# Force Evo Injection System Installation Manual

*016-0171-724 Rev. A* *12/20* *E36393*

# DISCLAIMER

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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.

# ⚠ 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.

# ⚠ 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.

# 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.

# CHAPTER 2 INTRODUCTION TO THE FORCE® EVO INJECTION SYSTEM

## OVERVIEW

The Force® EVO injection system is designed for use on planting and seeding implements with a liquid fertilizer application delivery system and a carrier product tank already installed. Carrier rate control is not included with the Force® EVO Injection system, but is available as an optional feature.

NOTE: Contact a local Raven dealer for more information about adding carrier rate control to your existing Force® Evo injection system.

The Force® Evo injection system has an output range of 1 to 40 oz./min [0.3 to 11.8 dL/min]. The system must be operated within this range to ensure proper operation of the injection pump and application of injected products. To help ensure that the minimum injection rate is achieved, the smallest section or implement width for use with Force® Evo injection system should not be below 8 row units.

NOTE: Refer to the *Injection Rate Calculations* section on page 12 for information on verifying the pump output required for an operation.

## CARE AND USE

Proper care and maintenance is critical to ensure proper operation of the Force® Evo injection system. Please review and perform the following maintenance items as appropriate to help ensure the best performance and longest service life of the Force® Evo injection system:

IMPORTANT: Always wear appropriate personal protective equipment when working with the Force® Evo injection system. Review proper chemical handling, storage and disposal practices with your chemical provider before performing system maintenance and refer to the chemical label as necessary when working with agricultural chemicals.

- Flush and winterize the carrier product lines and injection system at the end of the season or when storing the implement for periods longer than 3 months.

IMPORTANT: Do not use water to flush the injection pump. Use only RV anti-freeze when flushing or winterizing the injection system. Using water can have an adverse affect on the chemical.

TABLE 1.

# CHAPTER 3 INSTALLATION AND PREPARATION

## RAVEN DEALER

1. Install and mount the chemical cabinet and the injection pump on the planter and install the plumbing parts that interface the mixer and the point of injection to the carrier.
2. When the chemical box, carrier, and point of injection have been installed, please let the Syngenta representative know the planter is ready for Direct Contact Inc. to complete the installation.

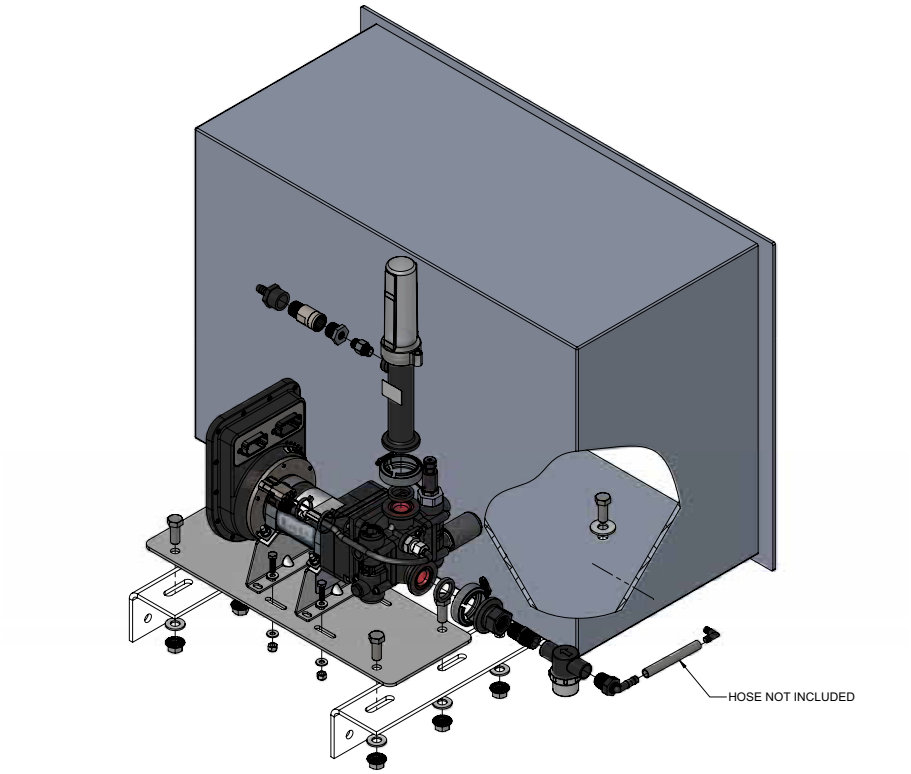
NOTE: There are two plastic envelopes in the kit with plumbing parts.

One envelope is labeled “THESE PARTS TO BE INSTALLED BY RAVEN DEALER.” The dealer will install these parts to interface the mixer and injection point to the carrier.

One envelope is labeled “THESE PARTS TO BE INSTALLED BY DIRECT CONTACT.” A representative from Direct Contact will use the parts in this envelope to hook up the plumbing from the chemical cabinet to the inlet of the injection pump and hook up the plumbing from the pump calibrator to the point of injection. Direct Contact Inc. will provide the hose and the clamps for this part of the installation.

Refer to Figure 2 on page 9.

FIGURE 1. Cabinet Mounted on Brackets



## BEST INSTALLATION PRACTICES

Please review and verify the following items when installing the Force® Evo injection system:

