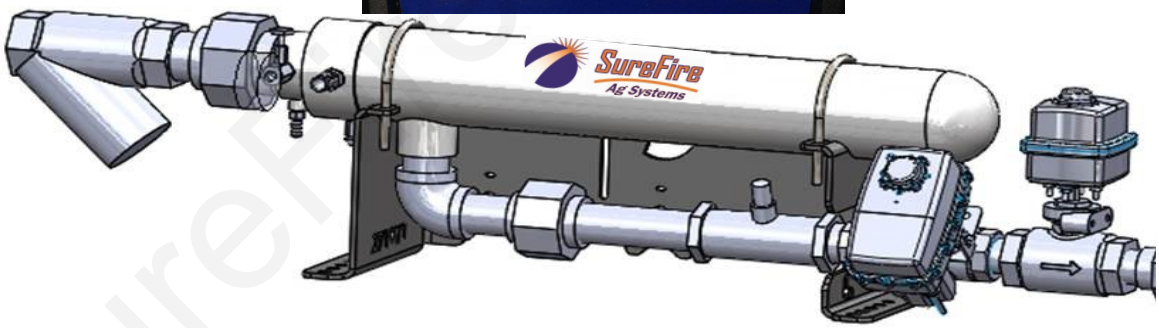
TORPEDO™

NH_3

Precision Anhydrous Ammonia Application for SureFire Commander II



396-2853Y1

SureFire Ag Systems

Table of Contents

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.

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 (NH_3)

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 NH_3. 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

	34 degrees F (50 PSI)		Max App Rate Lbs N / acre		60 degrees F (93 PSI)		Max App Rate Lbs N / acre	
Model #	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 NH_3 Flow

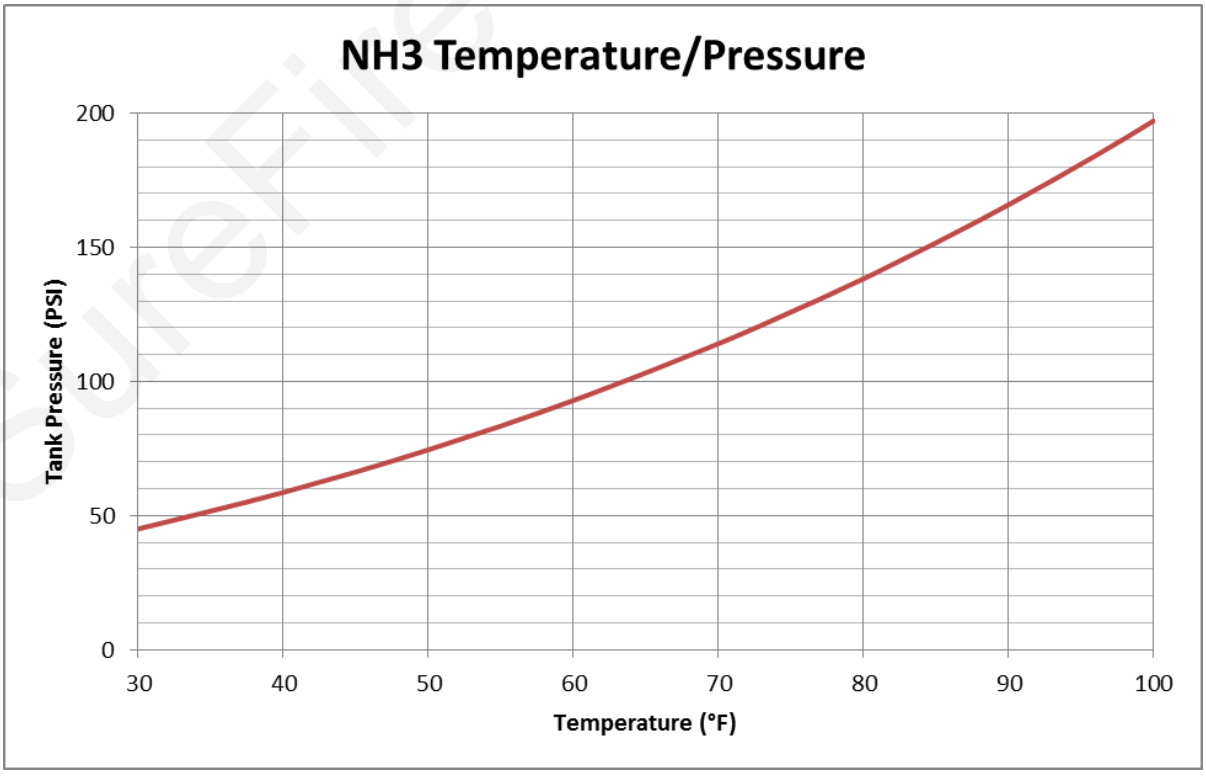
Do the following calculation to determine the proper Torpedo Model for your application:

Rate (**lbs of N**) per acre X Speed X Width (feet) X 0.1212 / 0.82 = **NH_3** Lbs / hr

NH_3 lbs/hr / 60 min/hr / 5.15 lbs/gal = GPM (**NH_3**)

