RAVEN

Installation & Operation Manual

AccuFlow™ Vortex and AccuFlow™ HP+

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CHAPTER 1

Important Safety Information

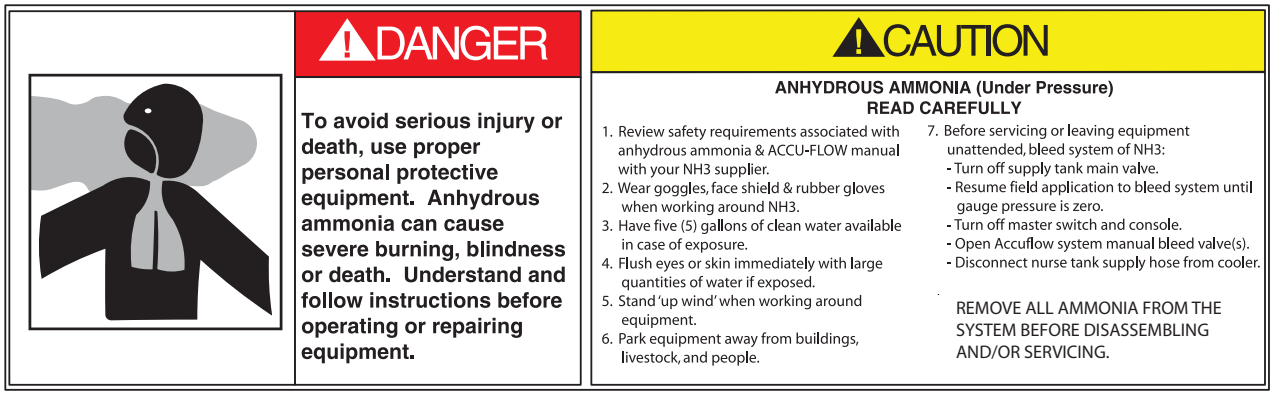
NOTICE

- Read this manual carefully before installing the system.
- Review procedures for safe handling and use of anhydrous ammonia (NH_3) with a local NH_3 supplier. If you are not trained to handle anhydrous ammonia, contact a local NH_3 supplier or the appropriate agricultural department for information on training.
- Please review the operation and safety instructions included with the implement and/or controller.
- Follow safety information presented within this manual and review operation of the AccuFlow system with a local Raven dealer or anhydrous ammonia (NH_3) supplier.
- Follow all safety labels affixed to the AccuFlow system components. Be sure to keep safety labels in good condition and replace any missing or damaged labels. To obtain replacements for missing or damaged safety labels, contact a local Raven dealer.
- Verify that pressure and temperature gauges are in working order before charging or operating the system with NH_3.
- Do not attempt to modify or lengthen any of the system control cables. Extension cables are available from a local Raven dealer.
- If you require assistance with any portion of the installation or service of Raven equipment, contact a local Raven dealer for support.

⚠ DANGER

1. Anhydrous Ammonia (NH_3) Under Pressure. Anhydrous ammonia can cause severe burning, blindness, or death. Carefully read and follow all safety instructions and warnings before operating or servicing equipment.
2. Always wear proper personal protective equipment when working with the AccuFlow system and anhydrous ammonia. Appropriate protective clothing includes, but is not limited to:
    - Goggles or face shield
    - Protective suit and gloves
    - Respirator
3. Do not allow any one to operate, service, or repair the AccuFlow system without proper instruction and training.

FIGURE 1. **Danger Warning Decal Affixed to AccuFlow Vortex Cooler (P/N 039-0159-066)**



⚠ CAUTION

1. Use caution when handling anhydrous ammonia (NH_3) products.
   a. Stand 'up wind' when working around anhydrous ammonia (NH_3) and related equipment. Always keep anhydrous ammonia equipment away from buildings, livestock, and other people.
   b. Anhydrous ammonia may cause sickness or death. Never work on NH_3 equipment in confined spaces. Seek immediate medical attention if symptoms of illness occur during, or shortly after, use of anhydrous ammonia products.
   c. Keep a source of clean water (at least five gallons) readily available while working with anhydrous ammonia. In case of exposure, flush exposed skin or eyes immediately with large quantities of water and seek immediate medical attention.
   d. NH_3 can be harmful to the environment if not used properly. Follow all local, state, and federal regulations regarding proper handling of anhydrous ammonia.
   e. Always close nurse tank valve(s) when suspending field operation for any length of time.
2. Always remove the AccuFlow system from service before performing maintenance.
   a. Thoroughly bleed all system lines and disconnect nurse tank hose before beginning service or maintenance.
   b. Remove all NH_3 from the system before disassembling or servicing. Verify gauge pressure is at zero, and no frost is present on any components before opening the system.
3. Use extreme caution when opening a previously pressurized system.

Before performing service or maintenance on the AccuFlow system, read and follow the instructions provided in the *Discharging the AccuFlow™ System* section on page 5 or page 51 to properly discharge the Vortex cooler and application lines.

- Remove rings and other jewelry to prevent electrical shorts or entanglement in moving parts.

Instructions for Wire Routing

The word harness is used to mean all electrical leads and cables, bundled and unbundled. When installing harness, secure it at least every 30 cm (12in) to the frame. Follow existing harness as much as possible and use these guidelines:

Harness should not contact or be attached to:

- Lines and hoses with high vibration forces or pressure spikes
- Lines and hoses carrying hot fluids beyond harness component specifications

Avoid contact with any sharp edge or abrading surfaces such as, but not limited to:

- Sheared or flame cut edges
- Edges of machined surfaces
- Fastener threads or cap screw heads
- Ends of adjustable hose clamps
- Wire exiting conduit without protection, either ends or side of conduit
- Hose and tube fittings

Routing should not allow harnesses to:

- Hang below the unit
- Have the potential to become damaged due to exposure to the exterior environment. (i.e. tree limbs, debris, attachments)
- Be placed in areas of or in contact with machine components which develop temperatures higher than the temperature rating of harness components
- Wiring should be protected or shielded if it needs to route near hot temperatures beyond harness component specifications

Harnessing should not have sharp bends

Allow sufficient clearance from machine component operational zones such as:

- Drive shafts, universal joints and hitches (i.e. 3-point hitch)
- Pulleys, gears, sprockets
- Deflection and backlash of belts and chains
- Adjustment zones of adjustable brackets
- Changes of position in steering and suspension systems
- Moving linkages, cylinders, articulation joints, attachments
- Ground engaging components

For harness sections that move during machine operation:

- Allow sufficient length for free movement without interference to prevent: pulling, pinching, catching or rubbing, especially in articulation and pivot points
- Clamp harnesses securely to force controlled movement to occur in the desired harness section
- Avoid sharp twisting or flexing of harnesses in short distances
- Connectors and splices should not be located in harness sections that move

Protect harnesses from:

- Foreign objects such as rocks that may fall or be thrown by the unit
- Buildup of dirt, mud, snow, ice, submersion in water and oil
- Tree limbs, brush and debris
- Damage where service personnel or operators might step or use as a grab bar
- Damage when passing through metal structures
- High pressure wash

Instructions for Hose Routing

The word hoses is used to mean all flexible fluid carrying components. Follow existing hoses as much as possible and use these guidelines:

Hoses should not contact or be attached to:

- Components with high vibration forces
- Components carrying hot fluids beyond hoses component specifications

Avoid contact with any sharp edge or abrading surfaces such as, but not limited to:

- Sheared or flame cut edges
- Edges of machined surfaces
- Fastener threads or cap screw heads
- Ends of adjustable hose clamps

Routing should not allow hoses to:

- Hang below the unit
- Have the potential to become damaged due to exposure to the exterior environment. (i.e. tree limbs, debris, attachments)
- Be placed in areas of or in contact with machine components which develop temperatures higher than the temperature rating of hose components
- Hoses should be protected or shielded if it needs to route near hot temperatures beyond hose component specifications

Hoses should not have sharp bends

Allow sufficient clearance from machine component operational zones such as:

- Drive shafts, universal joints and hitches (i.e. 3-point hitch)
- Pulleys, gears, sprockets
- Deflection and backlash of belts and chains
- Adjustment zones of adjustable brackets
- Changes of position in steering and suspension systems
- Moving linkages, cylinders, articulation joints, attachments
- Ground engaging components

For hose sections that move during machine operation:

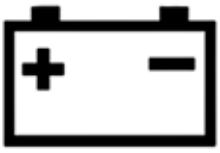
- Allow sufficient length for free movement without interference to prevent: pulling, pinching, catching or rubbing, especially in articulation and pivot points
- Clamp hoses securely to force controlled movement to occur in the desired hose section
- Avoid sharp twisting or flexing of hoses in short distances

Protect hoses from:

- Foreign objects such as rocks that may fall or be thrown by the unit
- Buildup of dirt, mud, snow, ice, submersion in water and oil
- Tree limbs, brush and debris
- Damage where service personnel or operators might step or use as a grab bar
- Damage when passing through metal structures
- High pressure wash

Additional Safety Information

Electrical Safety



⚠ CAUTION

Do not reverse power leads. Doing so could cause severe damage to the equipment. Always make sure that the power leads are connected to the correct polarity as marked. Ensure that the power cable is the last cable to be connected.

Discharging the AccuFlow™ System

The AccuFlow system must be discharged of all anhydrous ammonia and the system must be completely shut down before the implement can be transported.

⚠ DANGER

DO NOT transport the AccuFlow system while it is charged with anhydrous ammonia. The AccuFlow Vortex cooler and product lines must be completely discharged before transporting the implement.

The following procedure outlines the proper method for discharging NH_3 from the AccuFlow system and preparing the system for transport, service, or maintenance.

DANGER

Use extreme caution when opening a previously pressurized system. Exposure to anhydrous ammonia can cause severe burning, blindness, or death. To avoid injury or death, always wear proper personal protective equipment.

Note: *Personal protective equipment such as a respirator, goggles, face shield, clothing that fully covers bare skin, protective suit, and gloves are required when working with anhydrous ammonia products.*

Note: *Refer to Figure 2 and table on page 7 when referencing component locations for discharging the AccuFlow System.*

Before transporting the AccuFlow system or beginning service or maintenance:

1. Toggle the console or vehicle master switch to the off position.
2. (AccuFlow HP+ only) Turn off boost pump control by closing the tractor SCV (selective control valve).
3. Completely close the main shutoff valve Figure 2 on page 7 (Item 1) on the supply or nurse tank. Also close the shutoff valve at the nurse tank bulkhead if so equipped.

Note: *Never run the pump without product in the application lines as damage to the pump seals will result.*

4. Resume field application until the pressure gauge reads no remaining pressure is in the AccuFlow system.
5. Verify that the console and/or vehicle master switch, and all section switches, are in the off position. Ensure the tow vehicle is upwind (as shown in Figure 2 on page 7) of the toolbar implement.
6. Completely close the emergency shut-off valve (Item 3) either by using the rope from the cab of the tractor, or the handle on the valve itself on the AccuFlow Vortex cooler.
7. Bleed and disconnect the nurse tank supply hose (Item 2) from the nurse tank.
8. While standing upwind from the implement, with wind direction as show in Figure 2 on page 7, slowly open the AccuFlow system primary bleed valve (Item 4), until it is fully open. Ammonia will discharge out the vapor knives on the toolbar.
9. Always bleed system slowly by leaving valves open slightly over an extended period of time.
10. Remain at the primary bleed valve (Item 4) and adjust or close as necessary until ammonia cloud is no longer coming out of the vapor knives. After ammonia cloud has dispersed, check the pressure and temperature gauges (Item 6) to verify that the pressure reads zero, and all parts are at ambient temperature (no frost).
11. Open secondary bleed valve (Item 5) slowly to relieve any remaining liquid ammonia from the system
12. Re-verify that the pressure gauge on the AccuFlow manifold reads zero and all AccuFlow components are not cold to the touch before opening the system.

FIGURE 2. **System Bleed and Emergency Shutoff (Top View)**

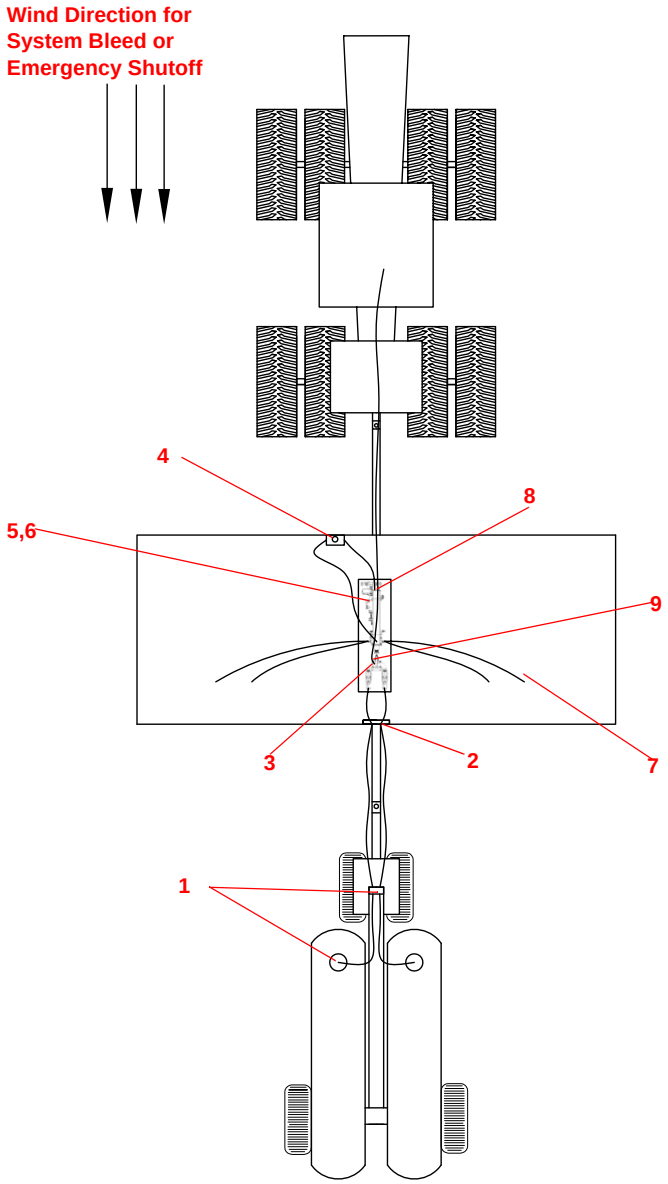
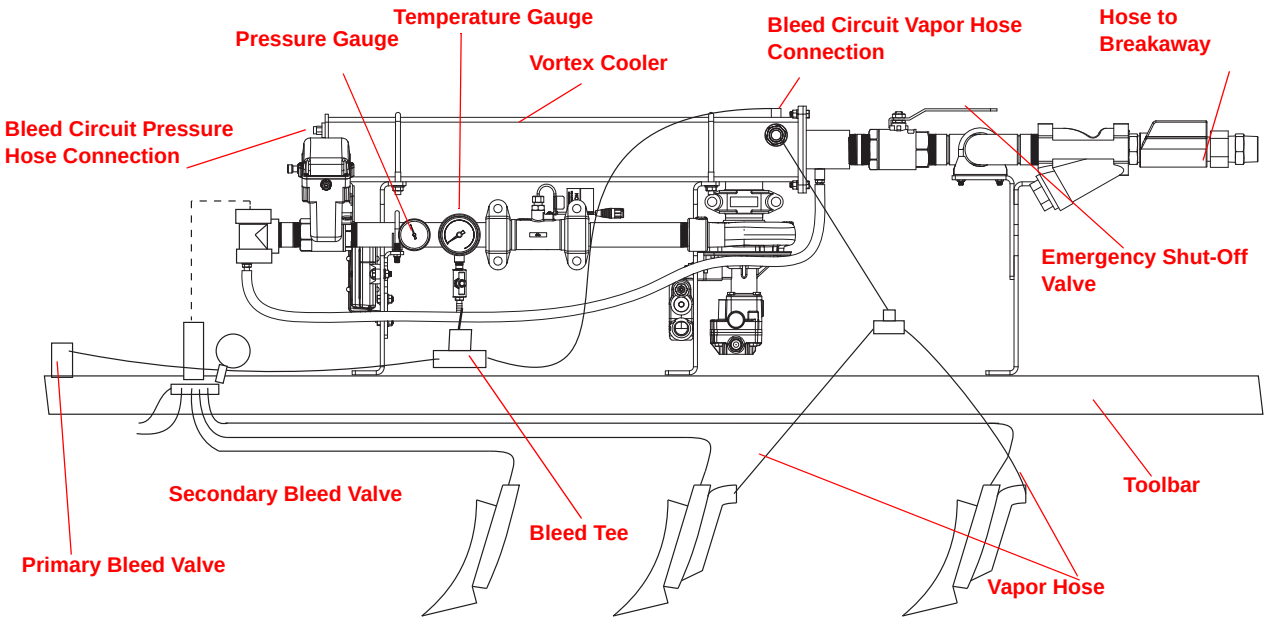


TABLE 1. **System Bleed and Emergency Shutoff Components**

Component #	Description
1	Nurse Tank Main Shutoff and Bleed Valves (At Bulkhead or Withdrawal Valve)
2	Supply Hose Bleed Valves and Breakaway Couplers
3	Accuflow System Emergency Shutoff Valve and Rope to Tractor Cab
4	Accuflow System Primary Bleed Valve
5	Accuflow System Secondary Bleed Valve
6	Accuflow System Pressure and Temperature Gauges
7	Vapor Rows
8	Bleeder on Check Valve
9	Bleeder on Strainer

FIGURE 3. **System Bleed and Emergency Shutoff (Side View)**



CHAPTER 2

Introduction

Overview

The Raven AccuFlow Vortex and HP+ system are designed to provide continuous and automatic control of anhydrous ammonia (NH_3) applications via a Raven control system. The rate of application is monitored via a flow meter and controlled by the Raven console and control valve(s). The operator sets the target application rate in the Raven control console and the system automatically adjusts for vehicle speed and section status changes.

Note: *To properly measure and control application, anhydrous ammonia must be in a liquid state when it passes through the flow meter. To remain liquid, anhydrous ammonia must be stored at a temperature of -28° F [-33° C] or kept under pressure at higher temperatures. To help ensure that the ammonia is in a liquid state as it passes through the flow meter the AccuFlow Vortex cooler uses a small amount of anhydrous ammonia from the system to reduce the temperature of the ammonia being applied.*

The Raven AccuFlow Vortex system is available in two configurations to match the NH_3 application needs:

- AccuFlow Vortex System
- AccuFlow HP+ High Performance System

AccuFlow™ Vortex and AccuFlow™ HP+ systems

The AccuFlow Vortex system is available in one or two valve configurations with a single Vortex cooler. The system is capable of applying anhydrous ammonia at rates up to 50 gallons per minute.

The AccuFlow HP+ system uses a boost pump to enhance the performance of the standard AccuFlow Vortex system to apply anhydrous ammonia in colder ambient temperatures, at higher rates, and at increased speeds. The AccuFlow HP+ system is only available in the single “fast valve” configuration. However, if a dual valve AccuFlow Vortex system is already present on the machine, the HP+ pump can be added to achieve rates over 50 gpm by using the pump to boost system pressure to the application lines. Refer to chapter 5 page 46 for operating Vortex system in NH3 Boost mode.

Note: *System capacity will vary based upon ambient conditions and plumbing configurations of the overall system. Refer to the following Table 2 on page 2 for recommended best practices to achieve the specifications listed. For additional assistance, contact a local Raven dealer for more information.*

Note: *Tank levels less than 25% will also reduce capacity.*

TABLE 1. System Specifications

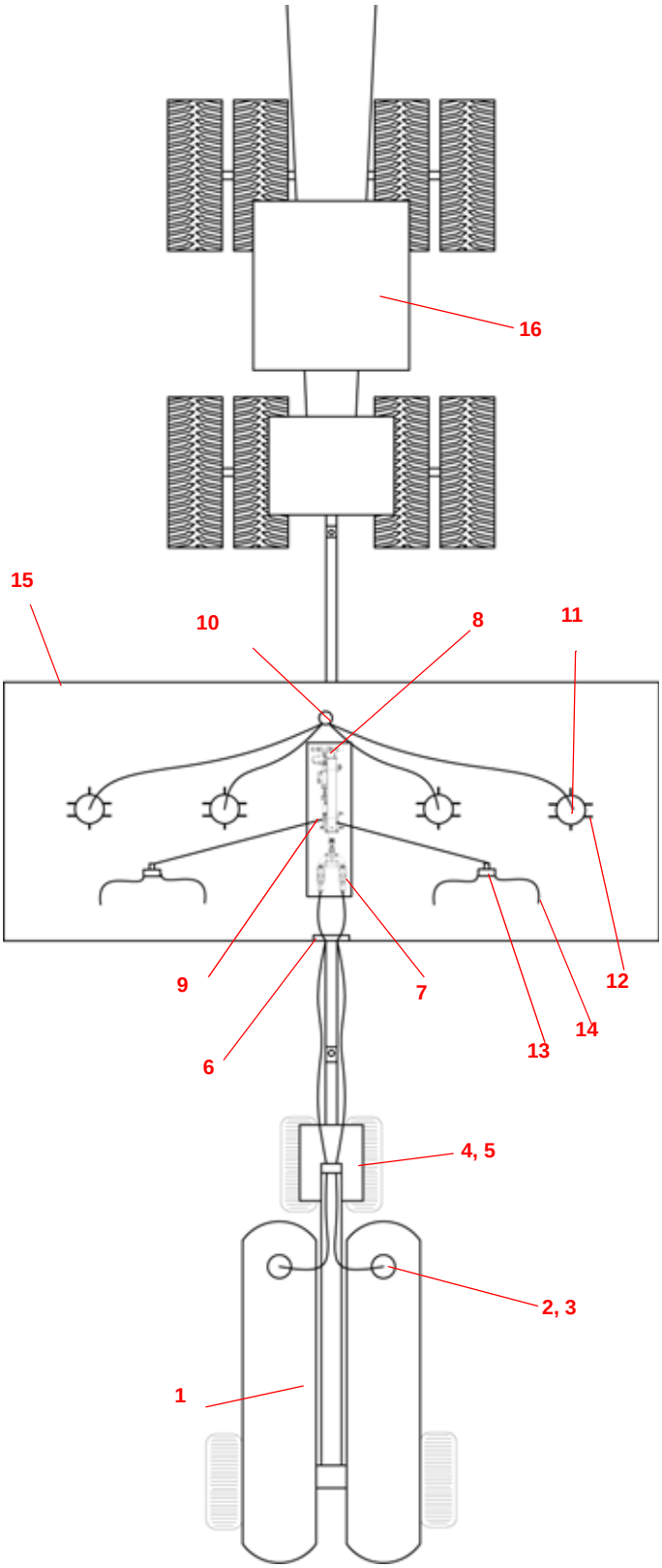
System Specifications	Max Flow Rate	Tank Pressure	Tank Full Level
AccuFlow Vortex System (non-Pump)	50 GPM*	60 psi	>25%
AccuFlow HP+ System (Pump)	80 GPM*	60 psi	>25%
Achieved Based on Recommendations Below			

TABLE 2. System Plumbing Component Recommendations.

	Component Recommendations				
	Component	**Component Description**	**Size (Qty)**	**Length**	**Additional**
Nurse Trailer and Cooler Plumbing	**1**	Nurse Trailer and Nurse Tanks	Dual Tanks	NA	
	2	Nurse Tank Drop Tubes	1-1/2” (2)	NA	
	3	Nurse Tank Withdraw Valves	1-1/2” (2)	NA	Rated capacity 60 gpm each (2).
	4	Trailer Bulkhead Couplers	2-1/4” Acme (2)	NA	
	5	Nurse Tank Main Shutoff Valves	1-1/2” (2)	NA	
	6	Toolbar Breakaway Couplers	1-1/2” (2)	NA	
	-	Hoses from Nurse Tank Withdrawal Valves to *Trailer Bulkhead Couplers*	1-1/2” (2)	Minimized and Equal Length	*If equipped with bulkhead couplers*
	-	Hoses from *Trailer Bulkhead Couplers* to Toolbar Breakaway Couplers	1-1/2” (2)	Minimized and Equal Length	Ensure hose has enough length to turn unit without pinching hose. Ensure hose does not drag on ground. Do not attach hose to tongue of toolbar or trailer**.**
	7	Cooler Inlets	1-1/2” (2)	NA	
	-	Hose from Toolbar Breakaway Couplers to Cooler Inlet Manifold	1-1/2” (2)	Minimized and Equal Length	
	-	Elbows from Toolbar Breakaway to Cooler Inlet Manifold	Not Recommended	NA	Recommend no street elbows. Sweep elbows may be used if necessary.
	-	Total Hose from Withdraw Valve to Cooler Inlet Manifold	1-1/2” (2)	Less than 25 ft	Sum of all lengths of hose from withdraw valve to cooler.
	8	Cooler System Outlets	1-1/4” (2)	NA	
	9	Cooler Vapor Outlets	1” (2)	NA	
Single Section	**-**	Hose from Cooler Outlet to Section Manifold/Valve	1-1/4”	Minimize	
Multi Section	**10**	Section Splitter	NA	NA	
	-	Hose from Cooler System Outlet to Section Splitters (ID)	1-1/4”	Minimized and Equal Length	
	-	Hose from Section Splitters to Section Manifolds/Valves (ID)	1”	Minimized and Equal Length	

Distribution	**11**	Section Manifold	NA	NA	
	12	Applicator Knife	NA	NA	
	-	Hose from Section Manifold to Applicator Knife (ID)	3/8”	Minimized and Equal Length	
	-	Hose from Cooler Vapor Outlet to Vapor Tee (ID)	1” (2)	Minimized and Equal Length	Use 1” tee to split the four vapor rows
		Hose from Vapor Tee to the Vapor Row	3/4” (4)	Minimized and Equal Length	Use 3/4” reducers in 1” tee
	13	Vapor Tee (ID)	1” (2)	NA	
	14	Vapor Rows	4	NA	Attempt to have at least one applicator knife in between each vapor row.
Toolbar	**15**	Toolbar or Applicator Unit	NA	NA	
Tractor	**16**	Tractor or Prime Mover	NA	NA	
Additional Fittings	**-**	Additional fittings needed for installation	NA	NA	Schedule 80 steel or equivalent pressure rating. Materials rated and approved for NH3 service.
Additional Hoses	**-**	Additional hoses needed for installation	NA	NA	Pressure rated 250 psi working, 750 psi burst (high pressure areas of circuit) Materials rated and approved for NH3 service.
Other Plumbing Components	**-**	Additional plumbing components needed for installation	NA	NA	Pressure rated 250 psi working, 750 psi burst (high pressure areas of circuit) Materials rated and approved for NH3 service.