- Select a mounting location where the Force® Evo cabinet assembly, or connected plumbing and hoses, will not interfere with, or be damaged by, the normal planter folding or leveling functions or operations.
- The Force® Evo cabinet must be mounted upright on the implement with the bottom mounting brackets pointing toward the ground. The injection pump must remain in an upright position (calibrator pointing upward) at all times during pump operation.
- The cabinet should not be mounted to any wing element which rotates the cabinet away from this orientation during folding operations to ensure that chemical containers remain in the cabinet rack and connected with the internal cabinet plumbing.
- The injection pump must remain in an upright position (calibrator pointing upward) at all times during pump operation. This orientation is important both to ensure proper pump operation and to ensure that the chemical pouches do not fall off the rack
- The point of injection should be after (downstream) the carrier pump and before (upstream) any manifold or flow divider in carrier product lines. It is recommended to place the point of injection as close as possible to the flow divider or manifold to reduce the amount of chemical wasted when flushing the injection system.
- Keep hose lengths as short as possible. Long hose runs will use more chemical for priming and calibration processes and will create more chemical waste when flushing the injection system.
- The Force® Evo cabinet pump and mounting brackets weigh approximately 140 pounds [63.5 kg] without chemical boxes loaded (add approximately 100 pounds [45 kg] for chemical boxes). Be sure that all materials and hardware utilized for fabrication of a mounting solution is capable of securing the weight of the injection cabinet, pump, mounting brackets, and chemicals.
- Make sure to install the supplied carrier and injection check valves to prevent back flow or contamination of the product reservoirs. The arrow stamped on the check valve must point in the direction of product flow.
- It is not necessary for injected products or chemicals to be measured by a flow meter. Depending upon the type of applications or chemical mixtures the injection system will normally be used with, it may be more desirable to place the injection point after any flow meter in the carrier product line. This configuration will minimize the exposure of the flow meter to corrosive chemicals and may extend the life of the flow meter.

## FORCE® EVO CABINET MOUNTING

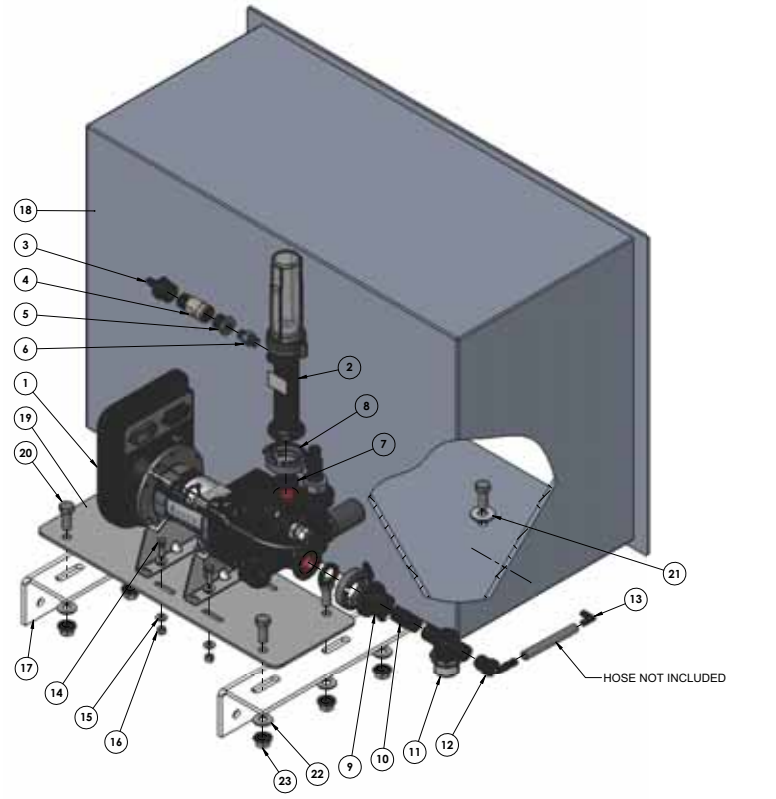
The following steps may be of assistance while mounting the Force® Evo injection cabinet on the implement.

1. Select a mounting location to provide a stable platform for the Force® Evo injection system. The selected mounting location should provide adequate clearance for the cabinet and allow normal implement functions without interference from, or damage to, the cabinet.
2. Fabricate a mounting bracket to secure the cabinet an integral frame member of the implement. The Force® Evo injection cabinet must be secure to avoid shifting during normal field operation.
3. Use hardware of adequate strength to fasten the fabricated mounting bracket to the brackets attached to the bottom of the Force® Evo cabinet. Use as many mounting points as possible to ensure that the cabinet is securely fastened to the implement.

# INJECTION PLUMBING INSTALLATION

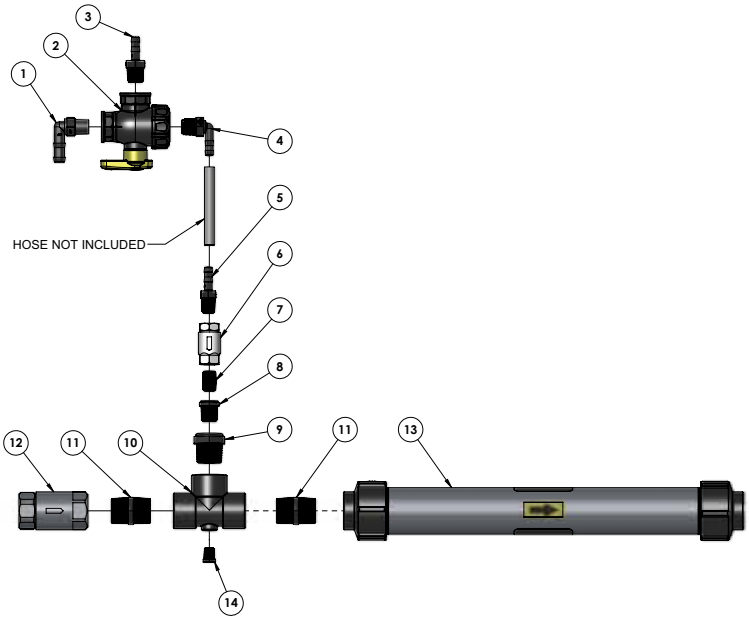
The Force® Evo injection system kit is designed to interface with existing 1” carrier product lines. The kit includes parts for installation of the “point of injection” including check valves and in-line mixer. Review the information in the following sections for assistance with assembling and installing the injection plumbing and connecting the Force® Evo injection cabinet to the point of injection.