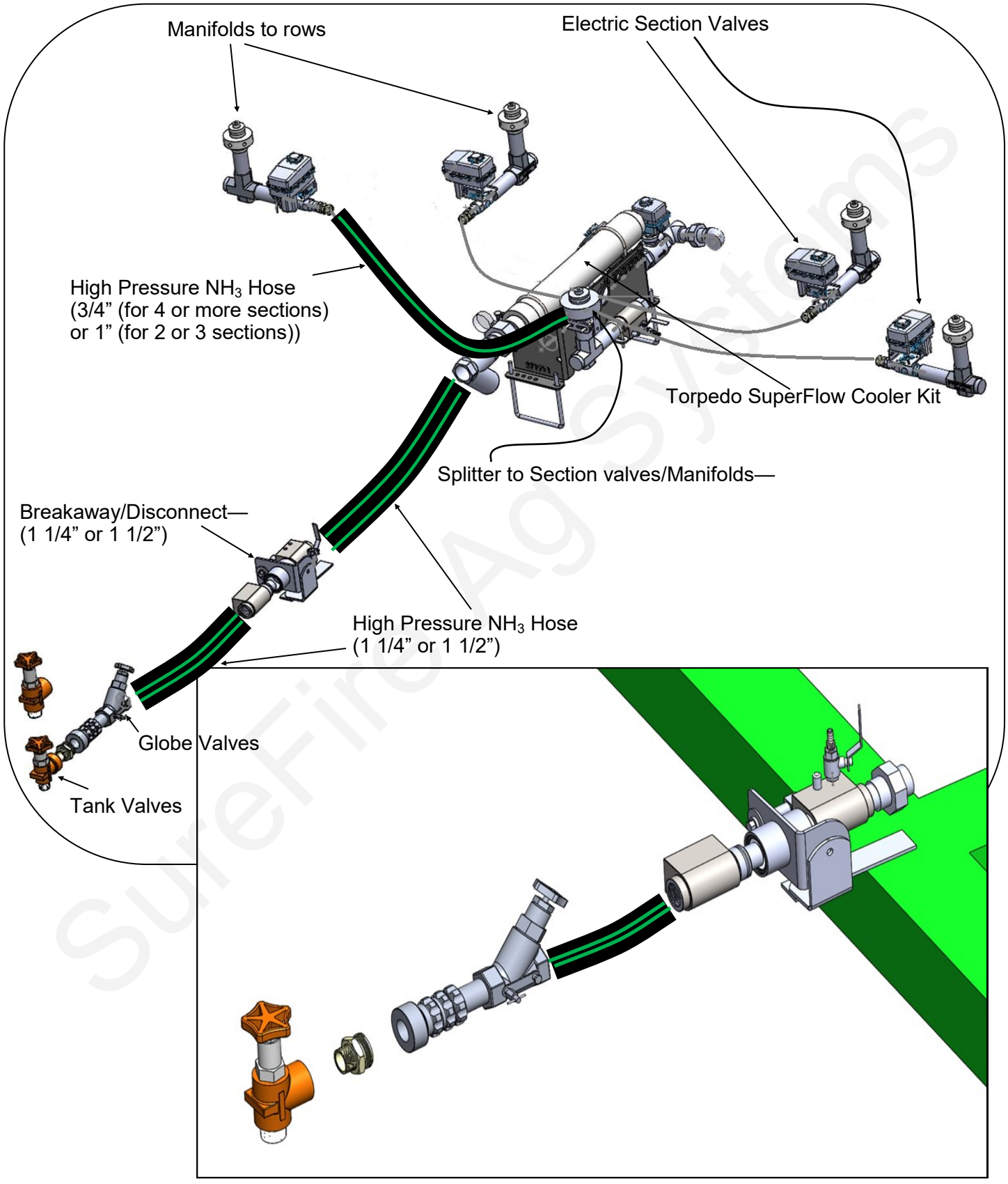
Lbs of **NH_3** X 0.82 = Lbs of **N**

Lbs of **NH_3** = Lbs of **N** / 0.82



System Overview with 4 electric Section Valves

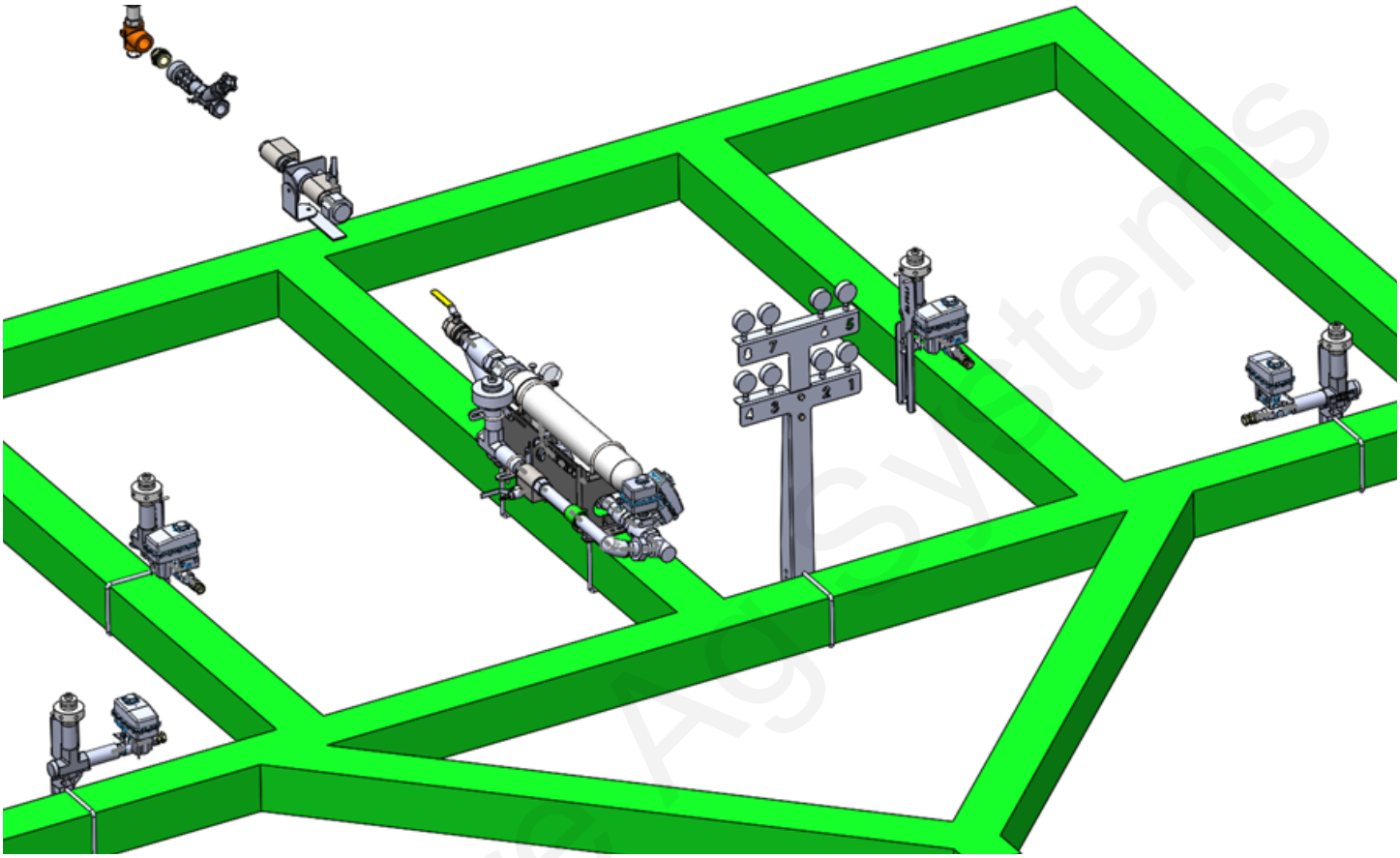
Torpedo™ Model 100 and Model 200

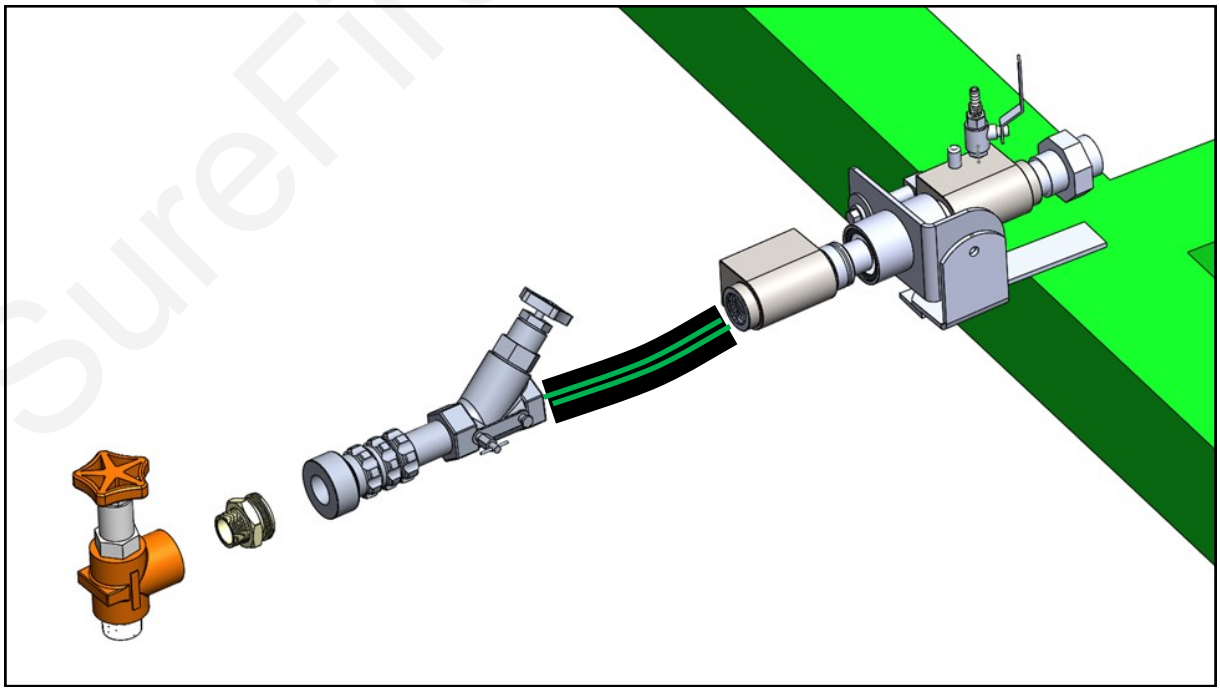


System Overview with 4 Electric Section Valves

Torpedo™ Model 100 and Model 200

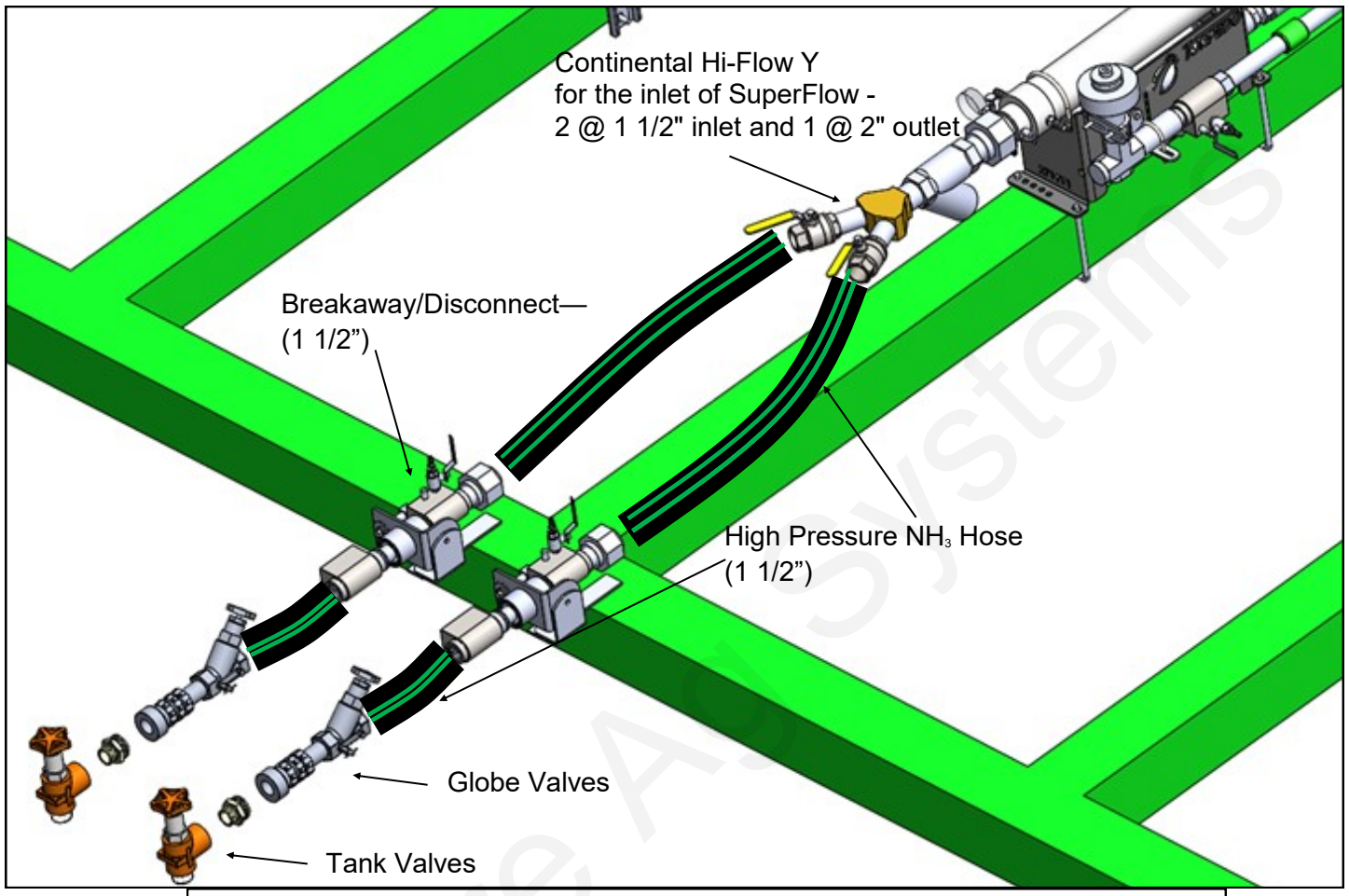
Optional Gauge Tree shown

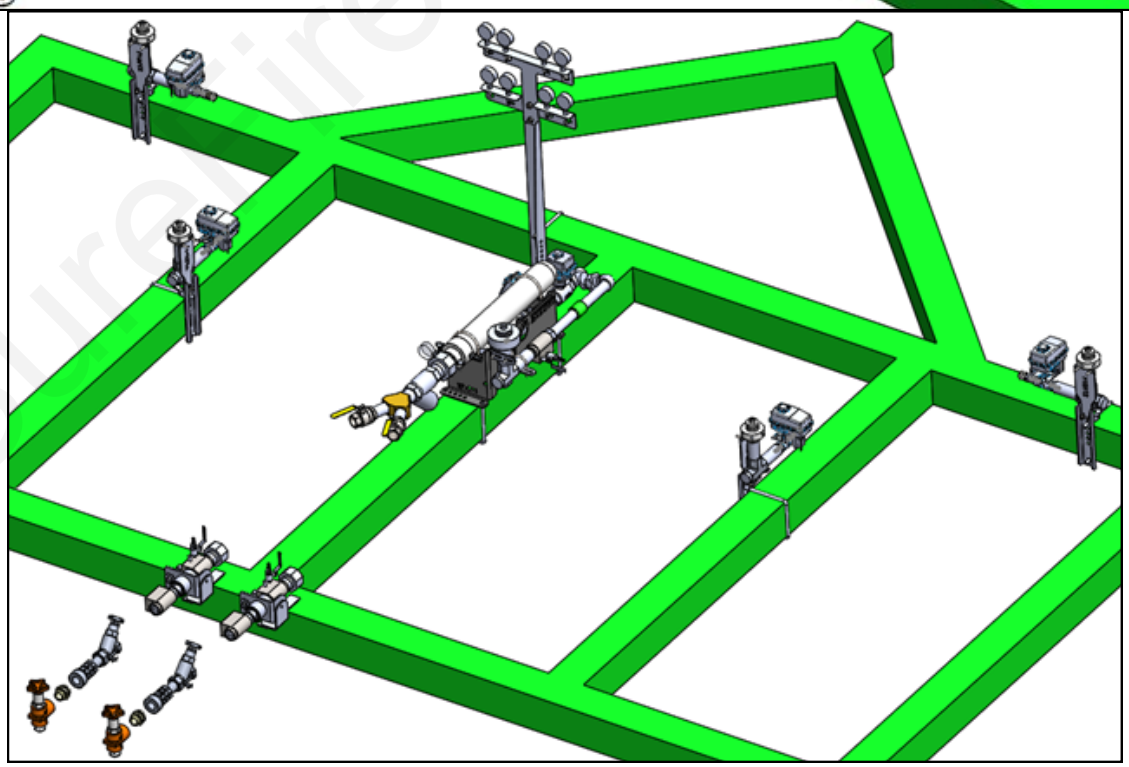




System Overview with Torpedo™ Model 300

159-00-200150





Important Installation and Setup Instructions -See the manual and accompanying literature for more information.

DUMP ORIFICE

To minimize the amount of ammonia going out the dump lines to the vapor tubes use the chart to determine the dump orifice size to use.

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

Tool bar width in feet X Speed
X Actual lbs N per acre X 0.1212
/ 0.82 / 5.14 / 60 = **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.
(Some applicators may have 4 vapor tubes. Use the 3/4" to 1/2" vapor tube kit (PN 159-12-100100) for this.)

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

A-360SP Splitter Orifices

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

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

Or

#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**

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.

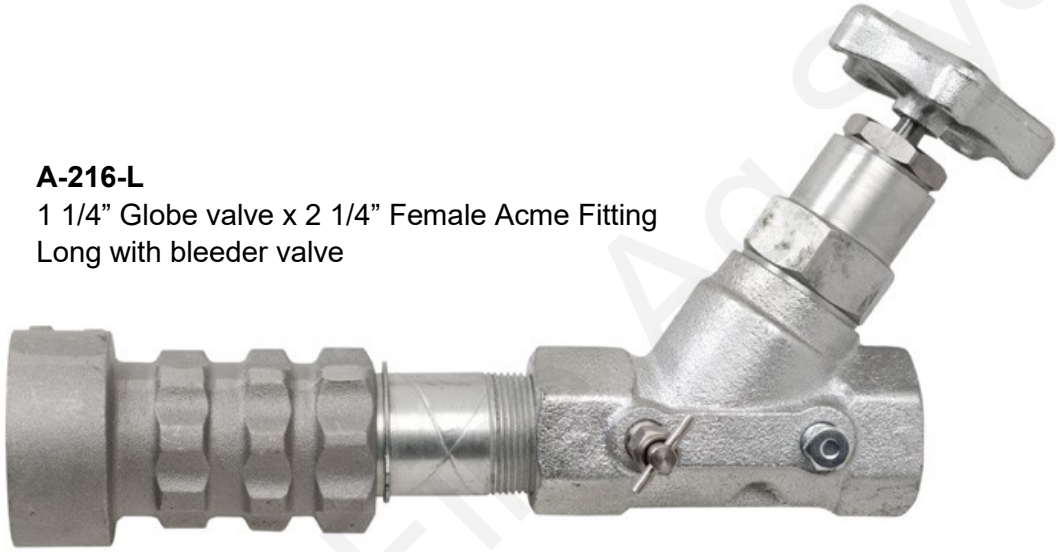
NH_3 Inlet Plumbing Kit from Nurse Tank to Breakaway 158-00-

