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

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CHAPTER 1 IMPORTANT INFORMATION

SAFETY

NOTICE

Follow the operation and safety instructions included with the implement and/or controller and read this manual carefully before installing or operating this Raven system.

- Follow all safety information presented within this manual. Review implement operation with your local dealer.
- Contact a local Raven dealer for assistance with any portion of the installation, service, or operation of Raven equipment.
- Follow all safety labels affixed to system components. Be sure to keep safety labels in good condition and replace any missing or damaged labels. Contact a local Raven dealer to obtain replacements for safety labels.

Observe the following safety measures when operating the implement after installing this Raven system:

- Do not operate this Raven system or any agricultural equipment while under the influence of alcohol or an illegal substance.
- Be alert and aware of surroundings and remain in the operator seat at all times when operating this Raven system.
    - Do not operate the implement on any public road with this Raven system enabled.
    - Disable this Raven system before exiting the operator seat.
    - Determine and remain a safe working distance from obstacles and bystanders. The operator is responsible for disabling the system when a safe working distance has diminished.
    - Disable this Raven system prior to starting any maintenance work on the implement or components of this Raven system.
- Do not attempt to modify or lengthen any of the system control cables. Extension cables are available from a local Raven dealer.

DISPLAYS AND CONTROL CONSOLES

- If the display will not be used for an extended period, it is best to remove the display from the machine and store it in a climate controlled environment. This may help to extend the service life of electronic components.
- To prevent theft, secure the display and GPS antenna when leaving the machine unattended.

DANGER

ANHYDROUS AMMONIA (NH_3) SAFETY

Anhydrous ammonia (NH_3) under pressure. NH_3 can cause severe burning, blindness, sickness, or death. Understand all safety instructions and warnings before operating or servicing equipment.

- Review the properties of NH_3 and the procedures for safe handling, and use with your NH_3 supplier.
    - Contact your NH_3 supplier or the appropriate agricultural department for training on handling, transporting, transferring, and applying NH_3. Training should be completed at least every three years.
    - Always wear appropriate personal protective equipment (PPE) when installing, inspecting, servicing, and operating the NH3 system. Appropriate PPE includes, but is not limited to:
      - Liquid proof gauntlet-style gloves impervious to NH3.
      - Long sleeved shirt and long pants or protective suit.
      - Indirect vent chemical splash goggles or indirect vent chemical splash goggles with full-face shield.
    - Check operation of system components (e.g. valves, temperature and pressure gages) prior to charging the system with NH_3.
    - Seek immediate medical attention if symptoms of illness occur during or shortly after use of NH_3 products.
- Use extreme caution when servicing or maintaining a system that has previously been pressurized with NH_3.
    - Keep a source of clean water (at least five gallons) readily available while working with NH_3. This source should be in addition to, and separate from, the water source on the nurse tank.
    - Read and follow instructions provided with the application system to properly discharge NH_3 before performing service or maintenance.
    - Pressure gauges can fail, become plugged, or display incorrect pressure. Slowly bleed pressure from a previously charged system by opening valves slightly. Allow pressure to discharge for an extended period of time. Treat every section where NH_3 can be trapped as though it is pressurized.
    - Thoroughly bleed all system lines and disconnect the nurse tank hose to remove NH_3 from the system before transporting the system or beginning service or maintenance. Liquid NH_3 can absorb heat from surroundings and re-pressurize the system. Any bleed valves that are opened to relieve pressure should remain open while transporting the system or maintenance is being performed.
    - Stand ‘up wind’ when working around NH_3 and related equipment. Never work on NH_3 equipment in confined spaces. Always keep NH_3 equipment away from buildings, livestock, and other people.
    - Before each day's use:
      - Visually inspect all system plumbing components for functionality, excessive wear, and damage.
      - Some components may have recommended “replace by” dates or maximum service periods regardless of visual condition.
      - Replace individual components if excessively worn, visually damaged, or non-functioning, as recommended by the component manufacturer, or as required by regulation, whichever is sooner.
      - Test excess flow valves and document the date and result of tests. Replace any components that do not pass inspection as needed.
    - Never uncouple an NH_3 applicator or intermediate towing vehicle without appropriate parking stands, wheel chocks, or other braking systems if a nurse take wagon is attached.

  - Immediately evacuate the area in case of leak or accidental release of NH_3. Contact your local fire department, and identify sources of clean water on the unit.
  - In case of exposure, flush exposed skin and eyes immediately with large quantities of water for at least 15 minutes and seek immediate medical attention.
- NH_3 can be harmful to the environment if not used properly.
  - Follow all federal, state, and local regulations regarding the handling and use of NH_3.
- Only NH_3 harness systems, control systems, and on/off valves approved by Raven Industries are recommended for use with NH_3 products. Raven shall not be liable for any damages and this warranty shall not cover defects from:
  - The use of a system with a harness not approved by Raven.
  - The use of a control system not approved by Raven.
  - The use of an on/off valve not approved by Raven.
  - The use of the system in a manner that is inconsistent with the instructions.
  - Unauthorized modification to the system or products used in the system.
  - Follow the best practices for installing and routing hoses provided in *Recommendations and Best Practices* section on page 5.

⚠ WARNING

AGRICULTURAL CHEMICAL SAFETY

Follow all federal, state, and local regulations regarding the handling, use, and disposal of agricultural chemicals, products, and containers. Triple-rinse and puncture or crush empty containers before properly disposing of them. Contact a local environmental agency or recycling center for additional information.

- Always follow safety labels and instructions provided by the chemical manufacturer or supplier.
- Always wear appropriate personal protective equipment as recommended by the chemical and/or equipment manufacturer.
- When storing unused agricultural chemicals:
  - Store agricultural chemicals in the original container and do not transfer chemicals to unmarked containers or containers used for food or drink.
  - Store chemicals in a secure, locked area away from human and livestock food.
  - Keep children away from chemical storage areas.
- Fill, flush, calibrate, and decontaminate chemical application systems in an area where runoff will not reach ponds, lakes, streams, livestock areas, gardens, or populated areas.
- Follow all label instructions for chemical mixing, handling, and disposal.
- Avoid direct contact with agricultural chemicals or inhaling chemical dust or spray particulate. Seek immediate medical attention if symptoms of illness occur during, or soon after, use of agricultural chemicals or products.
- After handling or applying agricultural chemicals:
  - Thoroughly wash hands and face after using agricultural chemicals and before eating, drinking, or using the restroom.
  - Thoroughly flush or rinse equipment used to mix, transfer, or apply chemicals with water after use or before servicing any component of the application system.

HYDRAULIC SAFETY

When installing or servicing a hydraulic system or hydraulic components, be aware that hydraulic fluid may be extremely hot and under high pressure. Caution must be exercised.

- Always wear appropriate personal protective equipment when installing or servicing hydraulic systems.
- Never attempt to open or work on a hydraulic system with the implement running.
- Any work performed on the hydraulic system must be done in accordance with the machine manufacturer's approved maintenance instructions.
- Care should always be taken when servicing or opening a system that has been pressurized.
- The implement or machine must remain stationary and switched off with booms or implement sections unfolded and supported during installation or maintenance.
- Take precautions to prevent foreign material or contaminants from being introduced into the implement hydraulic system. Contaminants that are able to bypass the hydraulic filtration system will reduce performance and may damage hydraulic components.
- Stand clear of the implement when starting the system for the first time after installing or servicing hydraulic components in case a hose has not been properly connected or tightened.

⚠ CAUTION

ELECTRICAL SAFETY

- Always verify that power leads are connected to the correct polarity as marked. Reversing the power leads could cause severe damage to the Raven system or other components.
- To prevent personal injury or fire, replace defective or blown fuses with only fuses of the same type and amperage.
- Do not connect the power leads to the battery until all system components are mounted and all electrical connections are completed.
- Always start the machine before initializing this Raven system to prevent power surges or peak voltage.
- To avoid tripping and entanglement hazards, route cables and harnesses away from walkways, steps, grab bars, and other areas used by the operator or service personnel when operating or servicing the equipment.

TOUCH SCREEN

- Only touch the touch-screen with your finger or by using a special touch-screen stylus/pen. Operating the touch-screen with sharp objects may cause permanent damage to the screen.
- Only clean the screen using a damp cloth. Never use caustic or other aggressive substances.

RECOMMENDATIONS AND BEST PRACTICES

HOSE ROUTING

The word “hose” is used to describe any flexible, fluid carrying components. Use the following guidelines and recommendations when connecting and routing hoses while installing or maintaining this Raven system:

- Leave protective caps/covers over hose ends until connecting the end into the hydraulic system to help prevent contaminants from entering the system.
- Follow existing hose runs already routed on the implement as much as possible. Proper hose routing should:
    - Secure hoses and prevent hoses from hanging below the implement.
    - Provide sufficient clearance from moving components and operational zones around shafts; universal joints and suspension components; pulleys, gears, belts, and chains; moving linkages, cylinders, articulation joints, etc.
    - Protect hoses from field debris and surrounding hazards (e.g. tree limbs, fence posts, crop stubble, dirt clumps or rocks that may fall or be thrown by the implement).
    - Protect hoses from sharp bends, twisting, or flexing over short distances and normal implement operation.
    - Ensure sufficient length for free movement of the implement during normal operation and prevent pulling, pinching, catching, or rubbing, especially in articulation and pivot points. Clamp hoses securely to force controlled movement of the hose.
    - Avoid abrasive surfaces and sharp edges such as sheared or flame cut corners, fastener threads or cap screw heads, hose clamp ends, etc.
    - Avoid areas where the operator or service personnel might step or use as a grab bar.
- Do not connect, affix, or allow hoses to come into contact with components with high vibration forces, hot surfaces, or components carrying hot fluids beyond the temperature rating of hose components.
    - Hoses should be protected or shielded if routing requires the hose to be exposed to conditions beyond hose component specifications.
- Avoid routing hoses in areas where damage may occur due to build up of material (e.g. dirt, mud, snow, ice, etc.).

HARNESS ROUTING

The word “harness” is used to describe any electrical cables and leads, both bundled and unbundled. Use the following guidelines and recommendations when connecting and routing harnesses while installing or maintaining this Raven system:

- Leave protective caps/covers over harness connectors until needed to avoid dirt and moisture from contaminating electrical circuits.
- Secure the harness to the frame or solid structural members at least every 12 in [30 cm].
- Follow existing harness runs already routed on the implement as much as possible. Proper harness routing should:
    - Secure harnessing and prevent the harness from hanging below the implement.
    - Provide sufficient clearance from moving components and operational zones around shafts; universal joints and suspension components; pulleys, gears, belts, and chains; moving linkages, cylinders, articulation joints, etc.
    - Protect harnessing from field debris and surrounding hazards (e.g. tree limbs, fence posts, crop stubble, dirt clumps or rocks that may fall or be thrown by the implement).

  - Protect harnessing from sharp bends, twisting, or flexing over short distances and normal implement operation.
  - Connectors and splices should not be located at bending points or in harness sections that move.
  - Ensure sufficient length for free movement of the implement during normal operation and prevent pulling, pinching, catching, or rubbing, especially in articulation and pivot points. Clamp harnessing securely to force controlled movement of the harness.
  - Avoid abrasive surfaces and sharp edges such as sheared or flame cut corners, fastener threads or cap screw heads, hose clamp ends, etc.
- Do not connect, affix, or allow harnessing to come into contact with components with high vibration forces, hot surfaces, or components carrying hot fluids beyond the temperature rating of harness components.
  - Harnessing should be protected or shielded if routing requires the hose to be exposed to conditions beyond harnessing component specifications.
- Avoid routing harnesses in areas where damage may occur due to build up of material (e.g. dirt, mud, snow, ice, etc.).
- Avoid routing harnesses in areas where the operator or service personnel might step or use as a grab bar.

IMPORTANT: Avoid applying direct spray or pressure washing of electrical components and connections. High pressure streams and sprays can penetrate seals, cause corrosion, or otherwise damage electrical components. When performing maintenance:

- Inspect electrical components and connectors for corrosion, damaged pins or housings, etc. Repair or replace components or harnessing as necessary.
- Ensure connectors are kept clean and dry. Apply dielectric grease to the sealing surfaces of all connections exposed to moisture, dirt, debris, and other contaminates. Repair or replace harnessing as necessary.
- Clean electrical components with pressurized air, aerosol electrical cleaning agent, or low pressure rinse.
- Remove visible surface water from electrical components and connections using pressurized air or an aerosol cleaning agent. Allow components to dry thoroughly before reconnecting cables.

DISCHARGING THE ACCUFLOW™ SYSTEM

Anhydrous ammonia (NH_3) must be completely discharged prior to transporting, servicing, or performing maintenance on the AccuFlow system or any toolbar/implement used to apply NH_3.

DANGER

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

DANGER

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

DANGER

Always wear appropriate personal protective equipment (PPE) as recommended by the chemical and/or equipment manufacturer when installing, servicing, and operating the NH3 system. Appropriate PPE includes, but is not limited to:

- Liquid proof gauntlet-style gloves impervious to NH3.
- Long sleeved shirt and long pants or protective suit.
- Indirect vent chemical splash goggles or indirect vent chemical splash goggles with full-face shield.

NOTE: Refer to the following procedure for additional details about system components, locations and assistance with discharging the AccuFlow system.

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

1. Toggle the control console or vehicle master switch to the off position.

2. (AccuFlow HP+) Turn off boost pump control by closing the tractor SCV (selective control valve).

DANGER

Pressure gauges can fail, become plugged, or display incorrect pressure. Liquid NH_3 can absorb heat from surroundings and re-pressurize the system. Any bleed valves that are opened to relieve pressure should remain open while transporting the system or maintenance is being performed. Treat every section where NH_3 can be trapped as though it is pressurized.

NOTE: Verify that the pressure gauge readings on both the AccuFlow system and the nurse tank(s) are matching before closing any valves between the nurse tank(s) and AccuFlow system. If the pressure gauge readings do not match, the gauges may be defective and should be replaced as soon as possible.

3. Completely close the main shut-off valve on the supply or nurse tank. Also close the shut-off 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 normal field application until the pressure gauge reads no remaining pressure is left in the AccuFlow system.
5. Toggle the control console or vehicle master switch to the off position and verify that all section switches are in the off position.
6. Ensure that the tow vehicle is upwind of the NH_3 toolbar and application system.

FIGURE 1. Example Discharge and Shutoff Component Locations and Wind Direction

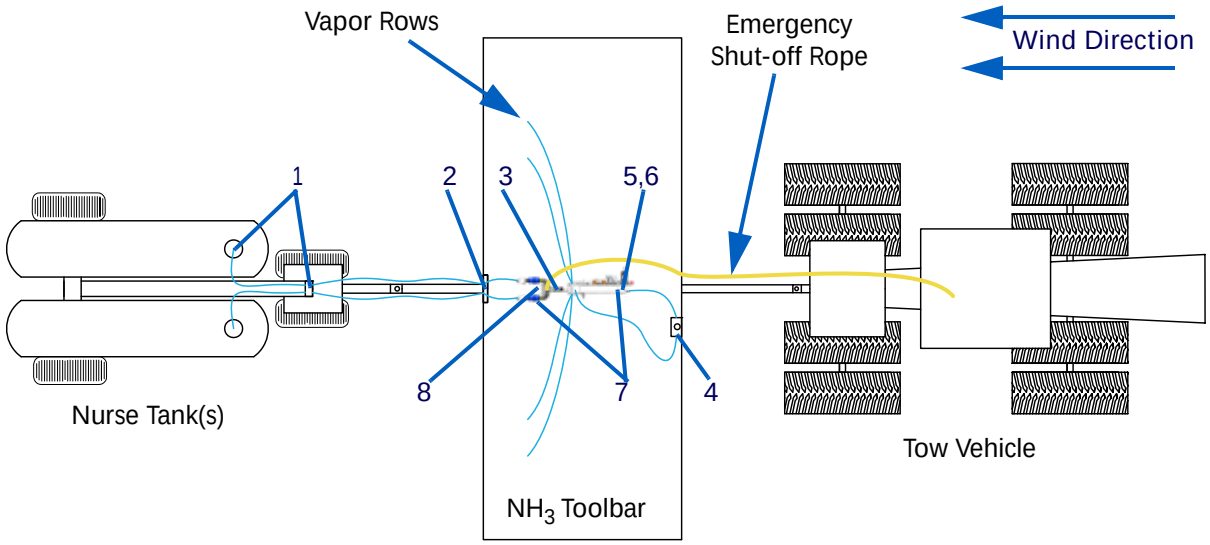


TABLE 1. **Example System Components**

Component	Description
1	Nurse Tank Main Shut-off and Bleed Valves (At Bulkhead or Withdrawal Valve)
2	Supply Hose Bleed Valves and Breakaway Couplers
3	AccuFlow System Emergency Shut-off 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	Bleeder on Check Valve
8	Bleeder on Strainer[1]

1. Some systems may feature more than one strainer.

NOTE: Equipment configurations may vary. Figure 1 on page 8 is an example diagram of an anhydrous ammonia (NH_3) system. Operators must familiarize themselves with the system, bleed valve locations, and procedures before charging the system with NH_3.

7. Completely close the emergency shut-off valve. The valve may be closed by either pulling the rope from the cab of the tractor or turning the handle at the valve mounted on the AccuFlow cooler.

DANGER

Stand ‘up wind’ when working around NH_3 and related equipment. Never work on NH_3 equipment in confined spaces. Always keep NH_3 equipment away from buildings, livestock, and other people.

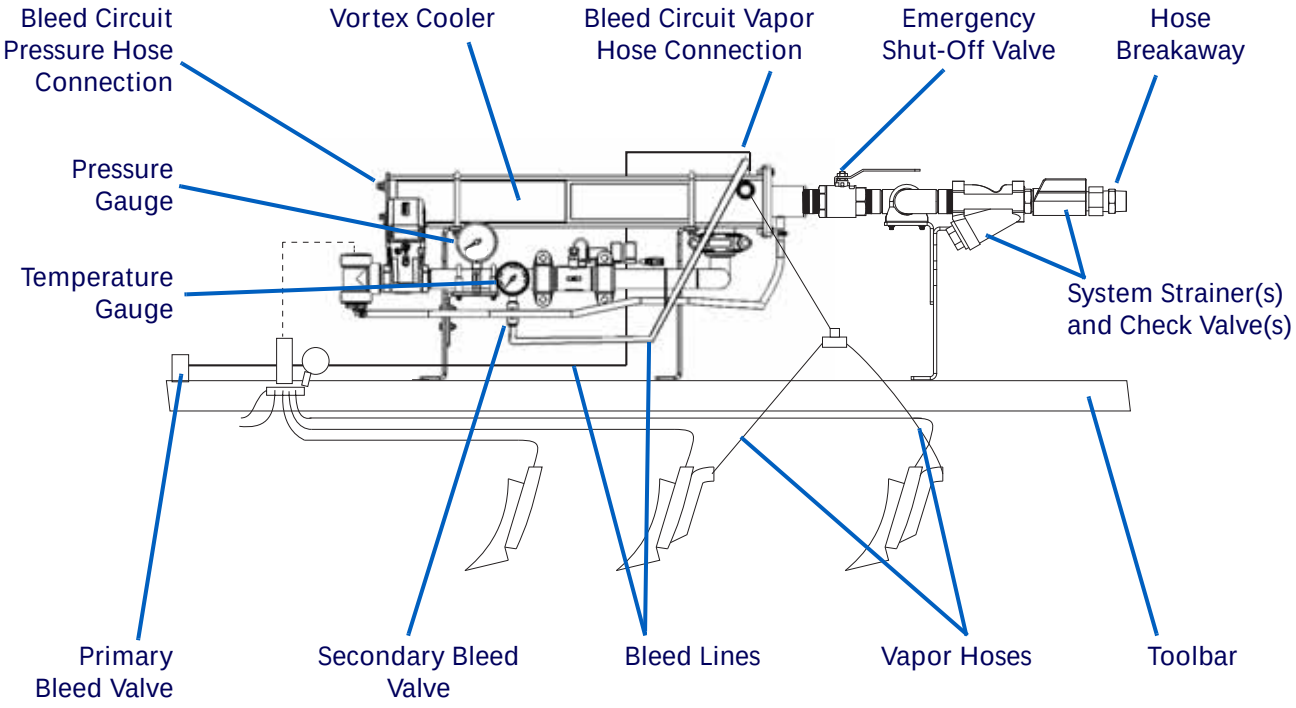
8. Bleed and disconnect the nurse tank supply hose from the nurse tank.
9. While standing upwind from the implement, with the wind direction as shown in Figure 1 on page 8, slowly open the AccuFlow system primary bleed valve until it is fully open. NH_3 will discharge from the vapor knives on the toolbar.

NOTE: Always bleed system pressure slowly by leaving valves open slightly over an extended period of time.

10. Remain at the primary bleed valve and adjust or close as necessary until NH_3 (gaseous cloud) is no longer being released at the vapor knives. After the cloud has dispersed, check the pressure and temperature gauges to verify that the pressure reads zero and all parts are at an ambient temperature (not frosted over).
11. Open the secondary bleed valve slowly to relieve any remaining liquid NH_3 from the system.
12. Recheck and verify that the pressure gauge on the AccuFlow manifold reads zero and that all AccuFlow components are not cold to the touch before opening the system.

NOTE: If you are still unsure if the system pressure has been bled off, verify the supply or nurse tank shut-off valves are closed, all bleed valves are open, slowly open the emergency shut-off valve, and repeat the steps above prior to starting any service or maintenance.

FIGURE 2. Example Discharge and Shutoff Component Locations (Side View)



NOTE: Equipment configurations may vary. Figure 2 on page 10 is an example diagram of an anhydrous ammonia (NH_3) system. Operators must familiarize themselves with the system, bleed valve locations, and procedures before charging the system with NH_3.

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 controller and control valve(s). The operator sets the target application rate in the Raven controller 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.