FIGURE 2. Plumbing Components




| ITEM # | QTY. | DESCRIPTION |
|---|---|---|
| 1 | 1 | SCS SIDEKICK PRO PUMP 1-40 OZ/MIN |
| 2 | 1 | CLOSED CALIBRATION ASSEMBLY |
| 3 | 1 | FITTING, 1/2" FNPT X 3/8" HB |
| 4 | 1 | CHECK VALVE, 1/2" 12 PSI W/BLEED HOLE |
| 5 | 1 | FITTING, BUSHING, 1/2" NPT X 1/4" NPT |
| 6 | 1 | FITTING, PIPE NIPPLE, 1/4" NPT W/HEX |
| 7 | 2 | GASKET, FLANGE M-100, VITON |
| 8 | 2 | CLAMP, V-BAND FC-100 |
| 9 | 1 | FITTING, FLANGED, M100 X 1/2" NPT |
| 10 | 1 | FITTING, PIPE NIPPLE, CLOSE, POLYPROPYLENE 1/2" |
| 11 | 1 | STRAINER, 1/2" MNPT, POLYPROPYLENE, BLK, 20 MESH |
| 12 | 1 | FITTING, ELBOW 3/8" HB X 1/2" NPT ST POLY |
| 13 | 1 | FITTING, ELBOW 3/8" HB X 3/8" HB |
| 14 | 4 | BOLT, 1/4-20 X 1IN SS HEX HD |
| 15 | 8 | WASHER, .281 ID X .625 OD X .080 THK |
| 16 | 4 | NUT, 1/4-20 UNC LOCK NYL INSERT |
| 17 | 2 | BRACKET, DUAL COOLER MNT JD NH3 |
| 18 | 1 | CABINET, CHEMICAL, SYNGENTA INJECTIONS |
| 19 | 1 | PLATE, PUMP MOUNT |
| 20 | 8 | BOLT, HEX 1/2-13 X 1 1/4 GRADE 5 |
| 21 | 4 | WASHER, .562 ID X 1.375 OD X .109 THK |
| 22 | 8 | WASHER, .531 ID X 1.062 OD X .095 THK |
| 23 | 8 | NUT, HEX 1/2-13 ZINC |

FIGURE 3. Plumbing Components Cont.




| ITEM # | QTY. | DESCRIPTION |
|---|---|---|
| 1 | 1 | FITTING, ELBOW 1/2" HB X 1/2" NPT ST POLY |
| 2 | 1 | VALVE, 3-WAY, POLY, 1/2" NPT, CONTINUOUS FLOW |
| 3 | 1 | FITTING, 3/8" HB X 1/2" NPT |
| 4 | 1 | FITTING, ELBOW 3/8" HB X 1/2" NPT ST POLY |
| 5 | 1 | FITTING, 3/8" HB X 3'8" NPT |
| 6 | 1 | CHECK VALVE, 3/8" NPT |
| 7 | 1 | FITTING, PIPE NIPPLE, 3/8" NPT |
| 8 | 1 | FITTING, BUSHING, 1/2" NPT X 3/8" NPT |
| 9 | 1 | FITTING, BUSHING, 1" NPT X 1/2" NPT |
| 10 | 1 | FITTING, PIPE TEE, 1" X 1/4" NPT |
| 11 | 2 | FITTING, PIPE NIPPLE 1" NPT POLY |
| 12 | 1 | CHECK VALVE, 1" NPT |
| 13 | 1 | MIXER, ASSEMBLY, LOW FLOW 1" NPT |
| 14 | 1 | FITTING, PLUG PIPE, 1/4" NPT POLY |

NOTE: Check valves are used in both the carrier and injection lines to prevent back flow and contamination of carrier and chemical reservoirs. The in-line mixer should be installed after the point of injection to ensure even mixing of the injected product.

## POINT OF INJECTION PLUMBING ASSEMBLY PROCEDURE

Review the following procedure for assistance assembling the point of injection components shown in Figure 3, “Plumbing Components Cont.,” as seen above. This assembly procedure must be done in preparation for connecting the Force® Evo plumbing into the existing carrier product line.

NOTE: Use pipe sealant (not supplied) on all fittings. Tighten all fittings with a pipe wrench as instructed.

1. Locate the supplied 1” tee fitting (item 10) and install the 1/4” plug (item 14). Tighten the fitting until snug.

NOTE: An optional pressure transducer (P/N 422-0000-090) may replace the 1/4” plug to monitor pressure during field operations. Contact a local Raven dealer for more information.

2. Thread a 1” pipe fitting (item 11) into each of the through ports of the tee fitting.
3. Thread the supplied 1” check valve (item 12) onto one of the pipe fittings. Be sure that the arrow formed on the check valve body points toward the tee fitting. Tighten the check valve and pipe fitting into the tee fitting.
4. Thread the in-line mixer assembly (item 13) onto the remaining pipe fitting installed into the tee fitting. Be sure that the arrow on the mixer assembly points away from the tee fitting. Tighten the mixer an pipe fitting into the tee fitting.
5. Thread the supplied 1” x 1/2” bushing (item 9) into the branch of the tee fitting.
6. Thread the supplied 1/2” x 3/8” bushing (item 8) into the installed bushing and thread the 3/8” pipe nipple (item 7) into the bushing.
7. Thread the supplied 3/8” check valve onto the pipe fitting. Be sure that the arrow formed on the check valve body points toward the tee fitting. Tighten the check valve, pipe fitting and bushings to the tee fitting.
8. Thread the 3/8” MNPT to 3/8” hose barb fitting (item 5) into the check valve and tighten.
9. The point of injection plumbing assembly is ready for installation on the implement.

## POINT OF INJECTION INSTALLATION

Review the following steps for information on installing the point of injection assembly into the existing carrier product line on the implement.

1. Select a point in the carrier product line in which the point of injection plumbing assembly may be installed in the carrier line. Review the *Best Installation Practices* section on page 8 for more information on considerations for the location of the point of injection.

NOTE: Use the point of injection assembly to “layout” or help determine the best installation location. The point of injection should be as close to the Force® Evo injection cabinet as possible to help reduce the amount of chemical wasted when flushing the injection system.

2. Install the point of injection assembly so that carrier product flow through the 1” check valve and 1” mixer follows the arrows formed on the check valve and mixer assemblies. Be sure to use pipe sealant on the check valve and mixer threads.
3. If necessary for your implement or the existing plumbing, secure the point of injection assembly to an integral implement frame using appropriate hardware.

## 3-WAY VALVE AND FINAL PLUMBING PROCEDURE

The 3-way valve provided with the Force® Evo system is required for proper flushing and winterizing of the Force® Evo injection system and allows the operator to properly dispose of chemicals more easily. Review the following steps for more information and assistance with installation of the 3-way valve and final plumbing connections for the Force® Evo injection system.