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-

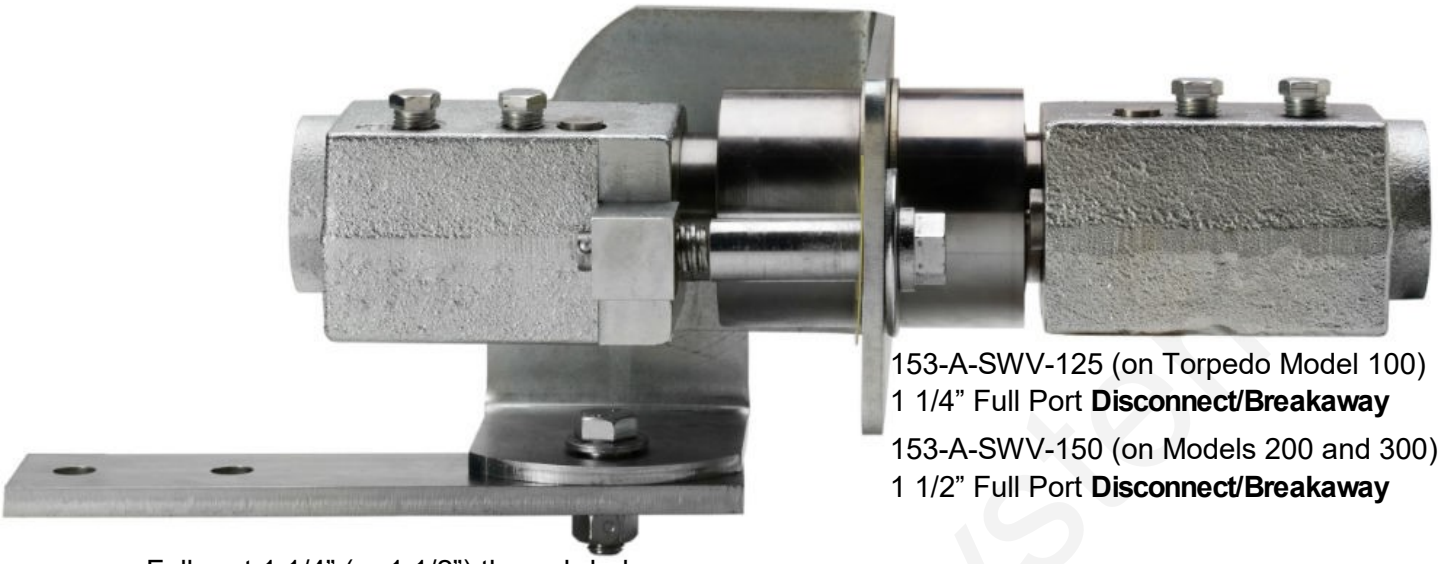
A-215-L
1 1/4” Globe valve x 1 3/4” Female Acme Fitting
Long with bleeder valve

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 NH_3 Hose and SuperFlow NH_3 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 NH_3 **Needle Valve**--
can attach pressure gauge or transducer here

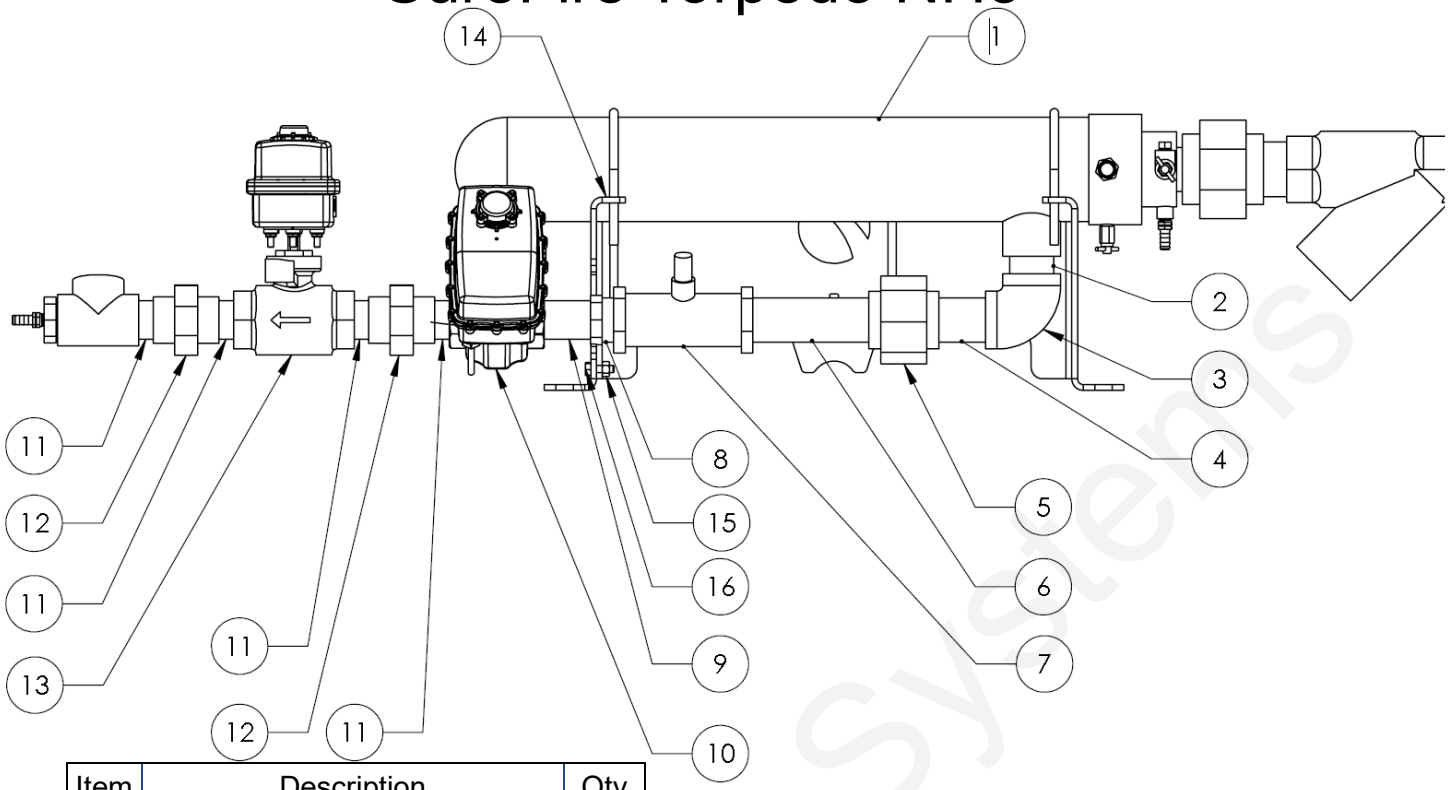
End view

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.

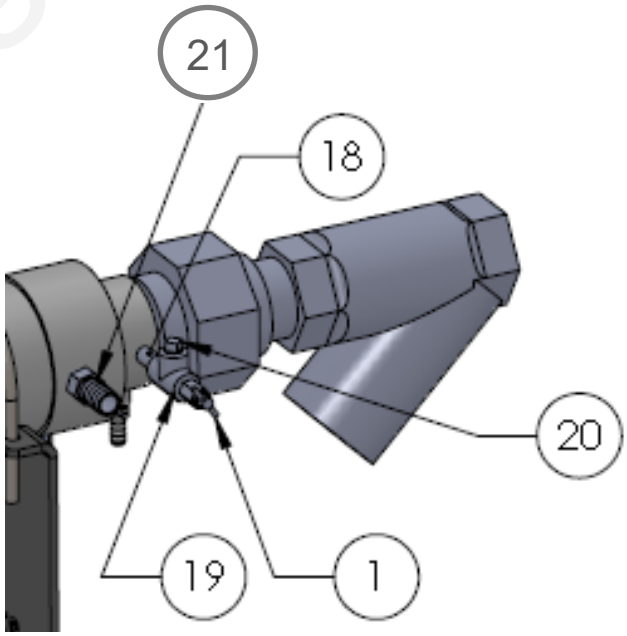
Safety Reminder

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

SureFire Torpedo NH3

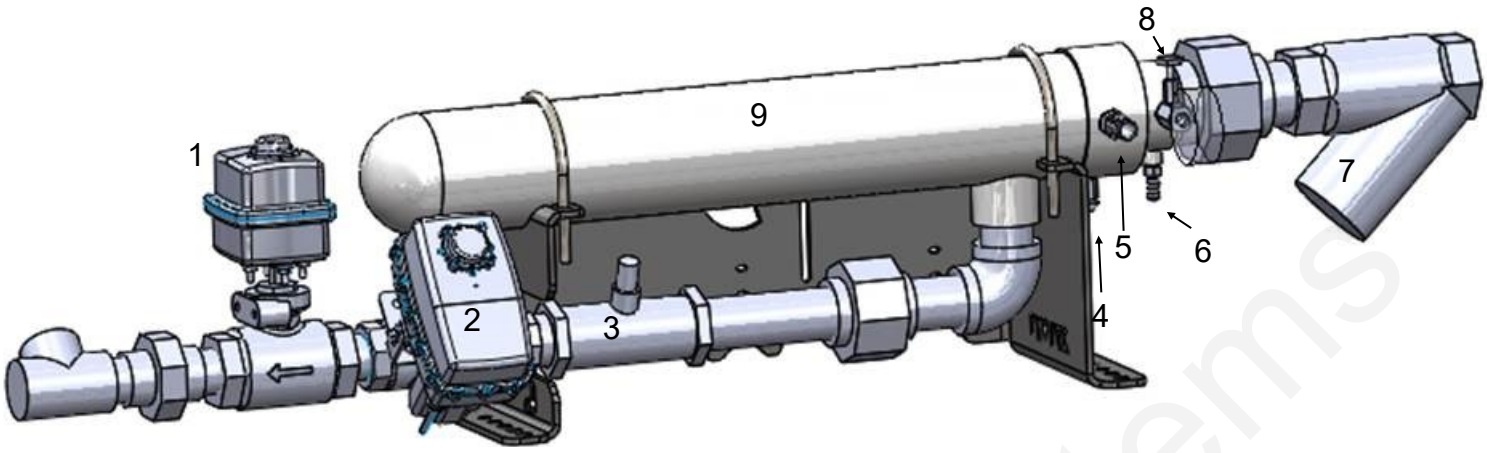


Item	Description	Qty
1	Heat Exchanger	1
2	Nipple	1
3	Elbow	1
4	Nipple	1
5	Union	1
6	Nipple	1
7	Flowmeter	1
8	Reducer Bushing	1
9	Nipple	1
10	On/Off Valve	1
11	Nipple	4
12	Union	2
13	Control Valve	1
14	Heat Exchanger Base	1
15	5/16” Flange Nut	2
16	5/16” x 1” HCS G5	2
18	Nipple	1
19	Tee	1
20	1/4” Plug	1
21	3/4” Dump Outlet Hose Barb	2

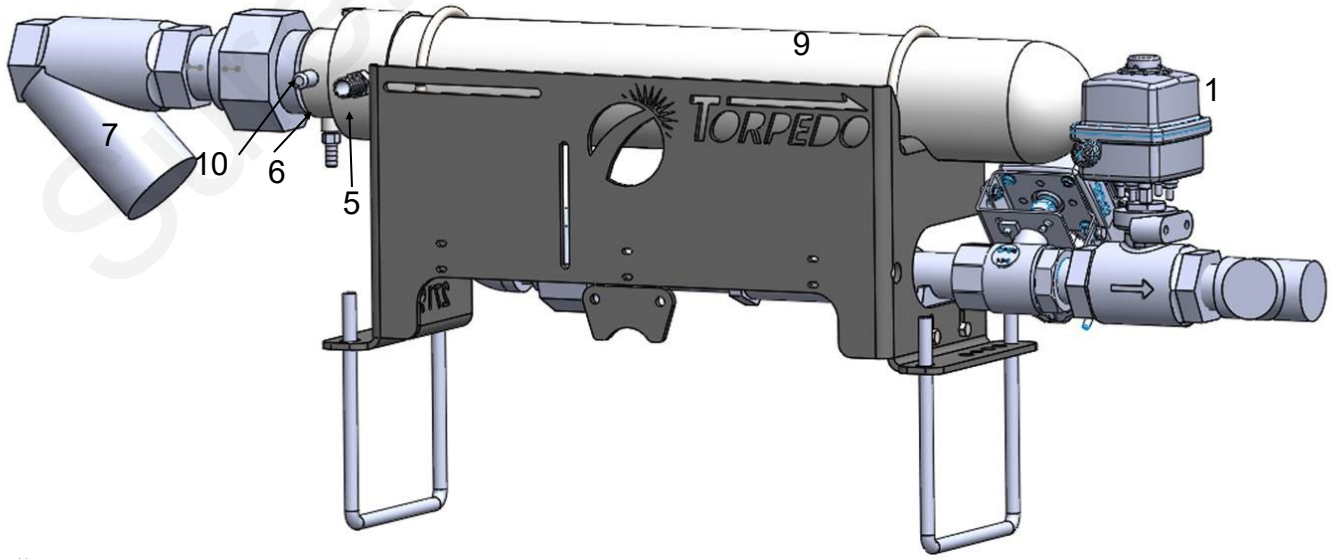


Components and configuration may vary slightly from that shown.

