

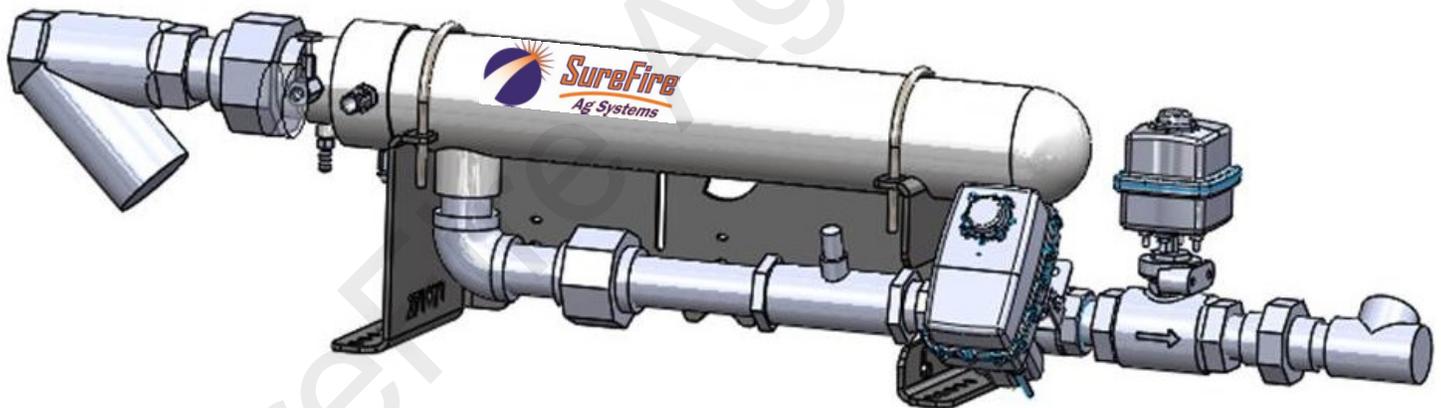


NH₃

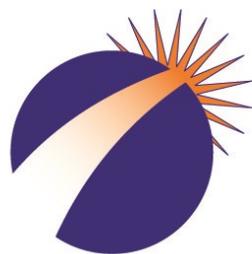
Precision Anhydrous Ammonia

Application for

 **Trimble.** **Field-IQ™**



396-2851Y1



SureFire
Ag Systems

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The components of your system may vary from the components shown in this manual due to different configurations and locations of valves, splitters, manifolds, and other components. Various configurations are shown in this manual, but not every situation can be covered here.

It is the responsibility of the owner/operator to assure that all necessary components are installed correctly and continue to remain in a safe operating condition.

All personnel operating or working around an anhydrous ammonia system must be thoroughly trained in safe anhydrous ammonia procedures.

Operators of anhydrous ammonia systems should always carry on their person an emergency squeeze bottle of fresh water. There should always be five gallons of clean water available on the nurse tank for immediate flushing in the event of an accidental exposure.

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Anhydrous Ammonia Safety

Anhydrous ammonia is an important source of nitrogen fertilizer for crops. The improper handling of anhydrous ammonia can have catastrophic results on both plants and farm workers. Common injuries are severe burns to eyes, skin and the respiratory tract.

- Personal protective equipment (PPE) should always be worn. Standard PPE should be non-vented goggles, rubber gloves with thermal lining, face shield or an approved respirator. Wear a lightweight rubber suit, or (at the very least) a long sleeve shirt and coveralls.
- Make sure anhydrous ammonia tanks are not filled beyond the recommended capacity.
- Use care when handling the hose end valve so that it does not open accidentally. Do not move the hose by handling valve handle.
- Be sure to bleed the hose coupling before disconnecting. Use care when cleaning plugged knives as anhydrous ammonia could be built up behind the plug.
- Use emergency water supply for at least 15 minutes if exposed to anhydrous ammonia and then seek emergency medical attention.
- The operator should have a small squeeze bottle of fresh water with him at all times.

Inspection

- Are the hoses in good condition?
- Has the expiration date been passed on any hose or other dated component?
- Are all fittings clean and free from rust?
- Do low-pressure tubes have any leaks?
- Are any knives plugged?
- Is the tank secure with a locking hitch pin?
- Is the pressure relief valve operating correctly?
- Does the tank have five gallons of fresh water?
- Is PPE available and being worn?

BE CAREFUL WITH THIS STUFF!



Things to Know About Anhydrous Ammonia (NH₃)

Anhydrous ammonia is a colorless non-flammable liquefied gas. Its vapor is lighter than air and has the same pungent odor as household ammonia. Although ammonia vapor is lighter than air, the vapors from a leak may hug the ground appearing as a white cloud. Chemically, ammonia is 82% nitrogen (N) and 18% hydrogen (H) and has the chemical formula NH₃. Ammonia by weight is 14 parts nitrogen to 3 parts hydrogen, or approximately *82% nitrogen and 18% hydrogen*.

The definition of *anhydrous* is *without water*. Whereas household ammonia is 95% water, anhydrous ammonia has no water. Ammonia is so hydroscopic (water loving) that one cubic foot of water will dissolve 1300 cubic feet of ammonia vapor making water the primary weapon for first responders.

Ammonia weighs 5.15 pounds per gallon in contrast to water which weighs 8.33 pounds per gallon. Since ammonia is so soluble in water there will be no layering effect when liquid ammonia is spilled into a surface water body. Booms, pads, sweeps and pillows that are usually used to contain and recover petroleum are ineffective on spills of ammonia into surface water.

Ammonia is a non-flammable gas but will ignite at a temperature of 1204°F within vapor concentration limits between 15% and 28%. (Paper ignites at 450°F, coal at 750°F.) Outside conditions that would support these vapor concentrations are very rare.

Ammonia will corrode galvanized metals, cast iron, copper, brass, or copper alloys. All ammonia piping, valves, tanks and fittings are constructed of steel.

Liquid ammonia boils at any temperature greater than -28°F and will expand to 850 times its liquid volume. One gallon of liquid will expand to 850 gallons or 113 cubic feet of gas.

Ammonia Fast Facts

NH₃ Vapor

Ammonia appears in nature as a natural substance that results from decomposition.

Ammonia vapor is a colorless gas with a pungent odor.

Ammonia exists as a vapor at atmospheric conditions.

Ammonia vapor is lighter than air and tends to rise when released to atmosphere.

NH₃ Liquid

Liquid ammonia released to atmosphere forms a white smoke by freezing the moisture in the air.

Liquid ammonia has a very high coefficient of expansion with temperature.

One gallon of liquid ammonia weighs approximately 5.15 lbs.; however the weight varies with temperature.

When liquid ammonia reaches a temperature between its melting and critical points, it exerts a vapor pressure that increases with temperature.

A closed container of liquid ammonia is in equilibrium with ammonia vapor and the container pressure bears a definite relationship to the temperature.

Physical Data

Boiling point is -28°F.

Ignition point is 1,204°F.



Storage and Handling

Ammonia is stored and transported as a liquid under pressure.

The pressure on the tank is the liquid pressure and remains the same whether the tank is 10% full or 80% full. This pressure is dependent on the temperature of the NH₃.

The maximum filling level of an anhydrous ammonia tank is 85%.

Flammability

Anhydrous ammonia is classified by the DOT as a non-flammable gas.

Ammonia vapor is flammable over a narrow range of 15% to 28% by volume in air and a strong ignition source must be present.

Anhydrous Ammonia Application

Precision application of anhydrous ammonia starts with a proper metering system. It is crucial to be sure the metering and control system is applying what is required.

Accurate metering of anhydrous ammonia is difficult to achieve with a conventional variable orifice meter. Anhydrous ammonia is stored and transported as a liquid. To maintain NH₃ as a liquid it must be kept below -28°F or maintained under pressure. If the temperature of the NH₃ increases above -28°F some of the liquid changes to a gas as the NH₃ begins to boil. Application equipment typically uses tank pressure to deliver NH₃ to the soil. An increase in tank pressure would tend to force more NH₃ through the distribution lines. The actual pounds of NH₃ being applied decreases or increases as tank pressure fluctuates unless continuous adjustments are made to the meter.

If NH₃ is released into the atmosphere it will expand rapidly to occupy a volume 850 times greater than the original liquid. NH₃ readily changes from liquid to gas in the nurse tank and distribution system. Consequently the ratio of NH₃ gas to liquid continually changes as it passes through the distribution lines. About 1% of the liquid will vaporize during the ammonia flow from the tank dip tube to the metering point. 1% liquid when expanded to vapor at 100 lb tank pressure will occupy approximately 25% to 30% of the delivery chamber. At 50 lb tank pressure this increases to over 60% of the delivery chamber occupied by vapor. This makes metering and distributing NH₃ very difficult to do consistently and accurately.

Automatic NH₃ controls utilizing the **SureFire Torpedo™ NH₃ System** eliminate the problems found in conventional systems. The first step to accuracy is **eliminating errors caused by vapor** in the system. The second step is **compensating for ground speed and tank pressure fluctuations**. The SureFire Torpedo™ system uses a **heat exchanger to convert the NH₃ to 100% liquid for precise metering**. *With the heat exchanger delivering 100% liquid to the flowmeter, the precise amount needed is metered and delivered.* The controller and control valve will **adjust for ground speed changes** to eliminate misapplications that are common in conventional meter systems. This eliminates guessing and manually adjusting for different tank pressures or rates.

For high volume application, wide implements, fast speeds and cold temperatures the *delivery component pieces are critical for delivering the flow needed*. A flow that can be delivered at 90° may not be achievable when the temperature drops to 40° if the system components are not designed and sized correctly. These pieces include: **Tank withdrawal valve, NH₃ delivery hose and breakaway coupler, and heat exchanger with adequate capacity**. The components of a SureFire system are designed to deliver the flow you need.



After this precise metering the *challenge of row distribution* still awaits. The proper **manifold system** is important for row to row accuracy. The manifold can also be a cause of flow restrictions in high flow applications. The SureFire Torpedo system uses the best in class Continental 360 series manifolds or the Continental Vertical Dam Manifold series.

Setting Up Your System

The following pages show some of the calculations needed to determine the specific components of your SureFire Torpedo™ NH₃ system.

First, the **width, rate, and speed** will be used to determine the amount of NH₃ your system will need to deliver. With this information, the **tank withdrawal valves, NH₃ hose(s), and Torpedo™ heat exchanger** can be selected.

Next, the distribution system will be set up. This takes into account the **row spacing, number of rows, amount of NH₃ per row, and how many sections** there will be. With this information, the **splitter, manifolds, section valves, and hoses** can be selected.

The Smaller Pieces

There are other smaller pieces that are, nonetheless, very important. One of these components is the **hydrostat relief valve**. These are located in segments of the system that may experience a build-up of pressure from NH₃ left in the line.



153-A-400-B 1/4" Hydrostat Relief Valve—250 PSI —
(Keep the dust cap on)
Used in various segments of the system
as a safety relief valve.



End view

The Hydrostat relief valve has a Manufactured Date (mfg). Replace 5 years after manufacture.

Bleeder valves are located throughout the system. The operator should be familiar with all the locations and make certain that all parts of a segment are bled off before working on the system.

Some components of your system may have separate Instruction Sheets, Installation Information, or Safety Information. Read all such product literature before installing or operating the system and retain the information for future reference.

Your SureFire Torpedo™ NH₃ system is designed to provide safe, reliable, dependable, and accurate distribution of NH₃. It requires the operator to exercise due diligence in setting up, operating, and maintaining all system components to continue operating safely.

Remember:

BE CAREFUL WITH THIS STUFF!

Sizing System components

The following table shows the flow and application rates that are attainable with each SureFire Torpedo™ model.

SureFire Torpedo™ Model # 100, 200 or 300 Kit

Model #	34 degrees F (50 PSI)		Max App Rate Lbs N / acre		60 degrees F (93 PSI)		Max App Rate Lbs N / acre	
	GPM	Lbs NH ₃ per hour	40' at 8 MPH	60' at 8 MPH	GPM	Lbs NH ₃ per hour	40' at 8 MPH	60' at 8 MPH
100	23	7100	150	100	28	8650	185	120
200	35	10800	230	150	43	13500	285	190
300	50	15450	330	220	64	20000	427	285

Calculating NH₃ Flow

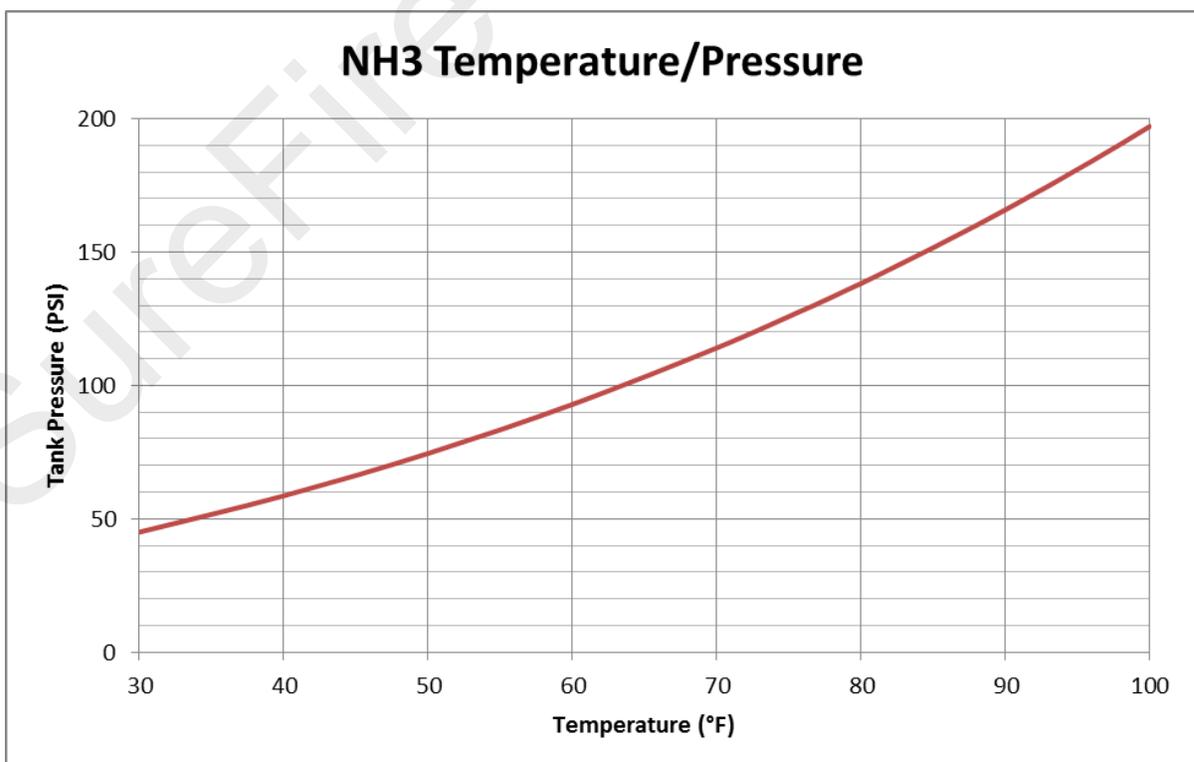
Do the following calculation to determine the proper Torpedo Model for your application:

$$\text{Rate (lbs of N) per acre} \times \text{Speed} \times \text{Width (feet)} \times 0.1212 / 0.82 = \text{NH}_3 \text{ Lbs / hr}$$

$$\text{NH}_3 \text{ lbs/hr} / 60 \text{ min/hr} / 5.15 \text{ lbs/gal} = \text{GPM (NH}_3\text{)}$$

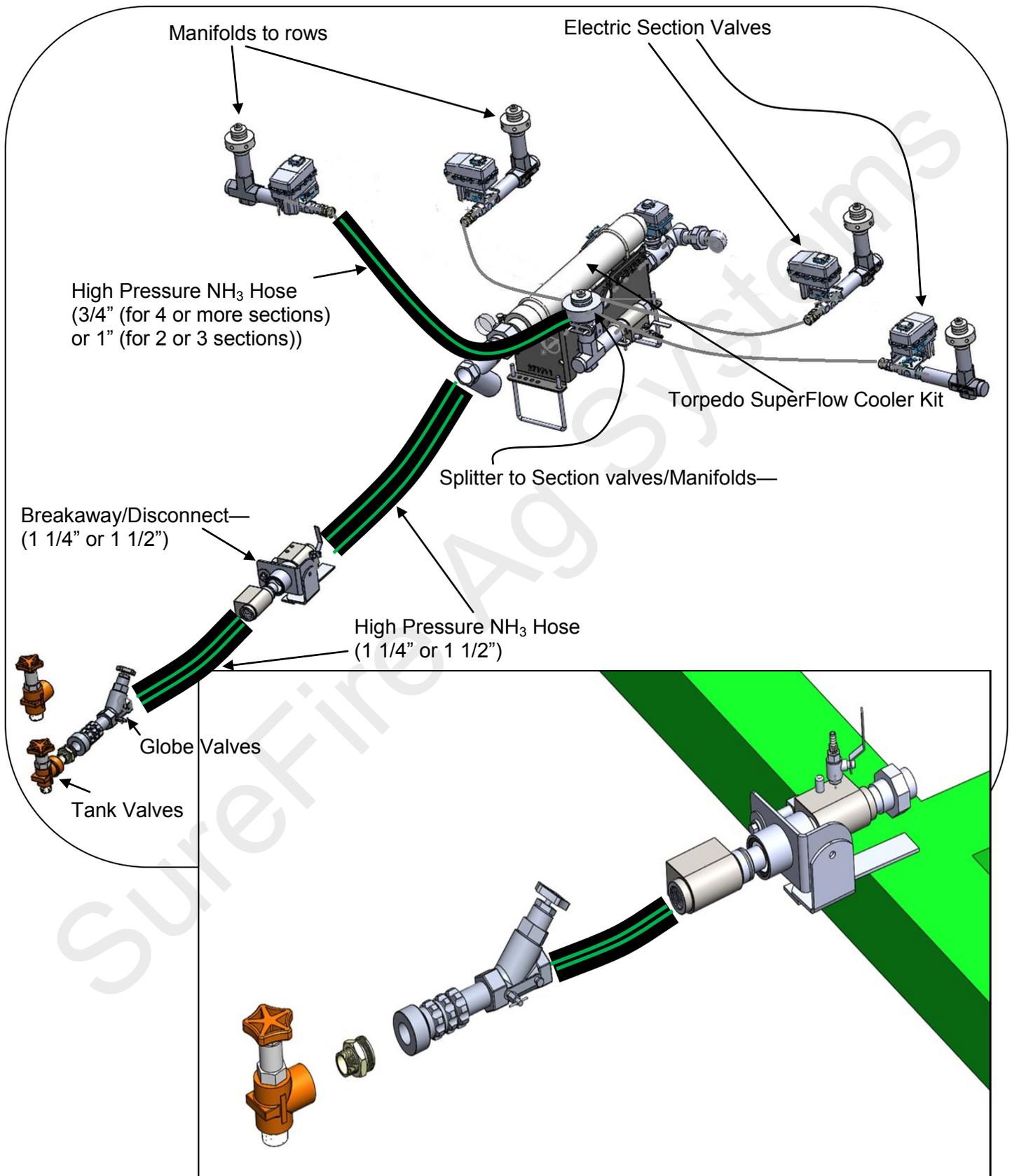
$$\text{Lbs of NH}_3 \times 0.82 = \text{Lbs of N}$$