NOTE: Use pipe sealant (not supplied) on all fittings. Tighten all fittings with a pipe wrench as instructed.

1. Select a location for the 3-way valve (item 2) used with the Force® Evo system. The valve should be located as close to the point of injection as possible within easy reach of the operator.

NOTE: Keep all hose lengths as short as possible to reduce the amount of chemical waste when flushing or winterizing the system.

2. Thread the supplied 3/8” hose barb fitting (item 3) into the 3-way valve port opposite of the valve handle. Tighten the fitting.
3. Thread the supplied hose barb elbow fittings (item 1 and item 4) into the through ports on the 3-way valve as shown and tighten. The 3/8” hose barb fitting goes toward the 3/8” hose barb fitting at the point of injection.
4. Place two hose clamps over the supplied and press the hose onto the 3/8” hose barb elbow.
5. Place and tighten the hose clamps to secure the hose to the hose barb.
6. Place two hose clamps over the remaining hose and press the hose onto the 1/2” hose barb fitting installed in the inlet branch of the 3-way valve.
7. Place and tighten the hose clamps to secure the hose to the hose barb.
8. Route the hose to the outlet of the 1/2” check valve at the injection pump.
9. Place the hose clamps over the 3/8” hose and press the hose onto the pump calibrator outlet port.
10. Place and tighten the hose clamps to secure the hose to the hose barb.

NOTE: It will be necessary to know the length of hose used between the injection pump outlet and point of injection. Measure and record the hose length for use when setting up for field operations.

## CABLE CONNECTIONS TO THE FORCE® EVO SYSTEM

Refer to Chapter 5, *System Diagrams and Ordering Instructions*, for system connection diagrams and review the Raven Sidekick Pro™ or Sidekick Pro™ ISO manual required cabling connections to the injection pump. For additional assistance with cabling options, contact a local Raven dealer.

IMPORTANT: If a Raven control console will not be installed to control the liquid carrier, the installer must provide for the following items:

- When the carrier product is shut off, the injection pump must stop. The carrier control must not allow the injection pump to operate in a “dead head” condition (e.g. injection pump running with carrier and section valves closed) at any time.
- When the carrier product is turned on, the injection pump must turn on. The carrier control must not allow skips in the injected chemical coverage.

## INJECTION RATE CALCULATIONS

Before operating the Force® Evo injection system, verify that the system will be able to meet the expected output of the operation. Adjust the operation speeds or injection rate as necessary to ensure that the injection pump is capable of performing in the anticipated operation conditions.

To calculate the volume per minute per row unit, use the following formula:

$$FPR = \frac{Rate \times Spacing \times Speed}{5940[60,000]}$$

Where FPR is the flow rate per row, Rate equals the target injection rate in oz./acre [dL/ha], spacing is the row spacing in inches [centimeters] and speed is the normal or maximum vehicle speed during operation in mph [km/hr].

Multiply the flow rate per row to find the total flow rate for the chemical injection.

FOR EXAMPLE:

Assume that the target rate is 8 oz./acre [5.8 dL/ha], row unit spacing of 30 inches [75 centimeters] and a typical vehicle speed of 5 mph [8 km/hr] on a 16 row implement.

| English (US) Units | Metric (SI) Units |
|---|---|
| $FPR = \frac{8 \times 30 \times 5}{5,940}$ | $FPR = \frac{5.8 \times 75 \times 8}{[60,000]}$ |

Therefore, the flow rate is 0.2 oz./min. [0.06 dL/min.] per row and the total flow rate for the chemical injection is 3.2 oz./min [0.96 dL/min.].

# CHAPTER 4 SYSTEM OPERATION

## SYSTEM OPERATION OVERVIEW

The Force® Evo injection system utilizes replaceable chemical boxes housed within the Force® Evo cabinet on a rack system. No chemical tank to refill or rinse between operations.

When the injection system is empty, disconnect and remove the empty boxes from the cabinet racks and replace with prefilled boxes.

NOTE: Prior to operating the system after installation, it is recommended to flush the injection lines with RV anti-freeze to rinse out any manufacturing or installation debris and to check plumbing connections for leaks. Refer to the *Flushing the Force® Evo System* section on page 13 for details on flushing and rinsing the injection or carrier system.

During this cleaning procedure, set the 3-way valve to by-pass the point of injection to prevent debris from plugging the check valves and in-line mixer. Return the 3-way valve to the inject position after clean-out is completed.

## FLUSHING THE FORCE® EVO SYSTEM

### PROCEDURE TO FLUSH THE INJECTION SYSTEM

IMPORTANT: When working with pesticides and other ag chemicals, personal protective gear must be worn. refer to the chemical manufacturer's label for required personal protective equipment. Decontaminate all equipment before making repairs or storing the implement.

It is normally acceptable to leave chemical that has not reached the point of injection in the injection lines for a short period. As long as the chemical is not mixed and the injection system remains sealed, the chemical should remain soluble and flow when the field operation resumes within a couple of days.

If the implement will be stored for part of the season, the injection system must be flushed and rinsed thoroughly. When storing the implement, it is recommended to winterize the injection pump and chemical lines to help ensure chemical residues do not damage the injection pump. Refer to the *Winterizing the Force® Evo Injection System* section on page 17 for details on winterizing the Force® Evo injection system.

NOTE: It is also recommended to flush the injection system prior to the initial operation to rinse out manufacturing or installation debris.

To flush the injection system:

1. Disconnect and remove the chemical boxes from the cabinet racks. Properly store or dispose of chemical containers according to the chemical manufacturer's recommended procedures.

2. Connect the chemical collection container to the 3-way valve at the in-line mixer. Contact a Syngenta supplier to obtain the chemical collection kit.
3. Place the 3-way valve in the position to by-pass the point of injection and to discharge the system to the chemical collection container.
4. Next, connect the clean out hose to the quick coupler in the injection cabinet.
5. Secure the open end of the clean out hose above the coupler to keep chemical from flowing out the hose. This will vent the injection manifold to air.

NOTE: To rinse the injection pump and plumbing, place the open end of the clean out hose in a container of RV anti-freeze and perform the following steps.

IMPORTANT: Do not rinse with water. Water can have an adverse affect on the chemical.

6. If a Raven control console is installed for carrier control, enter a self test speed of 6 mph [10 km/h] and set the injection pump to automatic control mode.