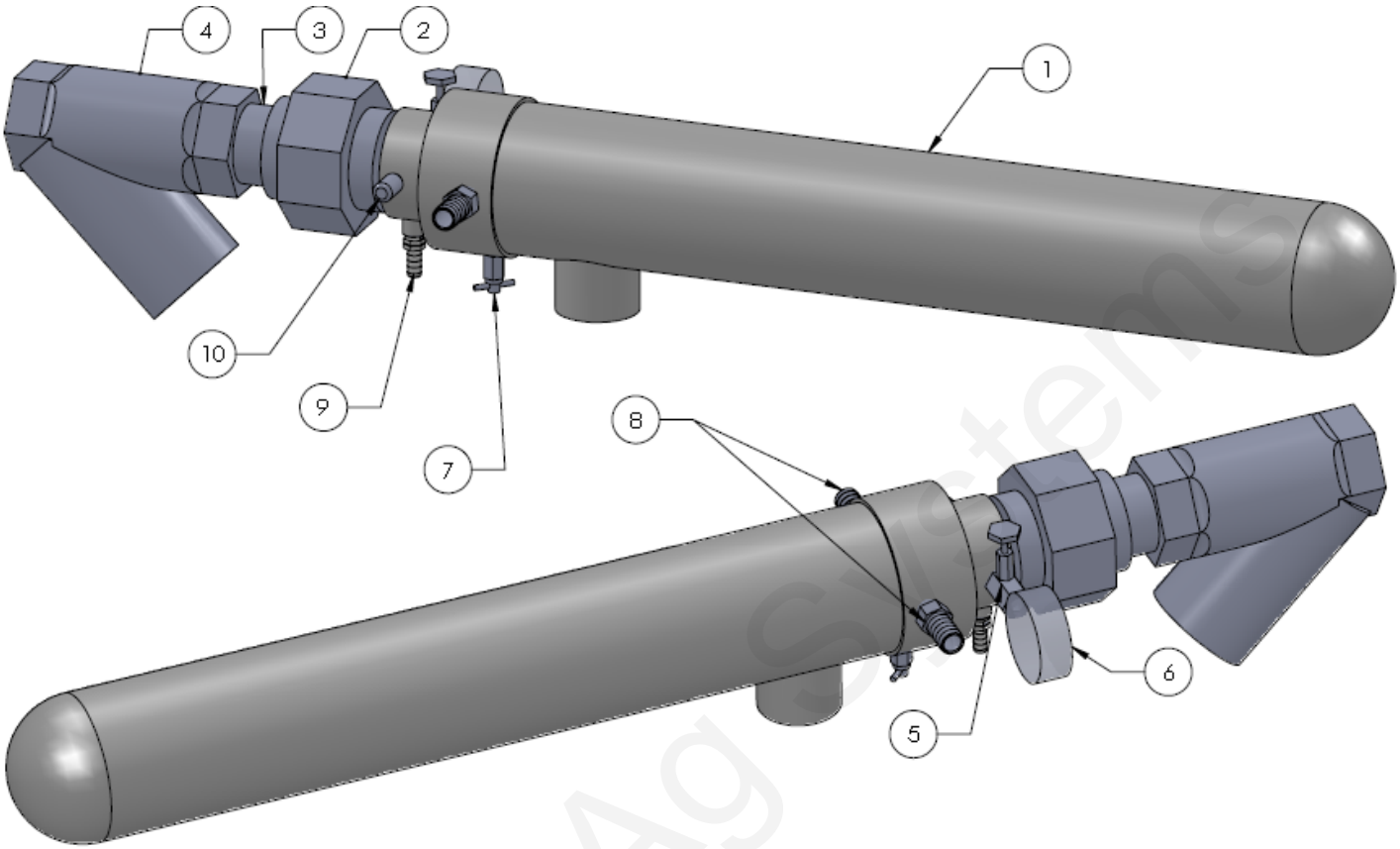
Torpedo™ SuperFlow NH_3 Assembly 202-2693Y1



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)
		Components and configuration may vary slightly from that shown.



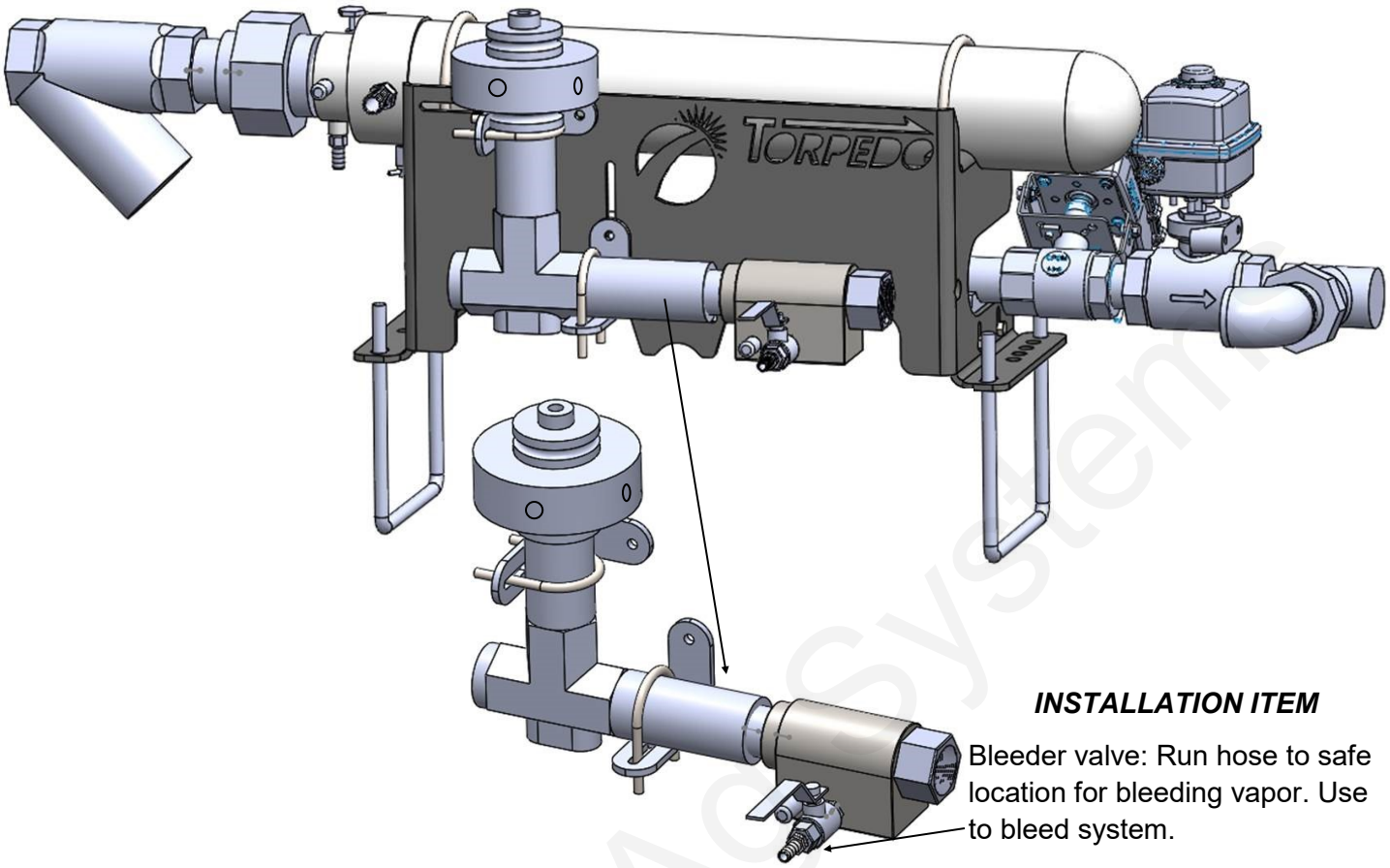
Torpedo™ SuperFlow NH_3 Assembly 202-2693Y1



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 NH3 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” Dump Outlet 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

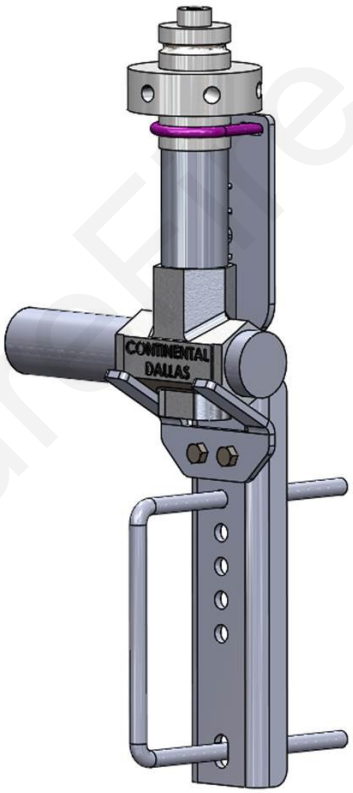
Components and configuration may vary slightly from that shown.

Splitter Options-mounted to Torpedo or mounted remotely



INSTALLATION ITEM

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



A-360 Bracket Kit 159-11-100500

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.

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

	100 PSI tank	50 PSI tank	Model Number
NH3	Up to 12 GPM	Up to 9 GPM	A-360SP
GPM per outlet	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**

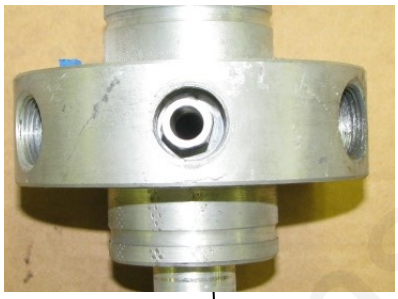
Gallons per minute ÷ number of manifolds **= GPM per outlet**

#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.

Correct orifice must be installed before use.



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.

Correct orifice must be installed before use.

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# NH3	Up to 127# NH3	A-360MA-W
	170-422# NH3	127-316# NH3	A-360MA-C
	Above 422# NH3	Above 316# NH3	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**)

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.

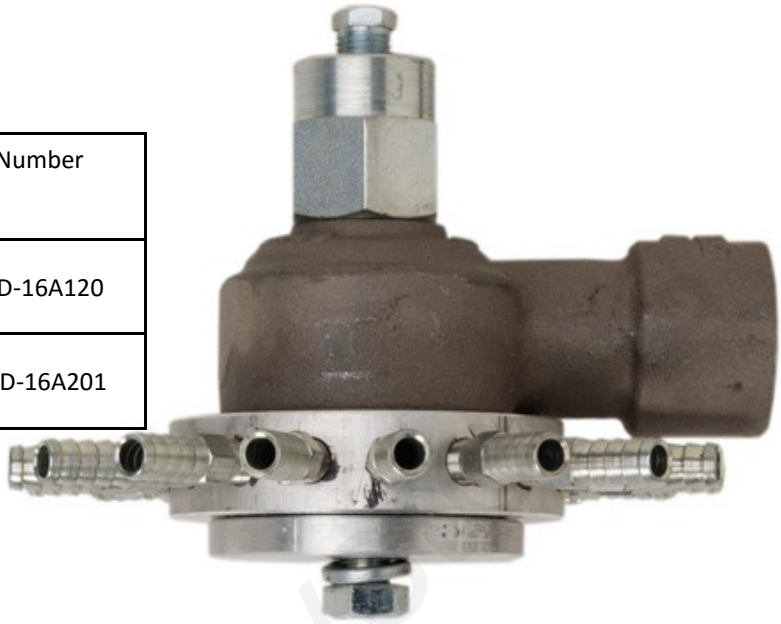
See the complete Continental NH3 Products *Installation, Operation, Repair and Maintenance Instructions* that came with the splitter and manifold for further tips and information.

Optional Vertical Dam Manifold

Continental Vertical Dam Manifold
Each manifold has 16 of 3/8” HB outlets

	100 PSI tank	50 PSI tank	Model Number
NH3 Lbs/hr per outlet			
	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.

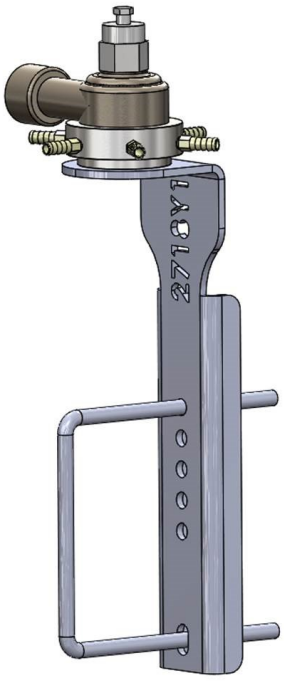


Features of A-MVD Vertical Dam Manifold

- 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.

