maxquip

INSTALLATION & OPERATORS MANUAL

maxflow VRC II

Pressurized NH3 Application an innovative product by maxquip

CALGARY 1 (866) 629-7847 | EDMONTON 1 (800) 661-7770
SASKATOON 1 (800) 667-5886 | WINNIPEG 1 (844) 278-5771

Monitor Reference Settings

Module	Initial Settings	Monitor Set To
All Monitors Flow Meter Setting Except Below	168 or 170	
Trimble Monitor Flow Meter Setting	710 or 720	
John Deere Monitor Flow Meter Setting	710 or 720 10 Gallon Checked 13 to 15% Rate Smoothing	
Topcon Monitor Flow Setting	16.8 or 17.0	
All Monitors Control Valve Setting (Except John Deere)	PWM – Closed 43	
John Deere Control Valve Setting	Fast Valve – Closed 293	
Boom 1		
Boom 2		
Boom 3		
Boom 4		
Boom 5		
Boom 6		
Boom 7		
Boom 8		
Hydraulic Setting All Kits	**MAXIMUM 8 GALLON/MINUTE**	

Please Note:

These are the initial settings for the monitors. If you have any issues with your monitor other than a Raven 440/450 please contact your dealer and they will be more than happy to assist you.

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Safety Considerations

Anhydrous Ammonia (NH3) may cause severe injury if improperly handled. Any person engaged in handling ammonia may reduce the risk of serious accidents by observing the following rules:

1. Review safety requirements associated with NH3 with your NH3 supplier.

2. Know the product, its characteristics and behavior.

3. Use only equipment suitable for NH3 service and make sure it is properly installed.

4. Make regular inspections of equipment to ensure everything is fully maintained. Always perform corrective measures immediately to maintain a high level of safety.

5. Use and maintain standard protective equipment necessary to safely handle NH3. Be certain to wear tight fitting safety goggles or a full face shield, protective suit and protective gloves made of rubber or other material impervious to NH3 when working with NH3.

6. Obtain proper training in handling & application of NH3.

7. Store and handle NH3 in accordance with applicable state, provincial and federal regulations.

8. Ensure all NH3 is out of the system before disconnecting or disassembling any parts. Be alert for frosting which is a certain indication of trapped liquid NH3 vaporizing. Depressurize all hoses when not in use. Lack of frost does not always indicate a lack of NH3.

9. Always repair NH3 leaks immediately.

10. Inspect hoses thoroughly before each season or when the hose has been subject to abnormal abuse. Ensure hoses are not kinked. Check for breaks or softening in the cover, blistering, swelling, loose couplings, or damage to the hose reinforcement. Correct any defects or retire the hose from service. Replace hoses as recommended by the manufacturer.

11. Always pick up the hose by the valve body or coupling, never by the valve hand wheel.

12. Always stay clear of valve or hose openings, particularly safety relief valves. This is true even when you have depressurized the system.

13. Use only proper capacity safety relief and excess flow valves - do not tamper with them or other safety relief valves.

14. Never use wrenches in closing hand wheel operated valves.

15. Always stand on the upwind side of NH3 transfer operations.

16. Be certain that no person or animal is in line with the discharge before opening any ammonia valve into the air.

17. Close all valves and disconnect all hoses when transfer operations are suspended or unattended.

18. Install an automatic liquid relief valve in any location where a possibility of NH3 could be trapped. This valve must open at a safe pressure and discharge into a safe location.

19. Be sure there is a proper shut off valve on both sides of any point where a connection is made.

20. Do not assume that all NH3 is out of the system just because all the valves have been opened and there is zero pressure. NH3 can remain in the system for several days and sometimes even weeks depending on weather conditions.

21. Clean, service and replace safety breakaway valves in accordance with the manufacturer's instructions.

22. Be aware that NH3 can collect in low parts.

23. Make sure you apply gas tape and thread sealant that is compatible with NH3 to all threaded connections.

Introduction

The Maxflow VRC system is a high pressure anhydrous ammonia application system. It will deliver a higher range of application rates and improved distribution accuracy over traditional manual and auto rate control systems.

To achieve the higher flow rates, a positive displacement vane pump is used to add energy to the overall system. The pump is hydraulically powered to control rates to the distribution manifolds.

Improved distribution accuracy is achieved by using distribution hoses with a smaller inner diameter that those traditionally used on ammonia application systems. The smaller hose creates higher manifold pressures which in turn improves distribution accuracy, reduces vapor formation and subsequently freezing lines and openers.

Application rates are controlled by adjusting the pump speed which is hydraulic driven. Application rates can be adjusted on the go by making adjustments to the target application rate in the controller.

Electric on/off manifold valves are installed onto each manifold to provide individual boom section control which can be either controlled manually or integrated into a GPS powered boom section control system. The manifold valves also provide for a quicker on/off response time.

Standard manifolds and harnesses are used making the system adaptable to using traditional system manifolds and a variety of common rate control systems.

A summary of the system features and benefits include;

Feature	***Benefit***
Positive Displacement Vane in Pump	• Increases application rates & speeds cooler conditions • Higher Manifold Pressures
Smaller Distribution Hoses	• Higher Manifold Pressures • Improved Distribution Accuracy • Reduces freezing manifolds, hoses & openers • Quicker response to rate changes in variable rate applications • Easier to route lines to openers

Cooler Eliminated (in many installations	• Eliminates problems inherent with vapor lines
Electric Valves on Manifolds	• Quicker on/off response • Boom Sectional Control (manual or automatic controlled)
Standard Components & Harnesses	• Integrates with variety of common electronic rate controllers • Traditional systems can be retrofitted to the Maxflow VRC system

System Capacity

For the purposes of calculating the requirements of a NH3 application system in pounds per hour, we use the following formula;

Applicator Width X Speed X Target Application Rate (lbs. /acre) X 0.1212 = Target

Example: 54ft X 6 MPH X 80 lbs./acre X 0.1212 = 3142 lbs. per hour.

This calculation will determine the system capacity when tank pressure is 110 PSI. To account for application rates in cold conditions where tank pressures will be 55 PSI, you need to increase the capacity of the system by 1/3rd.

Example: 3142 lbs. per hour X 1.334 = 4195 lbs. per hour

Capacity of the Maxflow VRC Pump:

Maximum capacity of the Maxflow VRC pump is 40 gallons per minute using the Max 2A pump or 12,336 lbs. NH3 per hour or 10,115 lbs. N per hour at 15PSI differential pressure.