NOTE: System capacity will vary based upon ambient conditions and plumbing configurations of the overall system. Refer to the following Table 2 on page 12 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[1]	60 PSI	>25%
AccuFlow HP+ System (Pump)	80 GPM[2]	60 PSI	>25%

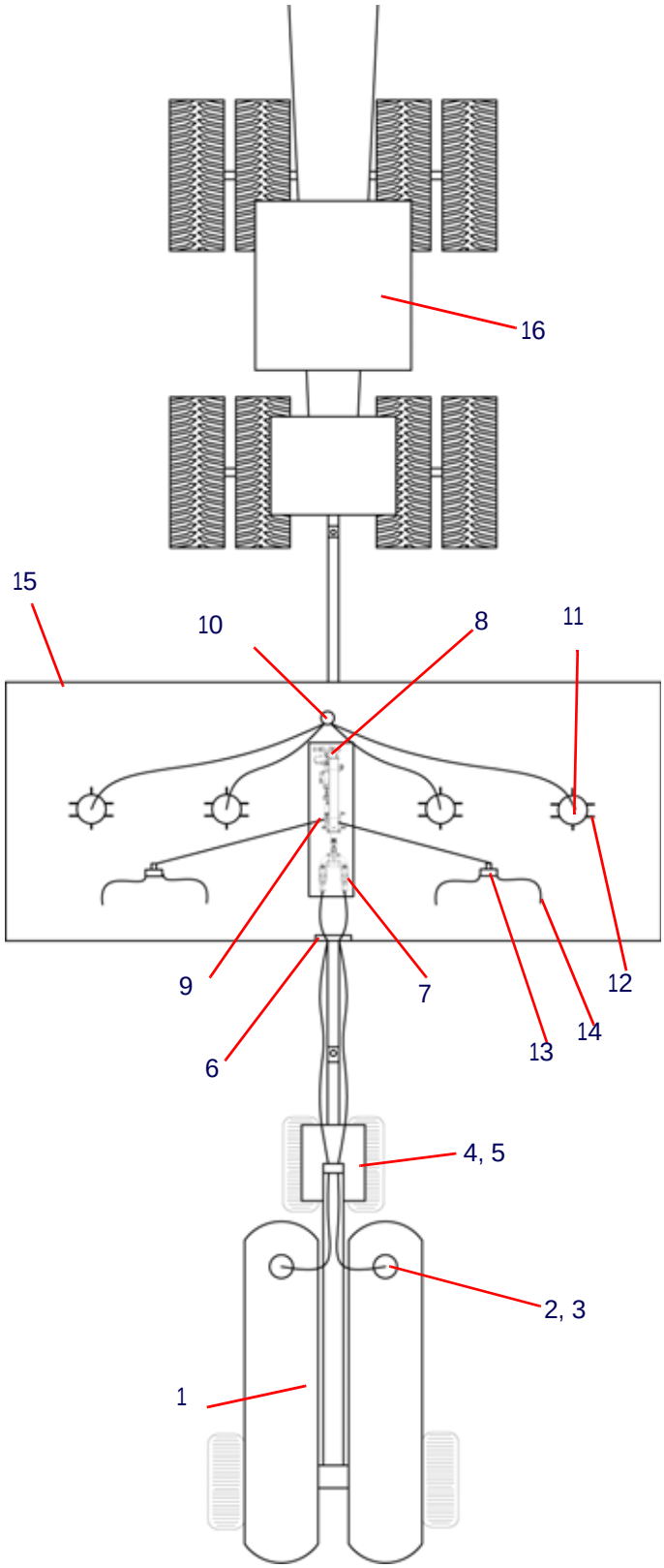
1. Achieved Based on Recommendations Below
2. Achieved Based on Recommendations Below

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 Shut-off 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:

https://portal.ravenprecision.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 and Operation Manual
-016-0171-573 Rev. G
-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

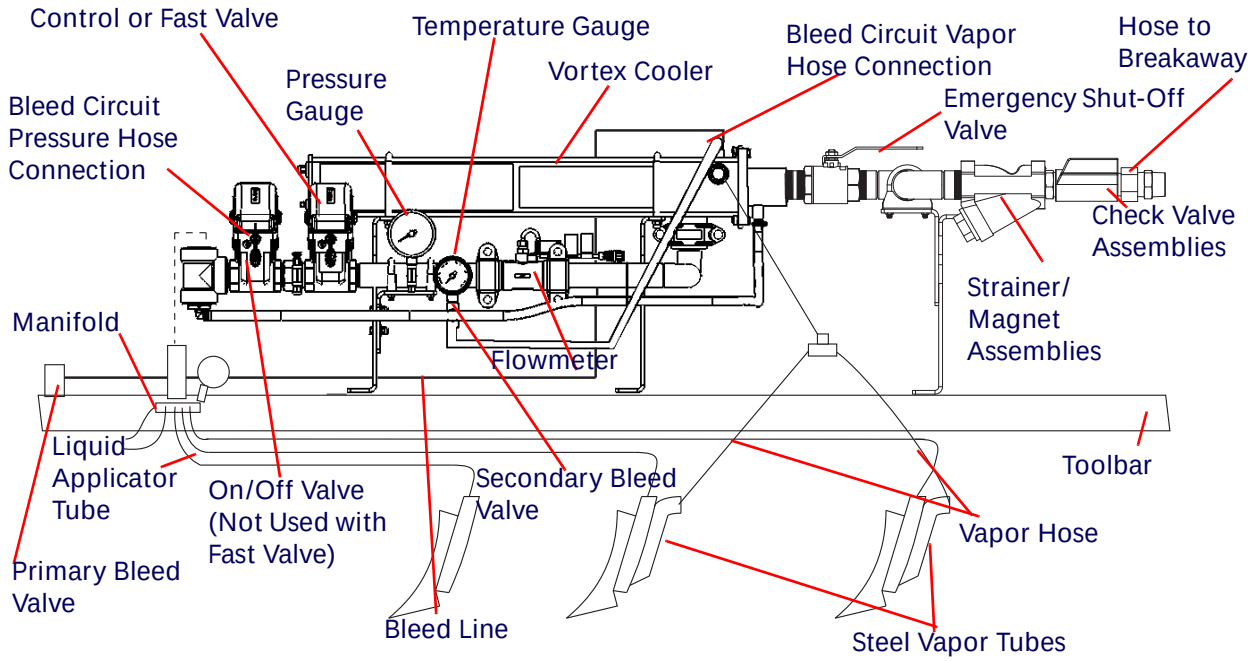
Anhydrous ammonia can cause severe burning, blindness, or death. Refer to *Discharging the AccuFlow™ System* section on page 5 or page 61 and follow the procedure for bleeding the AccuFlow system before beginning maintenance.

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 77 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



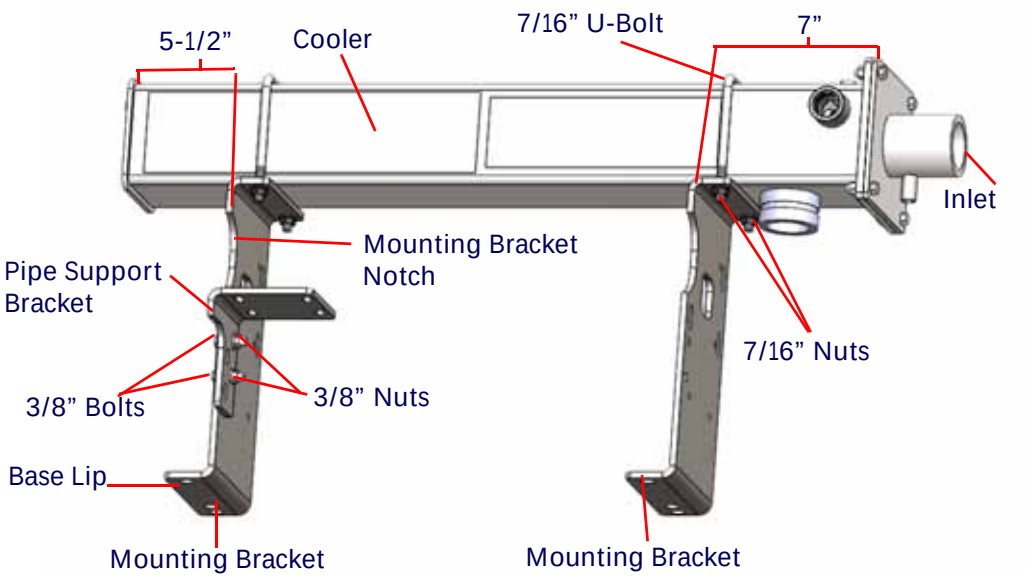
ASSEMBLING THE ACCUFLOW™ SYSTEM

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

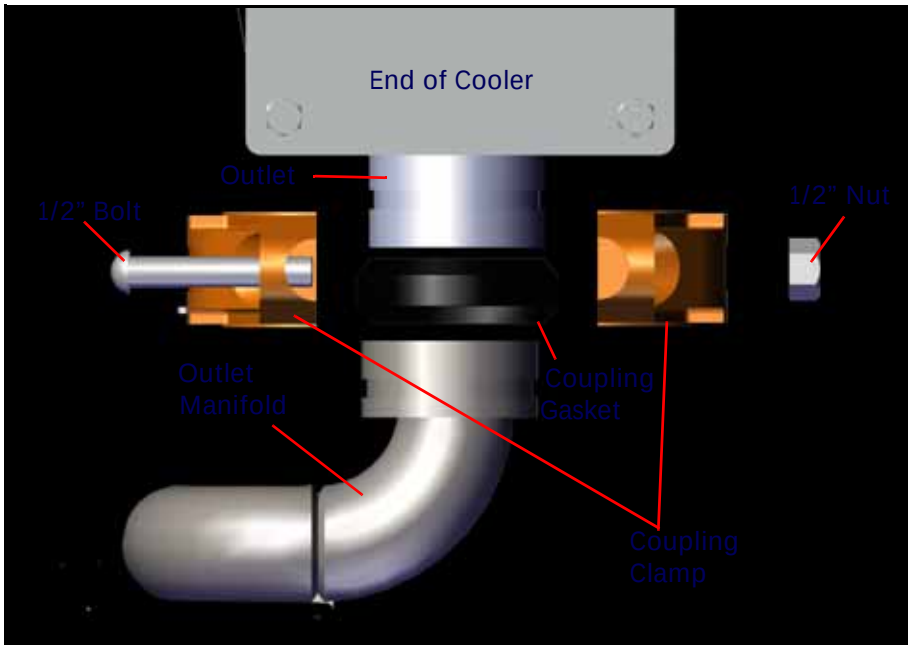
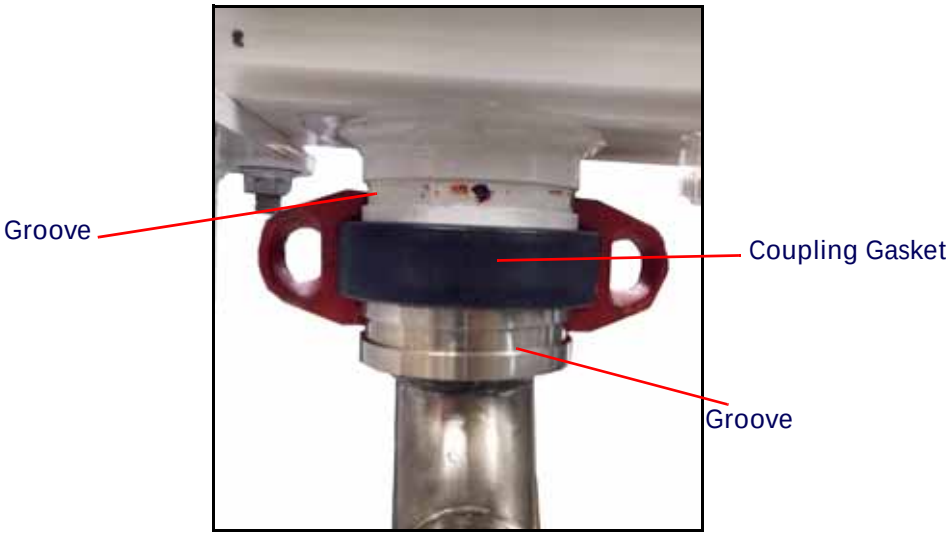
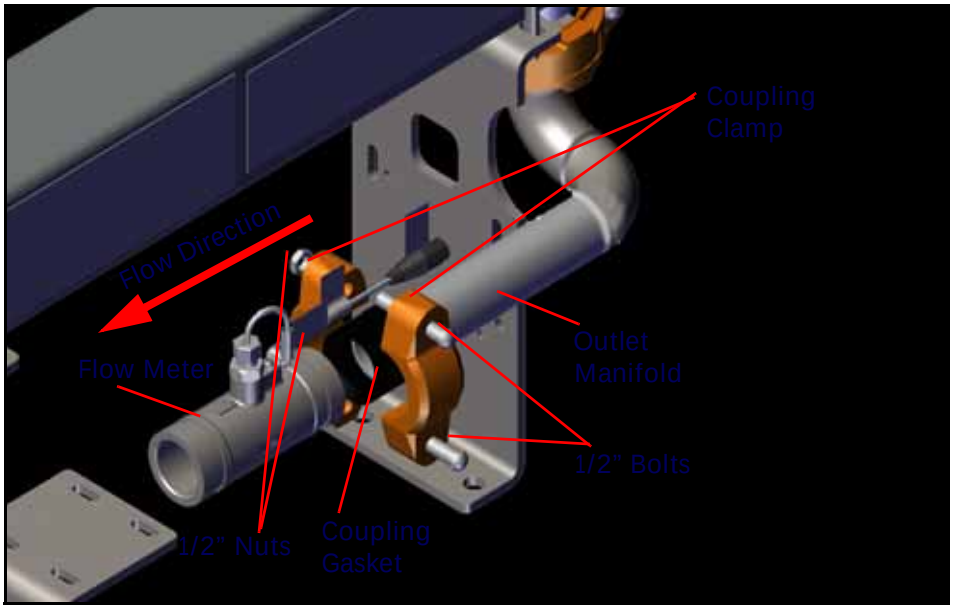


FIGURE 4. Outlet Manifold Clamp Assembly



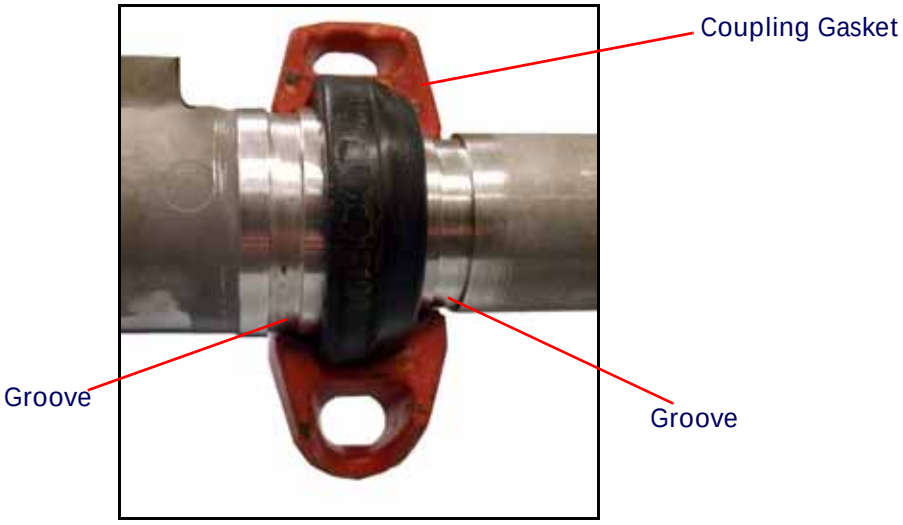
1. Slide the coupling gasket over the end of the outlet sticking out of the bottom of the cooler.
2. Slide the bent end outlet manifold into the coupling gasket.
3. Place the two parts of the coupling clamp over the coupling gasket so the bolt holes are above and below the outlet manifold.
4. Using two 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

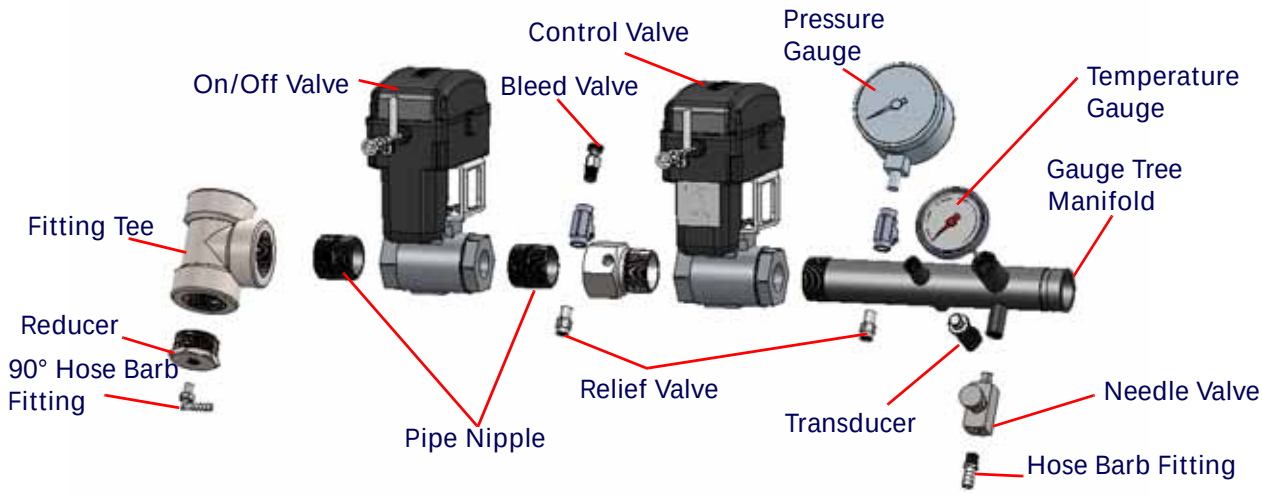


7. Using two 1/2" bolts and two 1/2" nuts to secure the coupling clamp to the flow meter and the outlet manifold.
8. Tighten the 1/2" nuts to 80 to 100 ft-lbs.

1.5” GAUGE TREE AND VALVE ASSEMBLY

GAUGE TREE AND VALVE ASSEMBLY

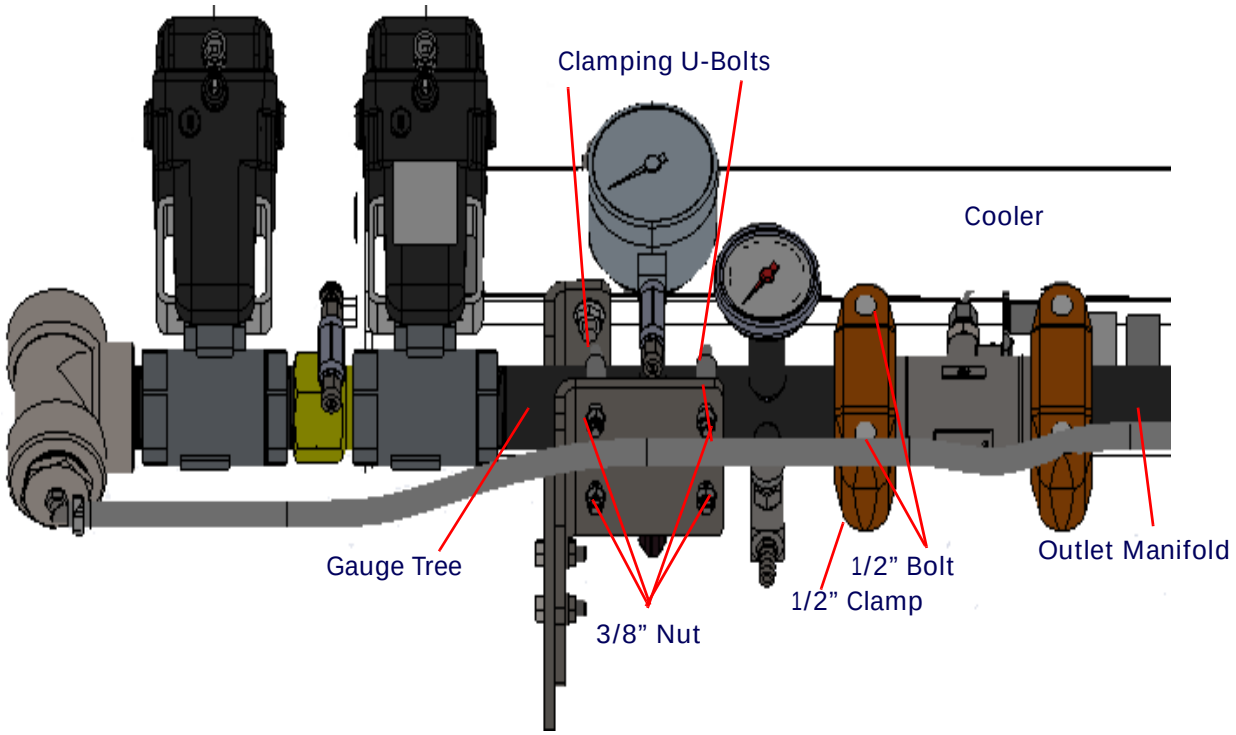
FIGURE 7. Gauge Tree and Valve Assembly



1. Apply PTFE thread sealant 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 pipe nipple between the on/off valve and the controller valve.
5. Use the second 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

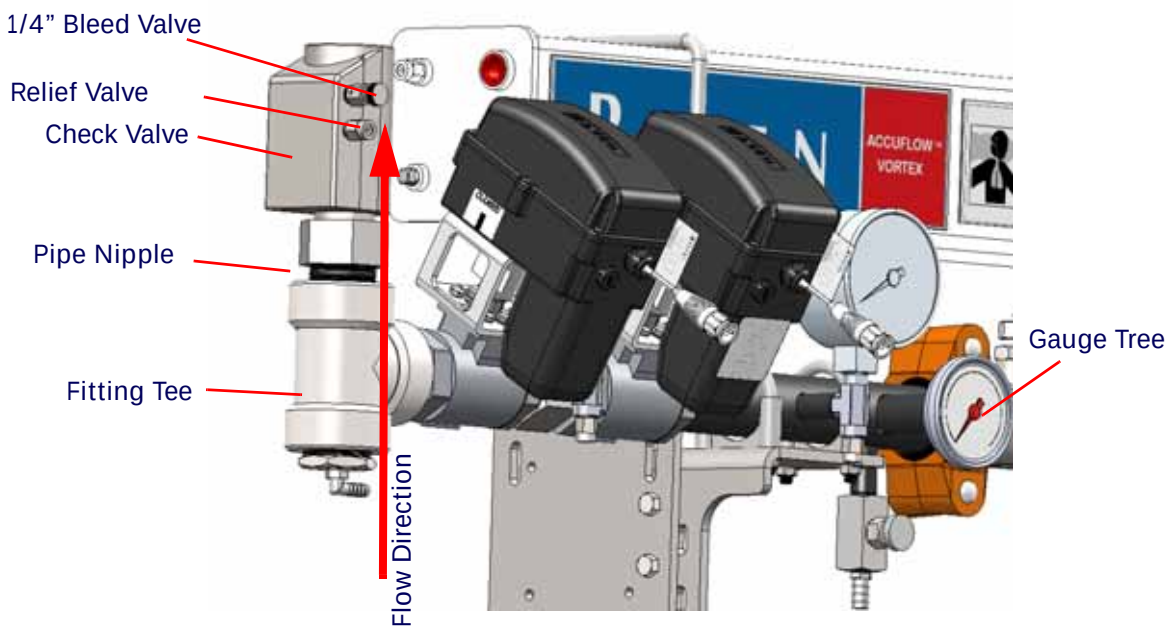
FIGURE 8. Attaching the Gauge Tree to the Cooler



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

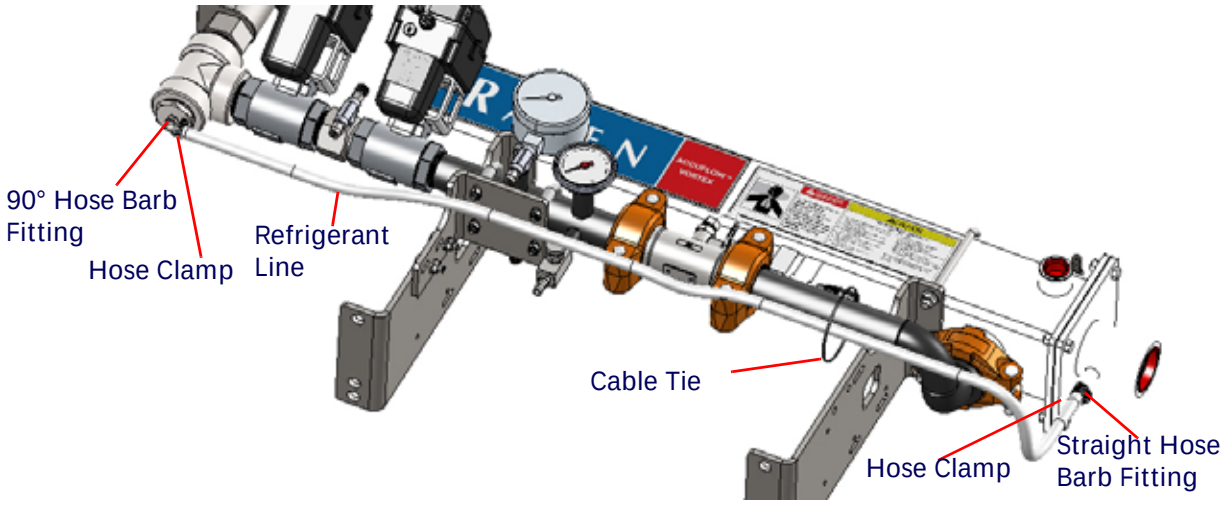


1. Apply PTFE thread sealant to all threaded joints.
2. Install the pipe nipple into the top of the fitting tee.
3. Attach the check valve to the pipe nipple with the flow direction as shown in Figure 9.