FIGURE 1. **Application Unit System Components**



Updates

Updates for Raven manuals as well as software updates for Raven consoles are available at the Raven Applied Technology Division web site:

www.ravenhelp.com

At Raven Industries, we strive to make your experience with our products as rewarding as possible. One way to improve this experience is to provide us with feedback on this manual.

Your feedback will help shape the future of our product documentation and the overall service we provide. We appreciate the opportunity to see ourselves as our customers see us and are eager to gather ideas on how we have been helping or how we can do better.

To serve you best, please send an email with the following information to

techwriting@ravenind.com

-Accuflow Vortex and Accuflow HP+ Installation & Operation Manual
-Manual No. 016-0171-573 Rev. B
-Any comments or feedback (include chapter or page numbers if applicable).
-Let us know how long have you been using this or other Raven products.

We will not share your email or any information you provide with anyone else. Your feedback is valued and extremely important to us.

Thank you for your time.

CHAPTER 3

AccuFlow™ Vortex and AccuFlow™ HP+ Installation

The following sections are included to illustrate the proper procedure for mounting and plumbing the AccuFlow system.

⚠ DANGER

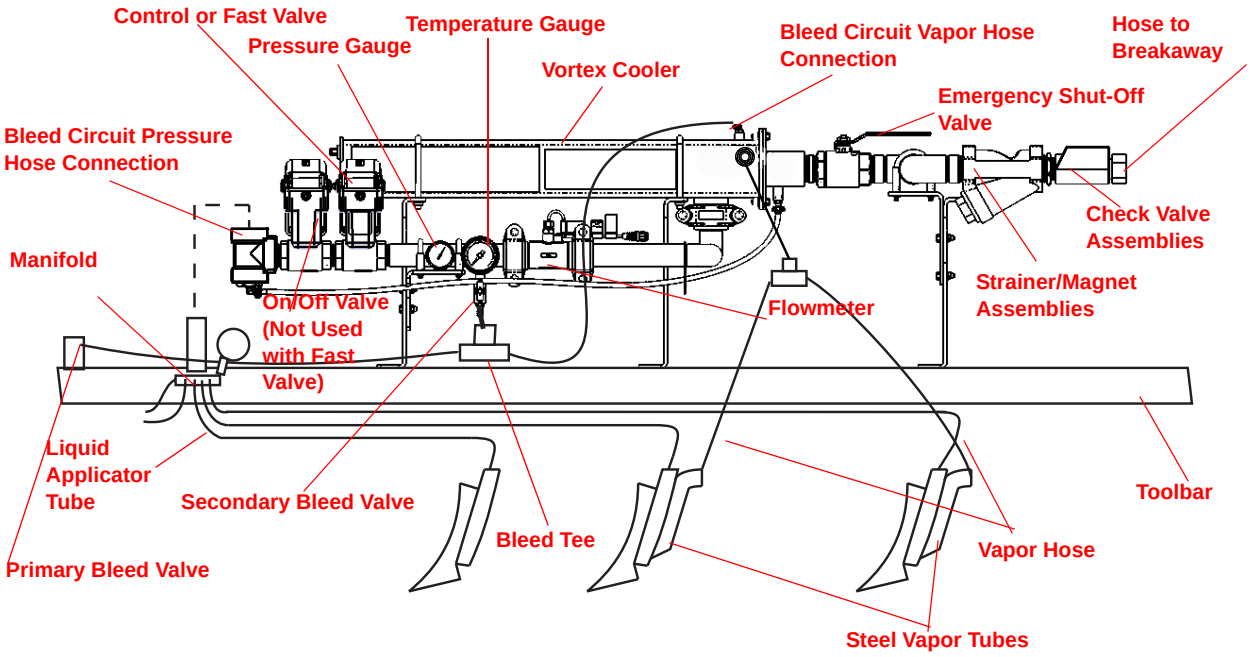
Anhydrous ammonia can cause severe burning, blindness, or death. Refer to *Discharging the AccuFlow™ System* section on page 5 or page 51 and follow the procedure for bleeding the AccuFlow system before beginning maintenance.

This section assumes that the Raven control console has already been installed and all installation and safety procedures have been completed or understood.

Note: *In addition to the Raven control console and associated cabling, a speed sensor and flow cabling must also be installed with the Raven AccuFlow system. Refer to Testing the Speed Sensor Extension Cable section on page 68 for examples of AccuFlow systems and cable connections. Contact a local Raven dealer for more information and assistance.*

When installing hoses, cables, and wires always take care that they cannot be pinched, cut, or otherwise damaged during normal operation.

FIGURE 1. **Typical Vortex System Single and Dual Valve**



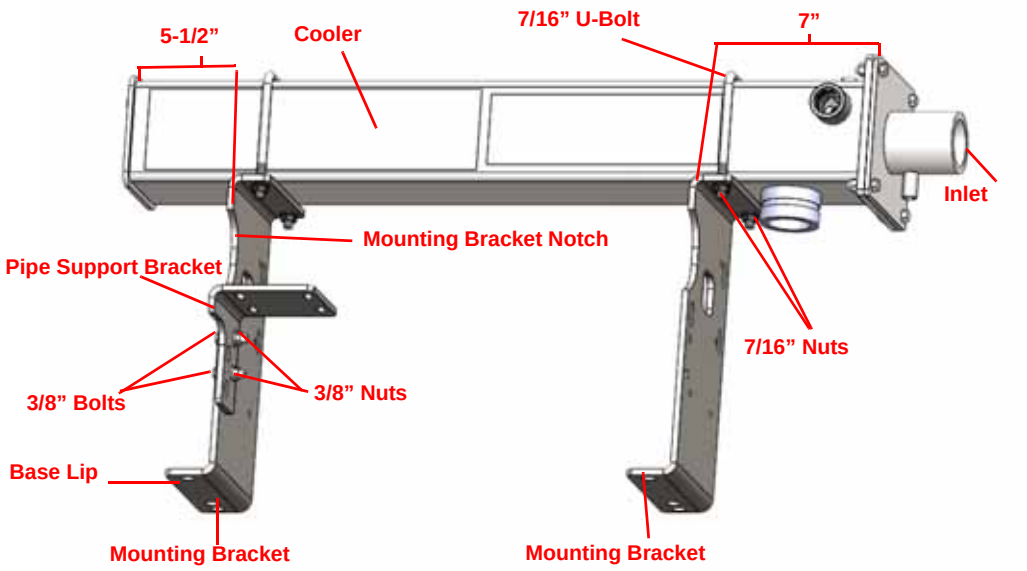
Assembling the AccuFlow™ System

⚠ DANGER

Anhydrous ammonia in vapor form can cause serious injury or death. Pipe joints must be properly sealed with PTFE pipe thread sealant, or an equivalent thread sealant, to prevent leaks.

Cooler Bracket Assembly

FIGURE 2. Cooler Bracket Assembly



1. Insert two 3/8” bolts through the two holes above the base lip and below the notch on the front edge of one of the mounting brackets.
2. On the side of the mounting bracket opposite of the base lip, slide the pipe support bracket over the 3/8” bolts. The flange of the pipe support mounting bracket should stick out in front of the mounting bracket approximately 3.5”.
3. Loosely install the two 3/8” nuts that secure the pipe support bracket.
4. With the cooler positioned so the intake is on the right end of the cooler, place the mounting bracket and pipe support assembly approximately 5-1/2” from the left end of the cooler with the base lip facing left.
5. Install the 7/16” u-bolt from the top of the cooler so the threaded portion of the U-bolt is through the two holes on top of the mounting bracket.
6. Thread and secure the 7/16” nuts to the threaded ends of the 7/16” u-bolt.
7. Place the second mounting bracket assembly approximately 7” from the right end of the cooler with the base lip facing left.
8. Install the 7/16” u-bolt from the top of the cooler so the threaded portion of the u-bolt is through the two holes on top of the mounting bracket.
9. Secure the two 7/16” nuts to the threaded ends of the 7/16” u-bolt.
10. Torque the 7/16” nuts to 28.5 ft-lbs.

Flow Meter and Outlet Manifold Assembly

FIGURE 3. Outlet Manifold Assembly

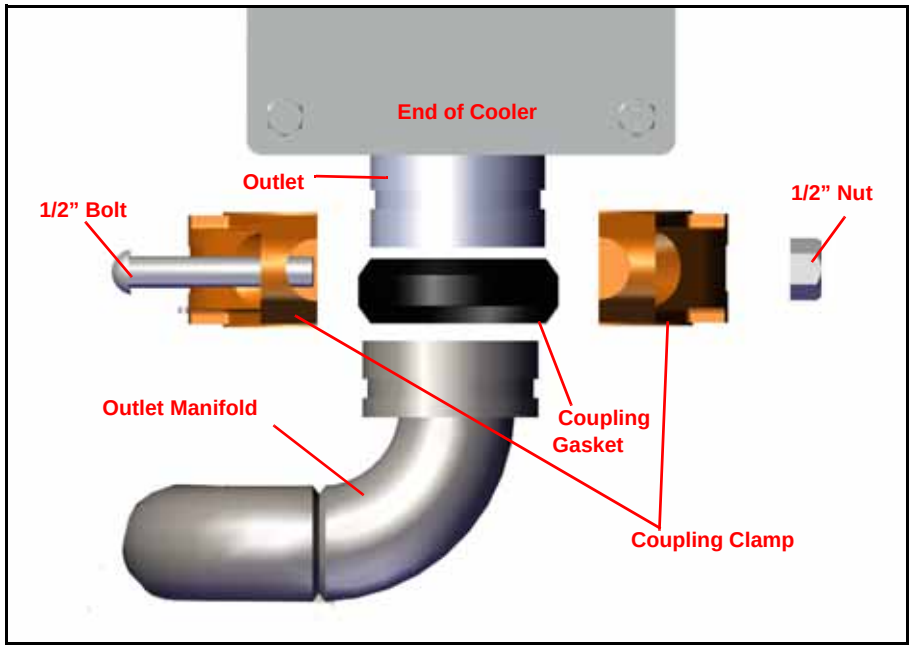
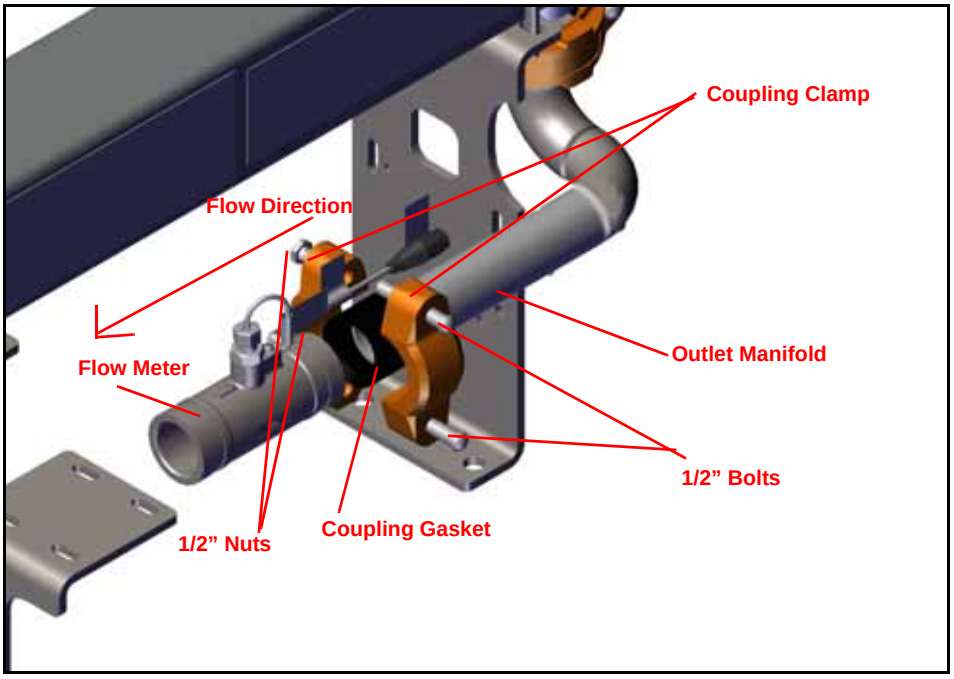


FIGURE 4. Outlet Manifold Clamp Assembly

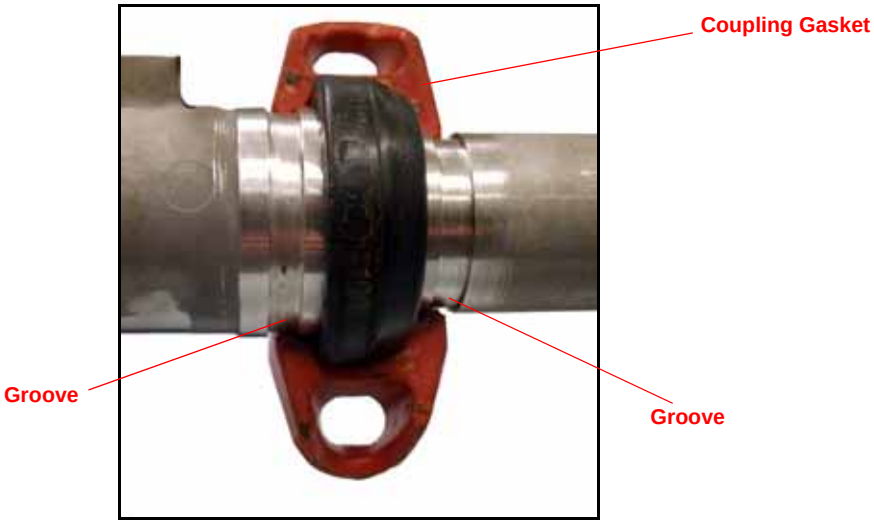
1. Slide the coupling gasket over the end of the outlet sticking out of the bottom of the cooler.
2. Slide the bent end outlet manifold into the coupling gasket.
3. Place the two parts of the coupling clamp over the coupling gasket so the bolt holes are above and below the outlet manifold.
4. Using two 1/2" bolts and two 1/2" nuts to secure the coupling clamp to the cooler and the outlet manifold. Tighten the 1/2" nuts to 80 to 100 ft-lbs.Slide the coupling gasket over the straight end of the outlet manifold.

FIGURE 5. **Flow Meter Assembly**



5. Slide the flow meter into the end of the coupling gasket. Note the flow direction indicated on the flowmeter.
6. Place the two parts of the coupling clamp over the coupling gasket so the bolt holes are above and below the outlet manifold.

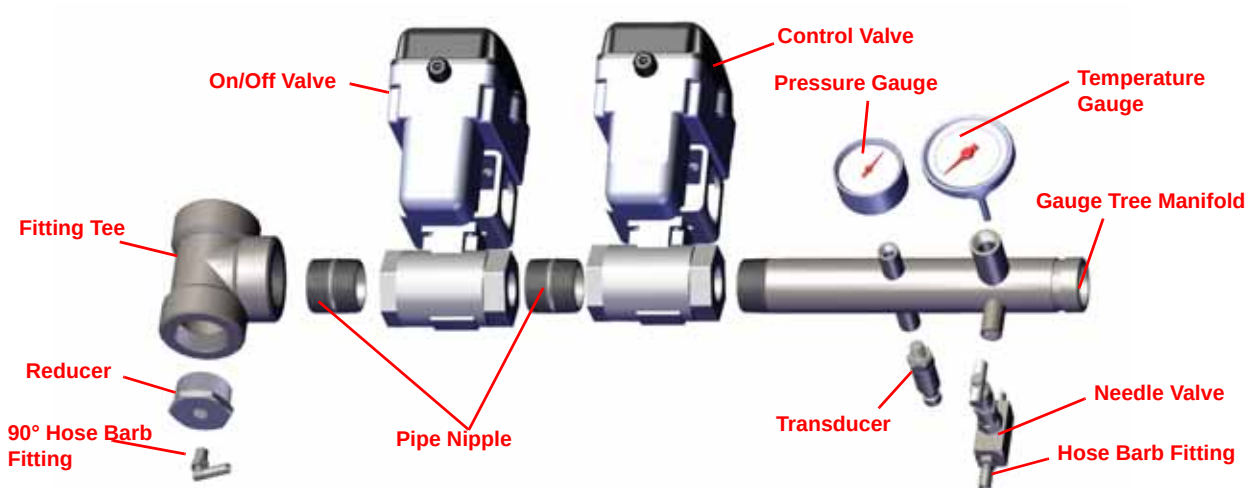
FIGURE 6. **Clamp Installation Detail**



7. Using two 1/2" bolts and two 1/2" nuts to secure the coupling clamp to the flow meter and the outlet manifold.
8. Tighten the 1/2" nuts to 80 to 100 ft-lbs.

Gauge Tree and Valve Assembly

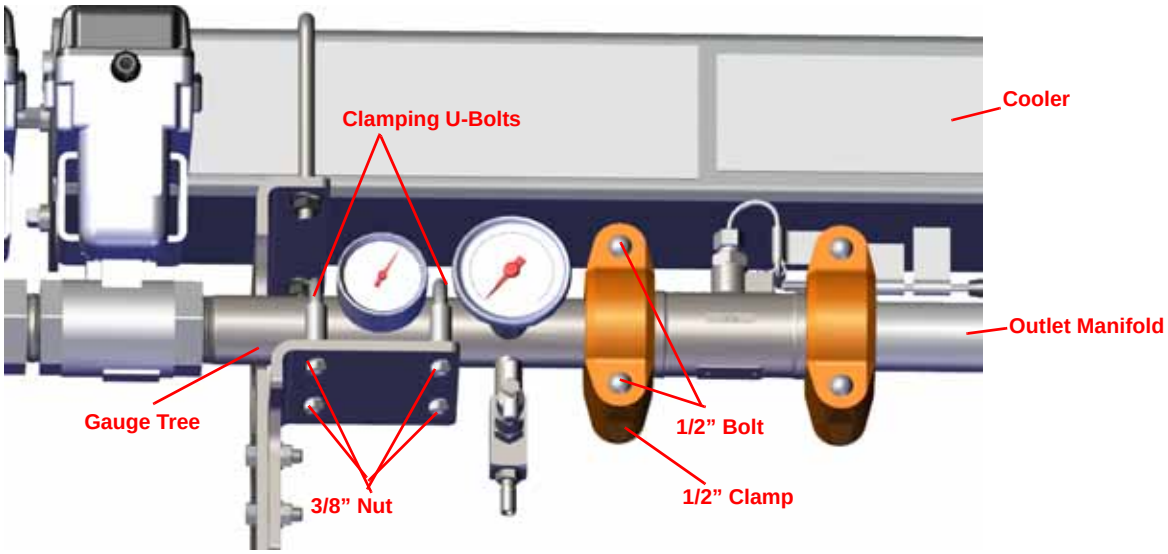
FIGURE 7. Gauge Tree and Valve Assembly



1. Apply PTFE thread sealant and teflon tape with nickel to all threaded joints.
2. Thread and secure the reducer into one end of the fitting tee.
3. Install the 90° hose barb fitting into the reducer.
4. Install a 2” pipe nipple between the on/off valve and the controller valve.
5. Use the second 2” pipe nipple to secure the fitting tee to the on/off valve. Verify that the 90° hose barb fitting if located at below the pipe.
6. Secure the gauge tree manifold to the controller valve.
7. Install the needle valve into the needle valve port of the gauge tree manifold.
8. Install the straight hose barb fitting into the end of the needle valve.
9. Install the transducer into the transducer port of the gauge tree manifold.
10. Screw the pressure gauge into the appropriate port on the gauge tree manifold.
11. Install the temperature gauge in the temperature gauge port on the gauge tree manifold.

Attaching the Gauge Tree to the Cooler

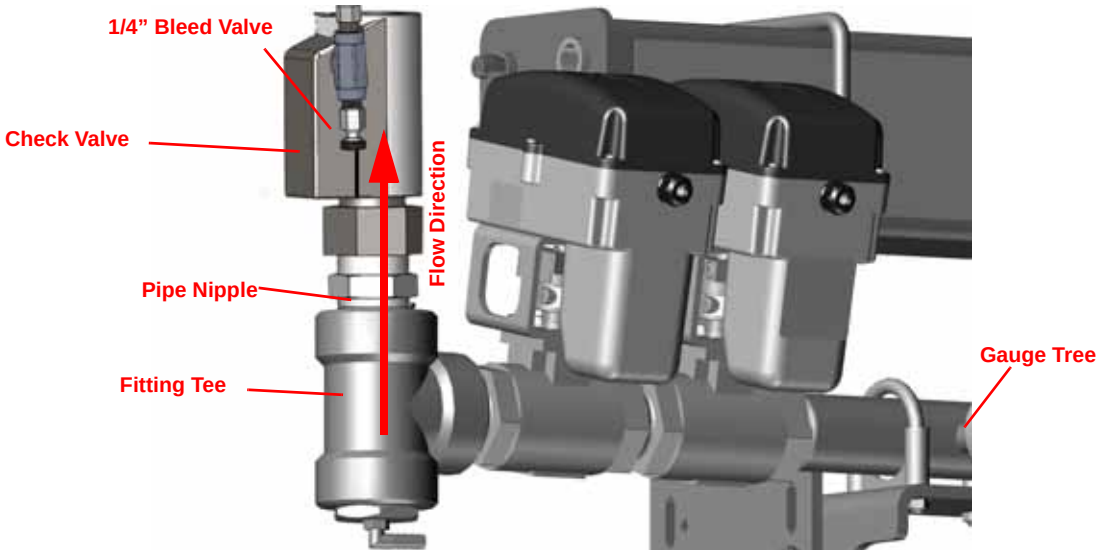
FIGURE 8. Attaching the Gauge Tree to the Cooler



1. Slide the coupling gasket over the end of the gauge tree that attaches to the flowmeter.
2. Connect the end of the gauge tree to the end of the flowmeter.
3. Use the provided coupling clamp, 1/2” bolts, and 1/2” nuts to secure the gauge tree to the outlet manifold.
4. Tighten the 1/2” nuts to 80 to 100 ft-lbs.
5. Install a clamping U-bolt over the top of the gauge tree so the threaded portion of the u-bolt is through the two holes on the pipe support bracket.
6. Thread and secure the 3/8” nuts to the threaded ends of the clamping u-bolt.
7. Loosely tighten the 3/8” nuts.
8. Repeat steps 5 - 7 for with the second clamping u-bolt.
9. Tighten the 3/8” nuts that secure the gauge tree to the pipe support bracket.
10. Tighten the 3/8” nuts that secure the pipe support bracket to the mounting bracket.

