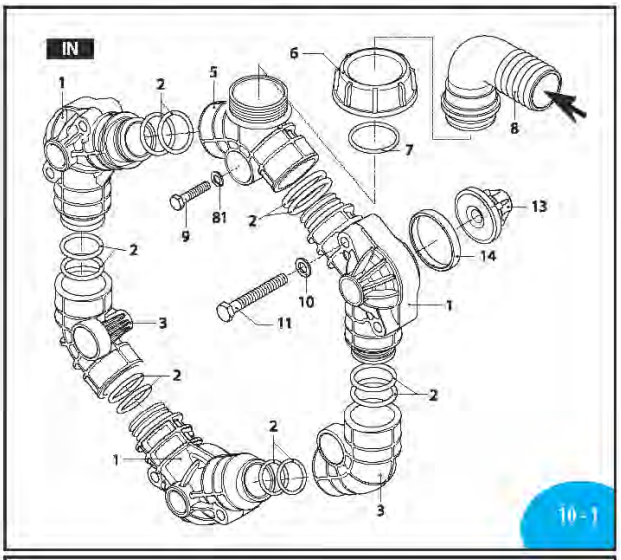
PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

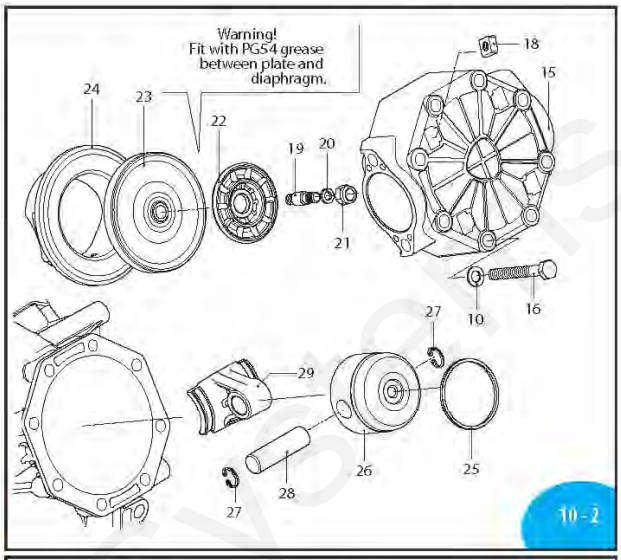
For other service parts, see individual Pump Part Breakout Diagrams

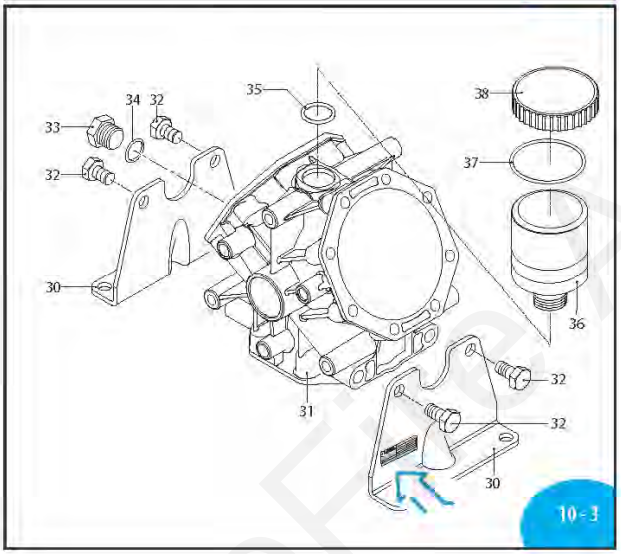
See SureFire Manual for PumpRight pumps—396-4034Y1 for more information

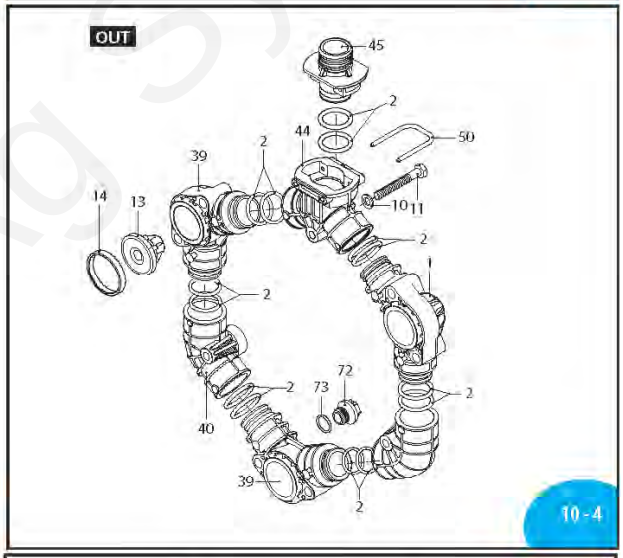
PR17 Assembly and Part Breakdowns

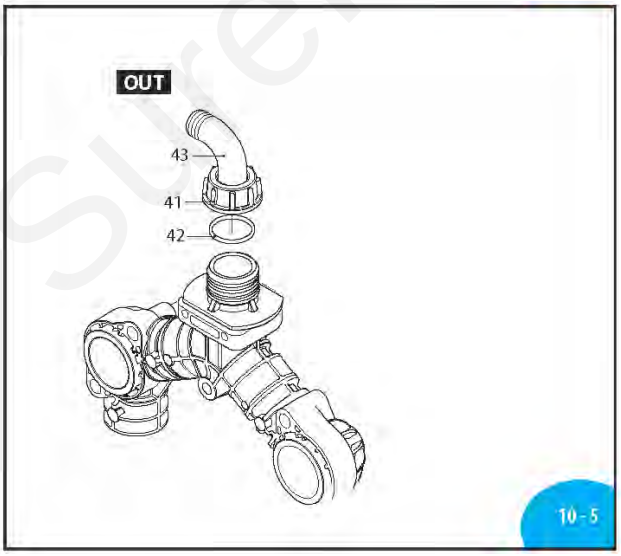
PR17 Polypropylene BlueFlex Diapragm Pump—17 GPM
P/N: 290-02-PR17 (SP)

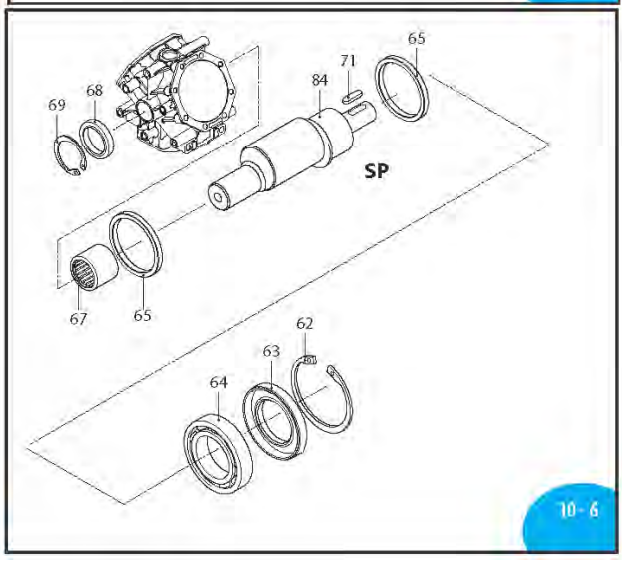












PR17 Assembly and Part Breakdowns

PR17 Polypropylene BlueFlex Diapragm Pump—17 GPM
P/N: 290-02-PR17 (SP)

Pos	Code	Discription		Qty	Note
1	3240030	Line	valve closed	4	
2	390292	O-ring	Ø 28.25x2.62	24	Viton LFP
3	3240040	Manifold		3	
5	3240050	Line	asp. threaded	1	
6	750670	Ring nut	1 1/2" G	1	
7	1880460	O-ring	Ø 29x3	1	Viton LFP
8	50267	Elbow	1 1/2"	1	
9	3240280	Screw	TE M8x55	6	SS T105*
10	3120760	Washer		36	SS
11	380211	Screw	TE M8x75	12	SS T90*
13	2429051	Valve	AISI 316L	6	LFP
14	3460380	Gasket		6	Viton LFP
15	3240020	Head		3	
16	621771	Screw	TE M8x80	24	SS T125*
17	395870	Washer		4	SS
18	3120510	Nut	M8	12	SS
19	3240101	Hub pin	AISI 316L	3	LFP T265* (a)
20	320622	Washer		3	SS
21	2240670	Nut	M10 AISI 316L	3	LFP T220*
22	3240110	Plate		3	
23	1040083	Diaphragm		3	BlueFlex™
24	3240130	Sleeve		3	
25	650190	Piston ring		1	
26	1040120	Piston	Ø 63	3	
27	1040270	Ring	circlip Øi 15	2	
28	1040070	Pin		3	
29	3240120	Connecting-rod		3	
30	3240090	Foot		2	
31	3240010	Pump body		1	
32	620342	Screw	TE M10x20	4	SS T265*
33	880530	Plug	3/8" G	1	T180*
34	740290	O-ring	Ø 14x1.78	1	
35	720030	O-ring	Ø 22.22x2.62	1	
36	3120240	Tank		1	T180*
37	650920	O-ring	Ø 53.65x2.62	1	
38	1040324	Plug	rosso	1	
39	3240031	Line		2	
40	3240060	Line		1	
41	3120440	Ring nut	1" G	1	
42	1140451	O-ring	Ø 20.24x2.62	1	Viton
43	3120460	Elbow	1"	1	
44	3240080	Line		1	For GS35 contoler
45	880311	O-ring	Ø 26.65x2.62	2	Viton LFP
50	3460210	Fork		1	
62	961790	Ring	circlip Øi 68	1	
63	3120160	Ring	seal	1	
64	961780	Bearing		1	
65	3240320	Ring	connecting rod	2	
67	3460110	Bearing		1	
68	1300230	Ring	seal	1	
69	480900	Ring	circlip Øi 35	1	
71	2280950	Key		1	(d)
72	3120690	Plug	3/8"G	1	
73	2840891	O-ring	Ø 14x2	1	Viton LFP