Maximum recommended pump speed is 740 RPM

Withdraw Hose Plumbing Considerations

One of the most important considerations for a proper installation is the withdraw hose plumbing from the nurse tank to the pump. A properly designed system will minimize vapor formation by limiting hose restrictions. Since NH3 will have a tendency to vaporize, the intake piping plays a critical role in the efficiency and longevity of every system. The following is a list of considerations to ensure you have optimal flow rates;

- Use ISC valves or high flow withdraw valves in nurse tank outlet.
- Use minimum 1-1/4" hose in place of 1" hose (1-1/4" hose has approximately 56% more capacity than a 1" hose and 1-1/2” hose has approximately 2X the flow of 1-1/4” hose.
- Use 1-1/4" or 1-1/2 high flow breakaway valves when they are required between nurse tank(s) and pump inlet.
- Use high flow angled hose end valves with at least a 2-1/4 acme instead of regular globe valves.
- Inlet piping from the tank to the pump should be as short as possible.
- Pump should be at a lower level that the tank's lowest liquid level.
- Withdraw hose pressure losses should be less than 2 psi. Use low restriction type valves and fittings. Long sweep radius elbow bends are preferred (45 degree instead of 90 degree).
- Avoid up-across and down pipe loops so that you do not create vapors in the withdraw hose (gooseneck trailers).

Mounting the Pump Assembly

The capacity of the pump will be optimized when;

1. It is mounted below the bottom of the NH3 nurse tank that is used to supply it.
2. It is as close to the withdrawal valve on the nurse tank as possible
3. Plumbing is optimized to minimize pressure drops to the pump inlet. No more than a 2 psi pressure drop is recommended.
4. Bottom withdrawal tanks are used.

Here are a couple of typical installations

Pump mounted on NH3 nurse wagon is recommended to achieve maximum pump performance

When mounting pump on applicator or the back of the air tank in a tow behind air tank configuration;

- Minimum 1-1/4" plumbing from nurse tanks to pump in these situations. Recommended would be 1-1/2” from the withdraw valve to a 1-1/2” breakaway. Then a 1-1/4” line to the pump.
- Two inch supply hose from tank to pump should be used when application rates are greater than 6,000 lbs. per hour.
- Avoid any configurations where the supply hose goes "up and over" between nurse tank and pump. (Goose neck trailers)

Installing Breakaway Couplers

1. Breakaway coupler will need to be installed at each hitch point on the applicator.

2. Most applicators will have a bracket available to fasten the breakaway too. Follow the manufacturer's recommendations when mounting the breakaway and hose couplers.

3. An applicator with a tow behind tank will require a breakaway mounted on the back of the applicator and the front of the tank.

4. If mounting the Pump on the hitch of the air drill or air cart mount the male tip on the pump side. You will have to mount the female side on the hitch of the nurse wagon. By mounting it this way you will be able to shorten the hose from the breakaway to the pump and it will allow you not to have a loop in the hose itself.

5. Install the breakaway that is in front of the air cart(TBH only). Install the male tip on the air cart side of the hitch and the female coupler on the air drill side of the hitch.

6. You are supplied with one 1-3/4” female acme to 1” hose barb. Install this on the male tip by threading it onto the male acme that was installed in step 5. Thread the 1”mnpt by 1” hose barb into the bushing that was installed on the female coupler in step 5.

Installing the Splitter

Identify the middle of the applicator.

Install one of the manifold stands with the bracket at this location with the ½” bolts & nuts that have been supplied. Bolt the splitter to the manifold stand with the bolt on the bottom of the housing.

If kit is a 6, 7 or 8 distribution it is recommended you manufacture a bracket specific to the mounting location and design of the applicator equipment.

Installing the Manifolds

The Maxflow VRC system is designed to be used with NH3 manifolds such as the Continental NH3 Products MVD manifolds. 1/8" ID hose (1/4" OD) is then attached to the manifolds with compression fittings and run to the opener. The restricted capacity of the hose results in these benefits;

1. Manifold pressures are increased which results in increased accuracy.

2. No pressure drop from manifold to hose results in less vapor in the distribution lines and improved distribution accuracy.

3. Smaller hose is easier to handle and route from manifold to opener.

4. Hose can be inserted into most steel tubing supplied with openers. This provides an extra level of insulation between the ammonia and the openers.

Distribution accuracy is better at higher manifold pressures. Distribution accuracy is greatly reduced when manifold pressures are less than 65% of tank pressure.

The hose supplied with the Maxflow VRC kit is rated for use with NH3 to 250 psi.

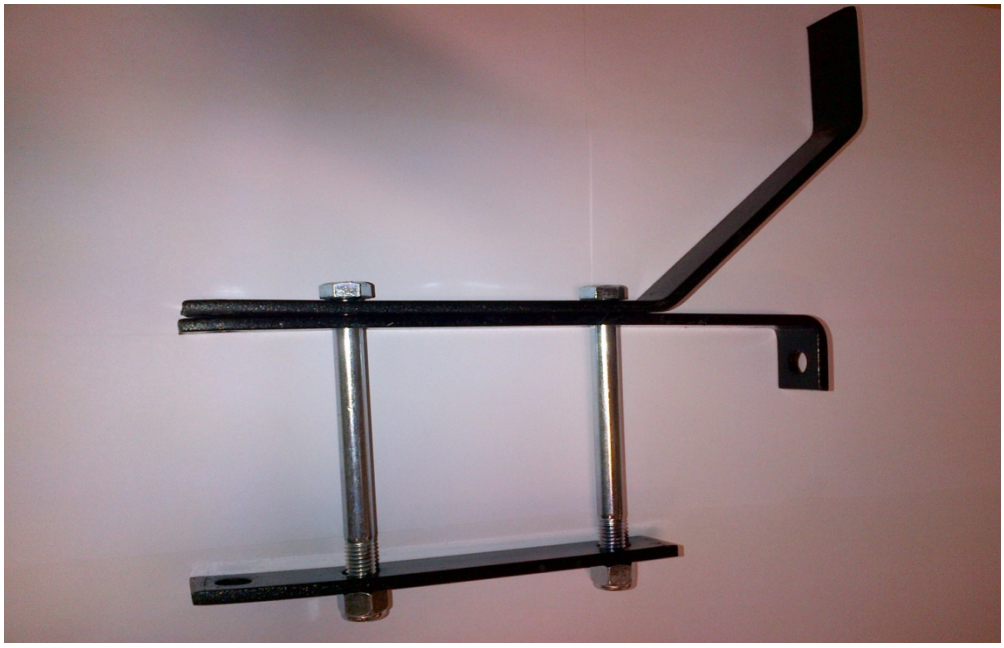
On/Off valves are installed on the inlet of each manifold to provide sectional control and quicker on/off response time.