$$\text{Lbs of NH}_3 = \text{Lbs of N} / 0.82$$



System Overview with 4 electric Section Valves

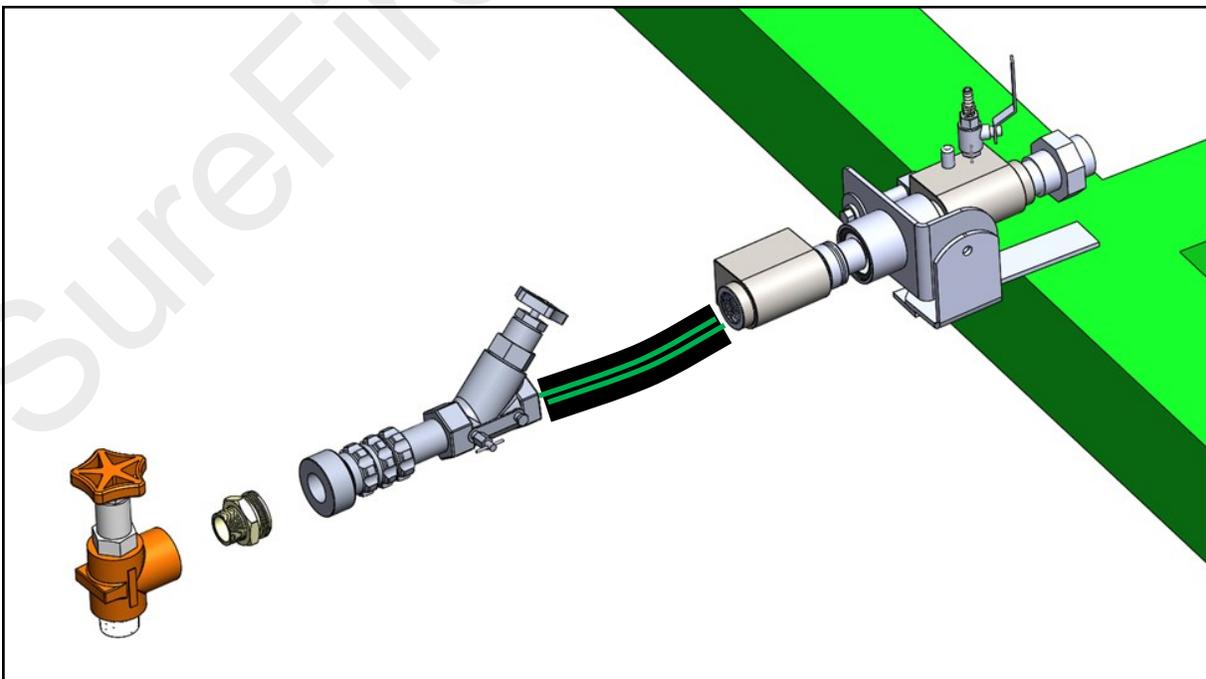
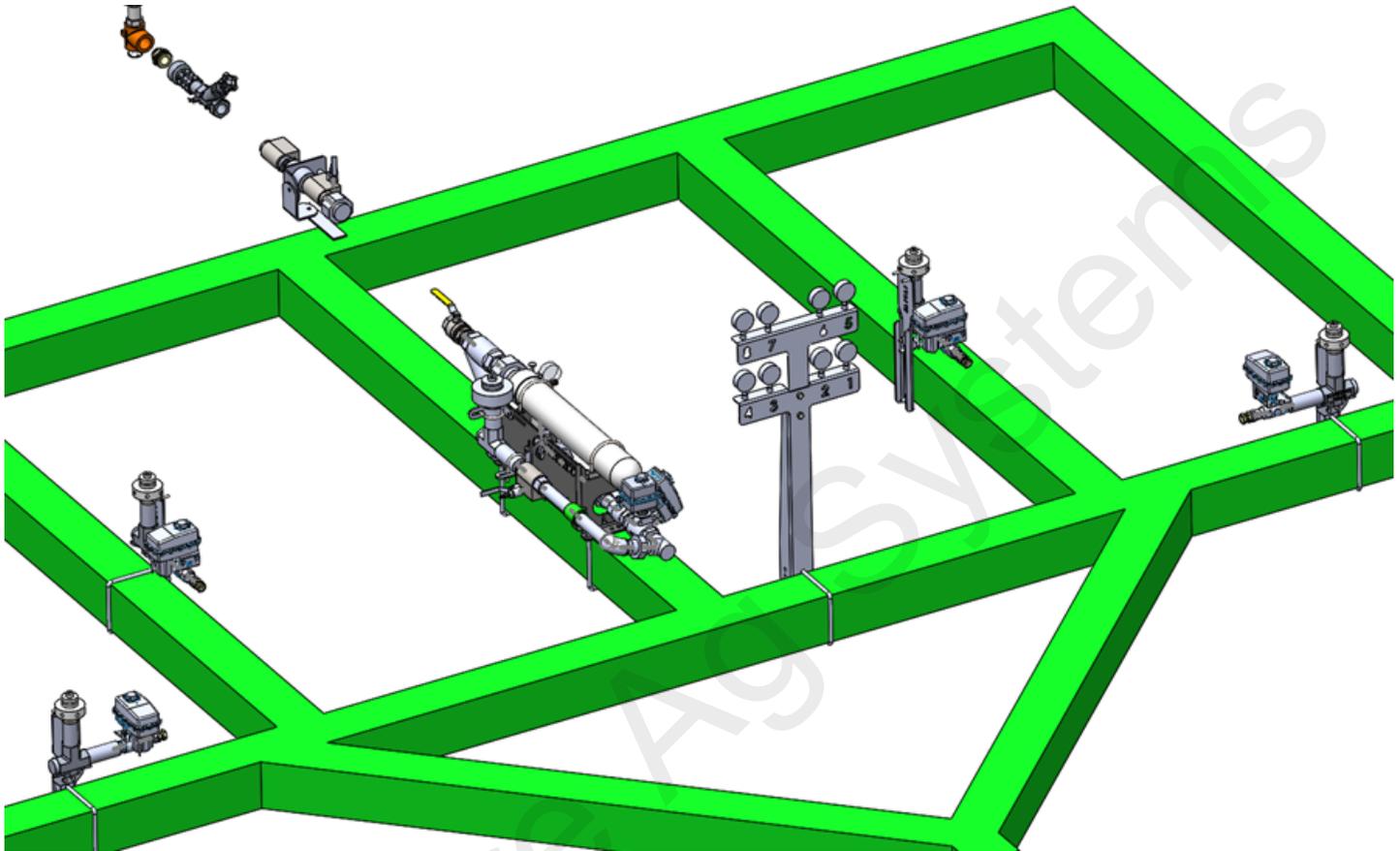
Torpedo™ Model 100 and Model 200



System Overview with 4 Electric Section Valves

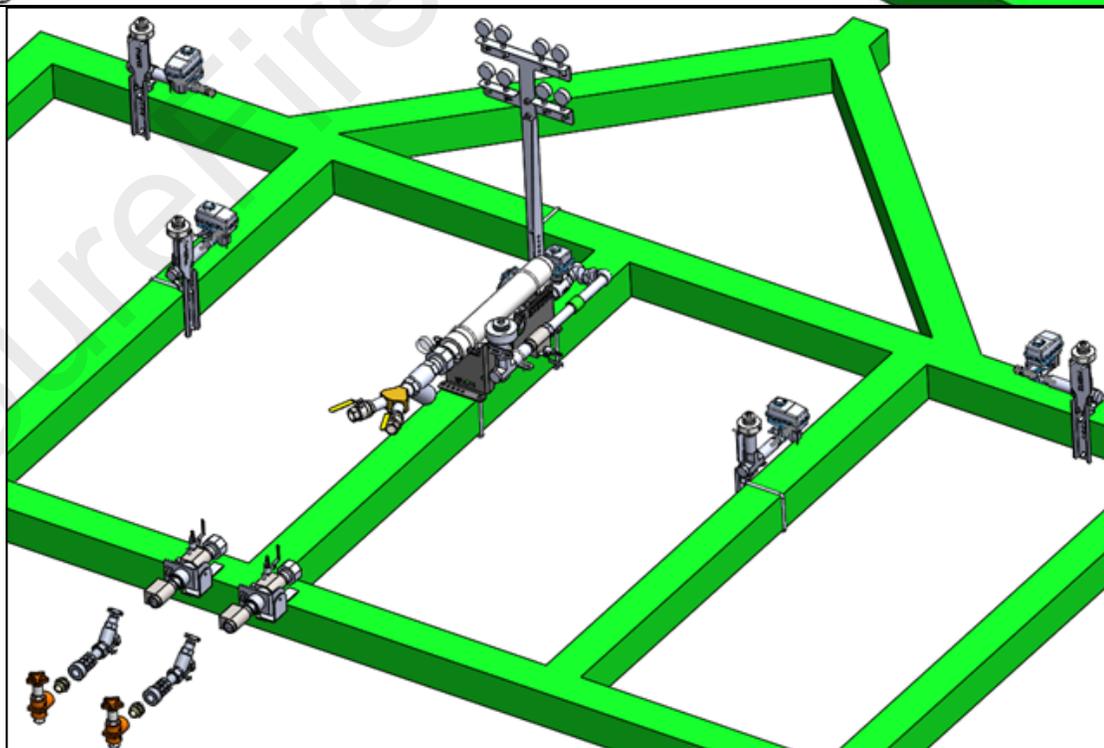
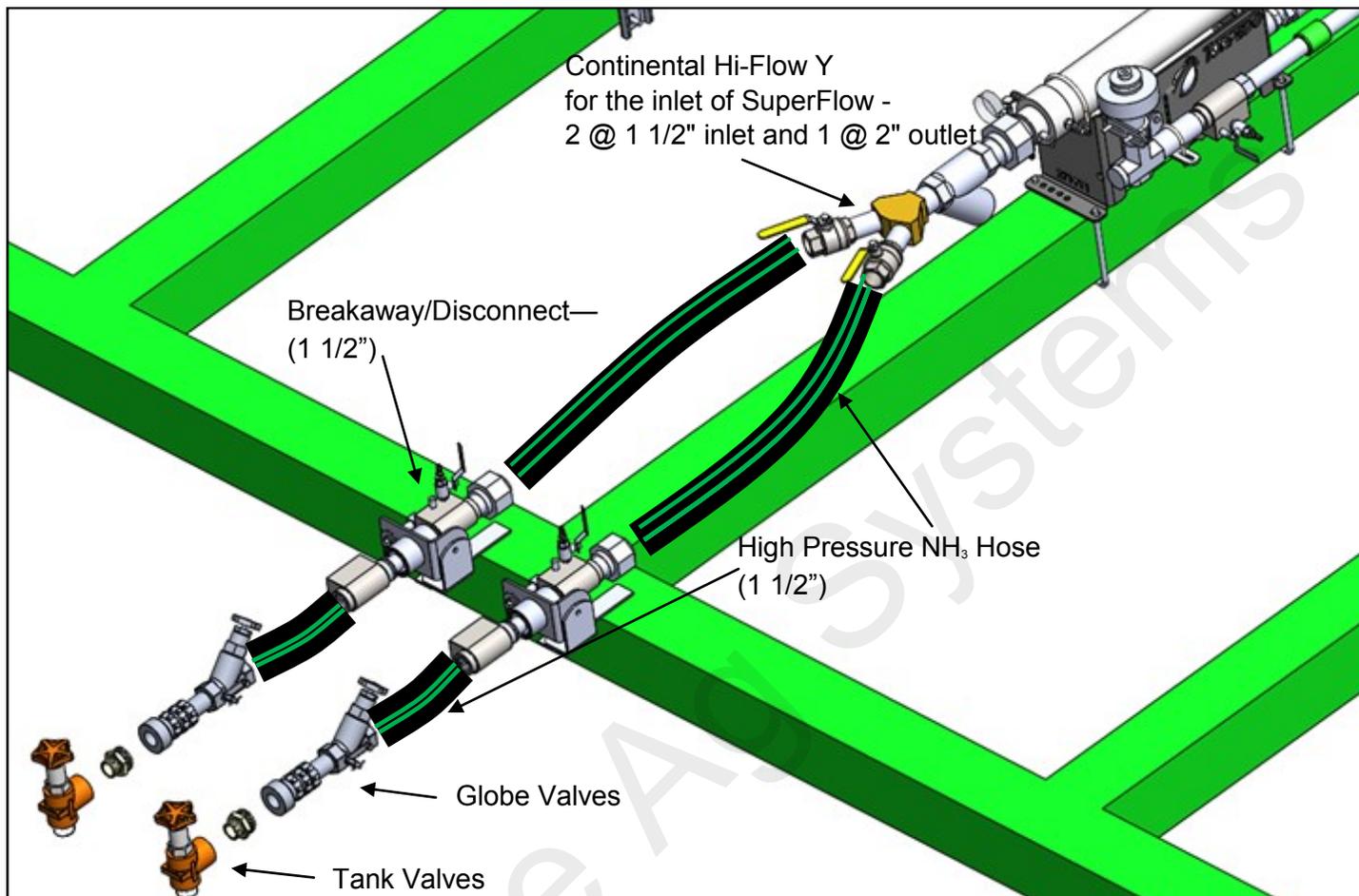
Torpedo™ Model 100 and Model 200

Optional Gauge Tree shown



System Overview with Torpedo™ Model 300

159-00-200150



Installation and Setup Instruction Tags-See the manual and accompanying literature for more information.

DUMP ORIFICE HOSE BARB

To minimize the amount of ammonia going out the dump lines use the chart to determine the hose barb size to use.

1-12 GPM	13-18 GPM	19-26 GPM	27-33 GPM	34-Up GPM
A	B	C	D	E

$$\text{Tool bar width in feet} \times \text{Speed} \times \text{Actual lbs N per acre} \times 0.1212$$

$$/ 0.82 / 5.14 / 60 = \text{GPM}$$

PN 398-10-2807Y1

DUMP OUTLET HOSE BARBS (2)

Connect an appropriate length of 3/4" hose from each dump outlet hose barb to the 2 vapor knives on the applicator. Fasten each end with a worm gear clamp.

PN 398-10-2808Y1

Some applicators already have the vapor knives attached. If not, use the ones in the kit.

PN 398-10-2808Y1

Installation Instructions A-360SP Splitter

Correct Orifices Must Be Installed
Before Use.

See orifice chart on back side of this tag.

See the instruction sheet and manual for details.

PN 398-10-2811Y1

Pressure	100 PSI	50 PSI	Orifice
Flow Per Outlet	Up to 7 GPM	Up to 5 GPM	.302
	5 to 12 GPM	4 to 9 GPM	.437

A-360SP Splitter Orifices

$$\#NH_3 \text{ per acre} \times \text{speed} \times \text{tool bar width in feet} \times .1212 \div 5.14 \div 60 \div \text{number of manifolds} = \text{GPM per outlet}$$

Or

$$\#N \text{ per acre} \times \text{speed} \times \text{tool bar width in feet} \times 0.1212 \div 0.82 \div 5.14 \div 60 \div \text{number of manifolds} = \text{GPM per outlet}$$

Bleeder Valve Installation Instructions

Connect hose and run hose to a safe location to bleed ammonia vapor.

PN 398-10-2810Y1

Bleeder Valve Safety

USE INSTRUCTIONS

This may not be the only place you have to bleed. Be certain entire system has been bled before working on system.

Be certain it is **safe** to bleed the system.

Open valve **SLOWLY** when bleeding system.

PN 398-10-2810Y1



Continental Tank Valves

153-

1406-G High Flow
1 1/4" MPT Tank Connector x 1 1/2" FPT Outlet
45 GPM

1809-BFV High Flow
1 1/2" MPT Tank Connector x 1 1/2" FPT Outlet
60 GPM



Depending on the rates, speeds, and tank pressure (temperature), a system may need to be connected to tanks with High Flow tank valves in order to allow enough product flow. The entire plumbing arrangement (valves, hoses, connections) must have high flow capacity in order to maximize flow to reach high rates at high speeds and cold temperatures.

Safety Reminder

Always bleed all segments of the system before working on or around the system.