NOTE: Do not run the carrier during this procedure.

Refer to the Raven control console manual for details on entering and using the self test speed feature. The self test speed will clear if any signals are received from an actual speed sensor. To keep the self test speed from clearing during the rinsing procedure.

7. Toggle the injection pump to automatic control mode.
8. Toggle the master switch and at least 1 section switch to the on position.
9. Run the injection pump for 2 minutes.
10. Toggle the injection pump to the off position.
11. Move the clean out hose to the next coupler and repeat step 7 through step 11 until all box connectors in the injection cabinet have been flushed or rinsed.

NOTE: Refer to the *Winterizing the Force® Evo Injection System* section on page 17 for information on winterizing the Force® Evo system.

## CHARGING THE FORCE® EVO INJECTION SYSTEM

Both the carrier and injection systems must be charged with chemical to ensure even coverage during a field operation. The system must be charged during the initial system start up after installation or when the system is pulled out of storage.

NOTE: Be sure to flush and rinse the system of antifreeze when the system has been in winter storage. Charge the carrier system before performing the following procedure.

If the chemical is depleted, the system will need to be recharged before resuming field application.

Replacement Colder quick couplers must be obtained from Syngenta and are not available from Raven.Couplers that are compatible with Force® Evo and can be identified with the green latch button.

1. Load chemical boxes into the Force® Evo cabinet.
2. Connect the quick couplers to the chemical boxes.

FIGURE 1. Force® Evo Injection Cabinet Manifold


3. Perform a pump priming procedure. Be sure that the 3-way valve is set to direct chemical to the point of injection. Refer to the Raven Sidekick Pro™ or Sidekick Pro ISO manual for details on priming the injection pump.
4. Repeat the priming procedure two more times to draw chemical from the connected boxes and eliminate air pockets in the cabinet manifold.
5. Perform a pump calibration test to verify pump operation. Refer to the Raven Sidekick Pro™ or Sidekick Pro ISO manual for details on performing a calibration with the closed calibration system.
6. If the pump passes the calibration test, proceed to the *Charging the Carrier Line with Injected Chemical* section on page 16 to complete the chemical charging process and prepare the system for field operations.

## CHARGING THE CARRIER LINE WITH INJECTED CHEMICAL

Review the following procedure once the injection pump is primed and successfully calibrated to prime the carrier lines with injected chemical.

1. Measure and record the hose length between the injection pump outlet and the point of injection. Refer to Table 1, “Calculating Hose Volume,” below and calculate the volume of chemical necessary for the injection system hose.
   TABLE 1. Calculating Hose Volume

| Hose Internal Diameter | Ounces per Linear Foot of Hose | Deciliters per Linear Meter of Hose |
|---|---|---|
| 3/8” [0.95 cm] | 0.734 | 0.712 |
| 1/2” [1.27 cm] | 1.305 | 1.27 |
| 3/4” [1.9 cm] | 2.937 | 2.85 |
| 1” [2.54 cm] | 5.224 | 5.07 |
| 1-1/4” [3.175 cm] | 8.16 | 7.92 |
| 1-1/2” [3.8 cm] | 11.75 | 11.4 |
| 2” [5.08 cm] | 20.90 | 20.27 |
| 2-1/2” [6.35 cm] | 32.65 | 31.67 |
| 3” [7.62 cm] | 47.02 | 45.61 |

NOTE: 1 gallon equals 128 oz [0.379 dL].

2. On the control console, enter a value of zero for the volume tally of injected chemical product.
3. Place the injection pump in automatic control mode and enter a self test speed of 6 mph [9 km/h].
4. Monitor the volume tally for the injected chemical. When the necessary volume required for the injection plumbing has been dispensed through the pump, set the pump control mode back to off.
5. Measure the hose length from the point of injection to the section tips. To prime the carrier lines with injected chemical to all sections, record the longest hose length and calculate the volume of chemical necessary for the carrier lines.
6. Toggle the master switch and all section switches to the on position and monitor the carrier volume until the calculated volume has been dispensed through the carrier product system.
7. The system should now be fully charged with injected chemical.

## FORCE® EVO SYSTEM OPERATION

When the chemical boxes are empty, the system will develop a higher than normal vacuum pressure. When this occurs, the control console will display a vacuum error.

NOTE: A vacuum error may also occur if the strainer is plugged or a chemical flow restriction has occurred.

Refer to the Raven Sidekick Pro™, Sidekick Pro ISO, or Sidekick PRO ICD manuals for details on using the specific control console to control the injection system. Review the console specific operation manual for details on setting up and controlling a liquid carrier during field operations.

## WINTERIZING THE FORCE® EVO INJECTION SYSTEM

1. Flush and rinse the Force® Evo injection system.
2. Connect the clean out hose to the quick coupler for the upper, left container in the injection cabinet.
3. Place the open end of the clean out hose into a container of antifreeze designed for recreational vehicles (R.V. antifreeze).
4. If a Raven control console is installed for carrier control, enter a self test speed of 6 mph [10 km/h] and set the injection pump to automatic control mode.

NOTE: Refer to the Raven control console manual for details on entering and using the self test speed feature. The self test speed will clear if any signals are received from an actual speed sensor. To keep the self test speed from clearing during the rinsing procedure.

5. Set the 3-way valve to the point of injection to route liquid into the carrier lines.
6. Set the carrier control to a normal rate during this procedure.
7. Toggle the injection pump to automatic control mode.
8. Toggle the master switch and at all section switches to the on position.
9. Run the injection pump for 2 minutes.
10. Toggle the injection pump to the off position.
11. Move the clean out hose to the next coupler and repeat step 7 through step 11 until all couplers in the injection cabinet have antifreeze in the lines.

NOTE: Use caution not to run out of antifreeze during this procedure.

# CHAPTER 5 SYSTEM DIAGRAMS AND ORDERING INSTRUCTIONS

Refer to the following sections for ordering information and cable connection details.

NOTE: Order a kit that relates to the type of CAN control that will be used on the planter.

Select from the follow:

| Description | Part Number |
|---|---|
| Raven CAN | 117-0171-836 |
| ISO CAN | 117-0171-837 |
| Raven ICD CAN | 117-0171-836 |

These kits include the chemical cabinet, injection pump, misc. plumbing, flow mixer, and basic mounting hardware.