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

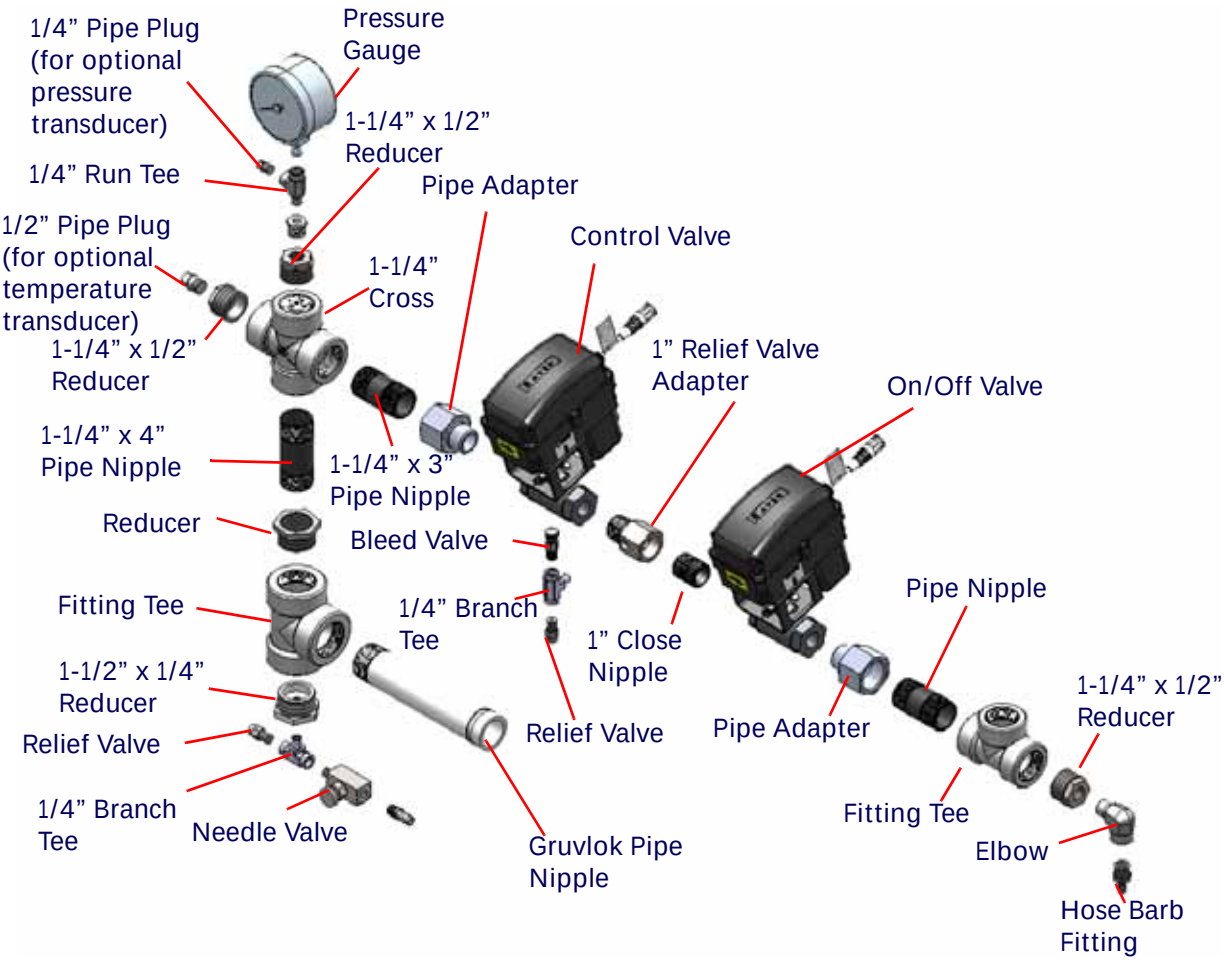


1. Slide a hose clamp over one end of the refrigerant line.
2. Slide the refrigerant line over the 90° hose barb fitting.
3. Secure the hose clamp over the 90° hose barb fitting.
4. Slide a hose clamp over the other end of the refrigerant line.
5. Slide the refrigerant line over the straight hose barb 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.

ONE INCH GAUGE TREE AND VALVE ASSEMBLY

GAUGE TREE AND VALVE ASSEMBLY

FIGURE 11. Gauge Tree and Valve Assembly

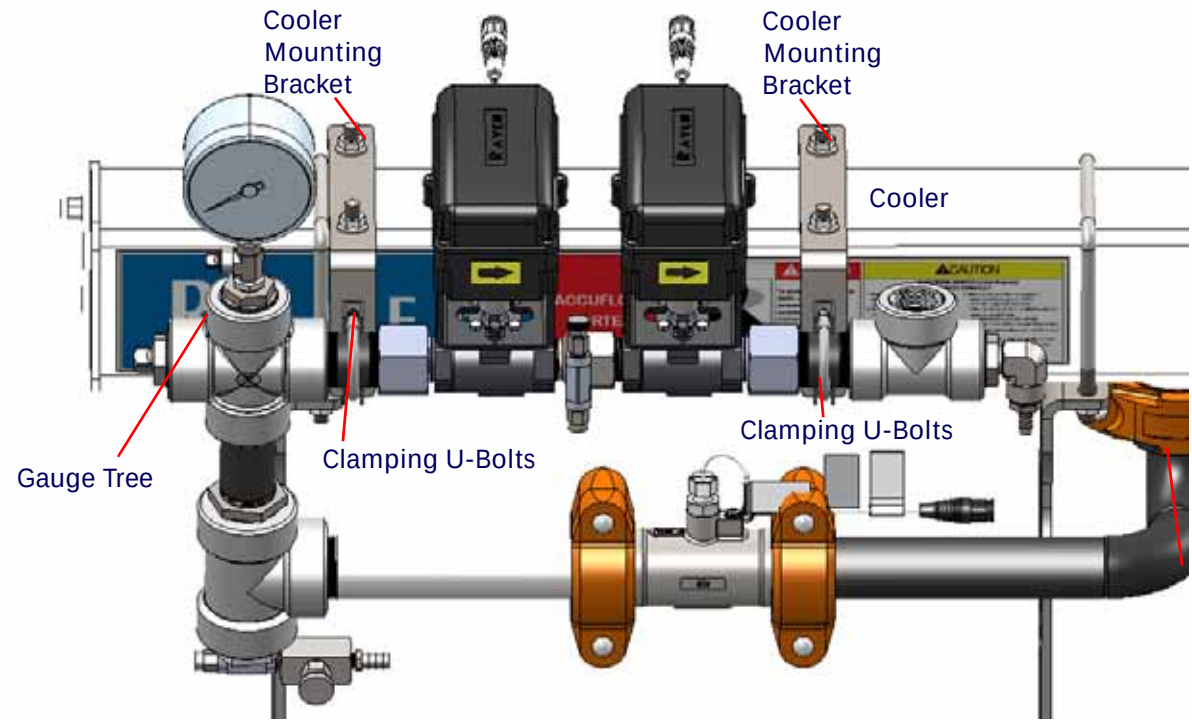


1. Apply PTFE thread sealant to all threaded joints.
2. Install the threaded end of the Gruvlok into the side of the fitting tee.
3. Install 1-1/2" x 1/4" reducer into one end of the fitting tee.
4. Install 1/4" branch tee into 1-1/2" x 1/4" reducer.
5. Install a needle valve into the 1/4" branch tee.
6. Install a reducer into the remaining available port on the fitting tee.
7. Install the long pipe nipple into the reducer.
8. Install the other end of the 1-1/4" x 4" long pipe nipple into 1-1/4" cross.
9. Install the 1-1/4" x 3" pipe nipple into one of the side ports on 1-1/4" cross.
10. Install a 1-1/4" x 1/2" reducer into the other side of the 1-1/4" cross.
11. Install the pressure gauge assembly into the top of 1-1/4" cross.
12. Thread a pipe adapter onto the other end of the 1-1/4" x 3" pipe nipple.
13. Install the control valve into the pipe adapter.
14. Install a 1" relief valve adapter and 1" close pipe nipple into the other end of the control valve.

15. Install the tee, bleed valve, and check valve into the relief valve adapter.
16. Install the on/off valve onto the 1” close nipple.
17. Install pipe adapter into the other end of the on/off valve.
18. Thread the 1” x 3” long pipe nipple into a pipe adapter.
19. Thread the other end of the pipe nipple into a 1-1/4” tee.
20. Install 1-1/4” x 1/2” reducer into the other end of the 1-1/4” tee.
21. Install an elbow into the 1-1/4 x 1/2” reducer.
22. Install the hose barb fitting into elbow.

ATTACHING THE GAUGE TREE TO THE COOLER

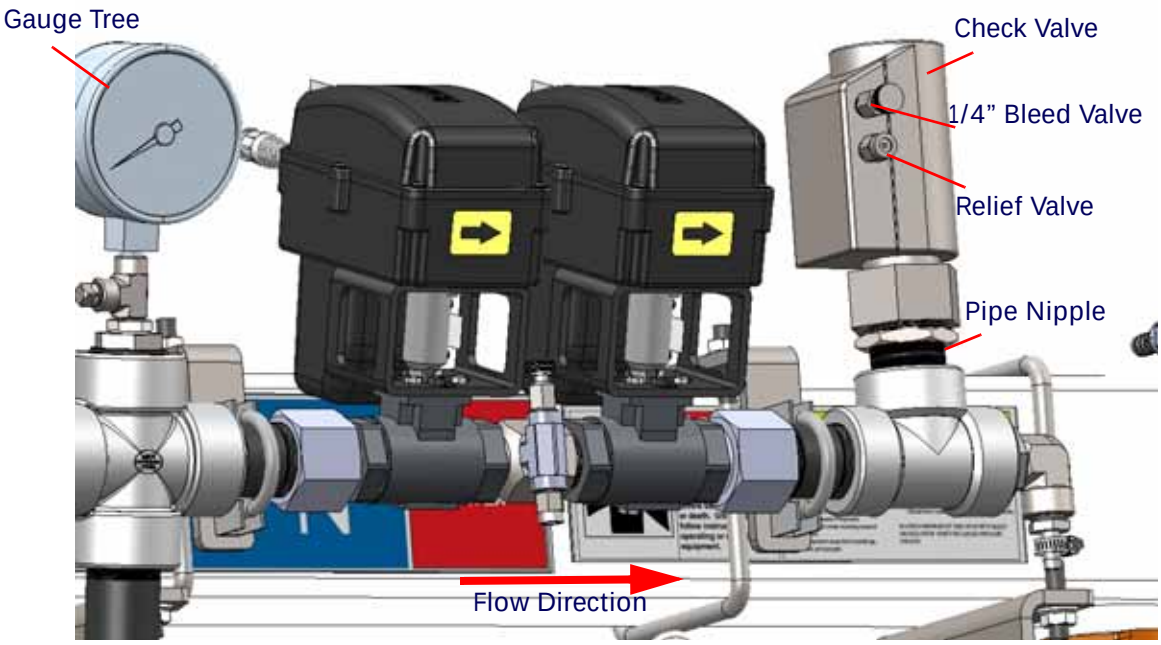
FIGURE 12. Attaching the Gauge Tree to the Cooler



1. Place the cooler mounting bracket on top of the cooler.
2. Use the provided large u-bolts to secure the mounting bracket to the cooler.
3. Place the clamping u-bolts over the horizontal pipe nipples on the assembly.
4. Feed the ends of the clamping u-bolts into the side of the mounting brackets.
5. Install the nuts on the end of the clamping u-bolts.
6. Slide the coupling gasket over the end of the gauge tree that attaches to the flowmeter.
7. Connect the end of the gauge tree to the end of the flowmeter.
8. Use the provided coupling clamp, 1/2” bolts, and 1/2” nuts to secure the gauge tree to the outlet manifold.
9. Tighten the 1/2” nuts to 80 to 100 ft-lbs.

CHECK VALVE ASSEMBLY (FOR MULTIPLE SECTION VALVES ONLY)

FIGURE 13. Check Valve Assembly

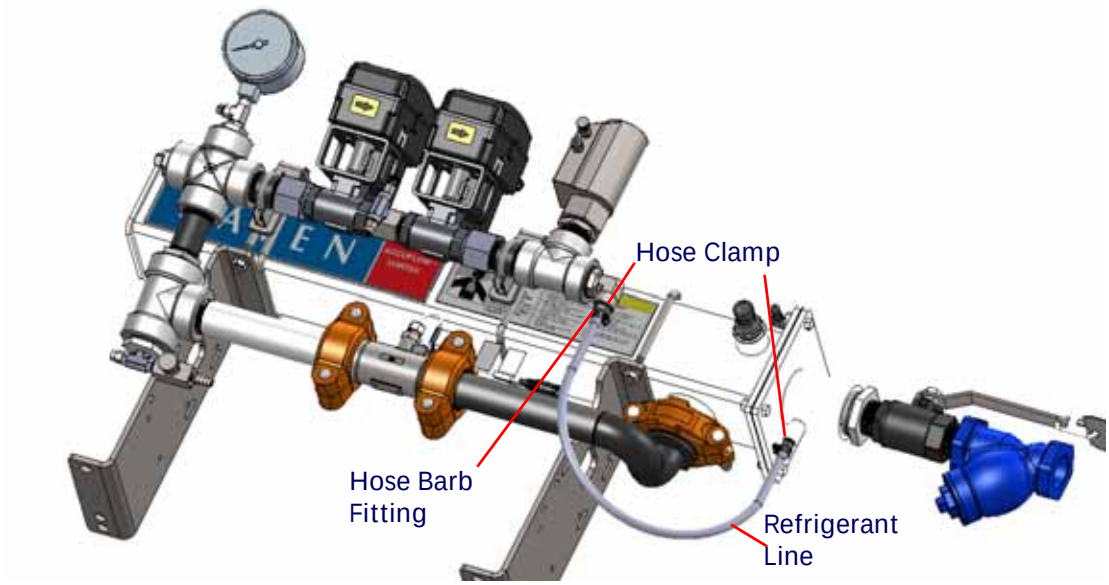


1. Apply PTFE thread sealant to all threaded joints.
2. Install the pipe nipple into the top of the fitting tee.
3. Attach the check valve to the pipe nipple with the flow direction as shown in Figure 9.

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 14. Refrigerant Line Assembly



1. Slide a hose clamp over one end of the refrigerant line.
2. Slide the refrigerant line over the hose barb fitting.
3. Secure the hose clamp over the 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.

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 15. Standard Inlet Manifold Assembly

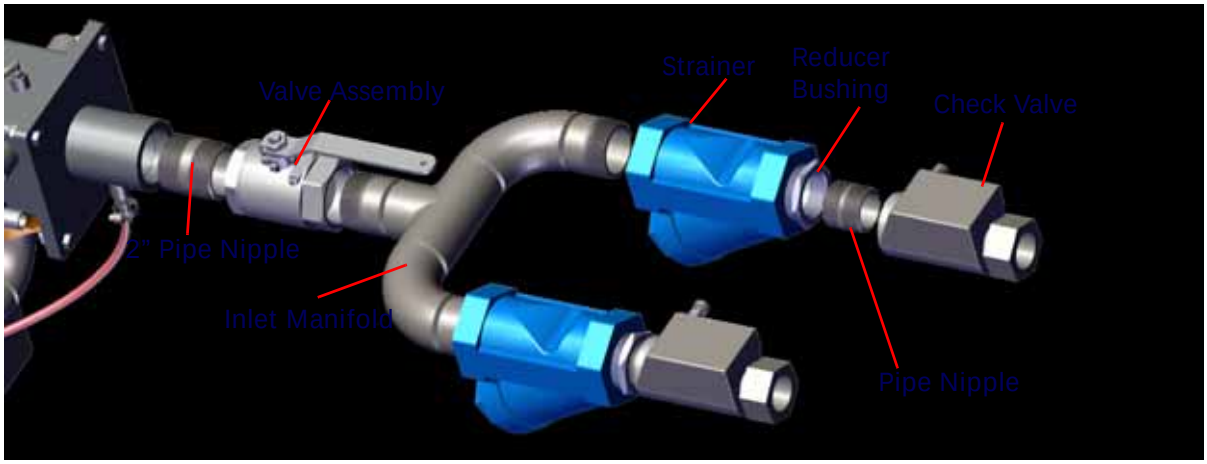
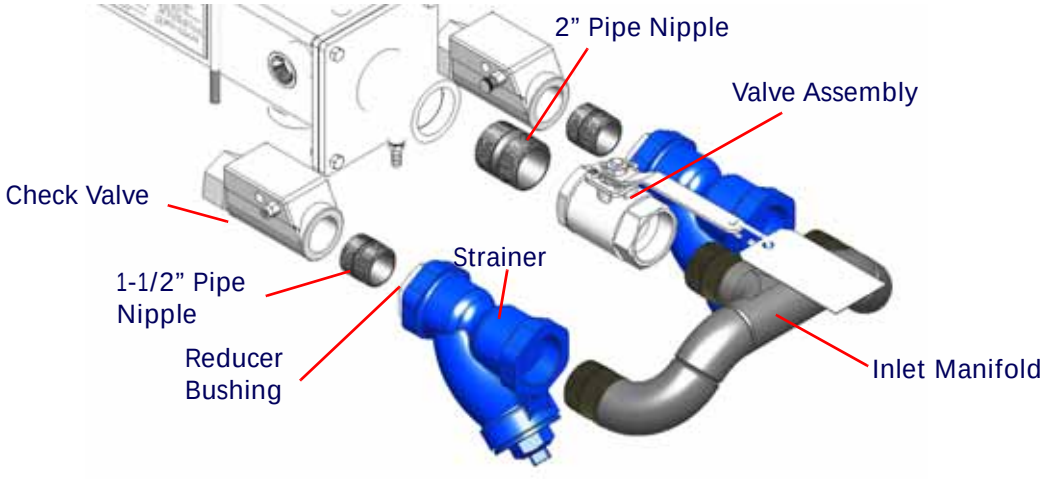


FIGURE 16. Reverse Inlet Manifold Assembly

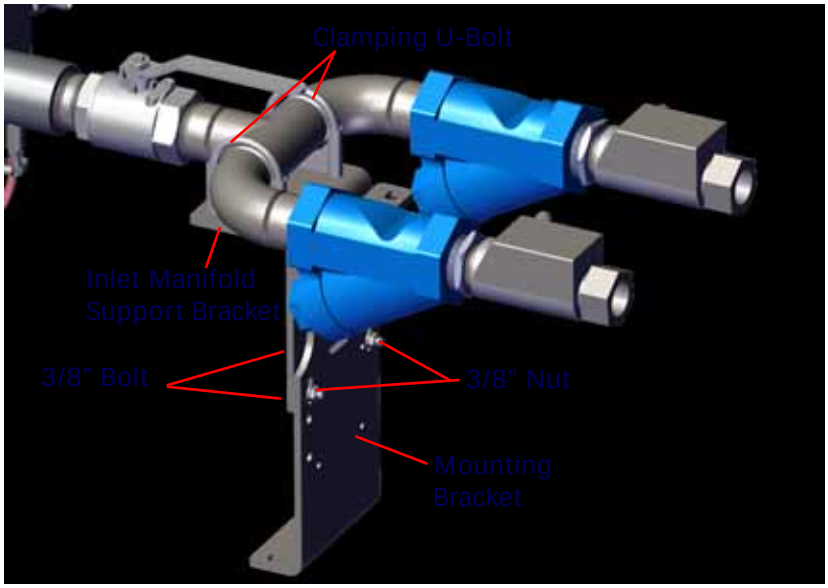


1. Apply PTFE thread sealant to all threaded joints.
2. Install the 2" pipe nipple into the end of the cooler.

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

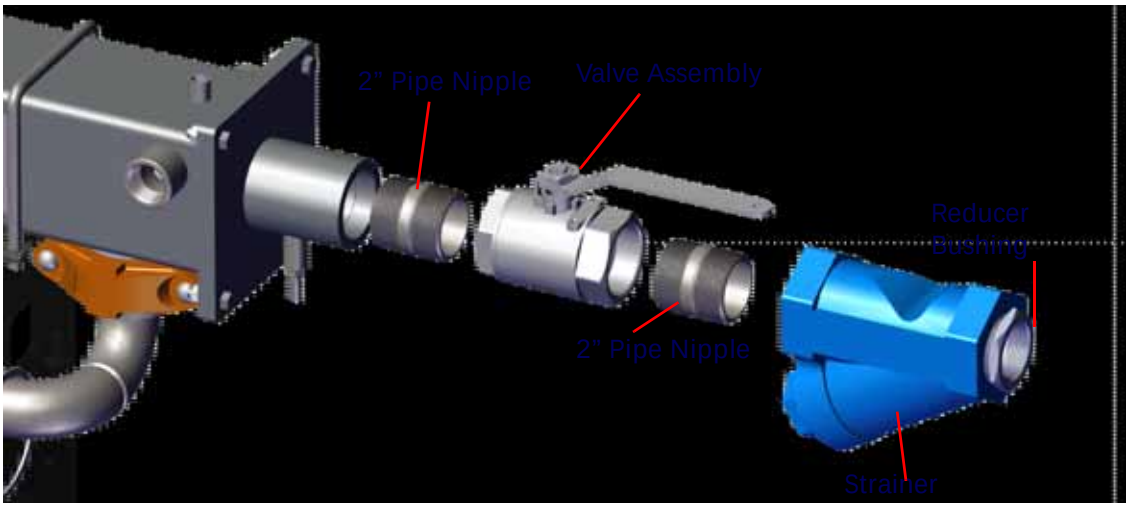
FIGURE 17. Standard Inlet Manifold Support Bracket



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 17).
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.