NH₃ Inlet Plumbing Kit from Nurse Tank to Breakaway 158-00-

This kit includes: 1 1/4" or 1 1/2" High Pressure hose and one of the following Globe Valve Assemblies

Globe Valve Assembly 153-

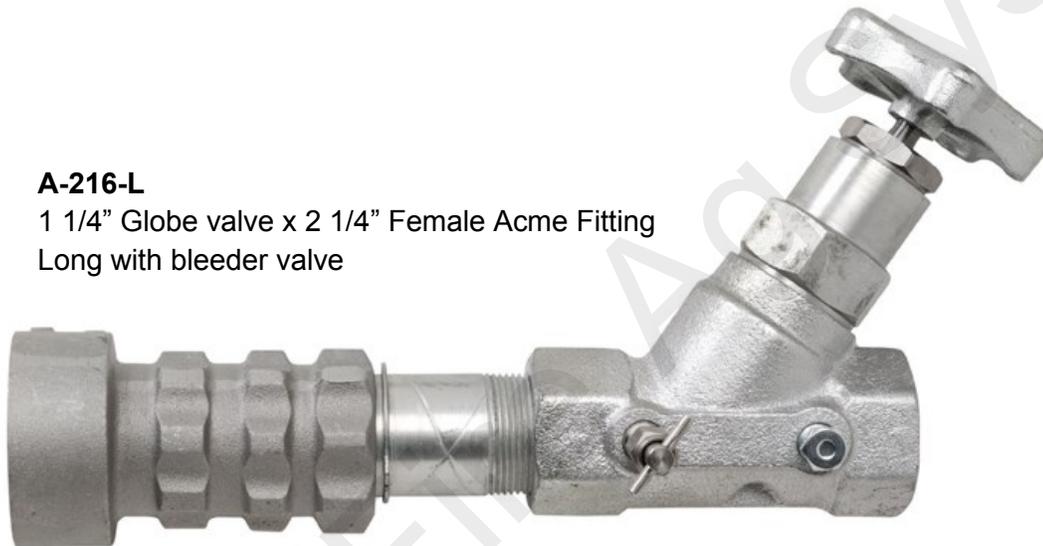
A-215-L

1 1/4" Globe valve x 1 3/4" Female Acme Fitting
Long with bleeder valve



A-216-L

1 1/4" Globe valve x 2 1/4" Female Acme Fitting
Long with bleeder valve

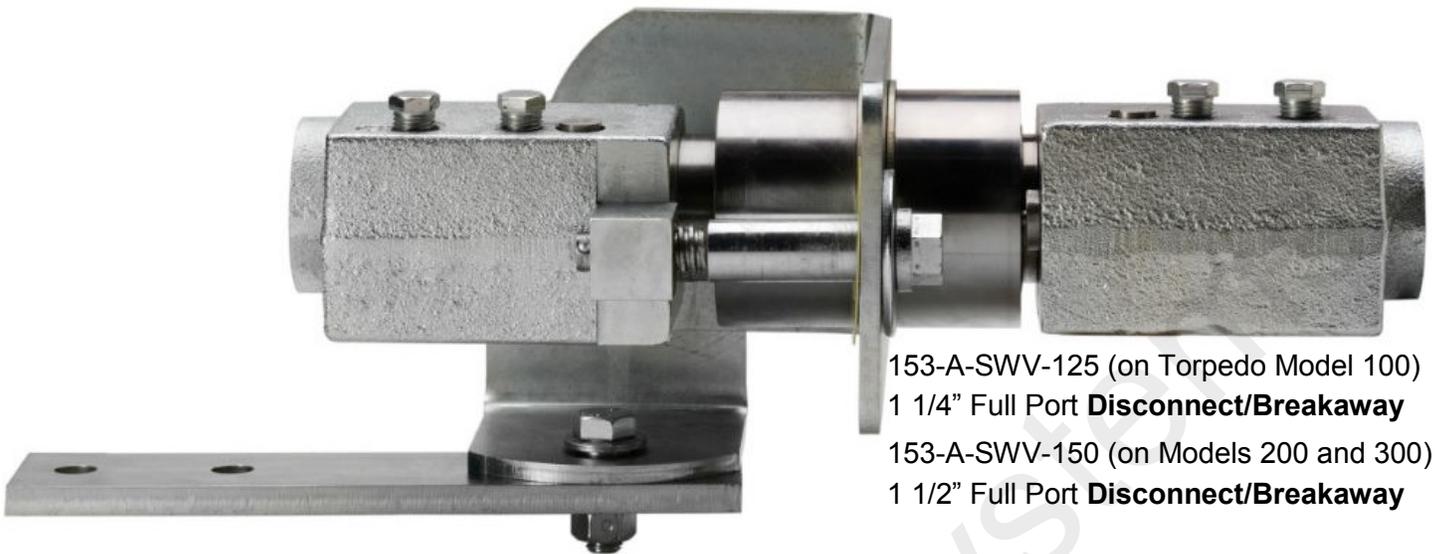


A-217-L

1 1/2" Globe valve x 2 1/4" Female Acme Fitting
Long with bleeder valve



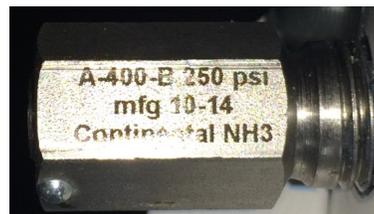
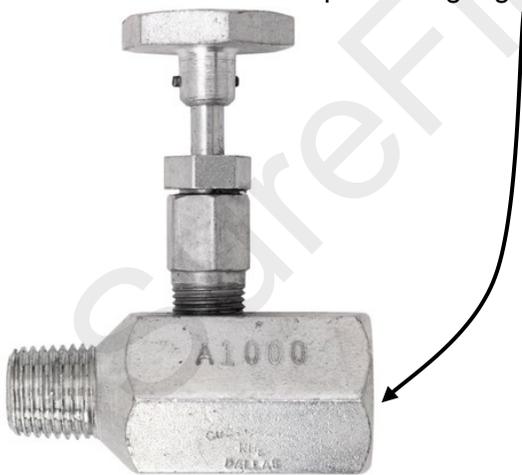
Torpedo Kit 159-00— Kit includes Breakaway, High Pressure NH₃ Hose and SuperFlow NH₃ Assembly



153-A-SWV-125 (on Torpedo Model 100)
1 1/4" Full Port **Disconnect/Breakaway**
153-A-SWV-150 (on Models 200 and 300)
1 1/2" Full Port **Disconnect/Breakaway**

- Full port 1 1/4" (or 1 1/2") through-holes
- Practically no pressure drop
- Swing valve style checks that swing out of the flow for superior flow characteristics
- All Stainless Steel, except housing, prevents rust and corrosion
- Built-in reconnection and disconnection acme bolt
- Dual 1/4" pipe ports on each side for bleeder valves and hydrostats
- 35% larger than other units
- **Read the complete installation and operating instructions that come with Disconnect/Breakaway**

153-A-1000 1/4" MPT x 1/4" FPT NH₃ **Needle Valve**--
can attach pressure gauge or transducer here



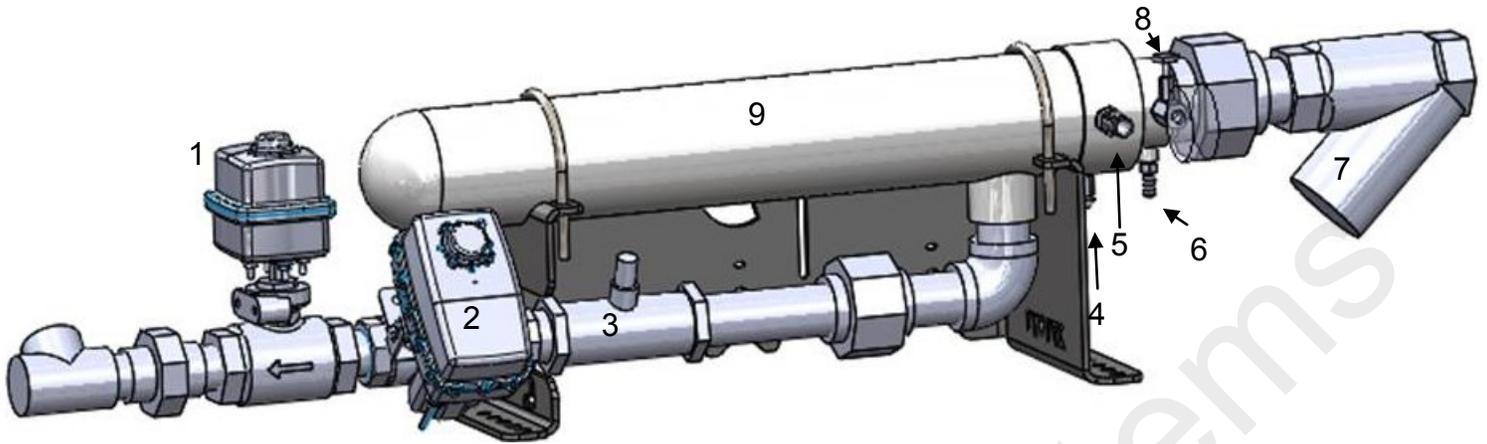
End view

153-A-400-B 1/4" **Hydrostat Relief Valve**—250 PSI—(Keep the black cap on)
Used in various segments of the system as a safety relief valve. This component has a **MFG Date** stamped on it. Replace within 5 years.

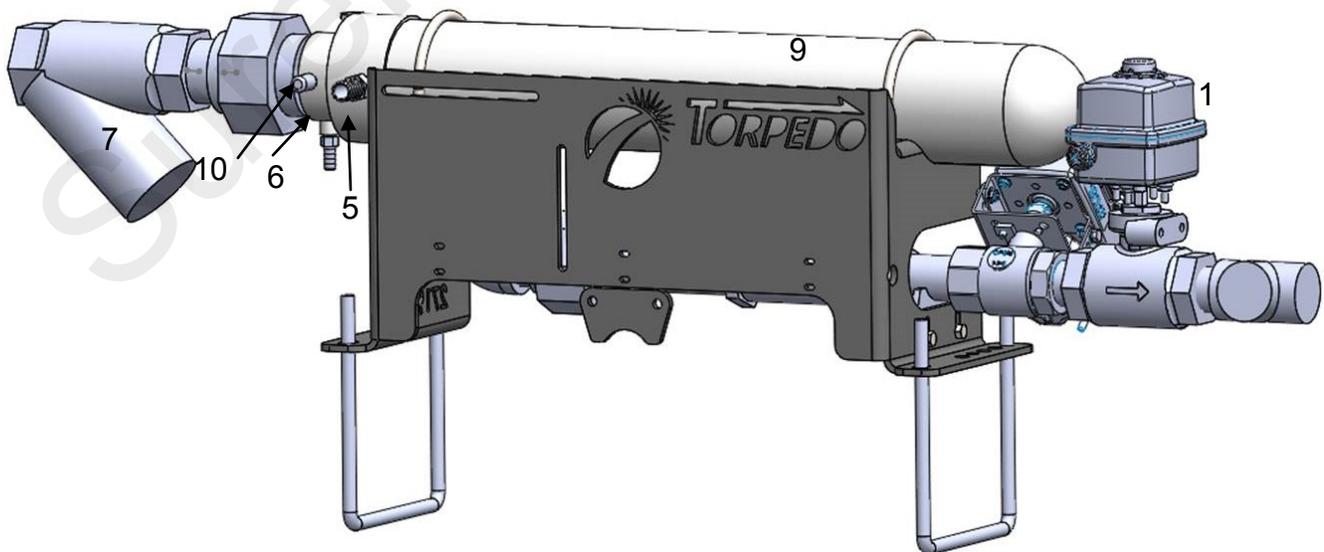
Safety Reminder

Wear tight-fitting non-vented goggles when working around anhydrous ammonia.

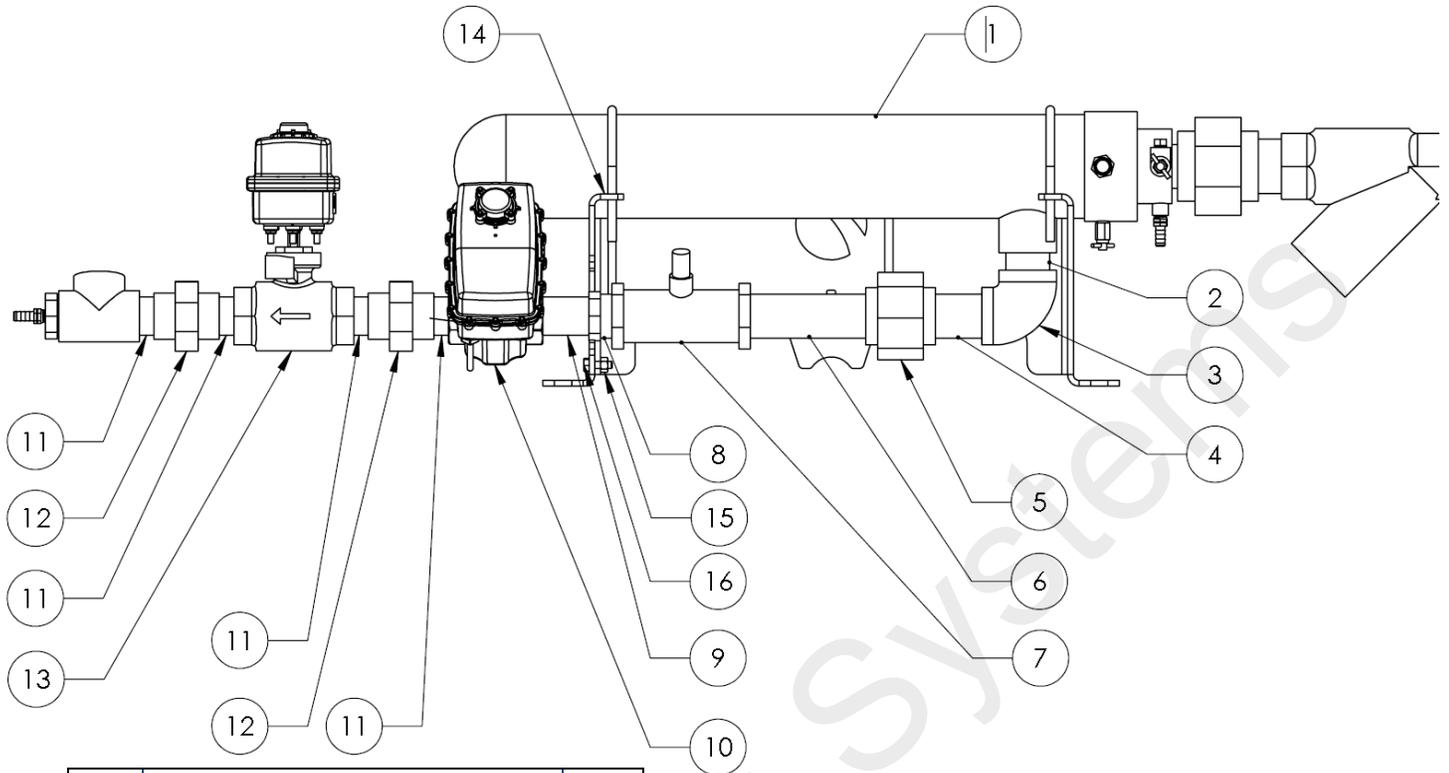
Torpedo™ SuperFlow NH₃ Assembly 202-2693Y1



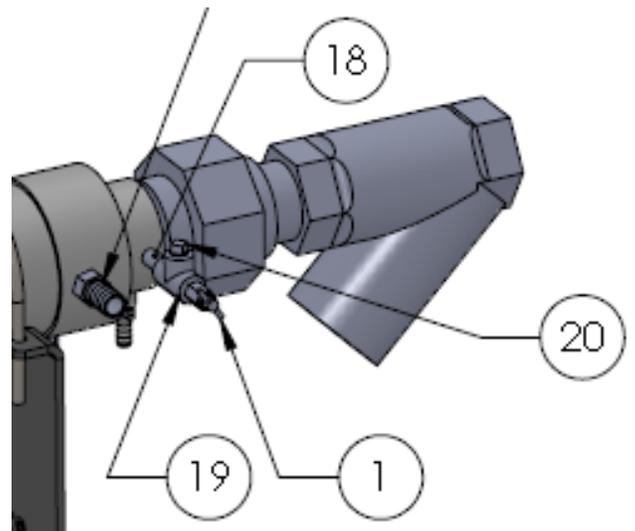
1	202-2691Y1	SureFire 1 1/4" NH ₃ Servo Valve —7 sec. 118 degree open/close - 3-pin WP tower (2-wire)
2	202-KZ67GY	1 1/4" SS KZ NH ₃ shut-off valve with 3-pin WP shroud
3	204-02-2692Y1	Raven SS RFM 60S Flowmeter 1 to 60 GPM with 3-pin MP 150 shroud
4	153-A-411	1/4" Bleeder valve
5	151-050075	1/2" MPT X 3/4" Hose Barb—Dump Outlet Hose Barb (plumb to Dump Knife)
6	151-025038	1/4" MPT X 3/8" Hose Barb—3/8" product feedback hose attaches here
7	762-A1SC-2	2" Y filter
8	153-A-1000	1/4" MPT x 1/4" FPT NH ₃ Needle Valve --can attach pressure gauge or transducer here
9	762-A-SF-3000Y2-S	Continental SuperFlow Exchanger and vapor tubes/ etc.
10	153-A-400-B	1/4" Hydrostat Relief Valve —250 PSI—(Keep the dust cap on)



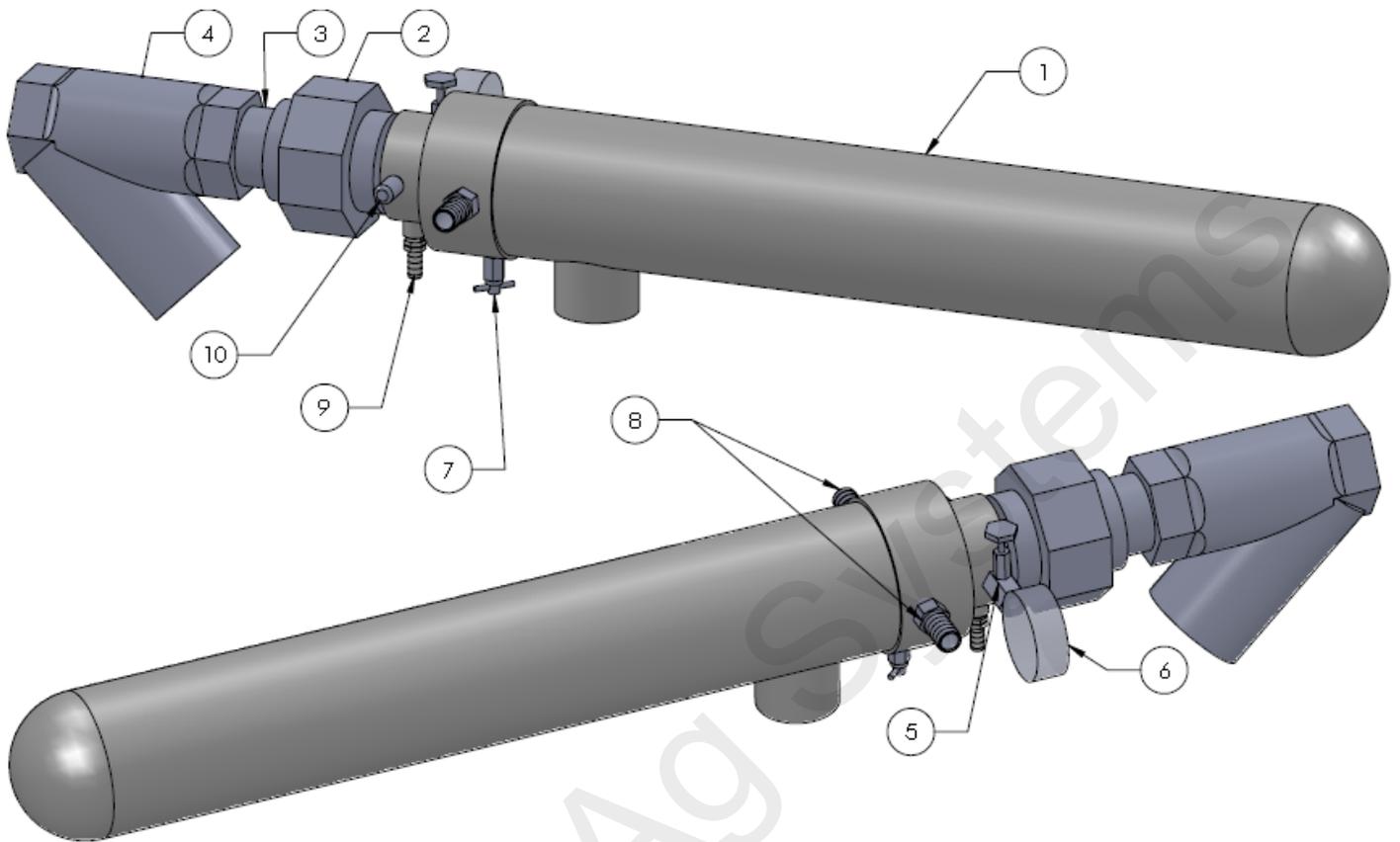
SureFire Torpedo NH3



Item	Description	Qty
1	Heat Exchanger	1
2	Nipple	1
3	Elbow	1
4	Nipple	1
5	Union	1
6	Nipple	1
7	Flowmeter	1
8	Reducer Bushing	1
9	Nipple	1
10	On/Off Valve	1
11	Nipple	4
12	Union	2
13	Control Valve	1
14	Heat Exchanger Base	1
15	5/16" Flange Nut	2
16	5/16" x 1" HCS G5	2
18	Nipple	1
19	Tee	1
20	1/4" Plug	1