Manifold Installation Notes:

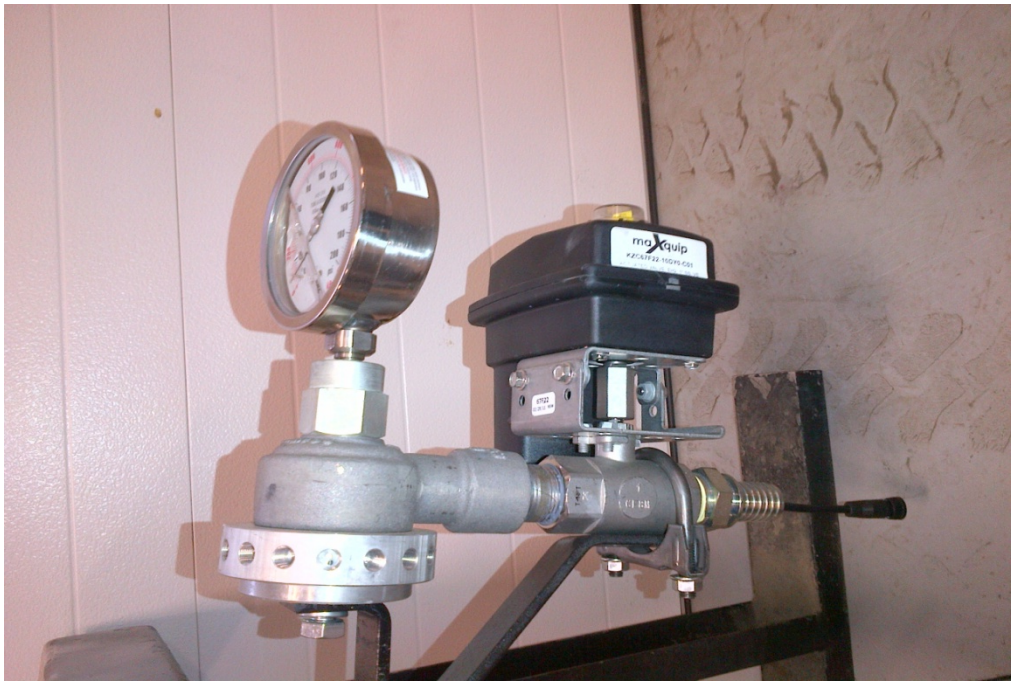
Your system has been designed and tailored to your application by our trained quoting personnel. The following are the notes that you will use to install the on/off manifolds to the applicator.

Identify on the drill where you will be installing the on/off manifolds. Typically there is one manifold for each wing of the applicator.

After identifying where to put your on/off manifold. Install the manifold stands and supports that come with the kit pictured below:



3) After installing the manifold stands you will now install the on/off valve assemblies that come pre-assembled in the kit. See below picture.



4) Install the pressure gauges on top of the MVD manifolds. These gauges are 0-300 PSI.

5) Install the pressure gauge on top of the 360 splitter. There is a 0-300 PSI gauge in this kit for this application.

Installing the Compression Fittings and Plugs

1) Identify how many runs to the shanks each manifold will be.

2) Install the 1/8" compression fittings into the manifold rings. Install the 1/8" MPT plugs into the holes that will not be used on the manifold ring.

Do not over tighten these plugs and compression fittings and use pipe paste only that is supplied in the kit.

DO NOT USE PIPE TAPE

Do not tighten the nut on the compression side of the fitting yet.

Installation of the Pressure Hoses

Install the 1-1/2” hose from the breakaway to the inlet side of the pump assembly. (make sure that it is the male tip that is on the other side of this hose.) Try to have no loop in this hose but make sure that the breakaway is free to move.

Install the 1” hose from the outlet side of the pump assembly to the splitter inlet side. Except if you have a tow behind kit, this hose will be split at the breakaway between the air cart and drill.

Install the 1” hose from the splitter out to the on/off manifold valves.

If using straight poly hose in the application. All the 1” hoses will be equal length to the on/off valves.

If using stainless tubes on the applicator you can shorten the hose by the following diagram.

Manifold 1	Manifold 2	Manifold 3	Manifold 4	Manifold 5
25 ft.	**19 ft.**	**14.5 ft.**	**19 ft.**	**25 ft.**

Manifold #1 & 5 – is usually the total width of the air drill divided by 2
E.g. 50ft/2 = 25 ft

Manifold #2 & 4 – Take the length of 1 & 5 and times it by 75%
E.g. 25*.75 = 19 ft

Manifold #3 – Take the length of #2 & 4 and times it by 75%
E.g. 19*.75 = 14.5 ft

******PLEASE NOTE THAT WHEN DOING THIS THAT NO HOSE CAN BE SHORTER THAN 14 FT******

Installation of the hose clamp onto the hose is critical to support the pressure in the hose and not to cut the hose itself. To slide the hose onto the barb easier use a little bit of grease on the nipples. Torque the bolts to the following specs.

1” Hose Barbs torque to 26 ft./lbs.
1-1/4” Hose Barbs torque to 35 ft./lbs.
1-1/2” Hose Barbs torque to 45 ft/lbs.

Installation of Poly Hoses to the Compression Fittings

Identify on the machine the furthest shank away from the manifolds on any given manifold plus allow length for the folding of the applicator. This will then give you the line length of the ¼" outside diameter poly hose.

Cut all of these hoses equal length from the MVD rings to the shanks. **The system needs these to be equal length so that the manifold pressures stay exactly the same and distribute evenly.**

Insert the hose into the compression fittings that were previously installed into the MVD rings. **Tighten the compression by rotating the nut 6 flats.** Gently pull on the hose to make sure it does not come out if hose moves tighten compression nut one more flat

Installation of Poly Hoses to the Openers

The Maxflow VRC system is designed to work with a variety of openers. Often a stainless steel tube is added to the opener, and the distribution hose from the manifold is then attached to the stainless steel tube using ear clamps. A minimum of one ear clamp per opener is recommended.

Stainless steel tubes with an outer diameter of .125 and an inner diameter of .085 or .055 are typically used in systems requiring greater pressure.

Poly tubing is another way of doing the system. The outside diameter of the hose is .250 and there are three different inside diameters .085, .125, or .170.

All packages are tailored for your application by the Maxquip Inc. staff.

The following are a few methods of attaching the manifold hoses to the openers:

Method #1

A stainless steel tube with outside diameter of 1/8" is inserted into ½" steel fertilizer tube that is included with opener. Rubber grommet is used to fasten stainless steel tube to fertilizer tube. Distribution hose then slides over stainless steel tube and is fastened using two ear clamps. Electrical heat shrink is sometimes used to seal the complete assembly.