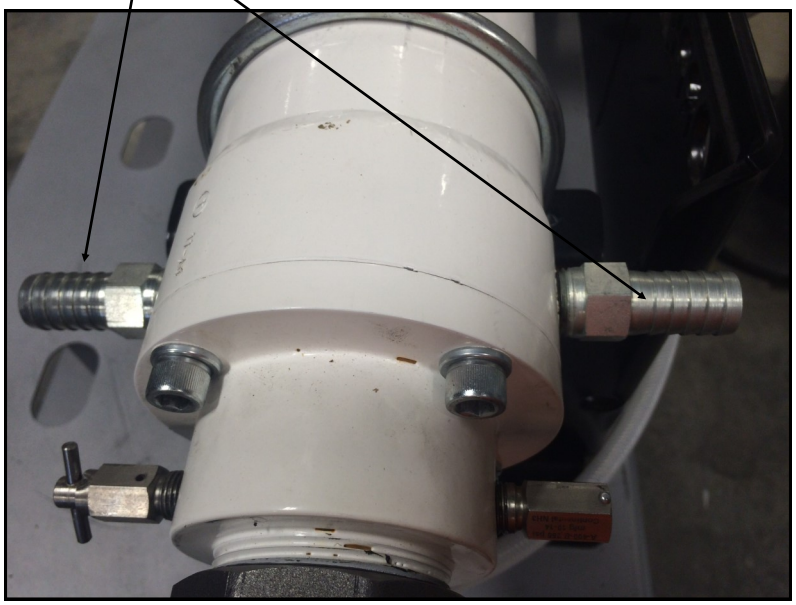
MVD Bracket Kit
159-11-200500

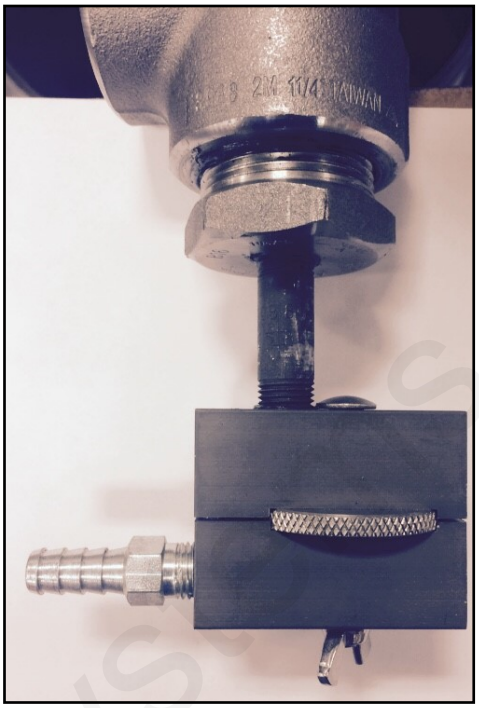


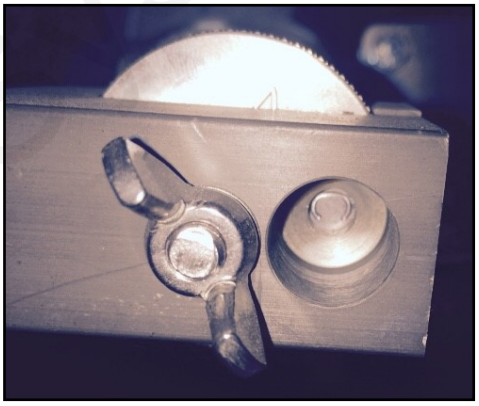
Be Careful Out There!

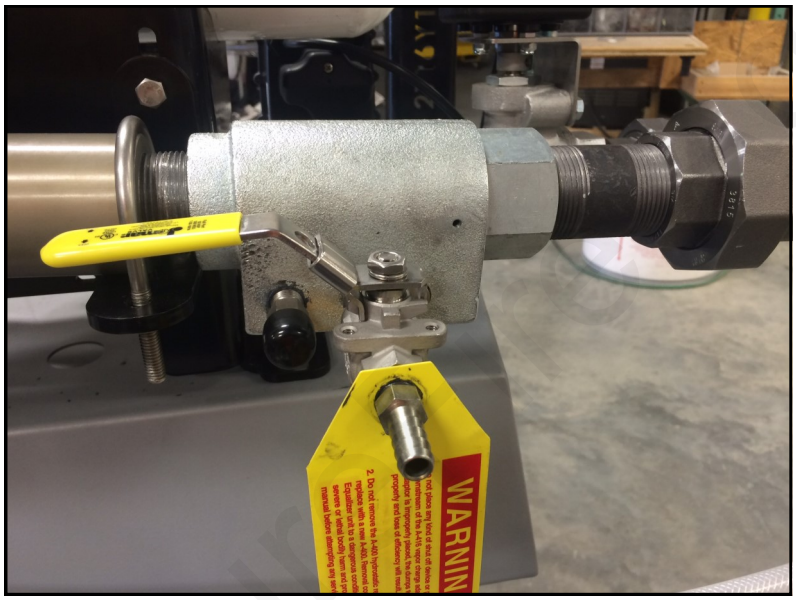
INSTALLATION ITEM

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









INSTALLATION ITEM

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

INSTALLATION ITEM

Variable Dump Orifice: The dump orifice draws a small amount of liquid ammonia and returns it to the center of the heat exchanger to do the cooling. The variable dump orifice 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.

(# N per acre) x speed x width / 2090.6 = GPM →

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

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.

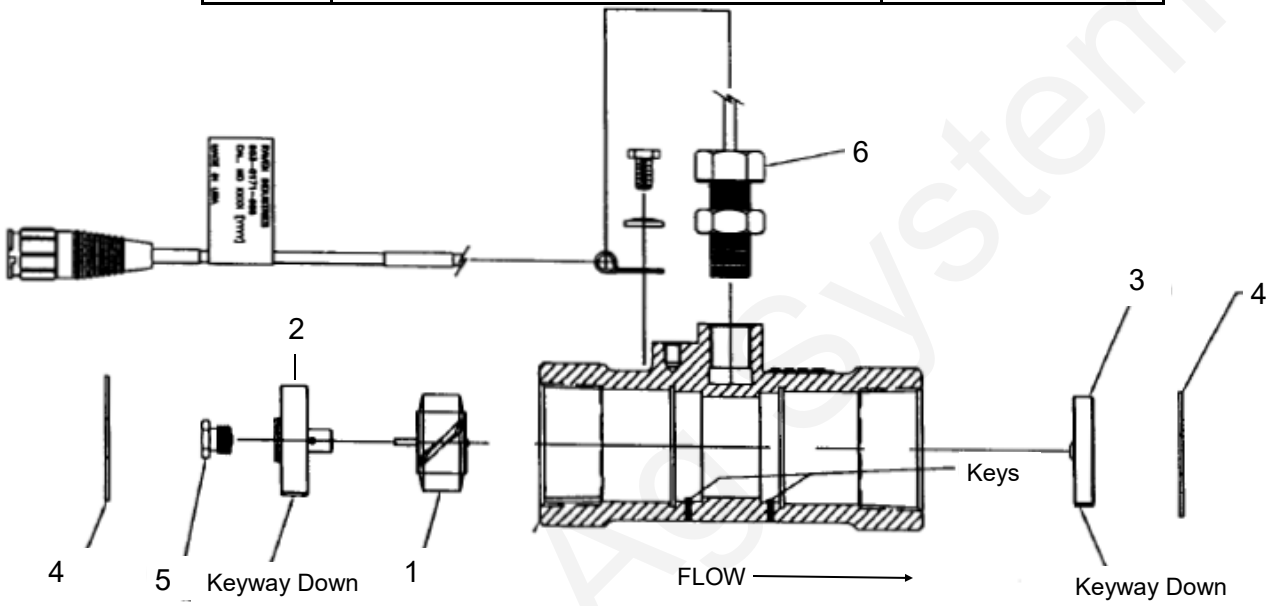
Use the following formula to adjust the flow cal number:

(Initial flow cal x Volume shown on screen) / Weigh ticket amount = new flow cal

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

RFM 60S Flowmeter

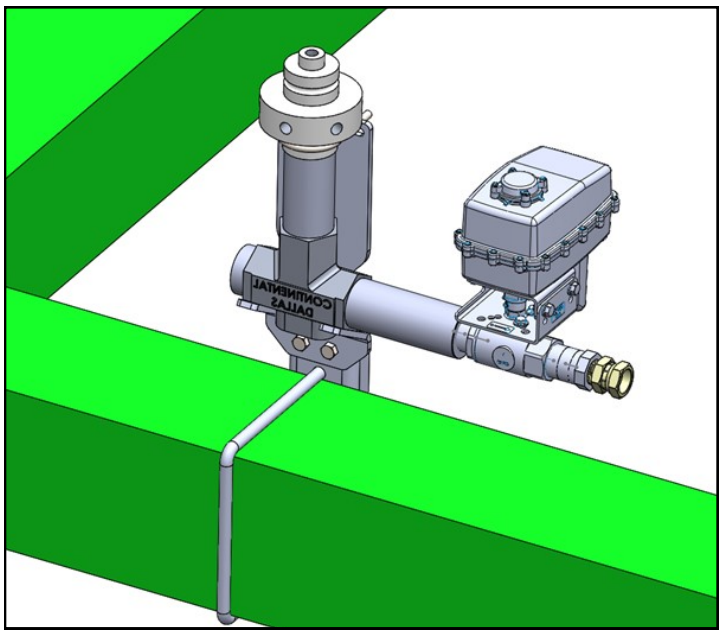
Item	Description	Raven Part #
1	Rotor / Magnet Assembly	063-0171-673
2	Hub / Bearing Assy, Upstream	063-0171-674
3	Hub Assembly, Downstream	063-0171-769
4	Ring, Retaining, Internal	335-0000-278
5	Stud Bearing	063-0173-062
6	Sensor Assembly	063-0171-669



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

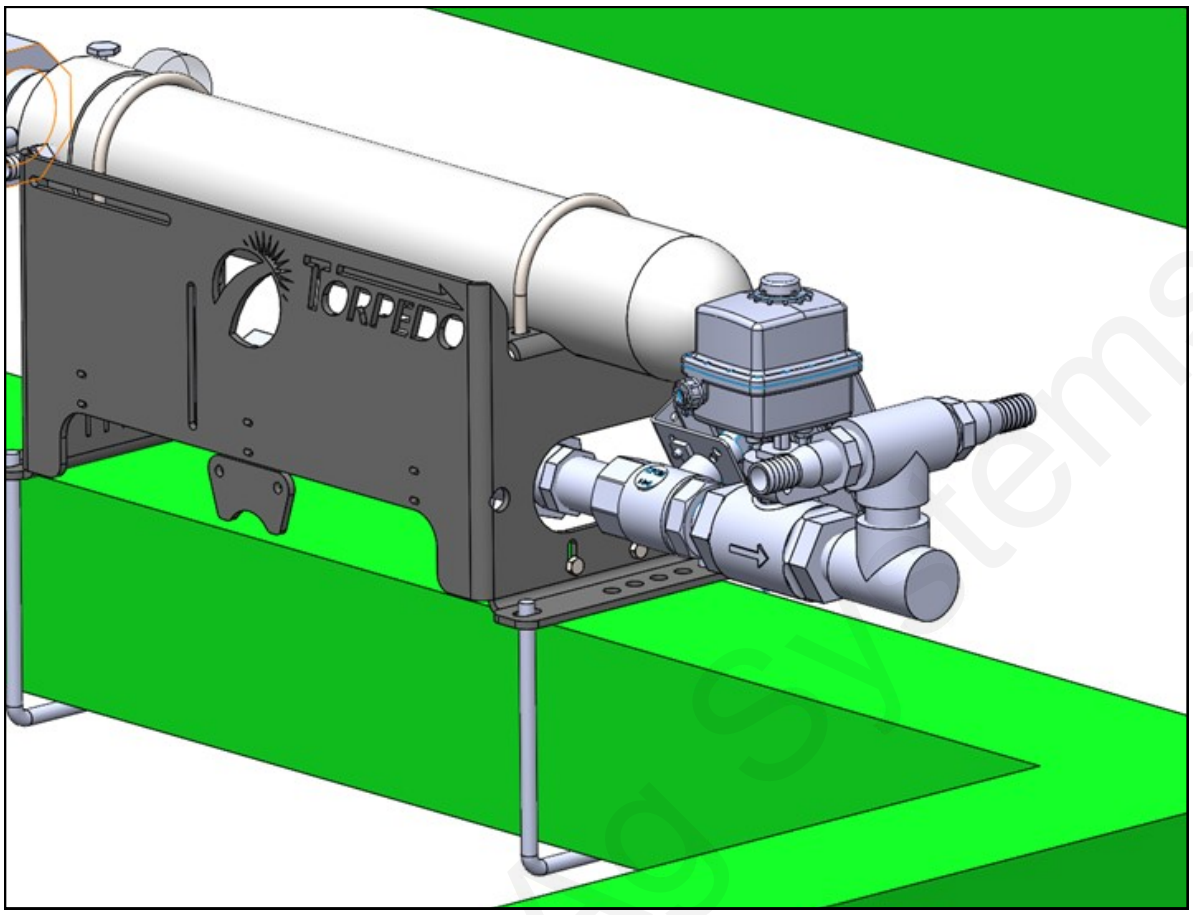
Three-wire ON/OFF Electric valve troubleshooting:

Valves must have constant 12 V power. With voltmeter, check voltage between Pins A & B. Should be 12-13 volts. When valve should be ON, check voltage between Pins B & C. There should be 12-13 volts when the valve should be open.