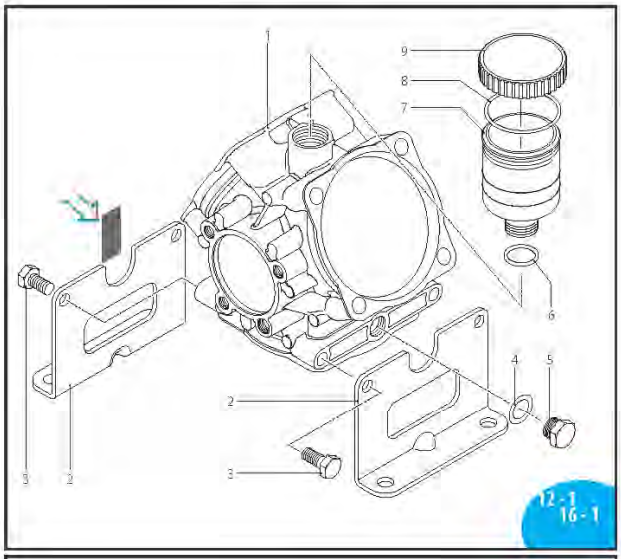
Pos	Code	Discription		Qty	Note
74	621782	Screw	TE M8x40	6	SS T180*
81	390315	Washer		6	SS
84	3240190	Shaft	SP marked EB	1	AR80
85	3240460	Complete Discharge	assembly	1	AR80bp
86	550351	Shaft	SP	1	AR60

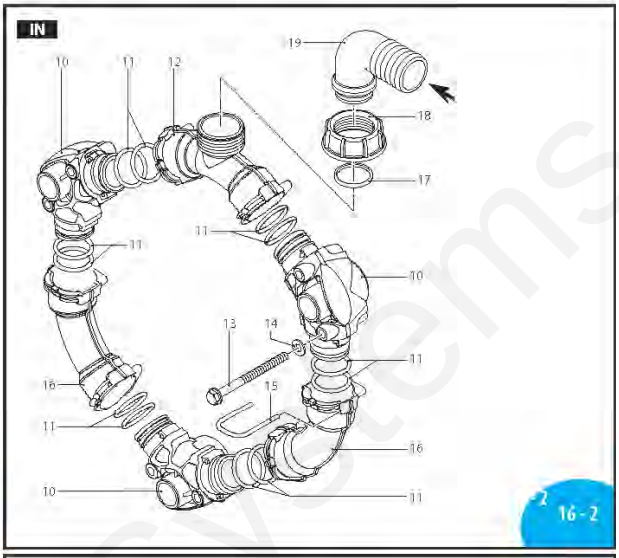
* Torque: in-lbs +/- 10%

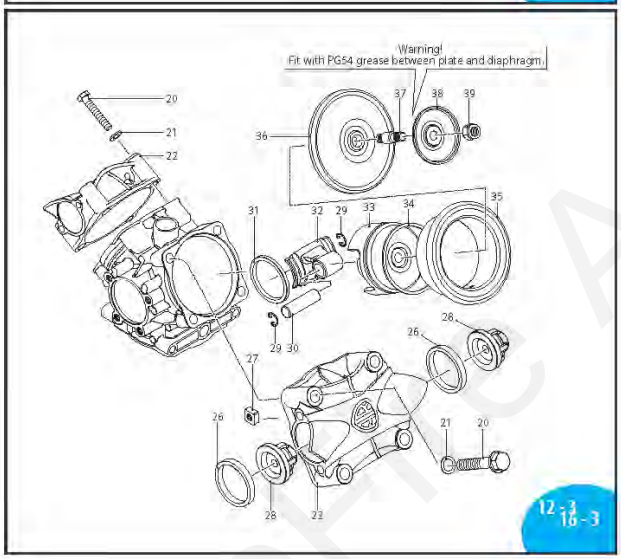
PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

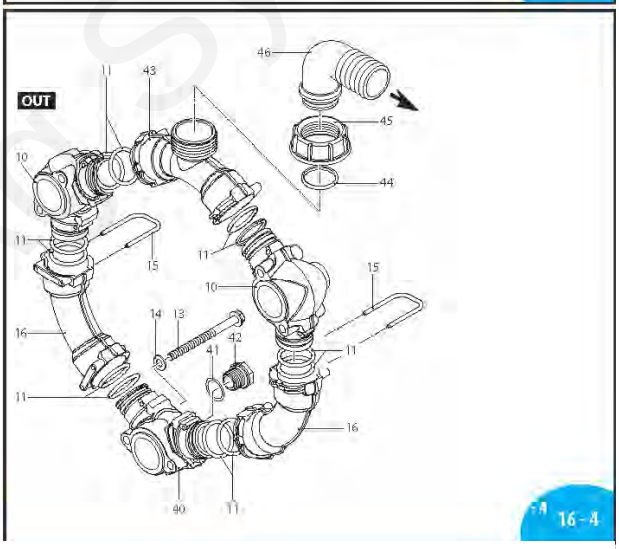
PR30 Diaphragm Pump Parts

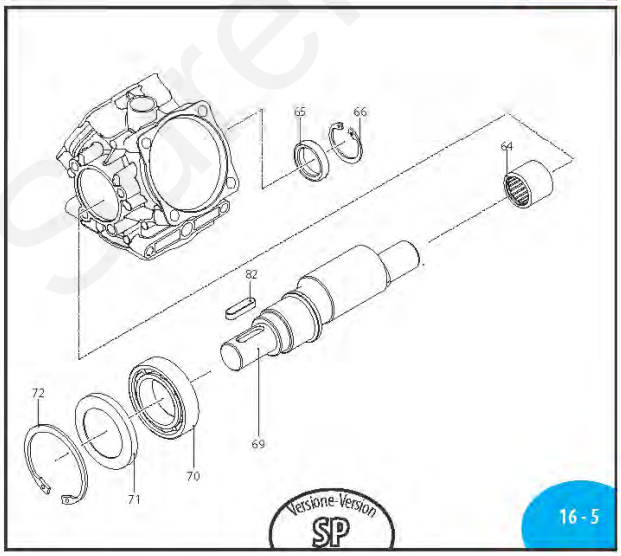
PR30 Polypropylene BlueFlex Diapragm Pump—30 GPM
P/N: 290-02-PR30 (SP)











PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

PR30 Diaphragm Pump Parts

PR30 Polypropylene BlueFlex Diapragm Pump—30 GPM
P/N: 290-02-PR30 (SP)

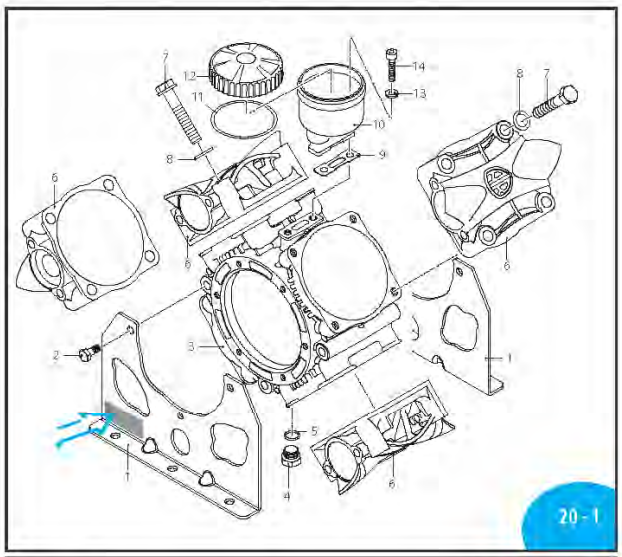
Pos	Code	Description		Qty	Note
1	3460010	Pump body		1	
2	3460100	Foot		2	Cataphoresis
3	160673	Screw	TE M10x25	4	SS T265* LFP
4	740290	O-ring	Ø 14x1.78	1	
5	880530	Plug	3/8" G	1	T180*
6	720030	O-ring	Ø 22.22x2.62	1	
7	3120240	Tank		1	T180*
8	650920	O-ring	Ø 53.65x2.62	1	
9	1040324	Plug	red	1	
10	3460030	Line		4	
11	2680141	O-ring	Ø 32.93x3.53	24	Viton LFP
12	3460050	Line	suction	1	
13	3460201	Screw	TE M8x100	12	SS T105* LFP
14	390315	Washer		24	SS LFP
15	3460210	Fork		13	
16	3460040	Line		3	
17	1880460	O-ring	Ø 29x3	1	Viton LFP
18	750670	Ring nut	1 1/2" G	1	
19	50267	Elbow	1 1/2"	1	
20	750072	Screw	TE M12x70	12	SS T310* LFP
21	390092	Washer		12	SS LFP
22	3460020	Head		3	
23	3240290	Shield		2	
26	3460380	Gasket		6	Viton LFP
27	3120510	Nut	M8	12	SS LFP
28	2429051	Valve	AISI 316L	6	LFP
29	380080	Ring	circlip Øi 14	6	
30	380300	Pin		3	
31	3460090	Ring	connecting rod	2	
32	3460080	Connecting-rod		3	
33	580120	Piston	Ø 80	3	
34	500260	Piston ring		3	
35	750110	Sleeve		3	
36	550081	Diaphragm		3	BlueFlex
37	2240101	Hub pin		3	T265* LFP
38	580090	Wobble plate		3	
39	2240670	Nut	M10 AISI 316L	3	T220* LFP
40	3460031	Line		2	
41	1140451	O-ring	Ø 20.24x2.62	1	Viton LFP
42	3460220	Plug	1/2"G	1	T90*
43	3460060	Line	manifold	1	
44	880311	O-ring	Ø 26.62x2.62	1	Viton LFP
45	651100	Ring nut	1" 1/4 G	1	
46	651460	Elbow	1"	1	
64	3460110	Bearing		1	
65	1300230	Ring	seal	1	
66	480900	Ring	circlip Øi 35	1	
69	3460260	Shaft	marked DV	1	AR 140bp /LFP SP
70	961781	Bearing		1	
71	3120160	Ring	seal	1	
72	961790	Ring	circlip Øi 68	1	
82	3469002	Complete Inlet	assembly	1	AR120bp