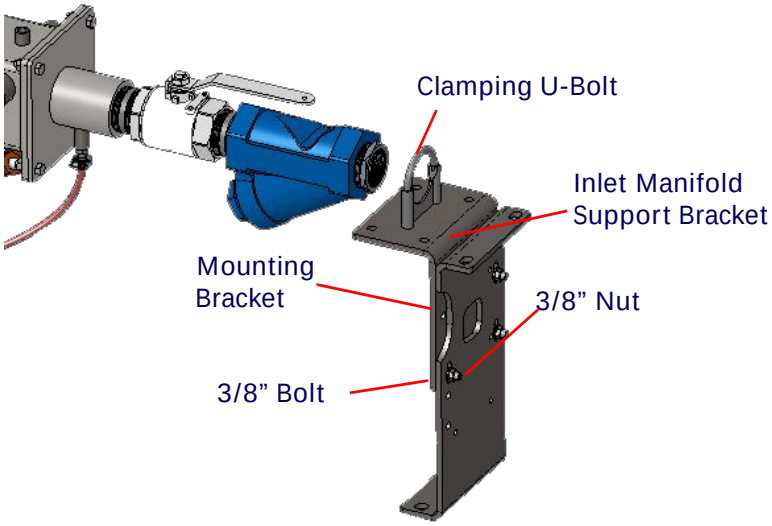
SINGLE INLET MANIFOLD ASSEMBLY

FIGURE 18. Single Inlet Manifold Assembly



SINGLE INLET MANIFOLD SUPPORT BRACKET INSTALLATION

FIGURE 19. Installed Single Inlet Manifold Support Bracket

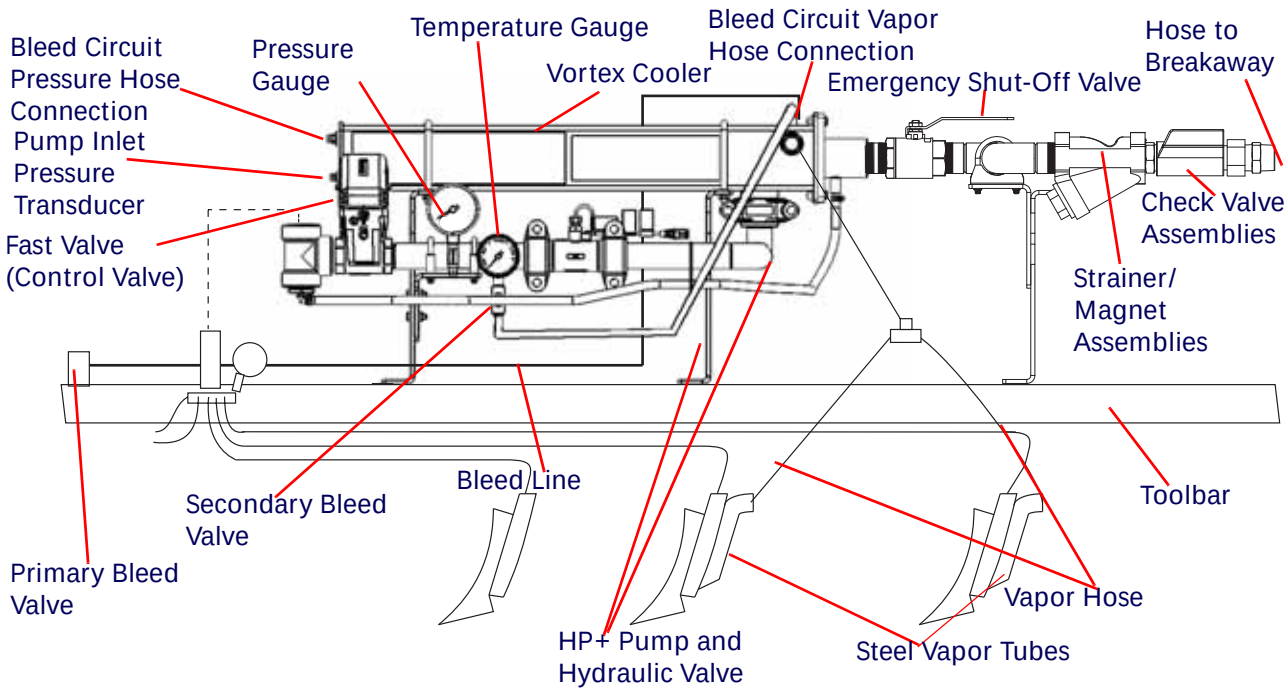


1. Use two 3/8" bolts and 3/8" nuts to secure the mounting bracket to the inlet manifold support bracket.
2. Install the clamping u-bolt around the inlet manifold without installing the nuts.
3. Place the inlet manifold support bracket against the bottom of the inlet.
4. Feed the threaded ends of the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

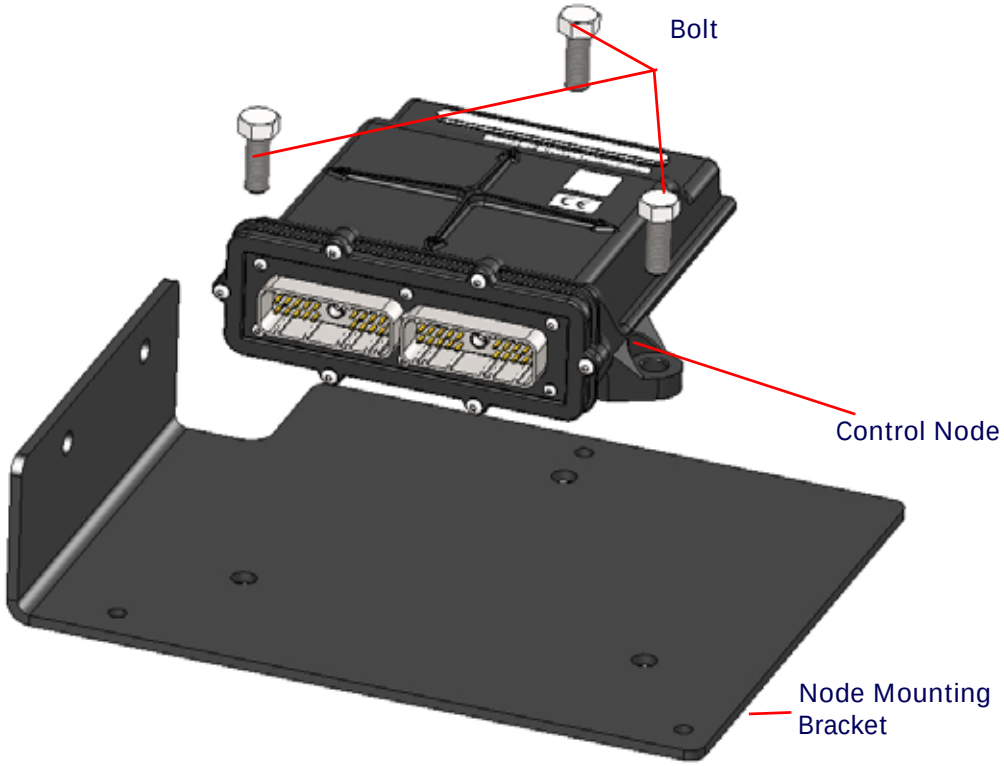
INSTALLING A HP+ SYSTEM

FIGURE 20. Typical AccuFlow HP+ System



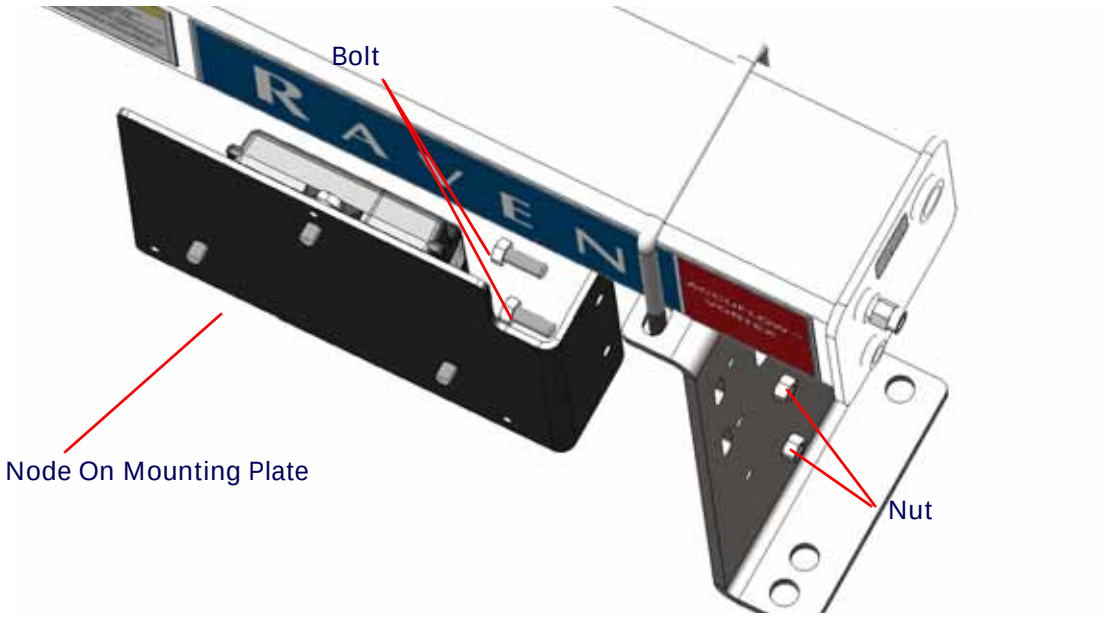
INSTALLING CONTROL NODE: ACCUFLOW HP+

FIGURE 21. Installing Control Node to Mounting Plate



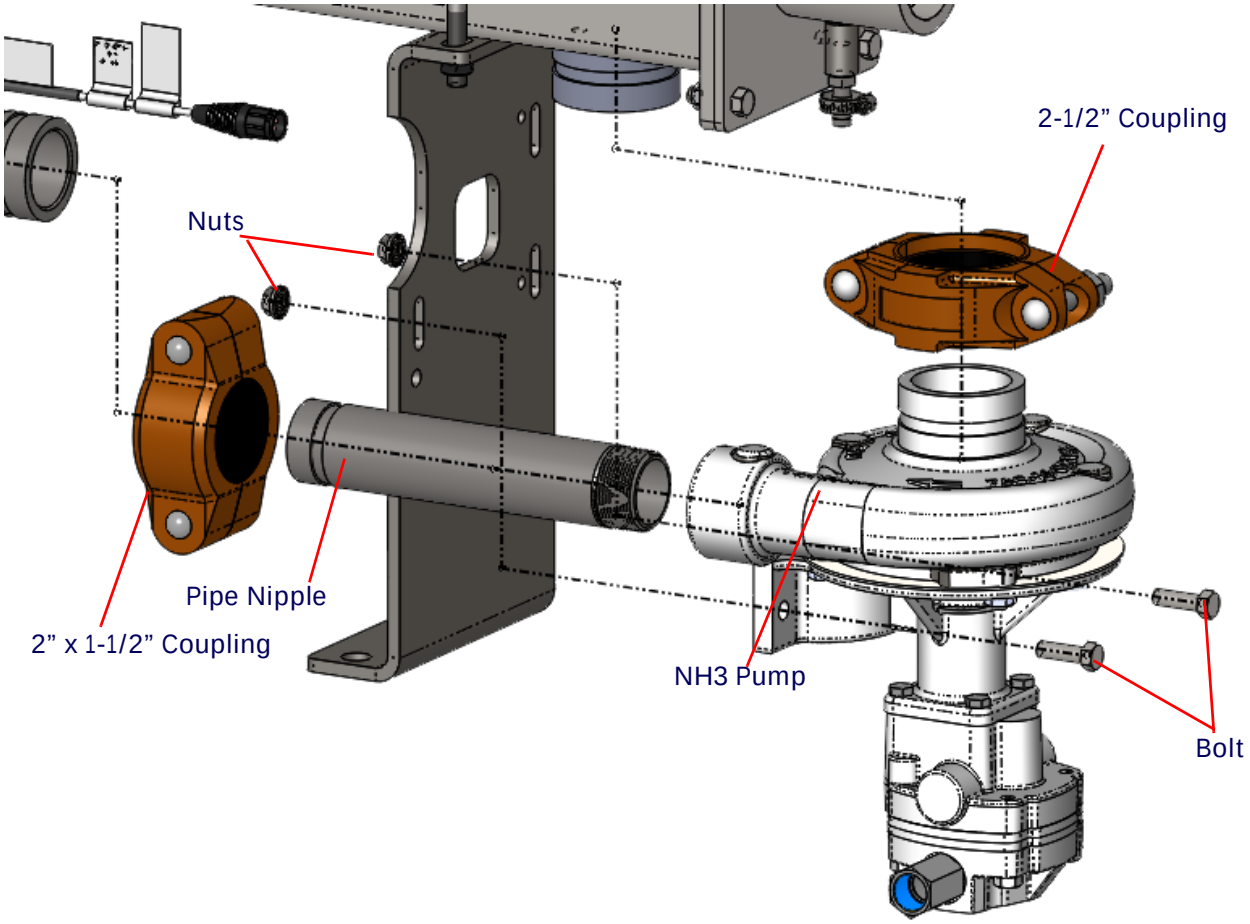
1. Place the control node (sold separately) on the mounting plate so the edge of the control node with the connections is flush with the flat side of the node mounting bracket. Refer to Figure 21.
2. Use three bolts and nuts to secure the control node to the mounting plate.
3. Use two bolts and nuts to secure the node mounting plate to the Vortex cooler support bracket (Figure 22).

FIGURE 22. Installing Control Node/Mounting Plate to Vortex Cooler Bracket



INSTALLING PUMP UPGRADE (VORTEX TO HP+ UPGRADE)

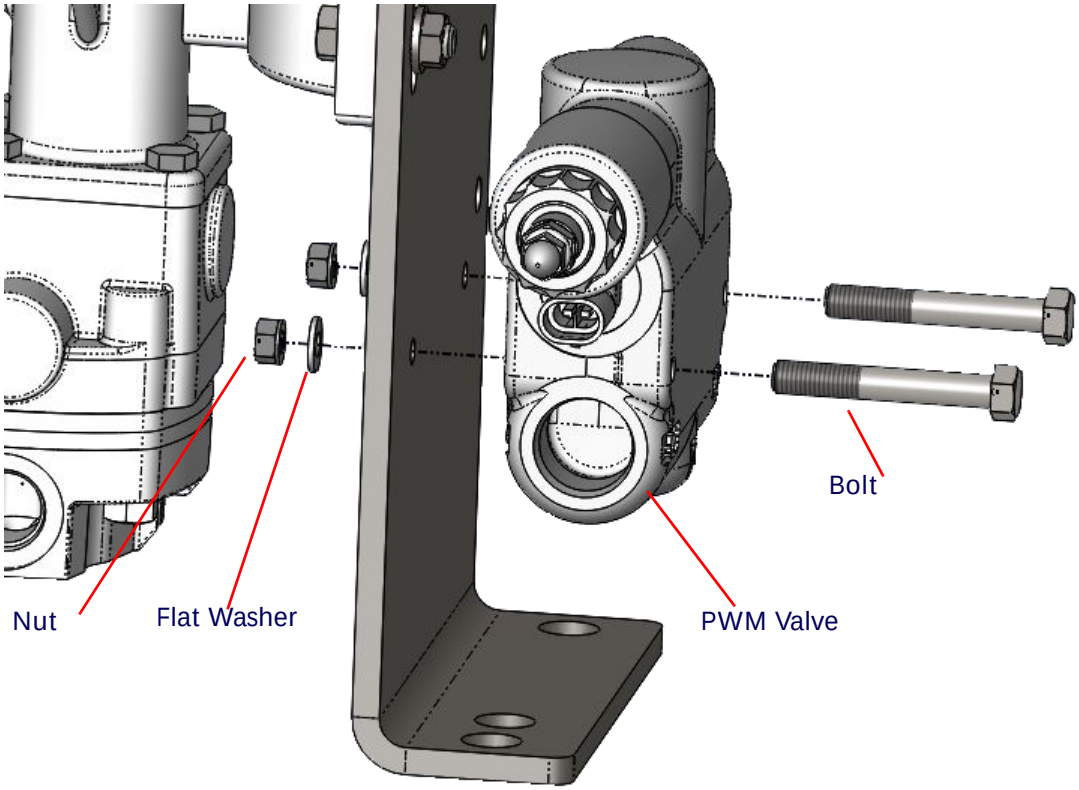
FIGURE 23. Installing Pump Upgrade and Fittings



1. Apply PTFE thread sealant to the threaded end of the pipe nipple.
2. Install the pipe nipple into the NH_3 pump as shown in Figure 23.
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 23.
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 24. 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 24.

BOOST PUMP HYDRAULIC CONNECTIONS (HP+ SYSTEM ONLY)

FIGURE 25. HP+ Hydraulic Fitting and Hose Installation

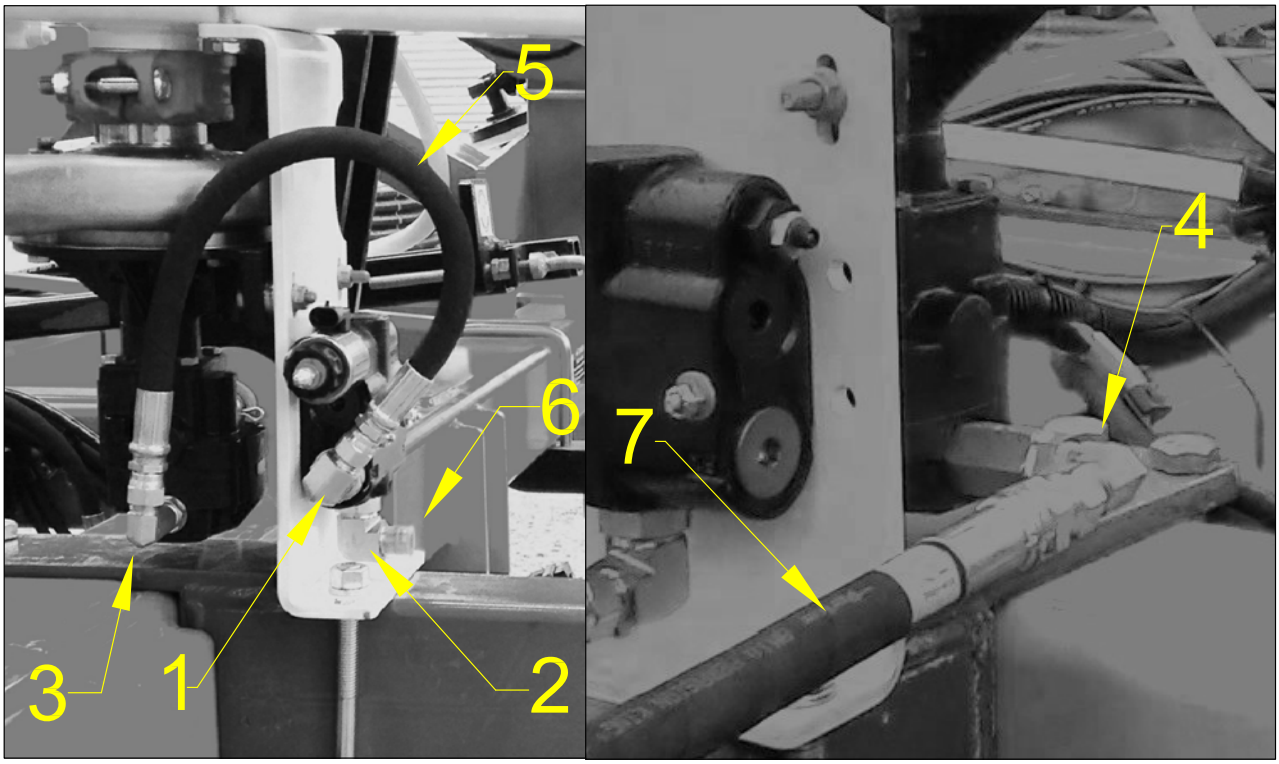


TABLE 1. HP+ Hydraulic Fitting and Hose Installation

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 Low Pressure Return Port

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: Use a low pressure port that returns oil directly to the hydraulic reservoir. Use of this port will extend motor seal life and prevent damaging pressure spikes. Consult the tractor-specific manual or call a dealer to determine the location and proper use of this port. If a port is not available, always turn the pump off in the float position.

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.

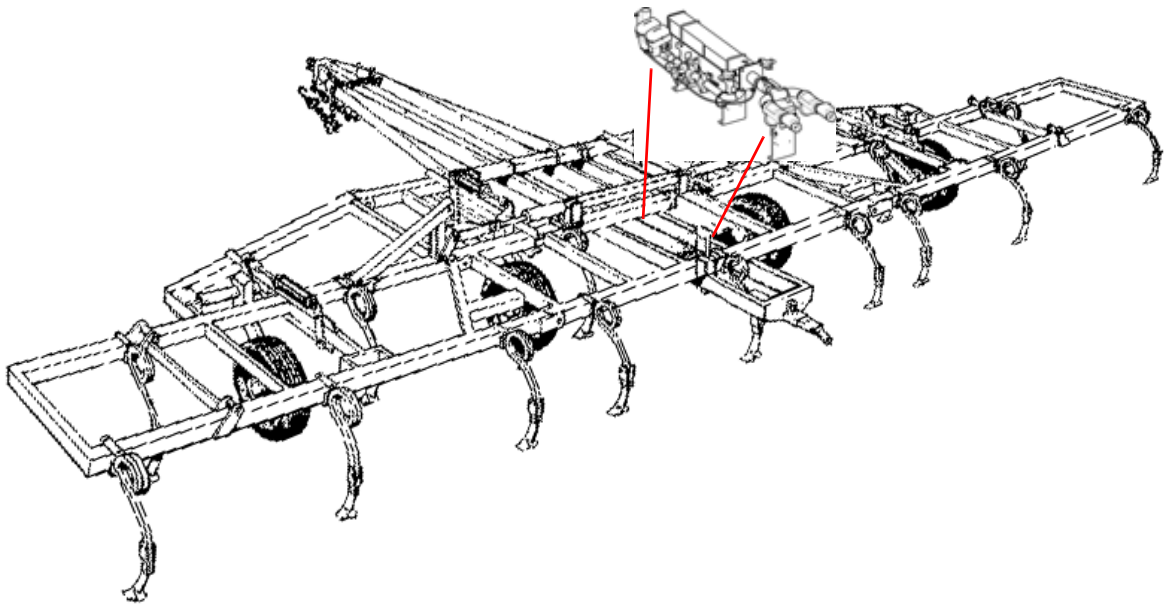
NOTE: Leave the mounting brackets slightly loose during initial installation to allow for adjustment. The mounting bracket location will vary to the left or right of center depending on the location of the standards.

NOTE: Ensure adequate clearance between the cooler and the standard so the standard has a full range of motion and does not contact the cooler assembly. Also verify that the ball valve hands can be pulled to the full off position with the emergency shut-off rope.

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.