Check Valve Assembly (For Multiple Section Valves Only)

FIGURE 9. Check Valve Assembly

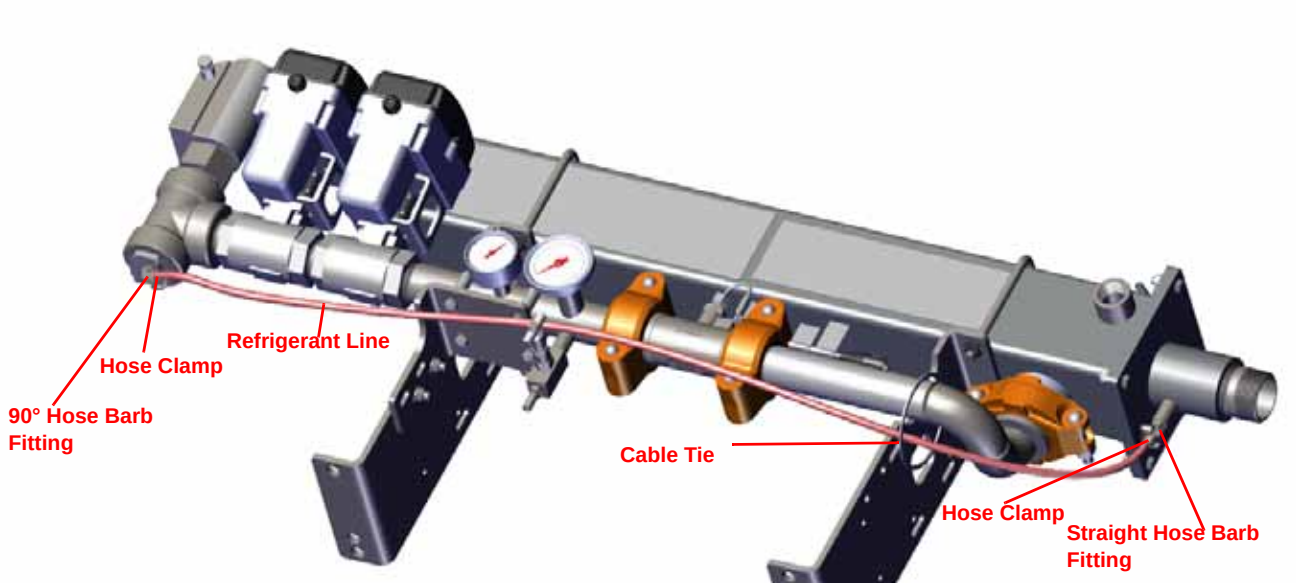


1. Apply PTFE thread sealant and teflon tape with nickel to all threaded joints.
2. Install the pipe nipple into the top of the fitting tee.
3. Attach the check valve to the pipe nipple with the flow direction as shown in Figure 9.

Note: *Refer to the spare parts list in Chapter 8, System Diagram and Replacement Parts for a list of replacement parts.*

Refrigerant Line Assembly

FIGURE 10. Refrigerant Line Assembly



1. Slide a hose clamp over one end of the refrigerant line.

2. Slide the refrigerant line over the 90° hose barb fitting.
3. Secure the hose clamp over the 90° hose barb fitting.
4. Slide a hose clamp over the other end of the refrigerant line.
5. Slide the refrigerant line over the straight hose barb fitting.
6. Secure the hose clamp over the straight hose barb fitting.
7. Secure the refrigerant line to the outlet manifold with a cable tie.

Inlet Manifold Assembly

There are variations in inlet manifolds. Locate the appropriate inlet manifold below and follow the appropriate instructions to install your inlet manifold.

Dual Inlet Manifold Assembly

FIGURE 11. Standard Inlet Manifold Assembly

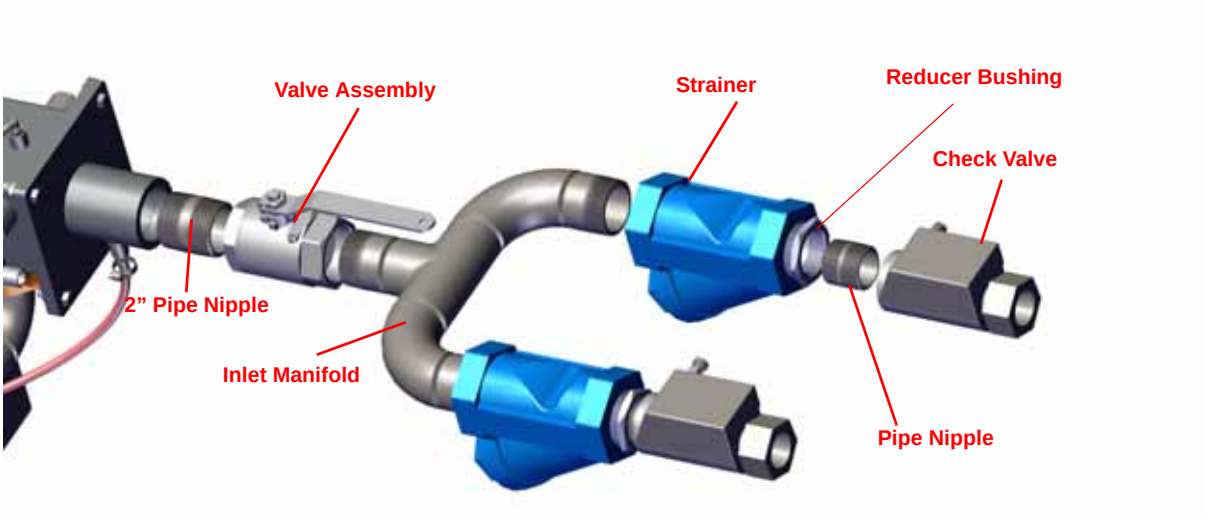
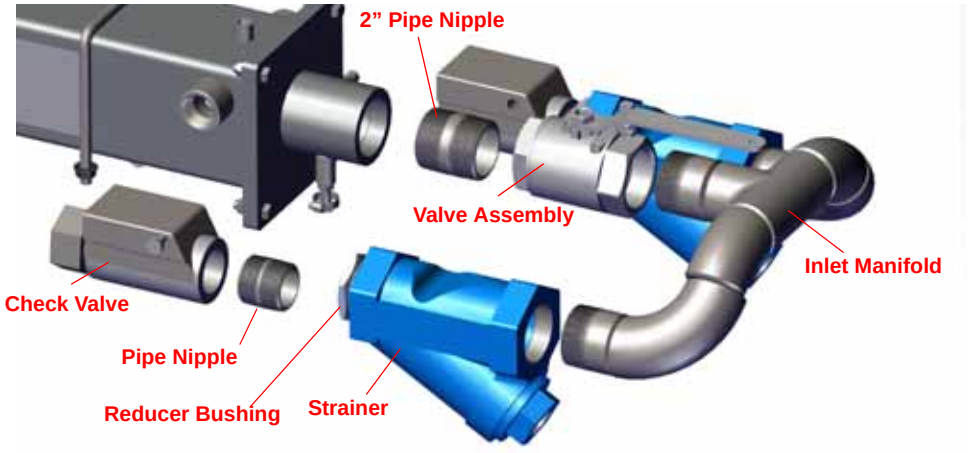


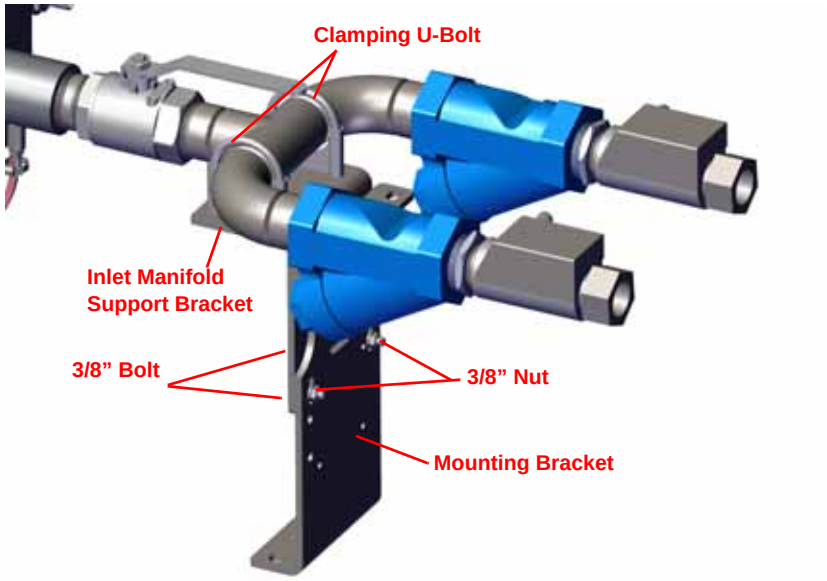
FIGURE 12. Reverse Inlet Manifold Assembly



1. Apply PTFE thread sealant and teflon tape with nickel to all threaded joints.
2. Install the 2” pipe nipple into the end of the cooler.
3. Attach the valve assembly to the end of the valve assembly to the 2” pipe nipple.
4. Secure the inlet manifold to the other end of the valve assembly.
5. Attach a strainer to each end of the inlet manifold. Ensure both strainers are in the same position.
6. Install and tighten a reducer bushing and a pipe nipple into the end of each strainer.
7. Install and tighten a check valve on each pipe nipple.

Dual Inlet Manifold Support Bracket Installation

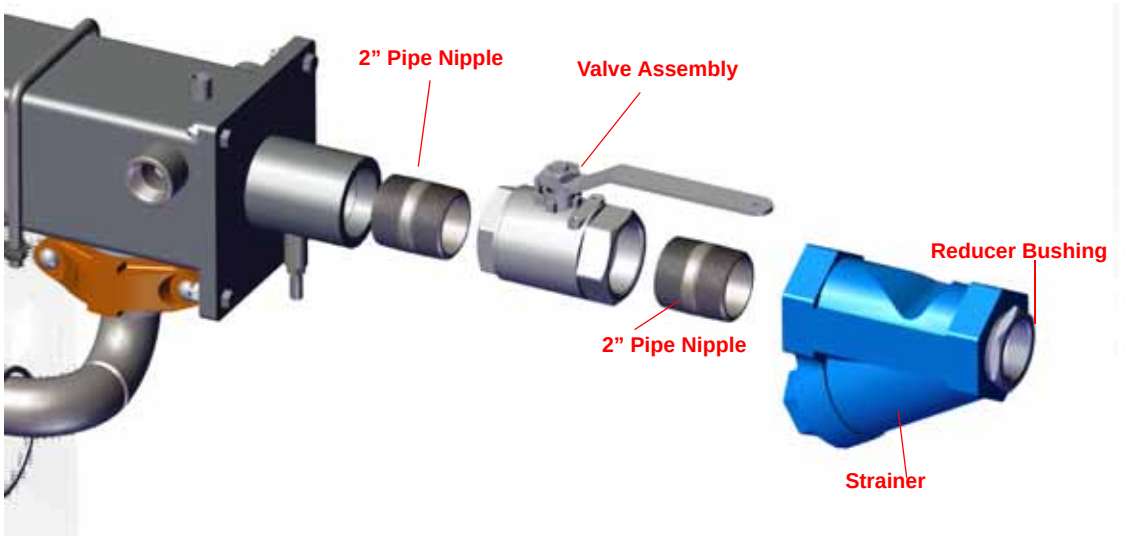
FIGURE 13. Standard Inlet Manifold Support Bracket



1. Use three 3/8” bolts and 3/8” nuts to secure the mounting bracket to the inlet manifold support bracket.
2. Install two clamping u-bolts around the inlet manifold without installing the nuts.
3. Place the inlet manifold support bracket against the bottom of the inlet manifold (as shown in Figure 13).
4. Feed the threaded ends of the u-bolts through the holes on the inlet manifold support bracket.
5. Install the nuts on the threaded ends of the u-bolts on the underside of the inlet manifold support bracket.

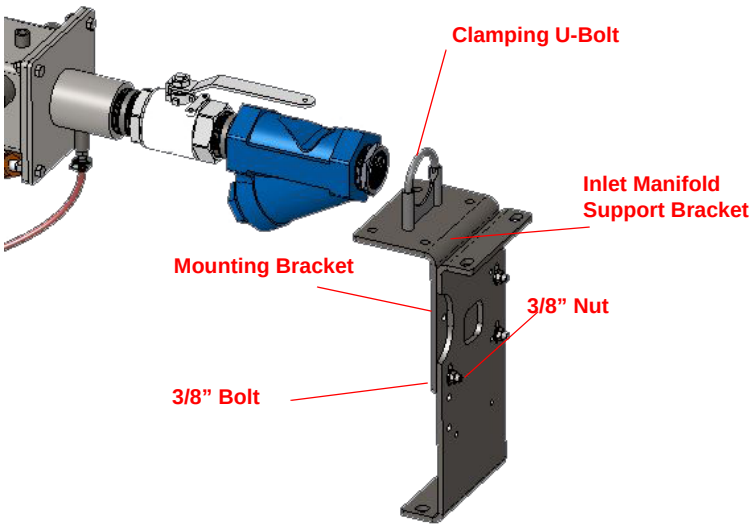
Single Inlet Manifold Assembly

FIGURE 14. Single Inlet Manifold Assembly



Single Inlet Manifold Support Bracket Installation

FIGURE 15. Installed Single Inlet Manifold Support Bracket

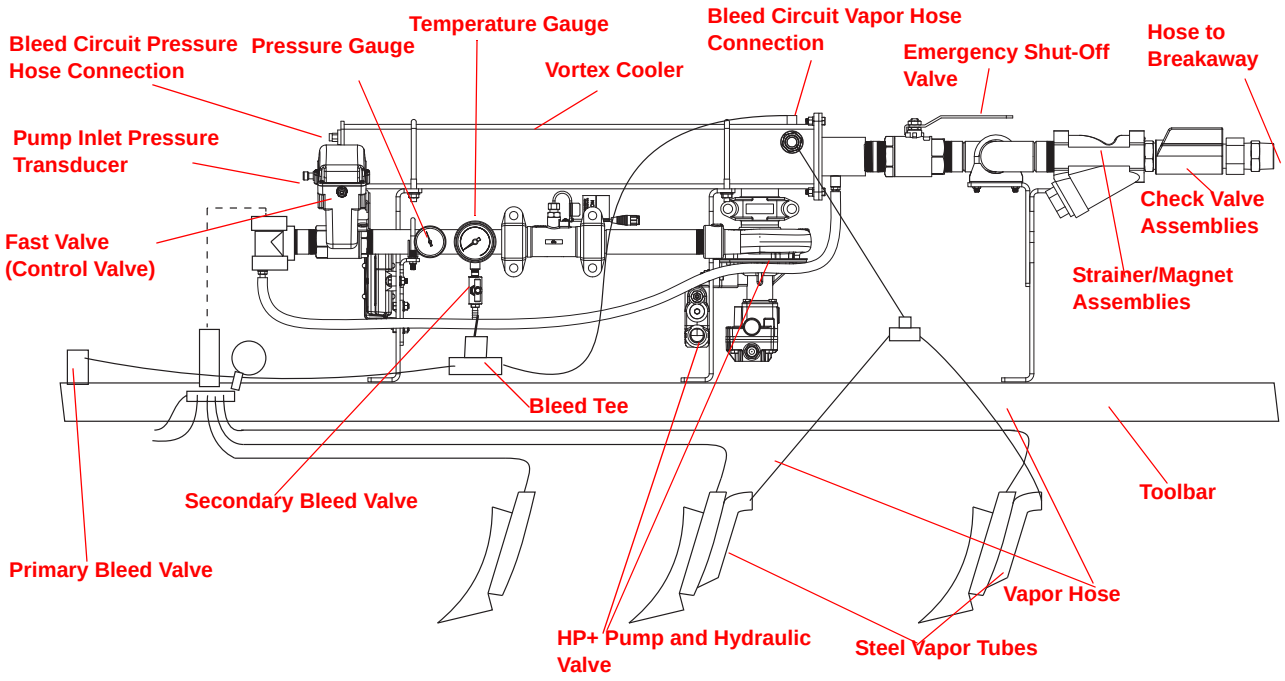


1. Use two 3/8” bolts and 3/8” nuts to secure the mounting bracket to the inlet manifold support bracket.
2. Install the clamping u-bolt around the inlet manifold without installing the nuts.
3. Place the inlet manifold support bracket against the bottom of the inlet.
4. Feed the threaded ends of the u-bolts through the holes on the inlet manifold support bracket.
5. Install the nuts on the threaded ends of the u-bolt on the underside of the inlet manifold support bracket.

Note: *Depending on location, the support bracket may need to be altered to support the inlet.*

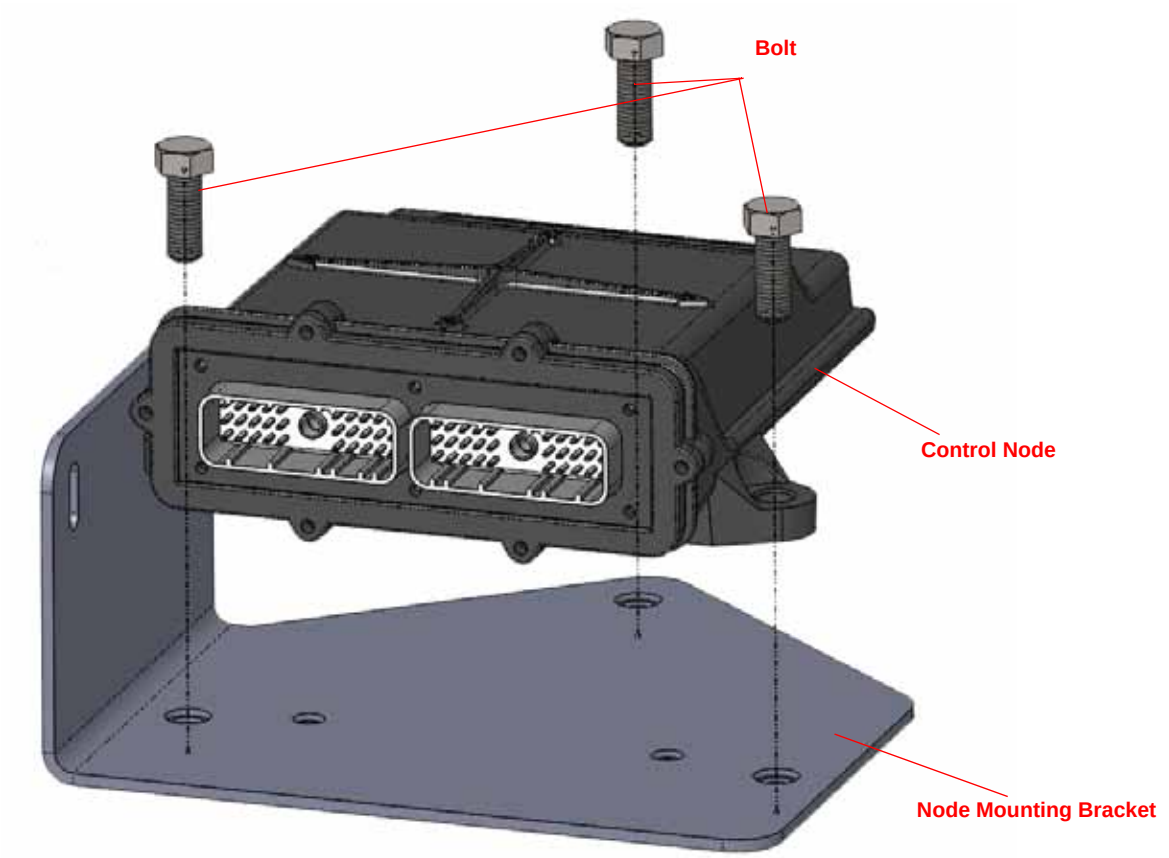
Installing a HP+ System

FIGURE 16. **Typical AccuFlow HP+ System**



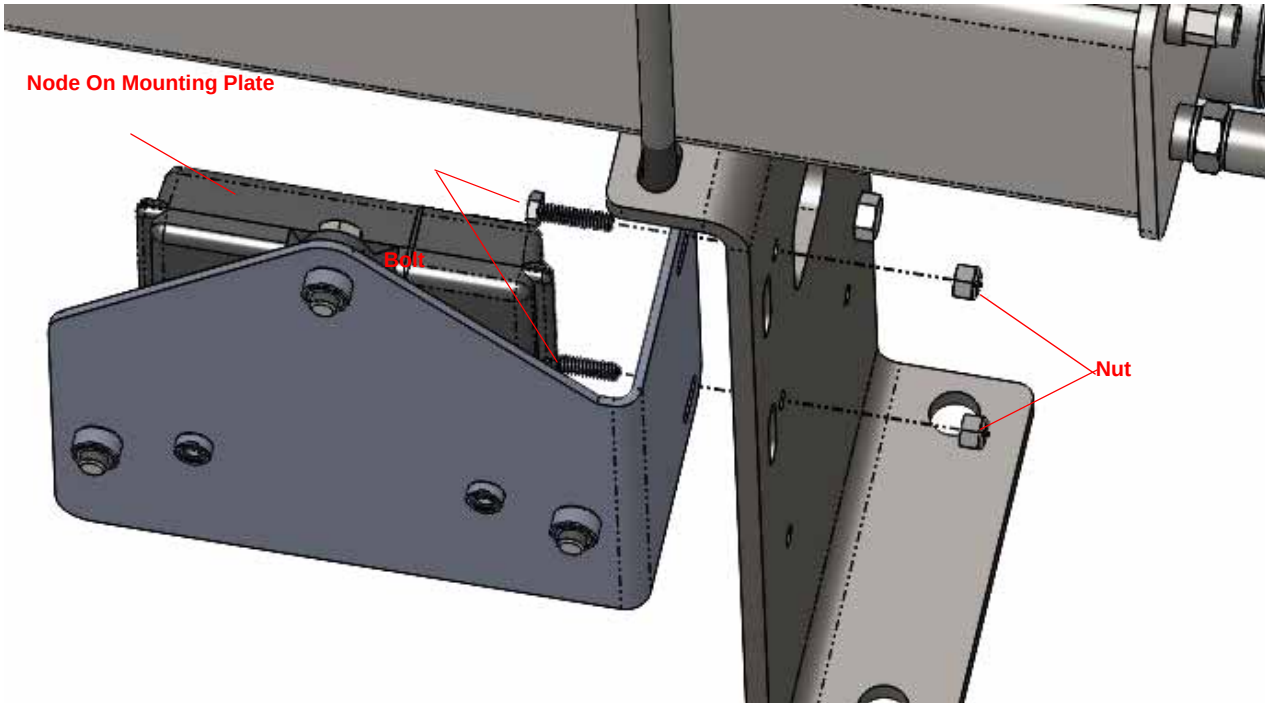
Installing Control Node: AccuFlow HP+

FIGURE 17. Installing Control Node to Mounting Plate



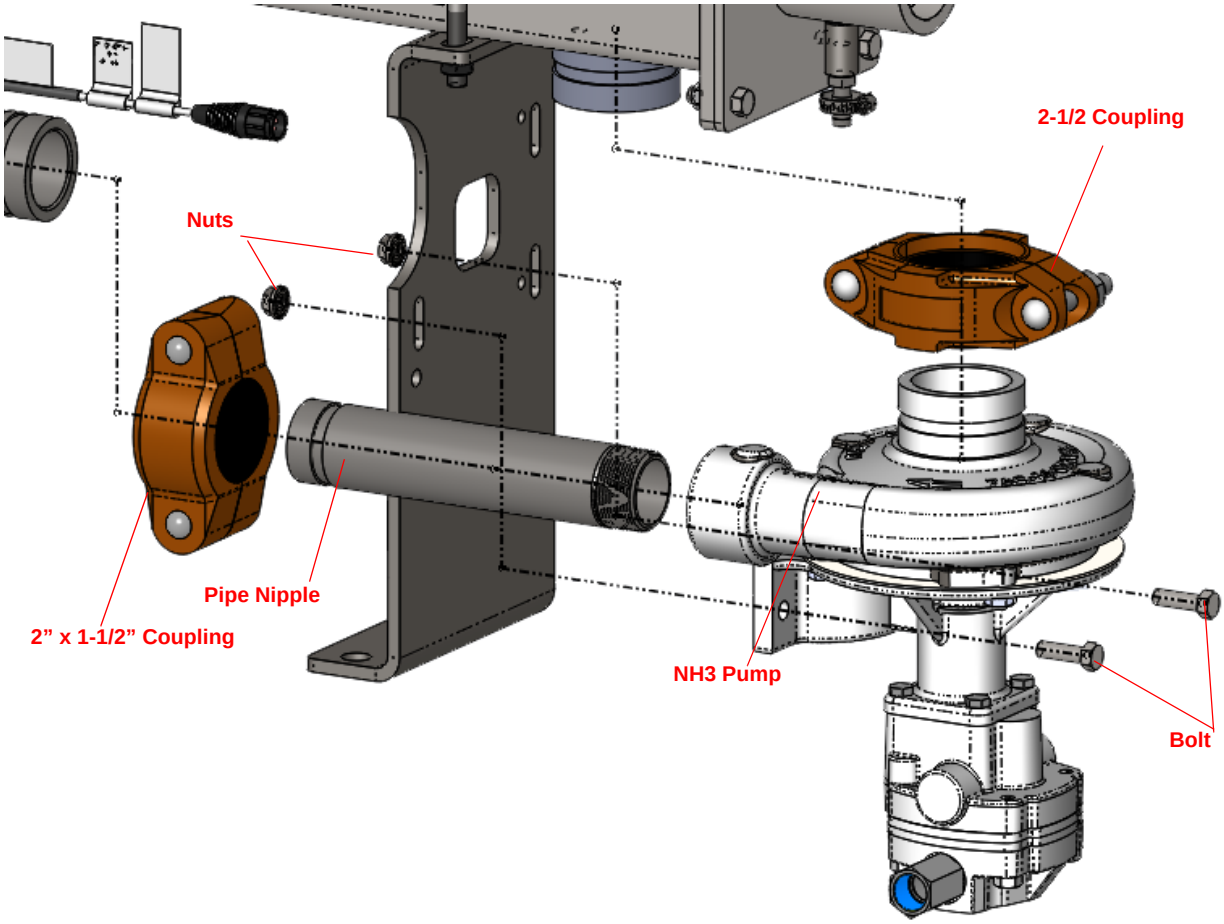
1. Place the control node (sold separately) on the mounting plate so the edge of the control node with the connections is flush with the flat side of the node mounting bracket. Refer to Figure 17.
2. Use three bolts to secure the control node to the mounting plate.
3. Use two bolts and nuts to secure the node mounting plate to the Vortex cooler support bracket (Figure 18).