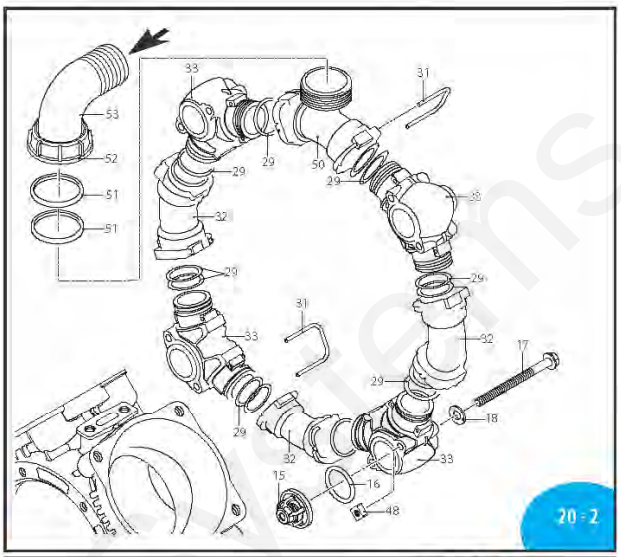
*Torque: in-lbs +/- 10%

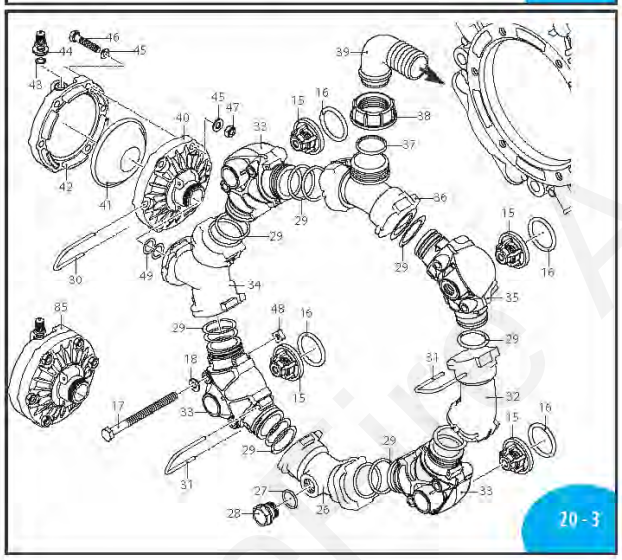
PUMPRIGHT HYDRAULIC DRIVE DIAPHRAGM PUMPS

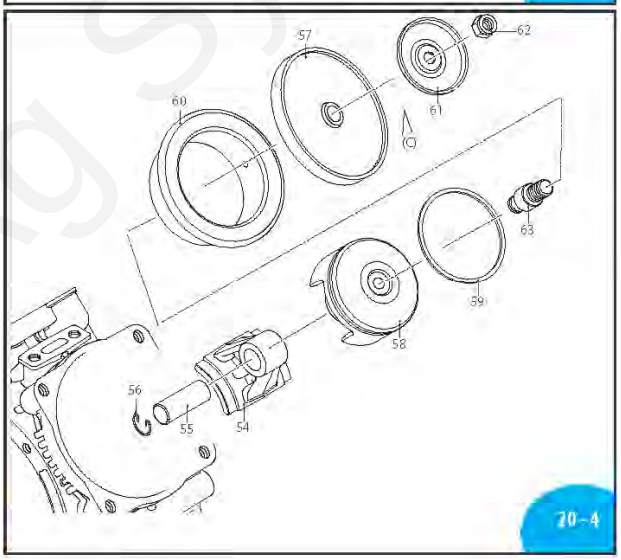
PR40 Diaphragm Pump Parts

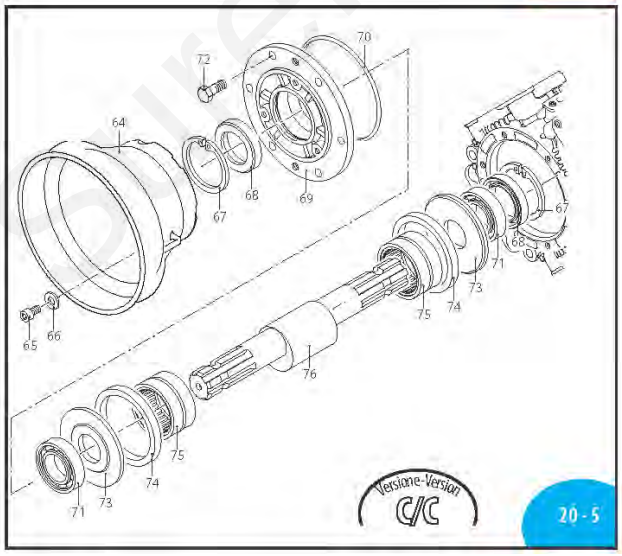
PR40 Polypropylene BlueFlex Diapragm Pump—40 GPM
P/N: 290-02-PR40 (C/C)











PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

PR40 Diaphragm Pump Parts

PR40 Polypropylene BlueFlex Diapragm Pump—40 GPM
P/N: 290-02-PR40 (C/C)

Pos	Cod.	Description		Q.ty	Note
1	761031	Foot		2	
2	160673	Screw	TE M10x25	6	Inox T355*
3	761010	Pump body		1	
4	880530	Plug	3/8" G	1	T180*
5	740290	O-ring	Ø 14x1,78	1	▶
6	3460020	Head		4	
7	750072	Screw	TE M12x70	16	Inox T265*
8	390092	Washer		16	Inox
9	750040	Gasket		1	
10	750030	Tank		1	
11	1040060	O-ring	Ø 72,69x2,62	1	
12	751183	Plug	rosso	1	AR 185 bp
13	380243	Washer		2	
14	680350	Screw	TCEI M8x35	2	T90*
15	2429051	Valve	AISI 316L	8	
16	3460380	Gasket		8	Viton
17	3460201	Screw	TE M8x100	16	Inox T90*
18	390315	Washer		16	Inox
26	761240	Line		1	
27	1140451	O-ring	Ø 20,24x2,62	1	Viton ▶
28	3460220	Plug	1/2"G	1	T90*
29	230061	O-ring	Ø 34,52x3,53	32	Viton
30	3460210	Fork		1	
31	761250	Fork		16	
32	761200	Line	asp. / mandata	4	
33	761190	Line	porta valvola/chiuso	7	
34	761230	Line	camera aria	1	
35	761191	Line	filettato 1/2" G	1	
36	761220	Line	mandata 1" 1/2G	1	
37	1880460	O-ring	Ø 29x3	1	Viton ▶
38	750670	Ring nut	1" 1/2 G	1	
39	3040160	Elbow	Ø 35	1	AR 185 bp
40	3460180	Semi air chamber	inferiore	1	Nylon
41	800192	Diaphragm	camera aria	1	Blueflex
42	3460190	Semi air chamber	superiore	1	Nylon
43	650542	Gasket		1	
44	180020	Air valve		1	$C_{2,5}$
45	390315	Washer		12	Inox
46	621782	Screw	TE M8x40	6	Inox T180*
47	3120260	Nut	M8	6	Inox T180*
48	3120510	Nut	quadro M8	16	Inox
49	880311	O-ring	Ø 26,65x2,62	2	Viton
50	761210	Line	asp. /filettato 2"G	1	
51	3040471	O-ring	Ø 39,34x2,62	2	Viton ▶
52	3040450	Ring nut	2" G	1	
53	3040440	Elbow	Ø 50	1	AR 185 bp
54	760140	Connecting-rod		4	
55	160700	Pin		4	▶
56	160691	Ring	seeger Øi 18	8	
57	550081	Diaphragm		4	BlueFlex
58	750122	Piston	Ø 80	4	
59	500260	Piston ring		4	

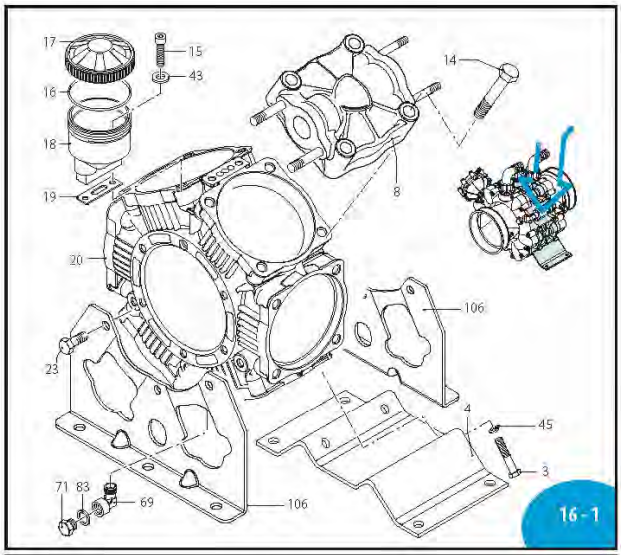
Pos	Cod.	Description		Q.ty	Note
60	750115	Sleeve		4	AR 185 bp
61	751251	Wobble plate		4	
62	2240670	Nut	M10 AISI 316L	4	T220*
63	2240101	Hub pin	AISI 316L	4	(a) T265*
64	1500470	Cardan protection		1	
65	850252	Screw	TCEI M8x12	3	Inox T90*
66	390315	Washer		3	Inox
67	200390	Ring	seeger Øi 62	2	
68	160740	Ring	tenuta	2	☒
69	680020	Support		1	
70	851360	O-ring	Ø 120,32x2,62	1	⊖
71	230350	Bearing		1	⬇
72	160673	Screw	TE M10x25	6	Inox T310*
73	540040	Plate		2	
74	750130	Ring	biella	2	▶
75	750090	Bearing		2	▶
76	750174	Shaft	C/C m-AV	1	AR 185 bp
85	43067	Air chamber	LFP BlueFlex™	1	