Method #2

Stainless steel tube and distribution hose is fastened to the fertilizer tube using a compression fitting. Two ear clamps are also used to secure distribution hose to stainless steel tubing.

Alternatively, the 1/2" steel fertilizer tube can be tapped, and the compression fitting screwed directly into the fertilizer tube. If using MRB by Bourgualt this is what you will have to do to secure the stainless tube and hose to the tubes supplied

Method #3

This method is used for applications that do not require the stainless steel tube. The distribution hose is fastened to the fertilizer tube with clamps, a piece of hose used as a busing and a piece to ½" ID hose.

Installation of Cabling

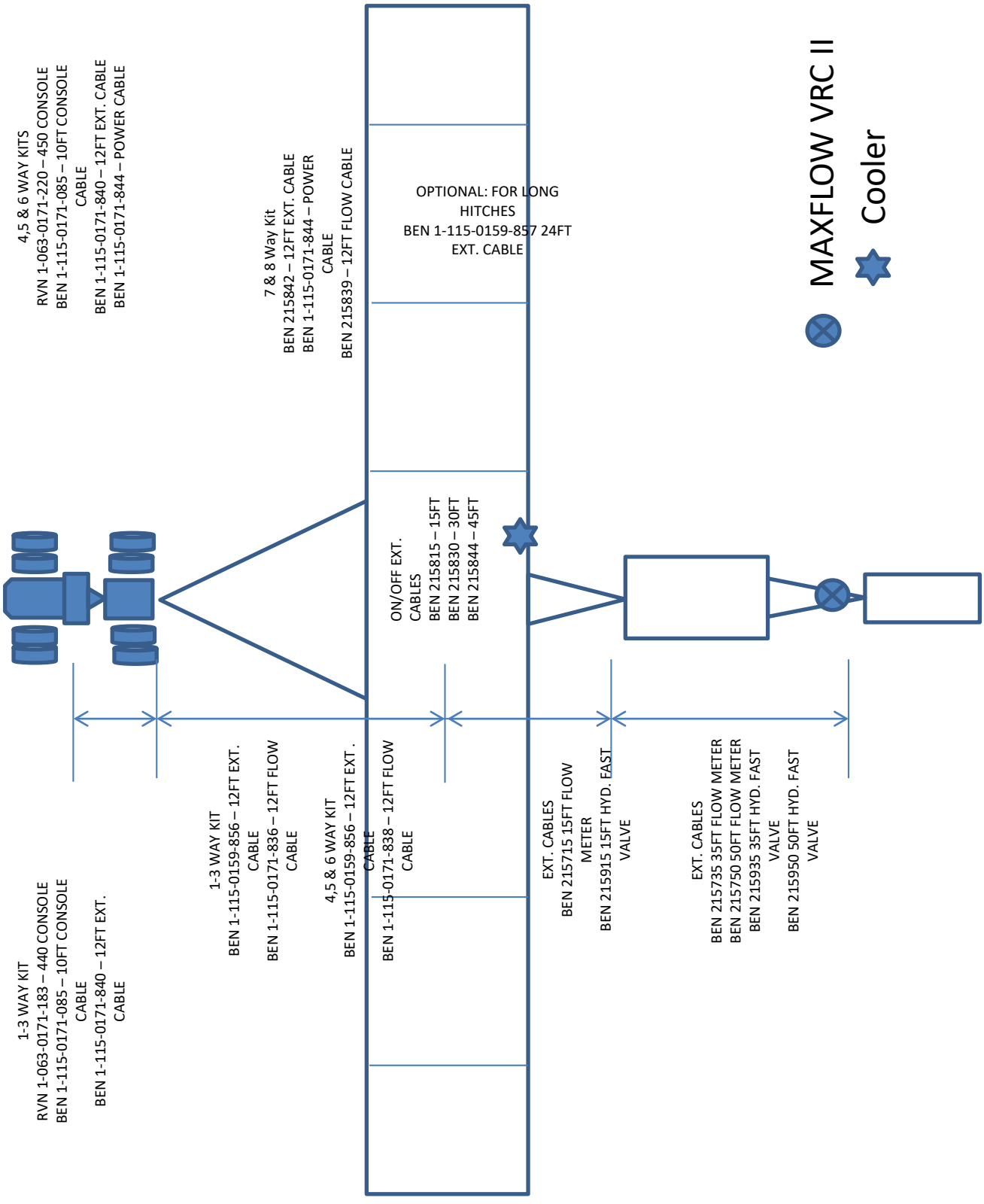
If basic monitor is being used your Kit will include a Raven 440/450 depending on how many manifold sections were shipped to you. This monitor and the proper cables to be run through the cab of the tractor(see following sheets for part numbers and the order that they do in.

If basic monitor is not supplied to you then you are using an existing monitoring system and in your kit there will be cables supplied to the draw pin of the tractor. (See following sheets for part numbers and order that they go in.