See the following system diagrams to select cables and accessories that relate to the desired type of control.

# RAVEN CANBUS SYSTEMS

FIGURE 1. Ordering Instructions for Viper 4 and Raven CAN Systems (P/N 054-2850-003 Rev. A)




A
Select One (1) Chassis Cable:

115-0171-915 Cable, Power/CAN, Chassis, Tractors with Front Mounted Batteries
Approved Tractor Models: CAT Challenger-MT 700, 800, 900; JD 6x20, 6x30, 7220, 7320, 7420, 7520, 7230, 7330, 7430, 7530 (Small Frame 7x20 and 7x30 Series JD)

115-0171-936 Cable, Power/CAN, Chassis, Generic 4WD Tractors
Approved Tractor Models: JD 4WD; Case IH 4WD; New Holland 4WD; Buhler 4WD

115-0171-937 Cable, Power/CAN, Chassis, Row Crop Tractors
Approved Tractor Models: Case IH Row Crop Tractors, CAT Challenger MT500, 600; JD 7x00, 7x10; New Holland Row Crop

115-0171-938 Cable, Power/CAN, Chassis, Large Frame JD and Buhler Row Crop Tractors
Approved Tractor Models: JD 8x00, 8x10, 8x20, 8x30, 7620, 7720, 7820, 7920, 7630, 7730, 7830, 7930; Buhler Row Crop Tractors

115-4001-085 Cable, Power/CAN, Chassis, Steering Only Systems

B
REQUIRED (1) Field Computer/Console Cable:

115-0172-025 CABLE CONSOLE VIPER 4 GEN II

C
Optional:

115-0171-929 Cable, 10' Extension, Cab Cable to Chassis Cable
117-0171-298 Kit, Magnetic Mount, Proximity Remote Swtich

D
Select One (1) CAN/Power Tee Extension Cable for Each Node (excluding SmarTrax and OmniRow Planter nodes)

115-0171-928 Cable, CAN/Power Implement Tee, 12" Lg
115-0171-951 Cable, CAN/Power Implement Extension Tee, 6' Lg
115-0171-916 Cable, CAN/Power Implement Extension Tee, 12' Lg
115-0171-917 Cable, CAN/Power Implement Extension Tee, 24' Lg
115-0171-934 Cable, CAN/Power Implement Extension Tee, 36' Lg

E
Select One (1) CAN TERMINATOR per implement (already included in OmniRow Planter, Product Controller, & AccuFlow System kits)

063-0173-224 Terminator, CAN Passive, 16 Pin AMP

F
Select One (1) Speed Sensor Extension Cable (if applicable)

115-0171-262 10'
115-0159-032 12'
115-0171-239 18'
115-0159-018 24'
115-0171-241 29'
115-0171-225 34'

FIGURE 2. Cable Connections for Viper 4 and Raven CAN Systems (P/N 054-2850-003 Rev. A)

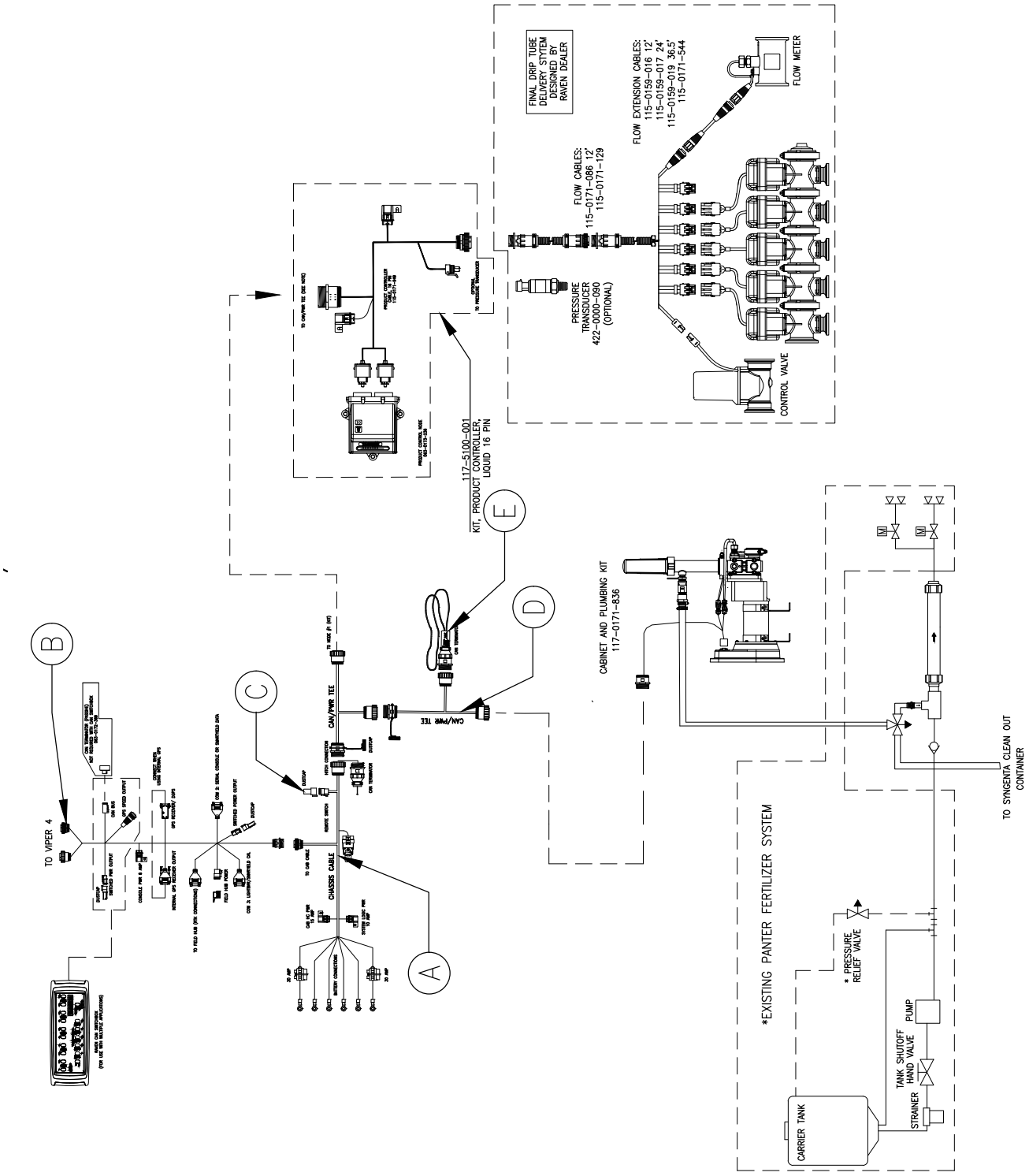
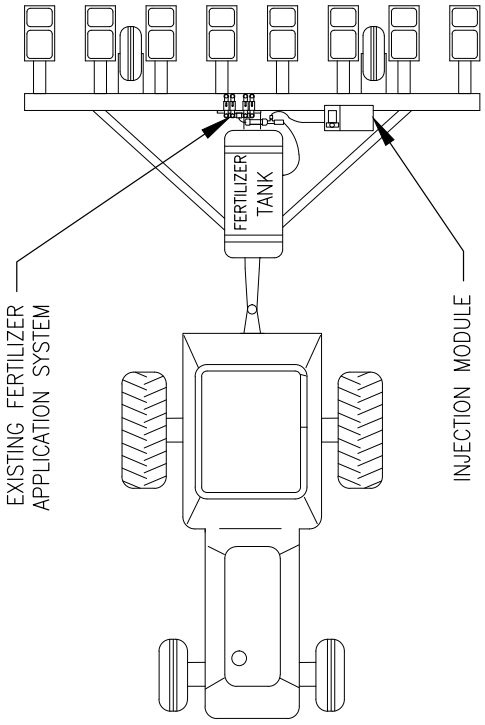