FIGURE 18. **Installing Control Node/Mounting Plate to Vortex Cooler Bracket**



Installing Pump Upgrade (Vortex to HP+ upgrade)

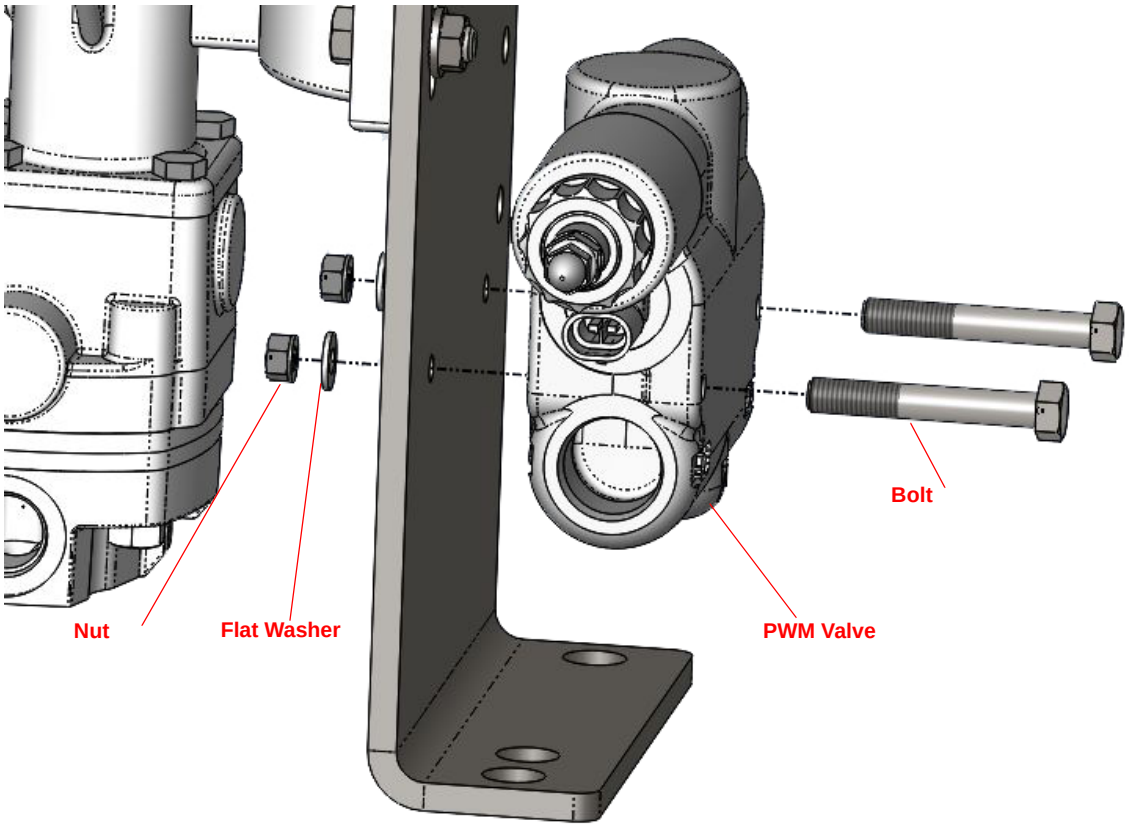
FIGURE 19. Installing Pump Upgrade and Fittings



1. Apply PTFE thread sealant and teflon tape with nickel to the threaded end of the pipe nipple.
2. Install the pipe nipple into the NH_3 pump as shown in Figure 19.
3. Attach the 2-1/2 coupling to the secure the pump to the outlet on the bottom of the Vortex cooler. Refer to Figure 19.
4. Use the 1-1/2” coupling to secure the pipe nipple to the flowmeter.
5. Torque coupling fasteners to 80-100 ft-lbs.
6. Use two bolts, flat washers, and nuts to secure the NH_3 pump to the Vortex cooler support bracket.

Installing Hydraulic Valve

FIGURE 20. Installing Hydraulic Valve to Vortex Cooler Bracket



1. Use two bolts, nuts, and flat washers to attach hydraulic valve to Vortex cooler support bracket as shown in Figure 20.

Boost Pump Hydraulic Connections (HP+ System Only)

FIGURE 21. HP+ Hydraulic Fitting and Hose Installation

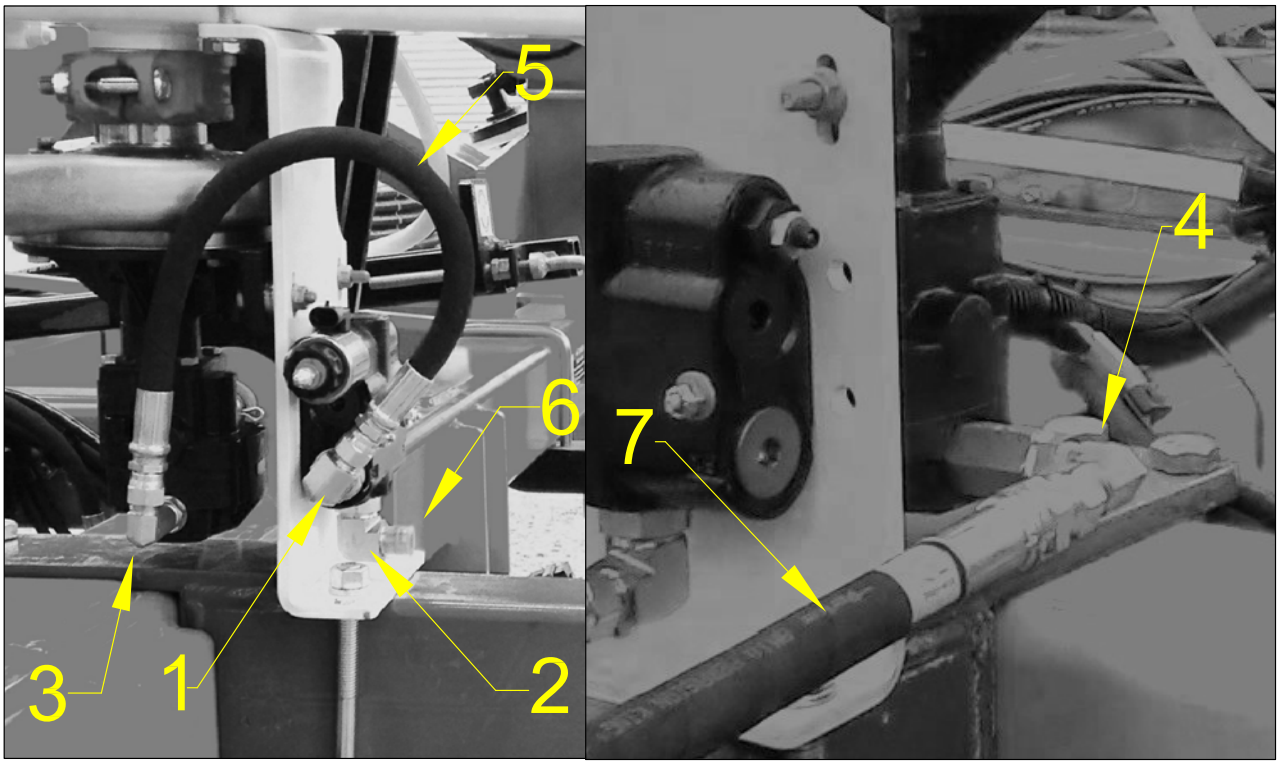


TABLE 1. HP+ Hydraulic Fitting and Hose Installation

Component #	Description	Placement
1	-8 JIC (M) to -16 SAE (M) Elbow	Valve “CF” Port
2	-8 JIC (M) to -16 SAE (M) Elbow	Valve “IN” Port
3	-8 JIC (M) to -8 SAE (M) Long Elbow	Motor “I” Port (No Check Valve Installed)
4	-10 JIC (M) to -10 SAE (M) Elbow	Motor “O” Port (Check Valve Installed)
5	-8 JIC (F) to -8 SAE (F) Hose 22”	Valve “CF” Port to Motor “I” Port
6	-8 JIC (F) to -8 SAE (M w/ISO tip) Hose 360”	Valve “IN” Port to Tractor
7	-10 JIC (F) to -10 SAE (M w/ISO tip) Hose 360”	Motor “O” Port (Check Valve Installed) to Tractor

1. Install the supplied hoses and fittings as described in the table and figure above.
2. Connect supplied ISO couplers to appropriate hose ends, and route hoses toward front of the implement.

Note: *Route hydraulic hoses so that they are free of twists or kinks and will not be pinched by surrounding mechanisms. Ensure at least 3 feet of hose extends past toolbar hitch point. Extra hose should be secured to the toolbar, away from moving parts or pinch points. Take care to prevent dirt or other contaminants from entering hydraulic assemblies which may cause premature wear or failure of hydraulic components.*

Mounting the AccuFlow™ System

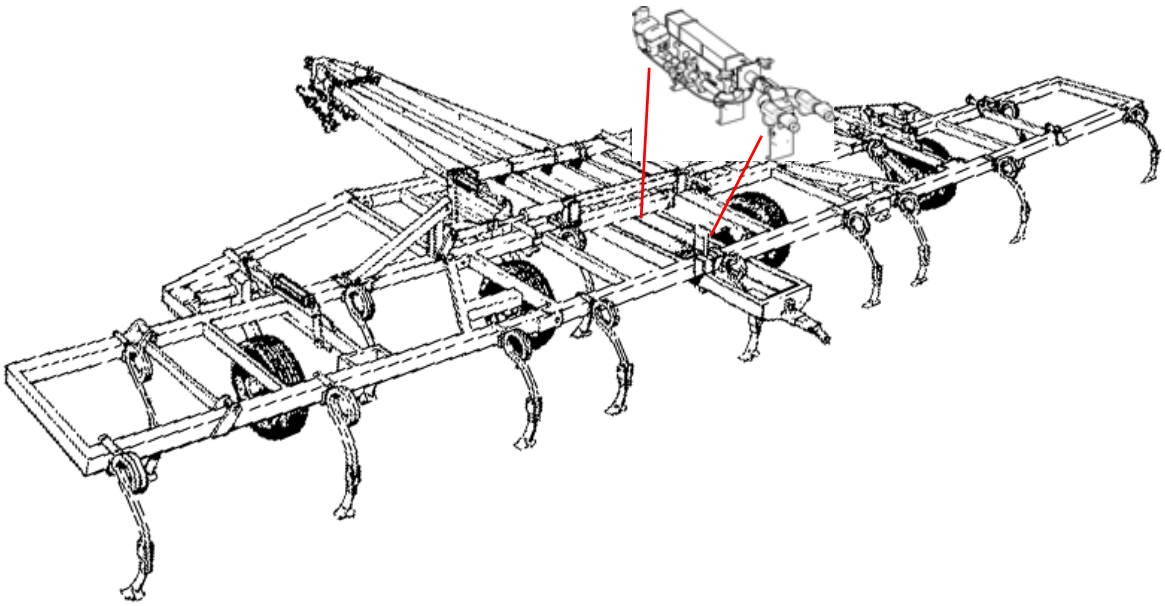
Mount the AccuFlow system directly to the frame of the tool bar or implement and as far rearward as possible to minimize hose length to nurse tank.

Note: *Ensure that toolbar can be folded without interfering with Accuflow system or components. Mounting brackets may need to be modified to allow for Accuflow system to be attached to toolbar.*

The intake port of the AccuFlow Vortex cooler should be pointing toward the rear of implement and nurse tank.

Note: *Follow plumbing recommendations on the Component Recommendations table found in Chapter 2 to achieve desired flow rates. If Accuflow system cannot be installed with intake port facing rear of implement, minimize the number of elbows and hose lengths used as recommended in the Component Recommendations table.*

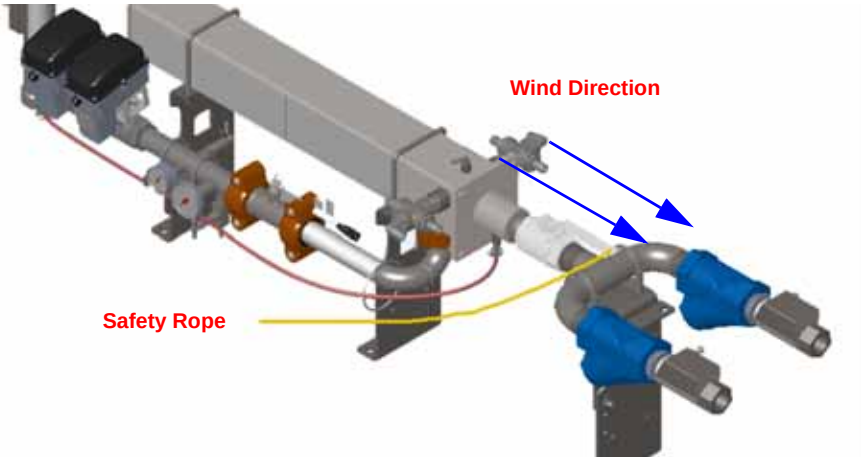
FIGURE 22. AccuFlow Mounting Example



Emergency Shut-off Rope Installation

Using the provided quick link, securely tie a length of rope to the emergency shut-off valve. Route the rope so that, when pulled, the emergency shut-off valve closes.

FIGURE 23. Using the Safety Rope

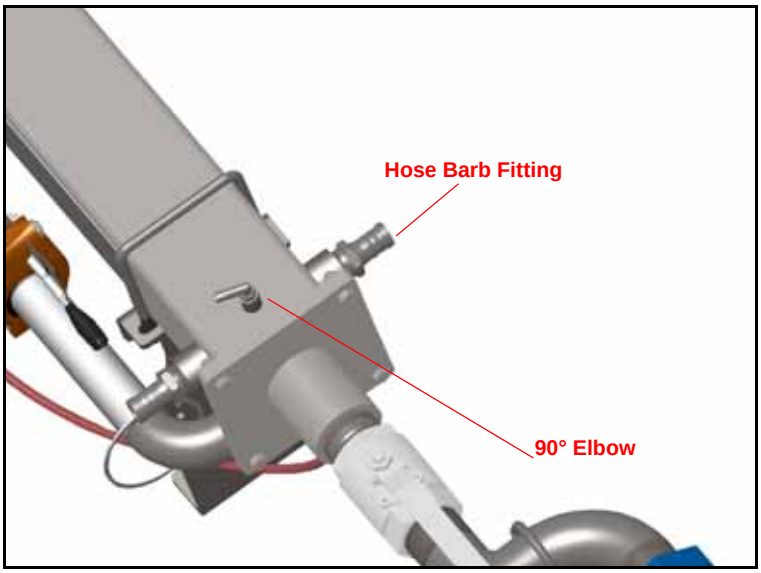


⚠ WARNING

Anhydrous ammonia can cause severe burning, blindness, or death. Always work upwind of an implement with the AccuFlow system. If the emergency shut-off rope cannot be routed to the vehicle's cab, make sure to orient the vehicle to allow the rope to be pulled from a location upwind of the implement.

Vapor Port Assembly

FIGURE 24. Six Vapor Port Assembly



1. Apply PTFE thread sealant and teflon tape with nickel to all threaded joints.
2. Install the vapor hose fitting into the vapor port openings.

AccuFlow™ Vapor and Applicator Plumbing Installation

DANGER

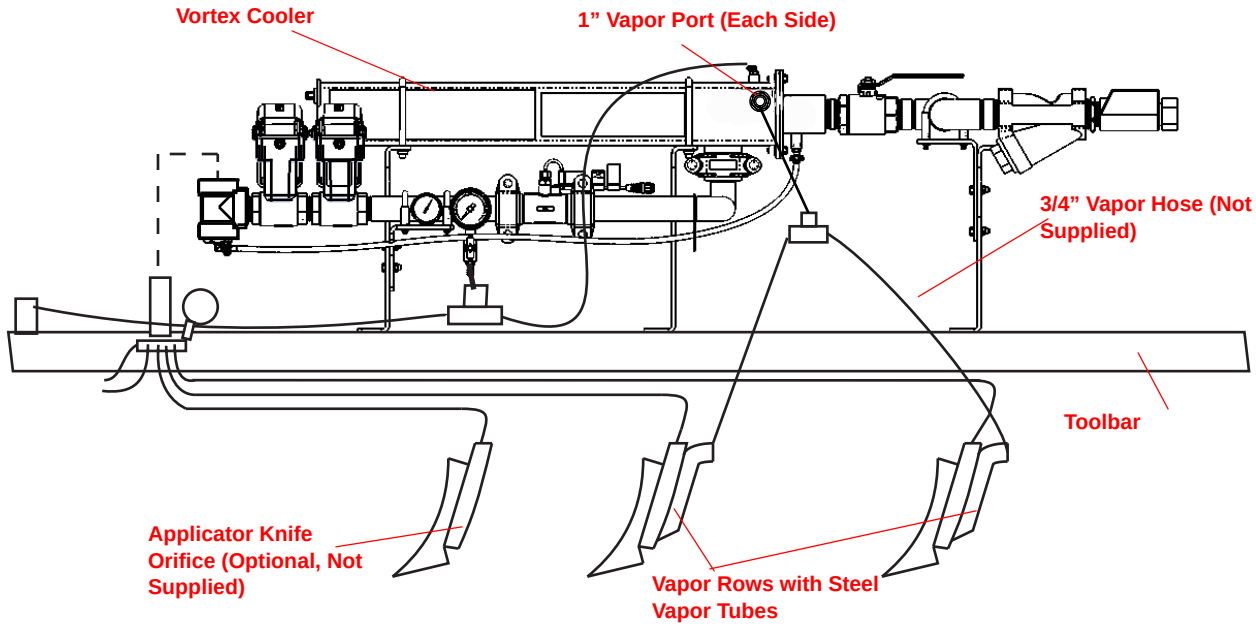
Anhydrous ammonia in vapor form can cause serious injury or death. Pipe joints must be properly sealed with PTFE pipe thread sealant, or an equivalent thread sealant, to prevent leaks.

The following will step through the final system connections for the AccuFlow Vortex cooler and NH_3 plumbing.

> *Generic Control valves used with liquid systems are not acceptable for NH_3. Valves specially designed for NH_3 are required. Special NH_3 valves can be used for other applications; i.e. herbicides, insecticides, and liquid fertilizer.*

1. Connect the hose barb fittings to the vapor ports on the cooler as shown below.

FIGURE 25. **AccuFlow Cooler Vapor Tube Installation**



DANGER

Anhydrous ammonia in vapor form can cause serious injury or death. Pipe joints must be properly sealed with PTFE pipe thread sealant, or an equivalent thread sealant, to prevent leaks.

Connect vapor tube hoses to vapor ports, tee and steel vapor tubes as shown in figure.

2. Weld vapor tubes provided with the kit to the back of liquid tubes. Vapor tubes should be spaced out evenly across the tool bar. Avoid connecting vapor tubes on wheel tracks and adjacent rows if possible.
3. Route 3/4” tubing from the 3/4” cooler vapor ports to the vapor tube tee as shown in figure. Cut tube lengths in equal lengths and allow enough hose to avoid kinking at any folding points. Connect one end of the vapor line to the hose barb on the cooler and secure using a supplied hose clamp. Connect the other end to the vapor tubes installed on the implement and secure using the supplied hose clamps.

Note: *Consult a local NH_3 supplier for appropriate hoses, breakaway fittings, manifolds, and orifices for use with the AccuFlow system. Always install breakaway fittings in the nurse tank supply lines to reduce NH_3 discharge if the nurse tank accidentally disconnects from the implement.*

Note: *To reduce risk of uneven application, Raven recommends using equal length hose to all 4 vapor knives, placed at least 1 row apart.*

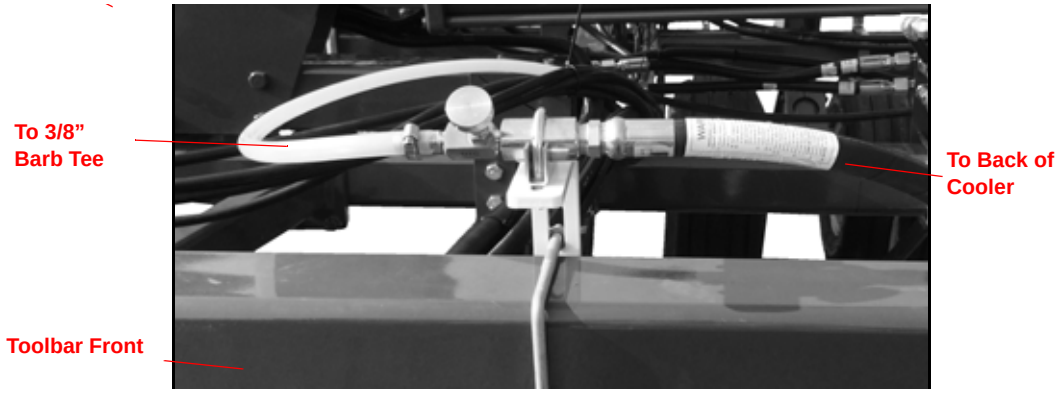
Bleed Line Hose Routing

1. Apply PTFE thread sealant and teflon tape with nickel to all threaded joints.
2. Route the bleed valve to the front of the tool bar.

Note: *When routing the bleed line hose avoid pinch points and sharp edges that may damage the hose.*

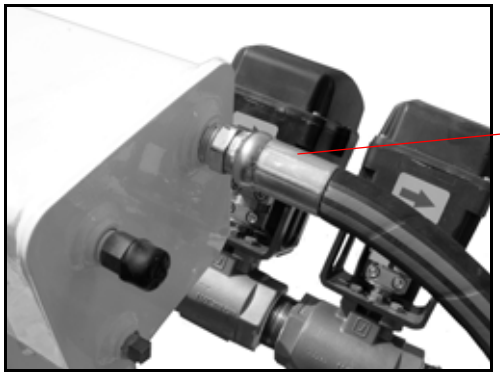
3. Secure the bleed hose to the front of the toolbar. Verify it is an easy to access location that will not allow the hose to pinch or be damaged.

FIGURE 26. Secured Bleed Valve (Bracket Shown Not Provided)



4. Connect one end of the 1/2” high pressure hose to the back of the Vortex cooler and the other end to the needle valve.

FIGURE 27. **Attached Bleed Hose.**

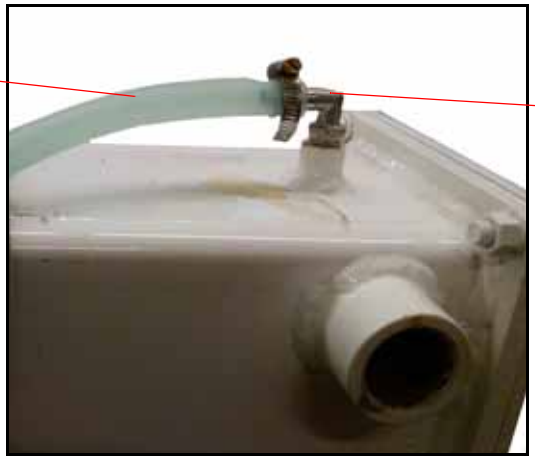


5. Connect the 3/8” low pressure hose to the other side of the needle valve.
6. Route the 3/8” low pressure hose to the 3/8” hose barb tee near the cooler.

FIGURE 28. **3/8” Barb Tee**

7. Connect to the 90° hose barb on the top of the cooler. This bleeds off into the cooler’s vapor chamber.

FIGURE 29. **Low Pressure Hose Connected to 90° Hose Barb On Cooler**



Checking for System Leaks

CAUTION

To avoid damage to boost pump seals, do not run the boost pump dry. Be sure to shutdown the boost pump when no anhydrous ammonia is flowing through the pump or when the nurse tank is empty. Even though the hydraulics are engaged, the boost pump will only run on demand.

Once AccuFlow has been installed on the implement, check the system for leaks by charging with 90 to 100 PSI of compressed air and monitoring pressure gauge. If system does not hold air pressure, apply soapy water to all plumbing joints and hoses to identify leaks. Fix any leaks and repeat air test before charging the AccuFlow system with anhydrous ammonia.

CHAPTER 4

AccuFlow™ Vortex System (Non-Pump) Calibration and Operation

This chapter contains information on calculating or adjusting calibration values for the AccuFlow system. These values must be programmed on the console providing product control. Refer to the control console *Installation and Operation* manual for detailed programming instructions.