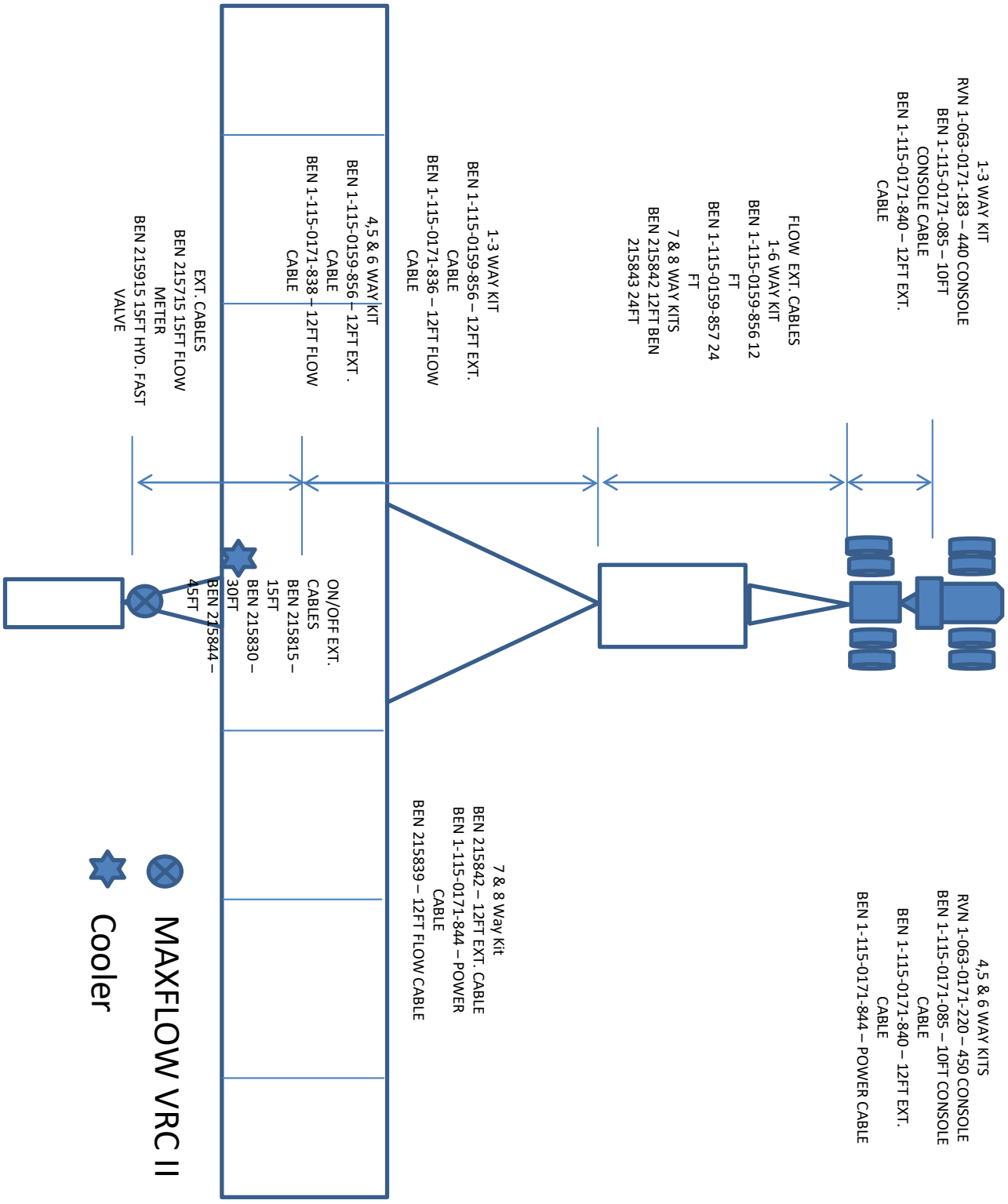
Note: The Maxflow VRC II is on a raven platform and can communicate with a variety of field computers. The following is a list of some of the systems.

Topcon X20 w/30S ECU
Topcon X30 w/30S ECU
JD 2630 w/ Rate Controller
JD 2600 w/ Rate Controller
JD 4100 w/ Rate Controller
Trimble EZ-Guide 500 w/ EZ Boom
Trimble FM750 w/ Field IQ
Trimble FM1000 w/ Field IQ
Raven Viper Pro
Raven Envisio Pro
Raven ISO w/ Any ISO Monitor except JD2600, Pro600, Intelliview Plus II
SeedHawk ICON

Tow Behind Cart - Cabling Diagram



Tow Between Cart - Cabling Diagram



Troubleshooting & Corrections

Flow Meter

Symptom	Correction
Inaccurate Rates	- Check flow meter tag and make sure the number is programmed properly (710-720, 168-170) - Clean the strainer before the flow meter - Verify that the speed input is correct. Do a distance calibration. (see page 11) - Check cables to make sure there are no breaks or bare wires. - Check voltages on the flow cables (see following page on procedures). - If cables check out replace flow meter sensor part# 1-063-0171-669. - If issue is not corrected replace flow meter Part# 1-063-0171-666 - If issue is not corrected go to troubleshooting control valve
Rate reads “0000”	- Verify that you have a speed input in the monitor - Check voltages on the flow cables (see following page)
Rate does not change in either manual or automatic mode	- Refer to Control valve trouble shooting.
Total Volume does not register	- Test the flow meter cables for wiring issues (see following page)
Total Volume registers flow inaccurately	- Verify product flow corresponds to the direction of the arrow on the flow meter.

Procedure to Test Flow Meter Cables

PIN DESIGNATIONS

2 o'clock socket location is ground.
10 o'clock socket location is power.
6 o'clock socket location is signal.

VOLTAGE READINGS

1. 2 o'clock socket to 6 o'clock socket = +5 VDC.
2. 2 o'clock socket to 10 o'clock socket = +5 VDC.

If a +5 VDC voltage reading is not present, disconnect the Speed Sensor cable. If the Flow reading is restored, Test the Speed Sensor cable per Appendix

PROCEDURE TO CHECK CABLE:

1. Enter a METER CAL number of one (1) in key labelled
2. Depress key labelled
3. Place BOOM switches to ON.
4. With 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 a contact is made, the TOTAL VOLUME should increase by increments of 1 or more counts.
5. If TOTAL VOLUME does not increase, remove the section of cable and repeat test at connector next closest to Console. Replace defective cable as required.
6. Perform above voltage checks.
7. If all cables test good, replace Flow Sensor.

NOTE: After testing is complete, re-enter correct METER CAL numbers before application.