FIGURE 3. Ordering Instructions for Force EVO ISO Injection (P/N 054-6100-009 Rev. F)



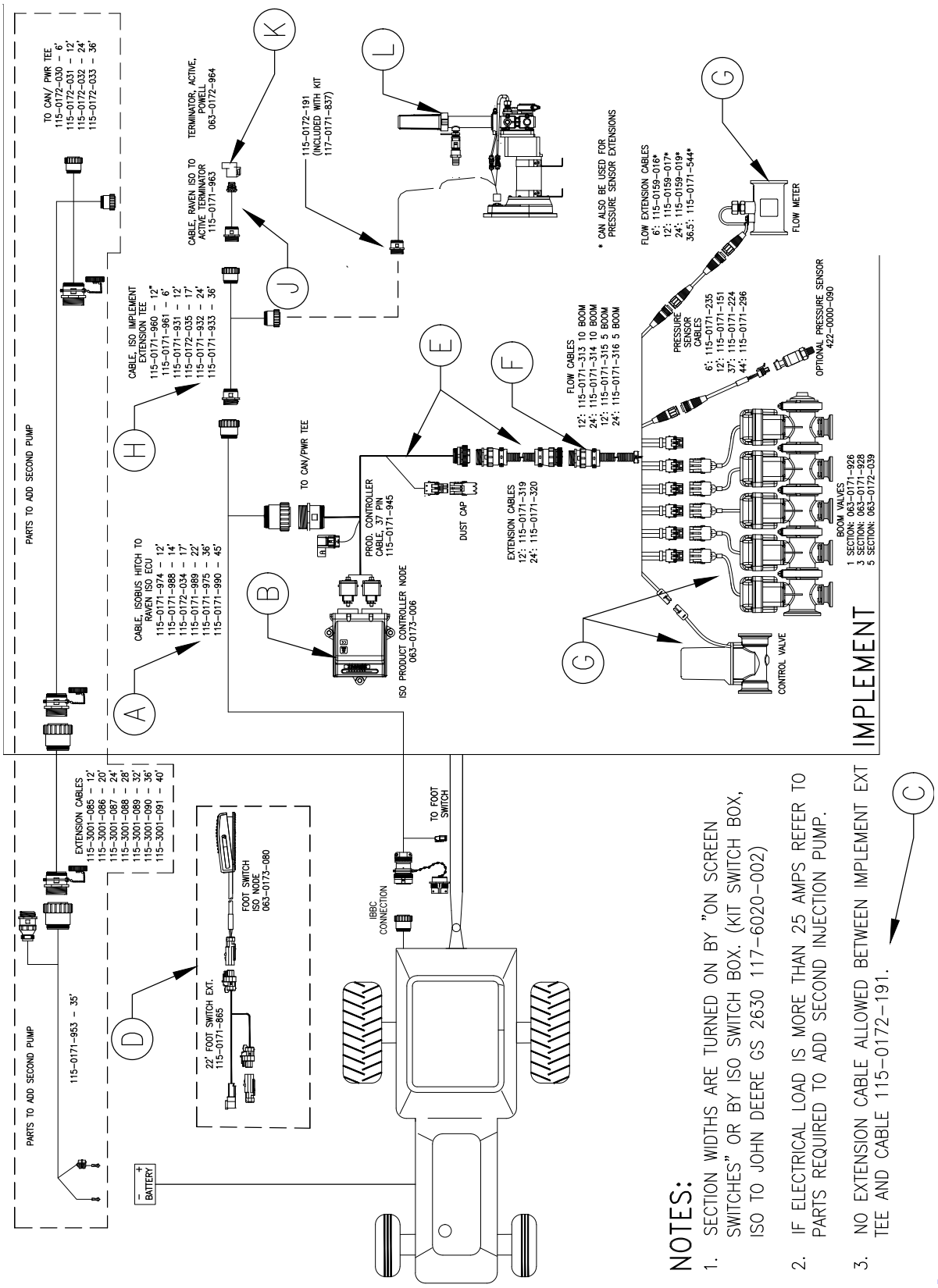

A DETERMINE IF EXTENSION CABLE IS NEEDED
REFERENCE 054-7000-002 FOR HARNESS PART NUMBERS.