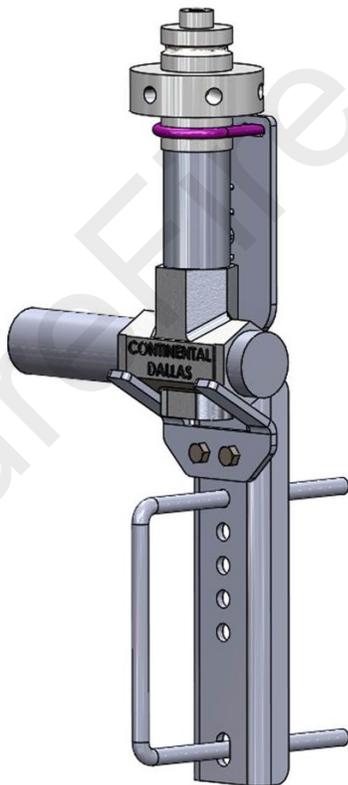
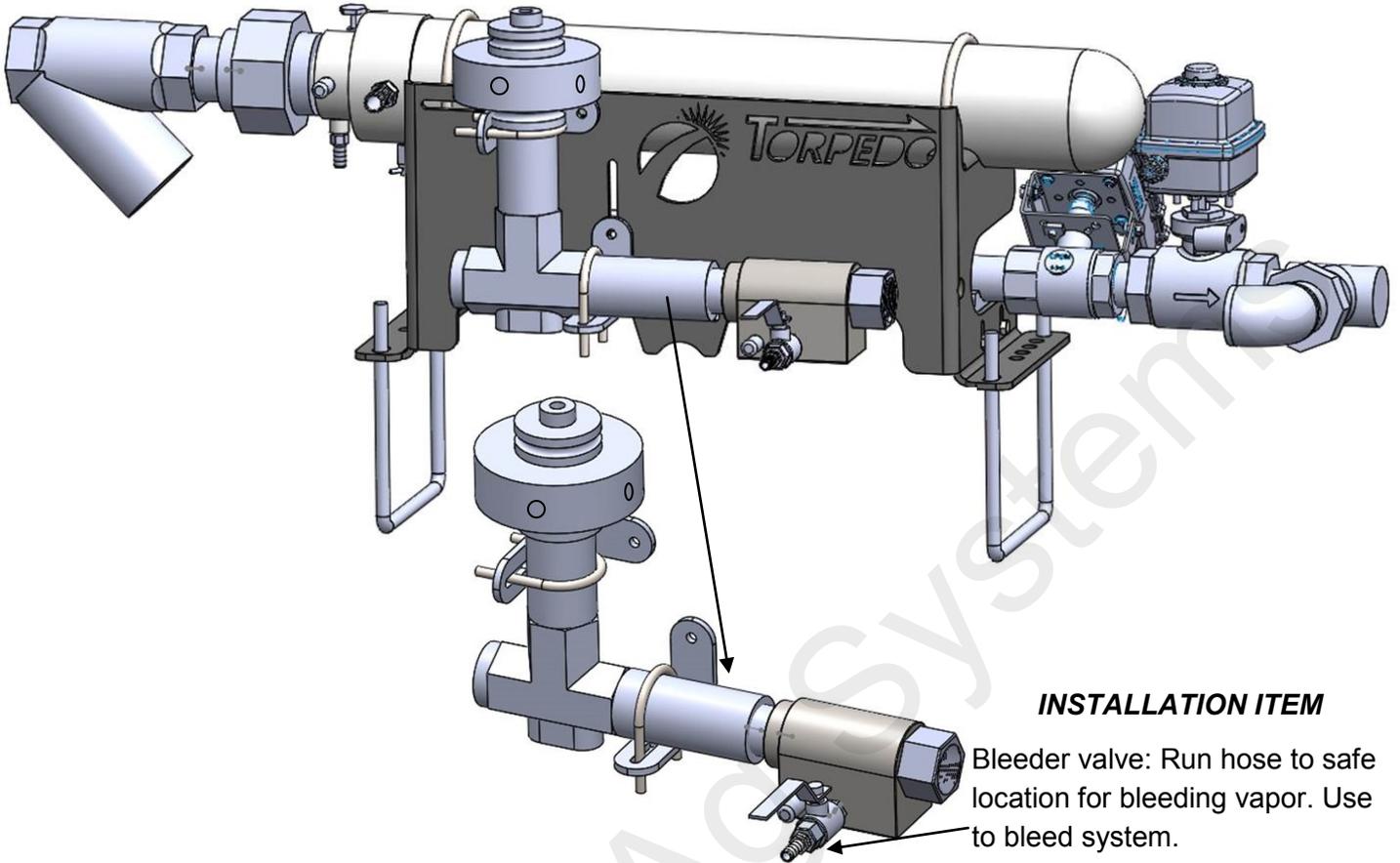


Torpedo™ SuperFlow NH₃ Assembly 202-2693Y1



Item No.	Part Number	Description	QTY
1	153-A-SF-3000GH-2	2" Exchanger	1
2	150-200UN-S80	2" Union-Schedule 80	1
3	150-200NIP-SH-S80	2" X SH Nipple-Schedule 80	1
4	762-A1SC-2	2" Y Filter	1
5	153-A-1000	1/4" MPT X 1/4" FPT NH ₃ Needle Valve	1
6	137-ASG400	Pressure Gauge (Optional)	1
7	153-A-411	1/4" Bleeder Valve-Continental	1
8	151-050075	1/2" MPT X 3/4" Hose Barb	2
9	151-025038	1/4" MPT X 3/8" Hose Barb	1
10	153-A-400-B	1/4" Relief Valve-250 PSI	1

Splitter Options-mounted to Torpedo or mounted remotely



A-360 Splitter Remote Mount

If the splitter is mounted remotely from the Torpedo, you will need an appropriate length of 1 1/4" high pressure hose from the Torpedo to the splitter if using electric section valves or 1" EVA hose if not using electric section valves.

A-360 Bracket Kit 159-11-100500

Safety Reminder

Check all hoses and fittings and immediately replace any that show signs of wear or are out of date.

Manifolds and Splitters



A-360 Manifold

A-360-MA-(W,C,or J)- *Medium, Large, or Jumbo*



A-360 Splitter

A-360-SP-(3-9) *Regular*

or

A-360-SP-J (3-4) *Jumbo*

INSTALLATION ITEM

Must install correct orifices in Splitter during installation. See the next page or see the instructions with the Splitter.

Features of A-360 Manifolds and Splitters

Patented step down injector technology mixes and accelerates the ammonia into an upper chamber, the tee, and the lower manifold chamber. These features mix the vapor and liquid so each outlet gets an equal amount of both.

- As close as 1 to 3 percent row-to-row variation
- Includes SS hose barbs on manifolds (Half-rate orifice hose barbs are available for half-rate end-rows)
- Manifold outlets available from 3 to 16 for medium (W), 3 to 13 for large (C), and 3 to 10 for jumbo (J)
- Splitter outlets available from 3 to 9 outlets (3 or 4 outlets on Jumbo)
- Pressure gauge port on both manifolds and splitters
- Can be mounted upside down

Splitter Selection

NH₃
GPM per outlet

100 PSI tank	50 PSI tank	Model Number
Up to 12 GPM	Up to 9 GPM	A-360SP
12 to 25 GPM	9 to 18 GPM	A-360SP-J

To determine your GPM per outlet use one of the following formulas

#NH₃ per acre **X** speed **X** tool bar width in feet **X** .1212 ÷ 5.14 ÷ 60 ÷ number of manifolds = **GPM per outlet**

Gallons per minute ÷ number of manifolds = **GPM per outlet**

#N per acre **X** speed **X** tool bar width in feet **X** 0.1212 ÷ 0.82 ÷ 5.14 ÷ 60 ÷ number of manifolds = **GPM per outlet**

A-360SP Splitter

The splitter was designed to have stainless steel threaded orifices on the outlet ports of the manifold. See picture below.



Threaded orifice not installed



Threaded orifice installed

Use a 5/8" socket wrench to install or remove them when necessary. See picture below.



These orifices can be swapped out for different sizes depending on your application needs. Select the correct orifice based on your application needs by referring to the chart below.



NH3 GPM per outlet 100 psi tank	GPM per outlet 50 psi tank	Orifice
Up to 7 GPM	Up to 5 GPM	.302
5 to 12 GPM	4 to 9 GPM	.437
12 to 25 GPM	9 to 18 GPM	JUMBO

To determine your GPM per outlet use one of the following formulas

#NH3 per acre **X** speed **X** tool bar width in feet **X** .1212 ÷ 5.14 ÷ 60 ÷ number of manifolds = **GPM per outlet**

Gallons per minute ÷ number of manifolds = **GPM per outlet**

#N per acre **X** speed **X** tool bar width in feet **X** .1212 ÷ .82 ÷ 5.14 ÷ 60 ÷ number of manifolds = **GPM per outlet**

As a general guideline, manifold pressures greater than 2/3 of tank pressure may restrict total system flow. Manifold pressures less than 30 PSI may result in increased row-to-row variation. Manifold pressures will change as rate, speed, and tank pressure (temperature) change.

A-360 Manifold



Manifold Selection

To choose the correct manifold, use one of the formulas below to determine your lbs NH₃ per outlet (per hour) and look on the chart to see which is the correct manifold for that application range.

NH₃
Lbs/hr
per outlet

100 PSI tank 64° F	50 PSI tank 34° F	Model Number
Up to 170# NH ₃	Up to 127# NH ₃	A-360MA-W
170-422# NH ₃	127-316# NH ₃	A-360MA-C
Above 422# NH ₃	Above 316# NH ₃	A-360MA-J

To determine your NH₃ per outlet use one of the following formulas:

(#NH₃ per acre X speed X tool bar width in feet X 0.1212 ÷ total number of outlets on the bar = **NH₃ per outlet**)

(Gallons per minute X 5.14 X 60 ÷ total number of outlets on the bar = **NH₃ per outlet**)

(#N per acre X speed X tool bar width in feet X 0.1212 ÷ 0.82 ÷ total number of outlets on the bar = **NH₃ per outlet**)

Note: All manifolds must be within one outlet of each other. For example, if you have 17 rows split into 3 sections, your manifolds must have 6, 6, and 5 outlets. You cannot have 5, 5, and 7.

As a general guideline, manifold pressures greater than 2/3 of tank pressure may restrict total system flow. Manifold pressures less than 30 PSI may result in increased row-to-row variation. Manifold pressures will change as rate, speed, and tank pressure (temperature) change.

Nitrogen stabilizers, such as N-serve, added to the ammonia may corrode aluminum and may also leave crystal-like deposits which could eventually clog up the orifices. To avoid problems, disassemble and thoroughly clean the manifolds at the end of each application season.

See the complete Continental NH₃ Products *Installation, Operation, Repair and Maintenance Instructions* that came with the splitter and manifold for further tips and information.

Optional Vertical Dam Manifold

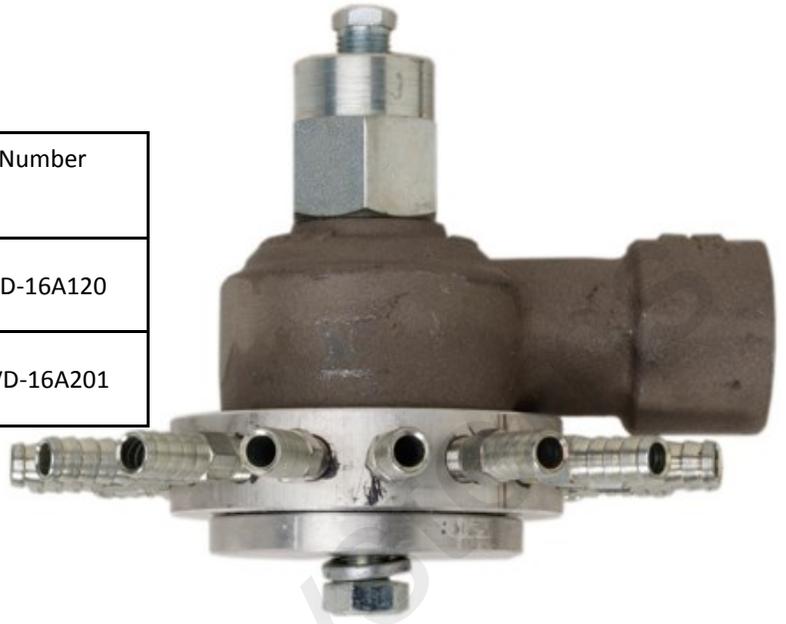
Continental Vertical Dam Manifold

Each manifold has 16 of 3/8" HB outlets

NH3
Lbs/hr
per outlet

100 PSI tank 64° F	50 PSI tank 34° F	Model Number
24-183	18-137	152-A-MVD-16A120
Above 183	Above 137	152-A-MVD-16A201

See the formulas on the previous page to calculate the NH3 lbs/hr per outlet.

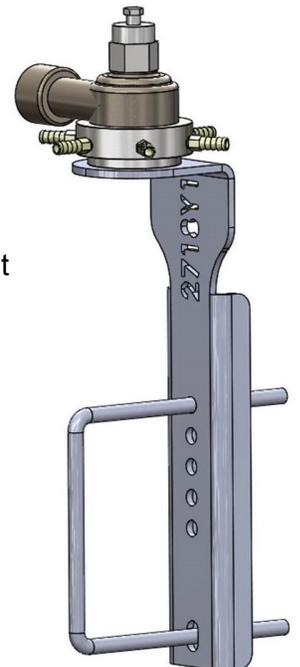


Features of A-MVD Vertical Dam Manifold

- Get within 6 to 8% row-to-row accuracy
- Better accuracy than traditional manifold
- Plug outlets you don't need
- Half-rate orifice hose barbs are available if needed for half-rate end rows

As a general guideline, manifold pressures greater than 2/3 of tank pressure may restrict total system flow. Manifold pressures less than 30 PSI may result in increased row-to-row variation. Manifold pressures will change as rate, speed, and tank pressure (temperature) change.

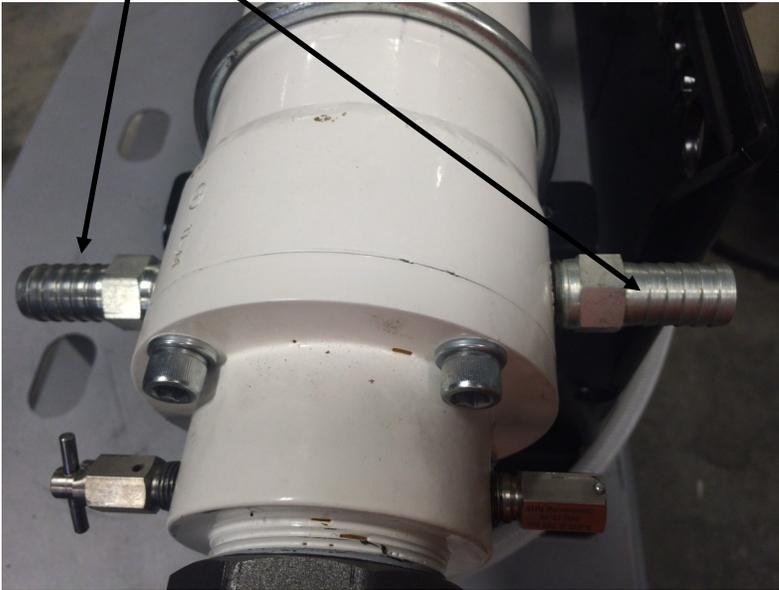
MVD Bracket Kit
159-11-200500



BE CAREFUL OUT THERE!

INSTALLATION ITEM

Dump Hose Barbs: Plumb 3/4" hose to vapor tube dump knives.



INSTALLATION ITEM

Dump Orifice Hose Barb: This controls the amount of ammonia that is used to cool the Exchanger. Using too small of an orifice may result in some vapor still being in the system when it goes through the flowmeter. Using too large an orifice will cause more ammonia than necessary to be dumped through the vapor tube dump knives. The letter indicating the orifice size is stamped on one of the hex sides.

GPM	1-12	13-18	19-26	27-33	34-UP
Orifice	A	B	C	D	E



INSTALLATION ITEM

Bleeder valve: Run hose to safe location for bleeding vapor. Use to bleed system.

TORPEDO™



SureFire

Ag Systems

Flowmeter 204-02-2692Y1

Raven SS RFM 60S Flowmeter 1 to 60 GPM with 3-pin MP 150 shroud



The flowmeter calibration number is **72 pulses per gallon**.

Verify accuracy of flowmeter by comparing the Volume shown on the display with actual weigh tickets.

If the weigh ticket amount is more than shown on the display, LOWER the flow cal number.

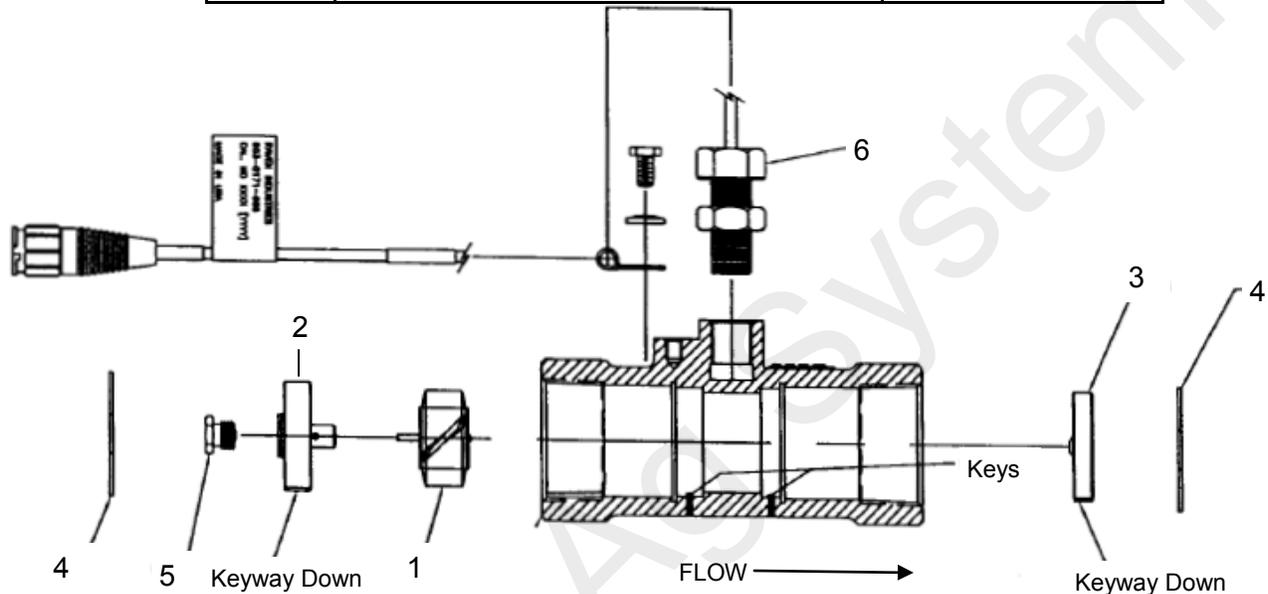
Use the following formula to adjust the flow cal number:

$$(\text{Initial flow cal} \times \text{Volume shown on screen}) / \text{Weigh ticket amount} = \text{new flow cal}$$

See the next page for flowmeter parts, repair and maintenance.