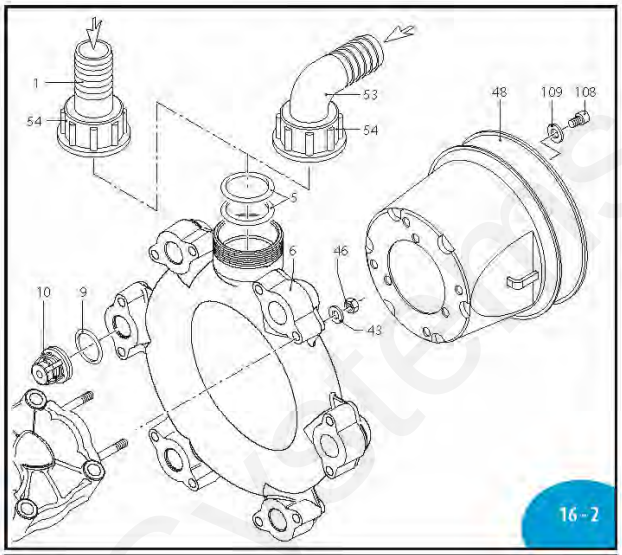
* Torque: in-lbs +/- 10%

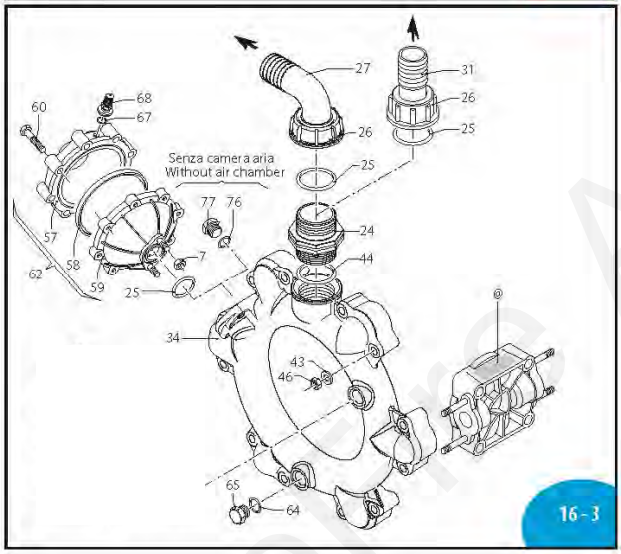
PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

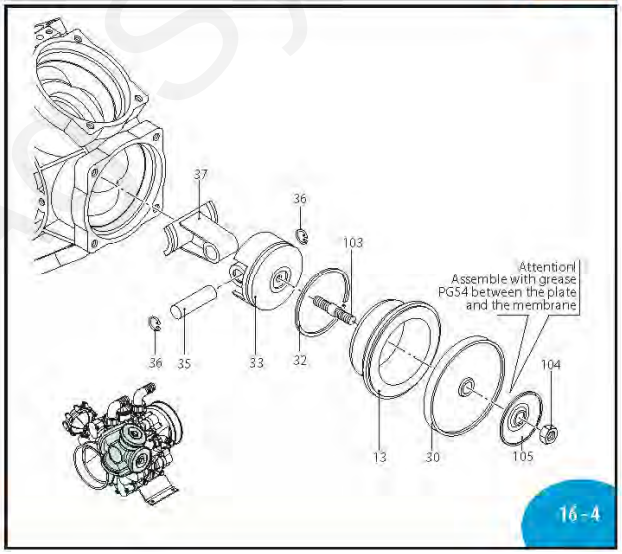
D250 Diaphragm Pump Parts

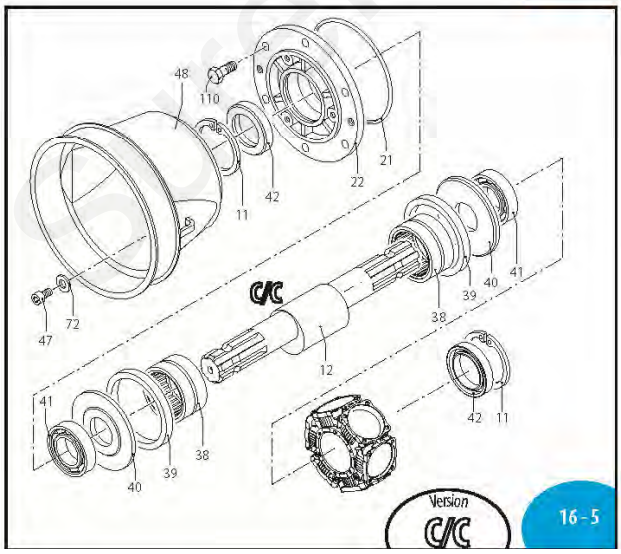
D250 BlueFlex Diaphragm Pump—55 GPM
P/N: 290-02-9910-D250











PUMPRIGHT
HYDRAULIC DRIVE DIAPHRAGM PUMPS

D250 Diaphragm Pump Parts

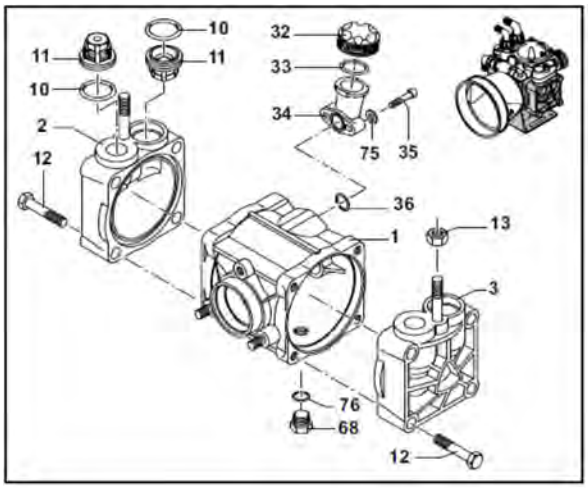
D250 BlueFlex Diapragm Pump—55 GPM
P/N: 290-02-9910-D250

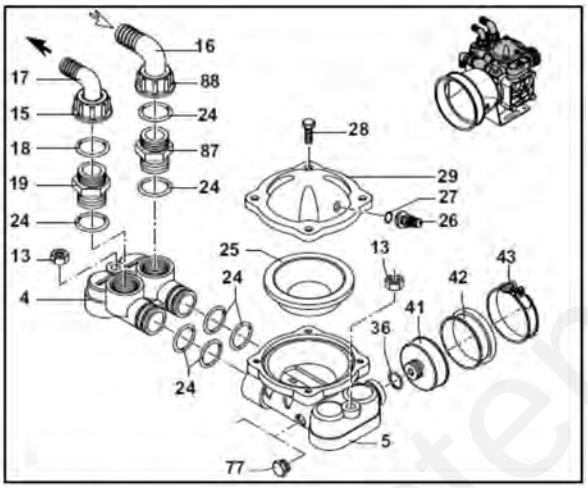
Pos	Code	Description		Qty	Note
1	750870	Hose tail	2"	1	Optional
	750730	Hose tail	Ø 60	1	Optional
3	750071	Screw	TE M12x70	4	Geomet T445*
4	750200	Foot		1	
5	750740	O-ring	Ø 56.74x3.53	2	
6	751070	Line	suction	1	
7	380242	Nut	M8	2	Geomet T220*
8	751350	Head	black plasticized	6	
9	680070	O-ring	Ø 31.5x4.25	12	
10	759051	Valve		12	
11	200390	Ring	circlip Øi 62	2	
12	750176	Shaft	marked AZ	1	AR 215 bp C/C
	750170	Shaft	marked AU	1	AR 250 bp C/C
	750174	Shaft	marked AV	1	AR 280 bp C/C
13	750117	Sleeve		6	AR 215 bp C/C
	750110	Sleeve		6	AR 250 bp C/C
	750115	Sleeve		6	AR 280 bp C/C
14	750061	Screw	TE M12x65	24	Geomet T445*
15	680350	Screw	TCEI M8x35	2	T90*
16	1040060	O-ring	Ø 72.69x2.62	1	
17	750051	Plug	green	1	AR 215 bp
	1800060	Plug	black	1	AR 250 bp
	750050	Plug	red	1	AR 280 bp
18	750030	Tank		1	
19	750040	Gasket		1	
20	751300	Pump body		1	
21	851360	O-ring	Ø 120.32x2.62	1	
22	680020	Support		1	
23	160672	Screw	TE M10x25	6	Geomet T355*
24	751130	Fitting	1"1/2 G M-M	1	T90*
25	390290	O-ring	Ø 29x3	2	
26	750670	Ring nut	1 1/2" G	1	
27	750660	Elbow	1 1/2"	1	
28	2420181	Support		1	
29	650640	Screw	TCEI M10x25	6	Geomet T310*
30	550081	Diaphragm		6	BlueFlex
	550080	Diaphragm		6	NBR
	550084	Diaphragm		6	Viton
	550085	Diaphragm		6	Desmopan
	550086	Diaphragm		6	HPDS
31	760940	Hose tail	Ø 35	1	
32	500260	Piston ring		6	
33	750122	Piston	Ø 80	6	
34	751080	Line	manifold	1	
35	160700	Pin		6	
36	160691	Ring	circlip Øi 18	12	
37	750140	Connecting-rod		6	
38	750090	Bearing		2	
39	750130	Ring	connecting rod	2	
40	540040	Plate		2	
41	751280	Bearing		2	
42	160740	Ring	seal	2	