Note: *Before the AccuFlow system and connected console may be used to control anhydrous ammonia application, the following calibration values must be programmed on the Raven product control console:*

- Boom Cal
- Speed Cal
- Meter Cal
- Valve Cal
- Rate Cal

Programming NH_3 Rate Control

Entering Boom Cal

The boom cal for the AccuFlow system can be calculated with the following formula:

Number of Applicator Knives x Spacing in inches = Implement Width **(EQ 1)**

For Example:

If the implement has 16 knives spaced 30 inches apart, the calculated implement width is equal to 480 inches. Enter 480 as the boom cal on the control console. If a multi-section implement has 24 knives on 30” spacing and is divided into 3 equal sections, the calculated section width is 8 knives x 30” = 240”. Enter 240 as the boom cal for section 1, section 2 & section 3.

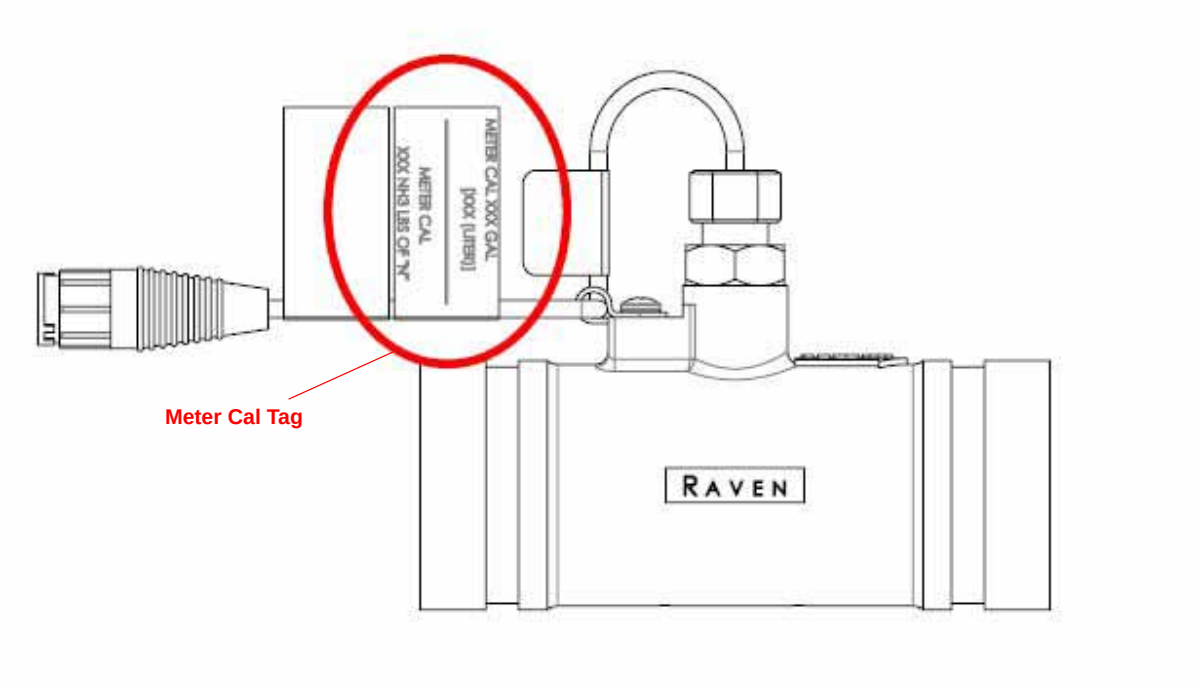
Entering Speed Cal

Calculate and enter the speed cal according to the console’s *Installation and Operation* manual. No adjustments to the speed cal are required for the AccuFlow system.

Entering Meter Cal

Locate the meter cal tag attached to the AccuFlow flow meter. Enter meter cal as shown on tag below for NH_3 LBS OF “N”.

FIGURE 1. Meter Cal Tag



Note: *All volumes will be displayed in pounds [kilograms] of actual nitrogen. To properly control the application of anhydrous ammonia, enter the target application rates as pounds [kilograms] of actual nitrogen per acre [hectare] or lbs(N)/acre [kg N)/ha].*

Note: *If meter cal tag does not have meter cal number in “Lbs of N” use the following* formulas to adjust the original meter cal for the desired display preferences.

$$\text{Meter Cal Gal} / 4.22 = \text{Meter Cal Lb N} \quad \textbf{(EQ 2)}$$

$$\text{Meter Cal Liter} / [0.506] = \text{Meter Cal Kg N} \quad \textbf{(EQ 3)}$$

$$\text{Example: } 720 \text{ Gal} / 4.22 = 170.62 \text{ Lb N} \quad \textbf{(EQ 4)}$$

$$\text{Example: } 190 \text{ Liter} / [0.506] = 375.494 \text{ Kg N} \quad \textbf{(EQ 5)}$$

From the calculated values, round the adjusted meter cal value to 171 [375] and enter this value on the Raven console.

Adjusting Valve Cal

Refer to the console *Installation and Operation Manual* for instructions on entering or adjusting the valve cal.

Note: *The valve cal may need to be adjusted to speed up or slow down the valve to obtain desired results, particularly in applications using low flow rates.*

Recommended Starting Valve Cals:

Vortex Fast Valve: 743 (If too slow try 643 or 543)

Vortex Two Valve: 2123 (If too slow try 2223 or 2323. If low-rate control is unstable, try 2133 or 2143)

Adjusting Rate Cal

Enter the target rate in actual pounds of nitrogen (N) per acre [kilograms per hectare].

Calculating the Required Capacity

To ensure that the desired application rate (in pounds [kilograms] of actual nitrogen per minute) does not exceed the AccuFlow system capacity, the required capacity of the application must be verified.

Using the following formula to calculate the required capacity:

$$\frac{\text{Target Application Rate x Target Application Speed x Implement Width}}{5940[60{,}000]} = \text{lbs[kg](N)/min} \quad \textbf{(EQ 6)}$$

Note: *Be sure to enter the target application rate in pounds [kilograms] of nitrogen per acre [hectare] and the implement width as calculated in the “Entering Boom Cal” section on page 31.*

For Example:

(English Units) Given a target application rate of 150 lbs(N)/acre at an average of 5.5 mph and a calculated implement width of 480 inches, the required capacity is:

$$\frac{150 \times 5.5 \times 480}{5940} = 66.6 \text{ lbs(N)/min} \quad \textbf{(EQ 7)}$$

(SI Units) Given a target application rate of 68 kg(N)/ha at an average of 10 km/hr and a calculated implement width of 1220 centimeters, the required capacity is:

$$\frac{68 \times 10 \times 1220}{60{,}000} = 13.8 \text{ kg(N)/min} \quad \textbf{(EQ 8)}$$

The maximum capacities of the various AccuFlow systems are shown below: Contact a local Raven dealer if the maximum rate is exceeded.

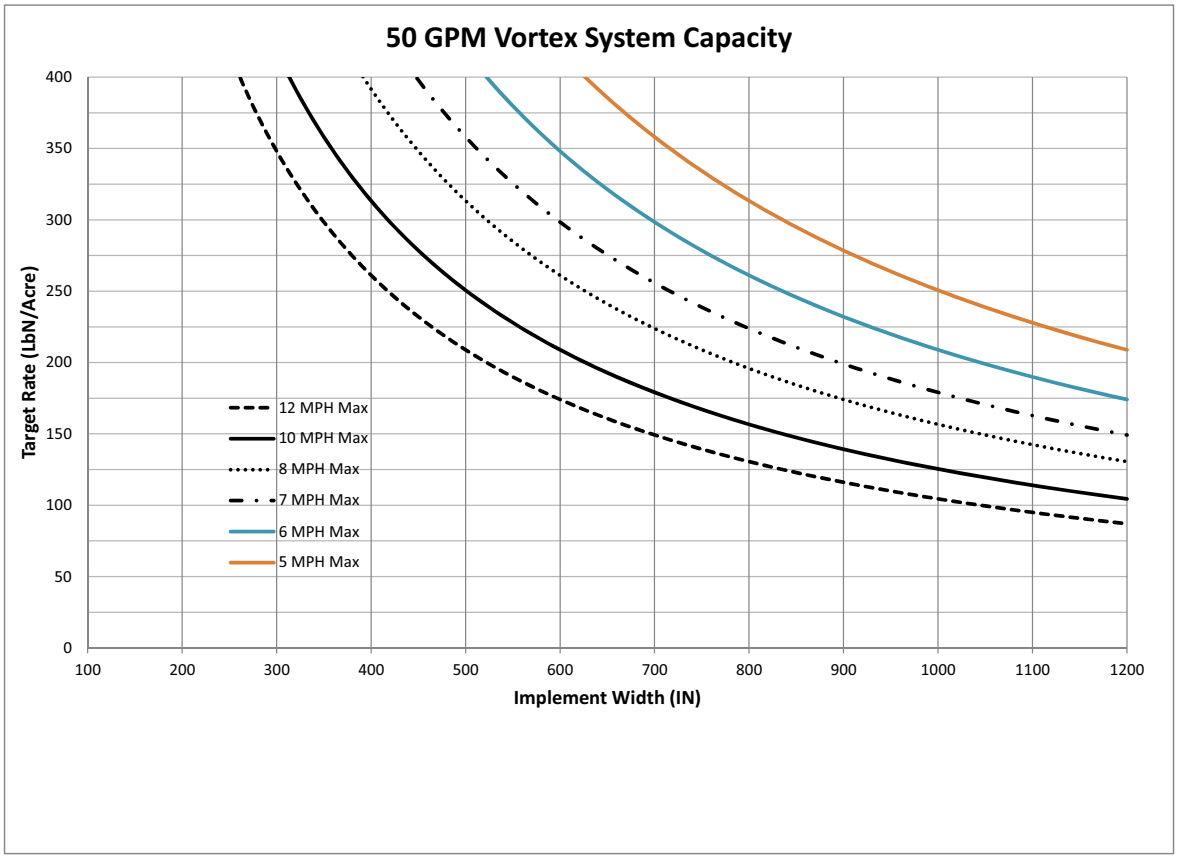
a. Single tank Vortex: 126 lbN/min [57 kgN/min].
b. Dual tank/dual hose Vortex: 210 lbN/min [95 kgN/min].

System Capacity Chart

Note: *This figure assumes all recommended plumbing practices have been followed. Failure to follow to those practices will limit the system capacity to values lower than those shown on this figure.*

The following figure illustrates the capacity of the AccuFlow system in various configurations. Refer to this chart as part of the calculation for required capacity and when troubleshooting the AccuFlow system.

FIGURE 2. System Capacity Chart



AccuFlow NH_3 Orifice Kit Instructions

Overview

Anhydrous ammonia will vaporize as is loses pressure from the nurse tank to the AccuFlow system. For the Accuflow system to work properly, the NH_3 passing through the flowmeter must be liquid. The AccuFlow cooler converts the vapor back to liquid using NH_3 as a refrigerant. This refrigerant then discharges through vapor knives installed behind applicator knives. This may add extra NH_3 to those rows.

Options to reduce the amount of refrigerant and row to row variances are:

1. Divide the refrigerant by installing additional vapor knives.
2. When applying at lower rates, use an orifice fitting to control the amount of refrigerant used.

The table below outlines desired product flow rates.

TABLE 1. Orficed NH3 Cooler Performance Table

	AccuFlow Orificed Cooler		Accuflow Orificed Dual Cooler		AccuFlow Vortex Cooler	
Orifice Size	**Flow Range, gpm [lbN/hr]**	**% Refrigerant**	**Flow Range, gpm [lbN/hr]**	**% Refrigerant**	**Flow Range, gpm [lbN/hr]**	**% Refrigerant**
.047*	28-32 [7080-8100]	1-1.5	40-43 [10080-10860]	3-4	30-35 [7600-8860]	1-1.5
.078	32-35 [8100-8880]	2.5-3	43-45 [10860-1140]	6-9	35-40 [8860-10125]	2.5-3
.093**	35-40 [8580-9900]	4-5	45-50 [11400-12660]	9.5-12	40-50 [10125-12660]	3.5-4

Note: *The values listed above will vary with tank pressures. Conditions will vary with tank pressure, hose size, withdraw valve size, fittings/or adapters that restrict flow to the heat exchanger.*

**To prevent the orifice from plugging, a 40 mesh strainer may be needed in from of the orifice inlet.*

***Orifice pre-installed in cooler.*

Calculating the Required Capacity

Use the formulas below to determine the orifice and cooler configuration for the desired application rate, speed, and implement width.

To convert to GPM:

$$\frac{\text{lbN/min}}{4.22} = \text{GPM} \qquad \textbf{(EQ 9)}$$

$$\frac{\text{Target Rate (lbN per acre) x Speed (mph) x Implement Width (inches)}}{5940} = \text{lbN/min} \quad \textbf{(EQ 10)}$$

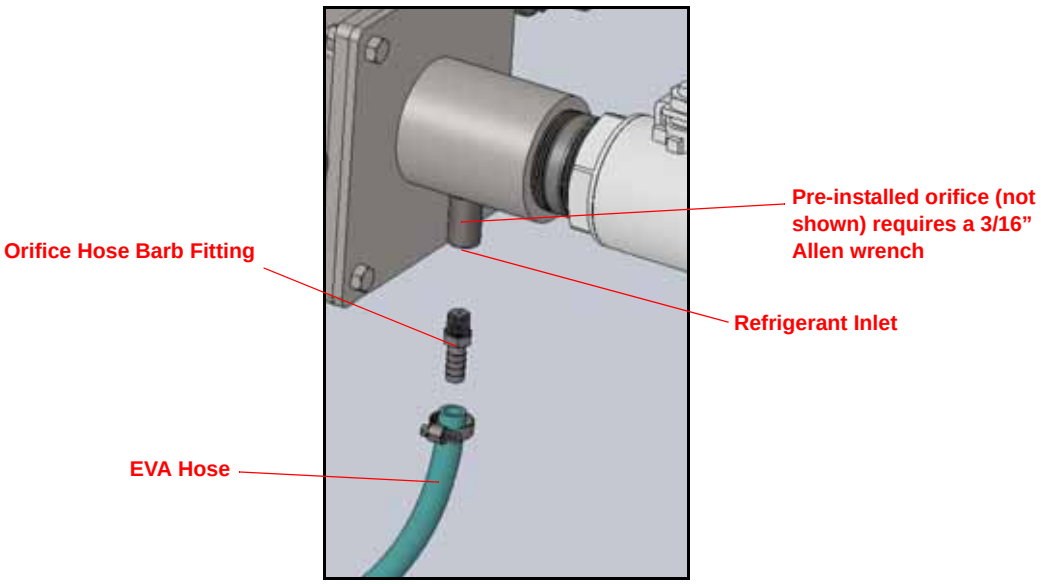
To convert lbN/Hr:

$$\frac{\text{lbN}}{\text{min x 60}} = \text{lbN/min} \quad \textbf{(EQ 11)}$$

Installing and Orifice Hose Barb Fitting

1. Follow the system bleed down procedure found in the AccuFlow manual before disassembly.
2. Remove the EVA hose from the hose barb.
3. Remove the current hose barb from the refrigerant inlet port.
4. Apply thread sealant to orifice hose barb fitting and re-install into refrigerant port.
5. Reinstall the hose onto the orifice hose barb fitting and secure with a hose clamp.

FIGURE 3. Orifice and Hose Barb Installation



Charging the AccuFlow™ System

The following procedure will step through the proper method for connecting and charging the AccuFlow system, this assumes installation checks have been completed.

NOTICE

Carefully read all directions in this section before beginning this procedure and make sure that all steps are completed before proceeding.

Review the safety requirements associated with the handling and application of anhydrous ammonia with a local NH_3 supplier.

1. Verify that all hoses, fittings, and mounting bolts are securely fastened or tightened.
2. Toggle the master switch to the off position.
3. Close bleed valves and all bleed ports.
4. Verify that the AccuFlow flow meter is connected to the flow meter connector on the product cable.
5. Verify that the AccuFlow control valve is connected to the product cable connector.
6. Verify the on/off valve(s) are connected to the on/off connectors on the product cable.
7. Verify that all motorized valves are in the 'off' position.
8. Turn the AccuFlow emergency shut-off valve(s) to the full open position.
9. Connect and secure the hose from the AccuFlow implement to the nurse tank.
10. Slightly open the nurse tank shut-off valve to allow NH_3 to slowly pressurize the system.

Note: Opening the emergency shutoff valve or the nurse tank shutoff valves too quickly may result in the excess flow valves on the nurse tanks to close, and the system not to charge properly. Excess flow valves must be re-set before system can be charged.

11. Inspect the system for leaks.
    a. If leaks are detected, close the nurse tank shutoff valve and proceed to step 12.
    b. If no leaks are detected, skip to step 13.
12. If leaks are present:
    a. Close the nurse tank shut-off valve.
    b. Open the bleed valve(s) and allow all NH_3 in the lines to evaporate and discharge from the system. When the system is fully discharged, all components should not feel cold and the pressure gauge reading on the AccuFlow system should be at zero.
    c. After the system is completely discharged, disconnect the nurse tank hose.

DANGER

Use extreme caution when opening a previously pressurized anhydrous ammonia system. Exposure to anhydrous ammonia can cause severe burning, blindness, or death. Always wear proper personal protective equipment when working with anhydrous ammonia products.

    d. Correct leaks and repeat step 9 through step 11.
13. Verify that pressure gauge readings on the AccuFlow system and the nurse tank are matching. If the pressure readings do not match, one of the gauges may be defective and should be replaced.
14. Fully open the nurse tank shut-off valve. The AccuFlow system is now charged and ready for operation.

Verifying AccuFlow™ Operation

Once the AccuFlow system is charged, the system is ready for the application of anhydrous ammonia to the field(s). The following items should be checked periodically to ensure proper operation of the AccuFlow system and application of anhydrous ammonia:

1. Verify that the implement/boom widths, speed cal, meter cal, valve cal, and rate cals have been programmed correctly on the console (refer to the control console's Operation manual for details).
2. Toggle the master switch to the off position.

3. Toggle the console to manual control mode.
4. Toggle the switch for section 1 (boom 1) on. If a multi-manifold system is in use, toggle all sections on. Toggle any section switches not in use to their off positions.
5. With the master switch in the off position, drive at the target application speed to verify the speed readout on the console.
6. With applicator knives in the ground, toggle the master switch to the on position.
7. While driving at the target application speed, manually adjust the flow with the INC/DEC switch until the target rate is achieved.
8. Toggle the console to automatic mode. In automatic mode, the console will adjust the control valve automatically to maintain the target rate regardless of vehicle speed. If the console is not capable of maintaining the target rate, refer Chapter 7, *Troubleshooting*.

For Example:

Given an observed pressure reading 70 PSI and temperature reading 40° F. The point where these two readings intersect is within the non-vapor area. See Figure 1, “Pressure vs. Temperature Chart,” on page 67.

If an additive such as N-Serve (Dow Chemical) or another nitrogen stabilizer is used with the system, periodic cleaning of the AccuFlow flow meter may be required. Refer to Chapter 7, *Troubleshooting*, for instructions on performing maintenance on the AccuFlow cooler or flow meter.

Note: *Due to the highly corrosive nature of many additives and nitrogen stabilizers, Raven recommends injection of the additive after the Vortex cooler, control valve, and vapor lines. This will help prevent corrosion of heat exchangers and other plumbing components. Corroded materials can cause system components such as strainers, flowmeters, and orifices to become obstructed, and can decrease service interval time and component life expectancy.*

CHAPTER 5

AccuFlow™ HP+ Calibration and Operation

This chapter contains information on calculating or adjusting calibration values for the AccuFlow HP+ system. These values must be programmed on the console providing product control. Refer to the console Installation and Operation manual for detailed programming instructions.

CAUTION

To avoid damage to boost pump seals, do not run the boost pump dry. Be sure to shutdown the boost pump when no anhydrous ammonia is flowing through the pump or when the nurse tank is empty.

The HP+ system requires a CANbus system with a Raven product control node.

- The HP+ system uses a 2-stage control. Stage 1 opens the control valve as needed to achieve target rate. Once the valve reaches the full open position, stage 2 starts controlling the pump and ramps it to reach the target rate (assuming tractor hydraulics are on). The process is reversed as the flow demand decreases.

Charging the AccuFlow™ HP+ System and Calibrating the Pressure Transducers (Pressure Cal)

The following procedure will step through the proper method for connecting and charging the AccuFlow system.

NOTICE

Carefully read all directions in this section before beginning this procedure and make sure that all steps are completed before proceeding.

Review the safety requirements associated with the handling and application of anhydrous ammonia with a local NH_3 supplier.

1. Verify that all hoses, fittings, and mounting bolts are securely fastened or tightened.
2. Verify that the AccuFlow flow meter is connected to the flow meter connector on the flow meter cabling.
3. Verify that the AccuFlow control valve is connected to the flow or product cable connector.
4. Verify the on/off valve(s) are connected to the on/off connectors on the flow meter cabling.
5. Verify pressure transducer connections (P1 connected to transducer near pressure gauge, P2 connected to transducer on Vortex cooler).
6. Toggle the master switch to the off position.
7. Verify that the motorized control valves are in the ‘off’ position.
8. Close bleed valves and all bleed ports.
9. Turn the AccuFlow emergency shut-off valve(s) to the full open position.
10. Connect and secure the hose from the nurse tank to the AccuFlow implement.
11. Slightly open the nurse tank shut-off valve to allow NH_3 to slowly pressurize the system.

Note: *Opening the emergency shutoff valve or the nurse tank shutoff valves too quickly may result in the excess flow valves on the nurse tanks to close, and the system not to charge properly. Excess flow valves must be re-set before system can be charged.*

12. Inspect the system for leaks.
    a. If leaks are detected, proceed to step 13.
    b. If no leaks are detected, skip to step 14.
13. If leaks are present:
    a. Close the nurse tank shut-off valve.
    b. Open the bleed valve(s) and allow all NH_3 in the lines to evaporate and discharge from the system. When the system is fully discharged, the AccuFlow Vortex cooler should not feel cold and the pressure gauge reading on the AccuFlow system should be at zero.

c. After the system is completely discharged, disconnect the nurse tank hose.

DANGER

Use extreme caution when opening a previously pressurized anhydrous ammonia system. Exposure to anhydrous ammonia can cause severe burning, blindness, or death. Always wear proper personal protective equipment when working with anhydrous ammonia products.

d. Correct leaks and repeat step 10 through step 12.

14. Once the system pressures have stabilized, verify that pressure gauge readings on the AccuFlow system and the nurse tank are matching. If the pressure readings do not match, one of the gauges may be defective and should be replaced.
15. Enter the pressure gauge reading on the AccuFlow system in the Pressure Cal field on the control console (e.g.Viper Pro or other field computer for both P1 & P2 pressure transducers).