Troubleshooting & Corrections

Control Valve

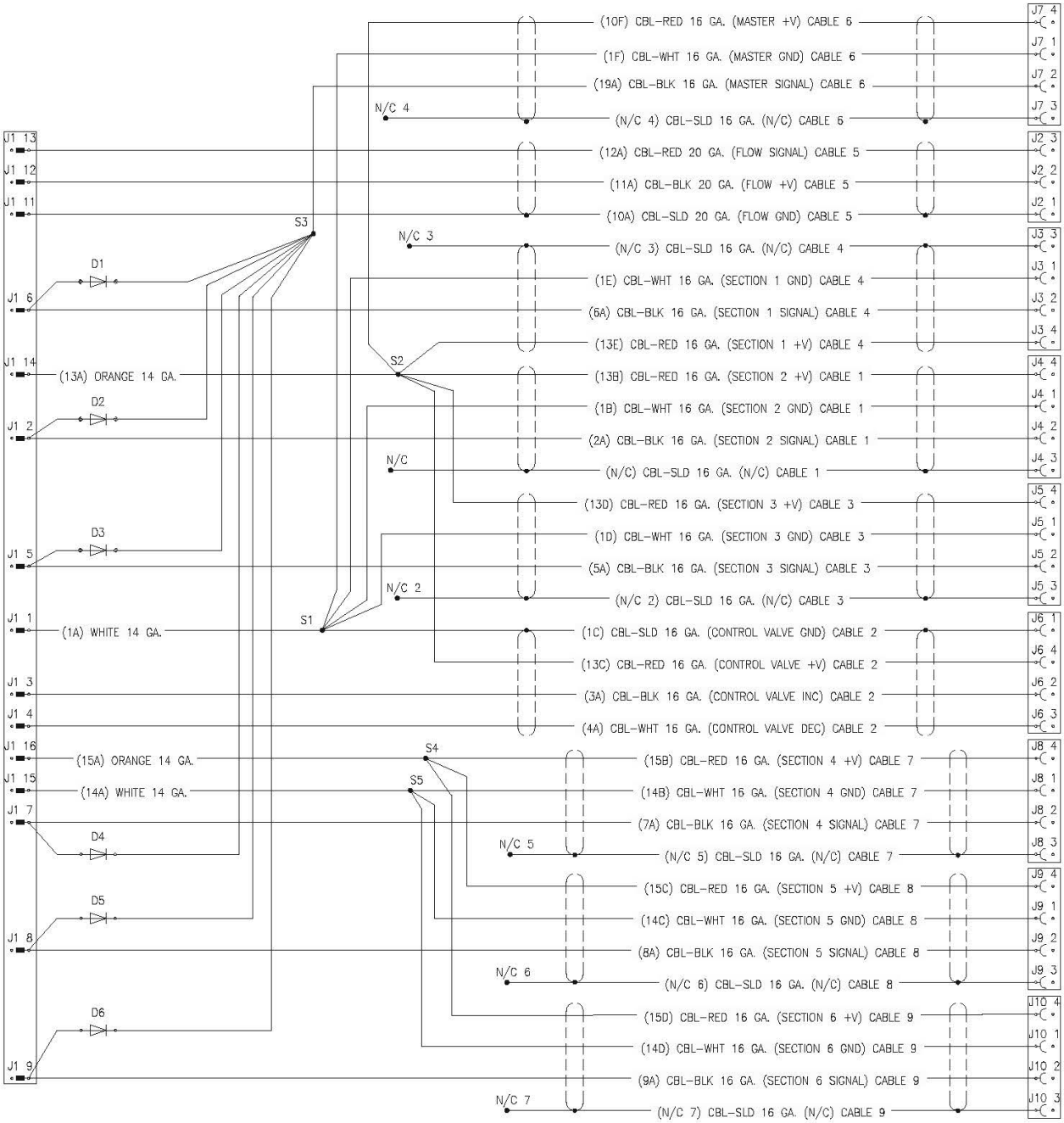
Symptom	Correction
Control valve to slow or too fast	- Verify the setting in the monitor should be 743 for Raven Controllers. - Increase or decrease the first digit between 1-9. 1 being the fastest and 9 being the slowest.
Control valve always over shooting or under shooting intended rate	- Verify the setting in the monitor should be 743 for Raven Controllers - Increase or Decrease the second digit between 1-9. 1 being fastest and 9 being the slowest. Explanation of the 2nd digit on the valve calibration % away from target before the valve slows down 1=10%, 2=20% 3=30% and so on.
Control Valve not responding to rate changes	- Verify the setting in the monitor should be 743 for Raven Controllers. - Increase or Decrease the third digit between 1-9. 1 being the fastest and 9 being the slowest. Explanation of the 3rd digit on the valve calibration. % of deviation allowed before the valve responds 1=1% 2=2% 3=3% and so on
Rate does not change in either manual or automatic mode	- Check cables for breaks or bare wires - Verify voltage on the Flow Cables and Extensions Flow Cable 10 o'clock position – Constant 12 Volts 2 o'clock position – Ground 4 o'clock position – 12 Volt Increase 6 o'clock position – 12 Volt Decrease Flow Cable Extensions Pin 1 – Ground Pin 14 – Constant 12 Volts Pin 3 – 12 Volt Increase Pin 4 – 12 Volt Decrease - If cables are good replace Motor drive on Fast Valve. Part # 1-063-0172-982 (Motor Only) - Maxflow VRC Only – Verify that the customer does not have the following cables on the machine – BEN 215515 or BEN 215535. These cables are adapter cables going from 4 pin connector to a 2 pin connector. If they do sell them the replacement cable – BEN 215915 or BEN 215935.

Troubleshooting & Corrections

Hydraulic Motor/Blackmer Max 2A

Symptom	Correction
Pump Turns for 4 seconds and then doesn't move	- Hydraulic lines reversed flow direction. Flip hydraulic lines in the remotes. Do Not just try in reverse detent as some tractors have remote issues running backwards. - There is a hydraulic back check in the system to prevent the pump from running backwards of flow direction.
Pump does not turn at all	- Make sure remotes are plugged in and flow is being delivered to the hydraulic block - Check couplers between the front and the back of the applicator to make sure flow is being delivered to the hydraulic block. - Always use pin style couplers instead of ball style couplers. - Refer to Fast Valve Troubleshooting
Hydraulic oil seeping out of the Blackmer coupler	- Unscrew the spit valve on the coupler. Is there hydraulic oil inside the coupler? If yes reseal the Eaton hydraulic motor with Part# HYP 60540-000
Pump runs for 20 to 60 seconds and then stops	- Make sure remote on the tractor is in continuous flow like when attached to an air cart.
Pump does not turn, Fast Valve works, Hydraulic oil being diverted through block.	- Unbolt Eaton Hydraulic motor from the white coupler. Verify the motor is turning and there are no leaks. If motor turns go to next step. - Unbolt the shaft guard on opposite side. With a small pipe wrench see if Blackmer pump turns. If it does not go to next step - Blackmer motor doesn't turn with a larger pipe wrench see if you can break the pump free - If pump will not break free rebuild or replace pump. See operators manual for pump rebuilding. If pump is under warranty do not touch it and call Maxquip Saskatoon and a trained Blackmer Tech will let you know what to do. (If pump is not under warranty you may do whatever you like to it.) **PLEASE BE INFORMED THAT WHEN PUMP IS NOT IN USE FOR ANY PERIOD OF TIME TO FILL IT UP WITH DIESEL FUEL. THIS WILL STOP ALL COROSION PROBLEMS WITH THE INTERNAL PARTS OF THE PUMP. THE PUMP HAS VERY LOW TORRANCES OF 5 THOUSANDS OF AN INCH AND ANY TYPE OF COROSION WILL LIMIT THE LIFE OF THE PUMP.**

Raven Pin Out Wiring Diagram



Pump Installation & Maintenance Procedures

Pump Identification

A pump Identification tag, containing the pump serial number, I.D. number, and model designation, is attached to each pump. It is recommended that the data from this tag be recorded and filed for future reference. If replacement parts are needed, or if information pertaining to the pump is required, this data must be furnished to a Maxquip representative.