RFM 60S Flowmeter

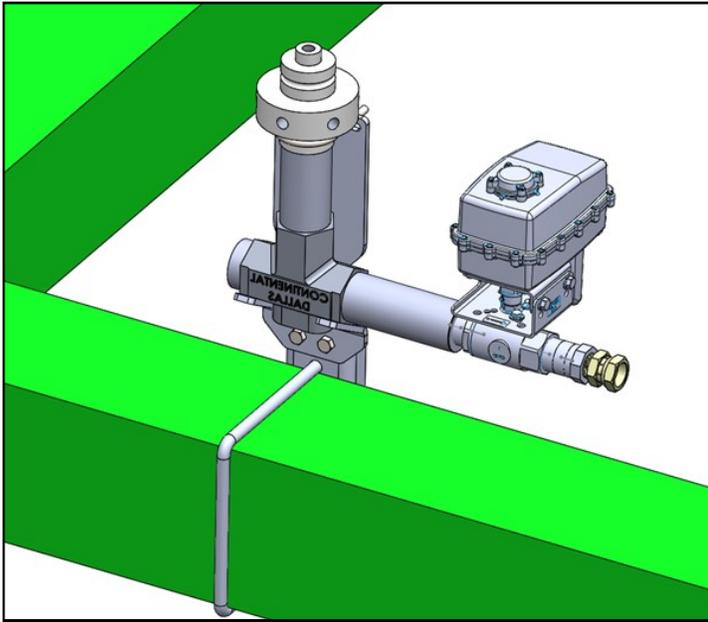
Item	Description	Raven Part #
1	Rotor / Magnet Assembly	063-0171-673
2	Hub / Bearing Assy, Upstream	063-0171-674
3	Hub Assembly, Downstream	063-0171-769
4	Ring, Retaining, Internal	335-0000-278
5	Stud Bearing	063-0173-062
6	Sensor Assembly	063-0171-669



RFM 60S Flowmeter Maintenance and Adjustment Procedure

1. Be sure all NH₃ has been bled from the system before starting maintenance.
2. Remove flowmeter, brush away any debris and flush with clean water.
3. Remove the retaining rings carefully. Remove the bearing hub, turbine hub, and turbine from inside flowmeter housing.
4. Clean the turbine and hubs of metal filings and any other foreign material. Use pressurized air to blow metal filings out of both hubs and turbine. Confirm that the turbine blades are not worn. Hold turbine and bearing hub in your hand and spin turbine. It should spin freely with very little drag.
5. If bearing hub stud is adjusted or replaced, verify the turbine fit before reassembling. Put turbine hub and retaining ring in place. Put bearing hub with turbine against turbine hub inside the flowmeter housing. (Stud keys inside flowmeter housing must be lined up in the groove on the hub.) Put the retaining ring into the groove to lock bearing hub in place. Spin turbine by blowing on it. Tighten bearing hub until turbine stalls. Loosen the stud 1/3 of a turn. The turbine should spin freely.
6. Use a low pressure (5 PSI) jet of air through flowmeter in the direction of flow and again in the opposite direction to verify the turbine spins freely. If there is drag, loosen the stud on the bearing hub 1/16 turn until the turbine spins freely.
7. If turbine spins freely and the cables have checked out, but the flowmeter is not totalizing properly, verify that the sensor assembly is threaded all the way into the flowmeter body, and the orientation groove on top of the sensor is parallel with flowmeter body. If flowmeter still does not totalize, replace Sensor Assembly.

Electric Section Valves



202-KZ67FY

1" SS KZ NH3 shut-off valve with 3-pin WP shroud

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:

Pin A—Red, 12 Volts +

Pin B—Black, Ground -

Pin C—White, Signal

12V=on ; 0V=off

Pressure gauges and sensors

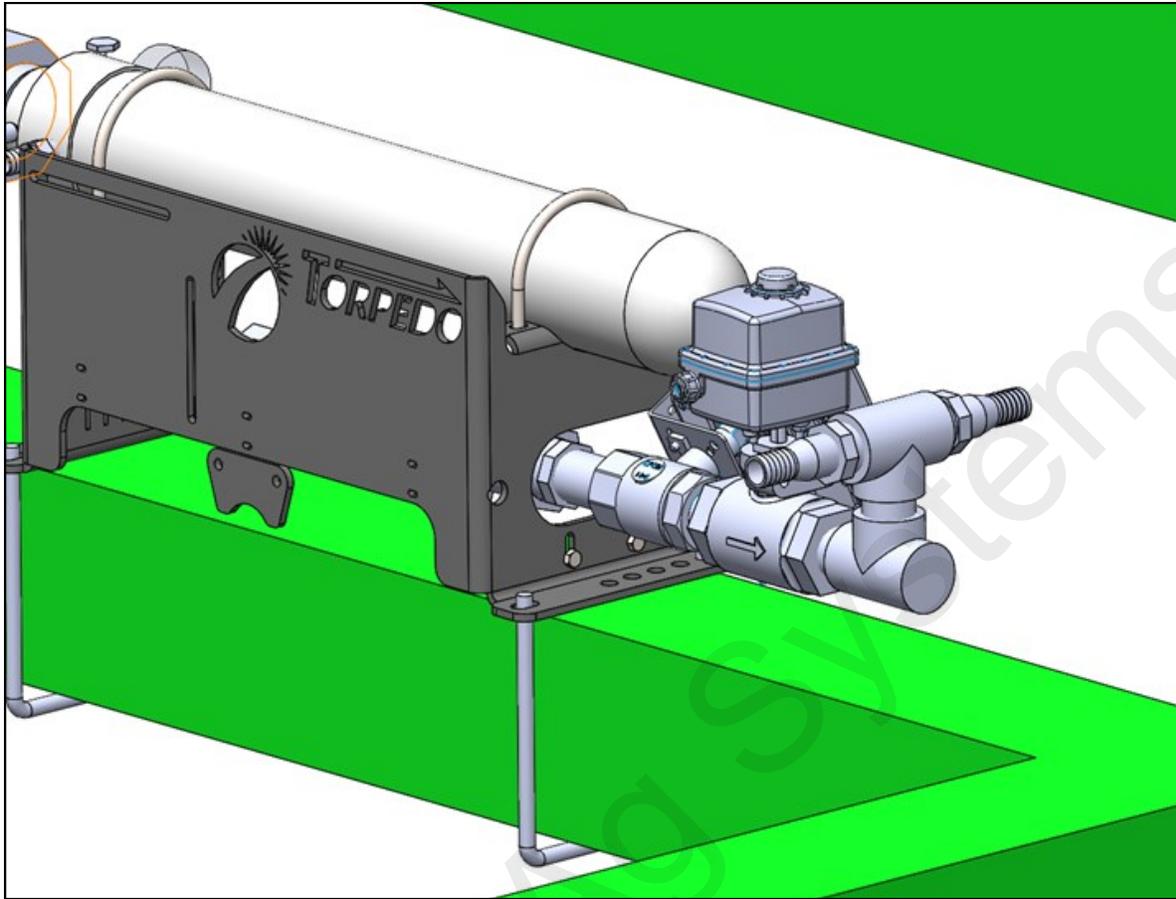
137-ASG60 2 1/2" Silicone Filled Stainless Gauge-60 PSI
For manifolds (optional)

137-ASG400 2 1/2" Silicone Filled Stainless Gauge-400 PSI
For Torpedo SuperCooler (optional)

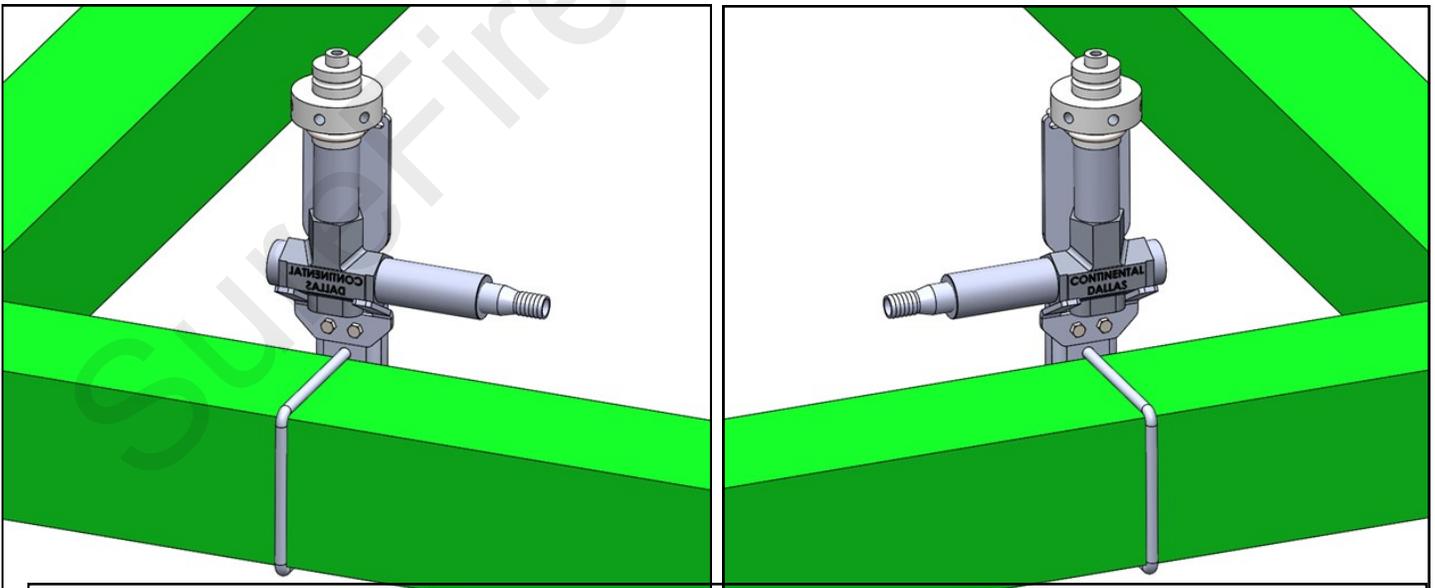
Or

521-05-050400 NH3 400 PSI 3-wire pressure sensor (0-5 V DC
12.5 mv/PSI) with 3-pin 150 MP Tower
For Torpedo SuperCooler (optional)

159-10-200200 SuperCooler Splitter Kit for 2 manifolds (NO ELECTRIC SECTIONS)



To split the flow to 2 manifolds a Tee is used. If going to 2 manifolds with no electric section valves 1" reinforced EVA hose is used (equal length to each manifold).

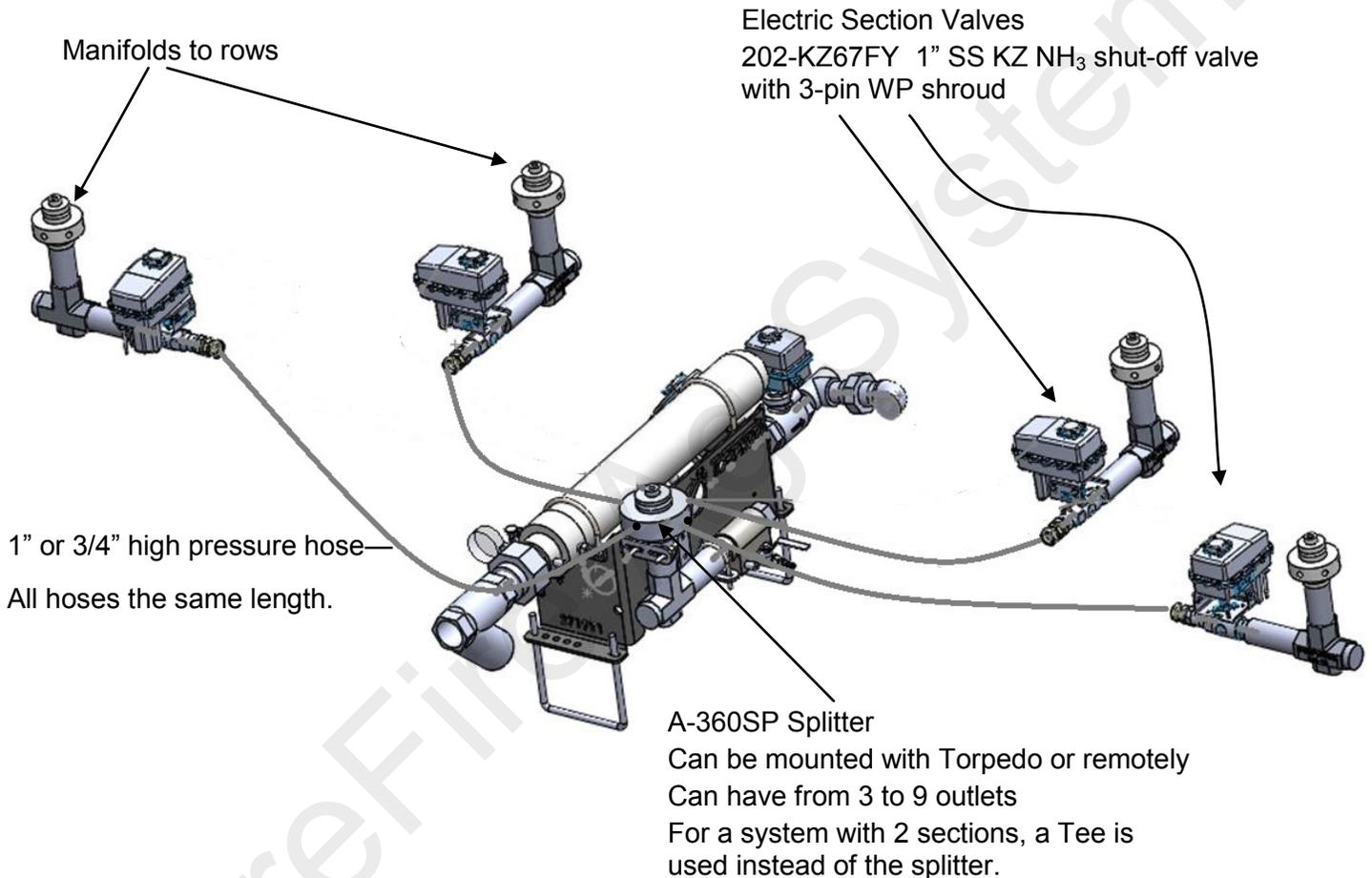


Safety Reminder

Flush with water for at least 15 minutes if exposed to anhydrous ammonia.

Electric Valve Kits for doing multiple sections

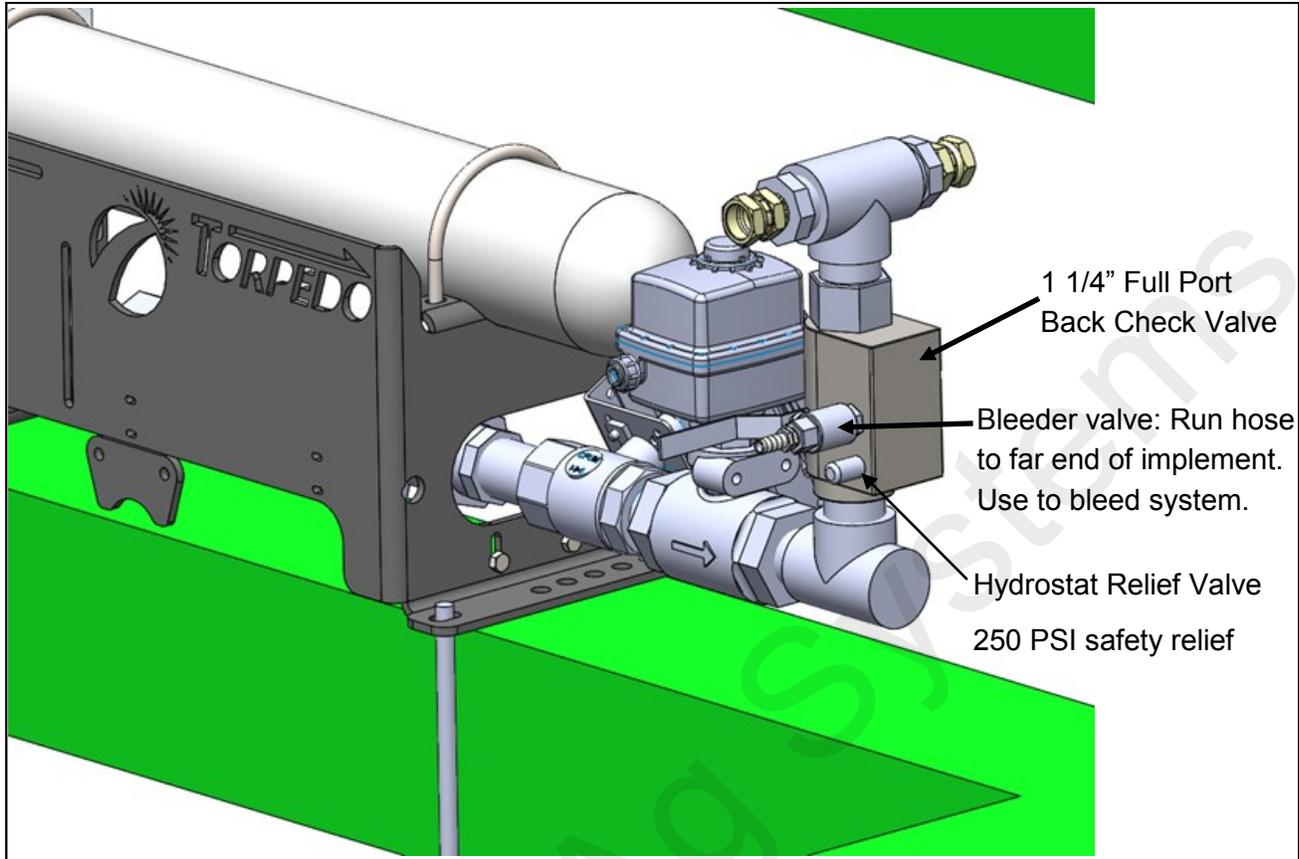
When using electric section valves, you must use high pressure hose from the Splitter to the section manifolds. These hoses must be the same length. Recommended hose is 1" high pressure hose for 3 sections or less and 3/4" high pressure hose for 4 or more sections.