B ORDER CABLE 115-0171-953 IF THE ADDED ELECTRICAL LOAD IS MORE THAN 25 AMPS, SELECT CABLES REQUIRED TO ADD A SECOND INJECTION PUMP

C SEE CAB NOTES

D A KIT, CABINET SYNGENTA ISO INJECTION IS REQUIRED – 117-0171-837

FIGURE 4. Raven ISO Product Control w/ Force EVO ISO Injection (P/N 054-6100-009 Rev. F)



# ISOBUS SYSTEMS

FIGURE 5. Ordering Instructions for ISOBUS Systems (D/N 054-6100-009 Rev. F)

A CABLE ISOBUS HITCH TO RAVEN ISO ECU IS REQUIRED — SEE PAGE 4
12': 115-0171-974
14': 115-0171-988
17': 115-0172-034
22': 115-0171-989
36': 115-0171-975
45': 115-0171-990

B A RAVEN ISO PRODUCT CONTROL NODE IS REQUIRED – 063-0173-006, THIS NODE IS REQUIRED EVEN IF CARRIER CONTROL IS DONE BY OTHER MEANS BECAUSE THIS NODE PROVIDES SECTION WIDTH INPUT.

C SEE NOTES

D OPTIONAL:
FOOT SWITCH ISO NODE 063-0173-080
FOOT SWITCH CABLE EXT 22' LONG 115-0171-865

E A PRODUCT CONTROLLER CABLE IS REQUIRED – 115-0171-945
OPTION EXTENSION CABLE: 12': 115-0171-319
24': 115-0171-320

F SELECT A FLOW CONTROL CABLE (IF CARRIER CONTROL IS DESIRED)
12': 115-0171-313 10 BOOM
24': 115-0171-314 10 BOOM
12': 115-0171-315 5 BOOM
24': 115-0171-316 5 BOOM

G SELECT A FLOW METER, CONTROL VALVE, AND SECTION VALVES AS DESIRED

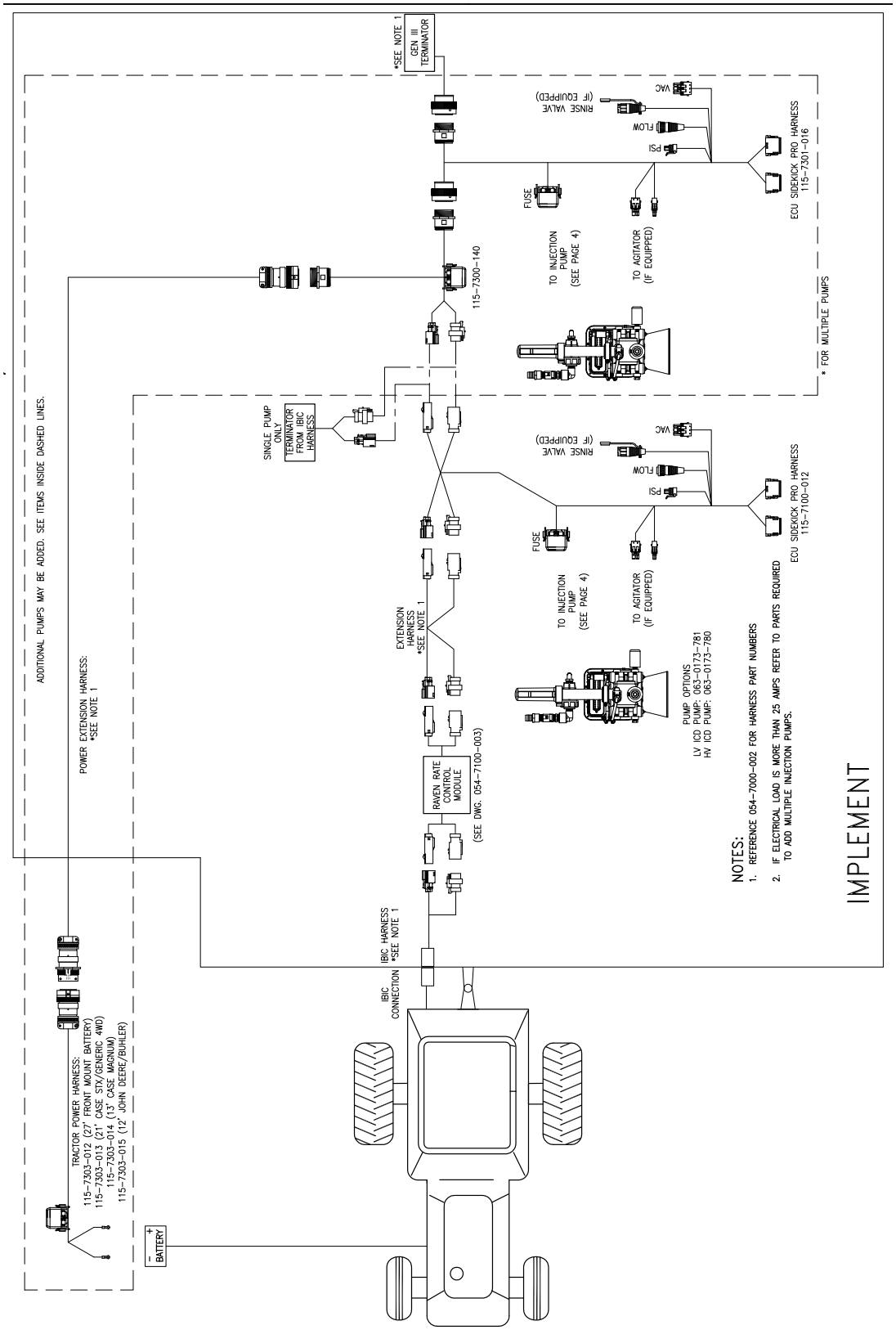
H CABLE ISO IMPLEMENT EXTENSION TEE IS REQUIRED
12": 115-0171-960
6': 115-0171-961
12': 115-0171-931
17': 115-0172-035
24': 115-0171-932
36': 115-0171-933

J A RAVEN ISO TO ACTIVATE TERMINATOR ADAPTOR CABLE IS REQUIRED – 115-0171-963

K A TERMINATOR, ACTIVE POWELL IS REQUIRED – 063-0172-964

L A KIT, CABINET SYNGENTA ISO INJECTION IS REQUIRED 117-0171-837

FIGURE 6. Cabling Connections for John Deere Rate Controller 2000 with Raven Sidekick PRO ICD (P/N 054-7120-001 Rev. B)



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