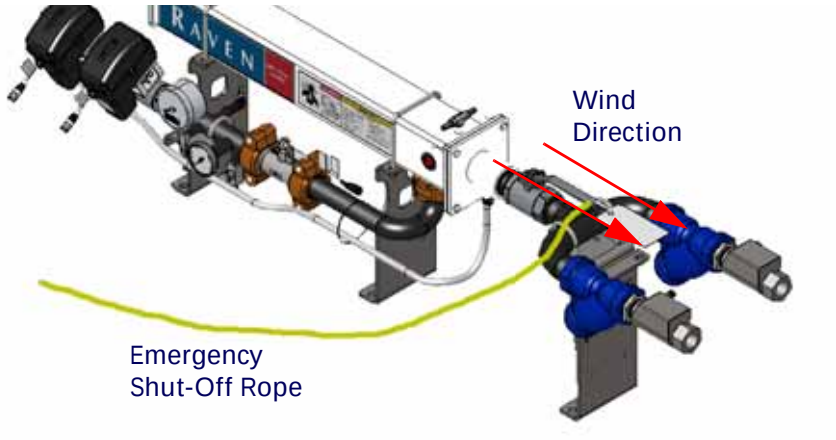
FIGURE 26. AccuFlow Mounting Example



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 27. Using the Emergency Shut-Off Rope

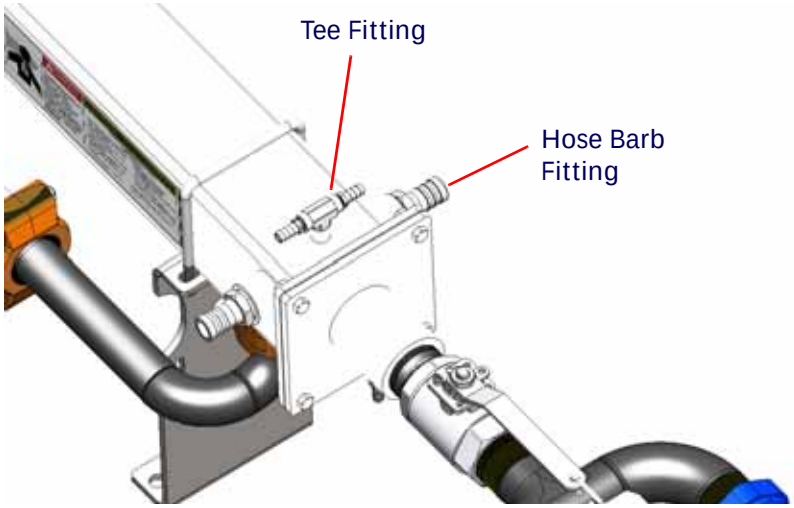


⚠ WARNING

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 28. Vapor Port Assembly



1. Apply PTFE thread sealant to all threaded joints.
2. Install the vapor hose fitting into the vapor port openings.

ACCUFLOW™ VAPOR AND APPLICATOR PLUMBING INSTALLATION

DANGER

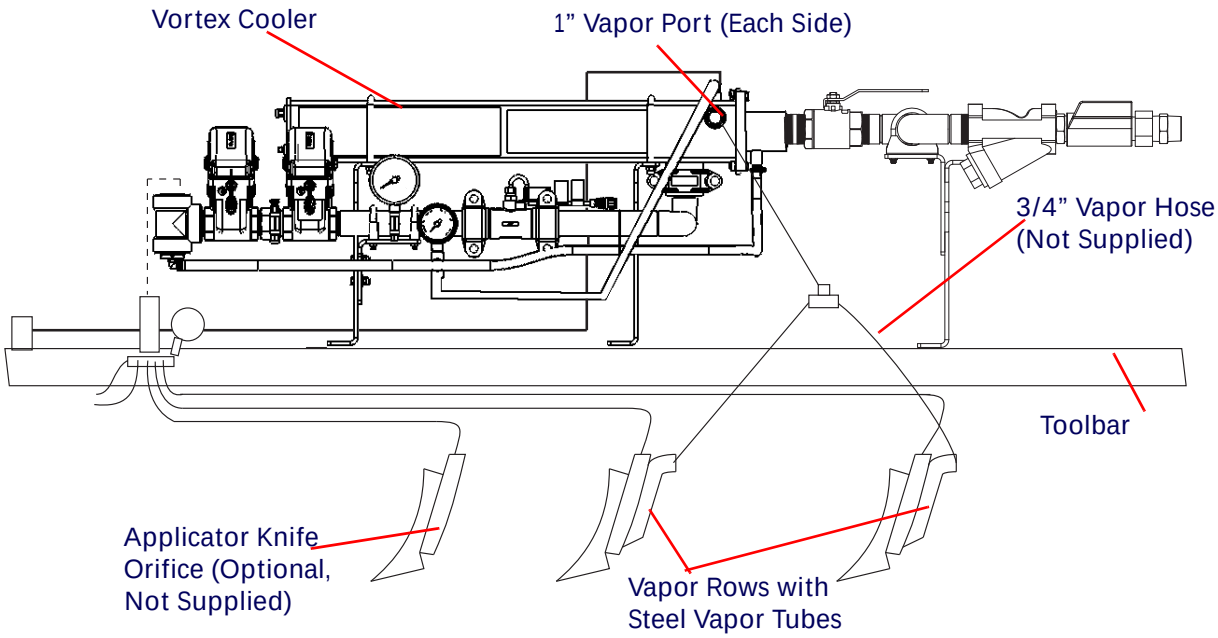
Anhydrous ammonia in vapor form can cause serious injury or death. Pipe joints must be properly sealed with PTFE pipe thread sealant, or an equivalent thread sealant, to prevent leaks.

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 29. 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.

2. Connect vapor tube hoses to vapor ports, tee and steel vapor tubes.
3. 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.
4. 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 vapor knives, placed at least 1 row apart.

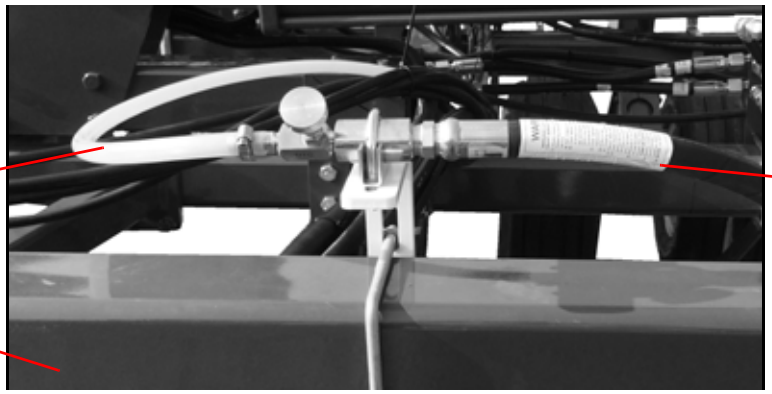
BLEED LINE HOSE ROUTING

1. Apply PTFE thread sealant 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.

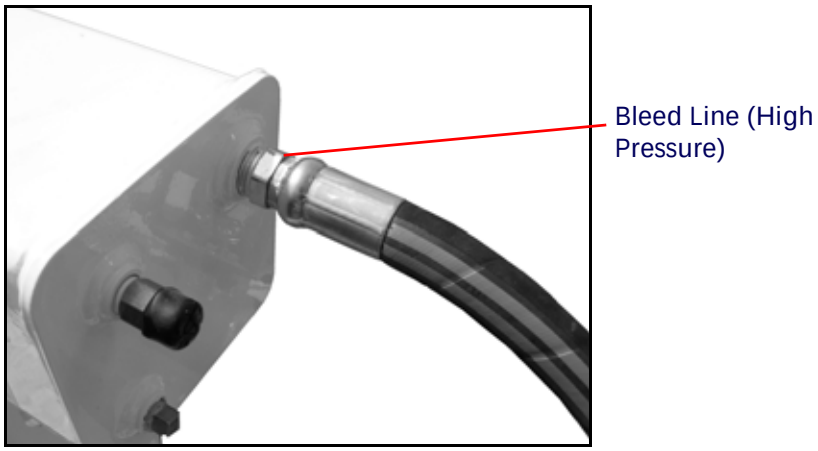
3. Secure the bleed hose to the front of the toolbar. Verify it is an easy to access location that will not allow the hose to pinch or be damaged.

FIGURE 30. Secured Bleed Valve (Bracket Shown Not Provided)



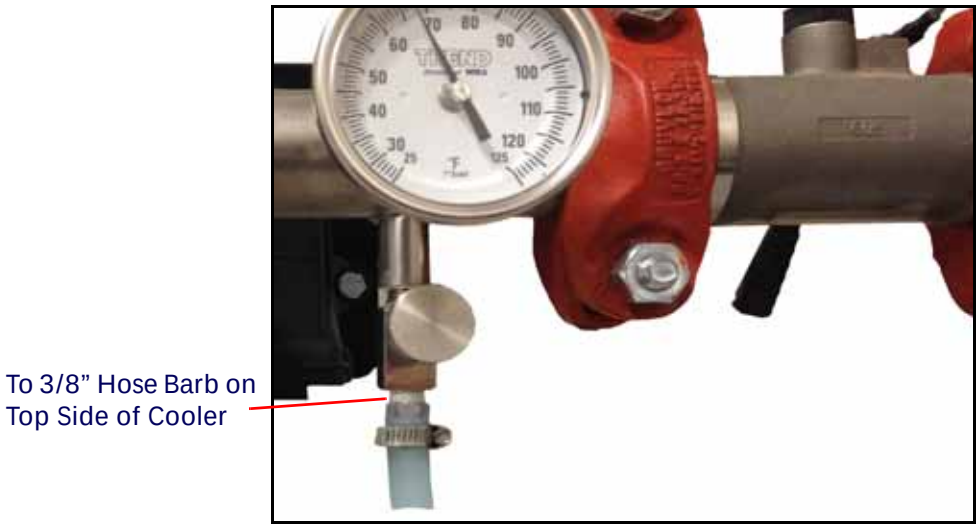
4. Connect one end of the 1/2” high pressure hose to the back of the Vortex cooler and the other end to the needle valve.

FIGURE 31. Attached Bleed Hose.



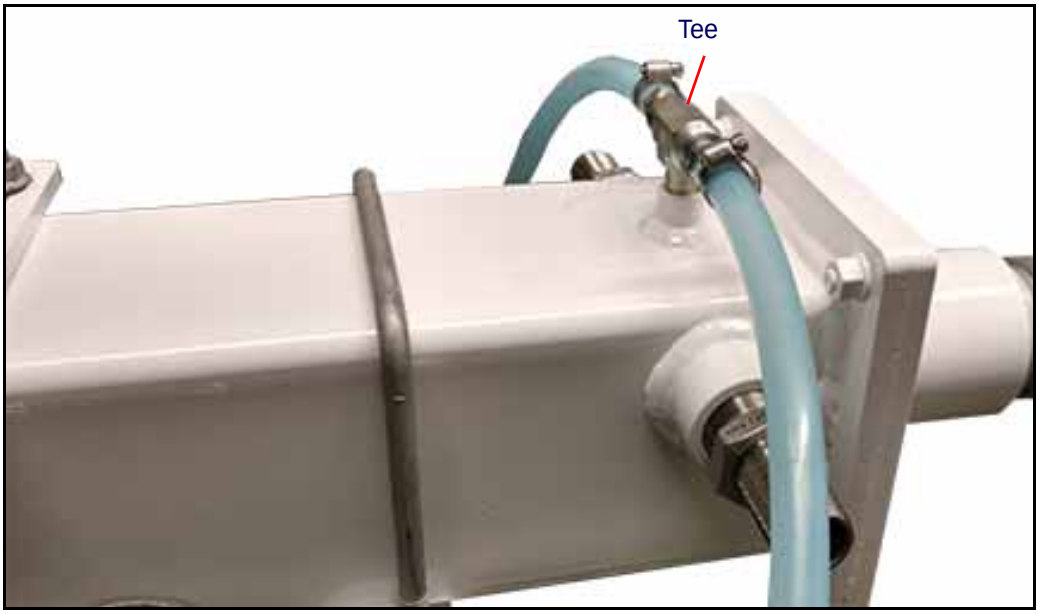
5. Connect the 3/8” low pressure hose to the other side of the needle valve.
6. Route the 3/8” low pressure hose to a 3/8” hose barb tee on the top side of the cooler.

FIGURE 32. 3/8” Barb Tee



7. Connect to the hose barbs on the top of the cooler. This bleeds off into the cooler’s vapor chamber and out to vapor tube knives.

FIGURE 33. 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. If the system is pressurized but the pressure gauge on the system and the gauge on the regulated air source are not equal, inspect both gauge for damage and replace if necessary.

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.

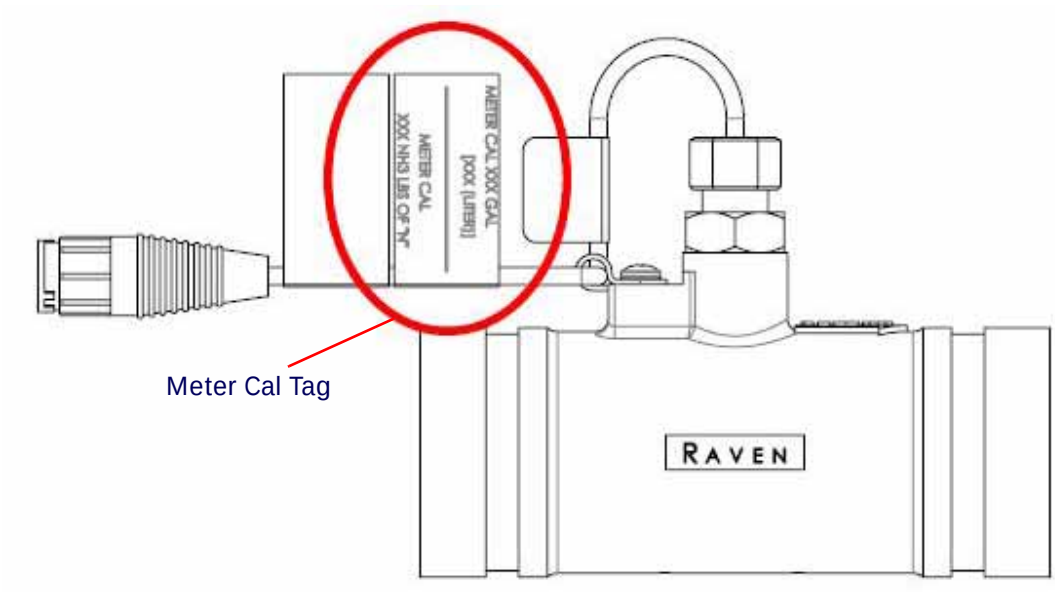
ENTERING SPEED CAL

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.

Meter Cal Gal / 4.22 = Meter Cal Lb N (EQ 2)

Meter Cal Liter / [0.506] = Meter Cal Kg N (EQ 3)

Example: 720 Gal / 4.22 = 170.62 Lb N (EQ 4)

Example: 190 Liter / [0.506] = 375.494 Kg N (EQ 5)

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:

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

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 43.

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:

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

(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:

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

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

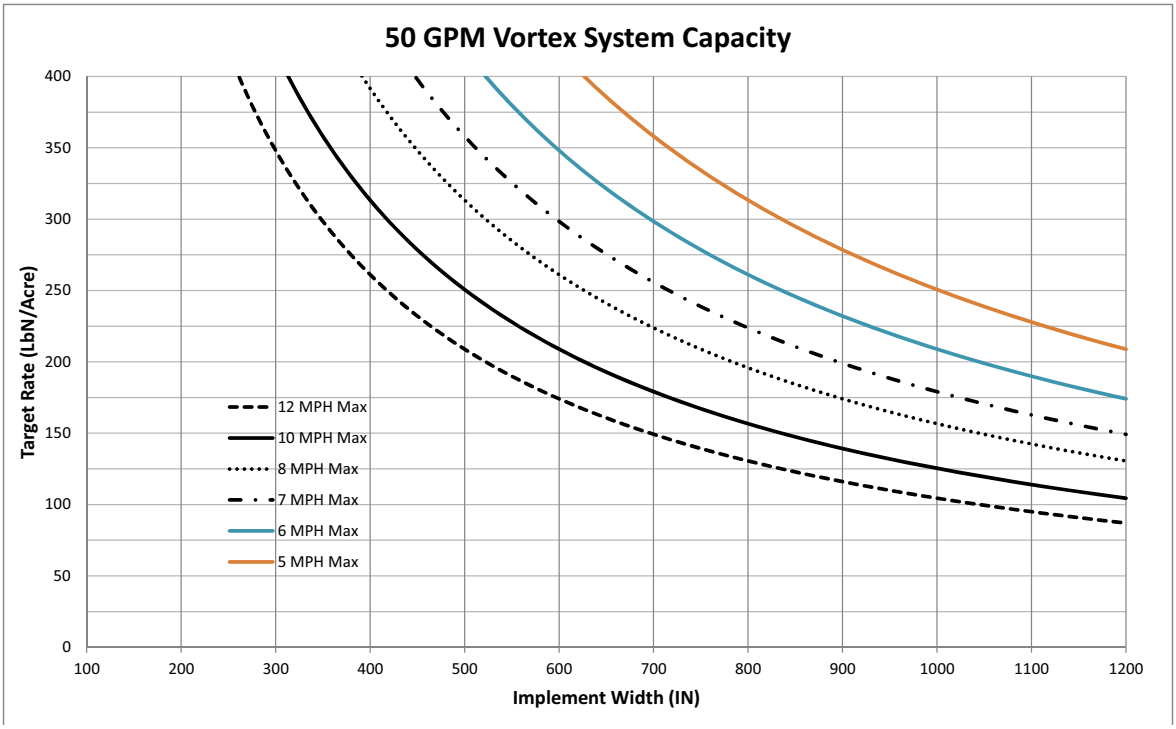
a. Single tank Vortex: 126 lbN/min [57 kgN/min].
b. Dual tank/dual hose Vortex: 210 lbN/min [95 kgN/min].

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 lower values.

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	40-45 [10125-11394]	3.5-4
.125	N/A		N/A		45-50 [11394-112660]	5-6

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 front of the orifice inlet.

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:

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

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

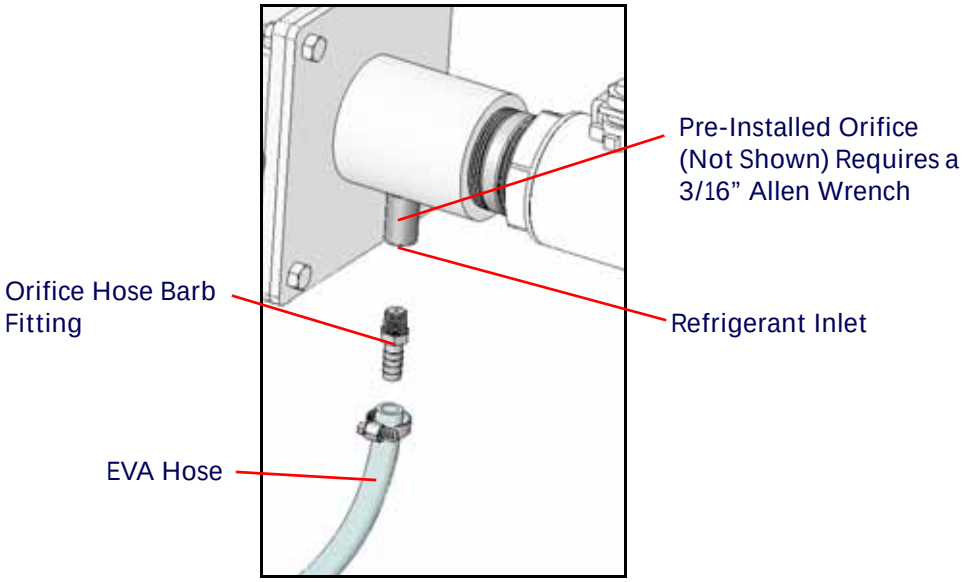
To convert lbN/Hr:

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

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 shut-off valve or the nurse tank shut-off 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 shut-off 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*.

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.

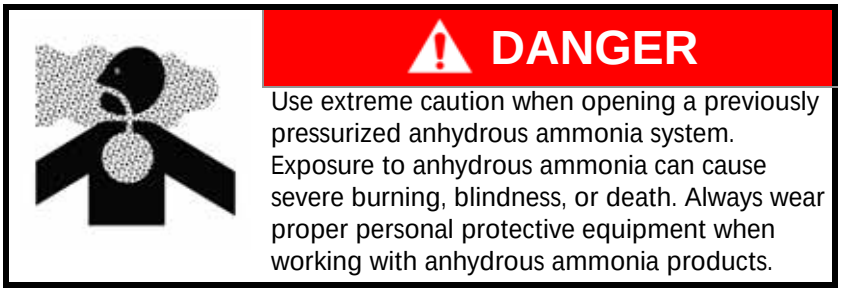
Review the safety requirements associated with the handling and application of anhydrous ammonia with a local NH_3 supplier.

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 shut-off valve or the nurse tank shut-off 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.



    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)

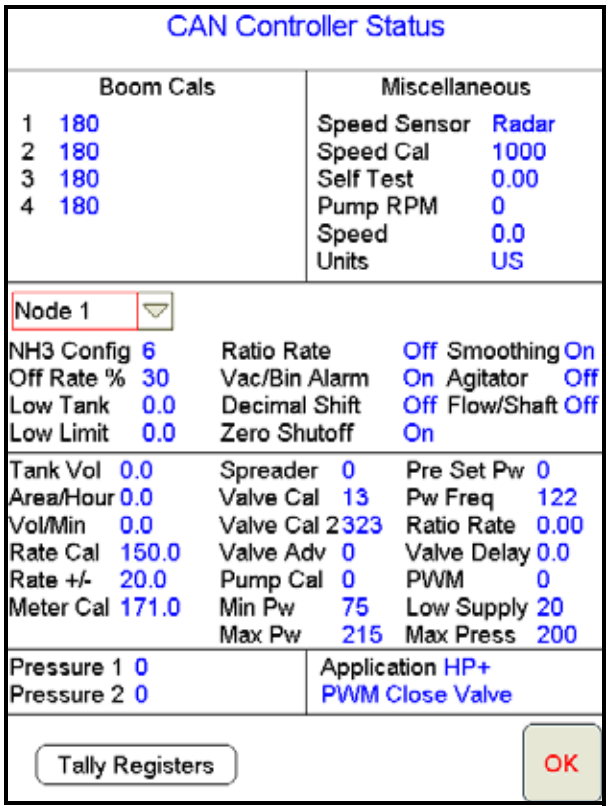
NOTE: For high pulse flowmeters, re-enter the CAL number on the Meter Cal Tag.

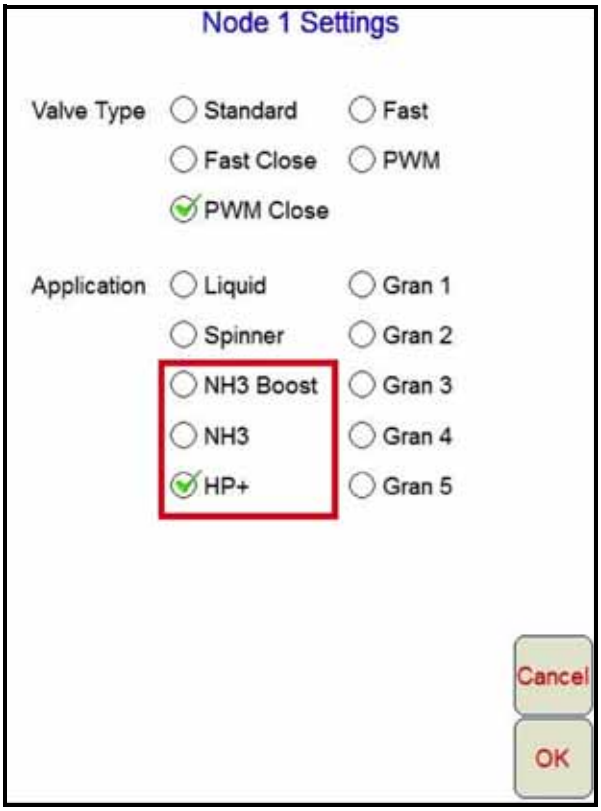
- Valve cal = 13; Valve cal2 = 323.
- Target rate cal = User defined.
- Rate bump = 25 LB/Acre
- PWM frequency = 122
- Min Pw = 45
- Preset Pw = 45
- Max Pw = 255
- Low Supply = 20
- Max Press = 200
- NH_3 Config = 6

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.