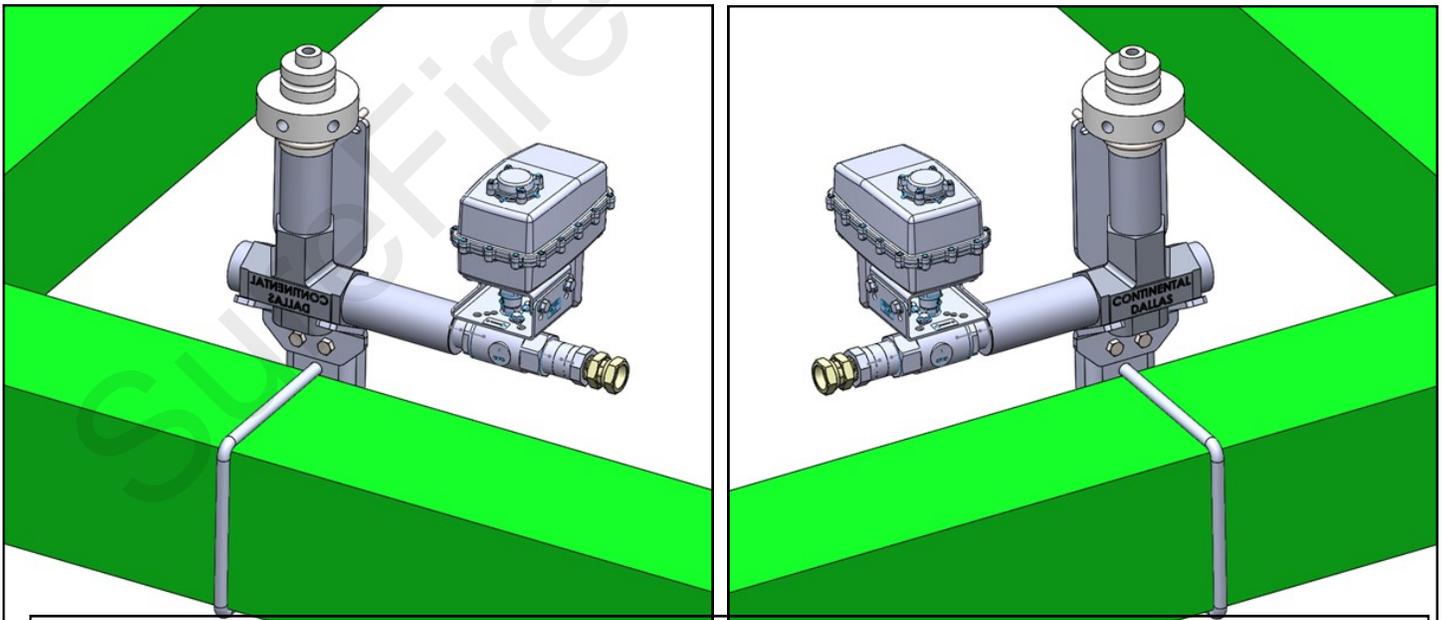
Safety Reminder

Make sure the nurse tank has 5 gallons of fresh clean water.

159-10-100200 SuperCooler Splitter Kit for 2 ELECTRIC SECTIONS



To split the flow to 2 manifolds a Tee is used. If going to 2 manifolds with electric section valves 1" high pressure hose is used (equal length to each manifold).



Safety Reminder

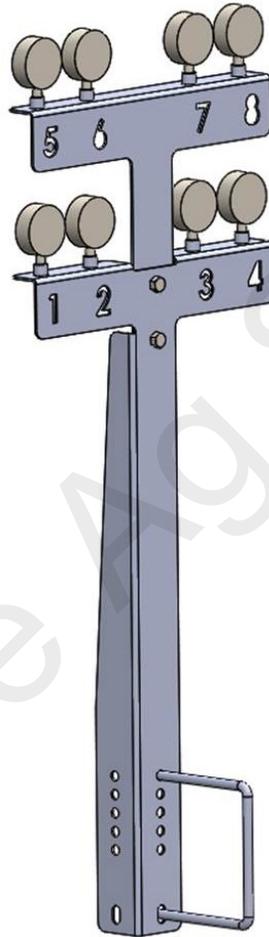
Always know the wind direction and park in an appropriate direction when servicing the system or changing tanks. The wind is your friend.

Gauge Tree Assembly (Optional)

159-11-500500 Black Gauge Tree Kit for 1-4 gauges with 7x7 u-bolt

159-11-500600 Black Add-on Gauge Tree Kit for 5-8 gauges w/ mounting hardware
(Gauges not included)

Use 137-ASG60 2 1/2" Silicone Filled Stainless Gauge-60 PSI-one per manifold



Safety Reminder

Anyone working around anhydrous ammonia should keep a small squeeze bottle of fresh water with him at all times.

TORPEDO™



SureFire

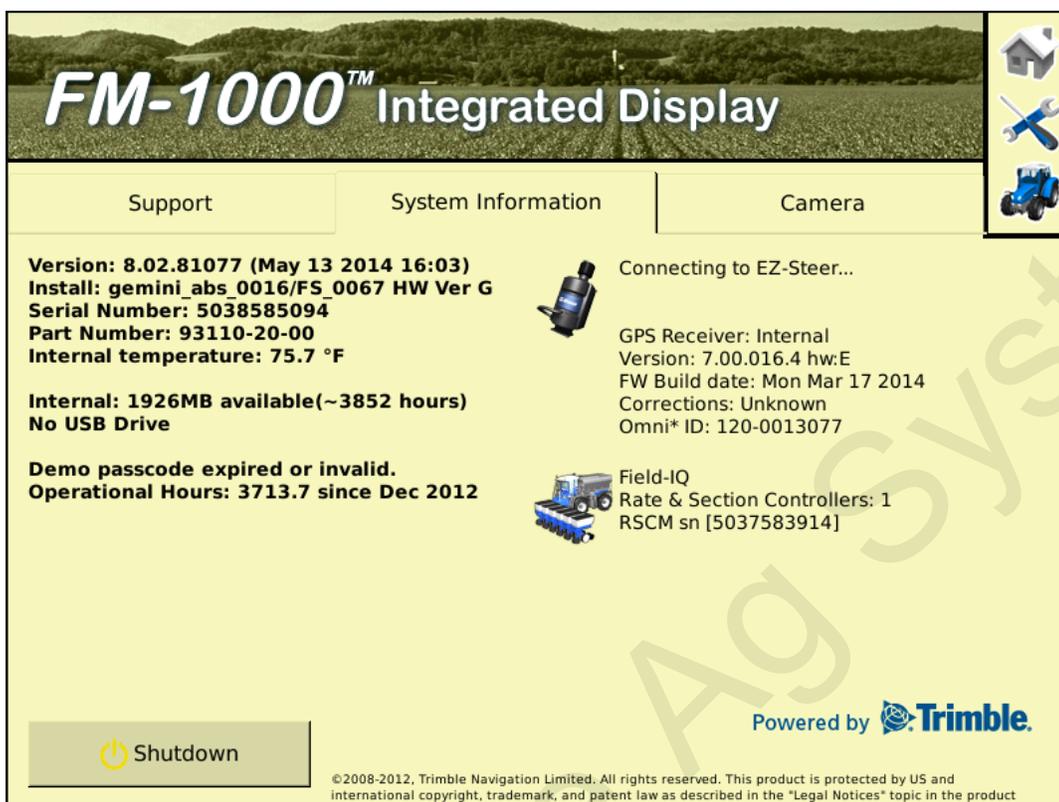
Ag Systems

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



The Trimble Field-IQ is a very flexible control platform with many capabilities. This section will show you the detailed steps to set up your Trimble Field-IQ to control your SureFire Torpedo™ System.

Home Screen



Navigation Buttons

- ← Home Screen
- ← Configuration
- ← Setup - Diagnostics
- ← Run Screen

System Information

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

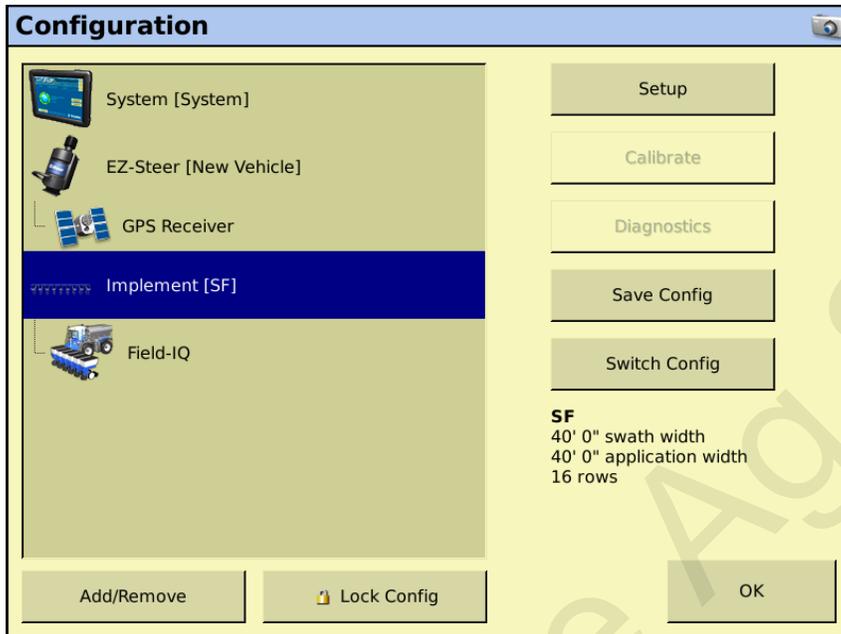
Use your Trimble FmX® Integrated Display USER GUIDE (Chapter 10 Field-IQ Plugin) for further configuration instructions.

Implement Setup

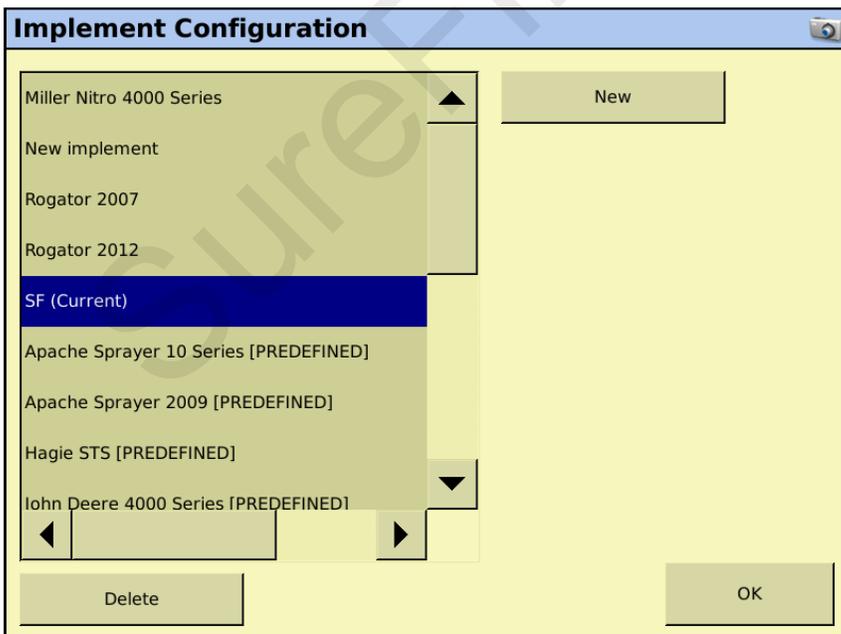


Implement Setup is where you set the information for the implement you are using. Some of these settings affect the guidance control. However, if using auto section shutoff, these settings will determine when each section valve shuts off.

Measure your implement carefully and consult your Trimble dealer or the Trimble FmX Integrated Display User Guide (Chapter 10) for additional assistance with the Implement Setup section.



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



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

Implement Setup (continued)



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

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

For Implement Type, select **Other** or the appropriate Implement Type.

Edit the Layout of the Implement as needed.

Enter the appropriate measurements for the Implement.

On the Next screen, enter the Geometry measurements requested.

Implement Setup (continued)



Implement Setup

Implement Type | Measurements | Geometry | **Overlap** | Switches

Infill Boundary: Outer

Select either “**Outer**” or “**Inner**” for the Infill Boundary on the Overlap Tab.

Outer uses the field boundary as the infill boundary. **Inner**: When running a Headland setting, this moves the boundary to the inside of the last headland pass.

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

If you will be using an Implement Lift Switch,

Implement Setup

Implement Type | Measurements | Geometry | Overlap | **Switches**

Implement Lift: Setup

Auxiliary Master Switch: Disabled

Add/Edit Implement Lift Sensor

Status: On

Number of Switches: 1

Minimum Changed Switches: 1

If using an Implement Lift Switch, change the Status to **On**. Enter the number of switches and the minimum number of switches that need to change.

You will need to Calibrate the Implement Lift Switch later on by going to Field IQ - Configuration - Implement Lift Switch.

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

The Implement should be set up.

Configuration

- System [System]
- EZ-Steer [New Vehicle]
- GPS Receiver
- Implement [SF]**
- Field-IQ

Buttons: Setup, Calibrate, Diagnostics, **Save Config**, Switch Config

SF
40' 0" swath width
40' 0" application width
16 rows

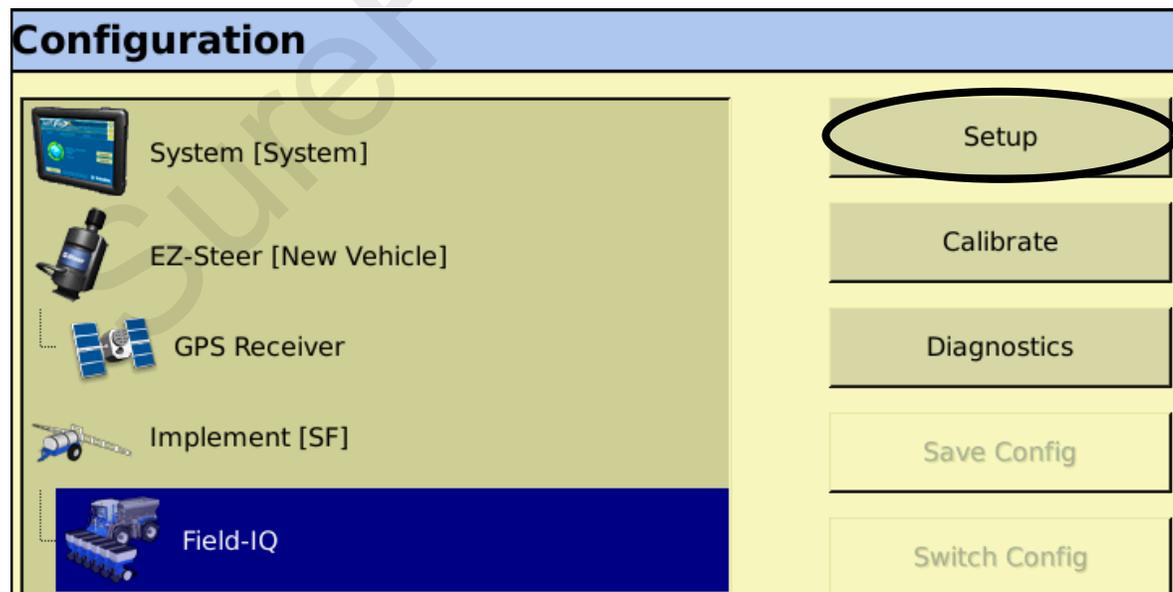
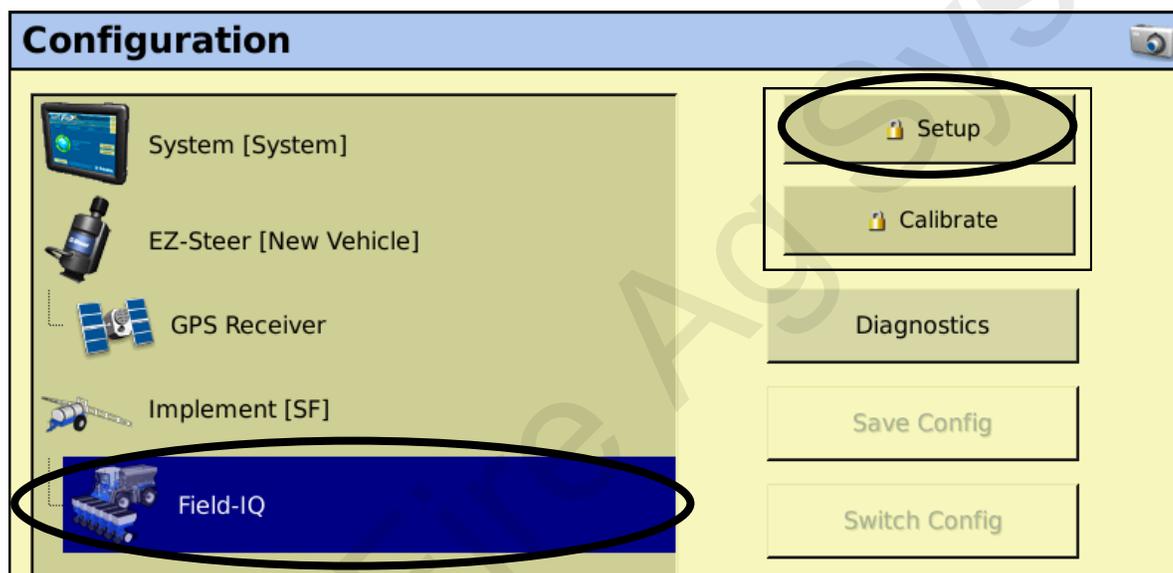
Configuration - Field-IQ™ Setup

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

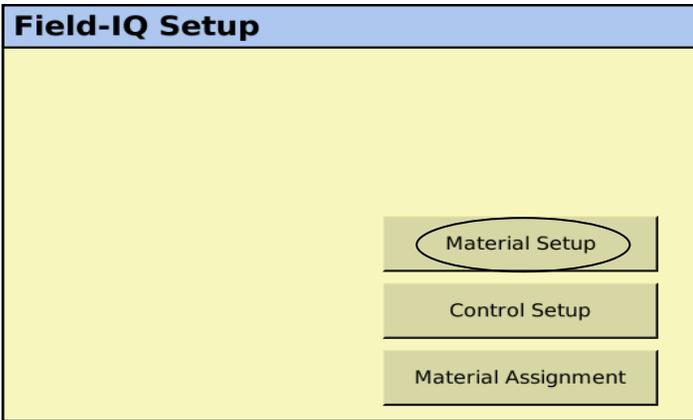


1. From the Home Screen access the Configuration screen (wrenches).
2. The Configuration screen below will appear. Choose **Field-IQ**. If the Setup & Calibrate buttons are locked, shown by a padlock next to them, Push **Setup**, then enter “2009”.
3. After entering the code, the locks will disappear.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

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

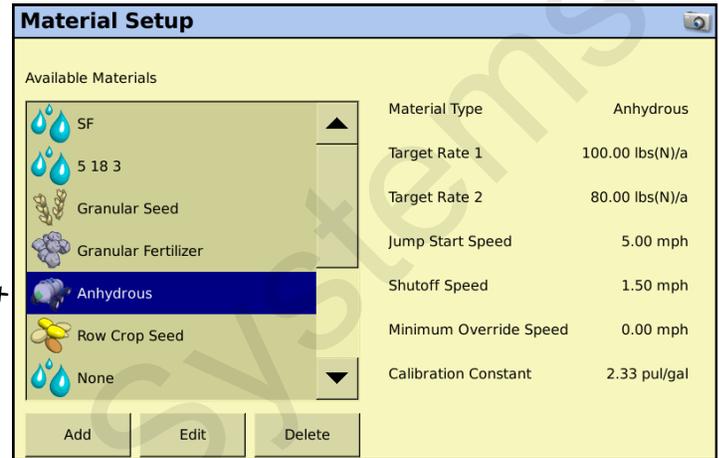


Trimble® Field-IQ™ Setup for FmX® or FM-1000™



Material Setup

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



Select one of the Available Materials or press **Add** to add a new material.