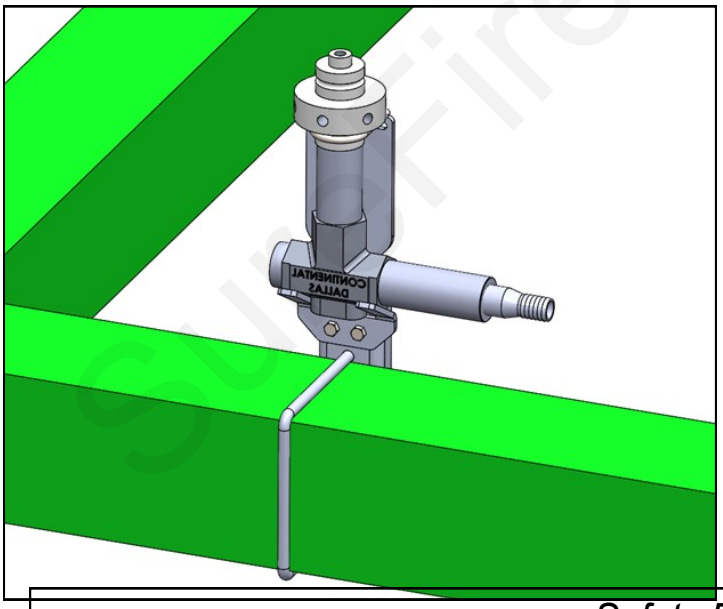
Pressure gauges and sensors

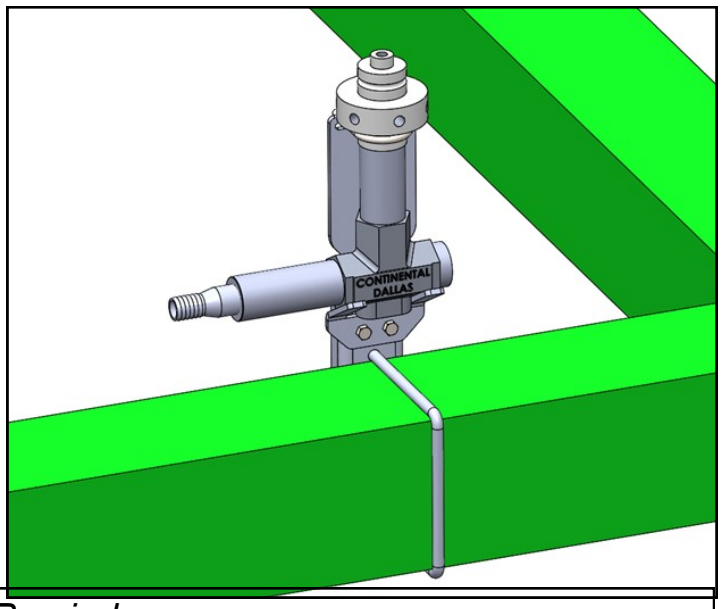
137-ASG60	2 1/2” Silicone Filled Stainless Gauge-60 PSI For manifolds (optional)
137-ASG400	2 1/2” Silicone Filled Stainless Gauge-400 PSI For Torpedo SuperCooler (optional)
Or	
521-05-050400	NH3 400 PSI 3-wire pressure sensor (0-5 V DC 12.5 mv/PSI) with 3-pin 150 MP Tower For Torpedo SuperCooler (optional)

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).



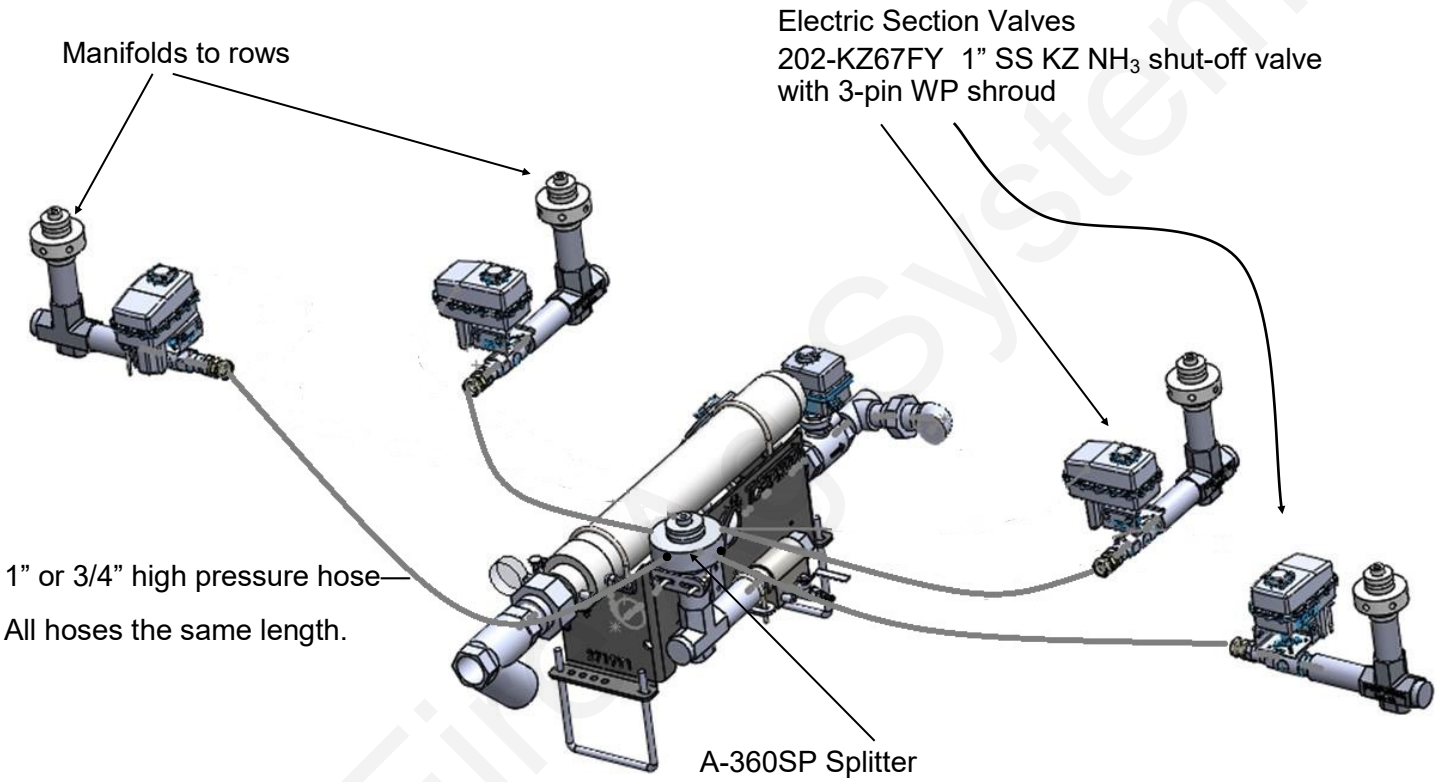


Safety Reminder

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

Electric Valve Kits for doing multiple sections

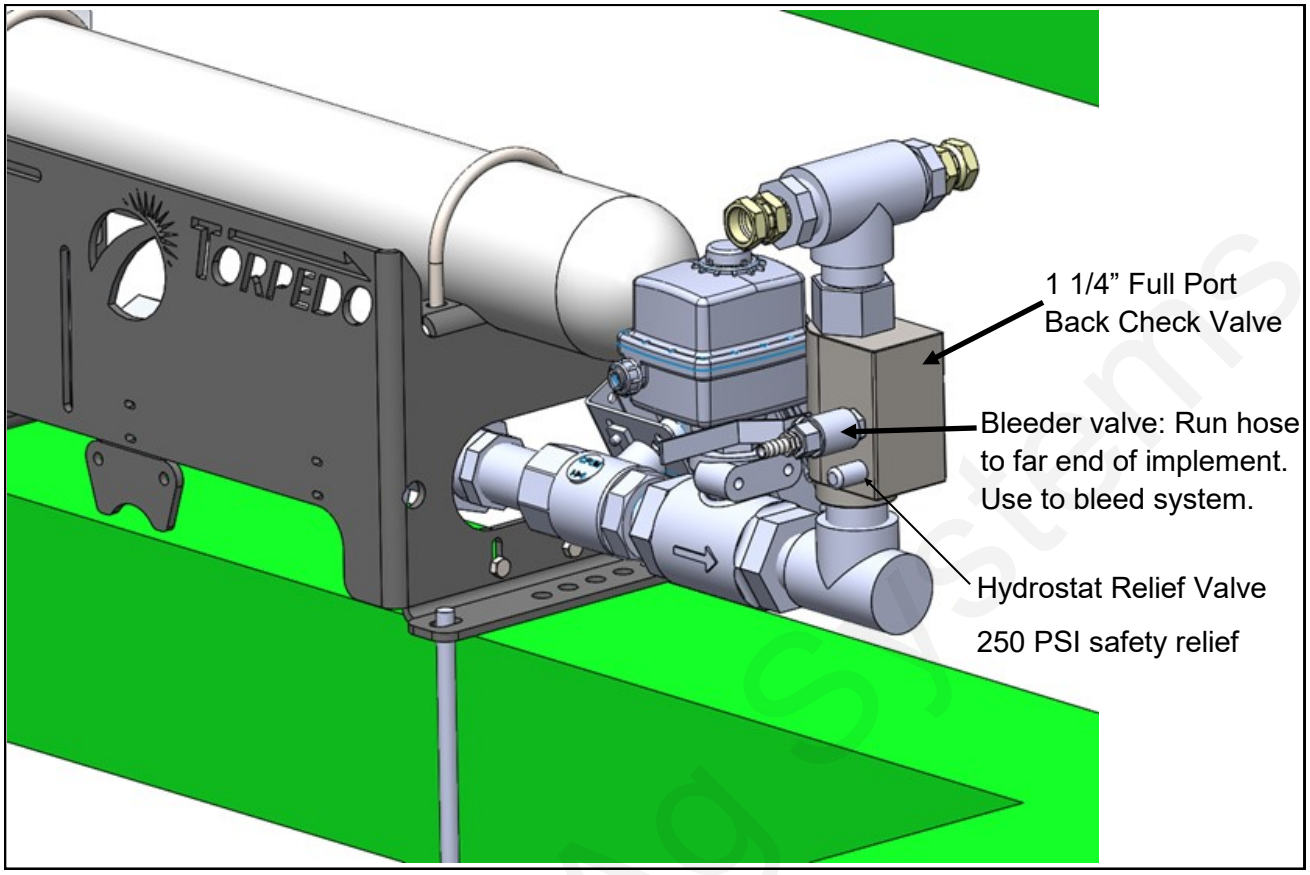
When using electric section valves, you must use high pressure hose from the Splitter to the section manifolds. These hoses must be the same length. Recommended hose is 1” high pressure hose for 3 sections or less and 3/4” high pressure hose for 4 or more sections.