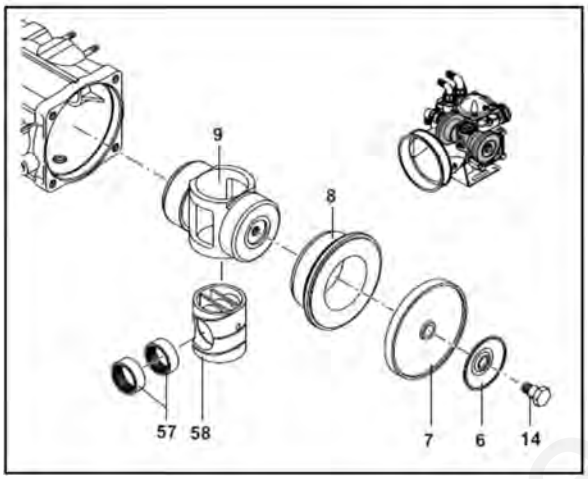
Pos	Code	Description		Qty	Note
43	380243	Washer		26	Geomet
44	751140	O-ring	Ø 47.22x3.53	1	
45	250143	Washer		4	Geomet
46	380242	Nut	M8	24	Geomet T180*
47	850251	Screw	TCEI M8x12	3	Geomet T90*
48	1500470	Shield		1	
53	750850	Elbow	2"	1	AR 215 bp - AR 250 bp
	750720	Elbow	Ø 60	1	AR 280 bp
54	750710	Ring nut	2" 1/2 G	1	
57	620232	Semi air chamber	upper	1	Black
58	550194	Diaphragm	air chamber	1	Blueflex
	550190	Diaphragm	air chamber	1	NBR
	550192	Diaphragm	air chamber	1	Viton
	550193	Diaphragm	air chamber	1	HPDS
59	680180	Semi air chamber	lower	1	
60	621781	Screw	TE M8x40	8	Geomet T220*
62	629230	Air chamber	BlueFlex*	1	
	629216	Air chamber	NBR	1	
64	180101	O-ring	Ø 17.5x2	1	
65	330173	Plug	1/2" G	1	Geomet T180*
67	650542	Gasket		1	
68	180020	Air valve		1	T25*
69	750370	Fitting	1/4" G M-F	1	
71	880581	Plug	1/4" G	1	T180*
72	390314	Washer		3	Geomet
76	740290	O-ring	Ø 14x1.78	1	
77	880530	Plug	3/8" G	1	T180*
78	881560	Fitting	1/2" G M-F	1	
79	1609000	Safety valve		1	290 PSI
80	880831	O-ring	Ø 15.54x2.62	1	Viton
81	550450	Ring nut	3/4" G	1	
82	550460	Elbow	Ø 18	1	
83	880820	Washer		1	
84	620330	Ring	circlip Øi 65	1	
85	1800090	Ring	seal	1	
86	230310	Bearing		1	
87	760510	Plate		1	
103	2240100	Hub pin		6	T265*
104	2240110	Nut	M10 SS	6	SS T220*
105	751250	Wobble plate		6	
106	751291	Foot		2	
108	820673	Screw	TCEI M10X16	3	Geomet T90*
109	320621	Washer		3	Geomet
110	160672	Screw	TE M10x25	6	Geomet T310*
111	1300280	Spacer		3	
112	760360	Guard		1	
113	320621	Washer		3	Geomet
114	650640	Screw	TCEI M10x25	3	Geomet T90*

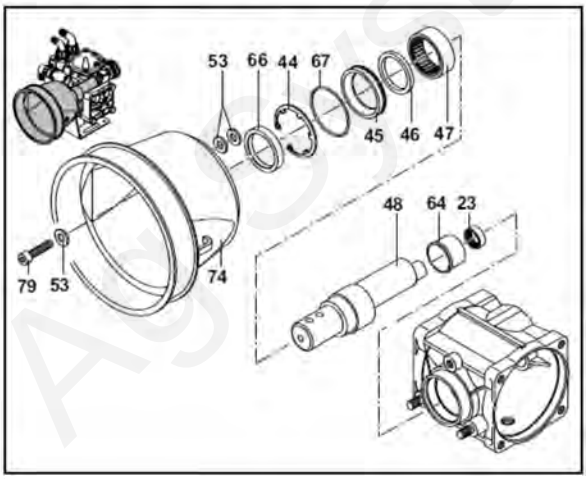
*Torque: in-lbs +/- 10%

D70 Diaphragm Pump Parts





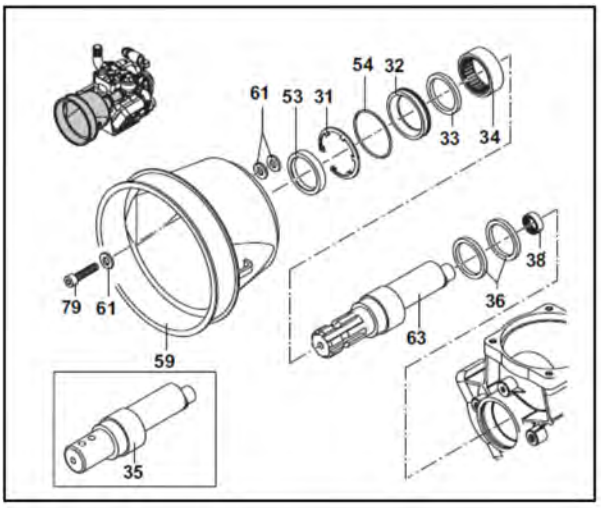


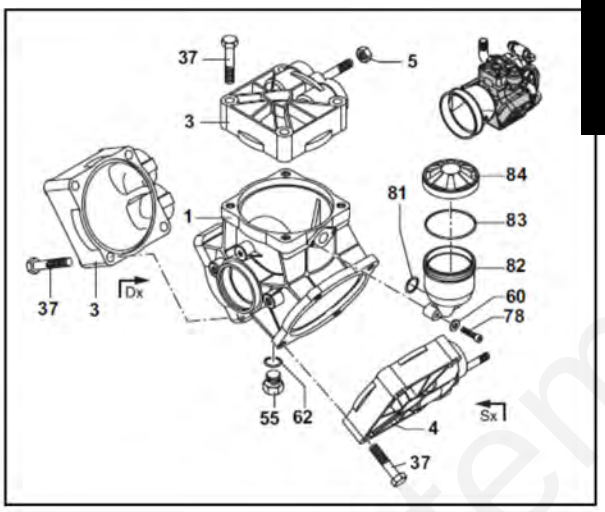


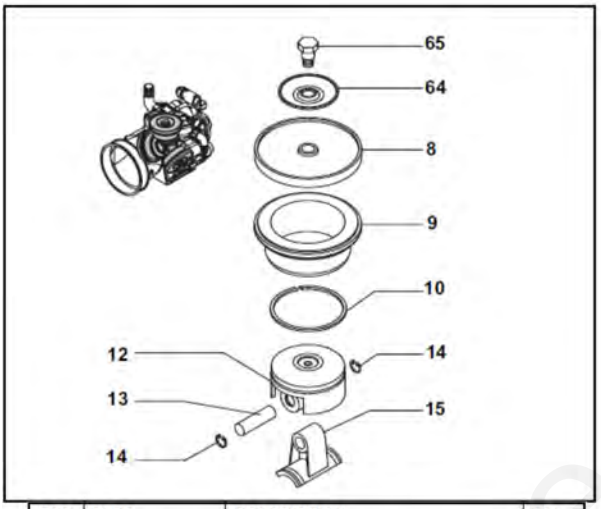
REF. NO.	PART NUMBER	DESCRIPTION	QTY. REQ'D
1	9910-550011	Pump Body with bolts	1
2	9910-550101	Right head DX	1
3	9910-550102	Left head SX	1
4	9910-550150	Manifold	1
5	9910-559200	Accumulator manifold	1
6	9910-580370	Plate	2
7	9910-550080	Diaphragm (Buna) Optional	2
7a	9910-550085	Diaphragm (Desmopan) Standard	2
8	9910-550110	Sleeve	2
9	9910-550120	Piston	1
10	9910-320030	O-ring	4
11	9910-759051	Complete valve assembly	4
12	9910-551040	M10 x 55 Bolt	8
13	9910-180152	Nut	4
14	9910-580360	Diaphragm bolt	2
15	9910-550880	Ring nut	1
16	9910-580040	Elbow 1-1/4"	1
17	9910-550370	Elbow 1"	1
18	9910-550350	O-ring	1
19	9910-550340	Threaded adapter	1
23	9910-550310	Roller bearing	1
24	9910-390290	O-ring	7
25	9910-550190	Accumulator diaphragm	1
26	9910-550300	Air valve	1
27	9910-650542	O-ring	1
28	9910-550680	Bolt	4
29	9910-559204	Upper air chamber	1

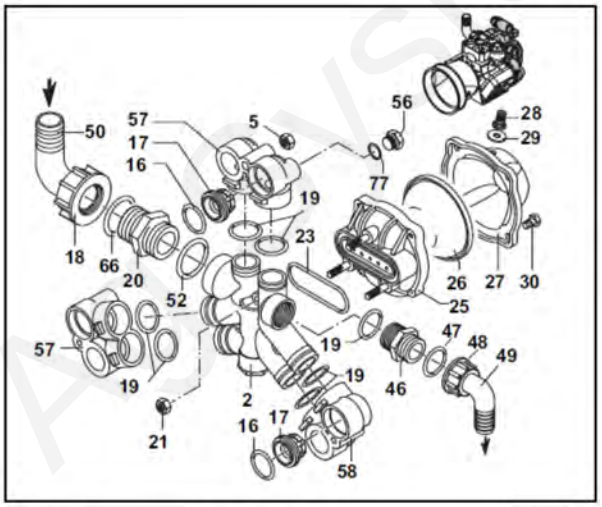
REF. NO.	PART NUMBER	DESCRIPTION	QTY. REQ'D
32	9910-550057	Sight glass cap	1
33	9910-550040	O-ring	1
34	9910-550030	Oil sight glass	2
36	9910-180101	O-ring	2
41	9910-650660	Diaphragm holder	1
42	9910-650670	Diaphragm	1
43	9910-650690	Clamp	1
44	9910-200391	Retainer ring	1
45	9910-550470	Seal ring	1
46	9910-550070	Spacer ring	1
47	9910-550060	Roller bushing	1
48	9910-550170	Shaft	1
52	9910-200233	Washer	2
53	9910-320621	Washer	5
57	9910-550280	Bearing	2
58	9910-550140	Cylinder	1
64	9910-550160	Spacer	1
66	9910-550491	Seal ring	1
67	9910-650920	O-ring	1
68	2406-0023	Oil drain plug	1
74	9910-1500350	Shield	1
75	9910-550332	Washer	2
76	9910-740290	O-ring	1
77	9910-330173	Plug	1
79	9910-620472	M10 x 20 Bolt	1
87	9910-450120	Threaded adapter	1
88	9910-550870	Ring nut	1