Technical Data

Model	MAX2A
Torque required @ 100 psi (6.9 bar)	48 lbs. ft.
Maximum Pump speed @ Max. Differential Pressure	740 RPM
Maximum Differential Pressure	150 PSI
Maximum Operating Temperature	240 F
Maximum Working Pressure	350 PSI

Note: This Pump is listed by Underwriter's Laboratories for NH3 service

Pump Storage

Do not store pump empty when it is not in use. If it cannot be stored with NH3 in it, remove NH3 Completely from pump. Then fill the pump cavity with either a light diesel fuel or solvent. Remove diesel fuel or solvent prior to using again with NH3.

Pre-Installation Cleaning

New pumps contain residual test fluid and rust inhibitor. If necessary, flush pump prior to use. Foreign matter entering the pump WILL cause extensive damage. The supply tank and intake piping MUST be cleaned and flushed prior to pump installation and operation.

Location & Piping

Pump life and performance will be significantly reduced when installed in an improperly designed system. Before starting the layout and installation of the piping system, review the following suggestions:

1. Locate the pump as near as possible to the source of supply to avoid excessive inlet pipe friction = excess pressure drop.
2. The inlet piping and fittings should be at least as large as the intake port on the pump. Slope the pipe downward to the pump, and do not install any upward loops. Minimize the number of intake hose fittings and eliminate restrictions such as sharp bends; globe valves, unnecessary elbows, and undersized strainers.
3. A strainer must be installed in the inlet line to protect the pump from foreign matter. Locate the strainer at least 24" (0.6m) from the pump. Strainers must have a net open area of at least four times the area of the intake piping and must be cleaned regularly to avoid pump starvation.
4. The intake and discharge piping system must be free of all leaks.
5. ALL piping and fittings MUST be properly supported to prevent any piping loads from being placed on the pump.
6. Check alignment of pipes to pump to avoid strains which might later cause misalignment. Unbolt flanges or break union joints. Pipes must not spring away or drop down. After the pump has been in operation for a week or two, completely recheck alignment.
7. Install pressure gauges in the NPT ports provided in the pump casing to check pump performance at start up.
8. Keeping the NH3 gas system full of liquid, will keep the O-rings from changing shape, shrinking or super cooling.

Pump Rotation

Confirm correct pump rotation by checking the pump rotation arrows respective to pump driver rotation.

Pump Maintenance

Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

Strainers

Strainers must be cleaned regularly to avoid pump starvation. Schedule will depend upon the application and conditions. Insert magnets into strainers to catch metallic particles.

Lubrication

DO NOT over grease pump bearings. While it is normal for some grease to escape from the grease tell-tale hole after lubrication, excessive grease can cause mechanical seal failure. The tell-tale hole is located in the head between the bearing and the mechanical seal.

To avoid possible entanglement in moving parts do not lubricate pump bearings, hydraulic adapter coupling or any other parts while pump is running. Pump bearings and hydraulic motor couplings (if equipped) must be lubricated every season of use.

The hydraulic orbit motor coupler to the pump is filled with grease during the coupler installation. The bearing on the opposite side of the coupler is also checked to ensure adequate grease levels for startup.

Recommended Grease:

Exxon® - Ronnex MP Grease
Mobil® - Mobilith AW2 (64353-6) Grease, or equivalent Lithium grease.

Greasing Procedure:

1. Remove the grease relief fittings from the bearing covers or hydraulic motor adapter.
2. SLOWLY apply grease with a hand gun until grease begins to escape from the grease relief fitting port. Discard excess grease in accordance with the proper codes and regulations.
3. Replace the grease relief fittings.

Start Up Procedure:

1. Operate pump for 10 hours:
    a. Stop pump and perform procedure as listed above. Do this procedure for each side. The coupler bearing will require grease to fill voids created by the shaft rotation.

2. Operate pump for 4 more hours:
    a. Stop pump and perform procedure as listed above. If grease flows out of the grease relief fitting ports with minimal application all voids have been filled in the coupler and bearing cover.

Repeat this procedure again after 3 days and continue to perform this procedure once per week during application season.

Perform Lubrication procedure 2 hours prior to completing the application season and putting pump into storage.

When ready to start up for the next season perform the procedure before initial start up to ensure fresh grease in bearing cover/coupler

Vane Replacement

Maintenance shall be performed by qualified technicians only, following the appropriate procedures and warnings as presented in this manual.

1. Drain and relieve pressure from the pump and system as required.
2. Remove the head assembly from the outboard (non-driven) side of the pump according to steps 4 - 9 in the "Pump Disassembly" section of this manual.
3. Turn the shaft by hand until a vane comes to the top (12 o'clock) position of the rotor. Remove the vane.
4. Install a new vane, ensuring that the rounded edge is UP, and the relief grooves are facing towards the direction of rotation.
5. Repeat steps 3 and 4 until all vanes have been replaced.
6. Reassemble the pump according to the "Pump Assembly." section of this manual.

Pump Disassembly

Follow all hazard warnings and instructions provided in the "maintenance" section of this manual.

1. Drain and relieve pressure from the pump and system as required.
2. Starting on the inboard (driven) end of the pump, clean the pump shaft thoroughly, making sure the shaft is free of nicks and burrs. This will prevent damage to the mechanical seal when the inboard head assembly is removed.

3. Remove the inboard bearing cover cap screws and slide the inboard bearing cover and gasket off the shaft. Discard the bearing cover gasket. On the 2- inch pump models the dirt shield will come off with the bearing cover.
4. Remove the outboard bearing cover cap screws and slide the outboard bearing cover and gasket off the shaft. Discard the bearing cover gasket. On the 2- inch pump models the dirt shield will come off with the bearing cover.
5. To remove locknuts and lock washers:
    a. Bend up the engaged lock washer tang and rotate the locknut counterclockwise to remove it from the shaft
    b. Slide the lock washer off the shaft. Inspect the lock washer for damage and replace as required.
    c. Repeat steps a and b on the opposite shaft end.
6. Remove the head cap screws and carefully pry the head away from the casing.
7. Slide the head off the shaft. The head O-ring, bearing, mechanical seal stationary seat and stationary O-ring will come off with the head assembly. Remove and discard the head O-ring.
    a. Pull the bearing from the housing in the head.
    b. To remove the mechanical seal stationary seat, use the blunt end of a screw driver to gently push the backside of the stationary seat from the head. Place a cloth under the seal to avoid damage. Be careful not to contact the polished face of the seal during removal. Remove and discard mechanical seal stationary O-ring.
8. Carefully pull the rotating seal assembly, consisting of seal jacket, rotating seal face and rotating O-ring from the shaft. Remove and discard the rotating O-ring.
9. Carefully remove the disc.
10. Carefully pull the rotor and shaft from the casing. While one hand is pulling the shaft, cup the other hand underneath the rotor to prevent the vanes and push rods from falling out. Carefully set the rotor and shaft aside for future vane replacement and reassembly. The rotor and shaft weighs approximately 34 pounds (15 kg). Be careful not to pinch the hand under the rotor and shaft when removing from casing.
11. Lay the pump flat with the remaining head facing upward to remove the head assembly mechanical seal and disc from the outboard side of the pump, as instructed in steps 6 - 9 above.
12. If necessary, remove the liner by tapping around the outside diameter of the liner with a hard wood drift and a hammer until it is driven from the casing.