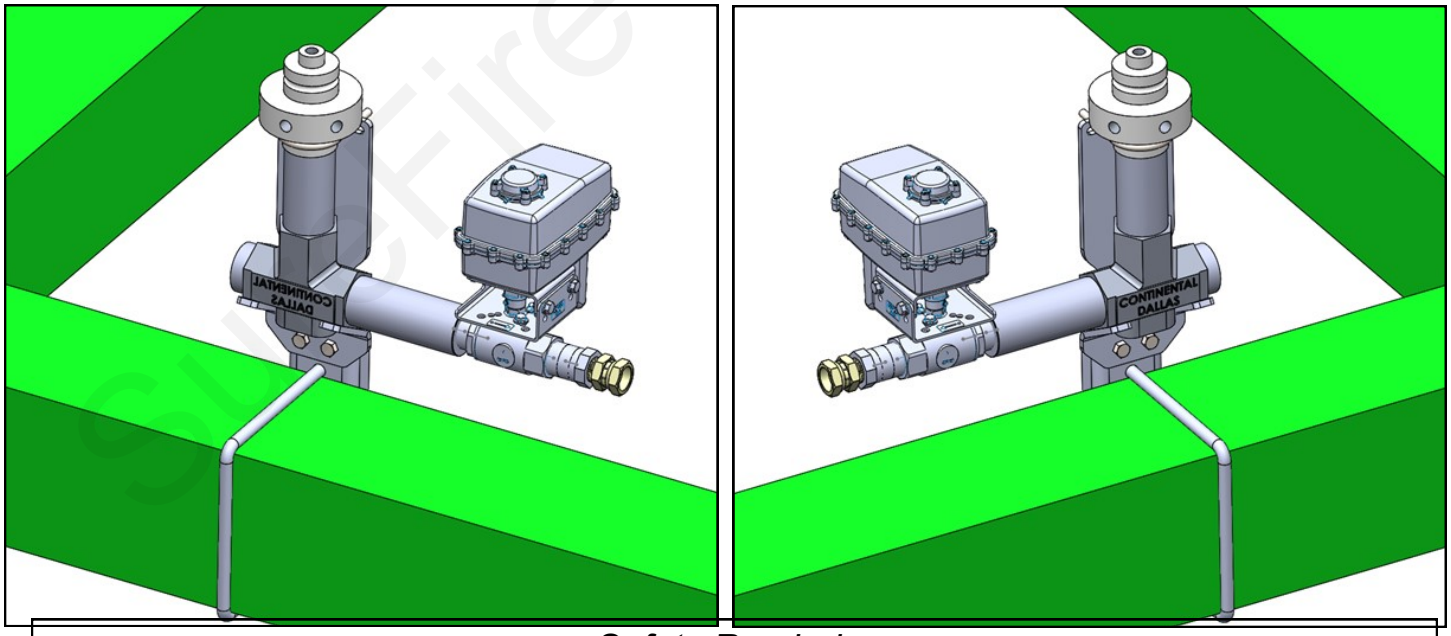
Safety Reminder

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

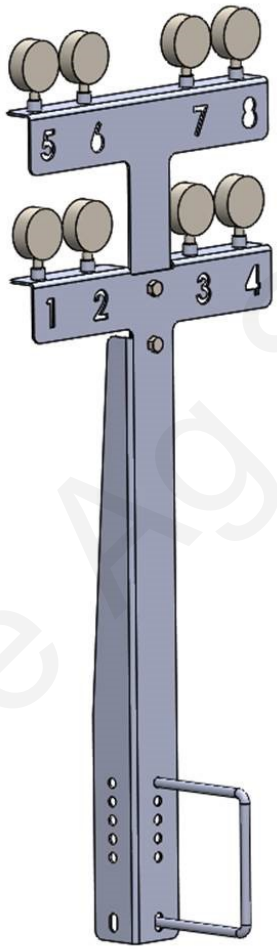
Always know the wind direction and park in an appropriate direction when servicing the system or changing tanks. The wind is your friend.

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.

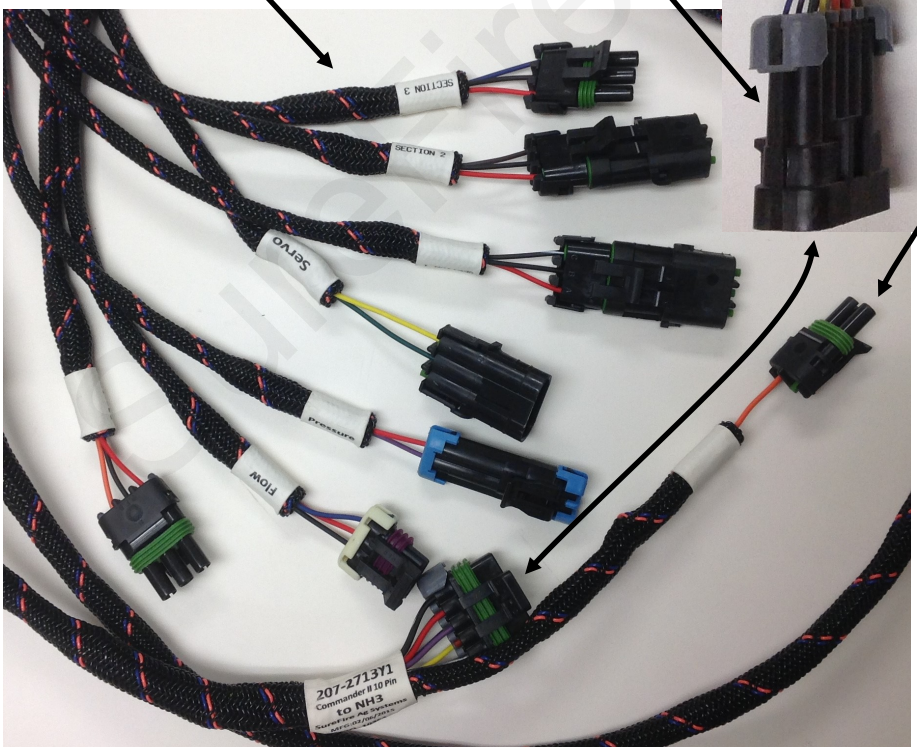
18034

Plugs into 10-pin connector from Commander II Console or to 10-pin extension from console

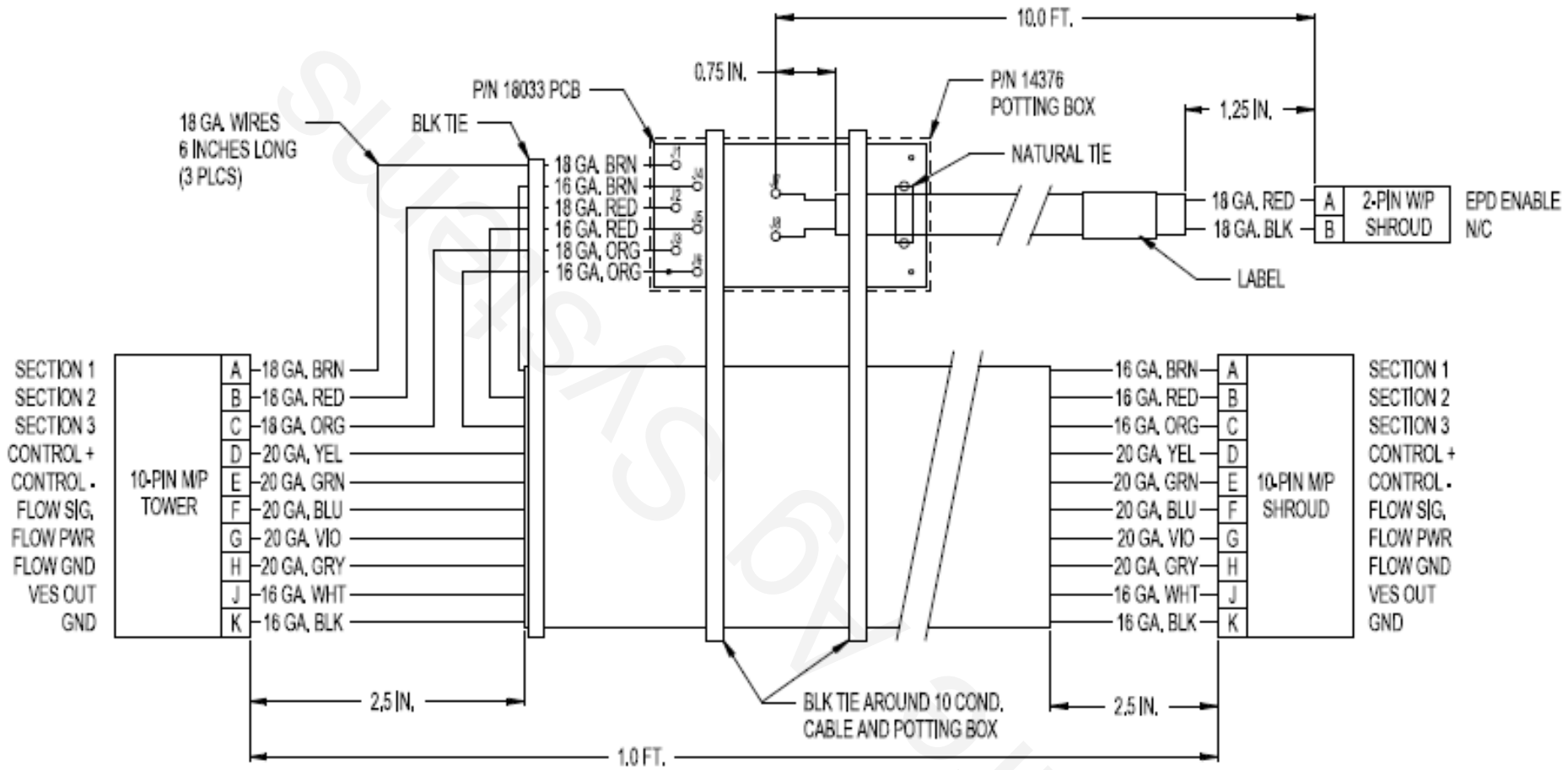
Connectors on 207-2713Y1 for Flowmeter, Master ON/ OFF valve, servo control valve, pressure, Section 1, Section 2, Section 3.