Important: *In standby, (master off) P1 & P2 pressure readings should be the same.*

Note: *The Pressure Cal is typically only set once per application season to calibrate the transducer. The Pressure Cal value will revert to zero once entered and does not need to be set repeatedly during an application season. This value must be set to the gauge pressure of the AccuFlow system or tool bar, not the anhydrous tank pressure.*

16. Turn the nurse tank main shut-off valve to fully open. The AccuFlow system is now charged and ready for operation.

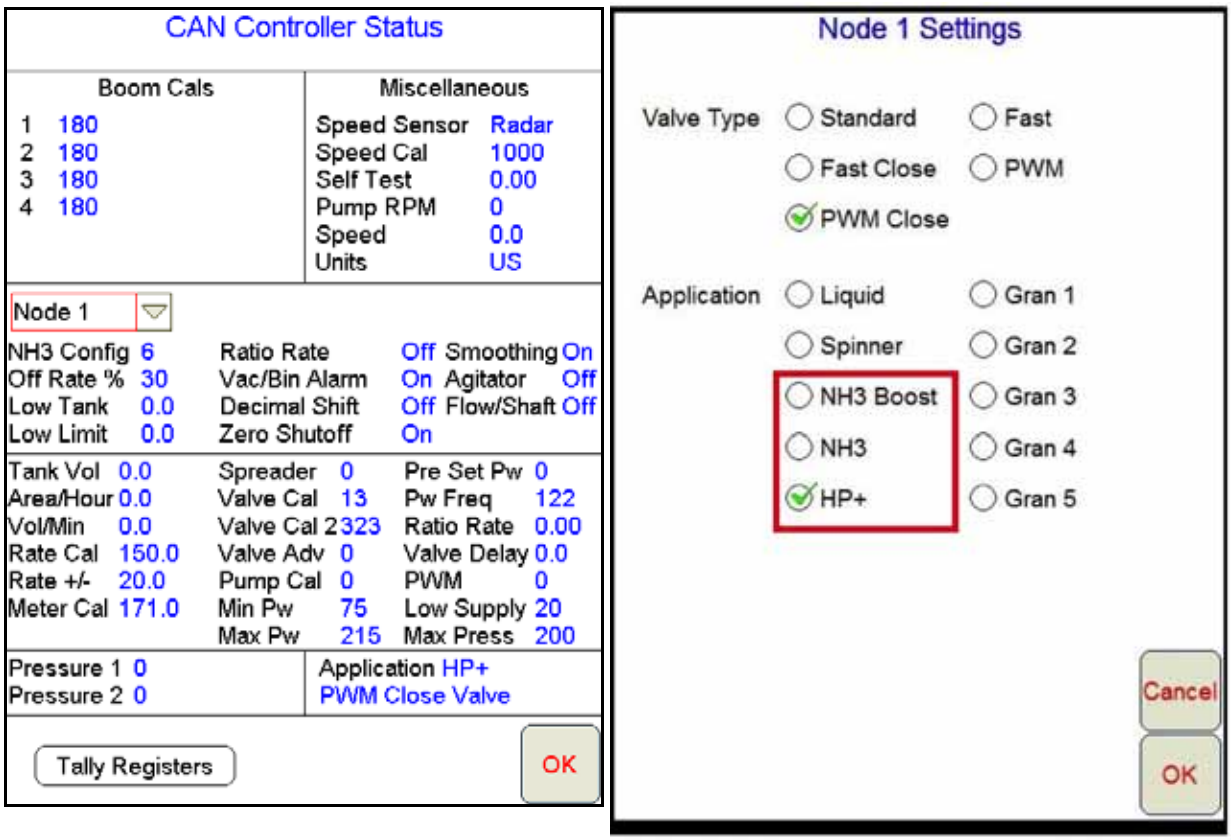
Default Calibration Values (NH_3 Pre-sets)

- Application Mode = HP+ PWM Close Valve
- Meter cal = 171 (LB N/Acre with RFM 60SG flow meter)
- Valve cal = 13; Valve cal2 = 323.
- Target rate cal = User defined.
- Rate bump = 25 LB/Acre
- PWM frequency = 122
- Min Pw = 75
- Preset Pw = 0
- Max Pw = 215
- Low Supply = 20
- Max Press = 200
- NH_3 Config = 6

Programming HP+ Rate Control - Viper Pro

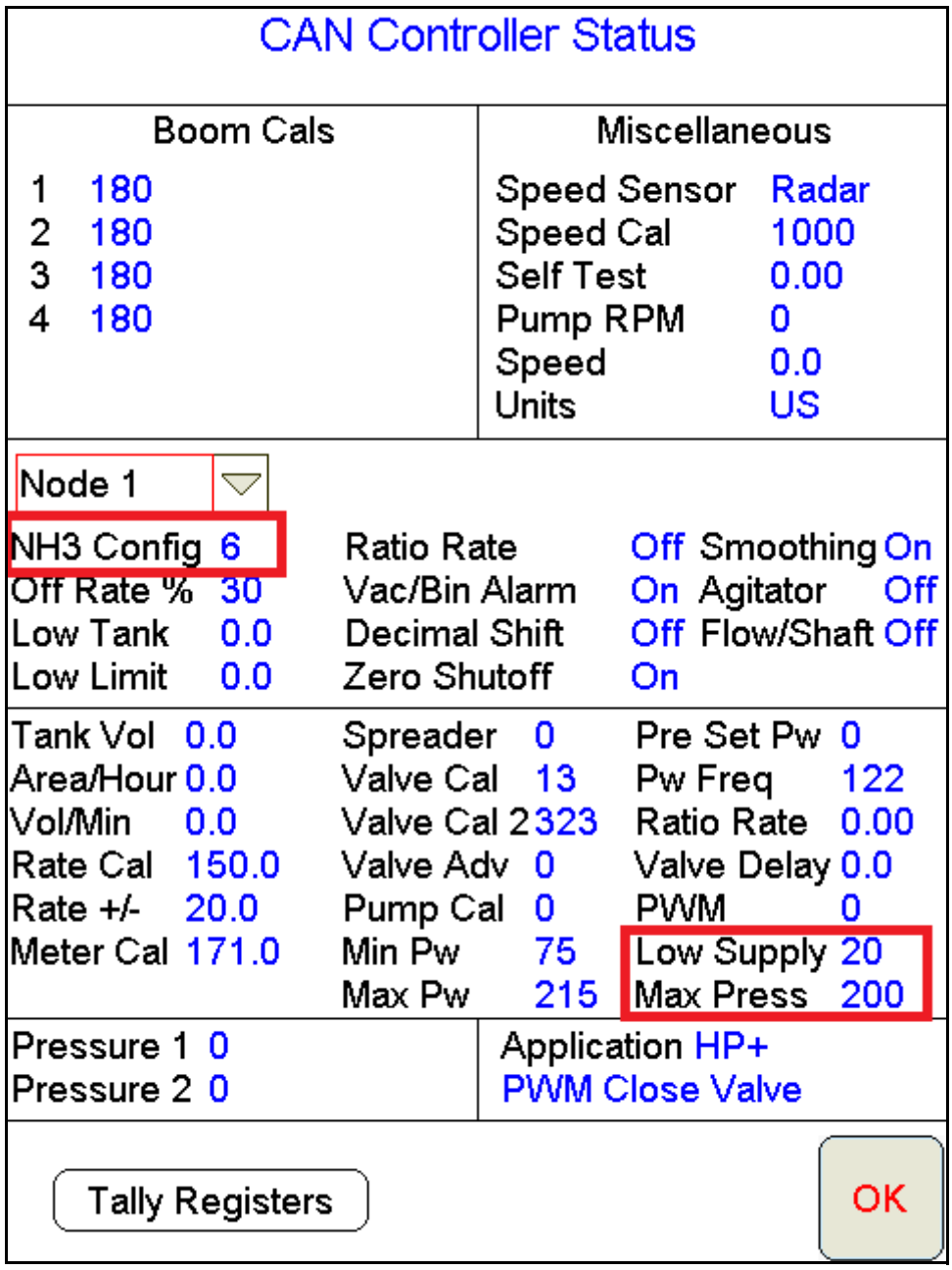
1. Boom cal, meter cal, speed cal and rate cal are the same as AccuFlow Vortex. See chapter 4 to verify settings.
2. To setup the proper HP+ application mode, from ‘CAN Controller Status’ screen, press ‘Application’ box.

FIGURE 1. CAN Controller Status Settings and Node 1 Settings



3. In ‘Node 1 Settings’ screen, select ‘HP+’ and press ‘OK’.
4. The control node will auto select PWM Close Valve and setup the default values as shown below. Verify default settings on 'CAN Controller Status' screen.
5. Raven section valves are equipped with status feedback. Viper Pro can display an error message identifying an out of position section valve (stuck open or stuck closed). By changing the 'NH_3 Config' setting, this feature along with the 'remote prox sensor' can be enabled or disabled.
   a. NH_3 Config will enable remote switch & section feedback if desired.
      i. 3 - remote prox sensor enabled, section feedback disabled
      ii. 4 - remote prox sensor disabled, section feedback disabled
      iii. 5 - remote prox sensor enabled, section feedback enabled
      iv. 6 - remote prox sensor disabled, section feedback enabled (DEFAULT setting)

FIGURE 2. **CAN Controller Status**

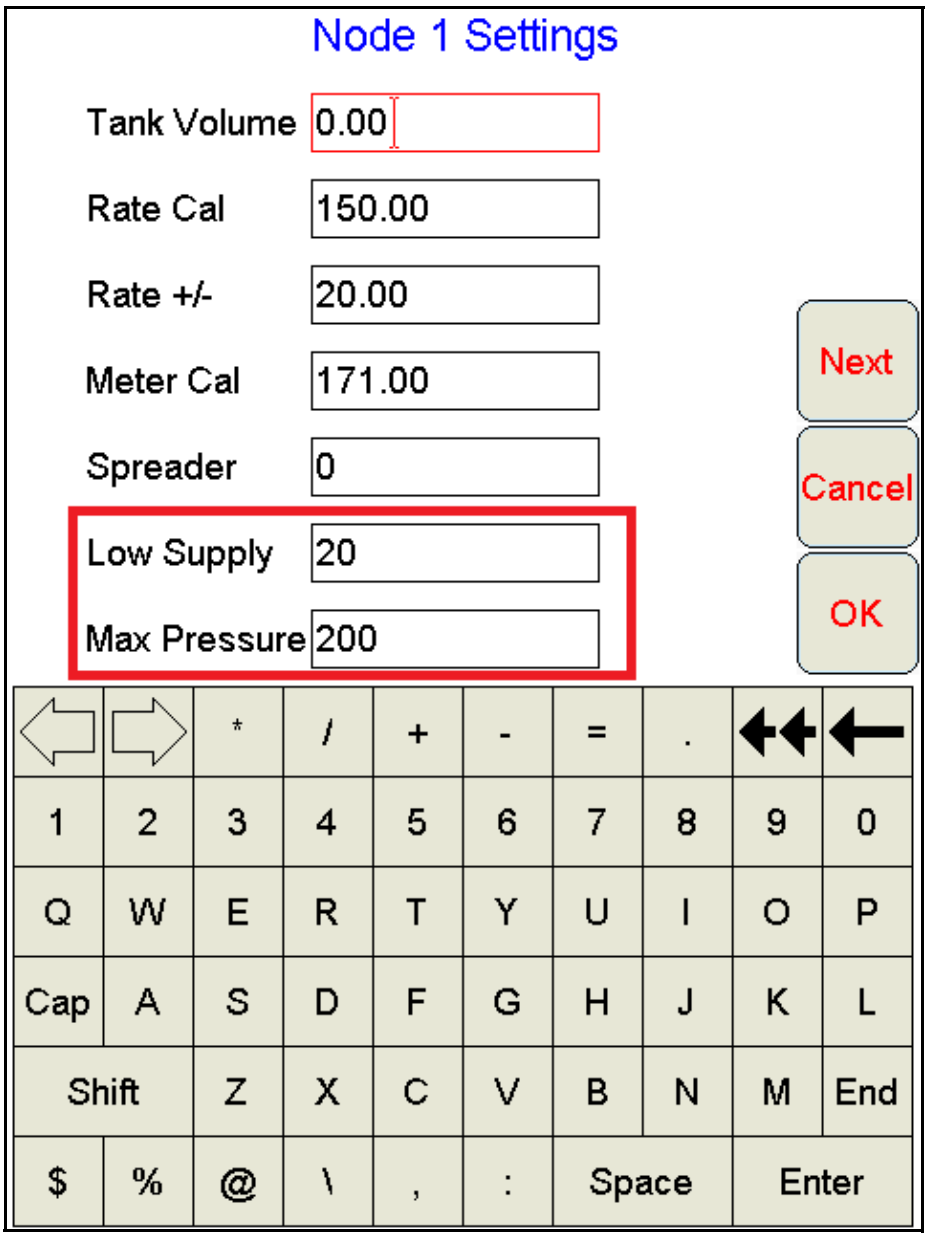


b. ‘Low Supply’ will generate an error message if pump inlet pressure drops below set value (20 psi default; adjustable from 0-50psi from Node 1 Settings screen). A setting of zero disables the feature.

c. Max Press limits the pressure the pump can generate (200 psi default; adjustable from 0-250 psi). Once the 'Max Press' limit is reached the control will temporarily turn the pump down. A setting of zero disables the feature.

6. AccuFlow HP+ has two pressure transducers; P2 at the pump inlet (Vortex cooler) and P1 at the gauge tree manifold. They are used to monitor pump status and performance.

FIGURE 3. Node 1 Settings

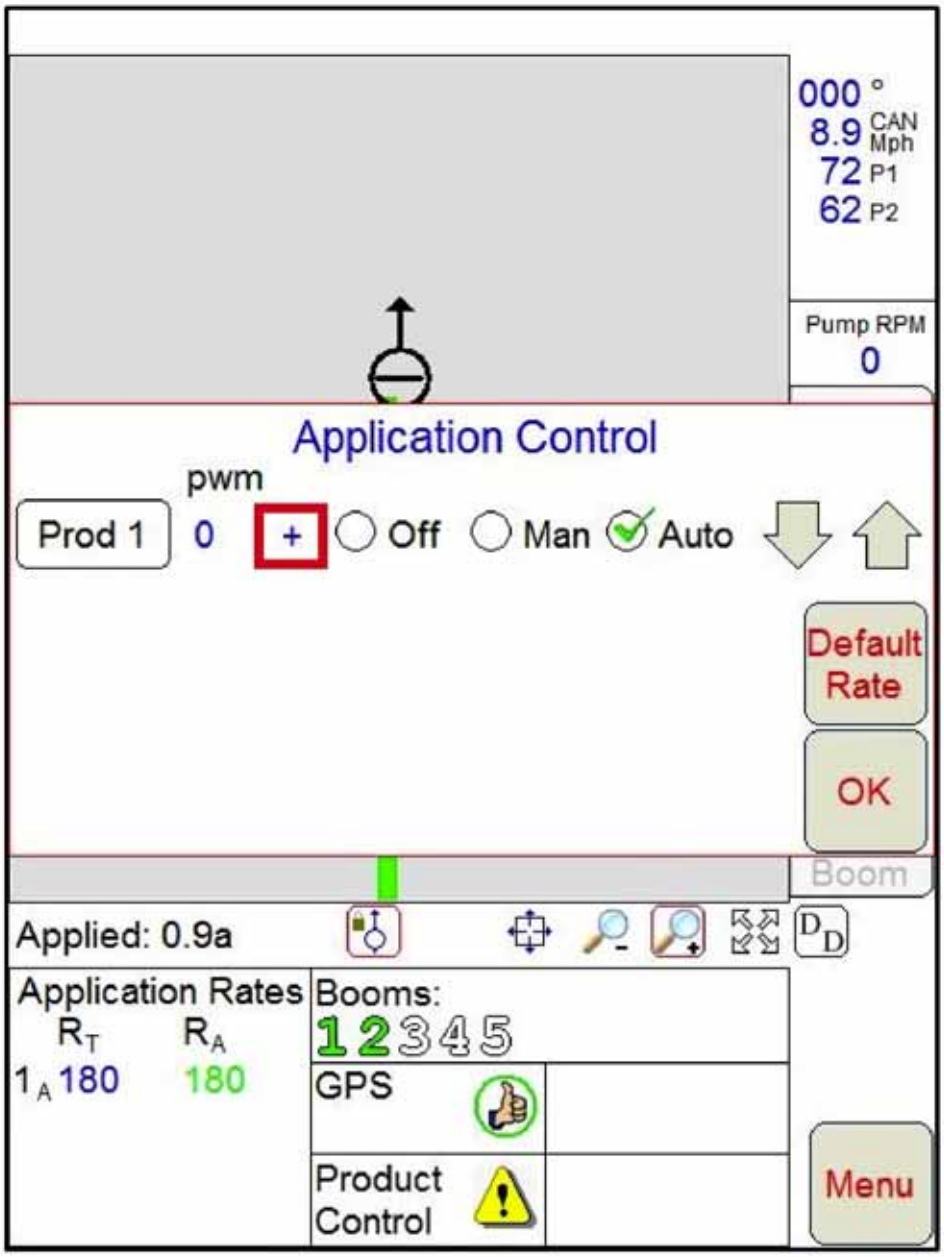


7. Pressure Transducer Cal - Calibrate pressures making sure P1 is the transducer at the gauge tree manifold and P2 is the transducer at the cooler. Complete transducer calibration after the AccuFlow system is fully charged and ready for operation. Refer to Viper Pro manual for steps on pressure transducer calibration.

Important: *Pressure transducers must be accurately calibrated for Low Supply, Max Pressure and Pump Fault errors to work properly. Cal both transducers to the same pressure value as indicated on the AccuFlow system pressure gauge (should also be the same as tank pressure).*

8. Viper Pro will now display valve drive status in addition to PWM duty cycle. A '+' symbol is displayed when the control is sending an increase command to the valve (as shown in red box) with a '-' displayed for decrease. This can be a useful tool for diagnostics and troubleshooting.

FIGURE 4. Symbols



9. HP+ uses P1 & P2 pressures to monitor pump performance. A 'Pump Fault' message is displayed if the pump does not boost pressure after 10 seconds of operation and shuts the pump off after 60 seconds.

Adjusting the Rate Cal

Enter the target rate in actual pounds [kilograms] of nitrogen (N) per acre [hectare].

Calculating the Required Capacity

To ensure that the desired application rate (in pounds [kilograms] of actual nitrogen per minute) does not exceed the AccuFlow system capacity, the required capacity of the application must be verified.

Using the following formula to calculate the required capacity:

$$\frac{\text{Target Application Rate x Target Application Speed x Implement Width}}{5940[60{,}000]} = \text{lbs[kg](N)/min} \quad \textbf{(EQ 1)}$$

Note: *Be sure to enter the target application rate in pounds [kilograms] of nitrogen per acre [hectare] and the implement width as calculated in the "Entering Boom Cal" section on page 31.*

If boost pump speed or 'Max Pw' is set too high, excess vapor will form in the supply lines. If vapor builds up in the supply lines, the boost pump may become vapor locked which results in no pressure boost.

This is more likely to occur when plumbing is too small, nurse tanks are near empty, in cold conditions, or plugged strainers. Reduce travel speed or lower pump speed (Max Pw) setting as required to reduce boost pump RPM.

For Example:

(English Units) Given a target application rate of 150 lbs(N)/acre at an average of 5.5 mph and a calculated implement width of 480 inches, the required capacity is:

$$\frac{150 \text{ x } 5.5 \text{ x } 480}{5940} = 606 \text{ lbs(N)/min} \quad \textbf{(EQ 2)}$$

(SI Units) Given a target application rate of 68 kg(N)/ha at an average of 10 km/hr and a calculated implement width of 1220 centimeters, the required capacity is:

$$\frac{68 \text{ x } 10 \text{ x } 1220}{60{,}000} = 13.8 \text{ kg(N)/min} \quad \textbf{(EQ 3)}$$

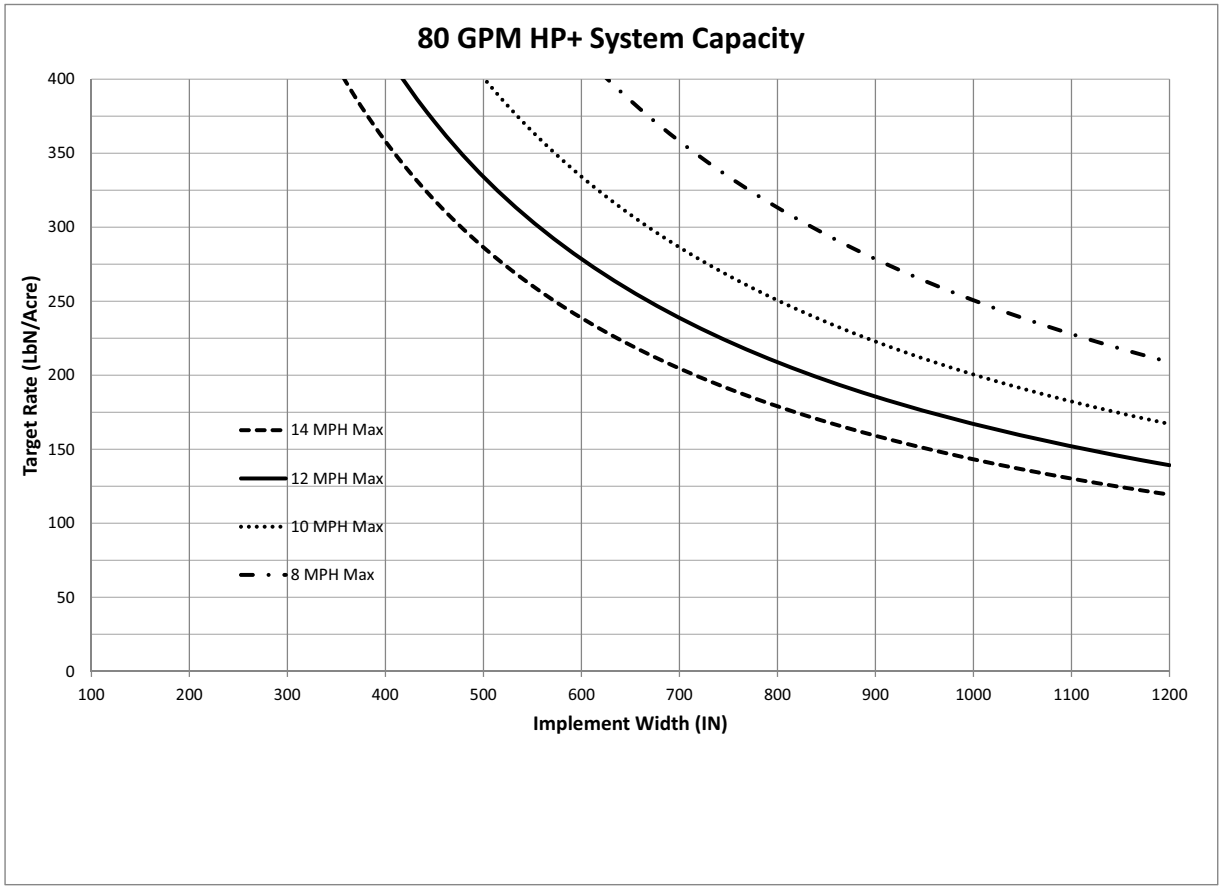
The maximum capacity of the 80 GPM AccuFlow HP+ system is 336 lbs(N)/min [152 kg(N)/min].

System Capacity Chart

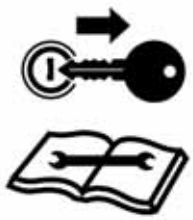
Note: *This figure assumes all recommended plumbing practices have been followed. Failure to follow to those practices will limit the system capacity to values lower than those shown on this figure.*

The following figure illustrates the capacity of the AccuFlow system in various configurations. Refer to this chart as part of the calculation for required capacity and when troubleshooting the AccuFlow system.

FIGURE 5. System Capacity Chart



Operating HP+ System in HP (NH_3 Boost) Mode



CAUTION

To avoid damage to boost pump seals, do not run the boost pump dry. Be sure to shutdown the boost pump when no anhydrous ammonia is flowing through the pump or when the nurse tank is empty.

The AccuFlow HP+ system must be operated in NH_3 boost mode if a Vortex Dual Valve system is upgraded to a Vortex system by adding a boost pump, or the controller is not capable of running the HP+ system as a single product. In this instance, set up Product 1 (Control Valve) using the steps outlined in the “Programming the NH_3 Rate Control” section. Set up Product 2 using the following steps.

Set up boost pump pressure control (single product node) as product 2 in “Spinner RPM” mode. Enter a product1 meter cal of '9999' and press 'OK'. Control node will set the following defaults. Exit and restart Viper Pro program and verify the settings in the Node 2 'CAN Controller Status' screen.

- Meter cal - 171
- Valve cal - 31
- PWM frequency - 122
- Min Pw low offset - 70
- PWM preset - 70 (provides soft start for the boost pump)
- Max Pw - 208
- Rate Cal (target rate): 40 - 80 PSI [275 - 550 kPa]
- Rate bump - 5 PSI [34 kPa]

Note: *For best results, set the boost pump target rate 5 to 10 PSI [34 to 68 kPa] above the static or tank pressure (pressure transducer reading with master switch 'off'). If the boost pump pressure (rate cal) is set too high, excess vapor will form in the supply lines. If vapor builds up in the supply lines, the boost pump may become vapor locked which results in no pressure boost.*

Do not enter the rate cal or target rate in the pressure cal field on the control console. The pressure cal value should only be used to calibrate the AccuFlow system pressure transducer installed at the gauge tree manifold assembly. Refer to the Charging the AccuFlow™ HP+ System and Calibrating the Pressure Transducers (Pressure Cal) section on page 40 to configure the pressure transducer.

Verifying AccuFlow HP+ Operation

Once the AccuFlow system is charged, the system is ready for the application of anhydrous ammonia to the field(s). The following items should be checked periodically to ensure proper operation of the AccuFlow system and application of anhydrous ammonia:

1. Verify that the implement/boom widths, speed cal, meter cal, valve cal, and rate cals have been programmed correctly on the console (refer to the console's Operation manual for details).
2. Toggle the master switch to the off position.
3. Toggle the console to manual control mode.
4. Detect tractor hydraulic selective control valve (SCV) attached to the Raven control pump control valve circuit to the continuous flow setting. Set the flow rate to provide maximum flow to the circuit. The HP+ control system will control and limit flow to the boost pump.
5. Toggle the switch for section 1 (boom 1) on. If a multi-manifold system is in use, toggle all sections on. Toggle any section switches not in use to their off positions.
6. With the master switch in the off position, drive at the target application speed to verify the speed readout on the control console.
7. With applicator knives in the ground, toggle the master switch to the on position.
8. While driving at the target application speed, manually adjust the flow with the INC/DEC switch until the target rate is achieved.
9. Set product 1 rate and start operation in Auto mode. Control node will operate both valve and pump as required to achieve target rate.
10. System operating pressure at control valve will display as P1 and pump inlet (cooler) pressure will display as P2.
11. As daytime temperature and nurse tank pressure increases the tractor hydraulics can be turned off to save power. An error message will be displayed if the control tries to use the boost pump and detects it is not running.

For Example:

Given an observed pressure reading 70 PSI and temperature reading 40° F. The point where these two readings intersect is within the non-vapor area. See Figure 1, "Pressure vs. Temperature Chart," on page 67.