Press **Edit** to change any of the parameters of the Material.



Set **Target Rate 1 & Target Rate 2** as desired.

Rate Increment increases or decreases Rate 1 or Rate 2 by this amount each time you press the Rate Adjustment Switch on the Master Switch Box.

→ **Manual Rate Increment** works when the Rate Switch is in the Manual Position. This number controls the speed at which the valve increases or decreases when you press the Rate Adjustment Switch on the Master Switch Box.

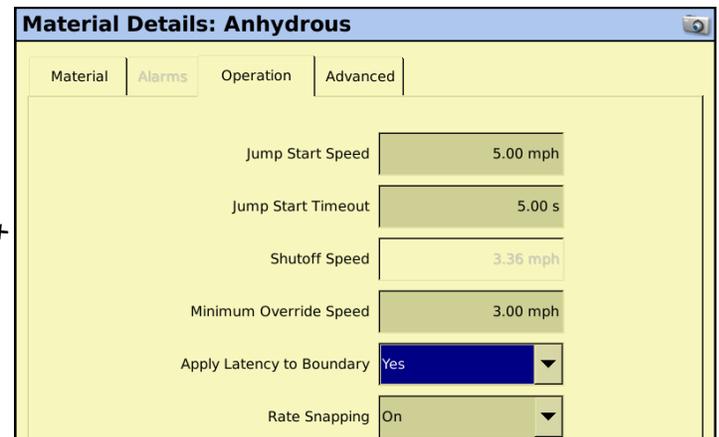
Minimum Rate is typically set at 0.

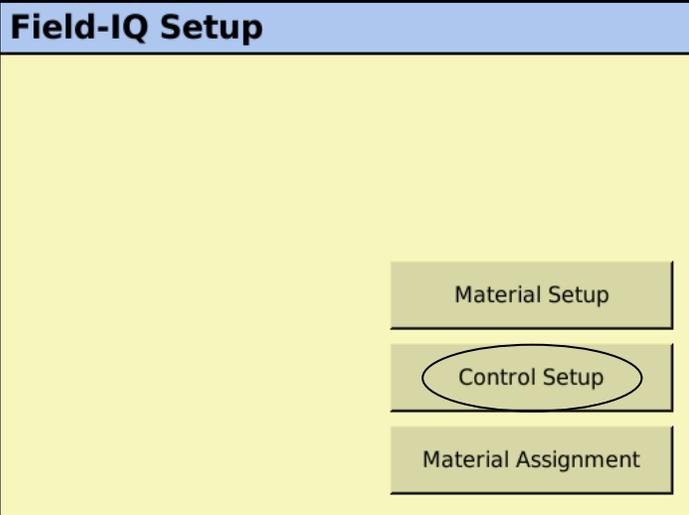
These parameters may be adjusted as desired.

Jump Start Speed is the speed the system will ramp up to when the operator pushes the Jump Start button on the Master Switch Box. 3.0-5.0 mph is a good setting for this. **Jump Start Timeout** allows the Jump Start Speed to run for a specified amount of time.

Apply Latency to Boundary: Set as needed so the system begins applying when needed.

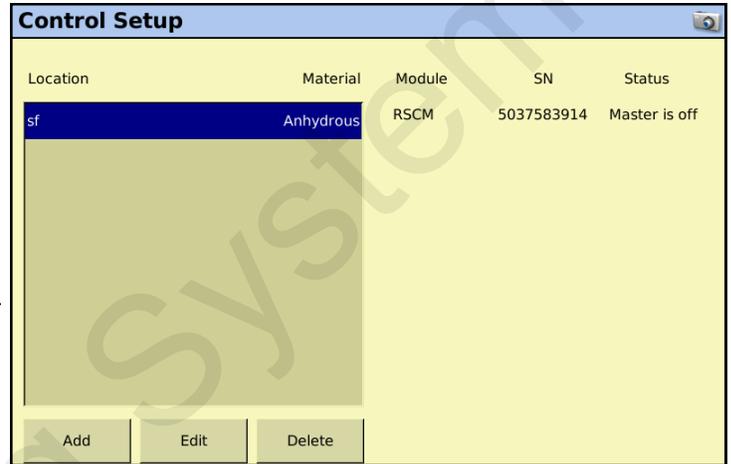
SureFire recommends setting the **Rate Snapping** to **On**. This will smooth out the normal rate fluctuation seen on the screen while operating.





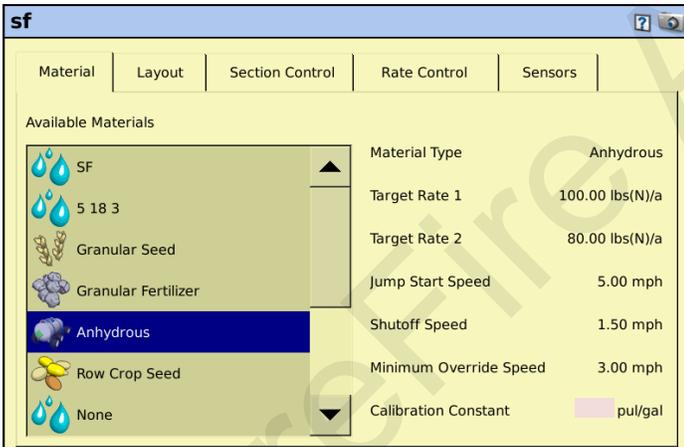
Control Setup

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



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

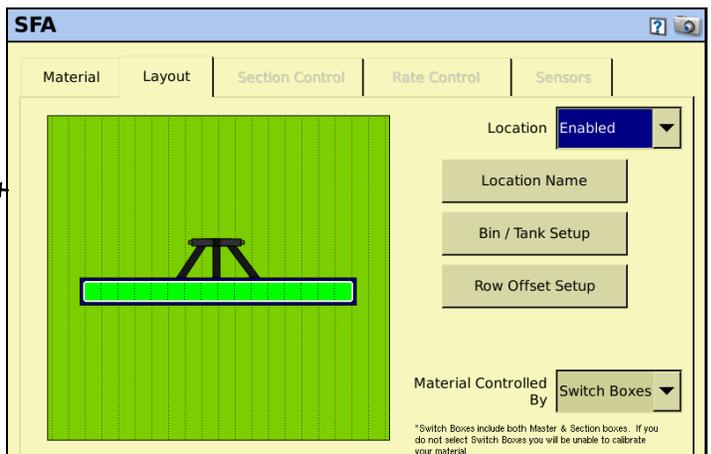
If there is a location and material set up, you can select and/or edit it.



► Select an Available Material.

From this screen, you can add a **Location Name** such as Nurse Tank, Rear Tank, etc..

If desired, you can set up the **Bin/Tank Setup** to allow the system to track how much material is left in the tank. (See screenshot on next page)



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



Virtual Bin/Tank Setup

Status: On

Capacity Units: Default Units

Bin Capacity: 4000.00 lbs(N)

Current Volume: 4000.00 lbs(N) Refill Tank/Bin

Partial Refill: 0.00 lbs(N) Partial Refill Tank/Bin

Warning Level: 1000.00 lbs(N)

Trip Area: 0.00 a Reset Trip

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

Section Control

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

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

SF

Material | Layout | **Section Control** | Rate Control | Sensors

Section Control: On

Section Control Module Location: Setup

Section Control: Setup

Section Control Module Setup

Number of Modules: 1

Module: 5037583914

Number of Sections: 4

Section Widths

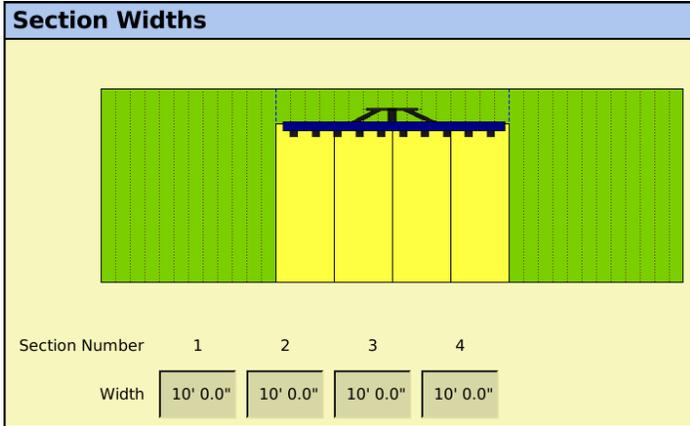
1. Set the Number of Modules in your system.
2. Select the Module Serial Number.
3. Set the number of Sections for your system.
4. Press **Section Widths**.



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

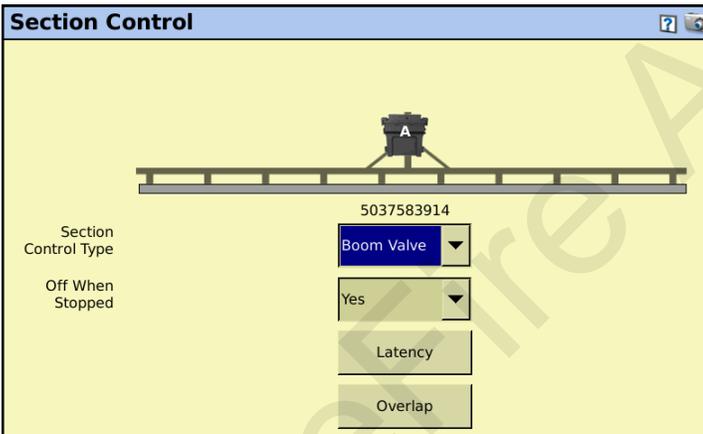
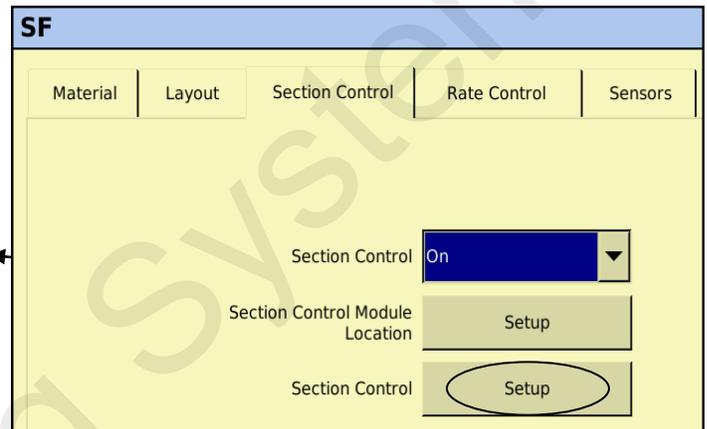


Section Control Setup (cont.)



➔ Set the width of your sections.

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

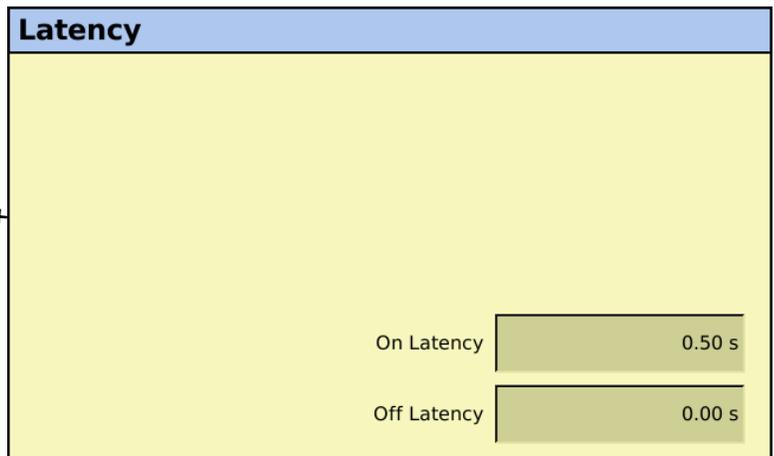


- ➔ 1. Set **Section Control Type** to **Boom Valve**.
- ➔ 2. Set **Off When Stopped** to **Yes**.
- ➔ 3. Press **Latency**.

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

➔ These numbers pertain to how long it takes for your system to actually begin applying or stop applying after the controller sends the signal to start or stop.

Adjust as necessary in the field.



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

F

Setup & Operation

Rate Control Setup

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

1. Select the **Rate Control** tab at the top.
2. Set **Rate Control** to **On**.
3. Set **Number of Nozzles**.
4. Press **Setup** next to **Rate Control Module Location**.

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

Set the Valve Setup as shown.

ValveType: Servo

**Valve Behavior When Sections Closed:
Lock in Last Position**

Auxiliary Valve: Master

Set the Feedback Setup screen as shown.
Flowmeter Calibration = 720 pul/10 gal.

Pressure Sensor Setup

The screenshot shows the SF main menu with five tabs: Material, Layout, Section Control, Rate Control, and Sensors. The Sensors tab is circled in yellow, and an arrow points to it from the right.

Select the **Sensor** tab.

The screenshot shows the 'Add Sensor' screen with the following fields: Sensor Type (NH3 Pressure), Name (NH3 Pressure), Alarm (Enabled), Warn if below (0.00 psi), Warn if above (225.00 psi), and Warn after (3.0 s). A 'Sensor Setup' button is at the bottom.

Sensor Type : NH3 Pressure

Name: NH3 Pressure (or other name)

Alarm: As desired (Enabled or Disabled). You may want to leave Warn if Below set to 0, and Warn if Above to 225 PSI.

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

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

Field-IQ Calibration

The screenshot shows the 'Field-IQ Calibration' screen with a tree view of options: Implement Lift, Rate and Section Control Module 5037583914 (containing Drive Calibration, Flow Calibration, and Pressure Calibration), and NH3 Pressure - Module 5037583914. The 'Pressure Calibration' option is circled in yellow.

To finish the Pressure Sensor setup, it will be necessary to go to Field-IQ Calibration and select Pressure Calibration and the name of the Pressure sensor you set up. (0-400 PSI, 0-5 V transducer)

Calibrate Type: Point/Slope

The calibration setting (slope) is **12.5 mv/PSI**.

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

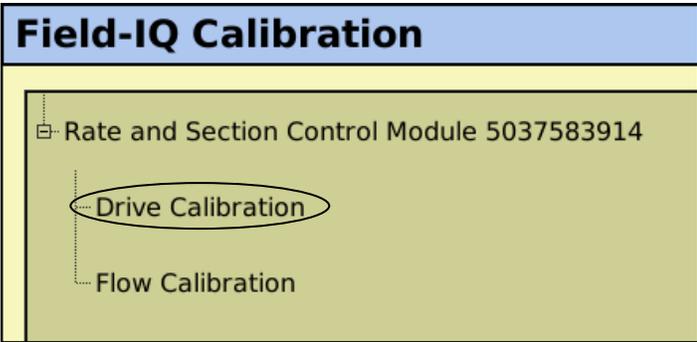
Implement Lift Switch Calibration

The screenshot shows the 'Field-IQ Calibration' screen with a tree view of options: Implement Lift, Rate and Section Control Module 5037583914 (containing Drive Calibration, Flow Calibration, and Pressure Calibration), and Transducer - Module 5037583914. The 'Implement Lift' option is circled in yellow.

The screenshot shows the 'NH3 Pressure Calibration' screen with the following fields: Enabled (Yes), Name (NH3 Pressure), and Pressure Slope (12.50 mV/psi). The 'Pressure Slope' field is circled in yellow.

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

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



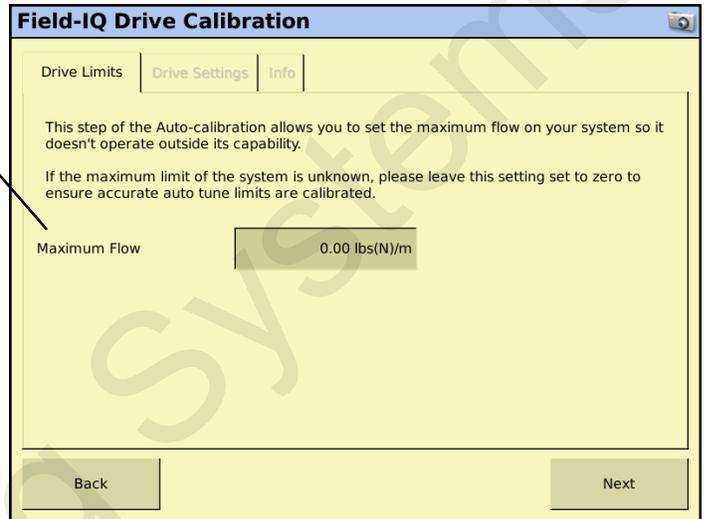
Field-IQ Calibration

Select **Field-IQ - Calibrate** on the Calibration screen.

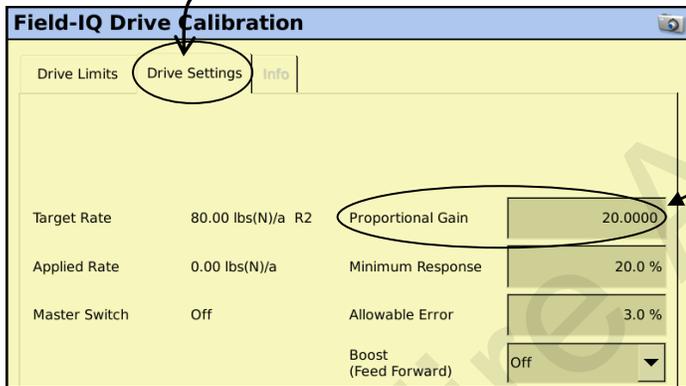
This brings up the screen on the left.

Select **Drive Calibration**.

You can leave Maximum Flow set at 0. Then press **Next**.



Drive Settings Screen



Proportional Gain: Start at 20. Adjust as needed so that Servo control valve responds as desired.

Advanced Tuning screen

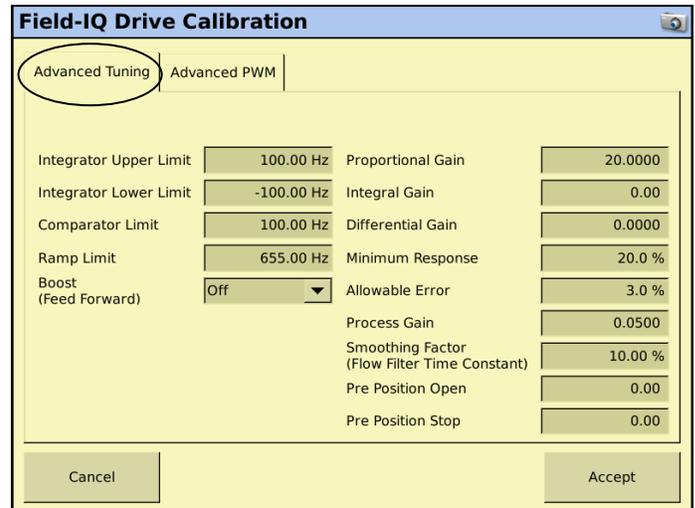
Normally, this screen will not need to be adjusted. These numbers are shown as default settings.

Recommended Settings for Torpedo NH3 system: ←

Proportional Gain: 20. If the gain is set too high, the system will surge above and below the desired flow. Lower the gain to achieve steady control valve operation. If set too low, the system may not adjust quickly enough.