D115 Diaphragm Pump Parts





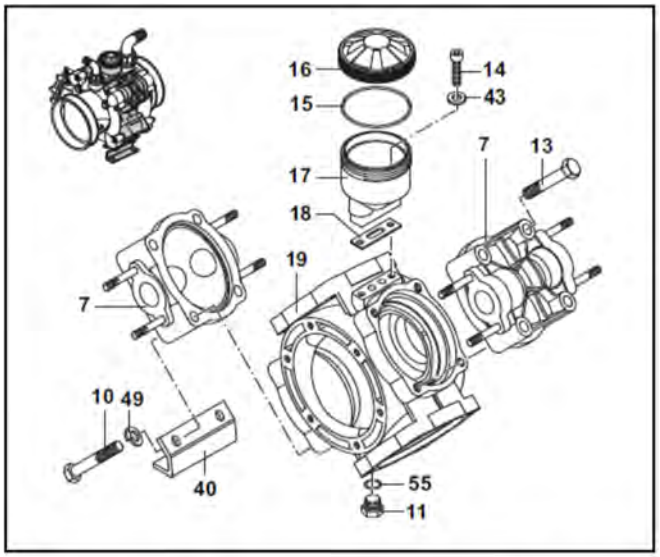


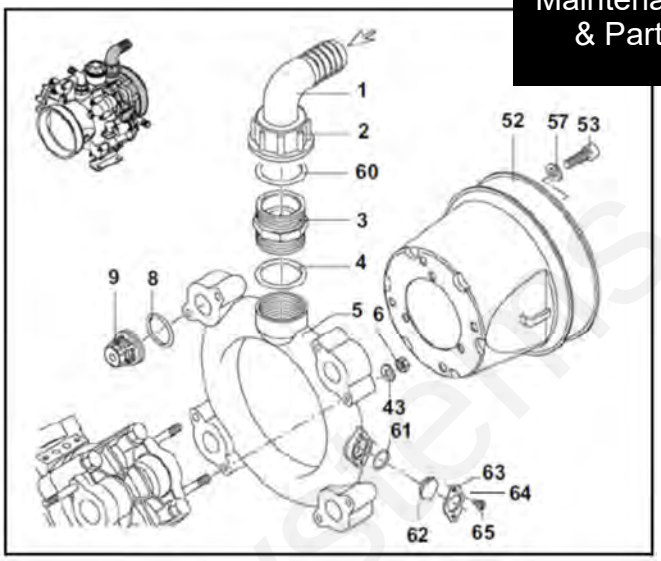


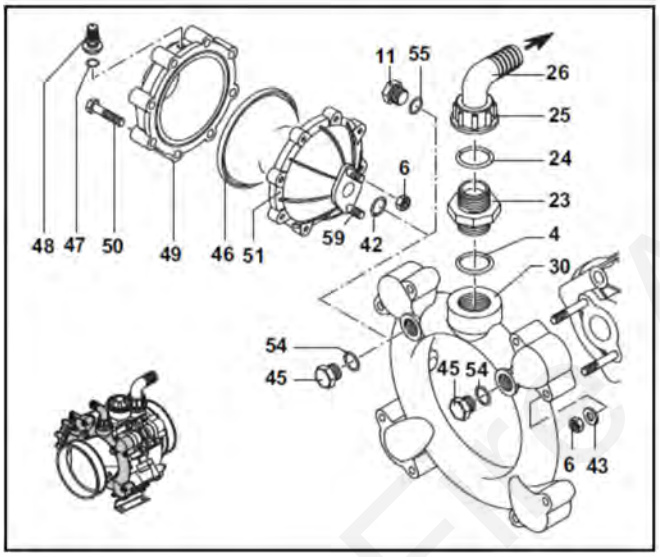
REF. NO.	PART NUMBER	DESCRIPTION	QTY. REQ'D
1	9910-580013	Pump body with bolts	1
2	9910-580150	Manifold	1
3	9910-550101	DX Right head	2
4	9910-550102	SX Left head	1
5	9910-180152	Nut	3
8	9910-550080	Diaphragm (Buna) Optional	3
8	9910-550085	Diaphragm (Desmopan) Standard	3
9	9910-580110	Sleeve (D115)	3
9	9910-580350	Sleeve (D135)	3
10	9910-500260	Piston ring	3
12	9910-580120	Piston	3
13	9910-380300	Pin	3
14	9910-380080	Pin ring	6
15	9910-580140	Connecting rod	3
16	9910-320030	O-ring	6
17	9910-759051	Complete valve	6
18	9910-540541	Ring nut	1
19	9910-390291	O-ring	7
20	9910-540530	Threaded adapter	1
21	9910-390271	Nut	3
23	9910-580050	Gasket	1
25	9910-580180	Accumulator manifold	1
26	9910-550190	Accumulator diaphragm	1
27	9910-559204	Accumulator head	1
28	9910-550300	Air valve	1
29	9910-650542	O-ring	1
30	9910-550680	M8 x 20 Bolt	4
31	9910-200391	Retainer ring	1
32	9910-550470	Gasket retainer	1
33	9910-550070	Spacer ring	1
34	9910-550060	Roller bearing	1
35	9910-550170	Shaft (D115)	1
36	9910-580470	Connecting rod ring	2

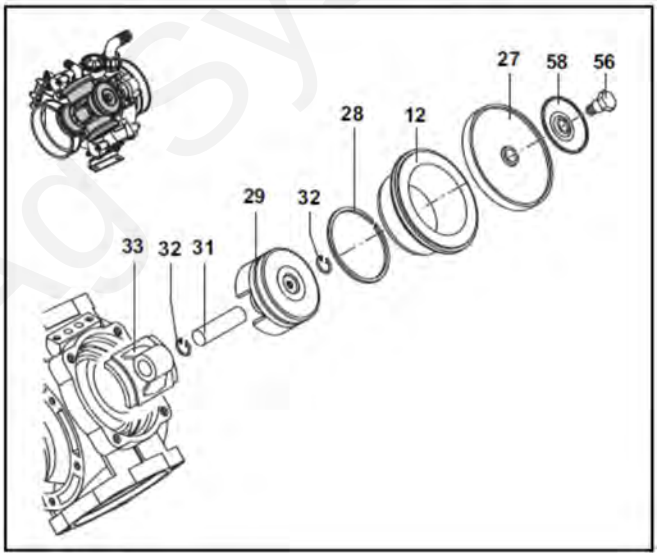
REF. NO.	PART NUMBER	DESCRIPTION	QTY. REQ'D
37	9910-551040	M10 x 55 Bolt	12
38	9910-550310	Roller bushing	1
46	9910-550340	Threaded adapter	1
47	9910-550350	O-ring	1
48	9910-550242	Ring nut	1
49	9910-550370	Elbow 1"	1
50	9910-540550	Elbow 1-1/2"	1
52	9910-250310	O-ring	1
53	9910-550491	Seal ring	1
54	9910-650920	O-ring	1
55	2406-0023	Oil drain plug	1
56	9910-330173	Plug	1
57	9910-589200	DX Right valve retainer w/plug/o-ring	2
58	9910-580072	SX Left valve retainer	1
59	9910-1500350	Shield	1
60	9910-550332	Washer	2
61	9910-320621	Washer	5
62	9910-740290	O-ring	1
63	9910-580330	Shaft (D135)	1
64	9910-580370	Plate	3
65	9910-580360	Diaphragm bolt	3
66	9910-250310	O-ring	1
69	9910-200233	Washer	2
77	9910-180101	O-ring	1
78	9910-850851	M6 x 30 Bolt	2
79	9910-620472	M10 x 20 Bolt	3
81	9910-390180	O-ring	1
82	9910-1040310	Oil sight glass	1
83	9910-650920	O-ring	1
84	9910-1040322	Black oil tank cap	1