12. If an additive such as N-Serve (Dow Chemical) or another nitrogen stabilizer is used with the system, periodic cleaning of the AccuFlow flow meter may be required. Refer to Chapter 7, *Troubleshooting*, for instructions on performing maintenance on the AccuFlow cooler or flow meter.

Note: *Due to the highly corrosive nature of many additives and nitrogen stabilizers, Raven recommends injection of the additive after the Vortex cooler, control valve, and vapor lines. This will help prevent corrosion of heat exchangers and other plumbing components. Corroded materials can cause system components such as strainers, flowmeters, and orifices to become obstructed, and can decrease service interval time and component life expectancy.*

CHAPTER 6

Service and Maintenance

The following sections are included to illustrate the proper procedure for servicing and maintaining the AccuFlow system. This chapter also includes instructions for disassembling the AccuFlow Vortex cooler for cleaning and storage.

DANGER

Anhydrous ammonia can cause severe burning, blindness, or death. Refer to *Discharging the AccuFlow™ System* section on page 5 or page 51 and follow the procedure for bleeding the AccuFlow system before beginning maintenance.

Discharging the AccuFlow™ System

The AccuFlow system must be discharged of all anhydrous ammonia and the system must be completely shut down before the implement can be transported.

DANGER

DO NOT transport the AccuFlow system while it is charged with anhydrous ammonia. The AccuFlow Vortex cooler and product lines must be completely discharged before transporting the implement.

The following procedure outlines the proper method for discharging NH_3 from the AccuFlow system and preparing the system for transport, service, or maintenance.

DANGER

Use extreme caution when opening a previously pressurized system. Exposure to anhydrous ammonia can cause severe burning, blindness, or death. To avoid injury or death, always wear proper personal protective equipment.

Note: *Personal protective equipment such as a respirator, goggles, face shield, clothing that fully covers bare skin, protective suit, and gloves are required when working with anhydrous ammonia products.*

Note: *Refer to Figure 1 and table on page 53 when referencing component locations for discharging the Accuflow System.*

Before transporting the AccuFlow system or beginning service or maintenance:

1. Toggle the console or vehicle master switch to the off position.
2. (AccuFlow HP+ only) Turn off boost pump control by closing the tractor SCV (selective control valve).
3. Completely close the main shutoff valve Figure 1 on page 53 (Item 1) on the supply or nurse tank. Also close the shutoff valve at the nurse tank bulkhead if so equipped.

Note: *Never run the pump without product in the application lines as damage to the pump seals will result.*

4. Resume field application until the pressure gauge reads no remaining pressure is in the AccuFlow system.
5. Verify that the console and/or vehicle master switch, and all section switches, are in the off position. Ensure the tow vehicle is upwind (as shown in Figure 1 on page 53) of the toolbar implement.
6. Completely close the emergency shut-off valve (Item 3) either by using the rope from the cab of the tractor, or the handle on the valve itself on the AccuFlow Vortex cooler.
7. Bleed and disconnect the nurse tank supply hose (Item 2) from the nurse tank.
8. While standing upwind from the implement, with wind direction as show in Figure 1 on page 53, slowly open the AccuFlow system primary bleed valve (Item 4), until it is fully open. Ammonia will discharge out the vapor knives on the toolbar.
9. Always bleed system slowly when time permits by leaving valves open slightly over an extended period of time.
10. Remain at the primary bleed valve (Item 4) and adjust or close as necessary until ammonia cloud is no longer coming out of the vapor knives. After ammonia cloud has dispersed, check the pressure and temperature gauges (Item 6) to verify that the pressure reads zero, and all parts are at ambient temperature (no frost).
11. Open secondary bleed valve (Item 5) slowly to relieve any remaining liquid ammonia from the system
12. Re-verify that the pressure gauge on the AccuFlow manifold reads zero and all AccuFlow components are not cold to the touch before opening the system.

FIGURE 1. **System Bleed and Emergency Shutoff (Top View)**

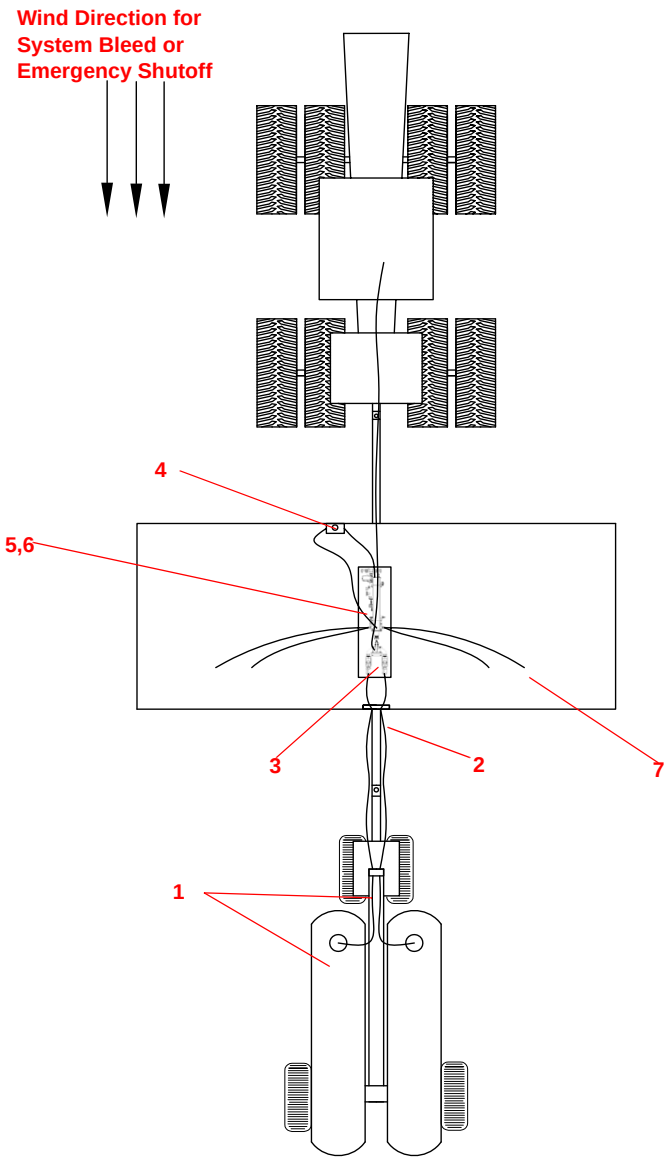
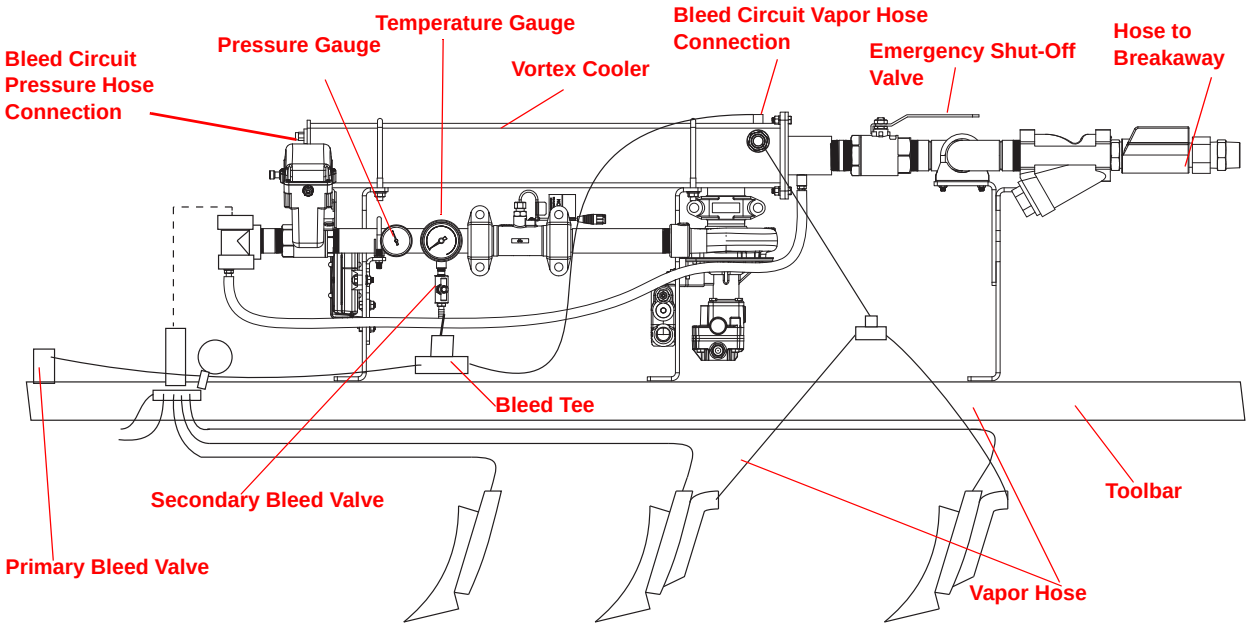


TABLE 1. **System Bleed and Emergency Shutoff Components**

Component #	Description
1	Nurse Tank Main Shutoff and Bleed Valves (At Bulkhead or Withdrawal Valve)
2	Supply Hose Bleed Valves and Breakaway Couplers
3	Accuflow System Emergency Shutoff Valve and Rope to Tractor Cab
4	Accuflow System Primary Bleed Valve
5	Accuflow System Secondary Bleed Valve
6	Accuflow System Pressure and Temperature Gauges
7	Vapor Rows

FIGURE 2. **System Bleed and Emergency Shutoff (Side View)**



Servicing and Storing the AccuFlow™ System

When storing the AccuFlow or AccuFlow HP system or when the system will not be used for extended periods, clean the inside of the Vortex cooler with kerosene and coat with a 10 weight motor oil. Refer to the following section for instructions on disassembling the AccuFlow Vortex cooler to perform service or maintenance.

⚠ DANGER

Anhydrous ammonia can cause severe burning, blindness, or death. Refer to *Discharging the AccuFlow™ System* section on page 5 or page 51 and follow the procedure for bleeding the AccuFlow system before beginning maintenance.

Maintaining the Vortex Cooler

⚠ CAUTION

Anhydrous ammonia residue may be present within the Vortex cooler chamber. Wear protective clothing and gloves when working with anhydrous ammonia products or servicing the AccuFlow system.

1. Refer to the *Discharging the AccuFlow™ System* section on page 51. Ensure that all NH_3 has evaporated and vapors have been exhausted before proceeding.
2. Disconnect inlet plumbing and fittings from the Vortex cooler assembly.
3. Remove the four bolts on the Vortex cooler closest to the inlet.
4. Remove the inner assembly with a twist-pull motion.

CAUTION

DO NOT FORCE. The Vortex cooler assembly should separate with moderate and steady pressure.

5. Clean residue from the inner assembly and inspect the Vortex cooler assemblies for damage and wear.

Note: *The relief valve (P/N 334-0002-005) must be replaced at minimum every five years from the date of manufacture.*

Note: *The relief valve is located at the opposite end of the Vortex cooler from the cooler inlet.*

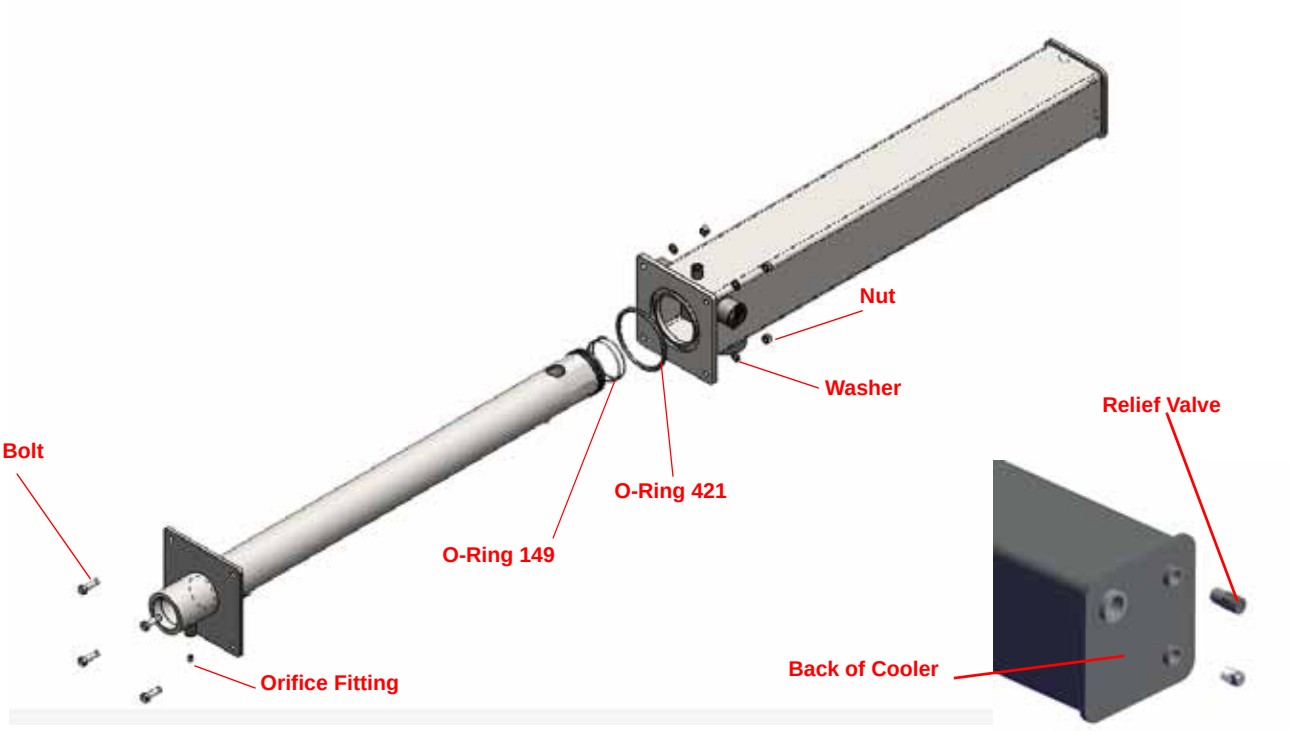
6. Apply thread sealant to the threads of the relief valve and thread the valve into the Vortex cooler body.
7. After cleaning and inspecting the assembly, replace the three o-ring seals. Lubricate the o-ring seals with a non-petroleum based lubricant such as brake fluid, silicone, or liquid soap and reseat seals on the intake end of the Vortex cooler before reassembling to ensure o-rings can be installed without damage or displacement.

Note: *O-rings should be replaced when the unit is disassembled. Tank-mixed nitrogen stabilizers can be corrosive to o-rings. Raven recommends injection of nitrogen stabilizers downstream of heat exchanger components and plumbing. Unit should be inspected, disassembled, and cleaned at the end of every season if nitrogen stabilizers are mixed in the ammonia nurse tanks. O-rings should be replaced when the unit is disassembled.*

Note: *For a list of replacement parts, refer to Chapter 8, System Diagram and Replacement Parts.*

8. Insert the inner assembly into the casing and replace the four bolts at the intake end of the Vortex cooler assembly and torque to 210 in-lbs.
9. Apply PTFE pipe thread sealant or equivalent to pipe threads to lubricate and seal pipe joints and re-connect external plumbing.

FIGURE 3. **AccuFlow Vortex Cooler Assemblies (P/N 063-0173-663)**



Strainer Maintenance Procedure

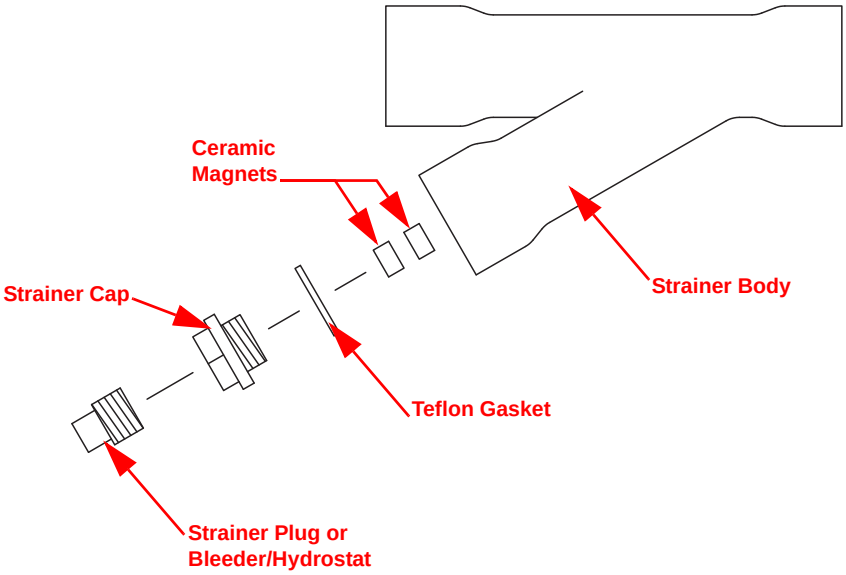
The strainer must be cleaned and inspected periodically or when system performance degrades. Refer to the following procedure to disassemble and maintain the strainer to ensure that the AccuFlow system is operating properly.

DANGER

Anhydrous ammonia can cause severe burning, blindness, or death. Refer to *Discharging the AccuFlow™ System* section on page 5 or page 51 and follow the procedure for bleeding the AccuFlow system before beginning maintenance.

1. Refer to the *Discharging the AccuFlow™ System* and ensure that all NH_3 has evaporated and vapors have been exhausted before proceeding.
2. Remove the strainer cap and remove the ceramic magnets, teflon washer and strainer screen (not shown).

FIGURE 4. **Y-Strainer Components**



3. Clean the ceramic magnets to remove excess grit or debris.
4. Clean and inspect the teflon gasket and strainer screen and replace as necessary.
5. Replace strainer screen and ceramic magnets into strainer body.
6. Place the teflon gasket onto the strainer cap.
7. Thread the strainer cap into the strainer body.

Important: *Avoid strainer damage. Use care to align strainer in housing and turn strainer cap all the way by hand. Do not force with pipe wrench or strainer screen can be crushed.*

8. Tighten the cap using a pipe wrench to secure the strainer assembly before operating the AccuFlow system.

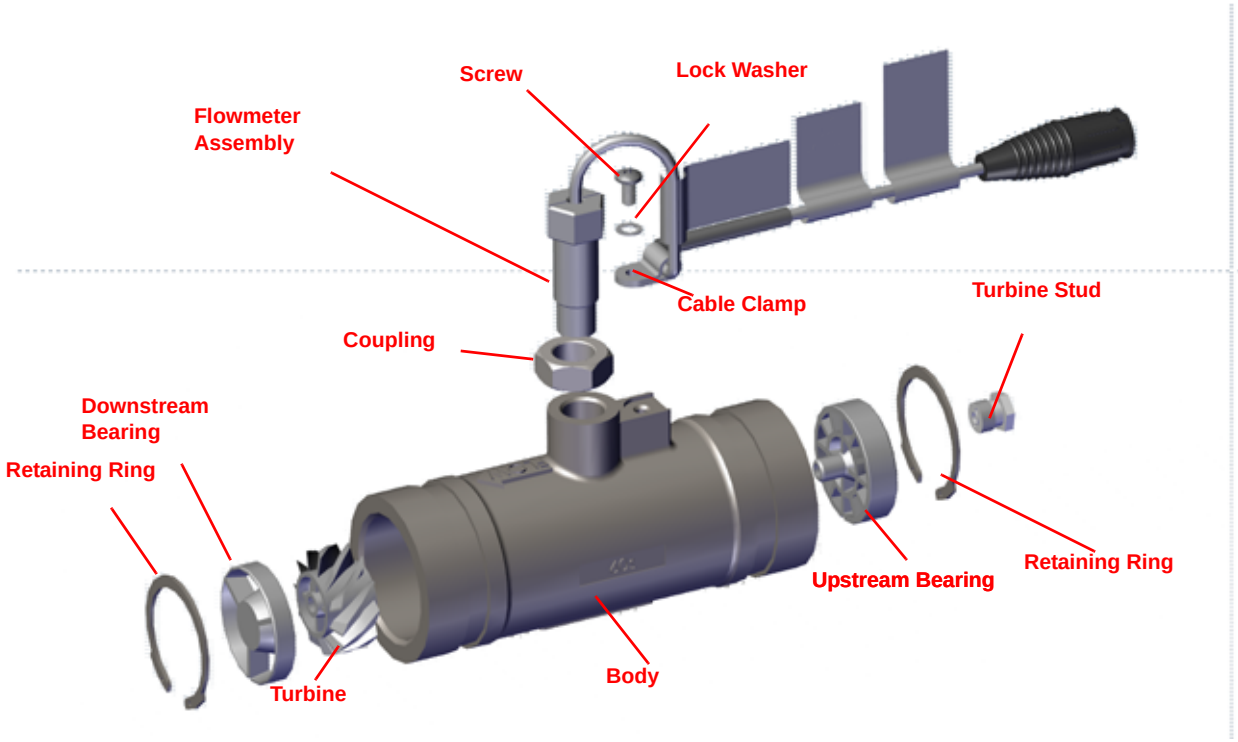
Flow Meter Maintenance and Adjustment

Refer to the following procedure when removing the flow meter for maintenance or service.

DANGER

Anhydrous ammonia can cause severe burning, blindness, or death. Refer to *Discharging the AccuFlow™ System* section on page 5 or page 51 and follow the procedure for bleeding the AccuFlow system before beginning maintenance.

FIGURE 5. **Flow Meter Housing and Assembly**



1. To avoid introducing foreign material to the AccuFlow system, brush off the outside of the flow meter before disassembling and removing the flow meter.
2. Carefully remove the retaining rings.
3. After discharging AccuFlow system of NH_3, remove grooved couplings attaching flowmeter to assembly.
4. Remove the bearing hub, turbine hub, and turbine from inside flow meter housing. Inspect the turbine shaft and hub bearings for wear.
5. Carefully clean any metal filings, residues, or foreign material from the turbine and hubs. Use pressurized air to blow metal filings and debris out of both hubs and turbine.
6. To confirm that the turbine and hub bearings are not worn, hold the turbine bearing hub while spinning the turbine. The turbine should spin freely with very little drag.
7. If the bearing hub stud is adjusted or replaced, repeat step 5 to verify turbine fit before reassembling.
8. Replace the turbine hub and retaining ring in the flow meter housing.
9. Place the turbine and turbine hub inside the flow meter housing so that the stud keys within the flow meter housing line up with the grooves in the hub.
10. Place the retaining ring on to lock bearing hub in place.
    a. Spin turbine by blowing on it.
    b. Tighten bearing hub stud until turbine stalls.
    c. Loosen the stud 1/3 of a turn. The turbine should be able to spin freely.
11. Carefully direct a low pressure jet of air (5 psi [34.5 kPa]) through flow meter in the direction of flow and again in the opposite direction to verify that the turbine spins freely.
12. If there is drag, loosen the stud on the bearing hub 1/16 turn until the turbine spins freely.
13. If turbine spins freely and the cables have checked out, but the flow meter still is not reading properly, verify that the sensor is threaded all the way into the flow meter body, and the orientation groove on top of the sensor is parallel with flow meter body. if flow meter still does not read, replace sensor assembly.

14. Re-connect the flowmeter to the system plumbing. Ensure gaskets on couplings slide over the piping and flowmeter body, centering gasket between components. Lubrication with soap may be required. Attach coupler clamp and re-torque hardware to 80-100 ft-lbs.

Note: *For a list of replacement parts, refer to Chapter 8, System Diagram and Replacement Parts.*

CHAPTER

7

Troubleshooting

⚠ WARNING

Anhydrous ammonia may be under pressure. Before disconnecting any fittings or hoses, be sure to purge the system of all NH_3 (see *Discharging the AccuFlow™ System* section on page 51).

TABLE 1. Issue and Resolution Table

Issue	Resolution
Raven control console reports inaccurate AccuFlow measurements (i.e. console indicate more product applies than actual product removed from tank.	1. Refer to Figure 2, “System Capacity Chart,” on page 34 or Figure 5, “System Capacity Chart,” on page 47 to verify that the target application speed is below the maximum speed allowed for the implement width and the target rate. a. If the maximum speed is exceeded, reduce the application speed especially if actual rate & pressures are unstable. b. If the application speed is within allowable range, skip to step 3. 2. Refer to the stem diagrams in and verify that the AccuFlow system is plumbed correctly. If the system is plumbed correctly, proceed to step 3. 3. Verify that the difference between the static and operating pressures do not exceed 5 PSI. If the pressure difference: a. is greater than 5 PSI, proceed to step 4. ***Note:*** *Bleed the system before performing maintenance and service (see “Discharging the AccuFlow™ System” section on page 51).* 4. The following maintenance and service steps should be: a. Clean the strainer located next to the Vortex cooler. Check hoses for deterioration and replace if necessary. b. Remove all excess hose length between the nurse tank and break-away coupler typically 12 feet). c. Remove excess hose between the break-away coupler and the AccuFlow system (typically 3 feet). d. Verify that the break-away coupler is 1-1/2”, not 1”. If the break-away coupler is the correct size, proceed to step 5. e. Verify flow through the Vortex cooler chamber by: • Removing the vapor hoses from the steel vapor tubes at applicator knives. • Secure hose ends so each hose can be viewed from the vehicle cab. • Operate vehicle and AccuFlow system for a short period (30 seconds max) in the field into the wind. • Verify a heavy stream of anhydrous ammonia vapor is discharged from each hose end. If not, disassemble and clean the Vortex cooler. Refer to *Maintaining the Vortex Cooler* section on page 55 for detailed instructions on disassembling the Vortex cooler.