Pump Assembly

Before reassembling the pump, inspect all parts for wear or damage, and replace as required. Wash out the bearing/seal recess of the head and remove any burrs or nicks from the rotor and shaft. Remove any burrs from the liner. Reassemble the OUTBOARD side of the pump first:

1. On 2-inch pump models, apply grease to the liner key groove in the pump casing to hold the key in place during liner installation. Install key in groove before starting liner into pump casing.
2. Align the liner key with the pump casing keyway and start the liner into the casing with the slots in the liner towards the INTAKE port, and the hole pattern in the liner towards the DISCHARGE port. Uniformly tap the outer edge of the liner with a rubber mallet to fully insert into the casing. ***NOTE***: If the liner is installed backwards, it will restrict the port openings and cause cavitation, noise and loss of capacity.
3. Place the disc against the liner with the seal cavity outward and disc relief hole.
4. Without installing the head O-ring or mechanical seal components, temporarily attach the outboard head (20) and bearing (24) to the casing (12). Install and hand tighten two head cap screws (21), 180 degrees apart. This head will be used to hold and align the rotor and shaft (13) while the inboard side of the pump is assembled.
5. Remove the vanes and push rods from the rotor and shaft assembly. Inspect for wear and damage, and replace as follows:
    a. Partially install the non-driven end of the rotor and shaft into the open side of the pump casing. On single-ended shafts, verify the rotation direction before proceeding.
    b. Leave part of the rotor outside of the casing so that the bottom vanes can be installed and held in place as the push rods are installed in the push rod holes of the rotor. Insert the new vanes into the rotor slots with the rounded edges outward, and the vane relief grooves facing TOWARDS the direction of rotation.
    c. After the bottom vanes and push rods are installed, insert the rotor and shaft fully into the casing.
    d. Install the remaining vanes into the top positions of the rotor.
6. Install the disc on the inboard side of the pump with the seal cavity facing outward and the disc relief hole.
7. Install a new head O-ring in the groove on the inside face of the head. Lay the O-ring flat and start in on one side of the groove, stretching ahead with the fingers.

8. MECHANICAL SEAL INSTALLATION
    a. Apply a small amount of motor oil on the shaft between the shaft threads and the rotor.
    b. Slide the seal jacket assembly over the shaft and into the disc cavity with the drive tangs of the jacket towards the rotor. Rotate the jacket assembly to engage the drive tangs in the rotor slots.
    c. Install a new rotating O-ring in the rotating seal face. Align and insert the rotating assembly into the seal jacket with the polished face outward. Clean the polished face with a clean tissue and alcohol.

9. Carefully install the head assembly over the shaft. Do not contact the end of the shaft with the polished face of the stationary seat. Rotate the head so that the drain hole (tell-tale hole), located at the back of the bearing cavity faces downward when the pump is mounted for operation. Install and uniformly tighten four head cap screws 90° apart, torqueing to 30 lbs. ft. (40.7 Nm).
10. Hand pack the spherical roller bearing with grease. See the "Lubrication" section for recommended greases.
11. Install the bearing into the head recess. Ensure the bearing is fully and squarely seated in the head.
12. Turn the pump casing around and remove the outboard head previously attached.
13. Install the outboard head, mechanical seal and bearing as instructed in steps 6 through 11.
14. Rotate the shaft by hand to engage the mechanical seal drive tangs, and to test for binding or tight spots. If the rotor does not turn freely, lightly tap the rims of the heads with a soft faced mallet until the correct position is found. Install all of the remaining head cap screws for each head and uniformly torque to 30 lbs. ft. (40.7 Nm).
15. LOCKNUT ADJUSTMENT It is important that the bearing locknuts and lock washers be installed and adjusted properly. Over tightening locknuts can cause bearing failure or a broken lock washer tang. Loose locknuts will allow the rotor to shift against the discs, causing wear.
    a. On both ends of the pump shaft, Install a lock washer with the tangs facing outward, followed by a locknut with the tapered end inward. Ensure the inner tang "A" of the lock washer is located in the slot in the shaft threads, bending it slightly, if necessary.
    b. Tighten both locknuts to ensure that the bearings are bottomed in the head recess. DO NOT over tighten and bend or shear the lock washer inner tang.
    c. Loosen both locknuts one complete turn.
    d. Tighten one locknut until a slight rotor drag is felt when turning the shaft by hand.
    e. Back off the nut the width of one lock washer tang "B". Secure the nut by bending the closest aligned lock washer tang into the slot in the locknut. The pump should turn freely when rotated by hand.

f. Tighten the opposite locknut by hand until it is snug against the bearing. Then, using a spanner wrench, tighten the nut the width of one lock washer tang. Tighten just past the desired tang, and then back off the nut to align the tang with the locknut slot. Secure the nut by bending the aligned lock washer tang into the slot in the locknut. The pump should continue to turn freely when rotated by hand.
g. To check adjustment, grasp the nut and washer with fingers and rotate back and forth. If this cannot be done, one or both locknuts are too tight and should be alternately loosened one stop at a time (.001" - 25 microns). Begin by loosening the locknut adjusted last.

16. Inspect the grease seal for wear or damage and replace as required. Grease the outside diameter of the grease seal and push it into the inboard bearing cover with the lip of the seal inward.
17. Attach a new bearing cover gasket and the bearing cover to the inboard head. Make sure the grease fittings are accessible. Install and torque the bearing cover cap screws to 30 lbs. ft. (40.7 Nm).
18. Install the grease seal and bearing cover on the opposite side of the pump as instructed in steps 16 and 17.
19. Push the dirt shield over the inboard and outboard shafts and firmly against the bearing over.
20. Attach the shaft protector to the non-driven shaft end of double ended pumps.

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