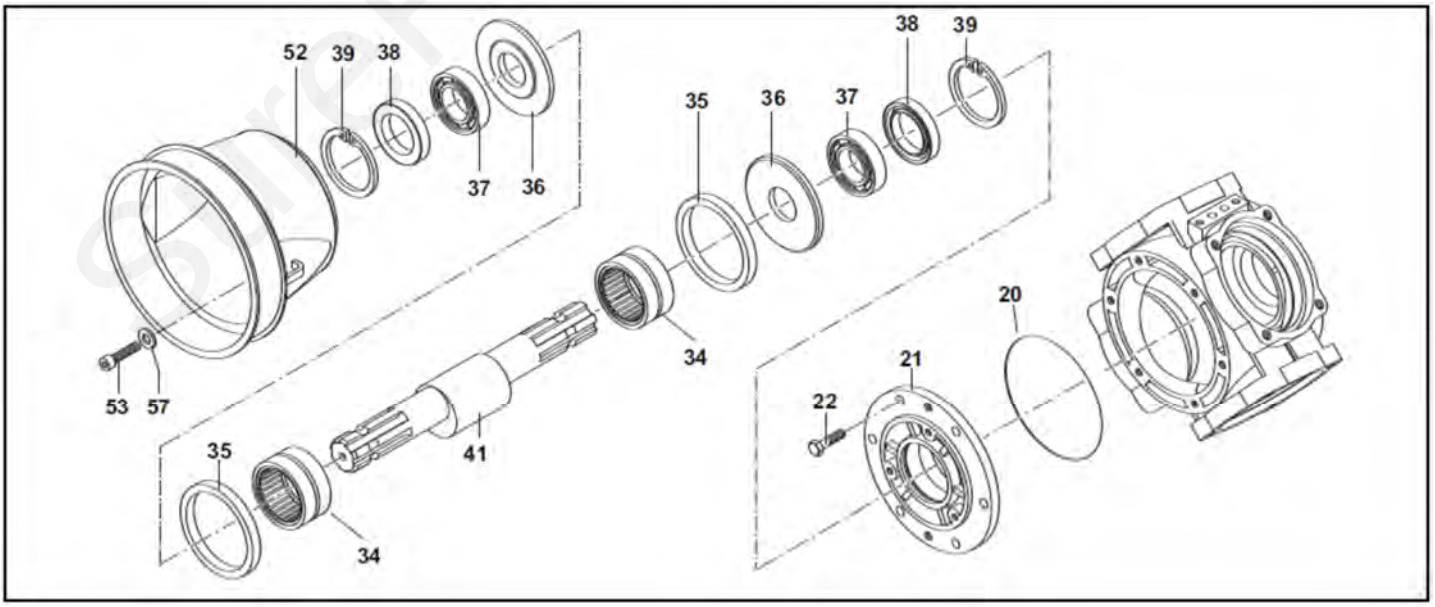
D160 Diaphragm Pump Parts







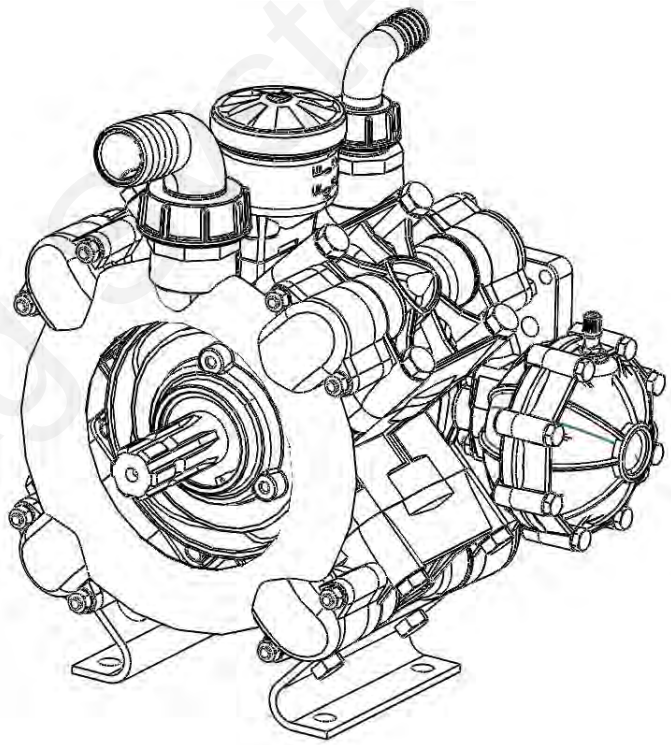




D160 Diaphragm Pump Parts

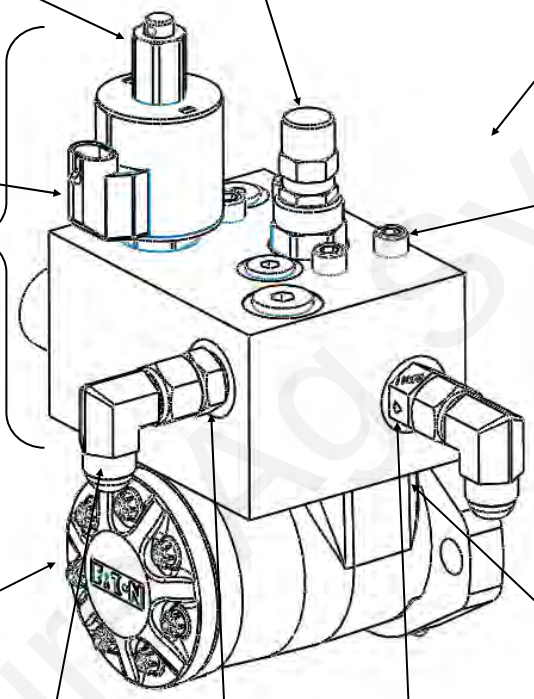
REF. NO.	PART NUMBER	DESCRIPTION	QTY. REQ'D
1	9910-760020	Elbow 2"	1
2	9910-760040	Ring nut	1
3	9910-760030	Threaded adapter	1
4	9910-250310	O-ring	1
5	9910-760220	Suction manifold	1
6	9910-380242	Nut	18
7	9910-750100	Head	4
8	9910-680070	O-ring	8
9	9910-759051	Complete valve	8
10	9910-750071	Bolt	4
11	2406-0023	Oil drain plug	2
12	9910-750110	Sleeve	4
13	9910-750061	M12 x 65 Bolt	12
14	9910-680350	M8 x 35 Bolt	2
15	9910-1040060	O-ring	1
16	9910-750057	Black oil tank cap	1
17	9910-750030	Oil sight glass	1
18	9910-750040	Gasket	1
19	9910-760010	Pump body	1
20	9910-851360	O-ring	1
21	9910-680020	Bearing support housing	1
22	9910-160672	M10 x 25Bolt	6
23	9910-540530	Threaded adapter	1
24	9910-250310	O-ring	1
25	9910-540540	Ring nut	1
26	9910-540550	Elbow 1-1/2"	1
27	9910-550085	Diaphragm (Desmopan) Standard	4
27a	9910-550080	Diaphragm (Buna) Optional	4
28	9910-500260	Piston ring	4
29	9910-750122	Piston	4
30	9910-760070	Manifold	1
31	9910-160700	Pin	4
32	9910-160691	Pin ring	8
33	9910-760140	Connecting rod	4
34	9910-750090	Roller bearing	2
35	9910-750130	Connecting rod ring	2
36	9910-540040	Spacer washer	2
37	9910-230350	Bearing	2
38	9910-160740	Seal ring	2
39	9910-200390	Retainer ring	2
40	9910-760201	Base	2
41	9910-750170	Crankshaft	1
42	9910-390290	O-ring	1
43	9910-380243	Washer	18
44	9910-250143	Washer	4
45	9910-330173	Plug	2
46	9910-550190	Accumulator diaphragm	1
47	9910-650542	O-ring	1
48	9910-180020	Air valve	1
49	9910-620232	Accumulator head	1
50	9910-621781	M8 x 40 Bolt	8
51	9910-680180	Accumulatorbody	1
52	9910-1500350	Shield	2
53	9910-850251	M8 x 12 Bolt	6
54	9910-180101	O-ring	2
55	9910-740290	O-ring	2
56	9910-580360	Diaphragm bolt	4
57	9910-390314	Washer	6
58	9910-580370	Retaining washer	4
59	9910-390670	Accumulator stud	1

REF. NO.	PART NUMBER	DESCRIPTION	QTY. REQ'D
60	9910-620210	Oring	1
61	9910-480440	Oring	1
62	9910-2420120	Flange Plug	1
63	9910-2420110	Flange	1
64	9910-2420290	Washer	2
65	9910-2420280	Bolt	2



PWM Valve and Motor Parts

164-FTA0994	4.0 CID Hydraulic Motor with PWM Valve and Bypass Valve, CW Rotation (includes all parts below EXCEPT hydraulic adapter fitting and elbows.)
164-FTA0925	same as above EXCEPT larger 4.9 CID motor. Uses 20% more oil than 4.0 CID motor (above)



166-SP10-20M-0-N-00
H/F Prop 2-W Solenoid Valve with Manual Over-ride (cartridge valve only, does NOT include electri-cal coil)

166-NV10-22C-O-N
Needle valve for hydraulic PWM motor

164-60564
Hydraulic Motor Seal Kit for Eaton T Series hydraulic motor with 1" shaft

166-4303512 Coil, 12 Volt DC EY Coil
910 Buna 90 Duro o-ring--#10 Male Boss

166-050308-SS
.312 (5/16) x 3 - 1/2" SS bolts for hydraulic motor
166-05LW-SS
5/16" SS lock washer for hydraulic motor

Qty 4 each

165-P15648-2
PWM Hydraulic Valve with Bypass, Complete Manifold Only for mounting to Eaton T Series Motor

166-158-1543-001
Eaton T Series Motor, 1" Shaft, 4.0 CID, Manifold Ports —-
The smaller 4.0 CID motor uses 20% less oil than the 4.9 CID motor.
Alternate: 166-158-1042-001
Eaton T Series Motor, 1" Shaft, 4.9 CID, Manifold Ports

161-02-8MJ-8FJX-90
Elbow - #8 Female JIC x #8 Male JIC - 90 (optional)

161-01-8MB-8MJ
Adapter - #8 Male O-Ring Boss x #8 Male JIC

161-07-1108R
Hydraulic Check Valve - #8 Male O-Ring Boss Inlet x #8 Male JIC Outlet

166-ORING-012
O-ring for manifold ports between valve and motor
Qty 2

396-001550

Commander II for PumpRight Hydraulic Pumps Quick Start Card

In-Field Operating Instructions

VOLUME: Displays total gallons (liters) of liquid applied. Can be reset to 0 by holding the reset button.

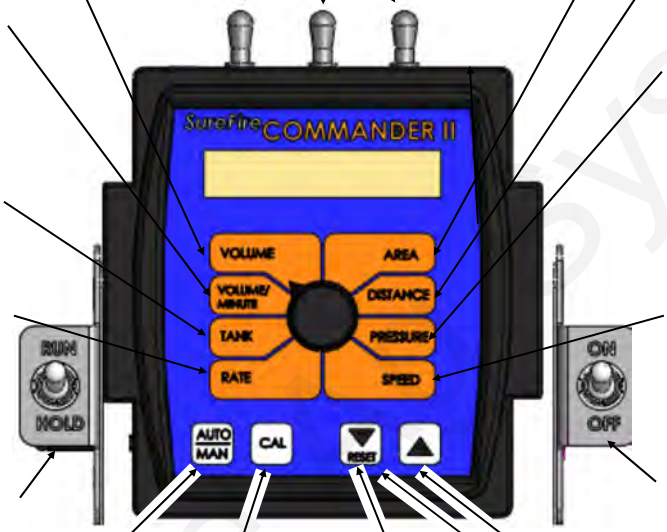
VOLUME/MINUTE: Displays gallons (liters) of liquid applied per minute. Use this to read instant flow in GPM.

TANK: Displays gallons (liters) of liquid remaining

RATE: Displays application rate GPA(LPH)

RUN/HOLD: Turns liquid application on (RUN) or off (HOLD)

3 SECTION SWITCHES: Turns application ON or OFF for each section. If not dividing implement into sections, use Section 1 switch only.



AREA: Displays the area of coverage by the equipment in acres (hectares). May be reset.

DISTANCE: Displays the distance traveled in feet (meters). May be reset.

PRESSURE: Displays the liquid pressure at the location of the optional pressure sensor. In addition to displaying Pressure the console will warn the operator with HiPSI (High Pressure) message when the input pressure exceeds the limit pressure (set in Special Cal)

SPEED: Displays ground speed in miles per hour (Kilometers per hour).

ON/OFF: Commander II power switch. When the console is turned on (except when starting in "SPECIAL" CALIBRATE) the data display will show the **Number of Hours** it has operated for one second, followed by the **Software Part Number (45124)** and the **Software Revision (rP X)** for 1.5 seconds each. Then it will display the **Control Mode (P-FLO or S-FLO)** for 1.5 seconds.