Issue	Resolution
Console does not power-up or no indicators are lit to verify system power-up.	1. Check fuses either on the back of the console or on the console's cable. Refer to the console Operation manual for assistance. 2. Check power and ground connections to the battery. Verify that the power leads from the console cable are connected directly to the battery, not chassis ground or another power source. 3. Check operation of the master switch. 4. Verify power at valve connectors If none of the above steps resolve the issue, the console may require repair. Contact a local Raven dealer for further assistance.
(SCS 400 to 700 Series consoles only) All keyboard lights are on at the same time.	The console may require repair. Contact a local Raven dealer for further assistance.
(SCS 400 to 700 Series consoles only) Keyboard does not work for entries.	The console may require repair. Contact a local Raven dealer for further assistance.
Indicator light(s) on specific keys will not illuminate	The console may require repair. Contact a local Raven dealer for further assistance.
Console displays flashing "CAL" whenever vehicle engine is started.	1. Check battery voltage. 2. Console power may be toggled by the vehicle's ignition switch or connected to a "dirty" power source. Verify that the power leads from the console cable are connected directly to the battery, not chassis ground or another power source.
Console displays flashing "CAL" whenever the master switch is toggled on or off.	1. Check battery voltage. 2. Console power may be connected to a "dirty" power source. Verify that the power leads from the console cable are connected directly to the battery, not chassis ground or another power source.
Console's TIME feature is inaccurate or drifts.	The console may require repair. Contact a local Raven dealer for further assistance.
Display digits are missing segments.	The console may require repair. Contact a local Raven dealer for further assistance.
Speed constantly displays a zero value.	1. Check speed sensor cable and connectors or the port on the back of the console for loose pins. 2. Clean pins and sockets on speed sensor cable connectors. 3. If no speed sensor extension cable is installed, the speed sensor switch assembly may require a replacement. Contact a local Raven dealer for further assistance.

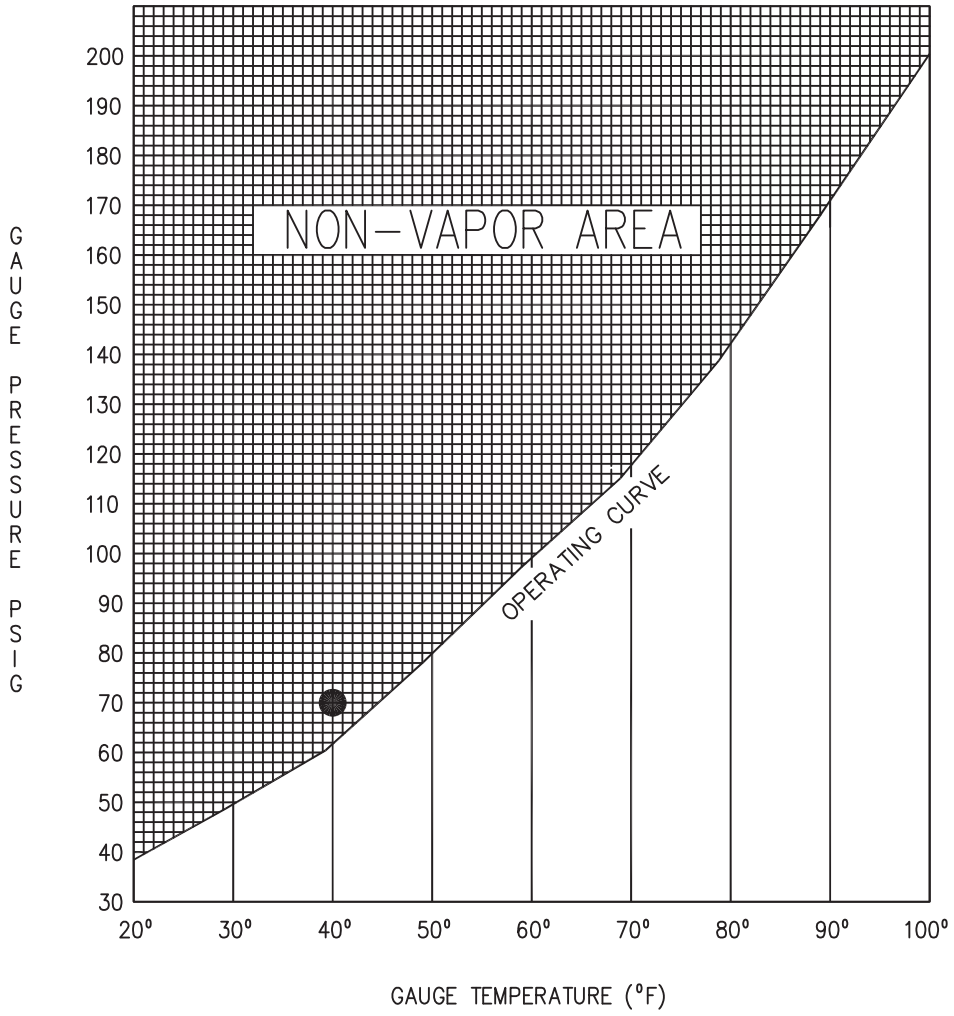
Issue	Resolution
(Wheel Drive Speed Sensors) Speed display is inaccurate or unstable.	1. Check that the issue is encountered on hard surface roads. a. If the speed display is accurate on hard surfaces, investigate mounting the speed sensor on a different wheel. b. If the speed display is still inaccurate on hard surfaces, proceed to step 2. 2. Verify that all magnets are detected by the speed sensor by: a. Removing one set of magnets (one red and one black) from the wheel. b. Reposition remaining magnets directly across from each other. c. Adjust the speed cal by entering a value twice as large as the correct speed cal value. d. Recheck speed display on hard surface road. e. Continue checking sets of magnets (replacing previously removed set) these two magnets and replace with other two. f. Run speed check again. 3. If the speed display is inaccurate with only one set of magnets, replace the bad set. 4. If the speed display is inaccurate with all sets of magnets, replace speed sensor assembly. 5. Re-enter original speed cal after testing is complete.
Rate Reads “0000”	1. Verify speed display is being registered accurately. If the speed displays a constant zero value, troubleshoot the speed sensor. 2. Verify that the console is registering flow by confirming the total volume display is correct. 3. If the total volume display is incorrect, seethe “Rate does not change in either manual or automatic control modes” for resolution.
Rate display is inaccurate or unstable.	1. Verify that all calibration values are entered correctly on the console (see the console operation manual for instructions). 2. Verify the speed display is registering accurately. If speed display is inaccurate, troubleshoot the speed sensor. 3. In manual (MAN) control mode, verify that the rate display holds a constant value. 4. Hoses connecting the AccuFlow system should not exceed 15’ [4.5 m] of 1-1/2” hoses and a 1-1/2” breakaway. 5. Remove any street elbows and replace with a conventional elbow and nipple. 6. Refer to the Chapter 7, *Troubleshooting*, to clean the flow meter and y-strainer screen and magnet assemblies. These procedures should be performed periodically or when system performance degrades. Be sure to follow the instructions in the *Discharging the AccuFlow™ System* section on page 51 before performing maintenance on the AccuFlow system. 7. Verify that the nurse tank has a high flow valve.

Issue	Resolution
Rate does not change in either manual or automatic control modes.	1. Check the control valve cabling for wear and breaks. 2. Check and clean cable connections as necessary. 3. Check the voltage at the control valve connector by: a. Powering on the console. b. Set the master switch to the 'on' position. c. Set all products or the console to manual (MAN) control mode. **Note:** *For multi-section systems, disconnect section 1 on/off valve. Turn section 1 on and all other sections off. This avoids opening section valves and accidental release of* NH_3. 4. Hold the increase/decrease (INC/DEC) switch. With the INC/DEC switch in operation, check for movement & voltage at the control valve. 5. Verify that valve is turning by watching the coupler shaft. If the valve does not open or close, replace the control valve motor.
Total volume does not register	1. Test the flow meter cable and any extension cables for breaks or shorts. Refer to the console operation manual for testing procedure. 2. Check and clean internal components of flow meter. Refer to the console operation manual for flow meter cleaning and adjustment procedure.
Total volume registers flow inaccurately.	1. Verify product flow corresponds to the direction of the arrow stamped on the flow meter. 2. Clean flow meter according to the *Flow Meter Maintenance and Adjustment* section on page 57. 3. See console installation manual.
Motorized control valve rotates more than 1/4 turn.	Replace the motorized control valve.
Pressure and temperature gauge readings indicate that NH_3 passing through the AccuFlow flow meter is not in a liquid state.	1. Check that the vapor tubes have been affixed to the applicator knives correctly and that the openings for NH_3 are not plugged or filled with debris. 2. If additives such as N-Serve or ACA have been or are being used with the AccuFlow system, disassemble and clean Vortex cooler chamber. See Chapter 6, *Service and Maintenance*, for more information about servicing the Vortex cooler. 3. Determine if the operating pressure drop is within tolerances. See step 3 in "Raven control console reports inaccurate AccuFlow measurements (i.e. console indicate more product applies than actual product removed from tank".
HP+ pump not running.	1. Check the HP boost pump hydraulic connections and verify proper connection to remote hydraulics on tractor. Inlet (small hose) should be connected to remote pressure and return (large hose) should be connected to remote tank. During operation, the return line from the AccuFlow hydraulic motor and check valve should be soft in comparison to the inlet hose. 2. Ensure tractor remote ports are engaged and pressure is adjusted to provide sufficient flow rate to HP boost pump. Refer to the *Verifying AccuFlow HP+ Operation* section on page 49 for details on adjusting the remote tractor hydraulics.

Issue	Resolution
Low supply pressure.	Triggered when pump inlet pressure falls below set value (20 psi default) for 5 seconds. Pump is shut off after 15 seconds when operating in 'Auto' mode only. Error message only is displayed when in 'Manual'. Likely causes are empty nurse tank, failed Pressure 1 transducer/cable/ connection, or plugged strainer screen. ***Note:*** *Setting pressure value to zero will disable.*
Pump fault	Triggered when pump is not building pressure after 10 seconds. Pump is shut off after 60 seconds. Likely causes are tractor hydraulics off or reversed, or incorrect Pressure transducer calibration.
Max pressure	Triggered when pump pressure exceeds setting. Control temporarily ramps pump rpm down and then resumes normal control. Reduce travel speed.
No pressure 1 or pressure 2 signal - no alarm for P2 fault but on screen as '----')	Triggered when there is no signal voltage present from transducer. Failed transducer or cable or disconnected are likely causes.
Master valve failed open or closed.	Triggered when control node does not sense the expected change in master control valve's amperage draw upon reaching the expected end of travel. Likely causes are cable connection or valve failure.
Section valve failed open or closed.	Triggered when status feedback signal does not match expected valve position. Likely causes are cable connection or valve failure.
Valve leaking.	Tighten the stem nuts.

Pressure vs. Temperature

FIGURE 1. Pressure vs. Temperature Chart

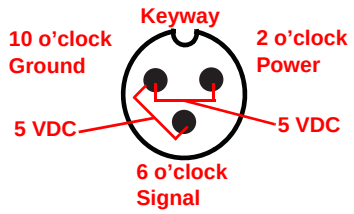


Given an observed pressure reading 70 PSI and temperature reading 40° F. The point where these two readings intersect is within the non-vapor area.

Speed Sensor Extension Cable

Disconnect the extension cable from the speed sensor assembly cable. Hold the extension cable connector so that the keyway is pointing in the 12 o'clock position as shown below.

FIGURE 2. Speed Sensor Extension Cable Connector Pins



Note: *If a radar type speed sensor is used, the voltage between the 10 o'clock and 2 o'clock positions may read 12 VDC.*

If a +5V DC voltage reading is not present, disconnect the flow meter cable and re-test the speed sensor cable. If the voltage reads +5V DC when the flow meter cable is disconnected, test the flow meter cable as described in the Testing the Flow Meter Cable section on page 69.

Testing the Speed Sensor Extension Cable

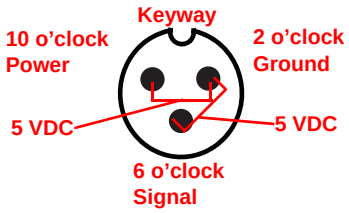
1. Enter a speed cal of 9999.
2. Zero the odometer by entering a zero value in the distance button.
3. With a small jumper wire (or paper clip), short between the 10 o'clock and 6 o'clock sockets with a 'short-no-short' motion. Each time contact is made, the distance total should increase by increments of 1 or more.
4. If the distance total does not increase, remove the section of cable and repeat the test at the connector that is the next closest to the node. If the distance total now increases with the short-no-short test, replace the defective cable as required.
5. If no pulses are registered, perform the above voltage checks.
6. If all of the cables test 'good', replace the Speed Sensor.

Note: *After testing is complete, re-enter the correct speed cal before starting an application.*

Flow Meter Extension Cable

Before starting this test, disconnect the flow meter cable from the flow meter. Hold the flow meter cable so that the keyway is pointing in the 12 o'clock position as shown below.

FIGURE 3. **Flow Meter Extension Cable Connector Pins**



Note: *If a +5 VDC voltage reading is not present, disconnect the speed sensor cable. If the voltage reading is restored, test the speed sensor cable as described in the Testing the Speed Sensor Extension Cable section on page 68.*

Testing the Flow Meter Cable

1. Enter a meter cal of 1 in liquid or direct injection modes, or density of 1 and spreader constant of 0 in granular mode.
2. Navigate to the volume/area settings screen and note the total volume for each product node connected to the CANbus.
3. Turn the boom and master switch 'on.'
4. With a small jumper wire (or paper clip), short between the 2 o'clock and 6 o'clock sockets with a 'short-no-short' motion. Each time contact is made, the total volume number should increase by increments of 1 or more.
5. If the total volume value does not increase, remove the section of cable and repeat the test at the connector that is the next closest to the node. Replace the defective cable as required.
6. Verify the pin connection and voltage from the previous chart.
7. If all of the cables test good, replace the rate sensor.

Note: *After testing is complete, re-enter the correct cal values before starting an application.*

CHAPTER

8

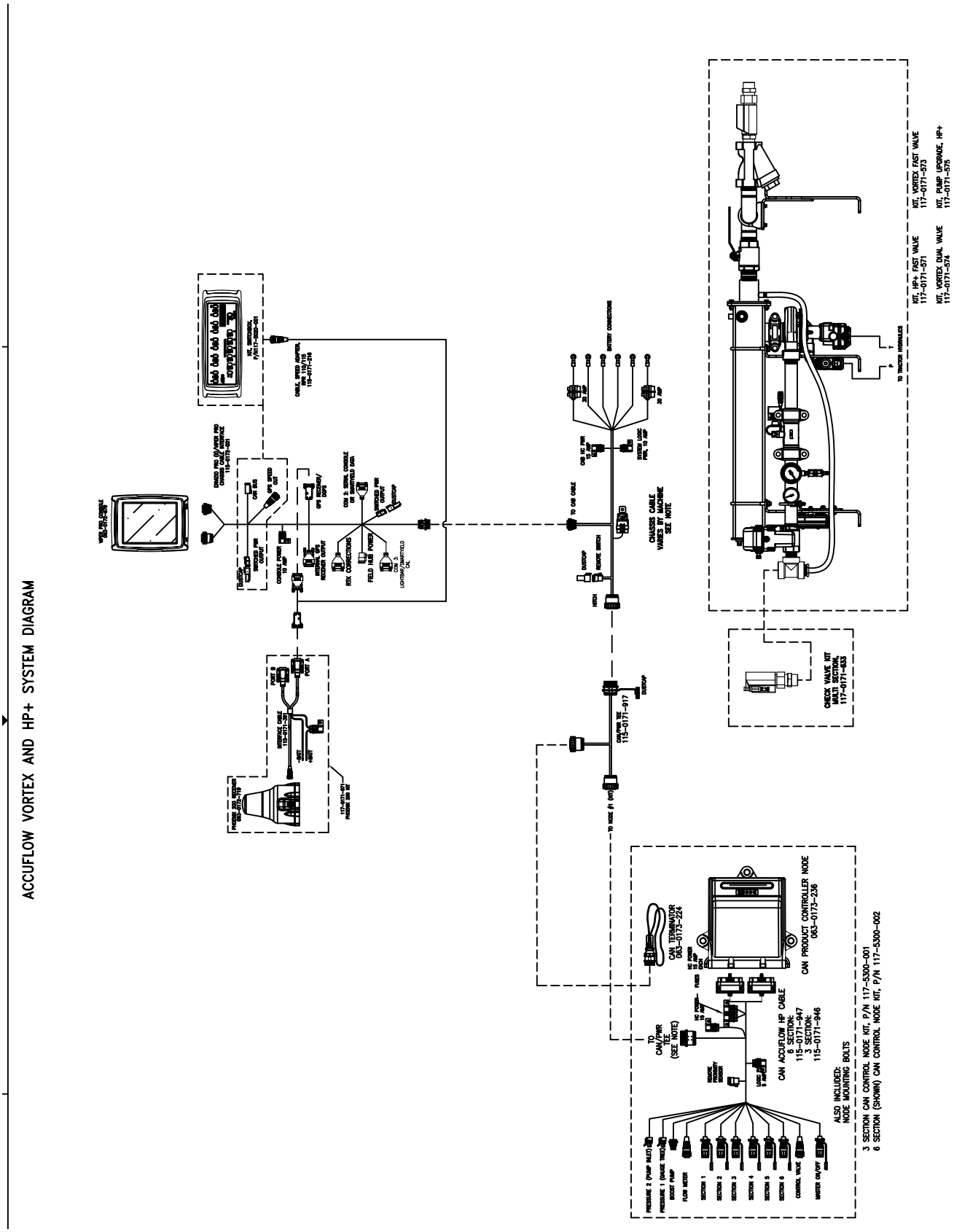
System Diagram and Replacement Parts

Standard AccuFlow™ Diagrams

The AccuFlow Vortex one and two valve systems may be operated using standard Raven SCS control cabling. Refer to the figure below for additional components used with the AccuFlow HP+ systems.

Note: *Contact a local Raven dealer for additional information or assistance with cabling or Raven AccuFlow system components.*

FIGURE 1. **AccuFlow Vortex and HP+ System Diagram (054-5300-004)**



Replacement Parts

TABLE 1. Inlet Plumbing Components

P/N	Description
116-0159-755	2” SS Inlet Reversed Manifold
333-0011-103	1-1/2” Check Valve
063-0173-655	2” Y-Strainer (Strainer, Screen, Gaskets, Magnets)
333-9000-071	40 Mesh Strainer Screen
219-0000-161	2” Strainer Gasket
418-0000-001	Strainer Magnet
116-0159-742	2” SS Inlet Y-Manifold
063-0173-627	2” Inlet Shutoff Valve

TABLE 2. Vortex Cooler and Bleed Components

P/N	Description
063-0173-663	Vortex Cooler Assembly (Cooler, Seals, Decals, Relief Valve)
117-0171-591	Seal/Hardware Kit
117-0171-592	Decal Kit
334-0002-005	SS Relief Valve
334-0001-064	1/4” Bleed Valve
214-0001-046	1/2” X 72” Bleed Circuit High Pressure Hose
116-0159-752	Weldment, Outlet Manifold

TABLE 3. HP+ Pump and Plumbing Components

P/N	Description
117-0171-575	Vortex to HP+ Pump Upgrade Kit
333-0006-031	2-1/2” Gruv-Lok Coupling w/Gasket
219-0003-266	Gasket, Replacement, 2-1/2”
416-1001-010	HP+ Boost Pump
117-0171-576	HP+ Hydraulic Motor Seal Kit
117-0171-577	HP+ Boost Pump Seal Kit
334-0001-042	PWM Hydraulic Valve
019-0159-591	1-1/2” SS Pump Outlet Fitting, Grooved End

TABLE 4. Flowmeter Components

P/N	Description
063-0173-618	RFM 60SG Flowmeter
117-0171-590	RFM 60SG Internal Replacement Parts Kit
063-0171-669	Flowmeter Sensor Assembly w/Nut
219-0003-267	Gasket, Replacement, 2” x 1-1/2”
333-0006-032	2” x 1-1/2” Gruv-Lok Coupling w/Gasket

TABLE 5. Gauge Tree and Sensor Components

P/N	Description
116-0159-743	1-1/2” SS Gauge Tree Manifold
417-0001-031	-40°F - 120°F Temperature Gauge
417-0001-030	0-250 PSI Pressure Gauge
422-0000-090	0-250 PSI Pressure Transducer

TABLE 6. Control and On/Off Valve Components

P/N	Description
063-0173-626	1-1/2” SS Fast Valve Assembly
063-0173-666	Fast Valve Motor Assembly
063-0173-668	1-1/2” On/Off Valve Assembly
063-0173-665	On/Off Motor Assembly
063-0173-667	1-1/2” Standard Control Valve
063-0173-664	Standard Control Valve Assembly
117-0171-219	Valve Position Indicator Kit

TABLE 7. Outlet Plumbing Components

P/N	Description
333-0003-098	Fitting, Reducing Bushing, 1-1/2” x 1/4” NPT
117-0171-633	Kit, Check Valve, 1-1/2” Multi-Section, NH_3
333-0011-103	1-1/2” Check Valve

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Limited Warranty

What Does this Warranty Cover?

This warranty covers all defects in workmanship or materials in your Raven Applied Technology Division product under normal use, maintenance, and service when used for intended purpose.

How Long is the Coverage Period?

Raven Applied Technology products are covered by this warranty for 12 months from the date of retail sale. In no case will the Limited Warranty period exceed 24 months from the date the product was issued by Raven Industries Applied Technology Division. This warranty coverage applies only to the original owner and is non-transferable.

How Can I Get Service?

Bring the defective part and proof of purchase to your Raven dealer. If the dealer approves the warranty claim, the dealer will process the claim and send it to Raven Industries for final approval. The freight cost to Raven Industries will be the customer's responsibility. The Return Materials Authorization (RMA) number must appear on the box and all documentation (including proof of purchase) must be included inside the box to be sent to Raven Industries.

What Will Raven Industries Do?

Upon confirmation of the warranty claim, Raven Industries will (at our discretion) repair or replace the defective product and pay for the standard return freight, regardless of the inbound shipping method. Expedited freight is available at the customer's expense.

What is not Covered by this Warranty?

Raven Industries will not assume any expense or liability for repairs made outside our facilities without written consent. Raven Industries is not responsible for damage to any associated equipment or products and will not be liable for loss of profit, labor, or other damages. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person or organization is authorized to assume any liability for Raven Industries.

Damages caused by normal wear and tear, misuse, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.

016-0171-537 Rev. A, E19889

RAVEN

Extended Warranty

What Does this Warranty Cover?

This warranty covers all defects in workmanship or materials in your Raven Applied Technology Division product under normal use, maintenance, and service when used for intended purpose.

Do I Need to Register My Product to Qualify for the Extended Warranty?

Yes. Products/systems must be registered within 30 days of retail sale to receive coverage under the Extended Warranty. If the component does not have a serial tag, the kit it came in must be registered instead.

Where Can I Register My Product for the Extended Warranty?

To register, go online to www.ravenhelp.com and select Product Registration.

How Long is the Extended Warranty Coverage Period?

Raven Applied Technology products that have been registered online are covered for an additional 12 months beyond the Limited Warranty for a total coverage period of 24 months from the date of retail sale. In no case will the Extended Warranty period exceed 36 months from the date the product was issued by Raven Industries Applied Technology Division. This Extended Warranty coverage applies only to the original owner and is non-transferable.

How Can I Get Service?

Bring the defective part and proof of purchase to your Raven dealer. If the dealer approves the warranty claim, the dealer will process the claim and send it to Raven Industries for final approval. The freight cost to Raven Industries will be the customer's responsibility. The Return Materials Authorization (RMA) number must appear on the box and all documentation (including proof of purchase) must be included inside the box to be sent to Raven Industries. In addition, the words "Extended Warranty" must appear on the box and all documentation if the failure is between 12 and 24 months from the retail sale.

What Will Raven Industries Do?

Upon confirmation of the product's registration for the Extended Warranty and the claim itself, Raven Industries will (at our discretion) repair or replace the defective product and pay for the standard return freight, regardless of the inbound shipping method. Expedited freight is available at the customer's expense.

What is Not Covered by the Extended Warranty?

Raven Industries will not assume any expense or liability for repairs made outside our facilities without written consent. Raven Industries is not responsible for damage to any associated equipment or products and will not be liable for loss of profit, labor, or other damages. Cables, hoses, software enhancements, and remanufactured items are not covered by this Extended Warranty. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person or organization is authorized to assume any liability for Raven Industries.

Damages caused by normal wear and tear, misuse, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.

AccuFlow™ Vortex and AccuFlow™ HP+ Installation & Operation Manual

(P/N 016-0171-573 Rev B 01/15 E22987)




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