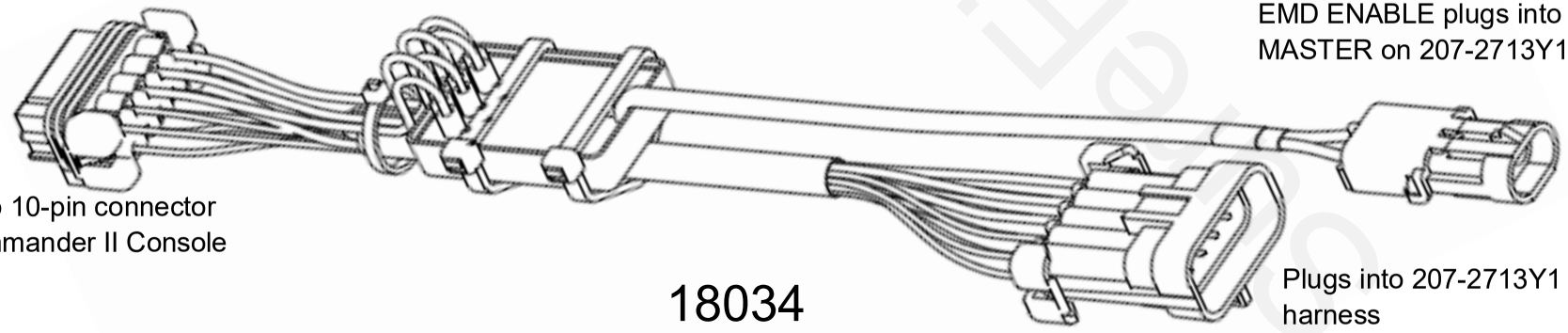
18034

Plugs into 207-2713Y1 harness



EMD ENABLE on 18034 plugs into MASTER 2-pin on 207-2713Y1





EMD ENABLE plugs into
MASTER on 207-2713Y1

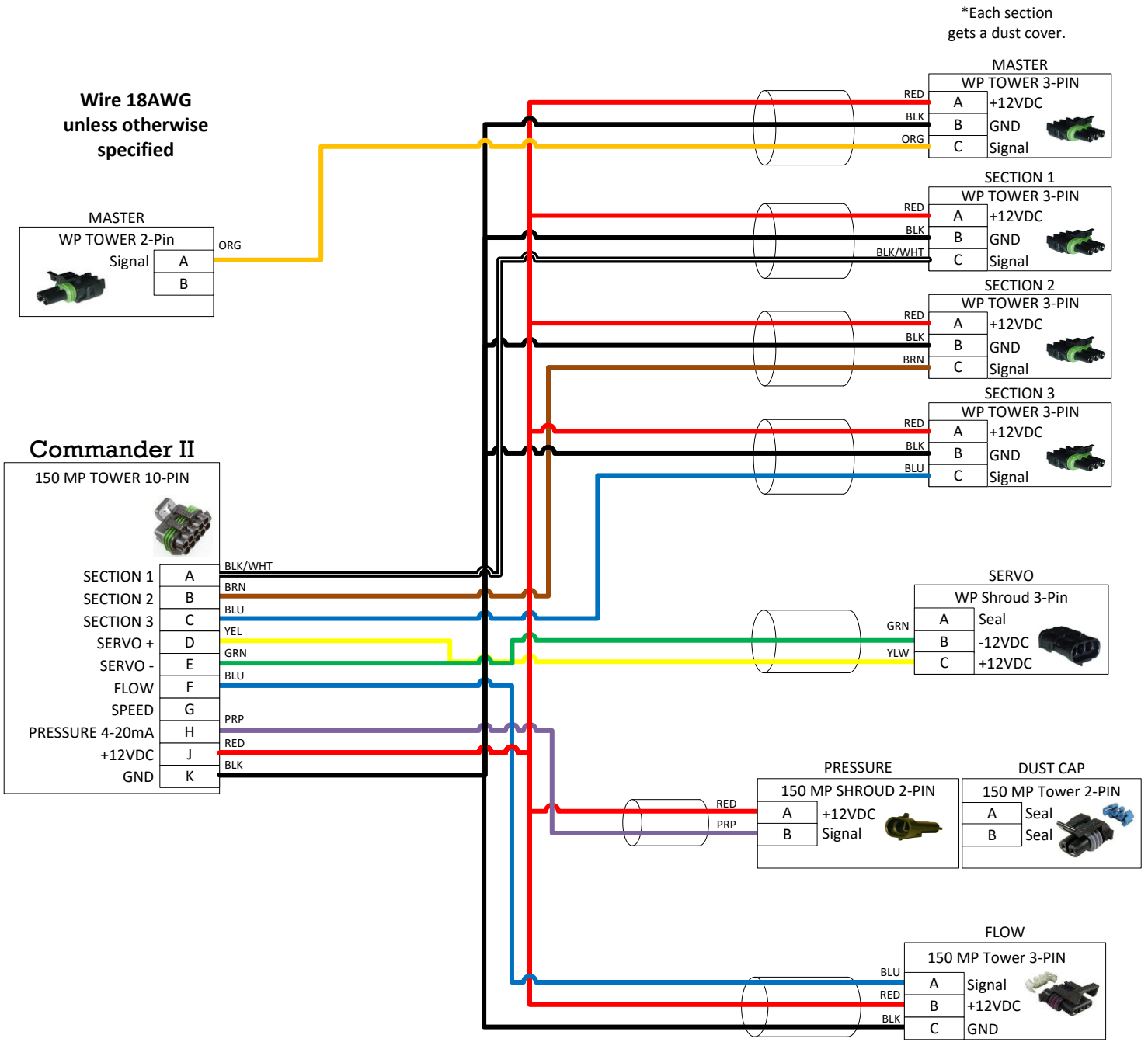
Plugs into 10-pin connector
from Commander II Console

Plugs into 207-2713Y1
harness

18034

207-2713Y1

Commander II 10pin to NH3



Commander II Console Functions For Anhydrous Ammonia Application

In-Field Operating Instructions

VOLUME: Displays total pounds (kg) of NH3 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.

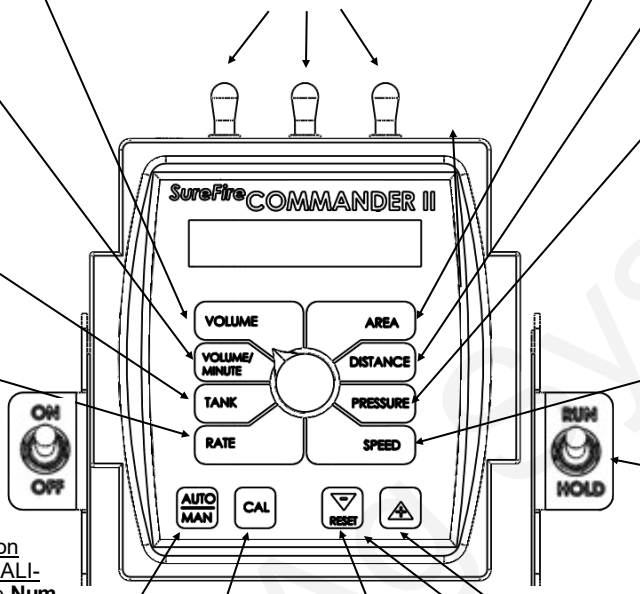
VOLUME/MINUTE: Displays pounds (kg) of NH3 applied per minute. Use this to read instant flow in lbs/min of NH3.

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 pounds (kg) of NH3 remaining

RATE: Displays application rate **lbs of N** per acre (kg/hect)

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.

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

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 Anhydrous Ammonia Systems

1. **Commander II Special Cal Quick Setup** (Factory defaults are for Tower Electric Pump Systems so this step must be completed for Anhydrous Ammonia 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

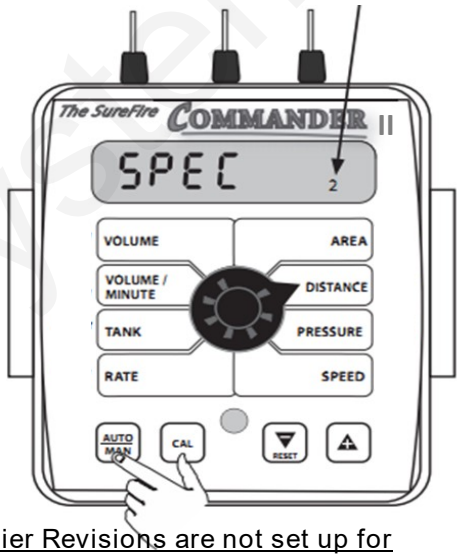
F
Setup & Operation

The Commander II has a quick setup feature to load the necessary defaults for a SureFire Anhydrous Ammonia 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 a small "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 "nh3-E" for Anhydrous Ammonia**.
   - 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 G. Earlier Revisions are not set up for Anhydrous application and 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	Anhydrous Ammonia nh3-E, nh3-S
Control Rate	-2	-2	-1	-2	-1
Min PWM	0	15	----	----	—-
Max PWM	100	80	----	----	—-
Start Time	Off	1	Off	Off	Off
PWM Start %	----	50	----	----	—-
Flow Cal	**6000**	**4000**	**6000**	**4000**	**72**
Control Mode	P-FLO	P-FLO	S-FLO	S-FLO	S-FLO
Max Pressure	50	80	50	80	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. The Raven flowmeter that comes with the Torpedo system is **72 pulses/gallon**.

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.

Liquid System Electromagnetic Flowmeters

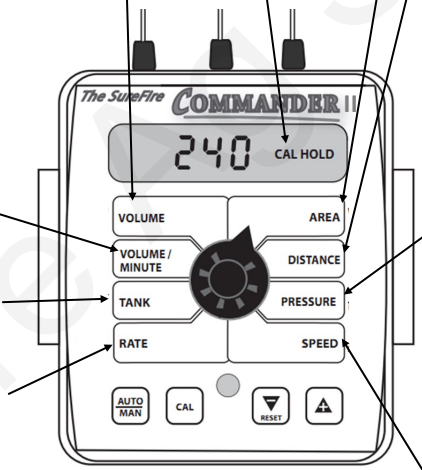
Flow Range (GPM)	Pulses/ Gallon	Commander II Flow CAL
0.13 - 2.6	3000	6000
0.3 - 5	3000	6000
0.6 - 13	2000	4000
1.3 - 26	2000	4000
2.6 - 53	2000	4000

P/F Ratio: Not used at this time.

ADJUST RATE: Sets amount of rate change by pressing "+" or "-" button once. Default for Anhydrous is 10 lbs N/acre.

TARGET RATE: Set to your intended target rate in lbs N per Acre. (Default is 100 lbs N/ 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: Default for Anhydrous is –1. Adjust as needed for stable operation in the field.

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

Software Revision identification displays briefly when Commander II is started.

Anhydrous Flowmeter 72 pulses/gal	**FLOW**	**VOLUME**	**WIDTH**	**Boom 1: 240 Inches** Boom 2: 0 Inches Boom 3: 0 Inches
Off	**P/F RATIO**	**VOLUME/ MINUTE**	**SPEED CAL**	0.189
10 lbs N/acre	**ADJUST RATE**	**TANK**	**CONTROL SPEED**	Servo Electric: -1 For Anhydrous
100 lbs N/acre	**TARGET**	**RATE**	**TEST SPEED**	Off

		AREA		
		DISTANCE		
		PRESSURE		
		SPEED		

Initial Operation Instructions

SureFire highly recommends you perform these steps with the nurse tank valve closed to verify system is correctly installed and ready for field use.

Step 3

Test the system in **MANUAL mode**.

1. Be sure the nurse tank valve is closed so anhydrous will not be released.
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**. The Master On/Off valve should turn on. Section 1 valve (if so equipped) should open. Test Section 2 and Section 3 if equipped with these. Verify that Master On/Off valve closes when system is put in Hold or when all sections are shut off.
4. Verify operation of Control Valve. Press and hold Up arrow (+). Control valve should open. Press and hold Down arrow (-). Control valve should close.

Proceed to the next step after you have verified that you can turn the Master On/Off valve on and off, that you can open and close section valves (if equipped), and that you can open and close the Control Valve.

Step 4

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.

Warning:

Before opening the nurse tank valve, be certain that the Master On/Off valve is off and that all section valves are closed. Be sure that all bleed valves are closed and that all connections and fittings are tight. Be sure the implement is parked in a safe place and all personnel are safe and wearing appropriate protective gear in case of unexpected anhydrous release.

Open the nurse tank valve slowly and watch for any signs of unwanted anhydrous release.

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.

See page 37 for instructions on checking operation of Control Valve, Master On/Off Valve and Electric Section Valves before opening the nurse tank valve.

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.

396-3260Y1 SureFire Commander II / NH3 Quick Setup

When turning the Commander II on, after a couple of numbers come up, it should show rP G (software version). (The G looks a little strange. If it shows rP F, these instructions will not work.)

Turn the controller off and hold down the AUTO/MAN and CAL button while you turn it on. The screen should show SPEC for Special Calibration mode. There should be a small “1” on the screen. If there is a “2” or “3”, press CAL until there is a small “1”.

Turn the dial to AREA. Press the + button until the screen shows nh3-E. Turn the dial to Volume and press and hold the CAL button until the red light goes out.

Press and hold the CAL button to go into CAL mode. The red light should come on.

With the dial on VOLUME (FLOW CAL) it should show 72 pulses/gallon.

Turn the dial to AREA (WIDTH CAL). Turn on Boom 1 switch and use the + or – buttons to enter the width of Section 1 (in inches) or the width of the entire implement if it will not be divided into sections for application.

If you have 2 sections, turn off Boom 1 switch, turn on Boom 2 switch, and enter the width of Section 2. If using Section 3, do the same procedure to set the width of Section 3.

The default Target Rate is 100 lb N per acre. If you want to enter a different Target Rate, turn the dial to RATE (TARGET RATE) and enter the Target Rate here.

The default delta application rate is 10 lb N per acre.

Adjust these numbers in CAL mode as needed for a particular application.

Press and hold the CAL button until the red light goes out to save the values entered.

Target Rate may also be adjusted from the main run screen. Set dial to Rate, press (-) or (+) button to decrease or increase target rate.

On the Commander II, the following units are used:

Volume (total) is in lbs. of NH3.

Volume per Minute is lbs. of NH3.

Tank volume is in lbs. of NH3.

Target Rate is lbs. of N per acre (default is 100 lbs N per acre).

Adjust Rate is lbs. of N per acre (default is 10 lbs N per acre).

Before opening the nurse tank valve use the following steps to verify that the Master On/Off valve and Control Valve are working correctly:

Test the system in **MANUAL mode**.

1. Be sure the nurse tank valve is closed so anhydrous will not be released.
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 and 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**. The Master On/Off valve should turn on. Section 1 valve (if so equipped) should open. Test Section 2 and Section 3 if equipped with these. Verify that Master On/Off valve closes when system is put in Hold or when all sections are shut off.
5. Verify operation of Control Valve. Press and hold Up arrow (+). Control valve should open. Press and hold Down arrow (-). Control valve should close.

All personnel operating or working on anhydrous ammonia systems must have appropriate education and training in safe anhydrous ammonia handling procedures.

Be sure that an adequate supply of water is nearby at all times in the event of an accidental exposure to ammonia. Wear appropriate protective gear. Stay upwind.