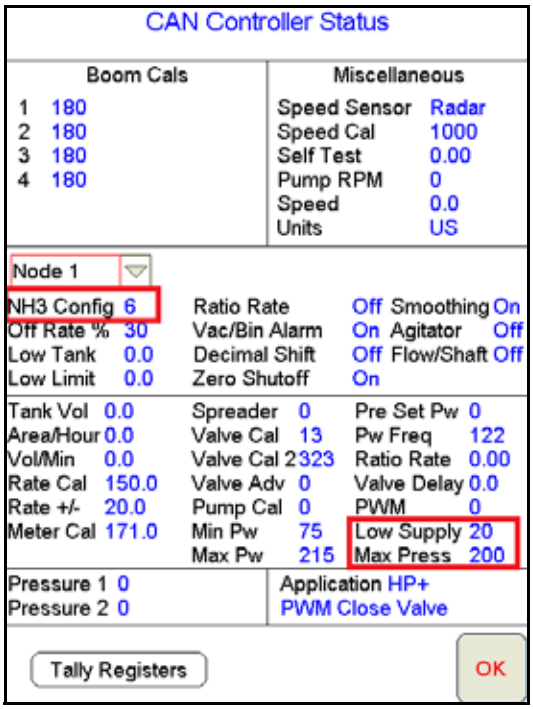
i. 3 - remote prox sensor enabled, section feedback disabled

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

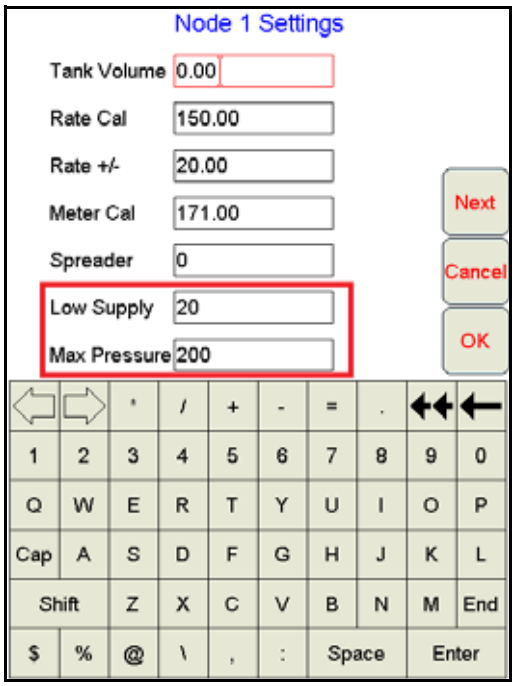


b. 'Low Supply' will generate an error message if pump inlet pressure drops below set value (20 psi default; adjustable from 0-50 psi from Node 1 Settings screen). A setting of zero disables the feature.

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

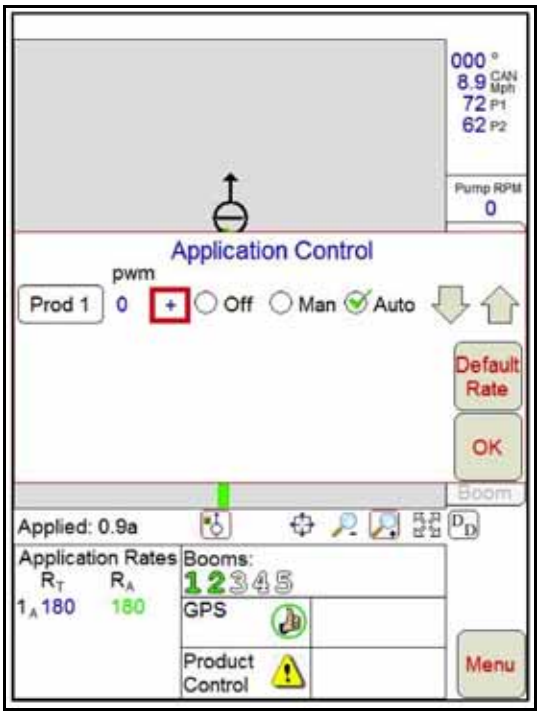


7. Pressure Transducer Cal - Calibrate pressures making sure P1 is the transducer at the gauge tree manifold and P2 is the transducer at the cooler. Complete transducer calibration after the AccuFlow system is fully charged and ready for operation. Refer to Viper Pro manual for steps on pressure transducer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

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

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 43.

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:

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

(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:

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

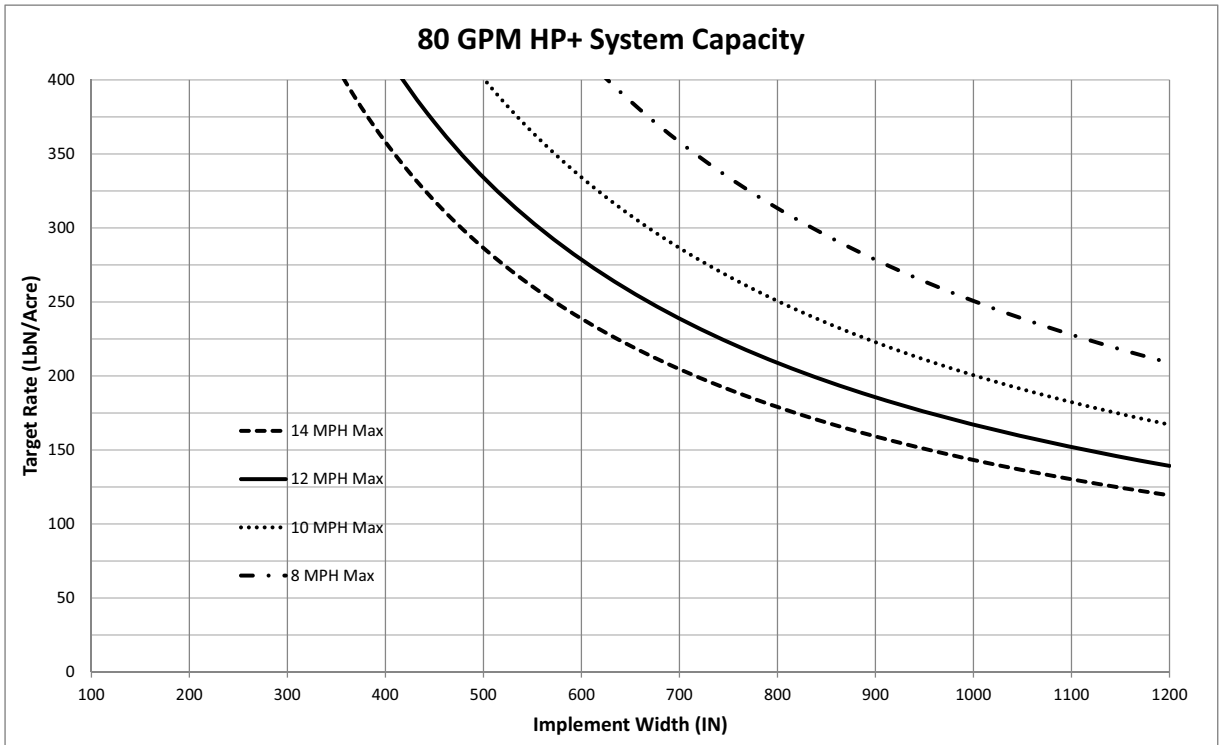
The maximum capacity of the 80 GPM AccuFlow HP+ system is 336 lbs(N)/min [152 kg(N)/min].

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 lower values.

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 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

NOTE: For high pulse flowmeters, enter the CAL number from the Meter Cal Tag

- 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 51 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 76.

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 61 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 63 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 shut-off valve Figure 1 on page 63 (Item 1) on the supply or nurse tank. Also close the shut-off 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 63) 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 63, 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 Shut-off (Top View)

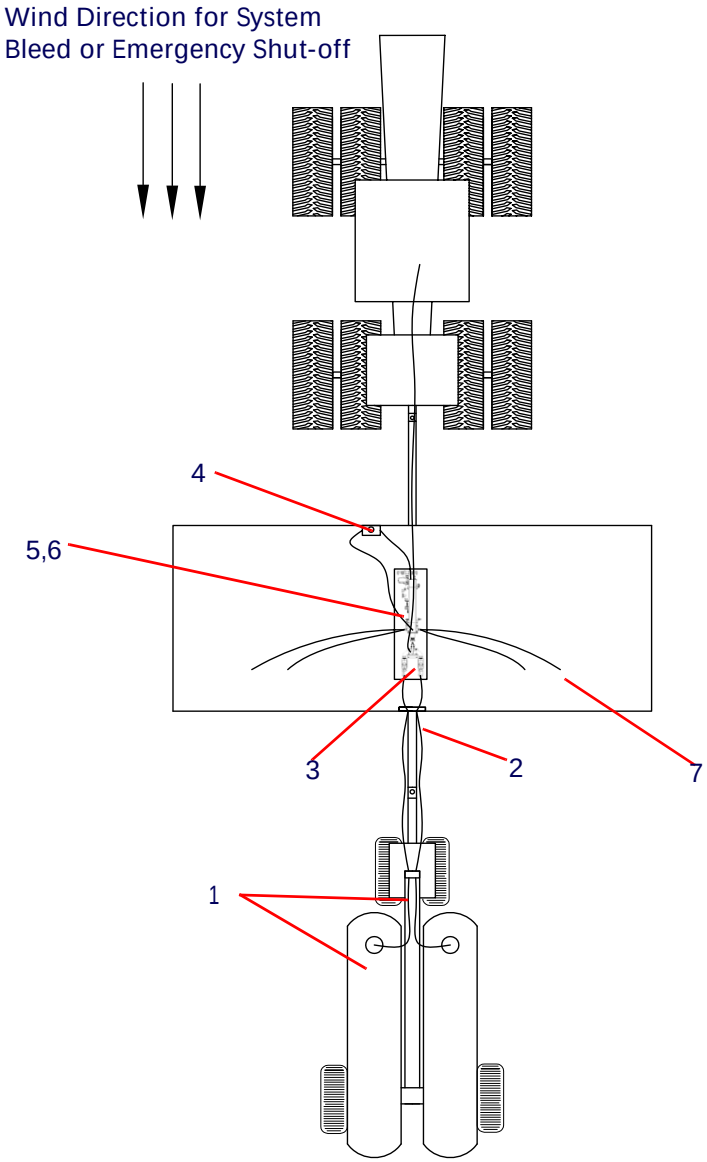
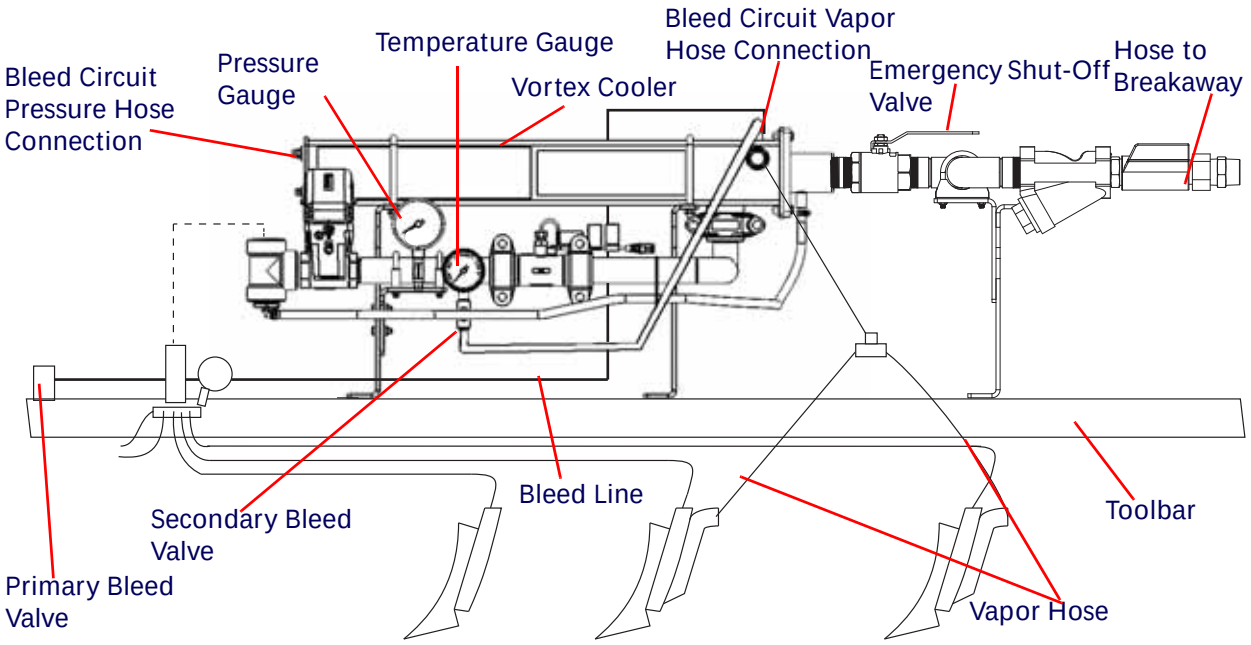


TABLE 1. System Bleed and Emergency Shut-off Components

Component #	Description
1	Nurse Tank Main Shut-off and Bleed Valves (At Bulkhead or Withdrawal Valve)
2	Supply Hose Bleed Valves and Breakaway Couplers
3	Accuflow System Emergency Shut-off 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 Shut-off (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 61 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.

NOTE: For a list of replacement parts and seal kits, refer to the replacement parts listed on the drawings in the *System Diagram and Replacement Parts* section on page 79.

1. Refer to the *Discharging the AccuFlow™ System* section on page 61. 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.

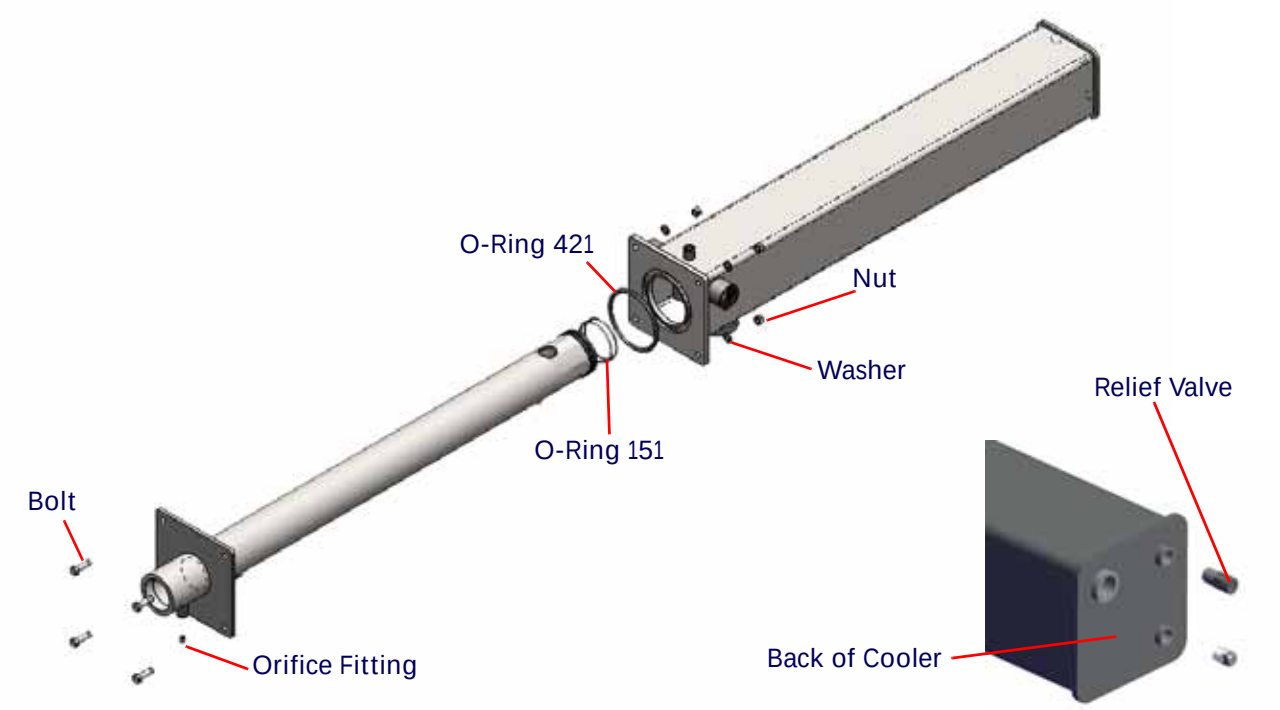
6. Apply thread sealant to the threads of the relief valve and thread the valve into the Vortex cooler body.

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.

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

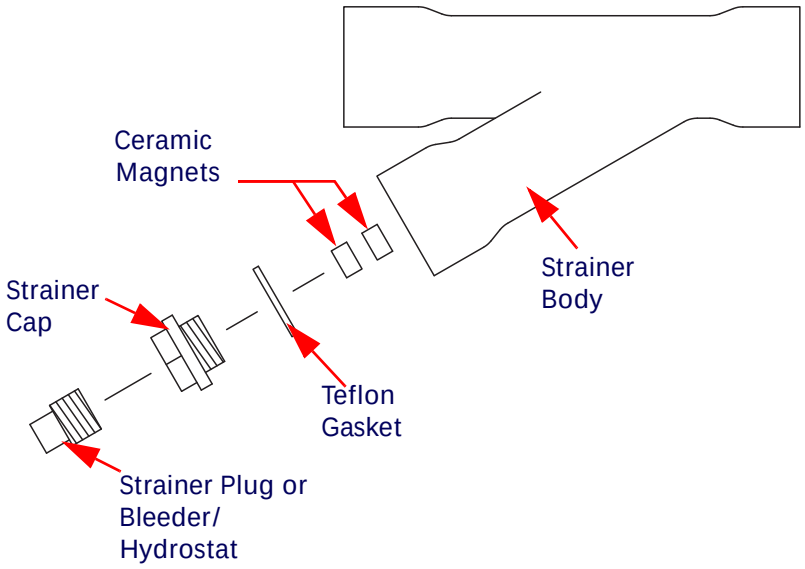
The strainer must be cleaned and inspected periodically or when system performance degrades. Refer to the following procedure to disassemble and maintain the strainer to ensure that the AccuFlow system is operating properly.

DANGER

Anhydrous ammonia can cause severe burning, blindness, or death. Refer to *Discharging the AccuFlow™ System* section on page 5 or page 61 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.

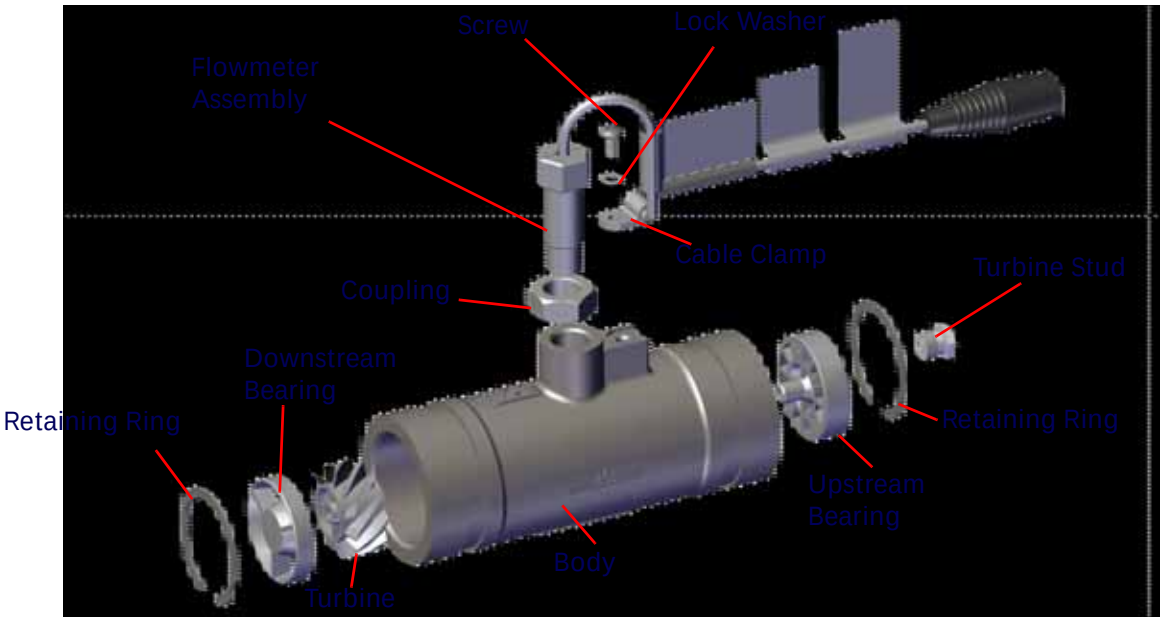
FLOW METER MAINTENANCE AND ADJUSTMENT

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 61 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 61).

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 46 or Figure 5, “System Capacity Chart,” on page 57 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 61). 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 65 for detailed instructions on disassembling the Vortex cooler.
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. 5. If none of the above steps resolve the issue, the console may require repair. Contact a local Raven dealer for further assistance.

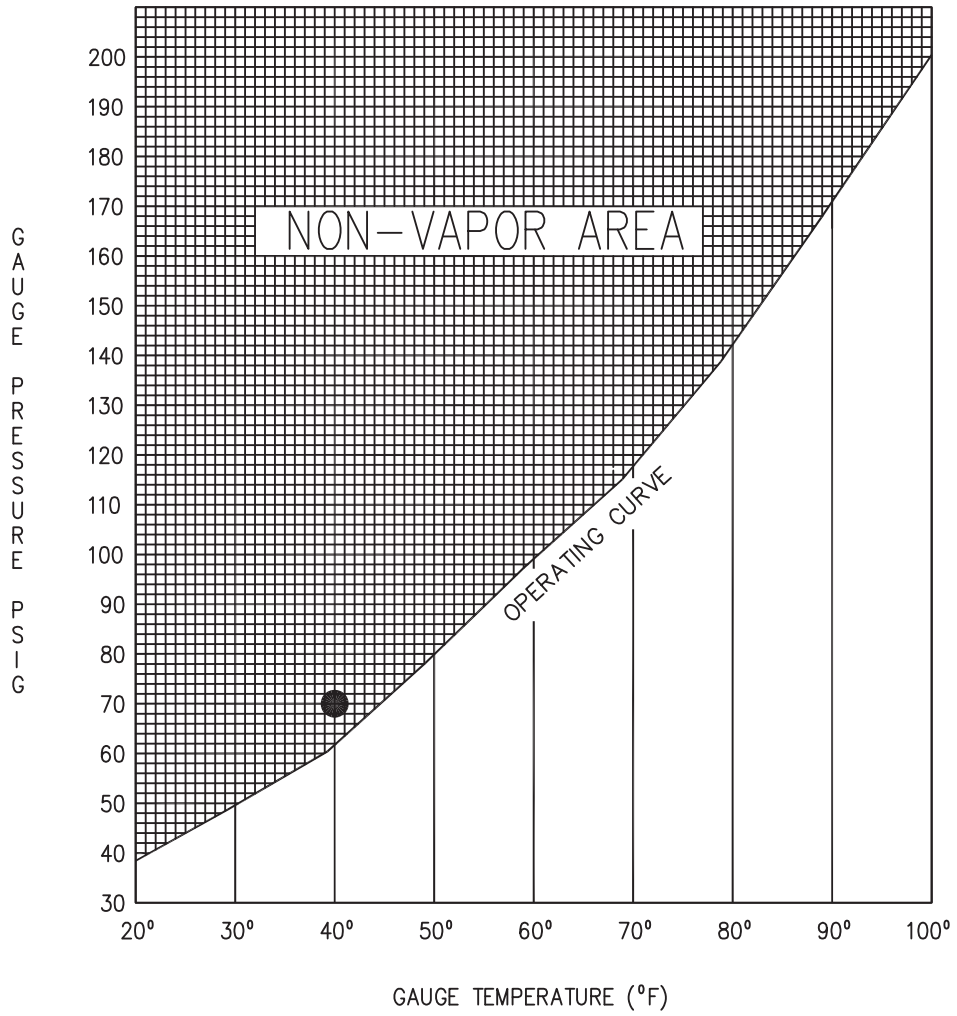
Issue	Resolution
(SCS 400 to 700 Series consoles only) All keyboard lights are on at the same time.	The console may require repair. Contact a local Raven dealer for further assistance.
(SCS 400 to 700 Series consoles only) Keyboard does not work for entries.	The console may require repair. Contact a 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.
(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.

Issue	Resolution
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 61 before performing maintenance on the AccuFlow system. 7. Verify that the nurse tank has a high flow valve.
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 68. 3. See console installation manual.