Minimum Response: 20

Allowable Error: 1% to 3% (or as desired). If set too low, control valve may overreact to try to stay on rate.

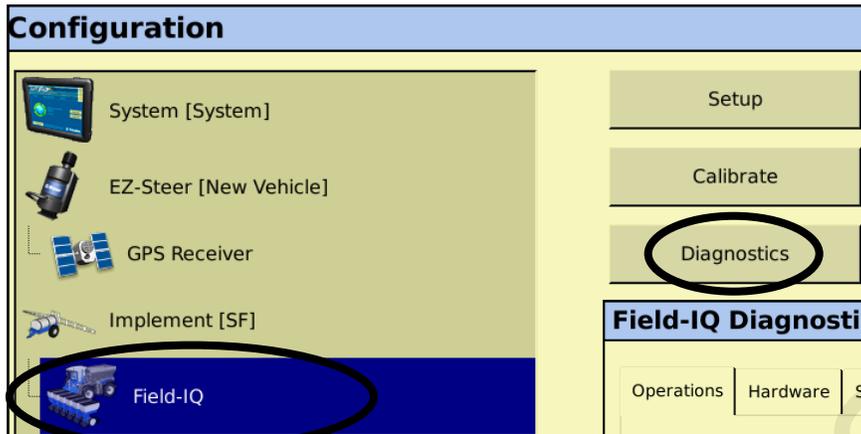


Initial Operation Instructions

This can be used to test system prior to field operation. Anhydrous ammonia will be released during this operation. Operator must insure that this release is safe. The implement should be in the ground and moving when anhydrous ammonia is turned on.

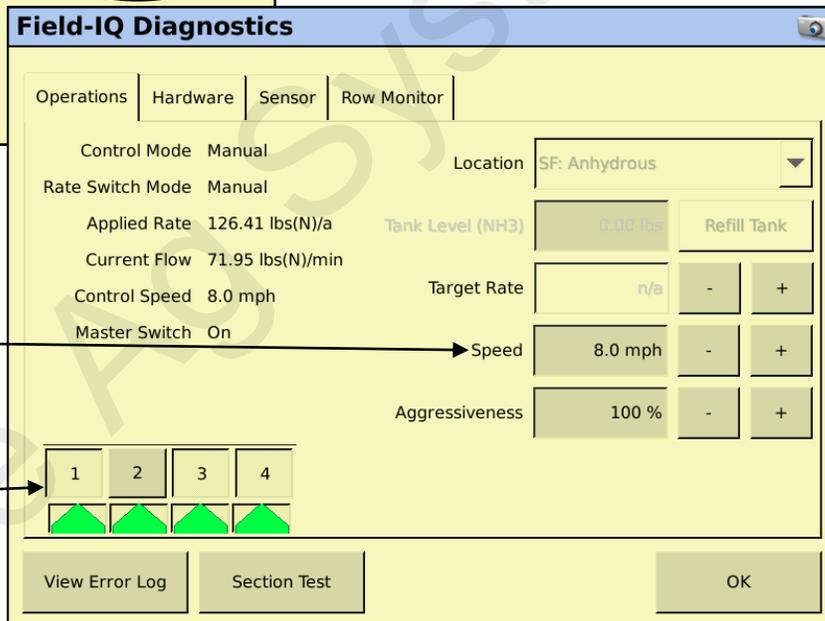
F

Setup & Operation



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

Operator must be sure it is safe to release anhydrous ammonia before starting this.



1. Is it safe to release anhydrous ammonia?
2. Open valve on nurse tank.
3. Press the + next to **Speed** to simulate a Speed signal.
4. Turn the **Field-IQ master switch (#5)** on.
5. Push each section valve button and verify each valve is working.
6. Turn **Switch #2 to Manual** and open the section valves. Use **switch #1** to increase flow. Does “**Current Flow**” display a flow rate? Is it stable after the system is primed? Do increase & decrease buttons (**switch #1**) increase & decrease flow?
7. Move **switch #2 to Rate 1** and set speed to your typical field speed.
8. The system should begin to dispense NH3 now in automatic control mode. Is the flow in GPM (or lbs N/min) stable? Is it applying at the correct rate? (applied rate = target rate?)
9. Change rate using screen buttons or switch #1 to increase/decrease rate or switch #2 to go to Rate 2. Does applied rate change to equal target?
10. Close 1 section valve, does flow decrease? Does applied rate still equal target rate?
11. Change speed and target rate to minimum and maximum values. Does system perform at these values? Use “**Sensor**” tab at the top of page to read the pressure sensor value (if equipped).
12. **Aggressiveness** (bottom right) can be adjusted to help achieve the desired rate.

Field-IQ Master Switch Box



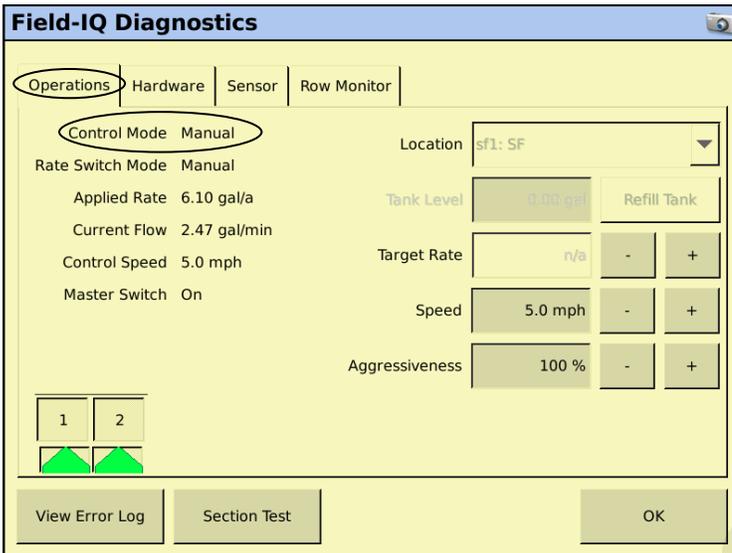
Field-IQ Diagnostics

F

Setup & Operation

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

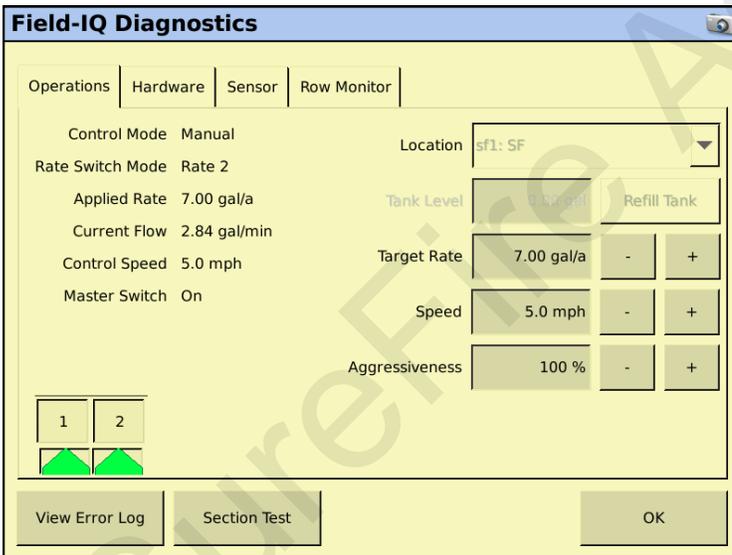
Operating the system from this screen will release NH₃. The operator must be certain it is safe to do this before starting the system from this screen.



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

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

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

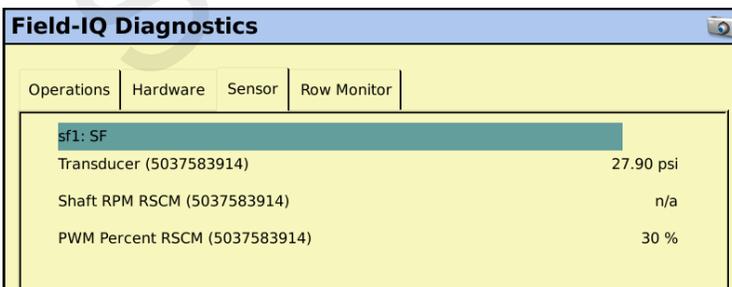


Operate the system, and check the value shown for *Applied Rate* at various *Speeds* and *Target or Manual Rates*.

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

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

Aggressiveness (bottom right) can be adjusted to help achieve the desired rate.



The **Sensor** tab provides information on the Pressure Sensor.

Wire Size: 18 AWG unless otherwise specified

201-215464Y3

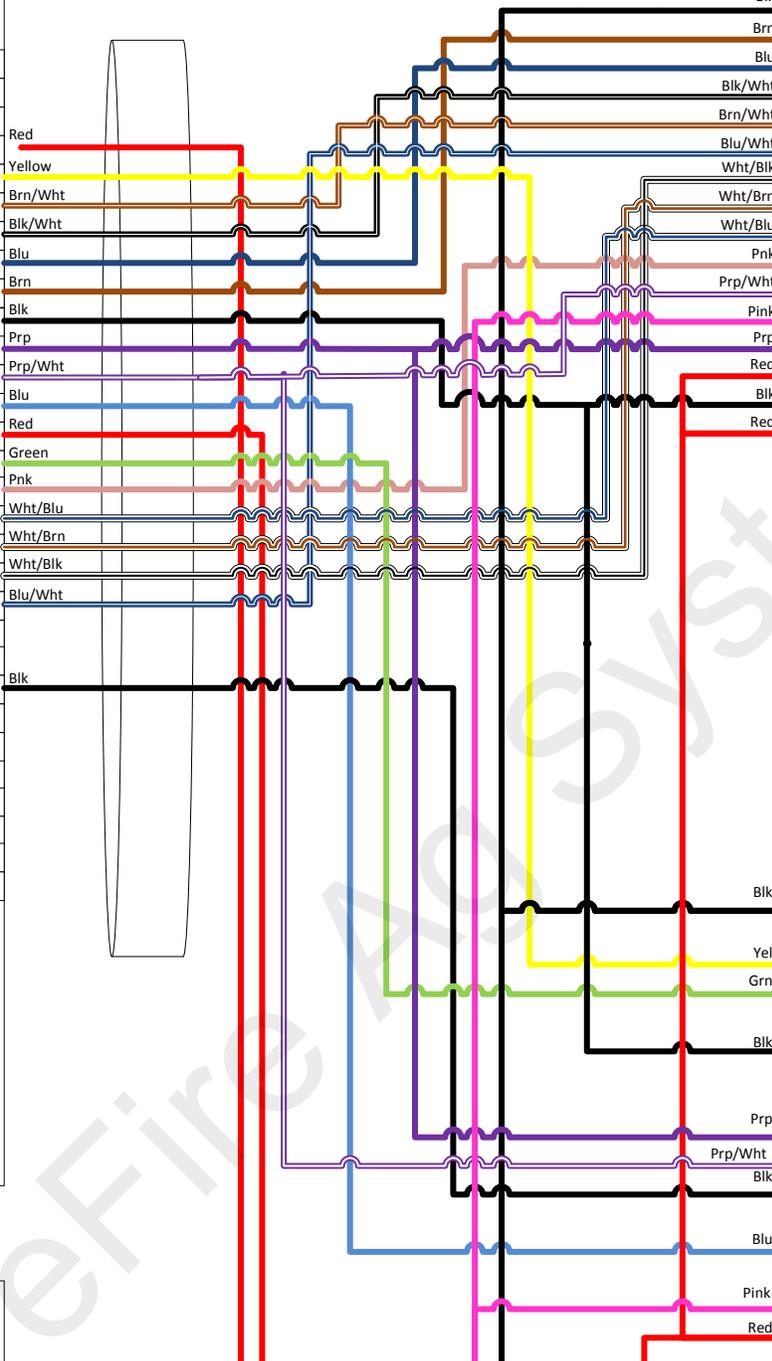
Length: 3ft Sections

Trimble Field IQ Adapter Cable – 30 pin to twin 16 pins- 2 pressure

Cinch Connector



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



1	Valve GND	16 Pin Round – AMP Male pins in male body (with threads for swivel nut)
2	Section 2	
3	Section 3	
4	Section 4	
5	Section 5	
6	Section 6	
7	Section 7	
8	Section 8	
9	Section 9	
10	Section 10	
11	Pressure 2 Signal	
12	Aux/Dump Valve	
13	Pressure 1 Signal	
14	Valve Power	
15	Section 1	Mates with 215466 or 215467
16	Valve Power	

Attach Dust cover to Connector Labeled "Sections"



Pump

16 Pin Round – AMP Female pins in female body (with swivel nut) Labeled "To Pump"	
1	GND
2	
3	Servo +/- PWM
4	Servo -/ PWM
5	
6	Section 1
7	
8	
9	Pressure 1 Signal
10	Pressure 2 Signal
11	Flow GND
12	
13	Flow Signal
14	
15	Master On/Off
16	Power



Mates with 215223 or 215218

2 Pin Connector – Deutsch DTP04-2P Male (Power In)



GND	1
+12VDC	2

12 Pin Connector Deutsch DTM04-12P



PIN 1	Pink
	Aux/Dump Valve Signal

Run/Hold

150 MP TOWER 3-PIN	
A	Imp Sw Signal
B	
C	Imp Sw 5V

Dust Cap

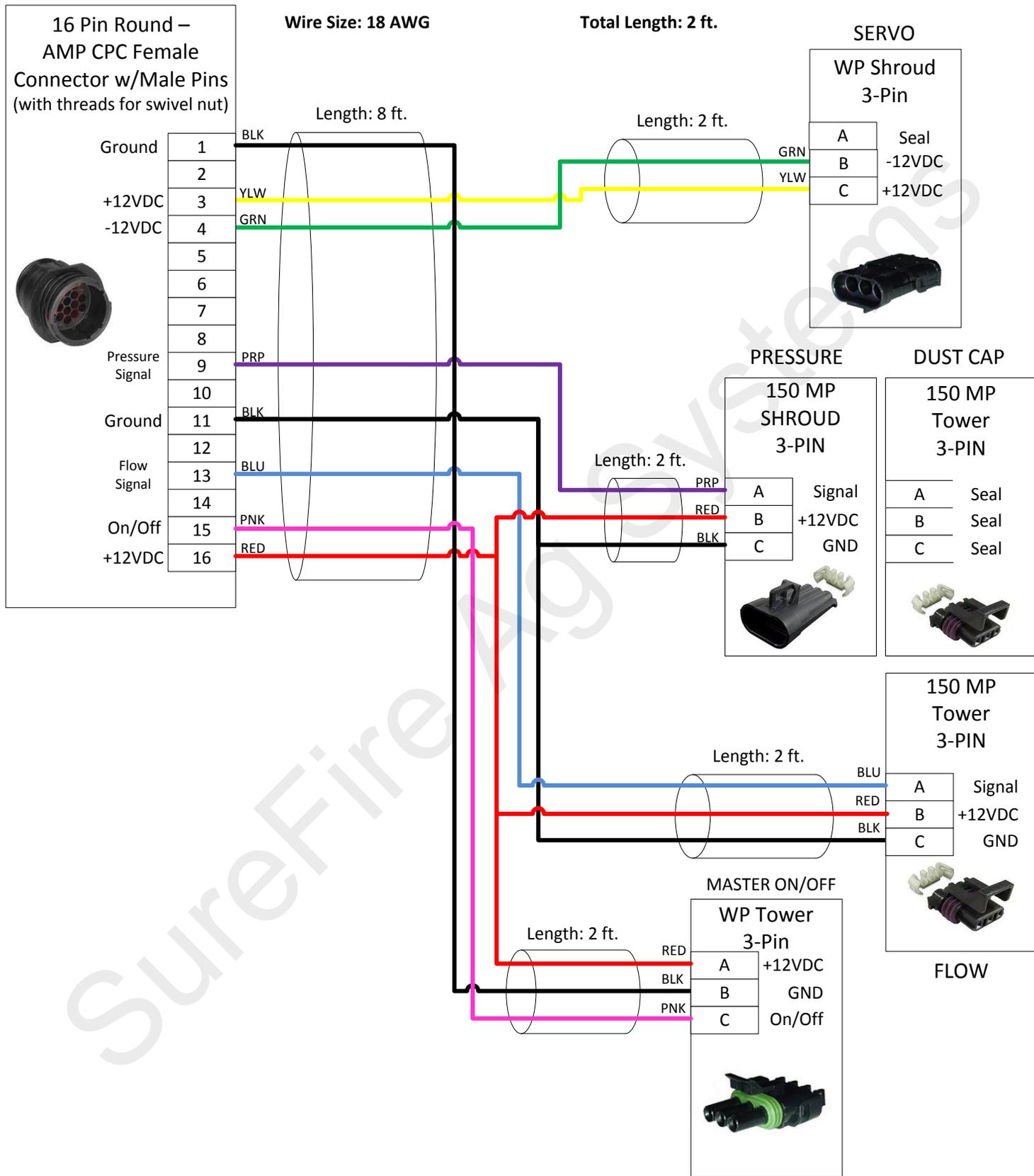
150 MP SHROUD 3-PIN	
A	Plug
B	Plug
C	Plug



Project:	201-215464Y3 Trimble Field IQ Adapter Cable – 30 pin to twin 16 pin—2 pressure, 10 section, aux/dump valve	Drawn By:	Brady Gragg Rev. by Mark Wolters, Ricker
Filename:	Trimble Field IQ Adapter Cable – 30 pin to twin 16 pin	Date:	10/23/12 Rev. 09/27/2013, 8/25/2014
Copyright 2012-2014 SureFire Ag Systems		Page of Pages	1 of 1

207-2292Y1

NH3 Control Cable- Flow Meter, Servo, Master On/Off, & Pressure



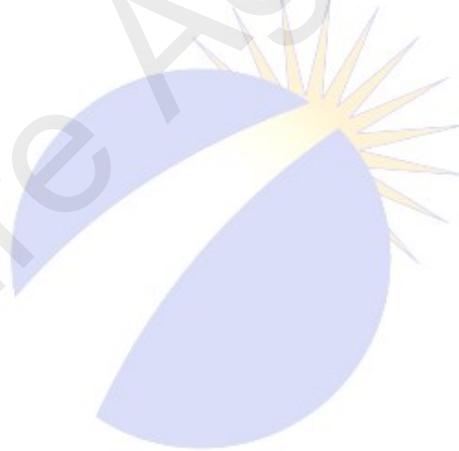
Project:	207-2292Y1	Drawn By:	Brady Gragg
Filename:	NH3 Control Cable- Flow Meter, Servo, Master On/Off, & Pressure	Date:	Date: 3/27/13
Copyright 2013 SureFire Ag Systems		Page of Pages	1 of 1

Read and save all product literature, installation instructions, and operating instructions that accompany this system.

Make sure all personnel that will be operating or working around this system have been properly trained in safe anhydrous ammonia practices.

On first use with anhydrous ammonia, be certain that all personnel are in a safe place as the nurse tank valve is opened and as each segment of the system is filled with anhydrous ammonia. Verify that all joints and connections are tight and that proper shut-off and control of the system is working.

TORPEDO™



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