AUTO/MAN: Key which changes operation from automatic control to manual.

CAL: This key is used to enter & exit calibration mode.

RESET/ - : When not in CAL, clears the selected counter when held for two seconds.

+ & - : Plus & Minus keys are used to increase and decrease values

Five Steps for Commander II Setup for SureFire PumpRight hydraulic pump Systems

1. Commander II Special Cal Quick Setup
2. Standard Calibration
3. Initial Operation in Manual Mode
4. Test Speed Operation in Automatic Mode
5. Speed Signal Verification & Field Operation

Commander II Special Cal Quick Setup

Step 1

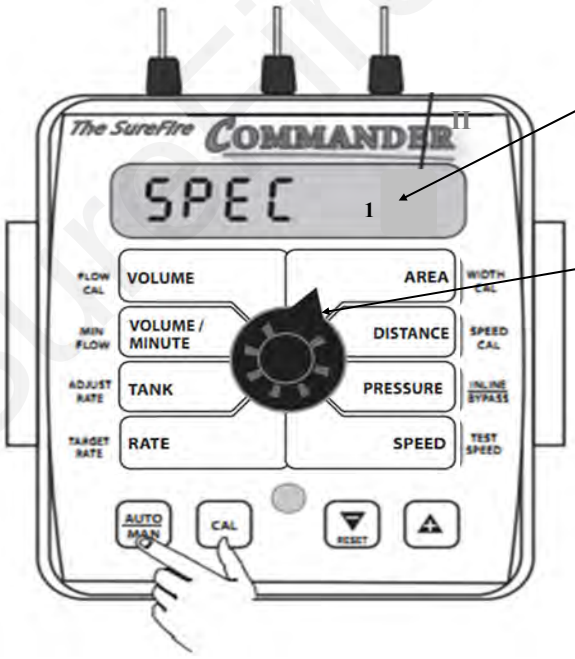
The Commander II has a quick setup feature to load the necessary defaults for a SureFire Tower or PumpRight system. **Follow the steps below BEFORE performing standard calibration on next page.**

To change defaults:

1. Power off Commander II.
2. Enter Special Cal by holding both the AUTO/MAN and the CAL button down while turning on the power switch.
3. You should see “SPEC” on the screen, if not repeat steps one and two.
4. Ensure “1” displays to indicate Page 1 in Special Cal. Press CAL to change if necessary.
5. Turn dial to point at AREA.
6. Select desired defaults from chart below. (Press the UP or DOWN arrows in bottom right corner to change selection.)
    - Select “EP-E” for Tower Electric Pumps (and English units. Select EP-M for metric units)
    - Select “**HP-E**” for **PumpRight or other Hydraulic Pumps** (and English units)
7. Save changes by holding CAL until red light goes out (about 3 seconds).

NOTE: **The above procedure will load all default values in the Commander II. It must be done before standard calibration.** For example, if you entered your implement width, then did the quick setup above, the Commander II would default back to 240 inches.

Special Cal



This number tells you which special CAL screen you are on. Pressing the CAL button will change this number. Quick Setup is on Page 1, with dial turned to AREA.

Select **“HP-E” for PumpRight Hydraulic Pumps** (Press the UP or DOWN arrows in bottom right corner to change selection.)

Standard Calibration Procedure:

Step 2

1. 1. Press CAL key for one (1) second to enter calibration mode.
2. 2. Red light will be on steady and CAL will be displayed in CAL mode.
3. 3. Turn the dial to the items listed below and set as instructed.
4. 4. When complete, press CAL for one (1) second to exit CAL mode. Red light should go out and CAL will not be displayed. **You MUST exit Calibration mode to save your settings.**

FLOW CAL: Enter the calibration number for your **flowmeter** here. On electromagnetic flowmeters the calibration number is from the chart below. **(These numbers are for flowmeters sold after 10/15/2012. These meters have a blue label with white text. Earlier flowmeters (white label with black text) use different FLOW CAL numbers.)** On turbine flowmeters, the calibration number is on a metal tag attached to the flowmeter.
Quick Tip: To quickly change the flow cal, press the AUTO/MAN button to allow you to directly change the 2 left digits (thousands). Then press the UP or DOWN arrow to change the number. Press AUTO/MAN again to change the right 3 digits.

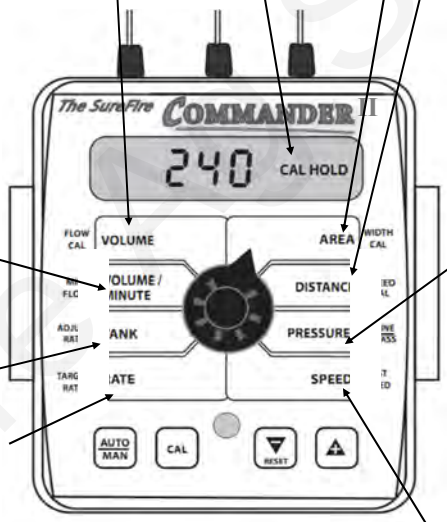
Flow Range (GPM)	Pulses/ Gallon	Commander II Flow CAL
0.13 - 2.6	3000	**6000**
0.3 - 5	3000	**6000**
0.6 - 13	2000	**4000**
1.3 - 26	2000	**4000**
2.6 - 53	2000	**4000**

P/F Ratio: Not used at this time.

ADJUST RATE: Sets amount of rate change by pressing "+" or "-" button once. Usually set to 1.0. This allows you to change from 8 GPA to 9 GPA to 10 GPA etc.

TARGET RATE: Set to your intended target rate in Gallons per Acre.

NOTE: This indicates you are in CAL mode.



WIDTH CAL: Enter the width of each fertilizer or chemical section of your implement. For a single section system, set Section One to the full implement width in inches. For example, for an 8 row 30" implement, set Section One to 240 inches. To set the section widths the Run/Hold Switch has to be in Run and the Section Switch must be ON. If using a single section implement, set Section 2 and 3 to ZERO.

SPEED CAL: Used in calibration mode to enter the speed calibration number in inches (cm) per pulse. Default is 0.189 for SureFire Astro GPS speed sensor.

When using the shaft speed sensor on grain drills, this will need calibrated. SureFire recommends you enter a value of 1.0 as a starting point. See section G for that calibration procedure under "Ground Speed Displayed is not correct".

CONTROL SPEED: Typically **-2 for PumpRight Hydraulic Pumps**.

Allows adjustment of response to "tune" the system for use with fast or slow valves. For example, if response is too slow, use the "+" button to adjust the valve response number to 1, 2 or 3. The range of adjustment is -4 to +3.

TEST SPEED: Use this mode to verify controller automatic operation only AFTER initial operation in MANUAL mode.

Standard CAL Factory Defaults: (for Software Revision rP F)

Software Revision identification displays briefly when Commander II is started.

Electric Pumps: 6000 Hydraulic Pumps: 4000	**FLOW CAL**	VOLUME	**WIDTH**	Boom 1: 240 Inches Boom 2: 0 Inches Boom 3: 0 Inches
Off	**P/F RATIO**	VOLUME/ MINUTE	**SPEED CAL**	0.189
1.0 GPA	**ADJUST RATE**	TANK	**CONTROL SPEED**	PWM Electric: -2 **PWM Hydraulic: -2** Servo Electric: -1 Servo Hydraulic: -2
10.0 GPA	**TARGET RATE**	RATE	**TEST SPEED**	Off

Initial Operation Instructions

SureFire highly recommends you perform these exact steps with water to verify system is correctly installed and ready for field use.
Note: When testing with water, the system will develop much less pressure than it will have with fertilizer.

Step 3

Test the system in **MANUAL mode**. ***DO THIS !***

1. Push the AUTO/MAN button until **MAN** is displayed on the Commander II. You are now in Manual mode.
2. Put the system in **RUN**. Turn the console switch to RUN or lower the implement if using a mercury Run/ Hold Switch. When HOLD Is not displayed on the screen the system is in RUN.
3. Turn **Section 1 switch ON**.
4. Open the Air Bleed valve on the PumpRight. Be prepared to close the valve when water comes out.
5. Turn dial to **VOLUME/MINUTE** position. Is a number displayed? If so push the "+" button. Does the flow increase? Push the "-" button. Does the flow decrease?
6. If no reading in VOLUME/MINUTE is the pump turning and is there water present at the pump inlet?
   NOTE: **Feel if pump is vibrating to tell if it is running.**
7. You must determine if the pump is turning to determine if you have an electric or a hydraulic issue. See Section G Troubleshooting “Pump Will Not Turn” to isolate electric vs. hydraulic issues.
8. If water is being pumped, but no reading on the Commander VOLUME/MINUTE, check the flowmeter connections and the Flow Cal value.

Proceed to Step 4, ONLY when you can increase and decrease the VOLUME/MINUTE reading using the "+" and "-" keys on the Commander II.

Step 4

Now, we will operate the Commander II in **Test Speed mode**. ***DO THIS !***

1. Enter Calibration by pushing and holding the **CAL** button until CAL is displayed on the Commander II and the red light is on.
2. Push the AUTO/MAN button until **AUTO** is displayed, indicating you are in automatic mode.
3. Turn the dial to **Test Speed** in the bottom right corner. Use the + key to adjust to your field operating speed.
4. Turn Run/Hold switch on Commander II to **RUN**.
5. Turn Run/Hold **mercury switch to RUN** by lowering the implement, unplugging it, or manually tilting the switch.
6. Turn at least **Section 1 switch on**.
7. You should now be dispensing liquid as if you were traveling through the field at the test speed you entered.

NOTE: When testing with water, the system will develop much less pressure than it will have with fertilizer. This is normal and to be expected.

Proceed to the next step when liquid application is verified in AUTO mode with Test Speed operation.

Step 5

Finally, we will verify the Commander II Speed is correct.
Turn the dial to **SPEED**. Drive the tractor. Does the speed reading seem reasonable and correct? The ASTRO II will be a more accurate speed than an un-calibrated tractor speedometer.

Proceed to the next step when your Commander II Ground Speed is correct.
You are now ready to verify regular field application.