Issue	Resolution
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 58 for details on adjusting the remote tractor hydraulics.
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

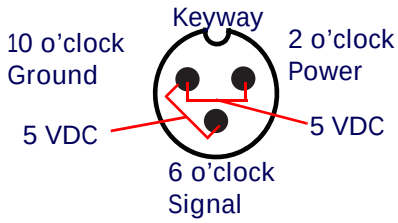


Given an observed pressure reading 70 PSI and temperature reading 40° F. The point where these two readings intersect is within the non-vapor area.

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 78.

TESTING THE SPEED SENSOR EXTENSION CABLE

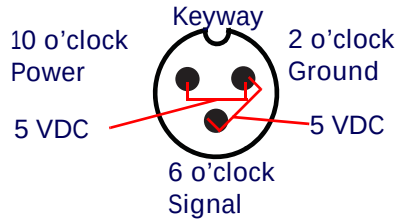
1. Enter a speed cal of 9999.
2. Zero the odometer by entering a zero value in the distance button.
3. With a small jumper wire (or paper clip), short between the 10 o'clock and 6 o'clock sockets with a 'short-no-short' motion. Each time contact is made, the distance total should increase by increments 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 77.

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.

CONTROL VALVE WIRING

MASTER ON/OFF AND SECTION VALVE PIN OUT

FIGURE 4. Master On/Off and Section Valves Plug End Pins

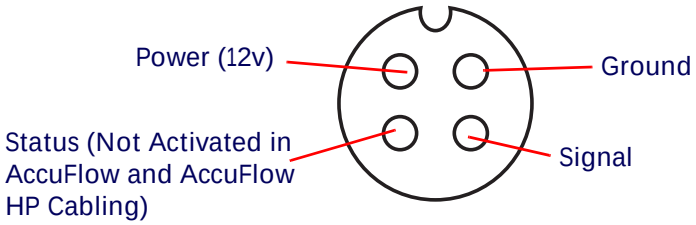
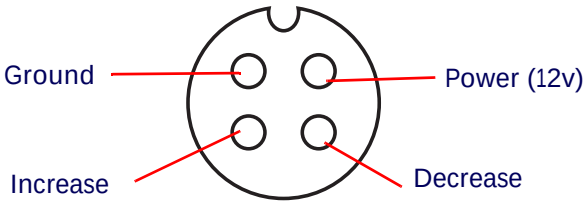


FIGURE 5. Control Valve Plug End Pins



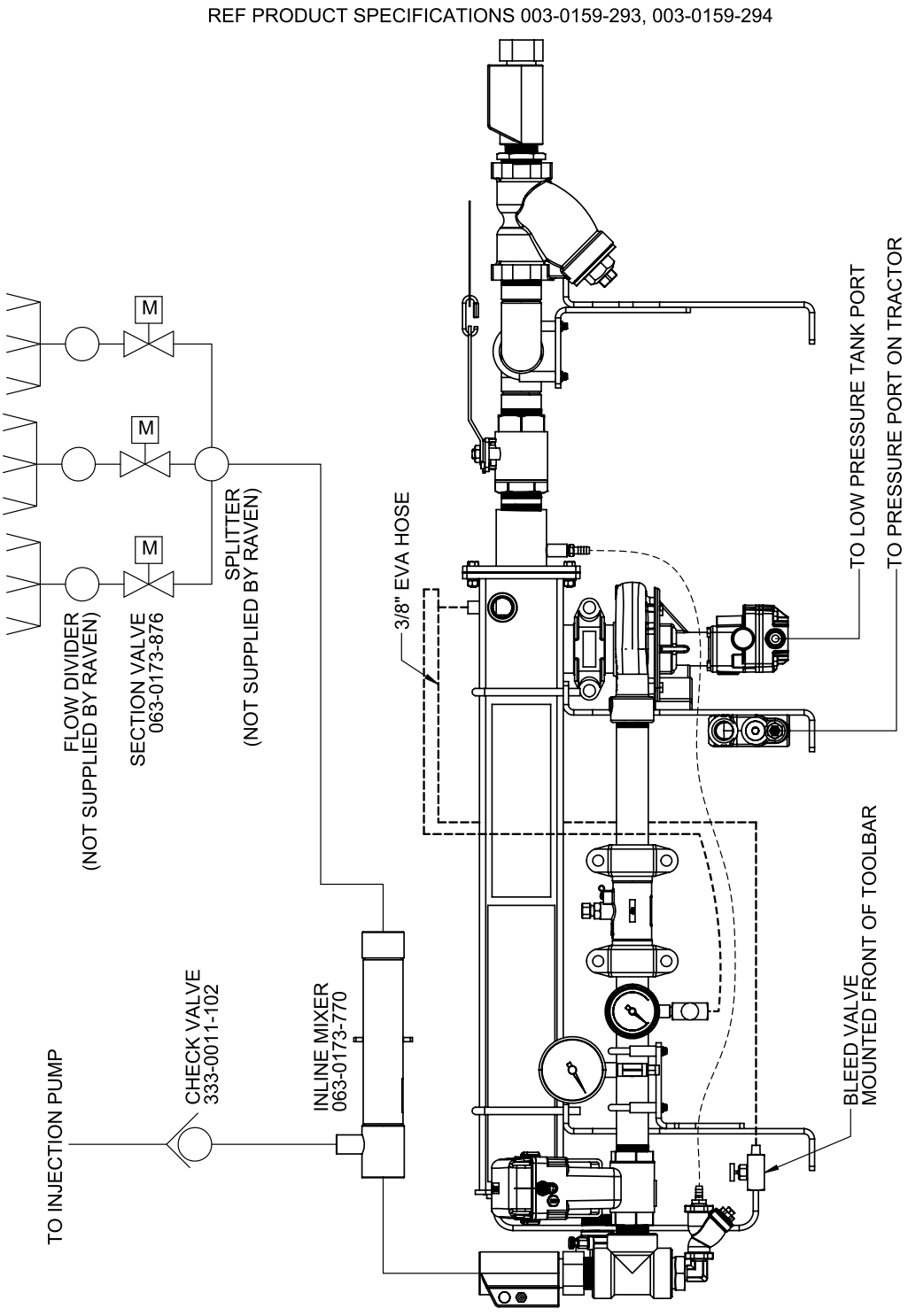
CHAPTER 8 SYSTEM DIAGRAM AND REPLACEMENT PARTS

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.

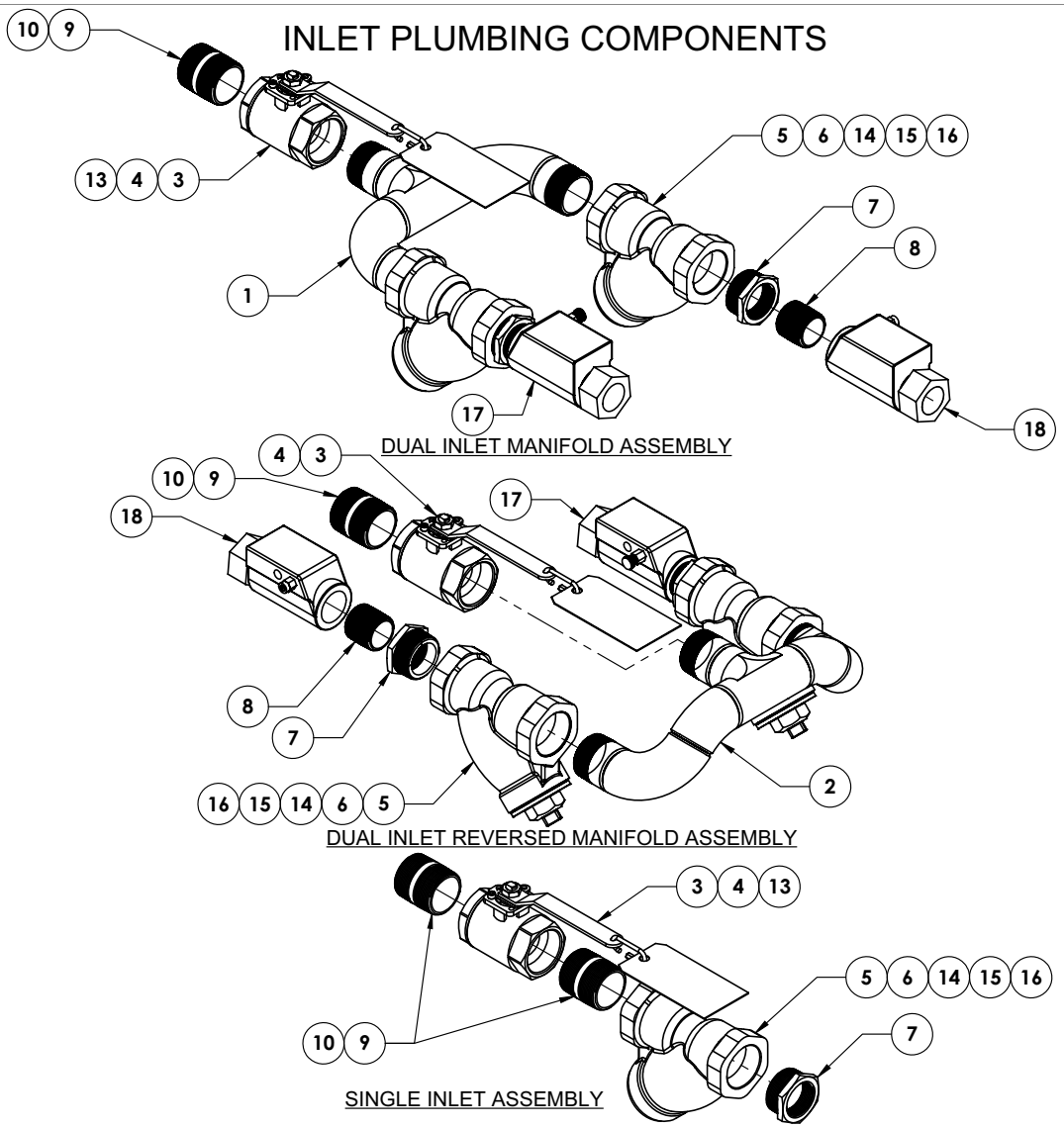
NOTE: Contact a local Raven dealer for additional information or assistance with cabling or Raven AccuFlow system components.

FIGURE 1. AccuFlow Vortex and HP+ System Diagram (054-1201-001)



REPLACEMENT PARTS DRAWINGS

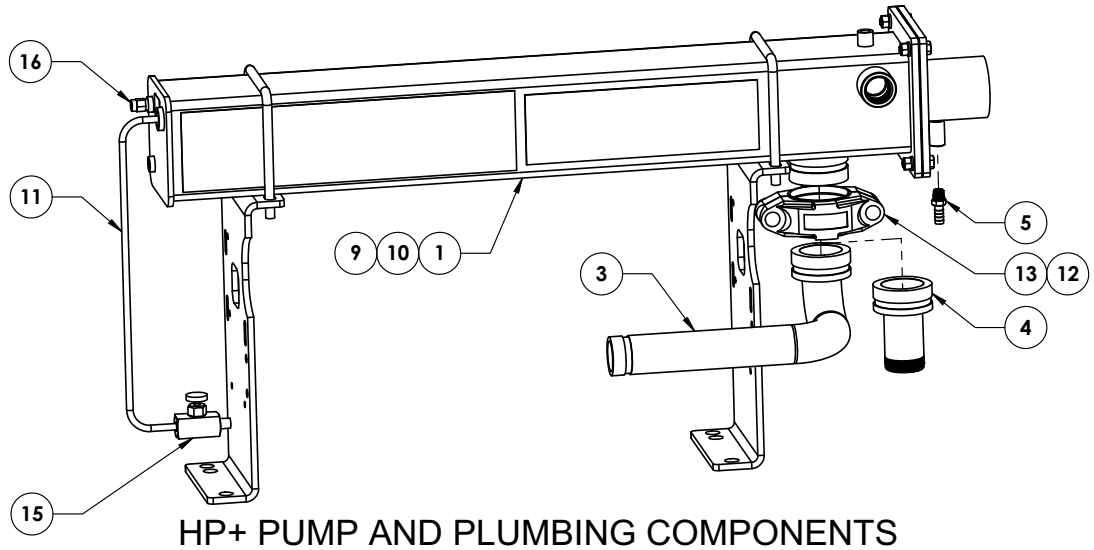
FIGURE 2. Inlet Plumbing Components (054-1201-001)



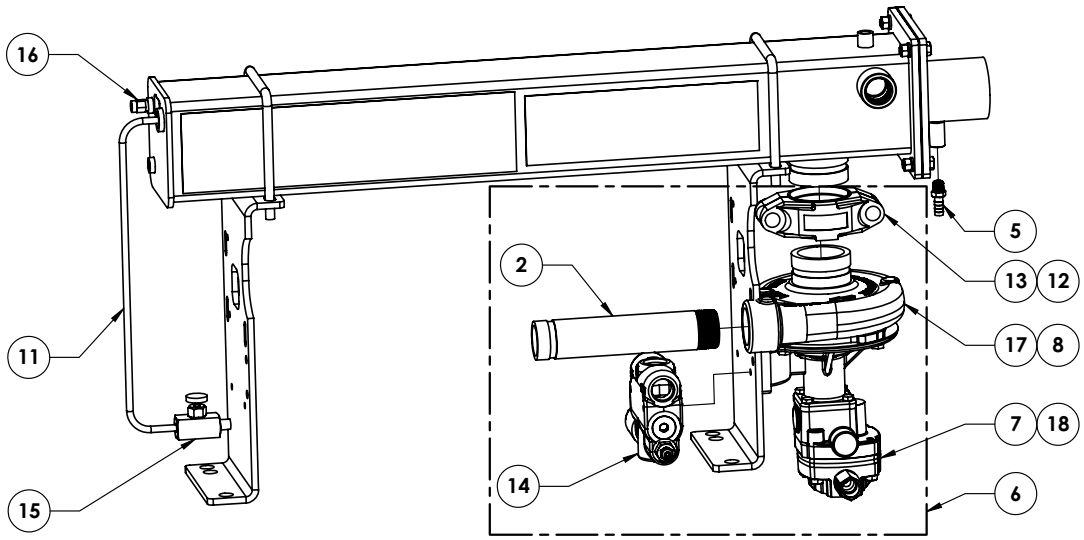
ITM	PART NUMBER	DESCRIPTION	SPECIAL NOTE
18	063-0173-691	BACK CHECK VALVE WITH HYDROSTAT	
17	063-0173-692	BACK CHECK VALVE WITH BLEED VALVE	
16	418-0000-001	STRAINER MAGNET	
15	333-9000-067	FITTING, 20 MESH SCREEN, 1-1/2" Y-STRAINER	
14	333-9000-071	STRAINER SCREEN, 40 MESH	
13	321-0000-359	ROPE, BRAIDED POLY, 1/4" (INCLUDED IN KIT 117-0171-597)	
12	219-0000-154	GASKET TEFLON WASHER 1 1/2" STRAINER, NH3	
11	219-0000-161	GASKET, TEFLON WASHER, 2" STRAINER, NH3	
10	333-0008-047	FITTINGS, PIPE NIPPLES, BLACK IRON SCHEDULE 80, 1-1/2" NPT X 2" L	
9	333-0008-493	FITTING, NIPPLE, 2" NPT X CLOSE, SCH 80, SEAMLESS, MAGNI 565	
8	333-0008-491	FITTING, NIPPLE, 1-1/2" NPT X CLOSE, SCH 80, SEAMLESS, MAGNI 565	
7	333-0003-097	FITTING, REDUCING BUSHING, 2" X 1-1/2" NPT, CLASS 3000, MAGNI 565	
6	063-0173-312	ASSEMBLY, NH3 STRAINER, Y-TYPE, 1 1/2" WITH MAGNETS	
5	063-0173-655	STRAINER, Y-TYPE, 2" W/MAGNETS	
4	063-0173-933	ASSEMBLY, 1-1/2" NH3 VALVE	
3	063-0173-627	ASSEMBLY, 2" VALVE	
2	116-0159-755	WELDMENT, INLET MANIFOLD, REVERSED	
1	116-0159-742	WELDMENT, INLET MANIFOLD	

SHEET 6 OF 9

FIGURE 3. Vortex Cooler and Bleed Components (054-1201-001)



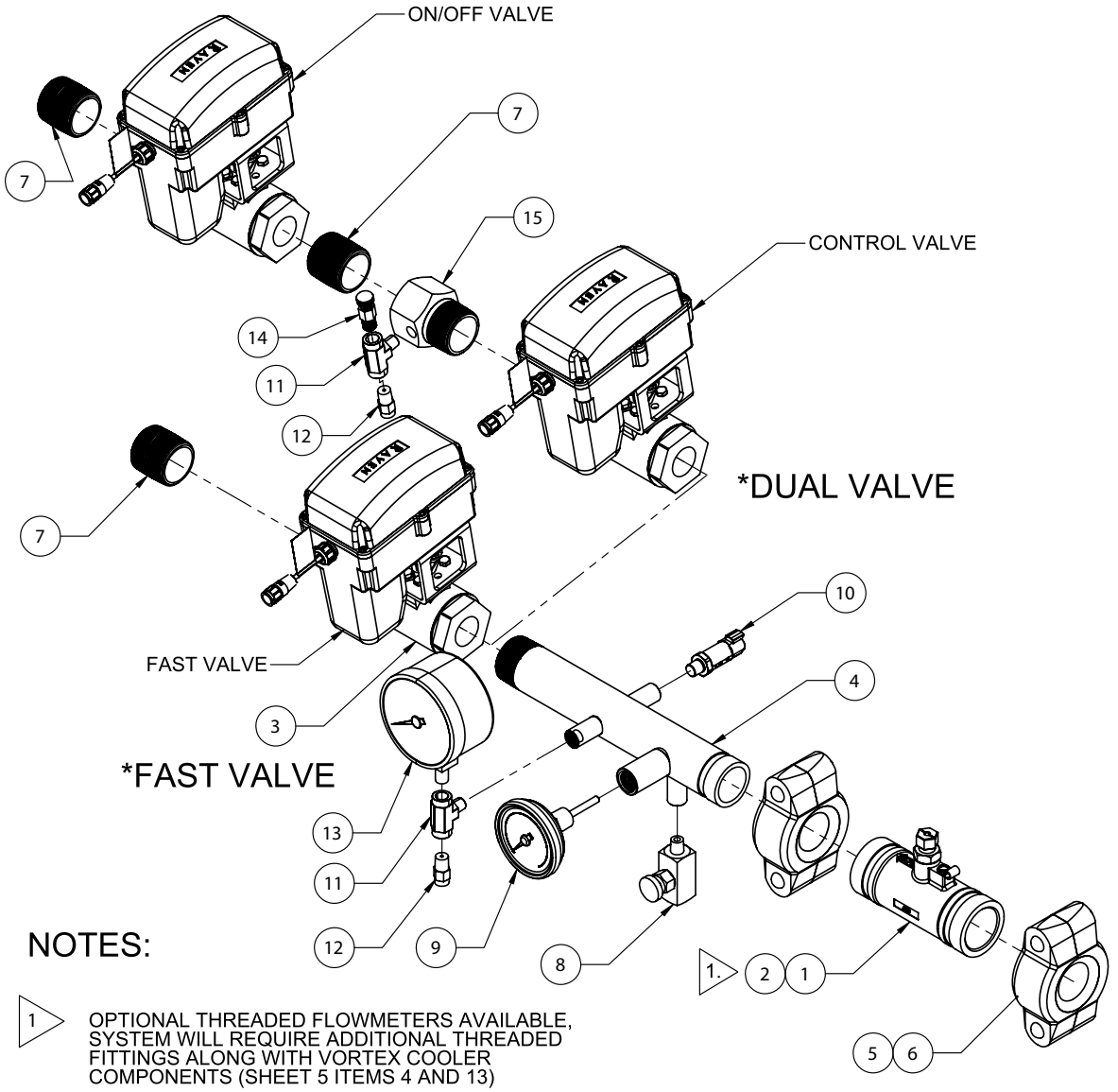
HP+ PUMP AND PLUMBING COMPONENTS



ITM	PART NUMBER	DESCRIPTION	SPECIAL NOTE
18	416-8000-005	HYDRAULIC MOTOR REPLACEMENT, NH3 HP+ PUMP (FOR 416-1001-010)	
17	416-1001-010	NH3 PUMP, HP+	
16	334-0002-005	VALVE, HYDROSTATIC RELIEF	
15	334-0001-064	NEEDLE VALVE, 1/4"NPT MALE/FEMALE	PRIMARY BLEED
14	334-0001-042	VALVE, BRAND, PULSE WIDTH MODULATION	
13	333-0006-031	COUPLING, 2-1/2", GROOVED, EPDM GASKET	
12	219-0003-266	GASKET, REPLACEMENT, 2-1/2", 7001 COUPLING	
11	214-0001-046	HOSE, NH3 1/2" x 72" BLEED CIRCUIT, HIGH PRESSURE	
10	117-0171-592	KIT, ACCUFLOW DECALS	
9	117-0171-591	KIT, ACCUFLOW, SEAL & HARDWARE	
8	117-0171-577	KIT, HP+ BOOST PUMP SEAL	
7	117-0171-576	KIT, HP+ HYDRAULIC MOTOR SEAL	
6	117-0171-575	KIT, HP+ PUMP UPGRADE	
5	117-0171-501	KIT, ORIFICE, NH3	
4	116-0159-776	WELDMENT, 2-1/2" GRUVLOK TO 1-1/2" NPT ADAPTER	OPTIONAL
3	116-0159-752	WELDMENT, OUTLET MANIFOLD	
2	019-0159-591	MODIFICATION, GRUV-LOK, PIPE NIPPLE	
1	063-0173-663	ASSEMBLY, VORTEX COOLER (BOXED)	

SHEET 7 OF 9

FIGURE 4. Gauge Tree, Sensor, Flowmeter & Valve Components (054-1201-001)



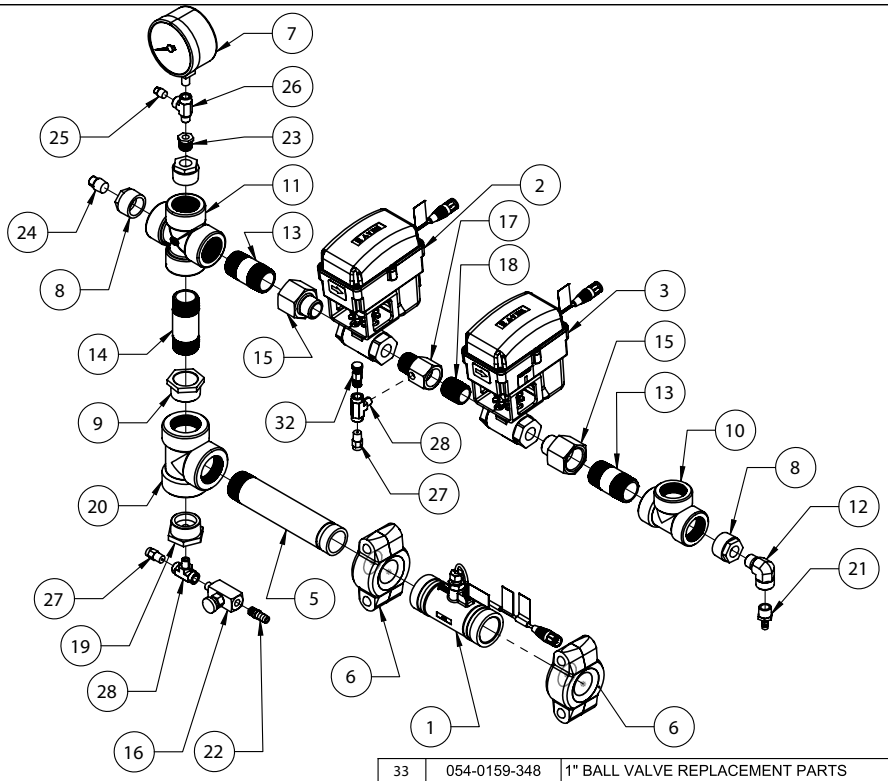
NOTES:

1. OPTIONAL THREADED FLOWMETERS AVAILABLE, SYSTEM WILL REQUIRE ADDITIONAL THREADED FITTINGS ALONG WITH VORTEX COOLER COMPONENTS (SHEET 5 ITEMS 4 AND 13)

ITM	PART NUMBER	DESCRIPTION	SPECIAL NOTE
15	333-0002-214	FITTING, ADAPTER, 1-1/2" NPT WITH 1/4" NPT RELIEF PORT	
14	334-0001-012	BLEED VALVE	
13	417-0001-034	GAUGE, PRESSURE, 0-400 PSI	
12	334-0002-005	VALVE, HYDROSTATIC RELIEF	
11	333-0004-039	FITTING, MALE BRANCH PIPE TEE, 1/4-18 NPTF	
10	422-0000-119	PRESSURE TRANSDUCER, 1-5V, 0-250 PSI, 1/4" NPT, STAINLESS STEEL	
9	417-0001-031	GAUGE, TEMPERATURE	
8	334-0001-064	NEEDLE VALVE, 1/4"NPT MALE/FEMALE	SECONDRY BLEED
7	333-0008-491	FITTING, NIPPLE, 1-1/2" NPT X CLOSE, SCH 80, SEAMLESS, MAGNI 565	
6	333-0006-032	COUPLING, 2" X 1.5", GROOVED, EPDM GASKET	
5	219-0003-267	GASKET, REPLACEMENT, 2" x 1-1/2"	
4	116-0159-743	WELDMENT, GAUGE MANIFOLD	
3	054-0159-342	1-1/2" BALL VALVE REPLACEMENT PARTS	
2	054-0159-334	FLOWMETER, RFM 15SG, REPLACEMENT PARTS	OPTIONAL
1	054-0159-144	FLOWMETER, RFM 60SG, REPLACEMENT PARTS	

SHEET 8 OF 9

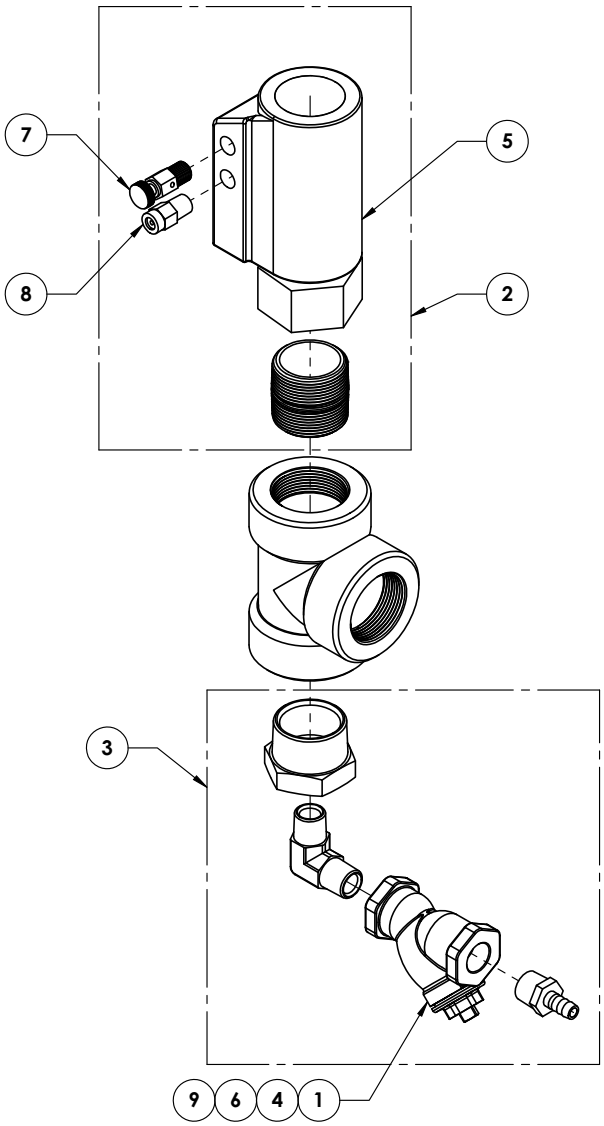
FIGURE 5. 1” Gauge Tree and Valve Assembly (054-1201-001)



ITM	PART NUMBER	DESCRIPTION
33	054-0159-348	1" BALL VALVE REPLACEMENT PARTS
32	334-0001-012	BLEED VALVE
31	333-0002-905	FITTING, COUPLING, REDUCING 1/2" X 1/4" NPT, 304 SS CLASS 3000
30	312-1001-169	NUT, FLANGED LOCK 5/16"-18 UNC ZINC PLATED
29	333-0002-214	FITTING, ADAPTER, 1-1/2" NPT WITH 1/4" NPT RELIEF PORT
28	333-0004-039	FITTING, MALE BRANCH PIPE TEE, 1/4-18 NPTF
27	334-0002-005	VALVE, HYDROSTATIC RELIEF
26	333-0004-062	FITTING, MALE RUN PIPE TEE, 1/4" NPT
25	333-0009-082	FITTING, PIPE PLUG, SQUARE HEAD, 1/4" NPT, GALVANIZED
24	333-0009-004	FITTING, PIPE PLUG STEEL, SQUARE HEAD
23	333-0003-005	FITTING, PIPE BUSHING, 1/2" NPT X 1/4" NPT
22	333-0002-004	FITTING, HOSE BARB, 1/4" NPT x 3/8 I.D. HOSE
21	333-0002-006	FITTING, HOSE BARB
20	333-0004-063	FITTING, TEE, 1-1/2" NPT, CLASS 2000
19	333-0003-030	FITTING, PIPE BUSHING, 1-1/2" NPT x 1/4" NPT
18	333-0008-503	FITTING, NIPPLE, 1" NPT X CLOSE, SCH 80, SEAMLESS
17	333-0002-342	FITTING, ADAPTER, 1" NPT WITH 1/4" NPT RELIEF PORT
16	334-0001-064	NEEDLE VALVE, 1/4"NPT MALE/FEMALE
15	333-0002-343	FITTING, PIPE ADAPTER, 1" NPTM X 1 1/4" NPTF
14	333-0008-041	FITTINGS, PIPE NIPPLES, BLACK IRON SCHEDULE 80, 1-1/4" NPT X 4" L
13	333-0008-040	FITTINGS, PIPE NIPPLES, BLACK IRON SCHEDULE 80, 1-1/4" NPT X 3" L
12	333-0005-076	FITTING, 90 DEG. STREET ELBOW, 1/2" NPT
11	333-0004-065	FITTING, PIPE CROSS, 1-1/4" NPT, FORGED STEEL, 2000#
10	333-0004-064	FITTING, TEE, 1-1/4" NPT, CLASS 2000
9	333-0003-019	FITTING, PIPE BUSHING, 1-1/2" NPT x 1-1/4" NPT, FORGED STEEL
8	333-0003-017	FITTING, PIPE BUSHING, 1-1/4" NPT x 1/2" NPT, FORGED STEEL
7	417-0001-034	GAUGE, PRESSURE, 0-400 PSI
6	333-0006-032	COUPLING, 2" X 1.5", GROOVED, EPDM GASKET
5	019-0159-591	MODIFICATION, GRUV-LOK, PIPE NIPPLE
4	063-0173-878	VALVE, FAST, 1" NPT, NH3 **NOT SHOWN**
3	063-0173-876	VALVE, ON/OFF, 1" NPT, NH3
2	063-0173-877	VALVE, CONTROL, 1" NPT, NH3
1	063-0173-869	FLOWMETER, RFM 60SG, HP

SHEET 5 OF 9

FIGURE 6. Optional Outlet Kits (054-1201-001)



ITM	PART NUMBER	DESCRIPTION	SPECIAL NOTE
9	418-0000-010	MAGNET, ROUND	
8	334-0002-005	VALVE, HYDROSTATIC RELIEF	
7	334-0001-012	BLEED VALVE	
6	333-9000-076	1/2" Y-STRAINER SCREEN, 40 MESH	
5	333-0011-103	CHECK VALVE, 1-1/2" FNPT X 1-1/2" FNPT, FULL PORT	
4	219-0000-167	GASKET, REPLACEMENT, 1/2" Y-STRAINER	
3	117-0171-697	KIT, STRAINER, REFRIGERANT LINE, NH3	
2	117-0171-633	KIT, CHECK VALVE, 1-1/2" MULTI SECTION, NH3	
1	063-0173-897	ASSEMBLY, 1/2" Y-STRAINER. W/ MAGNETS	

SHEET 9 OF 9

REPLACEMENT PARTS

FIGURE 7. RFM 60S/60SG Flow Meter Replacement Parts (054-0159-144)

ITEM	DESCRIPTION	RAVEN PART #
1	Rotor/ Magnet Assembly	063–0171–673
2	Hub/Bearing Assy, Upstream	063–0171–674
3	Hub Assembly, Downstream	063–0171–769
4	Ring, Retaining, Wire Formed	335–0003–200
5	Stud Bearing	063–0173–062
6	Sensor Assembly	
	CON–X–ALL, STD	063–0171–669
	CON–X–ALL, HP	063–0172–004
	DEUTSCH DT, HP	063–0172–447
	DEUTSCH DTM, HP	063–0172–458
7	Replacement Part Kit, RFM 60S/60SG (contains items 1 thru 5)	117–0171–590

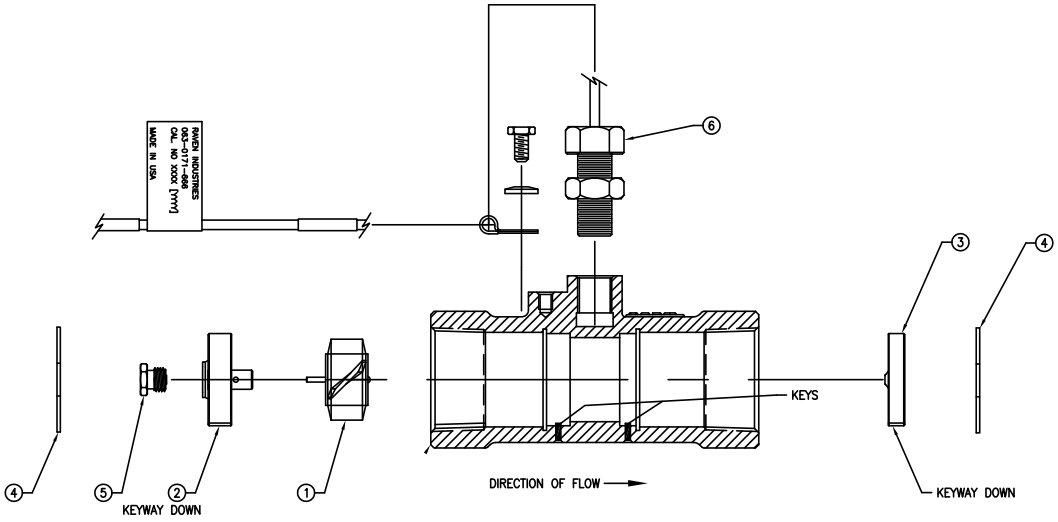
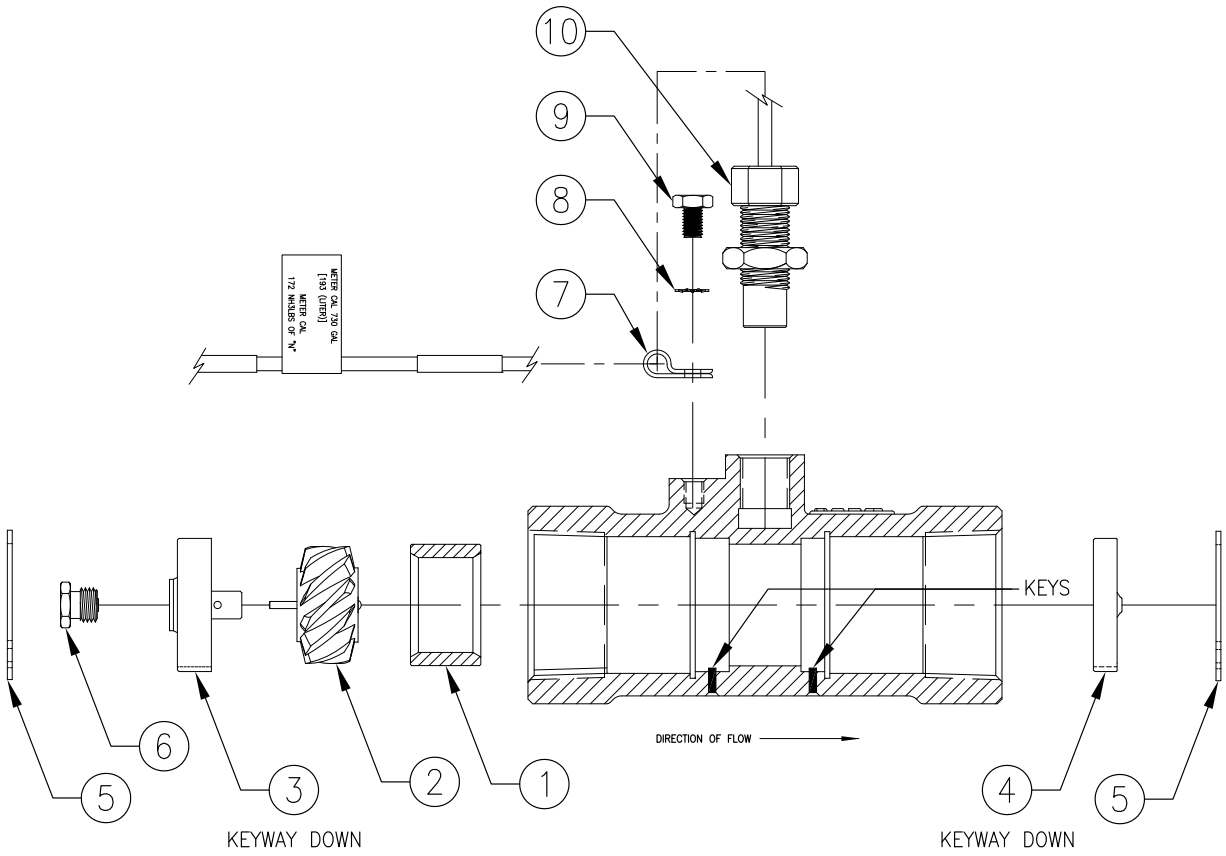


FIGURE 8. RFM 15s/15sg Flow Meter Replacement Parts (054-0159-334)

ITEM	DESCRIPTION	RAVEN PART #
1	SLEEVE, FLOW REDUCING SLEEVE	107-0171-356
2	ROTOR/MAGNET ASSEMBLY	063-0172-041
3	HUB/BEARING ASSEMBLY, UPSTREAM	063-0171-674
4	HUB ASSEMBLY, DOWNSTREAM	063-0171-769
5	RING, RETAINING, WIRE FORMED	335-0003-200
6	STUD, BEARING	063-0173-062
7	CLAMP, CABLE, INSULATED	435-3001-042
8	WASHER, SPRING	313-2400-001
9	BOLT, HEX HEAD	311-0050-254
10	SENSOR ASSEMBLY	
	CON-X-ALL, STD	063-0171-669
	CON-X-ALL, HP	063-0172-004
	DEUTSCH DT, HP	063-0172-447
	DEUTSCH DTM, HP	063-0172-458
11	REPLACEMENT PARTS KIT, RFM 15S / 15SG (CONTAINS ITEMS 2 THRU 6)	117-0171-590



054-0159-334
10/26/17 REV. D
SHEET 1 OF 1

FIGURE 9. 1-1/2” Ball Valve Replacement Parts (054-0159-342)

063-0173-626 FAST VALVE
063-0173-667 CONTROL VALVE
063-0173-668 ON/OFF VALVE

ITEM	DESCRIPTION	RAVEN PART NUMBER
1	MOTOR ASSEMBLY, CONTROLVALVE	063-0173-664
	MOTOR ASSEMBLY, ON/OFF VALVE	063-0173-665
	MOTOR ASSEMBLY, FAST VALVE	063-0173-666
2	BRACKET	107-0172-310
3	COUPLER	107-0172-494
4	SET SCREW, 1/4-20 UNC	311-0015-729
5	SCREW, HEX, M6 X 1 X 12MM LONG	311-0070-052
6	VALVE, 1.5" BALL	334-0001-066
7	SCREW, STAINLESS STEEL BUTTON HEAD SOCKET CAP	311-0071-053
8	LABEL, CLOSED	041-0159-790
9	LABEL, INDICATOR	041-0159-789

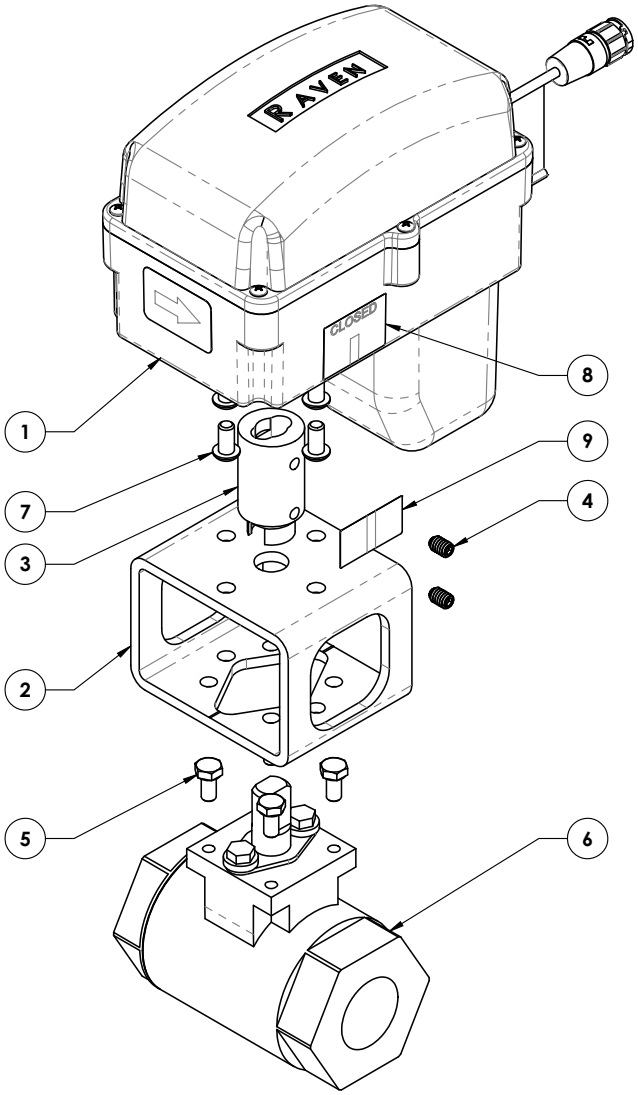
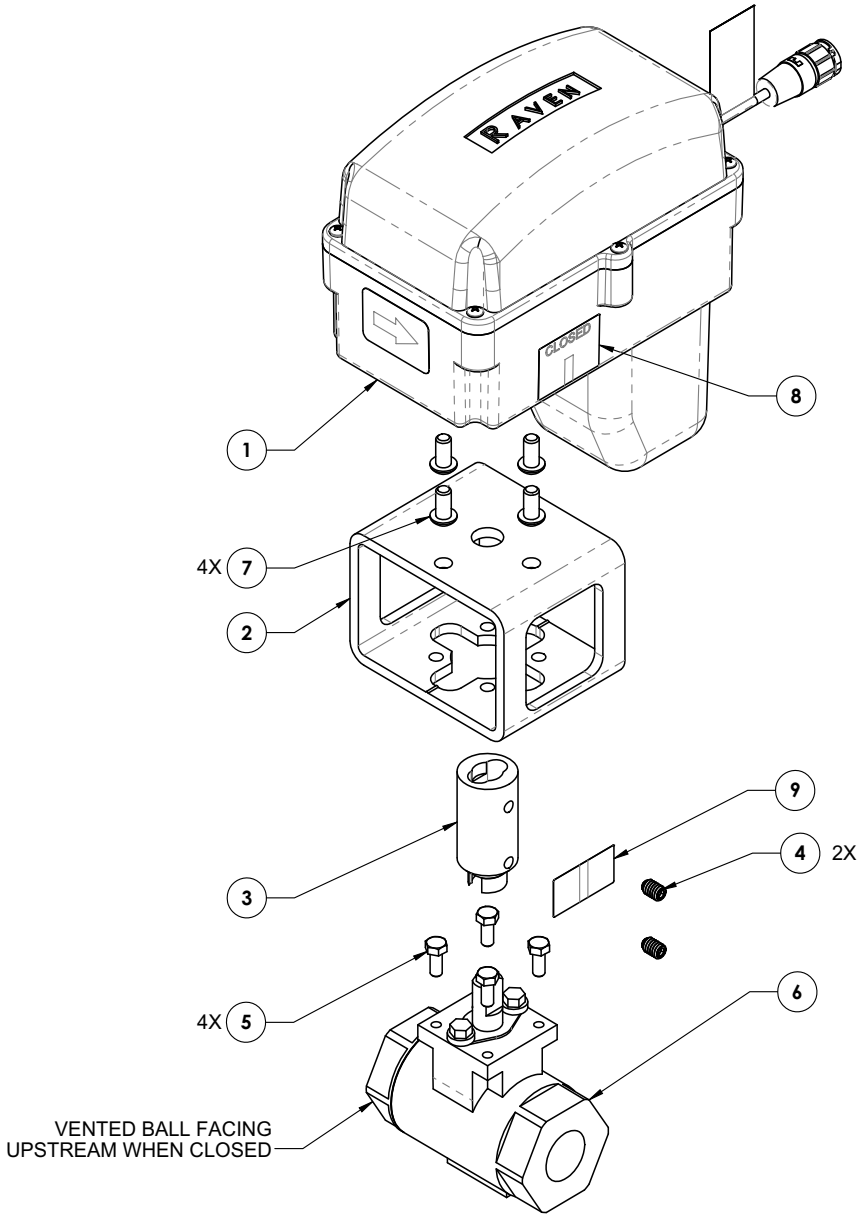


FIGURE 10. 1” Ball Valve Replacement Parts (054-0159-348)

063-0173-878 FAST VALVE
063-0173-877 CONTROL VALVE
063-0173-876 ON/OFF VALVE

ITEM	DESCRIPTION	RAVEN PART NUMBER
1	MOTOR ASSEMBLY, CONTROLVALVE	063-0173-664
	MOTOR ASSEMBLY, ON/OFF VALVE	063-0173-665
	MOTOR ASSEMBLY, FAST VALVE	063-0173-666
2	BRACKET	107-0172-497
3	COUPLER	107-0172-491
4	SET SCREW, 1/4-20 UNC	311-0015-729
5	SCREW, HEX, M5 X 0.8 X 12MM LONG	311-0070-063
6	VALVE, 1" BALL	334-0001-071
7	SCREW, STAINLESS STEEL BUTTON HEAD SOCKET CAP	311-0071-053
8	LABEL, CLOSED	041-0159-790
9	LABEL, INDICATOR	041-0159-789



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We Solve Great Challenges.

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.

We Solve Great Challenges.

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.

RAVEN